APPENDIX C: ENVIRONMENTAL SURVEY IN & AROUND TANJUNG PRIOK AND BOJONEGARA

C.1 OBJECTIVES

The JICA Study Team conducted environmental survey to grasp current environmental condition in the study area. Tanjung Priok Port and Bojonegara Port Project Site were selected target area for the field survey, because these 2 areas have first priority for Port Development Plan in West Java.

Implemented component of environmental survey and their survey periods are shown in Table C.1.1.

Table C.1.1 Component of Environmental Survey

Component	Survey Period	
	Tanjung Priok Port	Bojonegara Project Site
Water Quality	26-27th, June, 2002	24-25th, June, 2002
Sediment Quality	26-27th, June, 2002	24-25th, June, 2002
Air Quality	9-16th, July, 2002	1-8th, July, 2002
Noise and Vibration	9-16th, July, 2002	-
Socio Economic Condition	18-24th, July, 2002	9-16th, July, 2002

C.2 METHOD

C.2.1 Water Quality Survey

Sea Water sampling was carried out at the following locations (see Table C.2.1 and Figure C.2.1 and Figure C.2.2), in the spring tide. At each sampling point, the seawater samples were collected by using a Water Sampler in one day, at two layer (0,5 m under the surface water as “Upper Layer” and 1 m above the bottom as “Lower Layer”) of the water depth. Samples were taken twice a day, once in low tide and the other in high tide.

Table C.2.1 Sampling location for water and sediment survey

Port Name	Sampling Point	Coordinate Position	Location
Tanjung Priok	T-1	Long : 106° 55' 06" E Lat : 6° 5' 00" S	East of Pertamina Jetty
	T-2	Long : 106° 54' 30" E Lat : 6° 5' 48" S	Front of Koja Terminal
	T-3	Long : 106° 53' 06" E Lat : 6° 5' 36" S	Front of Palm Oil Tank yard
	T-4	Long : 106° 52' 12" E Lat : 6° 6' 00" S	Front of PLTU Generating Power Plant
	T-5	Long : 106° 54' 00" E Lat : 6° 4' 18" S	Outside of Project Site (as Background)
	T-6	Long : 106° 53' 21" E Lat : 6° 4' 42" S	Outside of Breakwater
	T-7	Long : 106° 54' 18" E Lat : 6° 5' 42" S	Inside of Port Area
Bojonegara	B-1	Long : 106° 5' 10" E Lat : 5° 53' 45" S	West-North Side of Project Site
	B-2	Long : 106° 5' 20" E Lat : 5° 53' 55" S	Near Planned Pier
	B-3	Long : 106° 05' 40" E Lat : 5° 54' 30" S	Inside of Project Site
	B-4	Long : 106° 05' 35" E Lat : 5° 54' 15" S	Inside of Project Site
	B-5	Long : 106° 05' 48" E Lat : 5° 54' 00" S	Outside of Kali Island (as Background)
	B-6	Long : 106° 05' 43" E Lat : 5° 53' 52" S	Out side of Kali Island

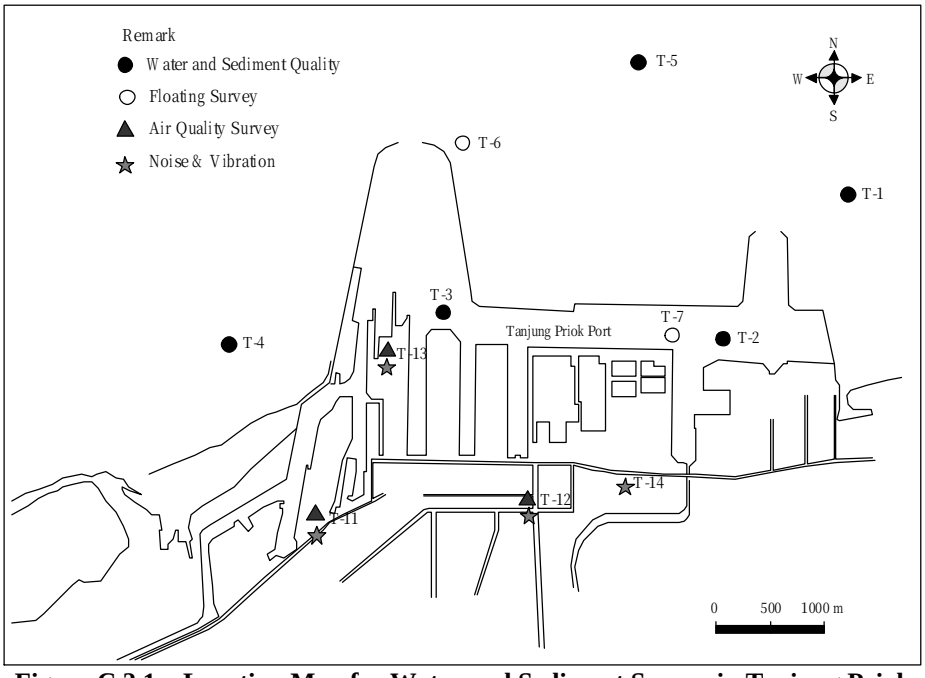


Figure C.2.1 Location Map for Water and Sediment Survey in Tanjung Priok

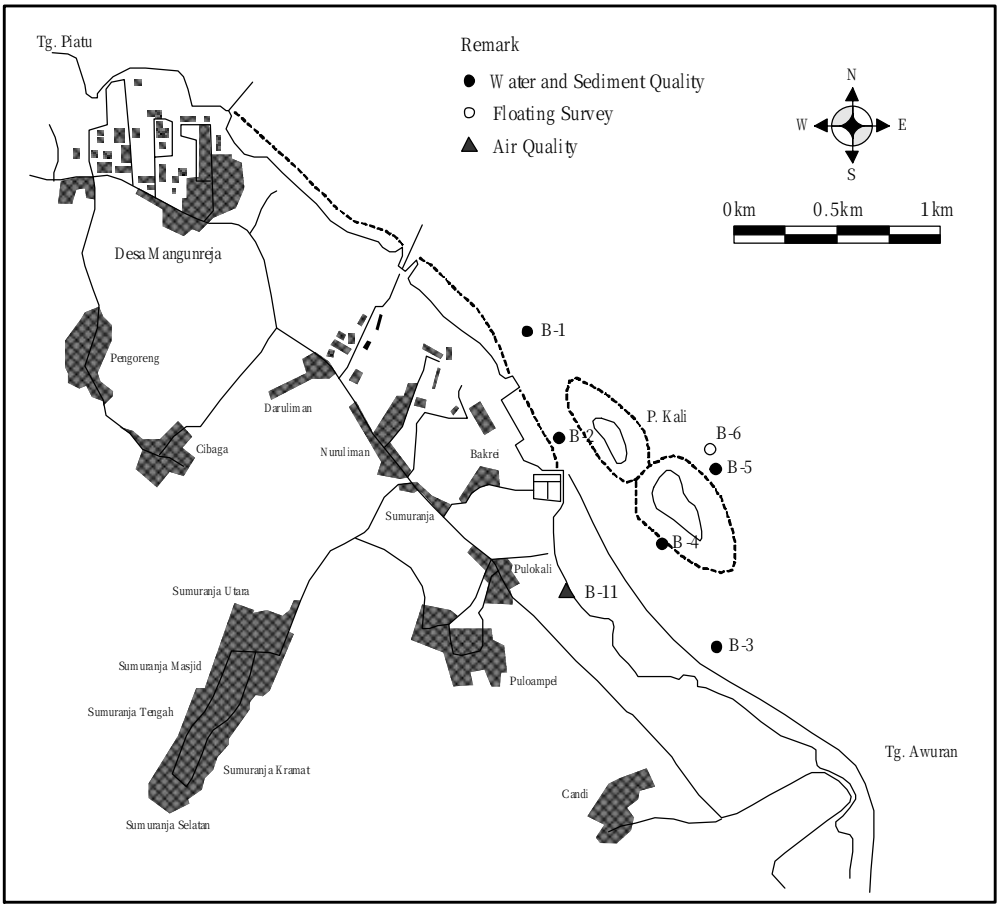


Figure C.2.2 Location Map for Water and Sediment Survey in Bojonegara

The parameters for water quality survey are shown in TableC.2.2. The flowing parameters were measured/observed on boat, other parameters were analyzed in the chemical laboratory.

- Water Temperature;
- pH;
- Transparency; and
- Field observation.

Target parameters and analysis methods for water quality survey are also shown in Table C.2.2.

Table C.2.2 Parameter and Analysis Method for Water Quality Survey

Parameter	Analysis Method
Temperature	Thermometric
Transparency	Visual
Color	Colorimetric
Salinity	Direct Reading
Total Suspended Solid (TSS)	Gravimetric
pH	Electrometric
Dissolved Oxygen (DO)	Titration
COD	Titration
Oil & Grease Content	Gravimetric
Phenol	Spectro photometric
Ammonia Nitrogen	Spectro photometric
Total N	Kjeldahl
Total P	Spectro photometric
Cadmium (Cd)	Atomic absorption spectrometry
Chromium (Cr)	Atomic absorption spectrometry
Copper (Cu)	Atomic absorption spectrometry
Nickel (Ni)	Atomic absorption spectrometry
Total Iron (Fe)	Atomic absorption spectrometry
Lead (Pb)	Atomic absorption spectrometry
Zinc (Zn)	Atomic absorption spectrometry
Coliform	Double Tube

The Sea Water quality analysis was done with comparing seawater quality value from measurement result with Sea Water Quality Standard, as mentioned in Attachment V of Kep Men KLH No. KEP-02/MENKLH/I/1988 about Environmental Standard Determination.

Floating survey was carried out at the two locations in Tanjung Priok and one location in Bojonegara (see Figure C.2.1 and C.2.2) at the same time as the water survey taken. At each sampling point, the floating survey was carried out twice a day, once in Ebb Tide and the other in Flood Tide. Measurement of sea current direction and speed were direct method with floating buoy. The position of Floating Material were measured observed by GPS.

C.2.2 Seabed Materials Survey

Seabed Materials samples were collected at the same positions as water quality survey using Elkman burdge type bottom sampler. Sampling was carried out one time. Target parameters and their analysis methods are shown in Table C.2.3.

Table C.2.3 Parameter and Analysis Method for Seabed Materials Survey

Parameter	Analysis Method
Odor	Direct Observation
Color	Observation
Grading Analysis	Separation method by sieve
Density	Gravimetric method
Water Content	Gravimetric method
Ignition Loss	Gravimetric method
COD	Titration
Mercury (Hg)	Atomic absorption spectrometry by reduction and vaporization
Arsenic (As)	Atomic absorption method by hydride
Lead (Pb)	Atomic absorption spectrometry
Chromium (Cr)	Atomic absorption spectrometry
Cadmium (Cd)	Atomic absorption spectrometry

C.2.3 Air Quality Survey

Air quality survey was carried out 3 points around Tanjung Priok Port and 1 point in Bojonegara at the following locations (see Table C.2.4). Sampling locations are shown in Figure C.2.1 and C.2.2.

Table C.2.4 Sampling Location for Air Quality and Noise/Vibration Survey

Port Name	Sampling Point	Coordinate Position	Location
Tanjung Priok	T-11	Long : 106° 52' 27" E Lat : 6° 6' 45" S	Near Gate I, Jl. RE Martadinata
	T-12	Long : 106° 53' 36" E Lat : 6° 6' 36" S	Crossroad of Jl. Enggano and Jl. Sulawesi
	T-13	Long : 106° 53' 27" E Lat : 6° 5' 56" S	Multipurpose Berth of Basin III (Air Quality Survey only)
	T-14	Long : 106° 54' 00" E Lat : 6° 6' 30" S	Near the Entrance Gate of Koja Hospital (Noise Survey only)
Bojonegara	B-11	Long : 106° 05' 10" E Lat : 5° 53' 45" S	Inside of The Project Area (Outside Village) (Air Quality Survey only)

The Air Quality parameters were CO, SO_2, NO_2 and Total Suspended Particulate (TSP), used equipment and analysis methods are shown in Table C.2.5.

Table C.2.5 Air Quality Equipment and Analysis Method

Parameter	Equipment	Analysis Method
CO	CO Analyzer (Gas Bag), Sibata	CO Analyzer (Gas Bag)
SO_2	Air Sampler (Impinger)	Absorption Spectrophotometry
NO_2	Air Sampler (Impinger)	Absorption Spectrophotometry
TSP	High Volume Sampler (HVS), Sibata	Gravimetric Method

The measurement of air quality survey was carried out continuously for 7 days. Air quality was measured every 3 hours. Upon the sampling, the following in site parameters were recorded:

- Wind Direction and Speed;
- Air Temperature; and
- Date, Time, Weather, and Location of Sampling Points.

The air quality analysis was done with comparing air quality value from measurement result with air quality standard, as mentioned in of Kep Men KLH No. KEP-02/MENKLH/I/1988 about Environmental Standard Determination, and Head of Bapedal Decree No. Kep-205/BAPEDAL/07/1996 about Technical Guideline for Immovable Air Quality Pollution Control.

C.2.4 Noise and Vibration

The measurement of noise and vibration survey was carried out around Tanjung Priok Port at the following locations (see Table C.2.4 and Figure C.2.1). Measuring points T-11, -12 and –13 were same as air quality survey.

For each noise and vibration was measured continuously every 2 hours for 7 days. Noise level was measured with sound level meter, while vibration level was measured with vibrator. The noise and vibration analysis was done with comparing noise and vibration value from measurement result with Noise and Vibration Standard, as mentioned in Kep Men LH No. 48/MENLH/II/1996 regarding Noise And Vibration Level Standard.

C.2.5 Biological Survey

Biological Survey was carried out using direct observation, sample collecting and interview and existing information. Target parameters, their methods and type of output data are shown in Table C.2.6.

Table C.2.6 Analysis Parameter and Output Data for Biological Survey

Parameter	Method	Type of Output Data
Terrestrial Biotic		
Flora	Interview and Existing Information	Inventory List
Fauna	Interview and Existing Information	Inventory List
Aquatic Biotic		
Phytoplankton & Zooplankton	Sample Collecting by Plankton Net	Inventory List, Abundance, Diversity Index and Similarity Index
Benthos	Sample Collecting by Sediment Sampler	Inventory List, Density, Diversity Index, Similarity Index and Dominancy Index
Nekton	Direct Observation	Inventory List and Fishery Production
Mangrove	Direct Observation	Inventory List and Density
Coral	Direct Observation	Inventory List, Percent Covered Ratio, Diversity Index, Similarity Index and Dominancy Index

C.2.6 Socio Economic Survey

Social Economy

Primary Data collection was carried out by interview method with the respondent at community surrounding the study area. Secondary Data was carried out with analysis method to the available data from *Kelurahan* /*Kantor Desa* and other instance, environmental factor and variable of socio economic and culture that analyzed is presented in Table C.2.7.

Table C.2.7 Method of Social Economy Data Collection

Factor	Parameter	Type of Data	Method
Socio Economy			
Demography	Population Structure	Secondary	-
	Resident and households distribution		
	Population Distribution	Secondary	-
	Mortality, Fertility and Migration	Secondary	-
Utilization of Natural Resources	Income	Primary	Interview
Infrastructure of Social Economy	Environmental Sanitation	Secondary/ Primary	Interview
	Transportation Network	Secondary/ Primary	-
	Public Facilities	Secondary/ Primary	-
Social Culture			
Culture Structure	Diversity of Ethnic and Religion	Secondary/ Primary	Interview
	Water rights and rights for common	Primary	Interview
	Public Structure	Primary	Interview
Aspiration and Perception	Aspiration and Perception about the planned port	Primary	Questioner
Infrastructure of Social Culture	Number and Distribution of Education	Secondary	-
Public Health			
Environmental Sanitation	Communities sanitation management	Primary	Interview
Prevalence of Disease	Number of Disease Sufferer	Secondary/ Primary	-
Infrastructure and Public Health	Number and Distribution of Puskesmas	Secondary	-

Location of socio-economic and culture survey at Tanjung Priok were (see Figure C.2.3):

- *Kelurahan* Tanjung Priok; and
- Kelurahan Koja.

Respondents were selected in consideration of the following targets:

- Communities surrounding planned port area;
- Communities which are in transportation route; and
- Communities, which are, affected cumulative environment impact.

Number of respondents was 40 persons, it was about 0.1 % of total residents in the study area.

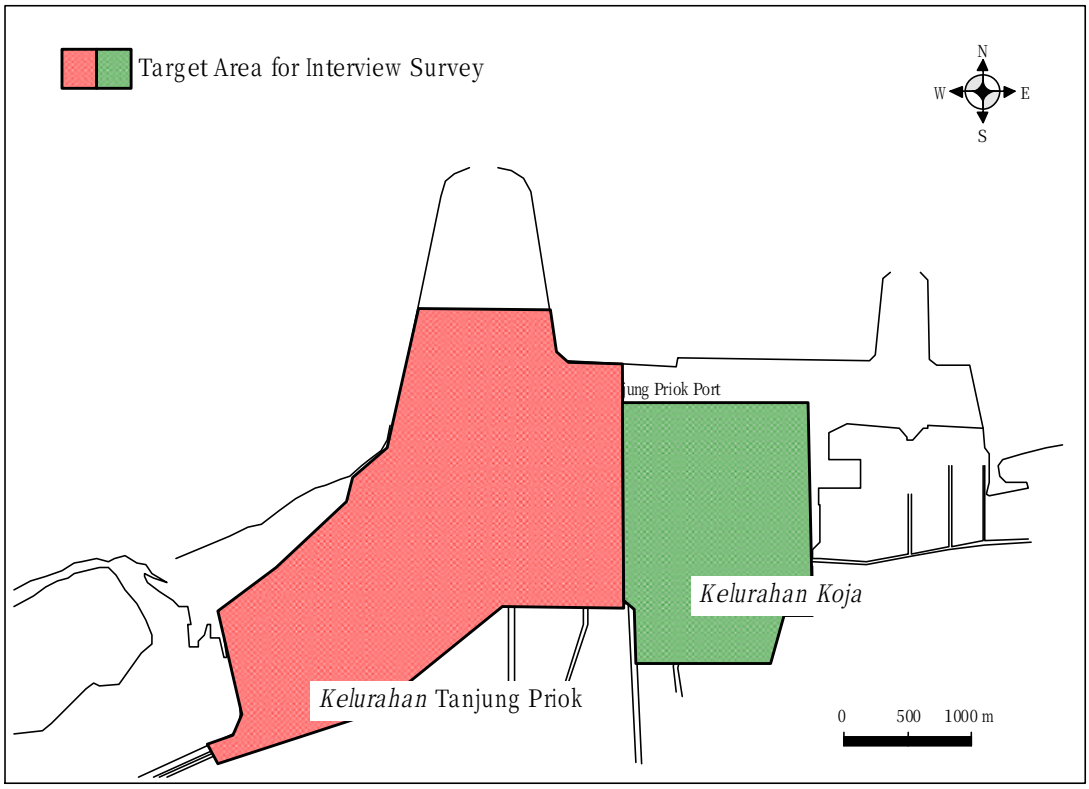


Table C.2.3 Target Area for Interview Survey in Tanjung Priok

Location of socio-economic and culture survey at Bojonegara were (see Figure C.2.4):

- *Desa* Pulo Ampel;
- *Desa* Sumuranja; and
- Desa Margasari.

Respondents were selected in consideration of the following targets:

- Communities who will be relocated;
- Communities surrounding at planned area port;
- Communities who are in transportation route; and
- Communities who are affected cumulative environment impact.

Number of respondents was 47 persons, it was about 0.5 % of total residents in the study area.

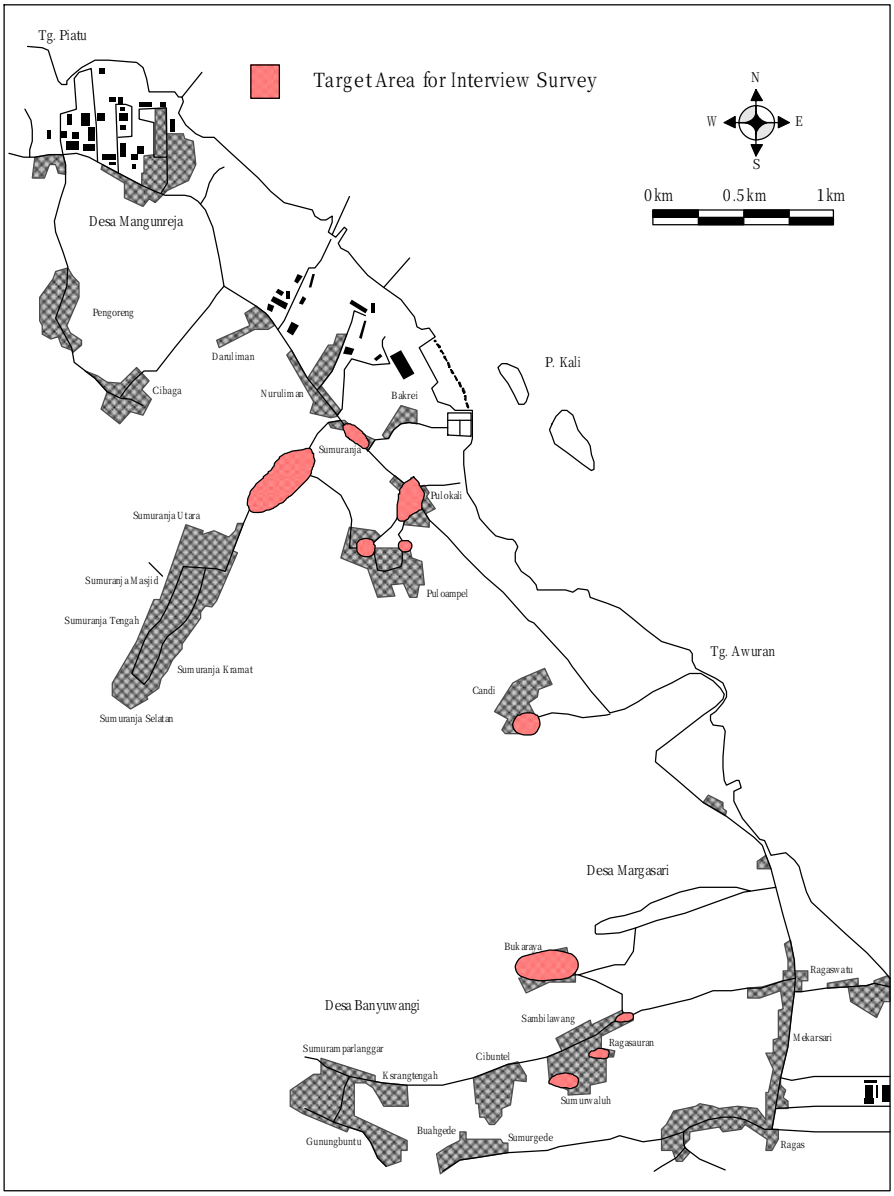


Figure C.2.4 Target Area for Interview Survey in Bojonegara

Land Use

Land use survey was carried out by interview with the related local governments and field observation. The land area was classified into six categories of its uses:

- Port Facilities;

- Commercial Area;
- Residential Area;
- Cultivated Area;
- Forest Area; and
- Fishery Area.

Fishery

Fishery survey was carried out by interview with local governments and respondents surrounding project location. The fishery data was classified into:

- Number of Fisherman;
- Fishery Production;
- Fishing Area; and
- Fishery Method.

