4.6 Results of Natural Conditions Survey

In order to analyze the present situation of natural conditions in the study area for the master plan study and the feasibility study, natural conditions survey was carried out as shown in Tables 4.6-1 and 4.6-2.

4.6.1 Topography

Results of shoreline survey and bathymetric survey are shown in Figures 4.6.1-1 to 4.6.1-5 for Sichon, Sakom, Thepha, Songkhla and Bang Ra Pha areas, respectively.

Figures 4.6.1-6 to 4.6.1-8 show the longitudinal profiles of coastal areas in Sichon, Sakom and Thepha.

In the navigation channel of Songkhla port, detailed cross-sectional and longitudinal surveys were carried out using an echo sounder with dual frequencies on the feasibility study stage.

Table 4.6-1 Natural Conditions Survey
(Master Plan Stage)

Items	Scope of Survey	Survey Period	Remarks
1. Shoreline Survey			
	Method : Levelling Survey Area : Sichon, Sakom, Thepha Length of Shoreline : Approx. 3 km	Thepha : Feb. 19 - Feb.24 Sakom : Feb. 8 - Mar. 2 Sichon : Mar. 15 - Mar.23	
2. Bathymetric Survey			
	Method : Sounding Survey Area : Sichon, Sakom, Thepha Area of Survey : 3 km x 1 km (offshore) Spacing : 50 m & 100 m Profiling : till –10 m depth (3 lines)	Thepha : Feb. 19 - Feb.24 Sakom : Feb. 8 - Mar. 2 Sichon : Mar. 15 - Mar.23	each area
3. Seabed Material Survey			
3.1 Port, River and Offshore Area			
	Method : Sampling & Testing Survey Area : Sichon, Sakom, Thepha No. of Point : 17 points Frequency : 2 times Lab. Test : Physical and Chemical Tests	Thepha : Feb.21 & Mar. 6 Sakom : Mar.8 & Mar. 21 Sichon : Mar.23 & Apr. 7	
3.2 Siltation Area (Approaching Channel)			
	Method : Sampling & Testing Sampling Area : Pak Nakhon, Pak Phanang, Pattani No. of Point : 5 points Lab. Test : Physical and Chemical Tests Suspended Solid	Pak Nakhon : Mar. 10 Pattani : Mar. 5 Pak Phanang : Mar. 28	each area
4. Oceanographic Observation			
4.1 Current and Wave Observation			
	Method : Electro-Magnetic Current Meter Survey Area : Sichon, Sakom, Thepha No. of Point : 3 points Duration : approx. 15 days	Thepha : Feb. 26 - Mar. 7 Sakom : Mar. 8 - Mar. 22 Sichon : Mar. 23 - Apr. 7	each area

Table 4.6-1 (Continued)

Items	Scope of Survey	Survey Period	Remarks
4.2 Littoral Current Observation			
	Method : Float Tracing Survey Area : Sichon, Sakom, Thepha Frequency : Calm and Rough Conditions	Thepha:Feb.22-23&Mar.6 Sakom : Mar.11-12 & 17 Sichon : Mar.25 & Apr.1	
4.3 Drift-Sand Observation			
	Method : Opto-electric Seabed Profiler Survey Area : Sichon, Sakom, Thepha No. of Point : 2 points Duration : approx. 15 days	Thepha : Feb. 26 - Mar. 7 Sakom : Mar. 8 - Mar. 22 Sichon : Mar. 23 - Apr. 7	each area
4.4 Diffusion Test			
	Method : Dye Tracing Survey Area : Sichon Frequency : Flood and Ebb Tides	March 24	
5. Water Quality			
	Method : Water-quality Meter Survey Area : Sichon, Sakom, Thepha No. of Point : 3 points Duration : approx. 15 days Observation Item : Salinity, Temperature, Turbidity	Thepha : Feb. 21 - Mar. 7 Sakom : Mar. 8 - Mar. 22 Sichon : Mar. 23 - Apr. 7	
6. River Flow			
	Method : Electromagnetic Current Meter Survey Area : Sichon, Sakom, Thepha No. of Point : 3 points (river-mouth) Duration : approx. 15 days Observation Item : Velocity, Direction Temperature	Thepha : Feb. 21 - Mar. 7 Sakom : Mar. 8 - Mar. 22 Sichon : Mar. 23 - Apr. 7	
7. Tidal Observation			
	Method : Automatic Tidal Gauge Survey Area : Sichon, Sakom, Thepha No. of Point : 3 points Duration : approx. 15 days	Thepha : Feb. 20 - Mar. 7 Sakom : Mar. 7 - Mar. 22 Sichon : Mar. 23 - Apr. 7	

Table 4.6-2 Natural Conditions Survey
(Feasibility Study Stage)

Items	Scope of Survey	Survey Period	Remarks
1. Shoreline Survey			
	Method : Levelling Survey Area : Songkhla, Bang Ra Pha, Length of Shoreline : Approx. 3 km	Songkhla:Aug.19-Aug.24 Bang Ra Pha : Sep. 8 – Sep. 2	
2. Bathymetric Survey			
	Method : Sounding Survey Area : Songkhla, Bang Ra Pha, Sichon Area of Survey : 3 km x 1 km (offshore) for Songkhla, Bang Ra Pha, and within channel for Sichon Spacing : 50 m & 100 m	Songkhla:Aug.19-Aug.24 Bang Ra Pha : Sep. 8 – Sep. 2 Sichon : Sep. 15 - Sep.23	
3. Seabed Material Survey			
	Method : Sampling & Testing Survey Area : Songkhla, Bang Ra Pha No. of Point : 10 points, 3 points Lab. Test : Physical and Chemical Tests	Songkhla:Aug.19-Aug.24 Oct. 13 Bang Ra Pha : Sep. 8 – Sep. 2	
4. Soil Investigation			
	Method : Boring & Testing Study Area : Songkhla, Bang Ra Pha No. of Point : 3 points (Songkhla) 1 point (Bang Ra Pha) In-situ Test : SPT Lab. Test : Physical and Chemical Tests	Songkhla:Aug.19-Aug.24 Bang Ra Pha : Sep. 8 – Sep. 2	