C.3 RESULT

C.3.1 Water Quality

Tanjung Priok

The results of water quality survey were shown in Table C.3.1.

The transparency measured at location T-1 (East of Pertamina Jetty) is 3.20 m and T-5 (Outside of Project Site, as Background) is 3.33 m, above the standards (> 3 m). On the other hand, T-2 and T-3 located inside of breakwater showed low transparency. This result gives that turbidity problem occurs in the Port Area. TSS concentration showed lower value than international standard (< 80 mg/L).

The salinity distribution was between 22.3-32.8 ‰, and lower layer showed higher value than the upper layer. Salinity at T-2 showed lower value than others because of fresh water inflowing from Sunter River (Estuary Condition).

At point T-2 and T-3, which located inside the breakwater of port, the seawater were smelled as dead organism (H_2S), however the other point T-1, T-4, T-5 which located outside breakwater were odorless.

The lowest DO concentration showed at T-2 (front of Koja Terminal), especially upper layer were 2.0 to 2.2 mg/l below the standard (< 4 mg/L). DO concentrations at other location were between 4.9-6.5 mg/L and still fulfilled the standard (> 4 mg/L).

COD concentrations were between 12.4-57.8 mg/L and still fulfilled the standard (< 80 mg/L). The highest of COD content was occurred at T-2, the same location for the lowest of DO content.

Oil and Grease contents were between < 1-2 mg/l. Phenol concentration at all the locations were below 0.002 mg/l and fulfilled the standard (< 0.002 mg/L).

The highest of NH_4-N content was observed at location T-2 (front of Koja Terminal) especially for upper layer with content 2.17-3.77 mg/L exceed the standard (< 1 mg/L). NH_4 content at other locations between 0.01-0.34 mg/L and still fulfilled the standard (< 1 mg/L). The total N contents occurred at all location were ranged between 0.40-5.35 mg/L and total P contents were ranged between 0.02-0.46 mg/L.

The result of Cd, Cr^{6+}, Cu, Ni, Pb and Zn were below the standard at all the locations. The total Fe contents occurred at all the location were ranged between 0.03-0.15 mg/L.

The Bacteriological contents observed at all the locations were ranged between 0-63 Nos/100 mL and still below the standard (< 1000 Nos/100 mLl).

Table C.3.1 The result of Water Quality Survey in Tanjung Priok

Parameter		T – 1		T – 2		T – 3		T – 4		T - 5		Standard
		Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	
Temperature (°C)	Upper	28.9	28.9	29.1	28.8	29.4	29.3	27.5	29.3	29.8	29.8	Natural
	Lower	29.4	29.0	29.3	29.2	29.4	29.4	29.3	29.6	29.8	29.3	
Transparency (m)			3		0		2		2		3	3
Color (Pt-Co)	Upper	5	6	4	44	3	10	3	3	2	5	50
	Lower	2	4	3	2	4	12	2	2	3	3	
Salinity ‰	Upper	30.9	30.6	24.9	22.3	31.1	31.6	31.7	31.8	31.9	31.1	
	Lower	31.8	31.6	30.9	31.5	31.3	31.5	32.8	31.9	32.2	32.1	
TSS (SS) (mg/L)	Upper	3.0	20.0	3.0	7.0	3.0	3.0	2.0	2.0	1.0	2.0	80
	Lower	2.0	3.0	3.0	3.0	3.0	4.0	2.0	1.0	2.0	3.0	
Odor	Upper	Odorless	Odorless	Odor	Odor	Odor	Odor	Odorless	Odorless	Odorless	Odorless	Natural
	Lower	Odorless	Odorless	Odor	Odor	Odor	Odor	Odorless	Odorless	Odorless	Odorless	
pH	Upper	8.11	7.84	7.84	7.90	8.15	8.12	8.18	8.19	8.19	8.16	6 – 9
	Lower	8.17	7.74	7.88	7.79	8.11	8.14	8.15	8.22	8.13	8.18	
DO (mg/L)	Upper	5.5	4.9	2.2	2.0	5.5	4.9	6.3	6.1	6.5	6.3	> 4
	Lower	6.3	5.8	6.1	5.8	6.1	6.0	6.3	6.3	6.5	6.3	
COD (mg/L)	Upper	16.5	20.6	45.4	57.8	20.6	16.5	16.5	16.5	16.5	16.5	80
	Lower	16.5	16.5	16.5	20.6	16.5	12.4	16.5	16.5	16.5	12.4	
Oil & Grease	Upper	< 1	1	2	2	2	2	1	<1	1	1	-
Content (mg/L)	Lower	< 1	1	1	1	1	2	1	<1	1	1	
Phenol (mg/L)	Upper	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0,002
	Lower	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
NH4-N (mg/L)	Upper	0.08	0.32	2.17	3.77	0.02	0.34	0.05	0.07	0.02	0.02	1
	Lower	0.05	0.01	0.10	0.09	0.02	0.16	0.01	0.04	0.02	0.05	
Total N (mg/L)	Upper	0.66	2.25	0.81	5.35	0.40	2.27	0.58	1.08	0.33	0.78	-
	Lower	0.45	1.01	0.48	1.24	0.69	0.57	0.47	0.73	0.28	0.57	
Total P (mg/L)	Upper	0.06	0.46	0.04	0.10	0.04	0.07	0.04	0.07	0.02	0.04	-
	Lower	0.03	0.05	0.03	0.04	0.03	0.04	0.03	0.04	0.02	0.04	
Cd (mg/L)	Upper	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0,01
	Lower	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Cr6+ (mg/L)	Upper	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0,01
	Lower	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	
Cu (mg/L)	Upper	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0,06
	Lower	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Ni (mg/L)	Upper	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0,002
	Lower	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
Total Fe (mg/L)	Upper	0.08	0.08	0.10	0.15	0.05	0.08	0.05	0.05	0.05	0.05	-
	Lower	0.05	0.08	0.08	0.05	0.05	0.05	0.03	0.03	0.08	0.08	
Pb (mg/L)	Upper	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0,01
	Lower	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	
Zn (mg/L)	Upper	0.027	0.025	0.027	0.030	0.025	0.030	0.025	0.025	0.027	0.025	0,1
	Lower	0.025	0.025	0.025	0.030	0.027	0.027	0.030	0.027	0.025	0.025	
Coliform	Upper	9	12	21	26	23	27	13	17	0	0	1000
(Nos/100 mL)	Lower	11	12	49	49	49	63	17	21	7	11	

NOTE: (*): Sea Water Quality Standard as mentioned in Attachment VII (Fishery) of Kep Men KLH No: KEP-02/MENKLH/I/1988
Odor: Dead Organism (Smelt H2S)

Bojonegara

The results of water quality survey were shown in Table C.3.2.

The range of transparency was between 1.60-2.60 m and fulfilled the standards (3 m). The highest transparency observed 2.60 m on location B-1 (West-North Side of Project Site) and the lower transparency observed 1.60 m on location C.3 (Inside of Project Site).

Salinity was between 31.9-32.4 ‰. Generally, the concentration of TSS at all the sampling locations were small values (1-18 mg/L) and still below the standard (< 80 mg/L). All of the pH values were between 7.98-8.09 and still fulfilled the standard range of 6-9.

DO contents were between 6.1-6.6 mg/L and still fulfilled the standard (> 4 mg/L). COD concentrations were between 8.1-16.3 mg/L and still fulfilled the standard (< 80 mg/L).

Oil and grease contents were small (< 1 mg/L).

The highest concentration of NH_4 showed outside Kali Island in upper layer, the value was 0.11 mg/L however still fulfilled the standard (1 mg/L). The total N contents observed on all location were between 0.07-0.27 mg/L and total P contents were between 0.01-0.27 mg/L.

The results of Cd, Cr^{6+}, Cu, Ni, Pb and Zn were below the standard at all the locations. Total Fe contents were between 0.03-0.10 mg/L.

The Bacteriological contents observed at all the locations were between 0-17 Nos/100 mL and still fulfilled the standard (< 1000 Nos/100 mL).

Table C.3.2 The result of Water Quality Survey in Bojonegara

Parameter		B – 1		B – 2		B – 3		B – 4		B - 5		STD(*)
		Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	Flood Tide	EBB Tide	
Temperature (°C)	Upper	29.9	30.2	29.9	29.9	29.9	30.8	29.6	30.2	29.8	30.6	Natural
	Lower	28.6	29.9	29.1	29.6	28.6	29.9	28.8	30.0	28.7	30.3	
Transparency (m)		-	3	-	2	-	2	-	2	-	2	3
		-	-	-	-	-	-	-	-	-	-	
Color (Pt-Co)	Upper	5	4	4	8	4	9	4	12	4	7	50
	Lower	8	6	9	6	21	12	6	4	3	5	
Salinity ‰	Upper	32.3	32.2	32.3	32.2	32.2	32.2	32.4	32.1	31.9	32.1	
	Lower	32.4	32.2	32.1	32.2	32.4	32.2	32.1	32.1	32.3	32.3	
TSS (SS) (mg/L)	Upper	3.0	2.0	2.0	2.0	7.0	5.0	5.0	3.0	2.0	2.0	80
	Lower	7.0	4.0	3.0	3.0	18.0	9.0	13.0	6.0	1.0	10.0	
Odor	Upper	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Natural
	Lower	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	
pH	Upper	8.07	8.07	8.07	8.09	8.07	8.02	8.07	7.98	8.09	7.99	37416
	Lower	8.06	8.06	8.08	8.06	8.06	8.01	8.08	7.98	8.08	7.98	
DO (mg/L)	Upper	6.6	6.3	6.6	6.5	6.3	6.1	6.5	6.5	6.5	6.5	> 4
	Lower	6.6	6.5	6.6	6.6	6.3	6.1	6.5	6.5	6.5	6.5	
COD (mg/L)	Upper	16.3	16.3	16.3	16.3	16.3	12.1	12.1	8.1	8.1	8.1	80
	Lower	16.3	16.3	16.3	16.3	16.3	12.1	16.3	12.1	8.1	8.1	
Oil & Grease	Upper	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-
Content (mg/L)	Lower	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Phenol (mg/L)	Upper	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
	Lower	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
NH4-N (mg/L)	Upper	0.07	0.06	0.02	0.03	0.05	0.06	0.06	0.03	0.11	0.03	1
	Lower	0.03	0.05	0.03	0.05	0.04	0.05	0.06	0.04	0.20	0.04	
Total N (mg/L)	Upper	0.14	0.11	0.08	0.07	0.12	0.10	0.09	0.08	0.18	0.10	-
	Lower	0.11	0.09	0.09	0.10	0.11	0.12	0.12	0.12	0.27	0.11	
Total P (mg/L)	Upper	0.02	0.04	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.04	-
	Lower	0.03	0.05	0.03	0.04	0.01	0.02	0.07	0.02	0.16	0.02	
Cd (mg/L)	Upper	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0
	Lower	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	<0.0005	< 0.0005	< 0.0005	
Cr6+ (mg/L)	Upper	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0
	Lower	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	<0.005	< 0.005	< 0.005	
Cu (mg/L)	Upper	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0
	Lower	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Ni (mg/L)	Upper	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
	Lower	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
Total Fe (mg/L)	Upper	0.05	0.05	0.03	0.03	0.05	0.05	0.03	0.05	0.05	0.05	-
	Lower	0.05	0.08	0.03	0.05	0.08	0.10	0.03	0.08	0.03	0.05	
Pb (mg/L)	Upper	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0
	Lower	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	
Zn (mg/L)	Upper	0.032	0.023	0.027	0.025	0.034	0.037	0.027	0.032	0.030	0.027	0
	Lower	0.027	0.025	0.032	0.025	0.025	0.032	0.023	0.023	0.027	0.027	
Coliform	Upper	0	0	0	0	11	11	7	17	0	0	1000
(Nos/100 mL)	Lower	0	0	0	0	17	15	11	11	0	0	

NOTE : (*) : Sea Water Quality Standard as mentioned in Attachment VII (Fishery) of Kep Men KLH No : KEP-02/MENKLH/I/1988

Odor : Dead Organism (Smelt H2S)

C.3.2 Water Current Survey

Tanjung Priok

The pattern of sea current around Tanjung Priok Port area, whether it is inside or outside of the Port, has the backward-forward type. The measurement during ebb tide outside of the Port showed the direction towards Northwest (230 – 245 °) with the magnitude speed of 0.006 - 0.103 m/s, and the average of 0.088 m/s. While the measurement during the flood tide showed the direction toward North-Northeast (350 – 10 °) with the magnitude speed of 0.040 – 0.066 m/s, and the average of 0.055 m/s.

The measurement during ebb tide inside of the Port showed the direction towards Southwest (240 – 245 °) with the magnitude speed of 0.062-0.079 m/s, and the average of 0.070 m/s. While the measurement during the floodtide showed the direction

towards North-Northeast (0 – 10 °) with the magnitude speed of 0.042 - 0.052 m/s, and the average of 0.044 m/s.

Bojonegara

The pattern of the current direction in Bojonegara is similar to backward-forward pattern. The measurement during ebb tide showed the direction towards Northwest (305 – 310 °) with the magnitude speed of 0.343 - 0.496 m/s, and the average of 0.4 m/s. While the measurement during the floodtide showed the direction towards Southeast (130 – 140 °) with the magnitude speed of 0.206 - 0.417 m/s, and the average of 0.359 m/s.

C.3.3 Seabed Materials Survey

Tanjung Priok

The results of seabed materials survey are shown in Table C.3.3.

The highest percentage of content in the sediment sample was sand as shown at T-1 (East of Pertamina Jetty) and T-4 (Front of PLTU Generating Power Plant), both were located outside of breakwater. Meanwhile the major content of sediment at T-2 (Front of Koja Terminal), T-3 (Front of Palm Oil Tank Yard) and T-5 (Outside of Project Site, as Background) were dust. The clay content of sample from outside breakwater showed higher value.

Table C.3.3 Seabed Materials Condition in Tanjung Priok

Parameter	T – 1	T – 2	T - 3	T - 4	T - 5
Appearance Odor	Sand Odorless	Mud Odor	Mud Odor	Sand Odorless	Mud Odor
Grading Analysis (%)					
Sand (0.05-2 mm)	58	8	8	77	7
Dust (0.002-0.05 mm)	32	69	71	17	60
Clay (< 0.002 mm)	10	23	21	6	33
Ignition Loss (%)					
Density (Bulk) (g/cm_2)	1.22	0.93	0.94	1.17	1.04
Water Content (%)	43.26	81.51	72.48	26.58	71.43
Hg (mg/kg)	0.2	0.73	0.68	0.01	0.46
As (mg/kg)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Pb (mg/kg)	18	47	69	22	16
Cr (mg/kg)	6	13	13	8	17
Cd (mg/kg)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Odor: Dead Organism (Smelt H_2S)

Heavy metal concentrations were:

- Hg: 0.01-0.73 mg/kg;
- As: < 0.5 mg/kg;
- Pb: 16-69 mg/kg;
- Cr: 6-17 mg/kg; and
- Cd: < 0.5 mg/kg.

The heavy metal concentration of T-2 & T-3 located inside breakwater showed high value compared with T-1, T-4, T-5. The highest Hg content showed at T-2.

Concentration of Hg at T-2, T-3 and T-5 exceeded the temporal standard (<0.3mg/kg based on Netherland's standard for dredged materials). These level of concentration was same or less than Hg concentration in Tokyo Bay Japan.

Bojonegara

The results of seabed materials survey are shown in Table C.3.4.

The highest percentage of content in sediment sample was sand as shown at location B-2 (Near Planned Pier), B-4 (Inside of Project Site), and B-5 (Outside of Kali Island, as Background). Meanwhile the major content of samples at B-1 (West-North Side of Project Site) and B-3 (Inside of Project Site) were dust.

Table C.3.4 Seabed Materials Condition in Bojonegara

Parameter	B - 1	B – 2	B – 3	B - 4	B – 5
Appearance	Mud	Sand	Sand & Mud	Sand & Mud	Sand
Odor	Odorless	Odorless	Odorless	Odorless	Odorless
Grading Analysis (%)					
Sand (0.05-2 mm)	9	94	38	84	95
Dust (0.002-0.05 mm)	55	5	44	12	5
Clay (< 0.002 mm)	36	1	18	4	0
Ignition Loss (%)					
Density (Bulk) (g/cm_2)	0.95	1.25	1.18	1.28	1.30
Water Content (%)	66.04	32.91	47.31	40.88	28.07
Hg (mg/kg)	0.1	<0.1	0.2	0.2	0.2
As (mg/kg)	< 0.5	<0.5	< 0.5	< 0.5	< 0.5
Pb (mg/kg)	22	33	29	29	26
Cr (mg/kg)	11	7	5	4	4
Cd (mg/kg)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Odor : Dead Organism (Smelt H_2S)

Heavy metal concentrations were:

- Hg: < 0.1-0.2 mg/kg;
- As: < 0.5 mg/kg;
- Pb: 22-33 mg/kg;
- Cr: 4-11 mg/kg; and
- Cd: < 0.5 mg/kg.

The heavy metal concentrations of all samples at Bojonegara were observed comperatively smaller value.

C.3.4 Air Quality

Tanjung Priok

The results of air quality survey are shown in Table C.3.5.

Table C.3.5 (1) Air Quality Condition in Tanjung Priok

Parameter	I	II	III	IV	V	VI	VII	STD *
T-11: Gate 1								
Air Temperature (°C)	26-34	26-33	26-34	27-35	27-36	26-35	28-34	-
Wind Direction	West	West	West	South	South	South-West	South	-
Wind Speed (m/s)	0.3-6.1	0.3-3.6	0.2-3.5	0.1-3.9	0.8-6.3	0.6-4.4	0.9-4.3	-
Weather	Bright	Bright	Bright	Bright	Bright	Bright	Bright	-
CO (ppm)	0.1-2.5	0.1-2.6	0.6-3.8	0.6-4.5	0.4-3.1	0.2-1.6	0.5-3.5	8.75
SO_2 ($\mu g/m^3$)	6.75-22.77	4.84-35.30	13.46-22.68	12.54-21.65	8.36-31.61	4.38-29.68	15.08-29.69	365
NO_2 ($\mu g/m^3$)	15.34-52.67	11.62-66.92	32.73-58.43	29.69-49.79	18.54-50.89	14.19-48.12	24.14-50.16	150
TSP ($\mu g/m^3$)	150-1.241	15-1,386	239-1,345	258-1,208	138-1,532	103-592	211-1,429	230
T-12: Crossroad of JL. Enggano & JL. Sulawesi								
Air Temperature (°C)	21-33	22-33	24-34	23-34	25-35	23-32	24-35	-
Wind Direction	West	West	West	South	West	West	West	-
Wind Speed (m/s)	0.4-8.0	0.5-7.0	0.6-4.8	0.4-4.6	0.6-3.8	0.5-2.5	0.6-9.4	-
Weather	Cloudy	Cloudy	Bright	Cloudy	Bright	Cloudy	Bright	-
CO (ppm)	0.3-5.1	0.2-5.6	0.5-4.1	0.7-3.8	0.7-4.3	0.5-4.3	1.2-4.3	8.75
SO_2 ($\mu g/m^3$)	6.80-29.86	6.78-24.53	8.65-36.81	15.33-58.10	10.95-20.67	6.14-20.17	8.40-34.70	365
NO_2 ($\mu g/m^3$)	16.63-73.02	12.39-80.72	37.18-60.27	50.72-128.7	35.28-70.27	10.45-47.83	28.28-92.37	150
TSP ($\mu g/m^3$)	151-463	99-844	326-548	256-745	226-773	128-404	212-628	230

Table C.3.5 (2) Air Quality Condition in Tanjung Priok

T-13: Multipurpose Berth of Basin III

Parameter	I	II	III	IV	V	VI	VII	STD *
Air Tempe-rature (℃)	24-34	24-34	25-33	25-35	25-35	24-37	24-36	-
Wind Direction	North	West	East	North	West	West	West	-
Wind Speed (m/s)	0.8-2.9	0.3-4.4	0.3-2.7	0.2-3.2	0.6-0.1	0.4-4.5	0.4-2.1	-
Weather	Bright	Cloudy	Bright	Bright	Bright	Cloudy	Bright-Cloudy	-
CO (ppm)	0.2-1.6	0.1-1.4	0.8-1.8	0.4-1.2	0.3-1.5	0.1-1.0	1.4-1.2	8.75
SO_2 ($\mu g/m^3$)	6.07-17.43	6.01-14.23	8.41-16.34	8.22-15.86	10.82-15.91	6.37-14.13	7.07-19.18	365
NO_2 ($\mu g/m^3$)	9.19-28.40	9.70-23.86	15.43-25.94	13.56-21.47	16.71-28.89	8.73-25.92	15.74-28.19	150
TSP ($\mu g/m^3$)	147-765	120-1,115	516-1,343	258-784	243-956	103-403	177-407	230

Note :
(*) : Air Quality Standard as mentioned in Attachment III of Kep Men KLH No. KEP-02/MENKLH/I/1988 about Environmental Standard Determination.
I : Tuesday, 9 July – Wednesday, 10 July 2002
II : Wednesday, 10 July – Thursday, 11 July 2002
III : Thursday, 11 July – Friday, 12 July 2002
IV : Friday, 12 July – Saturday, 13 July 2002
V : Saturday, 13 July – Sunday, 14 July 2002
VI : Sunday, 14 July – Monday, 15 July 2002
VII : Monday, 15 July – Tuesday, 16 July 2002

The results of CO for all location were still fulfilled the standard (8.75 ppm) with range between 0.1-5.6 ppm. The CO concentration at T-12 located Crossroad of Jl. Enggano & Jl. Sulawesi was higher than other locations (between 0.2-5.6 ppm). Generally, the concentrations of SO_2 were small (4.84-58.10 $\mu g/m^3$) and still below the standard (< 365 $\mu g/m^3$). The higher SO_2 content showed at T-12, SO2 behaves similar condition to CO. The NO_2 concentrations were between 8.73-128.65 $\mu g/m^3$and fulfilled the standard (< 150 $\mu g/m^3$). Behavior of NO_2 concentration showed similar to those of CO and SO_2.

On the other hand, the concentrations of TSP for all sampling locations were very high, almost exceeded the standard (< 230 $\mu g/m^3$).

Bojonegara

The results of air quality survey are shown in Table C.3.6.

Table C.3.6 Air Quality Condition in Bojonegara

Parameter	I	II	III	IV	V	VI	VII	STD *
Air Temperature (°C)	24-34	23-34	20-34	23-35	20-35	23-33	24-36	-
Wind Direction	North	North	West	North	West	North	West	-
Wind Speed (m/s)	1.9-9.3	2.1-14.5	0.3-9.7	1.2-10.0	7.2-10.8	3.3-9.9	0.9-17.2	-
Weather	Bright	Bright	Bright	Bright	Cloudy-Bright	Bright	Bright	-
CO (ppm)	< 0.1-0.7	< 0.1-0.6	< 0.1-0.3	< 0.1-0.2	< 0.1-0.3	< 0.1-0.3	< 0.1-0.3	8.75
SO_2 (ug/m^3)	2.31-4.38	2.07-5.53	1.61-4.84	1.15-8.76	4.15-15.68	2.3-7.84	0.92-8.99	365
NO_2 (ug/m^3)	5.81-16.34	5.10-20.26	4.56-12.72	3.46-9.74	4.87-12.57	4.08-10.52	3.46-9.27	150
TSP (ug/m^3)	41-73	17-86	15-97	20-73	50-80	24-66	32-96	230

Note :
(*) : Air Quality Standard as mentioned in Attachment III of Kep Men KLH No. KEP-02/MENKLH/I/1988 about Environmental Standard Determination.
I :Monday, 1 July – Tuesday, 2 July 2002
II :Tuesday, 2 July – Wednesday, 3 July 2002
III : Wednesday, 3 July - Thursday, 4 July 2002
IV : Thursday, 4 July - Friday, 5 July 2002
V : Friday, 5 July - Saturday, 6 July 2002
VI : Saturday, 6 July - Sunday, 7 July 2002
VII : Sunday, 7 July - Monday, 8 July 2002

All the results of CO, SO_2, NO_2 and TSP showed low values below the standards.

C.3.5 Noise and Vibration

Noise and vibration survey was carried out only among Tanjung Priok Port. The results are shown in TableC.3.7.

Table C.3.7 Noise and Vibration Conditions in Tanjung Priok

Period / Location	I	II	III	IV	V	VI	VII	STD (*)
Noise (dBA)								
Crossroad of Jl. Enggano & Jl. Sulawesi	60.0-73.8	63.2-73.2	64.0-71.8	63.4-71.5	65.0-72.0	64.6-74.3	66.2-74.3	70
Near Gate I	53.0-73.0	54.5-73.4	58.0-74.2	58.0-71.7	50.0-69.2	50.0-70.0	50.0-72.3	70
Multipurpose Berth of Basin III	47.0-57.0	44.5-64.0	50.1-60.0	52.1-65.3	47.9-64.2	50.3-63.5	53.1-63.2	70
Koja Hospital	57.8-76.0	58.1-73.5	59.3-75.6	61.1-72.4	57.8-71.9	55.9-85.4	54.5-72.5	65
Vibration (m/sec)								
Crossroad of Jl. Enggano & Jl. Sulawesi	0.7-7.1	0.7-6.5	0.5-1.4	0.5-1.2	0.4-1.9	0.9-1.6	0.6-2.7	-
Near Gate I	0.6-3.6	0.3-1.8	0.5-2.0	0.5-1.4	0.4-1.6	0.7-1.2	0.6-2.1	-
Multipurpose Berth of Basin III	0.4-2.7	0.5-3.2	0.6-3.6	0.4-2.9	0.5-5.1	0.8-.4.4	0.8-8.1	-
Koja Hospital	1.3-3.7	0.8-7.8	1.3-5.8	1.1-4.4	0.8-3.0	0.9-4.7	1.0-4.7	-

Note :
(*) : Noise Standard as mentioned in SK Gub Propinsi DKI Jakarta No. 551 Th. 2001 for:
Commercial and Service Area: 70 dBA
Port Area : 70 dBA
Hospital Area : 65 dBA
Sampling Time Period :
I :Tuesday, 9 July – Wednesday, 10 July 2002
II :Wednesday, 10 July – Thursday, 11 July 2002
III :Thursday, 11 July – Friday, 12 July 2002
IV :Friday, 12 July – Saturday, 13 July 2002
V :Saturday, 13 July – Sunday, 14 July 2002
VI :Sunday, 14 July – Monday, 15 July 2002
VII :Monday, 15 July – Tuesday, 16 July 2002

C.3.6 Biological Survey

Tanjung Priok

a) Terrestrial Biotic

Existing flora in study area consist of:

- Duwet (Syzygium cumini);
- Buni (Antidesma bunius);
- Sawo Kecik (Manilkara kauki);
- Akasia (Acacia mangium);

- Cemara (Thyja occidentalis);
- Kelapa (Cocos nucifera L);
- Palem Raja (Oreodoka regina);
- Lamtoro (Leucaena glauca);
- Ketapang (Terminalia catappa).
- Pisang (Musa paradisiaca);
- Angsana (Pterocarpus indicus);
- Kersen (Fragaria vesca);
- Asam Londo (Pithecolobium dulce); and

Domestic animals are very common at Tanjung Priok area because the study area is man made ecosystem. Identified animals from field survey were:

- Burung Gereja (*Passer montanus*);
- Anjing (*Canis sp*);
- Kucing (*Felis sp*); and
- Ayam (Galusnb galus).

From "Feasibility Study Report of Outpour and Container Terminal Tanjung Priok Port Development Plan, April 2000", the following birds were observed at Tanjung Priok:

- Burung Madu Kuning (*Nectarinia jugularis*);
- Ibis Kepala Hitam (Threskiomis melanocephalus);
- Kuntul Karang (*Egreta sacra*);
- Roko-roko (Pleghadis falcinellus); and
- Dara Laut (*Sterna sp*).

Concerning terrestrial flora and fauna, protected species regulated by Indonesian law/regulation or international treaties were not observed.

b) Aquatic Biotic

The plankton survey was conducted with two types of sampling methods, called Horizontal Type and Vertical Type. The horizontal type was conducted by pulling plankton net horizontally. The vertical type was conducted by pulling plankton net vertically from 5 m depth or 1 m above the bottom to surface.

Identified plankton in laboratory by vertical/horizontal towing in Tanjung Priok are shown in Table C.3.8. The identified benthos is explained in Table C.3.9.

Table C.3.8 (1) Identified Plankton Species in Tanjung Priok

Vertical Towing

	T1	T2	T3	T4	T5
Phytoplankton					
Abundance (Individu/m^3)	4600	5980	5980	5175	4025
(SHANNON - WEAVER)					
Diversity Index (H')	3.5241	3.6171	3.3195	3.5214	3.0142
Similarity Index (E)	0.8810	0.9043	0.8719	0.9013	0.8408
Zooplankton					
Abundance (Individu/m^3)	1035	1035	805	805	920
(SHANNON - WEAVER)					
Diversity Index (H')	2.1133	1.7527	1.8424	2.2359	1.5488
Similarity Index (E)	0.9101	0.8764	0.9212	0.9629	0.7744

Table C.3.8 (2) Identified Plankton Species in Tanjung Priok

Horizontal Towing

	T1	T2	T3	T4	T5
Phytoplankton					
Abundance (Individu/m^3)	7590	7245	5405	8395	7705
(SHANNON - WEAVER)					
Diversity Index (H')	3.1008	3.0098	3.3222	2.9526	2.8357
Similarity Index (E)	0.7586	0.7905	0.8503	0.7979	0.7910
Zooplankton					
Abundance (Individu/m^3)	1150	1840	690	805	1035
(SHANNON - WEAVER)					
Diversity Index (H')	2.5219	2.8750	1.9183	2.1281	1.6577
Similarity Index (E)	1.0000	1.8870	1.0000	1.0000	1.0000

Table C.3.9 Identified Benthos in Tanjung Priok

	T1	T2	T3	T4	T5
Aboundance (Individu/m^3)	225	125	100	275	250
(SHANNON - WEAVER)					
Diversity Index (H')	1.3516	0.9932	1.5	1.9717	0.7219
Similarity Index (E)	0.8528	0.6266	0.9464	0.8492	0.7219

Based on the interview with local fishermen and field survey, the commercial fish was not found at Tanjung Priok Port and surrounding. The fishermen catch their fish far away from Tanjung Priok area.

According to the underwater survey living coral reefs were not found. Only shell and dead coral were found at Northern area of Tanjung Priok Port.

Bojonegara

a) Terrestrial Biotic

Existing flora in study area consist of:

- Padi (*Oryza sativa*);
- Mangga (*Mangifera indica*);
- Asam (*Tamarindus indica*);
- Kelapa (*Cocos sp*);
- Pepaya (*Carica papaya*);
- Jati (*Tectona grandis*);
- Akasia (*Acacia auriculiformis*);
- Jeunjing (*Albazia falcata*);
- Pisang (*Musa paradisiaca*);
- Srikaya (*Sanga muricata*);
- Kacang Tanah (*Phaseolus sp*);
- Jagung (*Zea mays*);
- Terung (*Solamun sp*);
- Cabe Rawit (*Capsicum frutescen*);
- Beluntas (*Plucea indica*);
- Duranta (*Durant erecta*);
- Jambu Air (*Syzygium aqueum*).
- Melinjo (*Gnetum gnemon*);
- Lamtoro (*Leucaena glauca*);
- Nangka (*Arthocarpus integra*);
- Randu (*Ceiba petandra*);
- Angsana (*Pterocarpus indica*);
- Singkong (*Manihot esculenta crantz - utilissima*);
- Bambu (*Bambusa sp*);
- Rambutan (*nepelium lapaceum*);
- Jambu Batu (*Psidium guajava*);
- Kacang Panjang (*Vigna sinensis*);
- Pisang (*Musa paradisiaca*);
- Cabe (*Capsicum anuum*);
- Ipomoea pescaprae;
- Mangrove (*Avicenia sp*);
- Hanjuang (*Cordyline fructicosa*);
- Ubi jalar (*Ipomoea batatas poir*); and

Domestic animals were very common at Bojonegara area because the study area is man made ecosystem. Identified animals from inventory in 2002 were shown:

- Sapi/Cow (*Bos taurus*);
- Kambing/Goat (*Capra sp*);
- Ayam/Chicken (*Galusnb galus*);
- Itik/Duck (*Anas sp*);
- Kutilang (*Pycnonotus aurigaster*);
- Kuntul (*Bubulcus Ibis*);
- Layang-layang (*Hiruda tahitica*).
- Kerbau/Buffalo (*Bubalos bubalis*);
- Kucing/Cat (*Felis sp*);
- Angsa/Goose (*Nefopus sp*);
- Gereja (*Passer montanus*);
- Perkutut (*Geopelia striata*);
- Walet (*Colocalia esculenta*); and

b) Aquatic Biotic

Identified plankton in laboratory by vertical/horizontal towing in Bojonegara are shown in Table C.3.10. The identified benthos is explained in Table C.3.11.

Table C.3.10 (1) Identified Plankton Species in Bojonegara

Vertical Towing

	B-1	B-2	B-3	B-4	B-5
Phytoplankton					
Abundance (Individu/m^3)	7130	4370	6670	5290	4370
(SHANNON - WEAVER)					
Diversity Index (H')	3.4869	2.8999	3.4013	3.4182	2.8331
Similarity Index (E)	0.9158	0.8383	0.8933	0.8749	0.7903
Zooplankton					
Abundance (Individu/m^3)	1035	920	1265	575	1495
(SHANNON - WEAVER)					
Diversity Index (H')	2.1972	2.1556	2.2999	1.9219	2.4697
Similarity Index (E)	0.9463	0.9284	0.8897	0.9610	0.9554

Table C.3.10 (2) Identified Plankton Species in Bojonegara

Horizontal Towing

	B-1	B-2	B-3	B-4	B-5
Phytoplankton					
Abundance (Individu/m^3)	5980	6325	7360	7705	6325
(SHANNON - WEAVER)					
Diversity Index (H')	3.3998	3.3388	3.6392	3.8418	3.3832
Similarity Index (E)	0.8930	0.8769	0.8903	0.8747	0.8886
Zooplankton					
Abundance (Individu/m^3)	575	1150	575	345	575
(SHANNON - WEAVER)					
Diversity Index (H')	1.3709	2.4464	1.5219	1.5849	1.9219
Similarity Index (E)	0.8649	0.9464	0.9602	1.0000	0.9610

Table C.3.11 Identified Benthos in Bojonegara

	B-1	B-2	B-3	B-4	B-5
Abundance (Individu/m^3)	225	275	200	250	325
(SHANNON - WEAVER)					
Diversity Index (H')	2.1972	1.9808	2.1556	2.1219	2.0759
Similarity Index (E)	0.9463	0.9904	0.9284	0.9139	0.8940

The fish that have been observed in Bojonegara based on visual identification, interview with local fishery and data from Dinas Perikanan are:

- Baronang (*Siganus sp*);
- Kakap Merah (Lutjanus altifrontalis);
- Tongkol (Auxis thazard);
- Teri (Stolephorus sp).
- Kerapu (Epinephelus sp);
- Petek (Leioganthus bindus);
- Belanak (*Mugil cephalus*); and

Coral reefs are one of the most threatened ecosystems in the coastal areas of the world. Recently, stress caused by human activities-such as land-based sources of pollution and destruction of fishing practices- were considered to be primary dangers to coral reefs. Indonesia consists of many small islands and develop coral reefs as ecosystem in their coastal regions. The total area of coral reefs in Indonesia is estimated roughly about 85700 km_2 (Nontji, 2000). Unfortunately, it is reported that only about 6 % of Indonesian reefs are still in excellent condition, and the rest are in various stages of destructions.

Distribution of coral reef and mangrove forest are shown in Figure C.3.1.

Coral living coverage at Bojonegara is about 31.3-35.3 %, and coverage of biotic non-coral such as soft coral, sponge and invertebrate is 35.1 to 36.7 %. Scleractinian coral where living at the shallow water is dominated by *Porites lobata* and Alcyonacean *Tubipora musica* (see Table C.3.12). Living coverage of Staghorn corals, Acropora is about 6.8 to 8.2 %, most of the category is *Acropora selago* and *Acropora palifera* as shown in Figure C.3.2.

Table C.3.12 List of Coral Species at Pulau Kali, Bojonegara

No.	Species		Pulau Kali 1		Pulau Kali 2	
			windward	Leeward	Windward	Leeward
1.	*Acropora*	*formosa*			v	
2.	*Acropora*	*selago*	v		v	
3.	*Acropora*	*palifera*	v			
4.	*Acropora*	*microphtalma*		v		v
5.	*Cyphastrea*	*microphthalma*	v			
6.	*Echinopora*	*lamellosa*	v	v		v
7.	*Montipora*	*hispida*		v	v	v
8.	*Montipora*	*informis*			v	
9.	*Montipora*	*venosa*	v			
10.	*Oulastrea*	*crispata*	v			
11.	*Pachyseris*	*speciosa*			v	
12.	*Pavona*	*divaricata*		v		v
13.	*Pavona*	*decussata*	v	v		v
14.	*Goniastrea*	*aspera*	v			
15.	*Goniastrea*	*meandrina*		v		v
16.	*Goniopora*	*minor*		v		v
17.	*Favites*	*abdita*			v	
18.	*Porites*	*lobata*	v	v	v	v
19.	*Porites*	*lutea*	v	v		v
20.	*Porites*	*cylindrica*		v		v
21.	*Galaxea*	*fascicularis*	v			
22.	*Psammocora*	*profundacella*			v	
23.	*Tubipora*	*musica*	v		v	
24.	*Heliopora*	*coerulea*	v	v		v
25.	*Millepora*	*murayyi*			v	

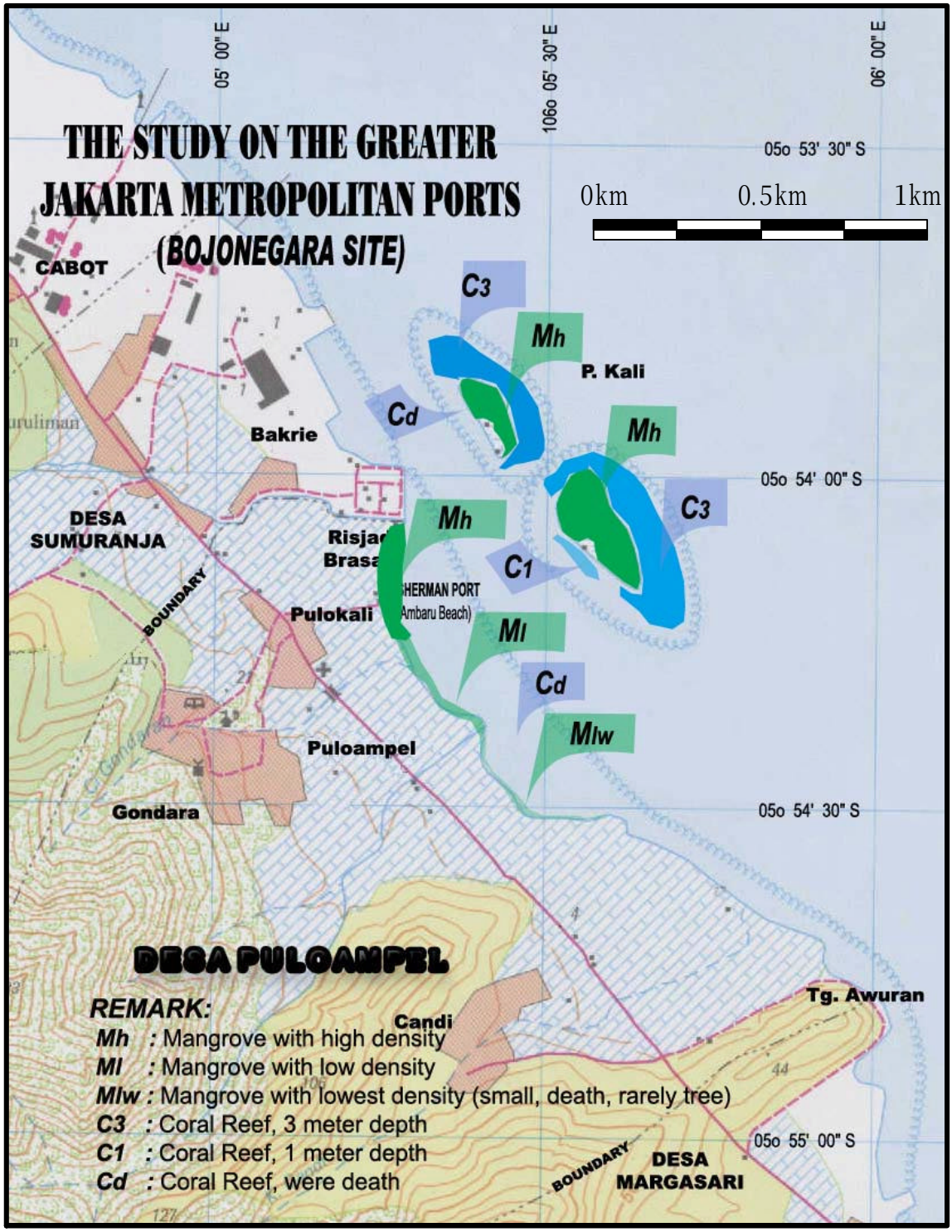


Figure C.3.1 Distribution of Coral Reefs and Mangrove Forests

Reef condition at Bojonegara is moderate, it appears that stony corals more frequently found at this area. But some of the stony corals have died, and then they become covered with algae. Dead Coral with Algae (DCA) coverage ratio is 20.7 to 22.7 % (see Figure C.3.3). Intermediately environmental impact was occurred at the reef ecosystem which species diversity index range in 2.0 to 2.3. Highly coverage of soft coral such as *Sinularian* and *Sarcophyton* was indicated that the coral reefs are threatened. Run-off and re suspension/sedimentation, which are main factors, may affected the ecosystem. Thus, coral massive (CM) was dominant in this condition, because that coral more survive in the bad environmental condition. Both run off and sedimentation may affect to distribution of the reef coral. Stony corals were found in windward of Pulau Kali at 3-meter depth and in the leeward area, stony corals were rare and that were only found at 1-meter depth. Species indicator at turbid area such as Sea urchin, *Diadema* was also found at the leeward area.

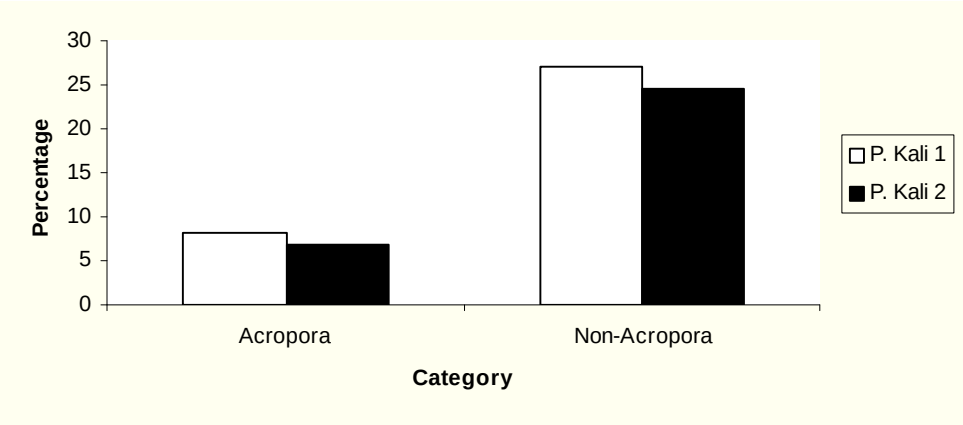


Figure C.3.2 Percent Coverage of Living Coral in Bojonegara

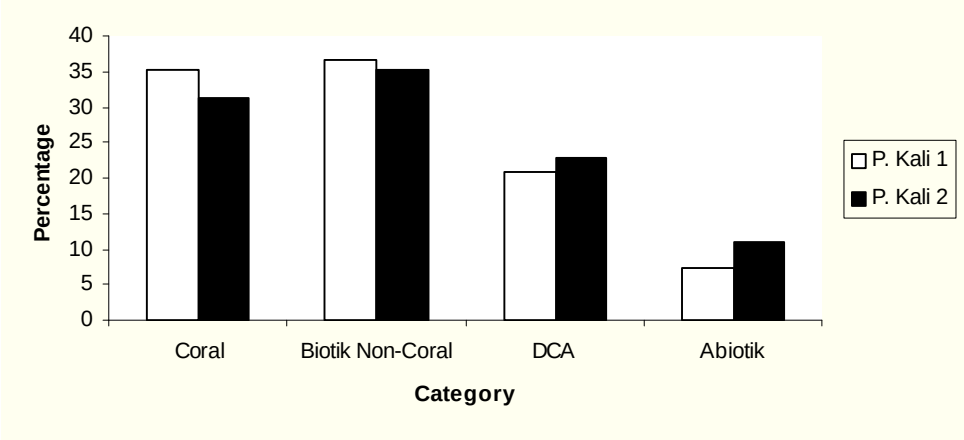


Figure C.3.3 Percent Coverage of Living Coral in Bojonegara

Mangrove ecosystem provides nursery ground and protected coastal areas by wave action. The formation of respiratory root provides habitat for fish larvae. Mangrove forest in Bojonegara is distributed along coastal areas, at Pulau Jawa and Pulau Kali. About 3 genera were found in this area, *Rhizophora*, *Avicennia* and *Sonneratia*. Mangrove density range from 0.01 to 0.42 ind/m^2 and higher density was composed by seedling of *Rhizophora* (see Figure C.3.4.). Thus indicates that ecosystem has been recovery.

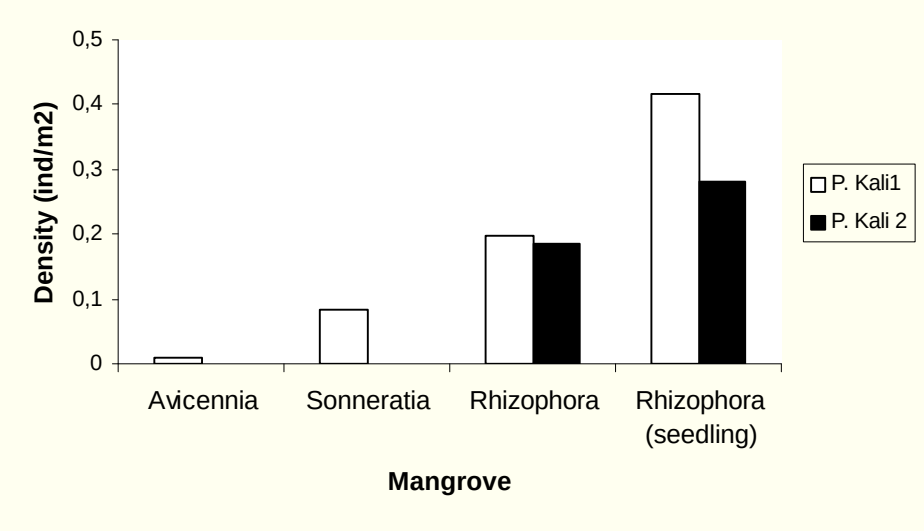


Figure C.3.4 Density of Mangrove Trees in Bojonegara

C.3.7 Socio Economic Environment

Tanjung Priok

a) Demography and Socio Economy

Table C.3.13 shows demographical condition of the study area in Tanjung Priok.

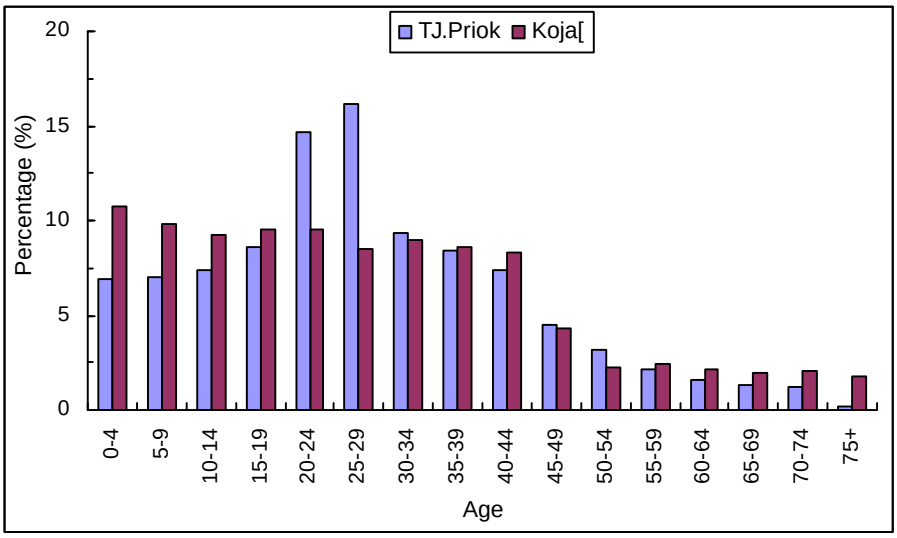
Table C.3.13 Area, Population and Population Density in Tanjung Priok Port

Village	Area (km_2)	Number of People	Number of Household	Density (person/km_2)
Tanjung Priok	5.54	26,731	6,709	4825/33,414*
Koja	3.28	32,645	8,995	9,953
Total/Average	8.82	59,376	15,704	6,732/14,552*
DKI Jakarta	661.52	7,578,701	-	11,454

Source: Tanjung Priok 2001 Yearly Report and Koja Monographic Data, 2002
*: Calculated as Tanjung Priok area for dwelling is 0.8km_2

Total area of *Kelurahan* Tanjung Priok is 554 ha. However port area managed by IPC2, their office and commercial area occupies 464 ha, dwelling area is only 80 ha, less than 15 %. So population density is extremely high, is over 33,000 persons per km^2. This value is 3 times as high as that of Jakarta. According to the information from Kelurahan Secretary of Tanjung Priok recorded population includes only legally registered inhabitants (having *Kelurahan* Tanjung Priok ID cards), temporary workers coming from outside are excluded. Number of temporary workers is assumed 6,000 to 7,000 persons. In addition there may be many illegal inhabitants in the study area, actually it will be difficult to grasp correct population. Kelurahan Koja includes Koja Container Terminal and Jakarta International Terminal, its population density is 9,953 persons per km^2.

Figure C.3.5 shows that productive age (15 to 54 years) in *Kelurahan* Tanjung Priok and Koja occupy more than half of total population.



Source: Tanjung Priok 2001 Yearly Report and Koja Monographic Data, 2002

Figure C.3.15 Percentage of Productive Age

Especially number of productive age in Tanjung Priok occupies 72 % of total population, 31 % of total population is young age (about 20 to 30 years old). This result explains that the study area can supply manpower, but need job.

People structure according to their livelihood can be observed from the type of livelihood or activity to fulfill their live requirement. Table C.3.14 shows people structure based on source of livelihood in *Kelurahan* Tanjung Priok and Koja.

Table C.3.14 People Structure Based on Source of Livelihood

Type of Livelihood	Tanjung Priok		Koja	
	People	Ratio (%)	People	Ratio (%)
1 Civil Government/Private Worker/Military	8,436	59.0	19,563	88.4
2 Trader/Entrepreneur	3,029	21.2	1,327	6.0
3 Farmer	-	-	-	-
4 Skilled Worker	2,620	18.3	380	1.7
5 Pension	190	1.3	840	3.8
6 Fisherman	15	0.1	-	-
7 Services	-	-	17	0.1
Total	14,290	100.0	22,127	100.0

Source: Monographic Data from each Village, 2002

This table gives that the primary source of livelihood in Tanjung Priok are civil government and private worker and military staff, 59 % of livelihood, next entrepreneur/trader occupies 21 %. And it should also be added that above 1,000 people are still poor condition.

Source of livelihood in *Kelurahan* Koja is similar to Tanjung Priok. Koja community open restaurants, truck rental services, car/truck lubrication services e.g. along the

Pelabuhan Main street. Sulawesi Street, which is administrative boundary of *Kelurahan* Tanjung Priok and Koja, is one of the busiest areas. Many people make business in this area, also use for land transportation, as a result Sulawasi Street is always crowded. Surrounding Slawesi Street and other main road are also community area for residents, many pleasure facilities such as Billiard, Bar, and Discotheque are located. However according to the interview with administrative securities of Koja and Tanjung Priok, these area are also criminal hotbed such as prostitution and illegal drag trades, they are worried increasing various criminal cases by port development which many cause serious impact to control of their security, crime and morality.

Educational level is one of the most important indicators to understand community condition. Greater part of the people in Tanjung Priok and Koja are junior and senior high school graduates. According to Tanjung Priok 2001 Yearly Report, 34 % of total population in Tanjung Priok was classified into this category. This result gives it will be difficult for two sub-districts to provide enough skilled worker.

Kelurahan Tanjung Priok has 1 hospital, 1 public health center (*Puskesmas*), 17 health units (*Pos Kesehatan*) and 5 pharmacies, and the health worker consists of 2 medical doctors and 1 midwife. On the other hand, *Kelurahan* Koja has 1 hospital, 1 public health center, 2 childbirth clinic, 4 pharmacies, 5 drug stores, 1 laboratory clinic, 2 health clinic and 1 family planning clinic, the health worker consists of 10 medical doctors and 4 midwives.

Kelurahan Tanjung Priok and koja may be vulnerable concerning security and criminal condition, because this area has big bus terminal and train station, many new comers with/without employment. According to interview with respondents, various crime such as robbery, rape, theft, violence and illegal trading occur daily however not all the crime can be reported to administration office, they can not fully grasp the condition.

b) Environment Sanitation Condition

- Water Supply System

Fresh water supply systems at these 2 *kelurahan* are supplied by PAM (Water Enterprise). Only few inhabitants use shallow well for main use or reserve use purposes. There is one MCK unit (Bath, Wash and Closet) at *Kelurahan* Koja built by Pertamina that can be used by surrounding inhabitants.

- Solid Waste

At *Kelurahan* Tanjung Priok and Koja, the waste material removal is run by RT/RW Sanitation Crew in coordination with the sanitation Division of DKI Jakarta to haul them to the waste Material Final Terminal Location.

- Drainage

The city drainage system is served by open gutter on both side of the road. These drainage systems are in a poor maintenance condition. Many are clogged with waste materials and thick sediments. During rainy season with heavy rainfall flood occurs at *Kelurahan* Koja. During rain and high tide this region is flood.

c) Land Use

Based on Tanjung Priok 2001 Yearly Report and Koja Monographic Data June 2002, the land use shows the largest area used of port facilities as shown in Table C.3.15.

Table C.3.15 Land Use in Tanjung Priok and Koja

Type of Land Use	Tanjung Priok		Koja	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Port Facility	439	79.2	115.7	35.3
General Warehouse	(419)	(75.6)	-	-
Office	(20)	(3.6)	-	-
Container Facility	-	-	(115.7)	(35.3)
Commercial Area	35	6.4	64.9	19.8
Market	(0.5)	(0.1)	-	-
Public/Government Facility	(0.2)	(0.1)	(30.6)	9.3
Industry	(24.3)	(4.4)	-	-
Office/Trading	(10)	(1.8)	-	-
Residential Area	80	14.4	115	35.1
Cultivated Area				
Forest Area				
Cemetery/Grave Yard				
Others			32.4	9.9
Total	554	100	327.8	100

Source: Tanjung Priok 2001 Yearly Report, January 2001 and Koja Monographic Data, June 2002

Port facilities managed by IPC2 occupy 79.2 % of land use in *Kelurahan* Tanjung Priok, and a container facility occupies 35.3 % of Koja. On the other hand, residential area only 14.4 % in Tanjung Priok, and 35.1 % in Koja. There are no areas for cultivated and forest in both *Kelurahan*. This condition indicates that port activity including development program causes not a small impacts not only to natural environment but also to residential living style.

d) Fishery Condition

Based on *Tanjung Priok Yearly Report, January 2002*, total of 15 people fisheries stay in *Kelurahan* Tanjung Priok. Actually now, all of the fishermen are already removed to another location.

Based on *Koja Report* there are no fishermen who live in this area, and based on land use of *Koja Monographic Data, June 2002*, there are no fishery area. According to the interview with Nahkoda fishermen who berth their boat at Digul Port located between UPTK III and Pertamina, they live at Cilincing area and catch fishes out of Tanjung Priok Port Area. The boat activities at Digul Port are only to served Anchor Ship necessity and deliver or pick up a man who wants to fishing for recreation at breakwater.

e) Community Perception and Aspiration

This survey aimed at the following issues:

- Communities Perception about Planned Area
  - To learn respondent aspiration and perception on future container port project.
  - To learn respondent aspiration and perception for the future open new job/business opportunities due to the container terminal project.
- Visual Existing Condition

- To learn, how far the linkage of activities of existing port with surrounding community
- To learn visual existing condition of:
Respondent's income, air quality, noise disturbance, sanitation, socio, economical, cultural and transportation condition.

Total 40 persons were selected as respondents for interview survey. The details of respondents are shown in Table C.3.16.

Table C.3.16 Total Respondents Based on Type of Citizen and Livelihood

		Tanjung Priok	Koja	Total
Type of Citizen				
1.	Permanent Jakarta Citizen	12	4	16
2.	Incomer	6	11	17
3.	Commuter (Worker in existing area)	7	-	7
	Total Respondent	25	14	40
Type of Livelihood				
1	Trader	7	6	12
2	Worker	13	8	21
	Government Worker	5	2	7
	Civil Worker	2	4	6
	Existing Port Worker	6	2	8
3	Food Stall	3	1	4
4	Movable Trader	1	-	1
5	Photo Copy Services	1	-	1
	Total	25	15	40

Respondent perceptions are shown in TableC.3.17.

Table C.3.17 (1) Results of Respondent Perceptions in Tanjung Priok

No.	Perception (%)	Tanjung Priok	Koja	Total (%)
1	**Linkage Port activities with surrounding community**			
1.1	Linkage with Port Activities			
	a. Port Worker	15 %	5 %	20 %
	b. Steel Scrap Trader	15 %	_	15 %
	c. Movable Port Trader	_	12,5 %	10 %
	d. Port Services			
	d.1 . Photo copy services	2,5 %	-	2,5 %
	d.2. Container Rental Services	2,5 %	-	2,5 %
	d.3 Sea Freight Forwarder	-	5 %	2,5 %
	d.4 Loading Unloading Services	-	2,5 %	2,5 %
	e. As Catering Services	7,5 %	-	7,5 %
	f. As Housing Rental Services	2,5 %	-	2,5 %
	Sub Total 1.1	**45 %**	**25 %**	**70 %**
1.2	No link with Port activities			
	a. Government worker	12,5 %	5 %	17,5%
	b. Garment trader	-	2,5 %	2,5 %
	c. Food and beverage Services	2,5 %	2,5 %	5 %
	d. Lecturer	-	2,5 %	2,5 %
	e. Retired	2,5 %	-	2,5 %
	Sub Total 1.2	**17,5 %**	**12,5 %**	**30 %**
	TOTAL	**62,5 %**	**37,5 %**	**100 %**
2	**Positive Impact Perception**			
2.1	New Job Opportunity			
	a. Construction Work	12,5 %	5 %	17,5 %
	b. Operational Work	12,5 %	5 %	17,5 %
	c. Open a new business of their own	27,5 %	17,5 %	45 %
	d. Not Interested	10 %	10 %	20 %
	Total	**62,5 %**	**37,5 %**	**100 %**
2.2	Other Positive Impact			
	a. Increasing of people's Income	,5 %	37,5 %	100 %
	b. Developing city	35 %	22,5 %	57,5 %
	c. Accelerating Port Services	37,5 %	22,5 %	60 %
	d Opening new kind of business	30 %	20 %	50 %

Table C.3.17 (2) Results of Respondent Perceptions in Tanjung Priok

No.	Perception (%)	Tanjung Priok	Koja	Total (%)
3.	**Negative Impact Perception**			
	a. Noise Disturbance	22,5 %	10 %	32,5 %
	b. Air Pollution	22,5 %	10 %	32,5 %
	c. Traffic Jam	47,5 %	32,5 %	80 %
	d. Illegal business opportunities	12,5 %	10 %	22,5 %
	f. Night Recreational Business Opportunities	15 %	10 %	25 %
	g. Social Conflict			
	- Social envy (jealous)	15 %	10 %	25 %
	- Grabbling other's field business	30 %	15 %	45 %
4.	**Existing Condition**			
4.1	Physical-Chemical			
	a. Air Quality			
	- Fresh	0 %	0 %	0 %
	- Polluted	62,5 %	37,5 %	100 %
	Total	62,5 %	37,5 %	100 %
	b. Noise Level			
	- Noise Disturbance	55 %	27,5 %	82,5 %
	- Not Noisy	7,5 %	10 %	17,5 %
	c. Traffic Disturbance			
	- Traffic Jam	100 %	100 %	100 %
	d. Flood			
	- Flood	10 %	20 %	30 %
4.2	Social-Cultural Condition			
	a. Social Friction between local people and new comer			
	- *No disturbance*	52,5 %	32,5 %	85 %
	b. Social Conflict			
	- Social envy	10 %	5 %	15 %
	- Grabbling other's field business	7,5 %	7,5 %	15 %
	c. Security Disturbance			
	-Often	20 %	27,5 %	47,5 %
	- Seldom	42,5 %	7.5 %	45 %
	- good	5 %	2,5 %	7,5 %
	d. Drugs Problem	15 %	5 %	20 %
4.3	Public Health			
	- good health	5 %	10 %	15 %
	- Minor diseases occur	62,5 %	27,5 %	85 %

Bojonegara

a) Demography and Socio Economy

Area, population and population density in the study area are shown in Table C.3.18.

Table C.3.18 Area, Population and population Density in Bojonegara Site

Village	Area(km_2)	Number of People	Number of Household	Density (person/km_2)
Sumuranja	2.90	3,552	999	1225
Pulo Ampel	4.46	2,071	574	464
Margasari	3.99	2,988	749	749
Total/Average	11.35	8,611	2322	759
Kabupaten Serang	1,724.09	1,652,763	385,953	959

Source: Monographic Data from each Village, 2002
Banten in Figures 2000
Study AMDAL in 1997

Average of population density in *Kabupaten* Serang was 959 persons, so density of *Desa* Pulo Ampel and Mangasari were lower than *Kabupaten* Serang, on the other hand *Desa* Sumuranja was higher density. Ratio of productive age (15 to 54 age) were 60.6 % in *Desa* Sumuranja, 56.7 % in Pulo Ampel and 55.3 % in Margasari, these results show increasing of employment is expected.

The people structure according to their livelihood can be detected from types of livelihood or activities for fulfilling their live requirements. In the study area, general work was farmers, and occupied 36 to 48 % of working people as shown in Table C.3.19. Next freelancer and skilled worker occupied 15 to 39 %.

Table C.3.19 People Structure Based on Source of Livelihood

Type of Livelihood		Sumuranja		Pulo Ampel		Margasari	
		People	Ratio(%)	People	Ratio(%)	People	Ratio(%)
1	Civil Government	35	7.8	32	5.7	35	1.9
2	Military	2	0.4	2	0.4	-	-
3	Freelancer	147	33.0	83	14.7	-	-
4	Trader/Entrepreneur	12	2.7	51	9.0	240	12.8
5	Farmer	213	47.8	255	45.1	672	36.0
6	Skilled Worker	-	-	46	8.1	723	38.7
7	Retired	7	1.6	1	0.2	10	0.5
8	Fishery	22	4.9	73	12.9	187	10.0
9	Services	8	1.8	22	3.9	2	0.1
Total		446	100	565	100	1869	100

Source: Monographic Data from each Village, 2002

Main agricultural production is Peanut. According to the interview survey, average incomes of peanuts farmer are Rp. 400,000 to 1,700,00- per month, rice farmer are Rp. 800,000 to 3,400,000- per month. And average incomes of traders are Rp. 750,000 to 3,000,000- per month, services like a food restaurant are Rp. 500,000 to 1,000,000- per month. Average income of fishermen were estimated Rp. 3,750,000 to 11,250,000- per

month, however fishermen go for catching fish far away from the project site sometimes near Sumatra Island, fish catches are estimated not so high.

All the residential people is obedient Moslem, there are total 29 units of Mosque and Mushila. Mosque and Mushila are one of the most important facilities for Moslem people, many traditional, religious and social problem are solved by meeting in these facilities.

There are 2 Public Health Center (*Puskesmas*), one is in *Desa* Sumuranja, and another is in *Desa* Pulo Ampel. On the other hand *Desa* Margasari does not have Puskesmas. The road condition among Desa Margasari, Desa Pulo Ampel and Sumuranja is so bad that People in Margasari have to go to Bojonegara Hospital. Table C.3.20 shows health facility.

TableC.3.20 Number of Health Facility in Bojonegara

Type of Health Facility	Sumuranja	Pulo Ampel	Margasari
Hospital	-	-	-
Clinic	1	-	-
Public Health Center (*PUSKESMAS*)	1	1	-
Integrated Health Care Services Unit (*PosYandu*)	4	2	4
Medical Doctor	1	-	-
Midwife	5	2	5
Pharmacy	-	-	-
Total	12	5	9

Source: Monographic Data from each Village, 2002

Health care for children under 5 years old is attended by women in each village, and assisted by midwives under the *Posyandu* Program controlled by the Integrated Health Care Services Unit. According to the data from *Puskesmas* in Pulo Ampel, total number of people who went to hospital in April and May, 2002 were 955 persons, 41 % of the patients were caused by respiratory illness, 21 % were by diarrhea, and 15 % were by dermatitis.

b) Environment Sanitation Condition

- Water supply system

Desa Pulo Ampel has 2 units of deep well facility for water supply, every households use the pipeline system using PVC or soft polyethylene pipes. All the fresh water supply services are operated by the society of village Mosque.

- Solid waste management

The solid waste management is carried out individually by each household. Usually they burn their collecting waste in their yard, some of them dumps waste materials into rivers. Actually their waste management system is still minimal level.

In *Desa* Sumuranja, there is a gutter in front of the Risyard Brasalli Factory, which gutter has narrowed by waste materials, as a result over flow often occurs.

c) Land Use

The study area consist of 3 villages: *Desa* Pulo Ampel consisting of *Kampung* Pulo Ampel, Gondara and Candi, *Desa* Sumuranja and *Desa* Margasari consisting of 4 *kampung* Ragasawuran, Sumur Waluh, Sambilawang and Bekeraya.

Desa Pulo Ampel with an area of 446,020 ha consists of 75,160 ha flat land and 370,86 ha hilly and mountainous land. The surface level is 12 m from sea level. Commercial centre of Pulo Ampel lies on Salira Street, the main street connecting Merak and Bojonegara. There are several shops to fulfil daily needs, stationary shop, workshop, food stall and the market. Pulo Ampel market opens only on Tuesdays and Fridays. PT. Risyard Brasali, which is plastic material factory lies partway in Pulo Ampel and the other part in *Desa* Sumuranja area. Ambaru seaside lies alongside of Salira street is also planned for new port at present is used as the fisherman port, used for the fishermen's shipping berth. The residential area at *Kampung* Candi lies a distance away from the other 2 *Kampungs*. The flat lands are used for residential area, and the hilly sides are functioned as farmlands.

Desa Sumuranja with an area of 290,139 ha mostly used for farming and residential. There is no special commercial area, although there are several small shops adjoining the owner's house. At Sumuranja Mesjid Street in front of IPC II Project office, Banten Branch, most are housing area. Some open a small shop in front of their house to serve school needs and also daily consumptive needs. There is also a junior high school along this street. The industrial area in *Desa* Sumuranja lies st Salira Street, those are part of Risyard Brasali Company, part of PT. Cabott and PT Trans Bakrie. The rest of land is greater part hilly land for rice farming and penut farming.

Desa Margasari has an area 399 ha. The commercial area of Margasari lies at the main street Salira which connected Merak and Bojonegara. Shops, Stalls, telecommunication centre facility are located along this street. There are 3 industrial factories in this village, PT. Guna Nusa Utama (construction plan engineering industry). PT. Hamparan Rezeki and PT. Kusuma Raya Utama (type C mining industry). The residential area are spread over the 4 *Kampungs*, the rests are farm land over the hill, including lands sold to Pelindo, either located according in permitted area or not located according in permitted area.

d) Fishery Condition

Total 282 fishermen live in 3 Village. From their information, the volume of fish catching was about 60 –100 kg fish/trip. The type of fish catching are such as tuna , kakap, baronang. The fish catching activity by the fisheries at Bojonegara generally is at the sea and have been hereditary activity as livelihood source. The catching zone is located far from Bojonegara site. The fishermen use simple catching tools such as gill net or coastal rig. Surrounding of Pulo Kali Island, only small fish such as Teri (*Stolephorus sp.*).

e) Community Perception and Aspiration

This survey aimed at the following issues:

- Land Acquisition Process:
  - To learn the community aspiration and perception toward the land acquisition process

- To learn the community aspiration and perception of the relocation plan

- Community Perception About The Project:
  - To learn the community aspiration and perception on the future container port project
  - To learn the community aspiration and perception for the future new jobs opportunities due to the container terminal project

- Existing Visual Condition:
  - To learn the existing visual condition about community income, air quality, noise level, social, economy, cultural and transportation condition

Total 47 persons were selected as respondents for interview survey. The details of respondents are shown in Table C.3.21.

Table C.3.21 Total Respondents Based on Type of Livelihood and Land Acquisition Process

	Pulo Ampel	Sumuranja	Margasari	Total
Type of Livelihood				
Trader	3	4	4	11
Civil/Government Worker	3	5	2	10
Farmer	6	8	8	22
Fisherman	2	-	-	-
FoodStall	-	1	-	-
Motor Cycle Transportation Services	-	1	-	-
Total	14	19	14	47
Land Acquisition Process				
Surrounding Area	-	8	2	10
Object area for Land Acquisition	14	11	12	37
Communities, who already sold to IPC2, will be relocated	3	-	-	3
Communities, who already sold to IPC2, although still use as farm	1	4	4	9
Communities, who sold only their land	-	3	4	7
Communities who have a problem	-	1	-	1
Communities who have not sold yet, although have to be relocated	10	3	4	17
Total	14	19	14	47

Respondent perceptions concerning land acquisition process are shown in Table C.3.22 and C.3.23.

Table C.3.22 Respondent Perception of Land Acquisition Process (Acquired Land House)

	Description	Pulo Ampel	Sumuranja	Margasari	Total
1	Respondents whom have already sold their land to Pelindo and will have to be relocated	3	-	-	3
2	Respondents whom have already sold their land to Pelindo but are still allowed to farm the productive land	1	4	4	9

3	Respondents whom have already sold their land outside the project zone	-	3	4	7
4	Respondents whom are still in dispute about their sold land	-	1		1
Total Respondents		4	8	8	20
Respondent Perception					
a	Satisfied	3 (15 %)	7 (35 %)	-	50 %
b	Not Satisfied because:	-	1 (5%)	8 (40 %)	45 %
	The received less than the standard price and the vegetations on the land had not been paid accordingly	-	-	8 (40 %)	-
	Their land has been acquired unknowingly	-	1 (5 %)	-	-
c	No comment	1 (5 %)	-	-	5 %

Table C.3.23 Respondent Perception of Land Acquisition Process (Land/House will have to be Acquired)

	Description	Pulo Ampel	Sumuranja	Margasari	Total
1	Respondents whom have not sold their land to Pelindo and will have to be relocated	10	3	4	17
Total Respondents		10	3	4	17
2	Community Perception				
a.	Agree to sell, with requirements	-	-	-	-
a.1	Effective market price	3 (17.7 %)	-	-	17.7 %
a.2	Effective market price, and relocation completed with religion & education facilities, and they expect to be relocated nearby the port boundary	7 (41.2 %)	2 (11.8%)	4 (23.5 %)	76.5 %
b.	Disagree to sell	-	-	-	-
c.	No comment	-	1 (5.9 %)	-	5.9 %

Respondent perceptions concerning positive/negative impact are shown in TableC.3.24.

Table C.3.24 (1) Results of Respondent Perceptions in Tanjung Priok

No	Perception (%)	Pulo Ampel	Sumuranja	Margasari	Total (%)
1	Positive Impact Perception				
1.1	New Job Opportunity				
	(in new and surrounding Port Area)				
	a. Contruction	2.2 %	6.4 %	4.3 %	12.8 %
	b. Operation	6.4 %	2.1 %	19.2 %	27.7 %
	c. Other opportunity of their own effort	6.4 %	31.9 %	4.3 %	42.6 %
	d. Not interested	14.9 %	0 %	2.1 %	17.0 %
	Total	29.8 %	40.4 %	29.8 %	100 %
1.2	Other Positive Impact				
	a. Increase of people Income	29.8 %	40.4 %	29.8 %	100 %
	b. Village progress	0 %	40.4 %	29.8 %	70.2 %
	c. Accelerate business	29.8 %	40.4 %	29.8 %	100 %

	d. Better facility transportation	29.8 %	40.4 %	29.8 %	100 %
2.	Negative Impact Perception				
	a. Noise disturbance	4.3 %	0 %	4.3 %	8.5 %
	b. Air pollution	4.3 %	0 %	4.3 %	8.5 %
	c. Traffic jam	4.3 %	0 %	4.3 %	8.5 %
	d. Reducing fisherman production	0 %	0 %	0 %	0 %
	e. Social friction between local people and newcomers	0 %	0 %	0 %	0 %
	f. Social conflict from the dissatisfied land acquisition process	4.3 %	4.3 %	17.0 %	25.5 %

Table C.3.24 (2) Results of Respondent Perceptions in Tanjung Priok

No	Perception (%)	Pulo Ampel	Sumuranja	Margasari	Total (%)
3.	Existing Condition				
3.1	Physic and Chemical Conditions				
	a. Air Quality				
	- Fresh	25.5 %	40.4 %	25.5 %	91.5 %
	- Polluted	4.3 %	0 %	4.3 %	8.5 %
	TOTAL	29.8 %	40.4 %	29.5 %	100 %
	b. Noise				
	- Noisy disturbance	4.3 %	0 %	4.3 %	8.5 %
	- Not noisy (No noise disturbance)	25.5 %	40.4 %	25.5 %	91.5 %
	c. Traffic Disturbance				
	- No traffic jam	29.8 %	40.4 %	29.8 %	100 %
	d. Flood				
	- Flood	10.6 %	0 %	0 %	10.6 %
3.2	Social, Economical, Cultural Perception				
	a. Social Friction				
	Between local people and new comer				
	- No disturbance	29.8 %	40.4 %	29.8 %	100 %
	b. Social Conflict				
	From the dissatisfied land acquisition process				
	- Occurance	0 %	0 %	0 %	0 %
	- Complains/protests	29.8 %	40.4 %	29.8 %	100 %
	c. Security Disturbance				
	- Often	0 %	0 %	0 %	100 %
	- Occasionally	12.8 %	8.5 %	4.3 %	25.5 %
	- Secure/safe	17.0 %	31.9 %	25.5 %	74.5 %
3.3	Public Health				
	- Good	8.5 %	21.3 %	4.3 %	34.0 %
	- Occational Disturbance (Minor disease)	21.3 %	19.2 %	25.5 %	66.0 %

C.4 TRAFFIC COUNTING SURVEY IN BOJONEGARA

The JICA Study Team carried out traffic counting survey in Bojonegara area in order to know the existence traffic condition caused by industrial/mining activities, and to know current condition cause to Bojonegara Port Project.

Traffic survey carried out at 2 locations shown in Figure C.4.1, on 27 th July 2002 during 16 hours from 6 a.m. to10 p.m.

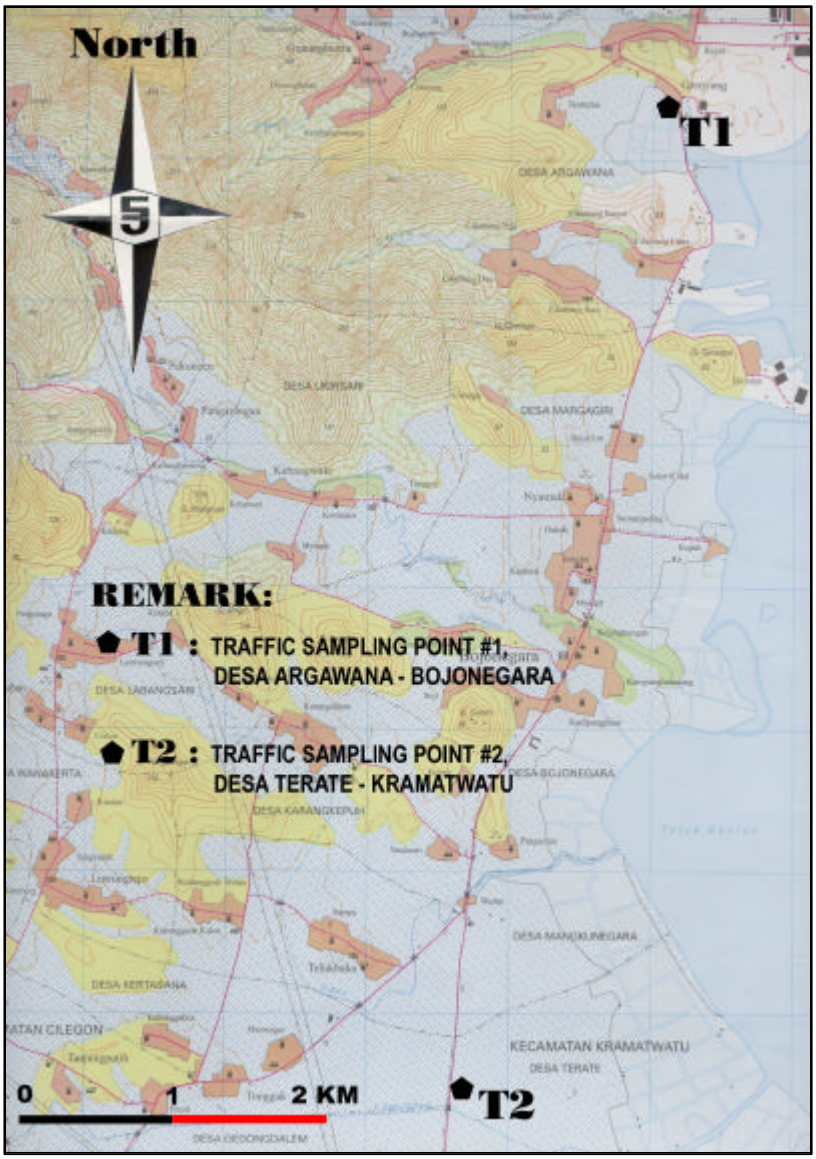


Figure C.4.1 Location of Traffic Survey in Bojonegara

The result are shown in Table C.4.1. And traffic volume by each type of Vehicle are shown in Figure C.4.2, time trend of traffic volume are shown in Figure C.4.3.

Table C.4.1 Brief Description of Traffic Survey in Bojonegara

Location Argawana

Direction	Hour	Type of Vehicle							
		Motor Bike	Private Car	Pick Up Truck	Truck (<5 t)	Truck (>5 t)	Head of Truck	Bus	Total
Down	6	46	6	-	-	1	-	1	54
	7	100	53	3	-	2	-	19	177
	8	160	34	9	1	12	-	-	217
	9	53	26	4	-	13	-	1	97
	10	55	30	4	1	6	-	1	98
	11	56	15	7	-	3	-	-	81
	12	71	25	7	-	6	-	-	109
	13	40	19	7	-	5	-	-	71
	14	40	17	6	2	6	-	2	73
	15	56	25	5	1	6	-	2	95
	16	60	13	5	-	5	-	1	84
	17	98	13	6	-	-	-	-	119
	18	80	13	3	-	1	-	-	97
	19	69	5	1	-	2	-	-	77
	20	33	2	1	2	2	-	-	40
	21	21	1	3	2	4	-	-	31
Sub Total		1,038	297	71	9	74	-	27	1,520
Up	6	38	8	1	-	1	-	2	50
	7	49	22	1	-	-	-	2	74
	8	79	20	4	-	11	-	3	117
	9	70	23	6	1	9	-	-	109
	10	59	16	7	2	11	-	-	95
	11	78	13	3	2	7	-	-	103
	12	46	23	8	2	5	-	3	87
	13	40	23	3	-	6	-	-	72
	14	58	13	8	1	-	-	-	80
	15	155	26	8	1	4	-	4	199
	16	148	25	7	1	3	-	13	198
	17	51	20	5	1	2	-	2	81
	18	67	21	3	2	3	-	-	98
	19	38	4	2	-	2	-	-	46
	20	37	1	-	1	4	-	-	43
	21	22	1	1	1	3	-	-	28
Sub Total		1,035	259	67	15	71	-	29	1,480
Total		2,073	556	138	24	145	-	56	3,000

Location Kramatwatu

Direction	Hour	Type of Vehicle							
		Motor Bike	Private Car	Pick Up Truck	Truck (<5 t)	Truck (>5 t)	Head of Truck	Bus	Total
Down	6	24	18	3	-	13	-	3	61
	7	37	39	4	1	40	-	13	134
	8	35	13	7	-	32	-	1	88
	9	32	20	6	4	31	-	-	93
	10	39	25	9	-	49	-	-	122
	11	27	8	2	-	48	-	-	85
	12	24	11	5	-	34	-	-	74
	13	21	16	2	-	45	-	-	84
	14	28	12	5	-	40	-	4	89
	15	33	15	4	5	46	-	2	105
	16	34	6	4	2	20	-	-	66
	17	27	6	3	-	29	-	-	65
	18	13	6	-	-	24	-	-	43
	19	7	3	4	1	23	-	-	38
	20	3	3	-	-	26	-	-	32
	21	5	1	1	-	6	-	-	13
Sub Total		389	202	59	13	506	-	23	1,192
Up	6	22	4	-	1	8	-	1	36
	7	30	3	-	1	9	-	3	46
	8	27	8	4	-	38	-	1	78
	9	37	14	8	3	47	-	1	110
	10	25	10	3	2	46	-	1	87
	11	24	19	6	-	45	-	-	94
	12	16	13	5	-	35	-	2	71
	13	28	22	3	-	38	-	-	91
	14	20	10	4	-	45	-	-	79
	15	16	15	2	1	36	-	10	80
	16	41	26	7	4	35	-	6	119
	17	30	9	2	1	14	-	-	56
	18	23	11	3	1	33	-	-	71
	19	10	7	1	-	29	-	-	47
	20	4	4	2	1	19	-	-	30
	21	4	2	1	1	3	-	-	11
Sub Total		357	177	51	16	480	-	25	1,106
Total		746	379	110	29	986	-	48	2,298

Generally, traffic intensity is under road capacity, seen there are no traffic jam and recorded as low dense vehicle passing this road. Most of traffic is coming from motorcycle, small truck (< 5 T) and bus of labor.

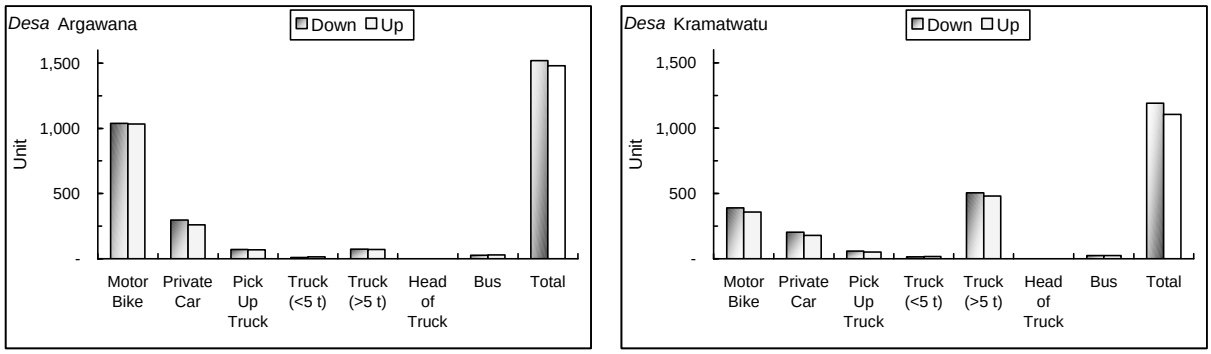


Figure C.4.2 Traffic Volume by Each Type of Vehicle

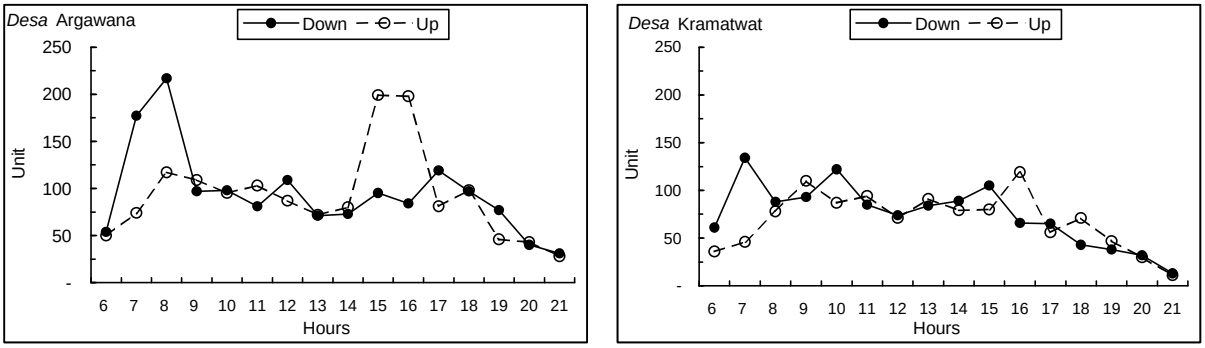


Figure C.4.3 Time Trend of Traffic Volume

APPENDIX D: WAVE HINDCAST IN WESTERN JAVA SEA

D.1 Introduction

This section deals with the wave hindcast in the western Java Sea area for port planning and port facilities design. Since no observed wave information along the north coast of western Java Sea is opened to public, the necessary wave data for the purpose of port planning must be prepared by wave hindcast.

The Study Team conducted wave hindcast at the points of Off-Tanjung Priok and Off-Bojonegara using the 5-year wind information (wind direction and wind speed at every hour; 1997 - 2001) at the Cengkareng meteorological station (Soekarno-Hatta Airport).

The Study Area, the north coast of western Java Sea, is located at latitude 5 - 6° S out of the affected area of the abnormal weather such as typhoon or cyclone. The method was the S-M-B method, the best common method applied for the wave hindcast of ordinary waves.

A 5-year wave table was prepared by the wave hindcast and combined frequencies were analysed on wave height, wave period and wave incident direction of the offshore waves. And an estimation of design deep water wave was set out using the wave hindcast data combining with the existing information of yearly peak waves for 18 years (1980 - 1997; wave hindcast by ITB, July 2000).

D.2 Winds at Cengkareng

A set of 5-year wind information (wind direction and wind speed at every hour) at the Cengkareng meteorological station of BMG* was collected for the years 1997 - 2001.

* BMG: Badan Meteorologi dan Geofisika

(1) Measurement

Measurement condition of the Cengkareng wind meter is as follows.

1) Ground elevation: MSL+1.00 m
2) Height of wind meter above ground level: 6.0 meter
3) Condition of measurement point is open near the Airport radar station.

(2) Wind Characteristics

The wind rose (combined frequency of wind speed and wind direction) at Cengkareng is shown in **Figures D.1** (1) - (5) in the following order.

1) All years (1997 - 2001)
2) March - May (1997 - 2001)
3) June - August (1997 - 2001)
4) September - November (1997 - 2001)
5) December - February (1997 - 2001)

1997～2002年（ 全年）　　測得率　89.5%（ 欠測回数　5528）

風速(m/s) \ 風向	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	静穏	合計
0.0 ～																	6120	6120
1.0 ～	172	163	143	384	368	633	1054	2191	1223	932	804	605	218	177	188	265		9520
2.0 ～	390	287	247	348	312	527	893	1538	860	1083	1355	1025	340	325	418	494		10442
3.0 ～	492	384	247	262	103	166	233	270	252	592	1103	839	289	346	476	596		6650
4.0 ～	581	540	324	189	73	44	76	84	127	305	789	643	272	322	413	565		5347
5.0 ～	461	562	332	137	29	21	16	36	66	267	616	626	163	275	384	310		4301
6.0 ～	175	351	247	70	13	11	14	15	16	121	383	412	75	106	111	86		2206
7.0 ～	63	240	158	39	11	9	7	8	7	55	242	286	48	34	61	48		1316
8.0 ～	17	106	98	17	2	2	1	6	5	38	93	121	23	11	29	33		602
9.0 ～	10	50	61	6	1	2	1	4	3	5	37	71	18	11	17	16		313
10.0 ～	5	14	25	1	2		1	1		6	14	31	6	7	4	10		127
11.0 ～	3	9	8	1			2		1	3	3	9	4	1	1	1		46
12.0 ～	1	5	6	1				1		1	2	10	2					29
13.0 ～		1	5	1				1			1	5	3	2		1		20
14.0 ～		1			1							7						9
15.0 ～			1									5	1					7
16.0 ～												1						1
合計	2370	2713	1902	1456	915	1415	2298	4155	2560	3408	5442	4696	1462	1617	2102	2425	6120	47056

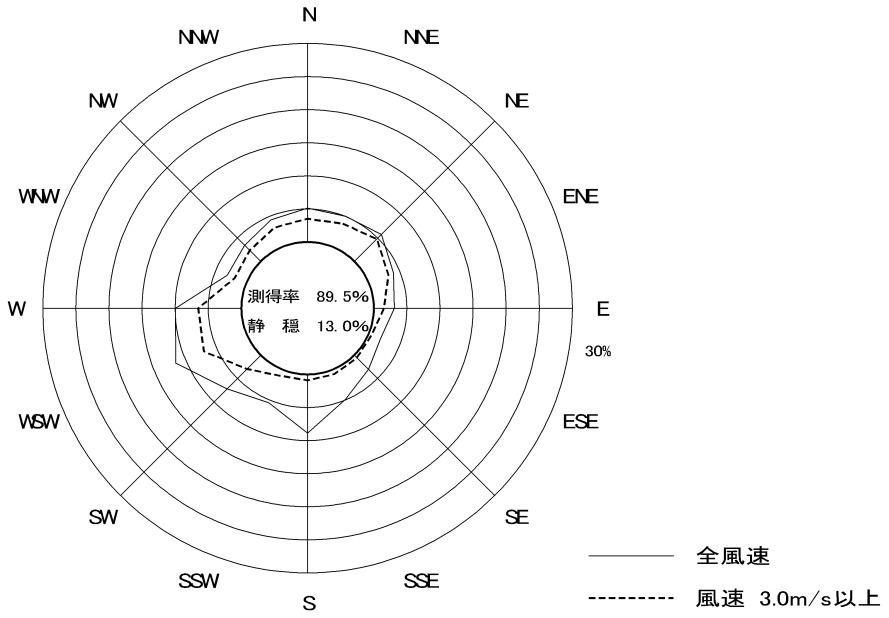


Figure D.1 (1) Wind Rose (Cengkareng; 1997 - 2001)

1997～2002年（　3～ 5月）　　測得率　97.1%（欠測回数　387）

風速(m/s) \ 風向	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	静穏	合計
0.0 ～																	1873	1873
1.0 ～	50	53	50	107	114	216	329	647	285	226	219	176	61	38	51	73		2695
2.0 ～	116	91	96	120	84	186	284	386	197	243	317	254	75	71	107	118		2745
3.0 ～	166	108	75	90	37	61	78	89	67	153	265	198	81	64	138	195		1865
4.0 ～	164	178	109	70	30	16	31	36	37	86	172	144	52	59	112	148		1444
5.0 ～	148	191	96	34	10	8	5	12	19	97	162	125	31	40	93	82		1153
6.0 ～	38	92	78	23	3	4	4	4		32	107	103	12	12	17	21		550
7.0 ～	13	58	30	12	4	4	2	5	1	17	72	55	8	7	9	10		307
8.0 ～	4	12	21	7	1	1		4	1	11	19	24	2	1	3	8		119
9.0 ～	5	11	8	4	1	1		1	3	3	8	13	2	4	5	4		73
10.0 ～	2	2	4				1	1			3	5	1		1	4		24
11.0 ～	1		1				2			1		2						7
12.0 ～	1										1							2
13.0 ～								1			1					1		3
14.0 ～					1													1
15.0 ～																		0
16.0 ～																		0
合計	708	796	568	467	285	497	736	1186	610	869	1346	1099	325	296	536	664	1873	12861

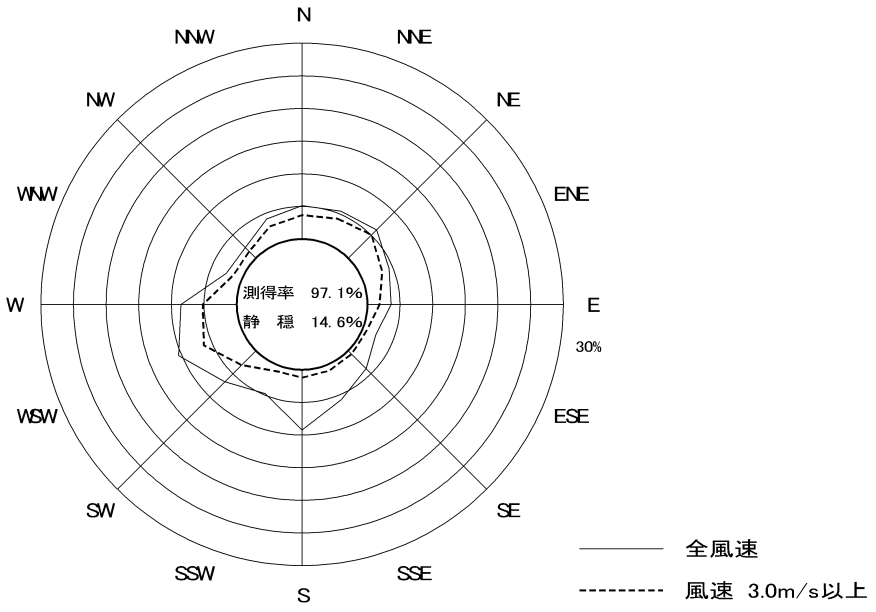


Figure D.1 (2) Wind Rose (Cengkareng; March - May of 1997 - 2001)

1997～2002年（ 6～ 8月）　　測得率 83.3%（欠測回数 2208）

風速(m/s) \ 風向	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	静穏	合計
0.0 ～																	1656	1656
1.0 ～	44	56	56	177	159	253	373	733	349	178	131	102	35	29	41	61		2777
2.0 ～	138	113	89	154	154	194	353	548	226	136	143	94	37	33	61	129		2602
3.0 ～	159	177	116	130	47	54	75	71	37	41	62	46	16	29	55	150		1265
4.0 ～	248	225	157	95	28	17	19	13	12	8	24	15	8	10	33	166		1078
5.0 ～	152	251	164	83	14	8	4	7	2	5	7	18	1	5	15	69		805
6.0 ～	59	148	120	39	7	5	4	1	2	1	7	8		1	3	9		414
7.0 ～	13	97	89	23	5	3	2			1			1			2		236
8.0 ～	3	46	53	7	1		1		1						1			113
9.0 ～	1	18	32	2		1	1	3								1		59
10.0 ～	1	4	11	1	2													19
11.0 ～		3	6	1														10
12.0 ～		2	2															4
13.0 ～			1															1
14.0 ～																		0
15.0 ～			1															1
16.0 ～																		0
合計	818	1140	897	712	417	535	832	1376	629	370	374	283	98	107	209	587	1656	11040

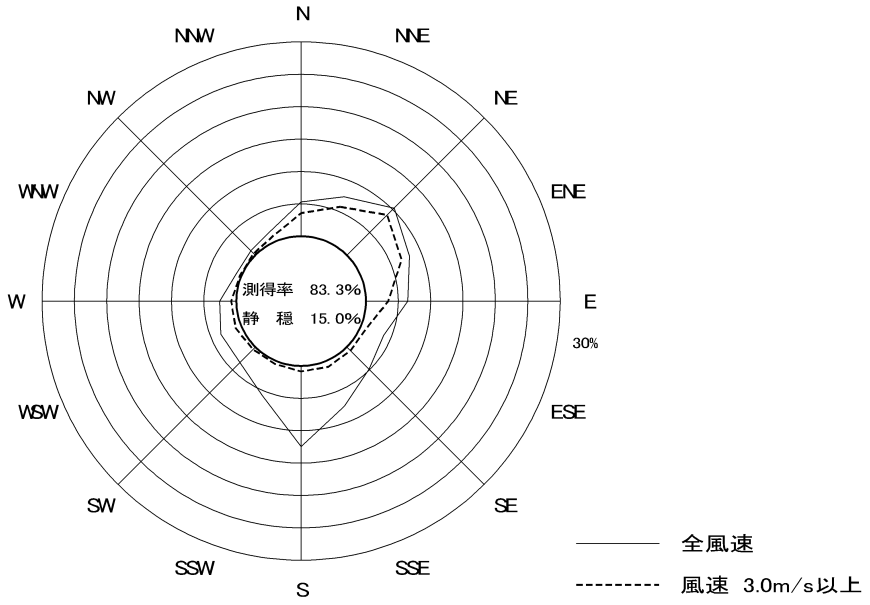


Figure D.1 (3) Wind Rose (Cengkareng; June - August of 1997 - 2001)

1997～2002年（　9～11月）　　測得率　83.3%（欠測回数　2187）

風速(m/s) \ 風向	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	静穏	合計
0.0 ～																	1530	1530
1.0 ～	45	35	20	67	69	83	233	532	399	298	239	124	44	50	36	60		2334
2.0 ～	86	55	45	51	55	96	158	377	270	359	408	233	57	61	88	110		2509
3.0 ～	126	77	46	37	13	37	50	72	73	139	263	154	44	50	76	138		1395
4.0 ～	139	116	51	23	11	7	20	19	36	80	187	128	42	28	68	147		1102
5.0 ～	136	110	70	19	4	4	7	10	23	54	150	123	8	20	42	96		876
6.0 ～	69	106	47	8	1	2	4	6	6	28	104	92	8	2	5	23		511
7.0 ～	31	83	37	4	2	2	2	3	2	18	62	69	5	3	7	12		342
8.0 ～	9	47	23	3		1		1	1	15	28	30	4		2	3		167
9.0 ～	1	19	20							1	13	17	1		1			73
10.0 ～	1	8	9							3	5	11	2					39
11.0 ～	1	6	1						1			1	2	1				13
12.0 ～		3	4	1				1				4						13
13.0 ～		1	4	1								1						7
14.0 ～		1										2						3
15.0 ～												3						3
16.0 ～																		0
合計	644	667	377	214	155	232	474	1021	811	995	1459	992	217	215	325	589	1530	10917

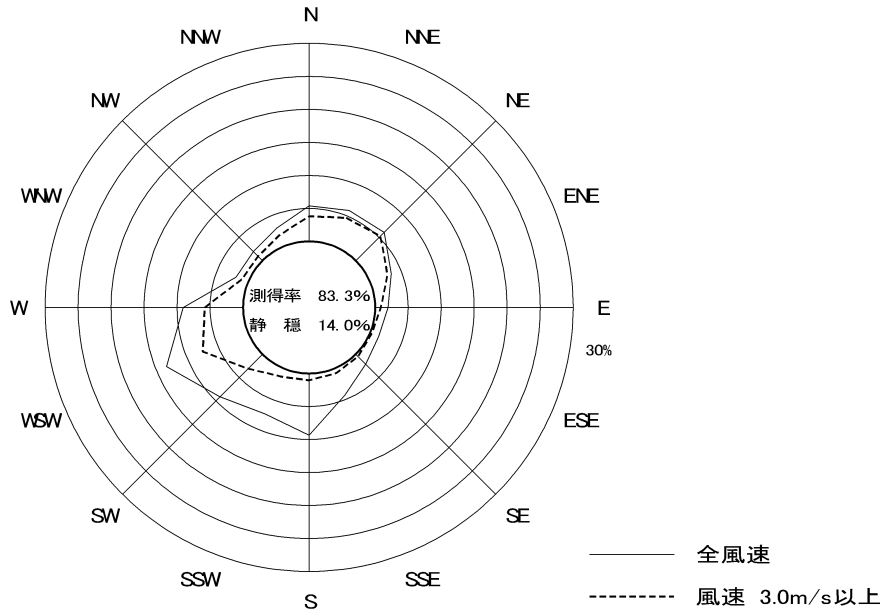


Figure D.1 (4) Wind Rose (Cengkareng; September - November of 1997 - 2001)

1997～2002年（ 12～ 2月）　　測得率　94.3%（ 欠測回数　746）

風速(m/s) \ 風向	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	静穏	合計
0.0 ～																	1061	1061
1.0 ～	33	19	17	33	26	81	119	279	190	230	215	203	78	60	60	71		1714
2.0 ～	50	28	17	23	19	51	98	227	167	345	487	444	171	160	162	137		2586
3.0 ～	41	22	10	5	6	14	30	38	75	259	513	441	148	203	207	113		2125
4.0 ～	30	21	7	1	4	4	6	16	42	131	406	356	170	225	200	104		1723
5.0 ～	25	10	2	1	1	1		7	22	111	297	360	123	210	234	63		1467
6.0 ～	9	5	2		2		2	4	8	60	165	209	55	91	86	33		731
7.0 ～	6	2	2				1		4	19	108	162	34	24	45	24		431
8.0 ～	1	1	1					1	2	12	46	67	17	10	23	22		203
9.0 ～	3	2	1							1	16	41	15	7	11	11		108
10.0 ～	1		1							3	6	15	3	7	3	6		45
11.0 ～	1									2	3	6	2		1	1		16
12.0 ～										1	1	6	2					10
13.0 ～												4	3	2				9
14.0 ～												5						5
15.0 ～												2	1					3
16.0 ～												1						1
合計	200	110	60	63	58	151	256	572	510	1174	2263	2322	822	999	1032	585	1061	12238

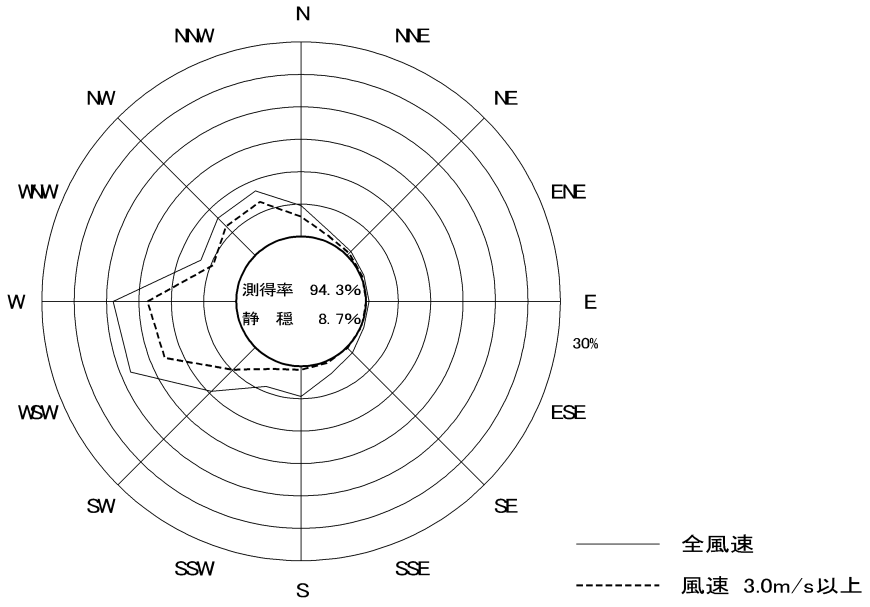


Figure D.1 (5) Wind Rose (Cengkareng; December - February of 1997 - 2001)

D.3 Wave Hindcast

D.3.1 S-M-B method and basic formula

The S-M-B method is used when the wind field is stationary. The height and period of deepwater significant waves are estimated from the wind velocity and wind duration in the fetch and fetch length in the wave generating water area. The method is based on the Wilson's formula on the formation of wind waves.

The wave hindcast was carried out using the following formula rewritten by Sakamoto-Ijima, which consider the influence of the water depth on wave formation (i.e., the energy loss due to friction with the sea bottom).

$$\frac{gH_{1/3}}{U^2} = 0.30A\left\{1-\frac{1}{[1+\frac{0.004}{A}(gF/U^2)^{1/2}]^2}\right\} \quad \text{..... 1)}$$

$$\frac{gT_{1/3}}{2pU} = 1.37B\left\{1-\frac{1}{[1+\frac{0.008}{B}(gF/U^2)^{1/3}]^5}\right\} \quad \text{..... 2)}$$

$$A = \tanh\left[0.578\left(\frac{gh}{U^2}\right)^{3/4}\right]$$

$$B = \tanh\left[0.520\left(\frac{gh}{U^2}\right)^{3/8}\right]$$

where, $H_{1/3}$：significant wave height（m），$T_{1/3}$：significant wave period（s），
U：wind velocity at 10 m above sea surface（m/s），F：fetch length（m），
g：acceleration of gravity（m/s^2）

Minimum duration time of wind (t_{min}) corresponding to the fetch length (F) is defined as the time that the waves progressing with group velocity (C_G) takes from x=0 (at t=0) until get to the position x=F, and is calculated by the following numerical integration.

$$t_{min} = \int_0^F \frac{dF}{C_G} \quad \text{..... 3)}$$

D.3.2 Conversion of wind data to sea surface wind velocity

In order to estimate the wave formation by wave hindcast using measured wind speed, it is necessary to convert the wind data to the wind velocity 10 m above sea surface. The conversion factor was selected referring to **Table D.1** and **Figure D.2**.

Measurement condition of the Cengkareng wind meter is considered as "Seashore on the downwind side surrounded by lowland or water" and the wind velocoty ratio (V/Vs) is given as

0.67. Since the elevation of the measurement at the Cengkareng wind meter is 7 m above sea surface, the wind velocity change by the elevation of measurement is given as 0.96 by **Figure D.2**.

The conversion factor was set as follows combining the two figures above.

1/（0.96*0.67） 1.55.

Table D.1 Relationship between Onshore Wind and Sea Surface Wind

(after Calzass)

Location	V/Vs
Sea surface	1.00
Low-lying island	0.92
Seashore on the windward side surrounded by lowland	0.83
Seashore on the downwind side surrounded by lowland or water	0.67
Non-sheltered open land area	0.67
Sheltered land area or urban area	0.50

V：Onshore Wind Velocity (measured at 10 m above ground level),

Vs：Wind Velocity at 10 m above sea surface

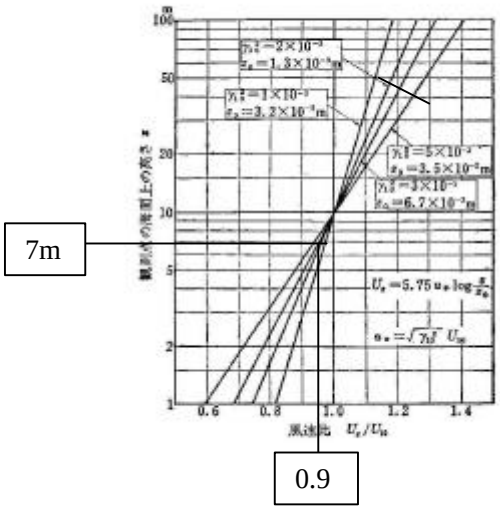


Figure D.2 Wind Velocity Change by Elelvation

D.3.3 Effective Fetch Length

When fetch width is small relative to the fetch length (for example, in a long bay), the fetch length is determined by the distance to the opposite shore. If the distance to the opposite shore varies greatly when the direction is changed only slightly, it is advisable to use the effective fetch length defined by the following formula (after Saville).

$$F_{eff} = \frac{\sum_{i=1}^{n} Fi \cos(\theta i - \theta)\Delta\theta i}{\sum_{i=1}^{n} \cos(\theta i - \theta)\Delta\theta i} \qquad \ldots\ldots 4)$$

where, F_{eff}: Effective Fetch Length (km),

θ_i: Angle between the direction of F_i and the principal wind direction (θ),

F_i: Distance to opposite shore in the θ_i direction.

In this method, distance (F_i) is assumed from the estimate point to the opposite shore (see **Figure D.3** and **Figure D.4**) and the average value of lengths cosine of differential angle to the principal wind direction (refer to formula 4). The interval of θ_i is set as 5º pitch in this study and the range of degree was $\pm 45^\circ$ from the principal wind direction.

Calculated effective fetch length is shown **Table D.2**.

Table D.2 Effective Fetch Length（unit: km）

Wind Direction	Bojonegara	Tj-Priok
NNE	369	468
NE	515	507
ENE	503	405
E	363	302
ESE	221	115
SE	42	20
SSE	15	18
S	10	16
SSW	8	14
SW	12	18
WSW	19	33
W	28	50
WNW	37	85
NW	63	148
NNW	139	262
N	253	338

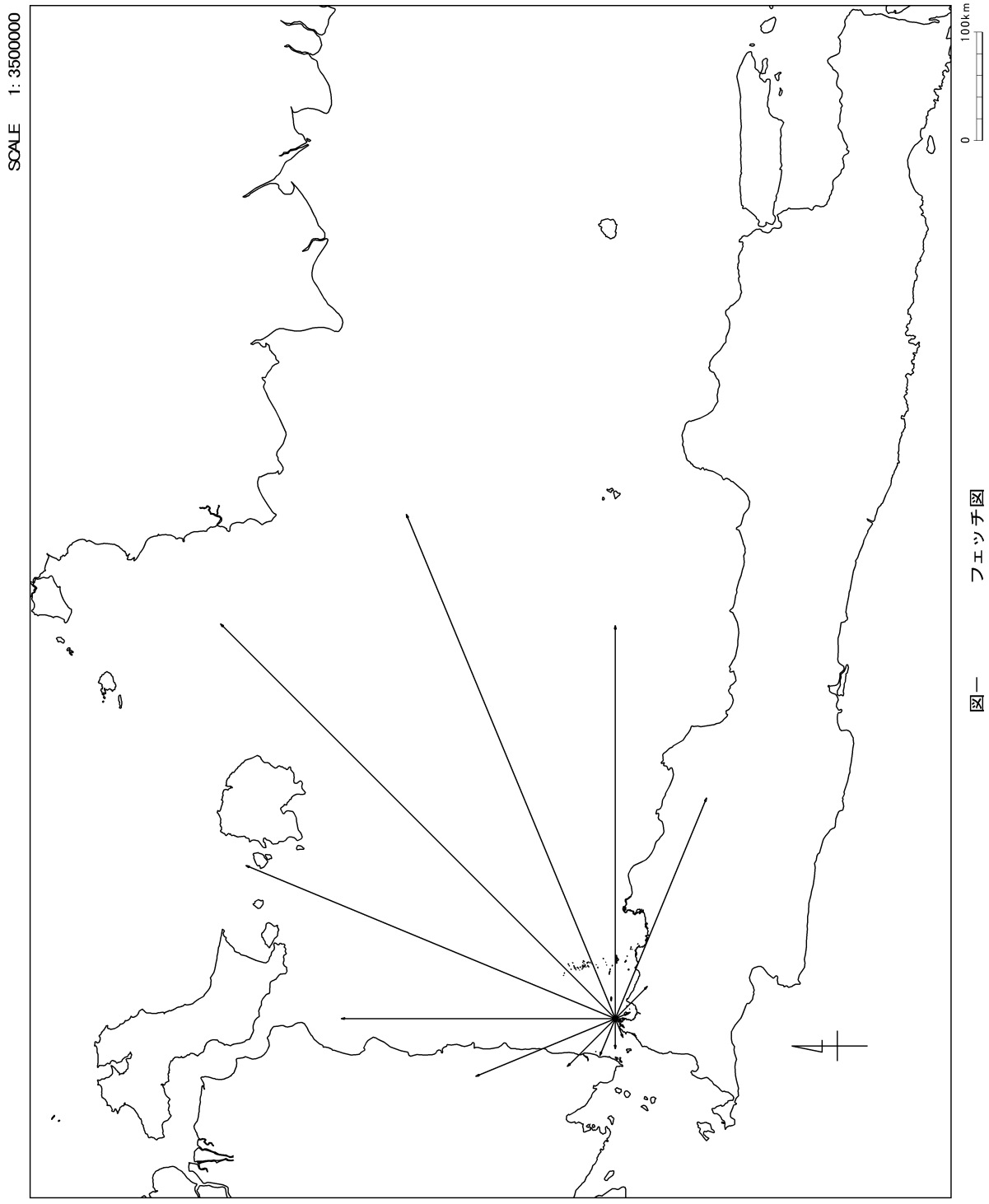


Figure D.3 Effective Fetch of Wave Hindcast for Bojonegara

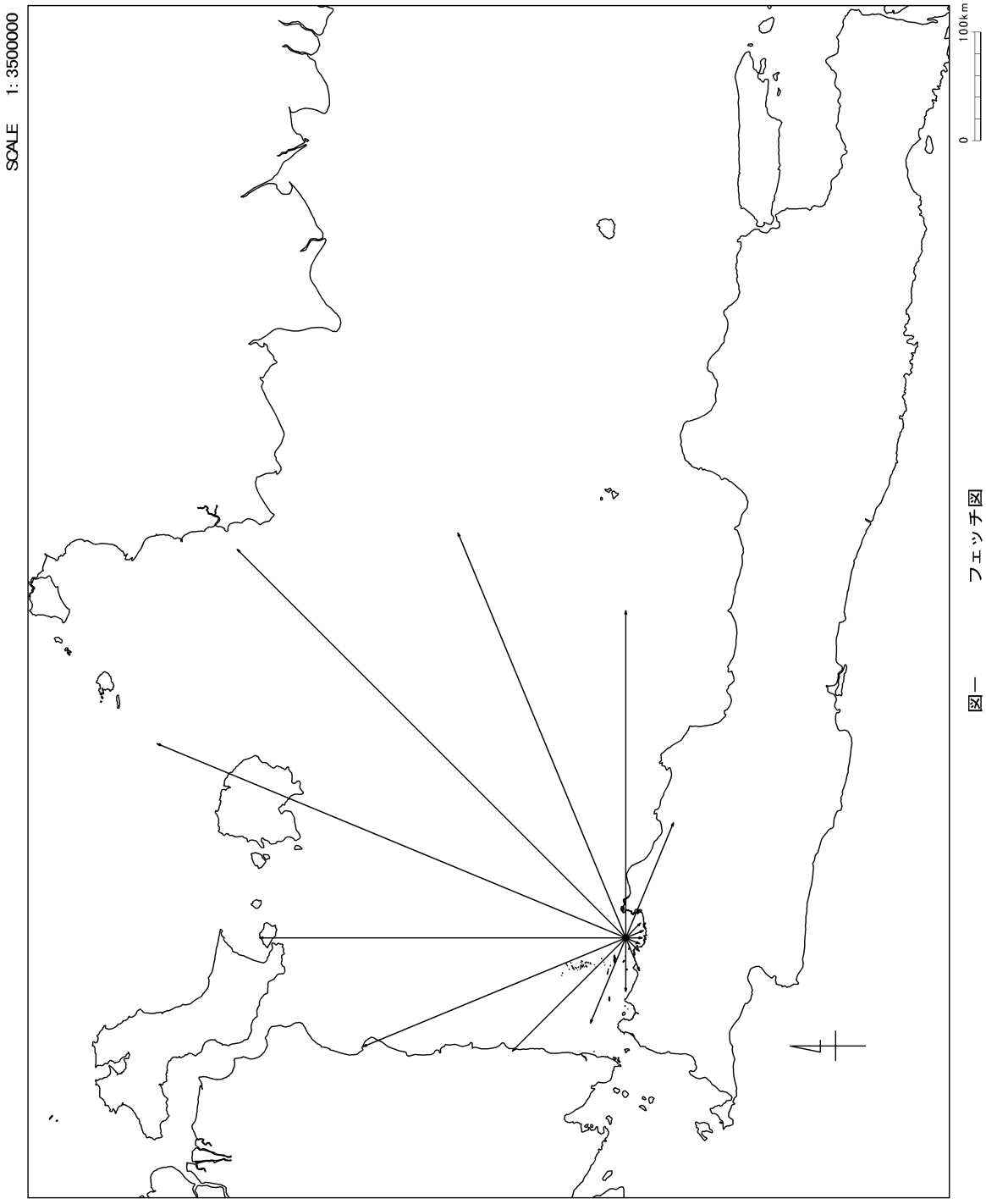


Figure D.4 Effective Fetch of Wave Hindcast for Tanjung Priok

D.4 Wave Caharacteristics

D.4.1 Tanjung Priok

Wave Occurrence Probability at offshore Tanjung Priok by the wave hindcast is shown in **Table D.3**. Wave condition is generally calm in the western portion of Java Sea and the cumulative frequency of wave height less than 0.5 m is about 87 %.

Westerly incident waves are most frequent in the table with about 11 % occurrence due to the wind of northwest monsoon and transitional seasons. N - NNE - NE incident waves are also frequent accounting for about 10 % of the frequency.

D.4.2 Bojonegara

Wave Occurrence Probability at offshore Bojonegara by the wave hindcast is shown in **Table D.4**. The cumulative frequency of wave height less than 0.5 m is about 87 %.

Westerly incident waves are most frequent in the table with about 11 % occurrence due to the wind of northwest monsoon and transitional seasons. N - NNE - NE incident waves are also frequent accounting for about 14 % of the frequency.

D.4.3 Wave Height - Wave Period Relationship

The relationships between wave height and wave period are estimated using wave hindcast data for Tanjung Priok and Bojonegara. See **Figures D.5** (1) and (2).

Table D.3 Wave Characteristics off-Tanjung Priok by Wave Hindcast (1997 - 2001)

Combined Occurrence of Wave Height and Period (%) (Unit: meter and second)

Height \ Period	0	2	3	4	5	6	7	8	9	Total	Cumu-lative
Calm										68.55	68.55
0≦H<0.25	5.36									5.36	73.92
0.25≦H<0.5	5.06	7.63								12.70	86.61
0.5≦H<0.75		5.19	1.70							6.89	93.50
0.75≦H<1.0		0.13	3.25	0.05						3.43	96.93
1.0≦H<1.25			1.02	0.63						1.64	98.58
1.25≦H<1.5			0.08	0.65	0.03					0.76	99.34
1.5≦H<1.75				0.28	0.07					0.36	99.69
1.75≦H<2.0				0.10	0.08					0.18	99.87
2.0≦H<2.5				0.05	0.07					0.12	99.99
2.5≦H<3.0				0.01						0.01	100.00
3.0≦H<3.5											
3.5≦H<4.0											
4.0≦H											
Total	10.43	12.95	6.05	1.77	0.25	0.00	0.00	0.00	0.00	100.00	

Combined Occurrence of Wave Height and Direction (%) (Unit: meter)

Height \ Direction	W	WNW	NW	NNW	N	NNE	NE	ENE	E	Total	Cumu-lative
Calm										68.55	68.55
0≦H<0.25	2.15	0.33	0.31	0.39	0.54	0.54	0.46	0.28	0.37	5.36	73.92
0.25≦H<0.5	3.79	0.88	0.92	1.15	1.30	1.49	1.67	0.85	0.64	12.70	86.61
0.5≦H<0.75	2.07	0.47	0.45	0.51	0.43	0.71	1.11	0.81	0.33	6.89	93.50
0.75≦H<1.0	1.32	0.40	0.16	0.13	0.09	0.24	0.51	0.44	0.15	3.43	96.93
1.0≦H<1.25	0.67	0.20	0.09	0.04	0.02	0.10	0.24	0.20	0.08	1.64	98.58
1.25≦H<1.5	0.29	0.16	0.02	0.01	0.01	0.03	0.08	0.12	0.03	0.76	99.34
1.5≦H<1.75	0.13	0.08	0.01	0.02	0.00	0.01	0.04	0.05	0.01	0.36	99.69
1.75≦H<2.0	0.06	0.02	0.01	0.01		0.01	0.03	0.04	0.00	0.18	99.87
2.0≦H<2.5	0.04	0.05	0.01					0.02	0.00	0.11	99.99
2.5≦H<3.0		0.01						0.00		0.01	100.00
3.0≦H<3.5											
3.5≦H<4.0											
4.0≦H											
Total	10.52	2.59	1.97	2.26	2.40	3.14	4.14	2.81	1.62	100.00	

Combined Occurrence of Wave Period and Direction (%) (Unit: second)

Period \ Direction	W	WNW	NW	NNW	N	NNE	NE	ENE	E	Total	Cumu-lative
Calm										68.55	68.55
0≦T<2.0	3.72	0.68	0.68	0.83	1.07	1.09	1.08	0.60	0.67	10.43	78.98
2.0≦T<3.0	3.83	0.82	0.90	1.10	1.12	1.47	1.96	1.17	0.59	12.95	91.93
3.0≦T<4.0	2.26	0.64	0.30	0.28	0.18	0.49	0.88	0.75	0.28	6.05	97.98
4.0≦T<5.0	0.68	0.38	0.07	0.03	0.02	0.08	0.21	0.22	0.08	1.77	99.75
5.0≦T<6.0	0.04	0.07	0.01	0.01	0.00	0.01	0.03	0.06	0.01	0.25	100.00
6.0≦T<7.0											
7.0≦T<8.0											
8.0≦T<9.0											
9.0≦T											
Total	10.52	2.59	1.97	2.26	2.40	3.14	4.14	2.81	1.62	100.00	

Table D.4 Wave Characteristics off-Bojonegara by Wave Hindcast (1997 - 2001)

Combined Occurrence of Wave Height and Period (%) (Unit: meter and second)

Height \ Period	0	2	3	4	5	6	7	8	8	total	Cumu-lative
Calm										68.55	68.55
0≦H<0.25	5.36									5.36	73.92
0.25≦H<0.5	5.06	8.03								13.09	87.01
0.5≦H<0.75		5.15	2.15							7.30	94.31
0.75≦H<1.0		0.13	3.09	0.05						3.27	97.58
1.0≦H<1.25			1.07	0.32						1.39	98.97
1.25≦H<1.5			0.08	0.51	0.02					0.62	99.58
1.5≦H<1.75			0.00	0.19	0.03					0.22	99.80
1.75≦H<2.0			0.00	0.07	0.07					0.14	99.95
2.0≦H<2.5				0.04	0.01					0.05	100.00
2.5≦H<3.0											
3.0≦H<3.5											
3.5≦H<4.0											
4.0≦H											
Total	10.43	13.31	6.39	1.19	0.13	0.00	0.00	0.00	0.00	100.00	

Combined Occurrence of Wave Height and Direction (%) (Unit: meter)

Height \ Direction	W	WNW	NW	NNW	N	NNE	NE	ENE	E	total	Cumu-lative
Calm										68.55	68.55
0≦H<0.25	2.15	0.33	0.31	0.39	0.54	0.54	0.46	0.28	0.37	5.36	73.92
0.25≦H<0.5	4.18	0.89	0.92	1.15	1.30	1.49	1.67	0.85	0.64	13.09	87.01
0.5≦H<0.75	2.52	0.40	0.46	0.52	0.43	0.72	1.11	0.81	0.33	7.30	94.31
0.75≦H<1.0	1.30	0.24	0.17	0.14	0.09	0.24	0.51	0.44	0.15	3.27	97.58
1.0≦H<1.25	0.42	0.20	0.07	0.05	0.02	0.10	0.24	0.20	0.08	1.39	98.97
1.25≦H<1.5	0.17	0.13	0.02	0.03	0.01	0.03	0.08	0.12	0.03	0.62	99.58
1.5≦H<1.75	0.05	0.04	0.01	0.01	0.01	0.01	0.04	0.05	0.01	0.22	99.80
1.75≦H<2.0	0.01	0.03	0.01	0.01	0.00	0.01	0.03	0.04	0.00	0.14	99.95
2.0≦H<2.5	0.02	0.00					0.00	0.02	0.00	0.05	100.00
2.5≦H<3.0											
3.0≦H<3.5											
3.5≦H<4.0											
4.0≦H											
Total	10.82	2.25	1.97	2.28	2.41	3.14	4.14	2.80	1.62	100.00	

Combined Occurrence of Wave Period and Direction (%) (Unit: second)

Period \ Direction	W	WNW	NW	NNW	N	NNE	NE	ENE	E	total	Cumu-lative
Calm										68.55	68.55
0≦T<2.0	3.72	0.68	0.68	0.83	1.07	1.09	1.08	0.60	0.67	10.43	78.98
2.0≦T<3.0	4.16	0.84	0.91	1.10	1.12	1.47	1.96	1.17	0.59	13.31	92.29
3.0≦T<4.0	2.69	0.50	0.33	0.30	0.18	0.49	0.88	0.75	0.28	6.39	98.68
4.0≦T<5.0	0.24	0.24	0.05	0.05	0.02	0.08	0.21	0.22	0.08	1.19	99.87
5.0≦T<6.0				0.01	0.00	0.01	0.03	0.06	0.01	0.13	100.00
6.0≦T<7.0											
7.0≦T<8.0											
8.0≦T<9.0											
9.0≦T											
Total	10.82	2.25	1.97	2.29	2.41	3.14	4.14	2.81	1.62	100.00	

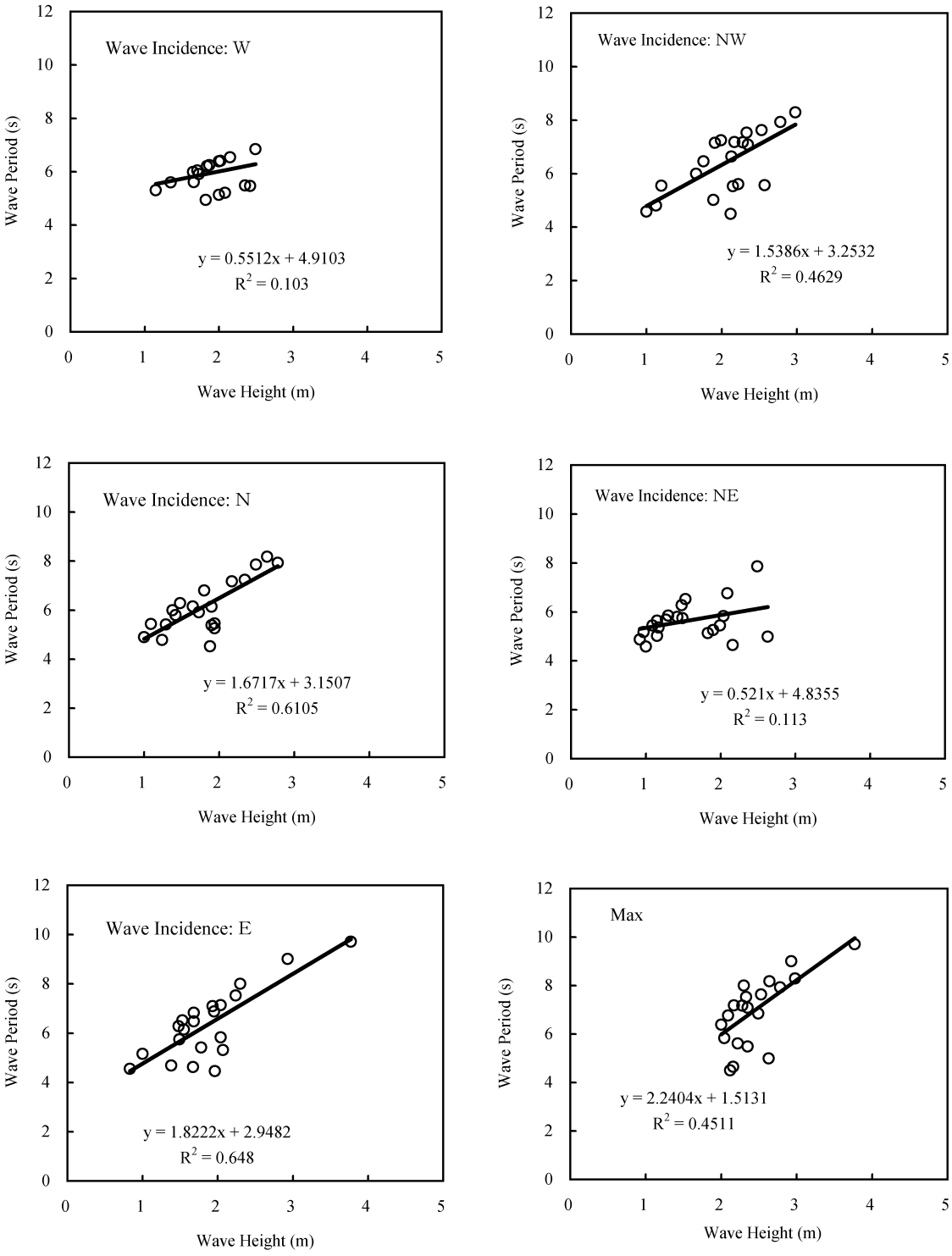


Figure D.5 (1) Wave Height - Period Relationship (Tanjung Priok)

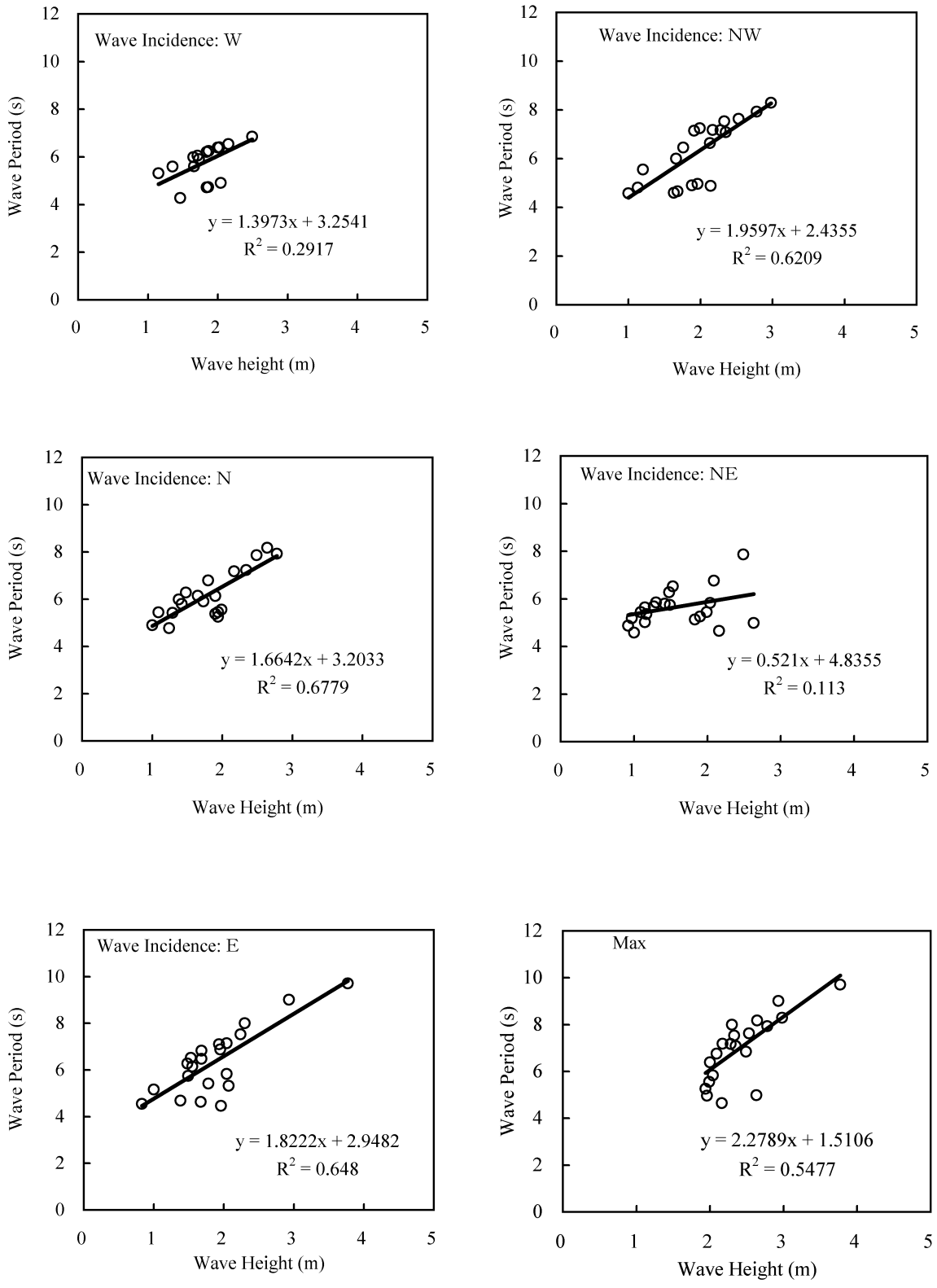


Figure D.5 (2) Wave Height - Period Relationship (Bojonegara)

D.5 Estimation of Design Deepwater Wave

An estimation of design deepwater wave was set out using the 5-year wave hindcast data combining with the existing information of yearly peak waves for 18 years (1980 - 1997; wave hindcast by ITB, July 2000).

The list of yearly peak wave heights for 22 years (1980 - 2001) is shown in **Table D.5**.

Encounter probability analysis was carried out for the list of peak waves and design deepwater wave is estimated as Return Wave Height assuming proper distribution function of probability.

Since the data on peak wave heights have not been accumulated over a prolonged period of time, it is not well known which distribution function is most suitable. Empirically, Gumbell distribution function and Weibull distribution function has been introduced for fitting, and the best fit distribution function for the particular data set is selected as the extreme distribution. **Table D.6** shows the estimated design deepwater waves.

Table D.5 Yaerly Peak Wave Heights by Wave Hindcast

	Direction / Year	W	NW	N	NE	E	Max
Wave Hindcast by existing Report (June 2000)**	1980	1.71	2.28	1.80	1.17	1.95	**2.28**
	1981	1.66	1.76	2.64	1.00	2.04	**2.64**
	1982	1.15	1.00	2.78	1.42	1.48	**2.78**
	1983	2.02	1.66	1.90	2.49	3.77	**3.77**
	1984	2.02	2.78	2.34	1.27	2.93	**2.93**
	1985	2.00	1.66	2.17	0.92	0.83	**2.17**
	1986	2.02	2.53	1.29	1.49	1.93	**2.53**
	1987	2.00	1.99	1.09	1.15	1.53	**2.00**
	1988	1.73	1.91	1.73	2.09	1.68	**2.09**
	1989	1.35	2.17	1.65	0.97	1.55	**2.17**
	1990	2.02	2.35	1.38	1.30	1.49	**2.35**
	1991	1.65	2.13	2.17	1.48	1.00	**2.17**
	1992	2.49	2.33	1.48	1.53	2.24	**2.49**
	1993	1.84	2.98	1.42	1.53	1.68	**2.98**
	1994	1.87	2.33	1.42	1.15	2.04	**2.33**
	1995	2.00	1.20	1.00	2.04	1.49	**2.04**
	1996	2.15	1.13	1.24	1.09	2.30	**2.30**
	1997	1.65	1.53	2.49	1.55	1.66	**2.49**
Tanjung Priok*	1997	2.42	2.57	1.91	2.63	2.07	**2.63**
	1998	2.00	2.22	1.94	1.83	1.38	**2.22**
	1999	2.08	1.89	1.94	2.16	1.96	**2.16**
	2000	2.35	2.15	1.88	1.99	1.67	**2.35**
	2001	1.82	2.12	1.90	1.90	1.78	**2.12**
Bojonegara*	1997	2.04	2.14	2.09	2.63	2.07	**2.63**
	1998	1.84	1.63	1.94	1.83	1.38	**1.94**
	1999	1.84	1.88	1.94	2.16	1.96	**2.16**
	2000	1.86	1.68	1.99	1.99	1.67	**1.99**
	2001	1.46	1.96	1.90	1.90	1.78	**1.96**

* Wave Hindcast by JICA Study Team (July 2002)
** Studi Kelayakan Rencana Pengembangan Terminal Curah dan Petikemas Pelabuhan Tanjung Priok, Final Report, June 2000, IPC2, ITB

Table D.6 Estimation of Design Deepwater Waves

Design Deepwater Waves and Return Period（off Tj. priok） Unit: m

Direction / Year	W	NW	N	NE	E	Maximum
5	2.32	2.70	2.46	2.24	2.64	**2.95**
10	2.46	2.93	2.69	2.47	2.99	**3.25**
20	2.59	3.14	2.90	2.69	3.34	**3.55**
30	2.66	3.25	3.02	2.80	3.54	**3.72**
50	2.74	3.39	3.15	2.94	3.79	**3.94**
100	2.84	3.56	3.32	3.11	4.13	**4.24**

Wave Period of Design Deepwater Waves (off Tj. priok） Unit: second

Direction / Year	W	NW	N	NE	E	Maximum
5	6.19	7.41	7.26	6.00	7.75	**8.12**
10	6.26	7.76	7.64	6.12	8.39	**8.79**
20	6.33	8.09	7.99	6.24	9.03	**9.46**
30	6.37	8.26	8.19	6.30	9.39	**9.84**
50	6.42	8.47	8.41	6.37	9.85	**10.34**
100	6.47	8.73	8.69	6.46	10.47	**11.01**

Design Deepwater Waves and Return Period（off Bojonegara） Unit: m

Direction / Year	W	NW	N	NE	E	Maximum
5	2.21	2.63	2.47	2.24	2.64	**2.95**
10	2.34	2.87	2.70	2.47	2.99	**3.27**
20	2.45	3.08	2.91	2.69	3.34	**3.59**
30	2.51	3.19	3.03	2.80	3.54	**3.78**
50	2.58	3.33	3.16	2.94	3.79	**4.01**
100	2.68	3.50	3.33	3.11	4.13	**4.33**

Wave Period of Design Deepwater Waves (off Bojonegara） Unit: second

Direction / Year	W	NW	N	NE	E	Maximum
5	6.34	7.59	7.30	6.00	7.75	**8.24**
10	6.53	8.07	7.68	6.12	8.39	**8.97**
20	6.68	8.48	8.03	6.24	9.03	**9.70**
30	6.76	8.69	8.23	6.30	9.39	**10.13**
50	6.86	8.97	8.45	6.37	9.85	**10.65**
100	7.00	9.30	8.73	6.46	10.47	**11.38**

APPENDIX E: DESIGN OF BREAKWATERS

E.1 Tanjung Priok Port

E.1.1 Tide

HHWL	(Highest high water level)	+1.05 m
MHWS	(Mean high water spring)	+0.91 m
MSL	(Mean sea level)	+0.48 m
MLWS	(Mean low water spring)	+0.09 m
DL	(Datum level = LLWL: Lowest low water level)	0.00 m

E.1.2 Design Wave

Two kinds of design waves are applied to the design of breakwaters, i.e., (i) high-frequency higher wave and (ii) low-frequency higher wave.

(1) High-frequency higher wave

High-frequency higher wave is applied as the design wave height to decide the crest elevation of breakwater considering the permissible rate of wave over-topping. The occurrence of at least once in every year (return period of the design wave is one year) is adopted as the frequency.

Design deepwater wave height and equivalent deepwater wave height in front of the assumed breakwater are shown in the following table based on the wave hindcast and the calculation of wave transformation.

Design Deepwater Wave Height and Period（off Tj. priok）
Return Period: 1/1-year

Direction / Wave	W	NW	N	NE	E
Height (m)	1.83	1.98	1.68	1.45	1.70
Period (s)	5.92	6.30	5.96	5.59	6.04

Equivalent Deepwater Wave Height in front of Break water (unit: m)

Direction / Location	W	NW	N	NE	E
Ancol Off	0.77	1.28	1.37	0.99	0.48
Ancol Inner	0.77	1.25	1.33	0.94	0.40
Central BW	0.55	1.07	1.17	0.84	0.41

The dimensions of the design wave can be set as follows as the representative.

$H_{1/3}$ = 1.5 m, T = 6.0 s, Wave incidence: N

(2) Low-frequency higher wave

Low-frequency higher wave is applied to examine the stability of breakwater and decide the design section of the breakwater. The low frequency wave (return period of the design wave is 30 years) is adopted.

Design deepwater wave height and equivalent deepwater wave height in front of the assumed breakwater are shown in the following table.

Design Deepwater Wave Height and Period（off Tj. priok）
Return Period: 1/30-year

Direction / Wave	W	NW	N	NE	E
Height (m)	2.66	3.25	3.02	2.80	3.54
Period (s)	6.37	8.26	8.19	6.30	9.39

Equivalent Deepwater Wave Height in front of Break water (unit: m)

Direction / Location	W	NW	N	NE	E
Ancol Off	1.13	2.10	2.46	1.91	1.00
Ancol Inner	1.11	2.06	2.39	1.82	0.83
Central BW	0.80	1.75	2.10	1.62	0.86

The dimensions of the design wave can be set as follows as the representative.

$H_{1/3}$ = 2.5 m, T = 8.5 s, Wave incidence: N

E.1.3 Assumption of Crest elevation of Breakwater

In a harbor of large ships calling, where the water area behind the breakwater is so wide that wave over-topping is allowed to some extent, the crest elevation of breakwater is determined at 0.6 x $H_{1/3}$ or greater above the mean monthly-highest water level. In this case, the elevation is calculated as follows.

Assumed Crest Elevation = MHWS + 0.6 x $H_{1/3}$

= 0.91 + 0.6 x 1.5 = +1.81 (say +2.00 m)

E.1.4 Permissible rate of Wave over-topping

The permissible rate of over-topping depends on factors such as the structural type of breakwater, the situation with regard to land use behind seawall. The following table gives a standard of the permissible rate of wave over-topping in line with the importance of the facilities behind the seawall (after Nagai).

Table E-1 Permissible Rate of Wave Over-topping (m^3/s/m)

Importance of Land Use behind Seawall	Rate of Over-topping (m^3/s/m)
Areas where there is a high concentration of houses, public facilities, etc. behind the seawall, and so it is anticipated that flooding due to over-topping or spray would cause particularly serious damages	about 0.01
Other important areas	about 0.02
Other areas	0.02 - 0.06

(Source: Technical Standards and Commentaries for Port and Harbour Facilities in Japan; January 2002)

The calculation of the design crest elevation for the breakwater of Tanjung Priok Port is given as

follows considering the permissible rate of wave over-topping as 0.01 m^3/s/m. The seabed elevation in front of the breakwater is set as -5.0 m.

Crest Elevation of Breakwater	DL+2.00 m	DL+2.10 m
Height of Crest above MHWS	+1.09 m	+1.19 m
Rate of wave over-topping (m^3/s/m)	0.0124	0.0098
Evaluation of Wave over-topping	Not acceptable	Acceptable

E.1.5 Design Crest Elevation of Breakwater

The above-mentioned crest elevation (DL+2.10 m) calculated from the rate of wave over-topping is based on the wave hind cast, while the existing West Breakwater has the crest elevation DL+2.50 m. Design crest elevation given to the breakwaters to be newly constructed should be decided as DL+2.50 m following the existing structures and also considering the uncertainty of the wave information.

E.1.6 Mass of Armor Stones and Concrete Blocks

The mass of rubble stones or concrete blocks necessary cover the front slope of a rubble mound type breakwater is calculated by the following formula.

$$M = \rho_r H^3/[N_S^3(S_r - 1)^3]$$

where M: minimum mass of rubble stones or concrete blocks, ρ_r: density of rubble stones or concrete blocks, H: design wave height, N_S: stability number, S_r: specific gravity of rubble stones or concrete blocks relative to sea water.

Assuming the front slope is 1:2.0 and the use of concrete block (K_D = 5) for the armor layer of the breakwater, the parameters in the above formula are decided as follows. Design wave height of return period 1/30-year is applied to this calculation.

ρ_r = 2.3 ton/m^3, $H_{1/3}$ = 2.5 m, $N_S^3 = K_D * \cot\alpha$ = 5*2 = 10, S_r = 2.3/1.03 = 2.23

$M = 2.3*2.5^3/[10(2.23-1)^3] = 1.93$ (ton)

3-ton type concrete block (Tetrapod; 2.88 ton/unit) can be recommended for the armor layer.

A typical section of the breakwater with the combined structure of Rubble Mound Slope Type is shown in the next page, **Figure E-1**.

E.1.7 Demolition of Breakwater

Relocation works of the existing breakwaters are planned in the Master Plan development of Tanjung Priok. The relocation works inevitably accompany the demolition works of the existing breakwaters.

The present condition of the existing breakwaters is not captured clearly in the technical documents of IPC2. An information (refer to **Figure E-2**) advises that the present condition

consists of unexpectedly complicated accumulation of the past construction and improvement works.

For the purpose of the cost estimate at the stage of the feasibility study, the cost of the demolition works is assumed as 20 % of the construction cost of the new breakwaters. A special purpose surveys and study on the existing breakwaters is necessary in order to estimate the precise demolition cost. This issue should be reconsidered in the stage of the detail design.

E.2 Bojonegara

E.2.1 Tide

HWS	(High water spring)	+1.03 m
MSL	(Mean sea level)	+0.58 m
DL	(Datum level = LWS: Low water spring)	0.00 m

E.2.2 Design Wave

(1) High-frequency higher wave

Design deepwater wave height and equivalent deepwater wave height in front of the assumed breakwater are shown in the following table based on the wave hindcast and the calculation of wave transformation.

The dimensions of the design wave can be set as follows as the representative.

$H_{1/3}$ = 1.5 m, T = 6.0 s, Wave incidence: NE

Design Deepwater Wave Height and Period（off Bojonegara）
Return Period: 1/1-year

Direction / Year	W	NW	N	NE	E
Height (m)	1.78	1.86	1.68	1.45	1.70
Period (s)	5.74	6.09	5.99	5.59	6.04

Equivalent Deepwater Wave Height in front of Break water (unit: m)

Direction / Location	W	NW	N	NE	E
Off BW	0.75	1.45	1.59	1.41	1.41
Inner BW	0.64	1.36	1.55	1.39	1.38

(2) Low-frequency higher wave

Low-frequency higher wave is applied to examine the stability of breakwater and decide the design section of the breakwater. The low frequency wave (return period of the design wave is 30 years) is adopted.

Design deepwater wave height and equivalent deepwater wave height in front of the assumed breakwater are shown in the following table.

The dimensions of the design wave can be set as follows as the representative.

$H_{1/3}$ = 3.0 m, T = 9.5 s, Wave incidence: E

Design Deepwater Wave Height and Period（off Bojonegara）
Return Period: 1/30-year

Direction / Year	W	NW	N	NE	E
Height (m)	2.51	3.19	3.03	2.80	3.54
Period (s)	6.76	8.69	8.23	6.30	9.39

Equivalent Deepwater Wave Height in front of Break water (unit: m)

Direction / Location	W	NW	N	NE	E
Off BW	1.05	2.48	2.87	2.71	2.94
Inner BW	0.91	2.33	2.79	2.69	2.88

E.2.3 Assumption of Crest elevation of Breakwater

Assumed Crest Elevation = HWS + 0.6 x $H_{1/3}$
= 1.03 + 0.6 x 1.5 = +1.93 (say 2.00 m)

E.2.4 Permissible rate of Wave over-topping

The calculation of the design crest elevation for the breakwater of Bojonegara Port is given as follows considering the rate of wave over-topping as 0.01 m^3/s/m. The seabed elevation in front of the breakwater is set as -10.0 m.

Crest Elevation of Breakwater	DL+2.00 m	DL+2.10 m
Height of Crest above HWS	+0.97 m	+1.07 m
Crest Elevation of Breakwater	0.0128	0.0096
Height of Crest above MHWS	Not acceptable	Acceptable

The calculation of the design crest elevation for the wave-breaker seawall of Bojonegara Port (in the case of the development of offshore container yard) is given as follows considering the rate of wave over-topping 0.01 m^3/s/m. The seabed elevation in front of the breakwater is set as -15.0 m.

Crest Elevation of Breakwater	DL+2.00 m	DL+2.10 m
Height of Crest above HWS	+0.97 m	+1.07 m
Crest Elevation of Breakwater	0.0127	0.0095
Height of Crest above MHWS	Not acceptable	Acceptable

E.2.5 Design Crest Elevation of Breakwater

The above-mentioned crest elevation (DL+2.10 m) calculated from the rate of wave over-topping is based on the wave hind cast. Design crest elevation given to the breakwaters to be newly constructed should be decided as DL+2.40 m as similar to Tanjung Priok Port and also considering the uncertainty of the wave information.

In the case that the area behind seawall is to be developed as cargo-handling yard, the formation level (DL+3 - 3.5 m) is usually decided higher than the crest elevation of breakwater.

E.2.6 Mass of Armor Stones and Concrete Blocks

Assuming the front slope is 1:2.0 and the use of concrete block (K_D = 5) for the armor layer of the breakwater, the parameters in the above formula are decided as follows. Design wave height of return period 1/30-year is applied to this calculation.

ρ_r = 2.3 ton/m^3, $H_{1/3}$ = 3.0 m, $N_S^3 = K_D * \cot\alpha$ = 5*2 = 10, S_r = 2.3/1.03 = 2.23

$M = 2.3*3.0^3/[10(2.23-1)^3] = 3.34$ (ton)

4-ton type concrete block (Tetrapod; 3.68 ton/unit) can be recommended for the armor layer.

A typical section of the breakwater with the combined structure of Rubble Mound Slope is shown in the next page, **Figure E-3**.

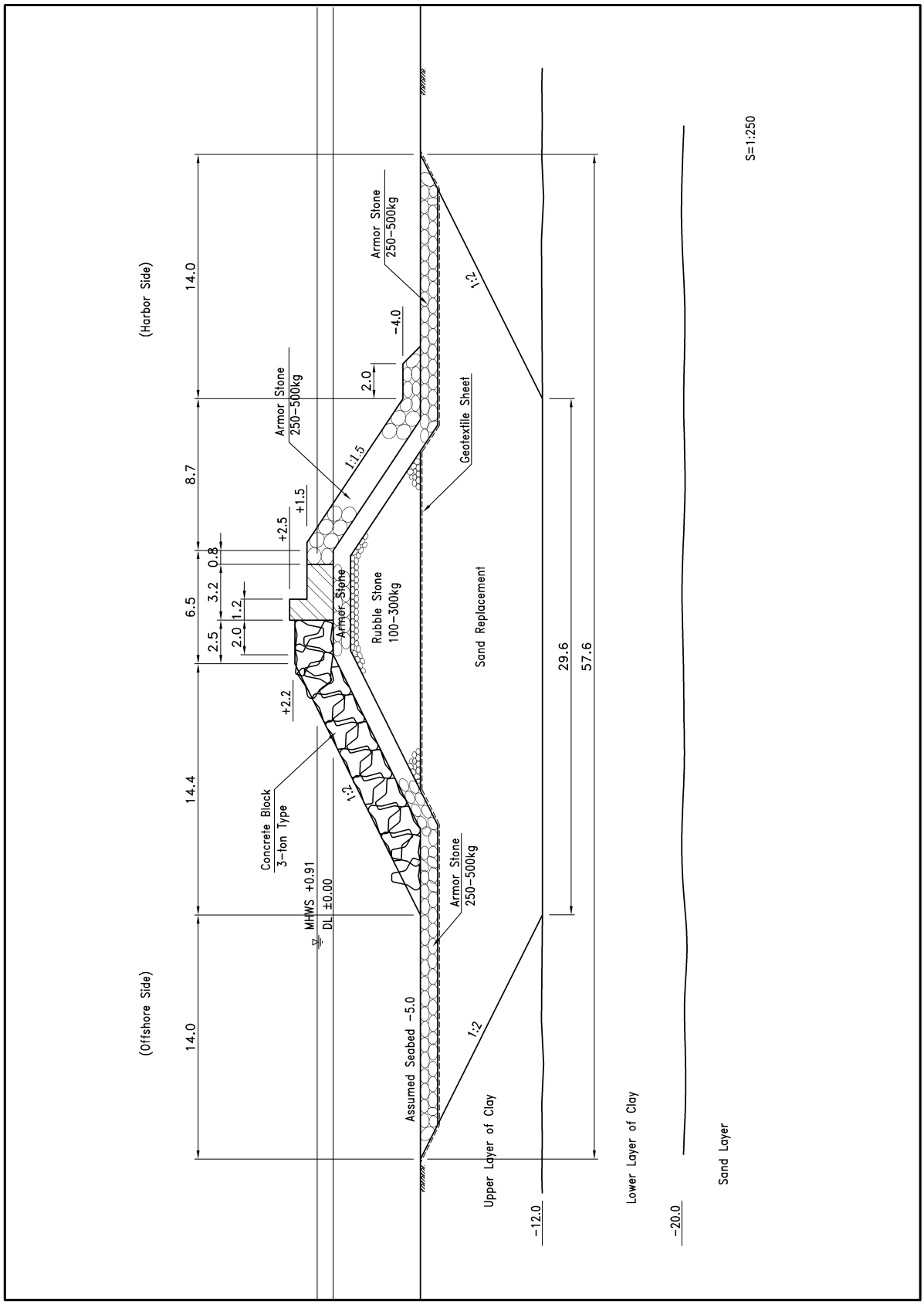
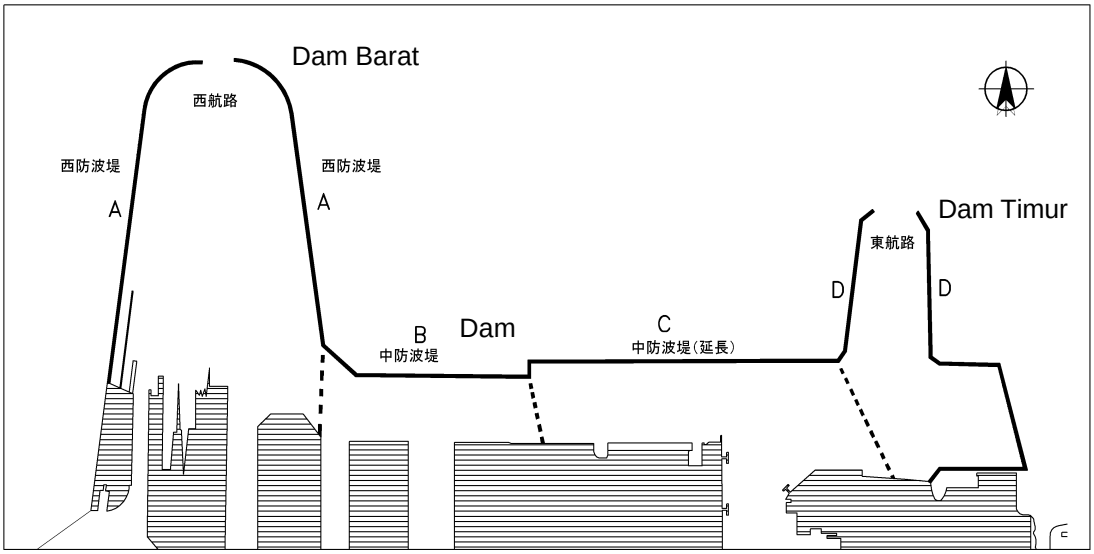
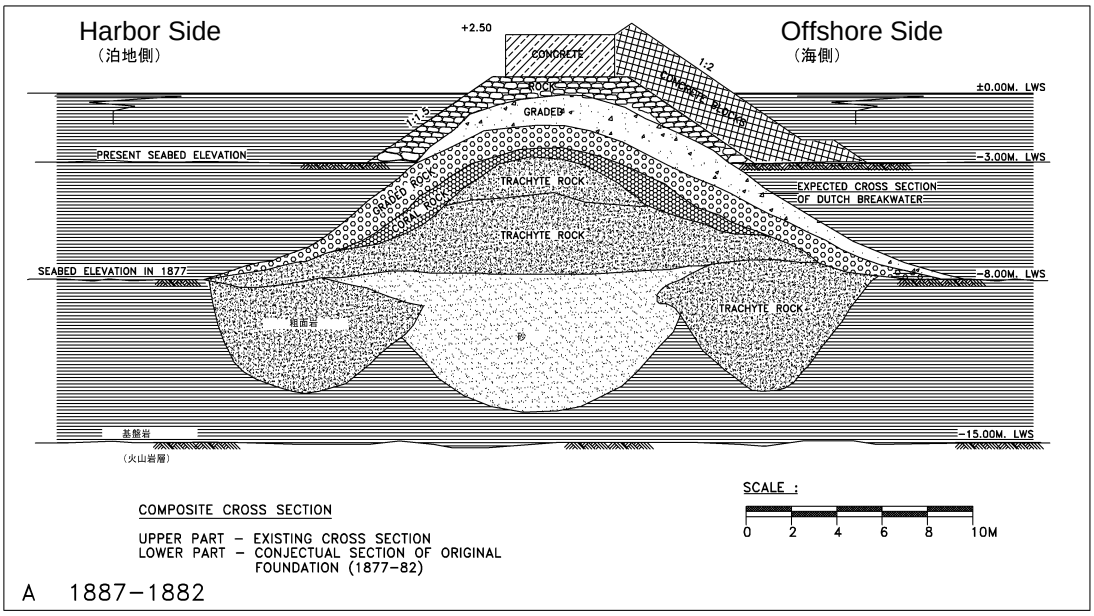


Figure E-1 Tanjung Priok Breakwater (Rubble Mound Sloping Type)





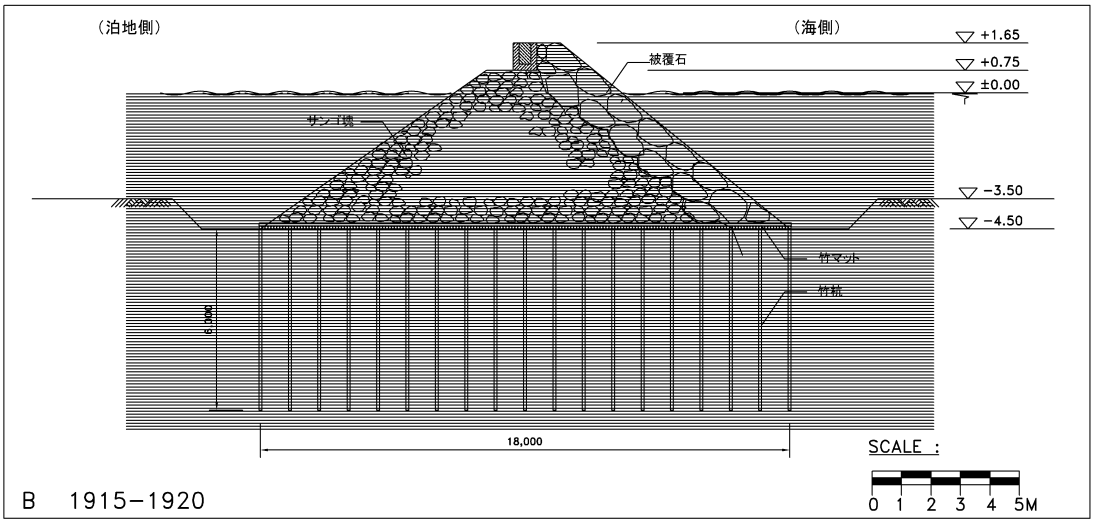


Figure E-2 Existing Breakwaters of Tanjung Priok Port

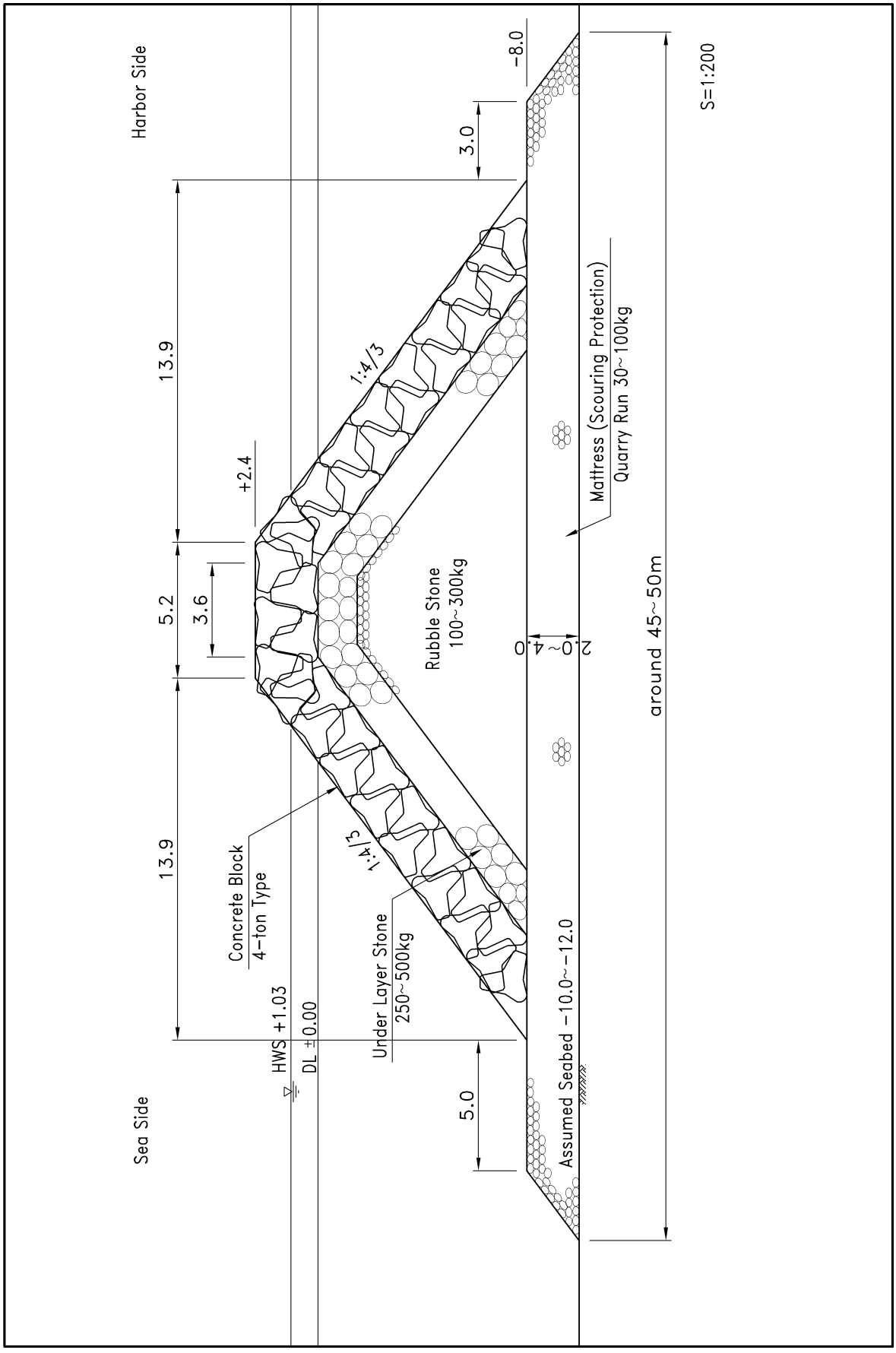


Figure E-3 Bojonegara Breakwater (Rubble Mound Sloping Type)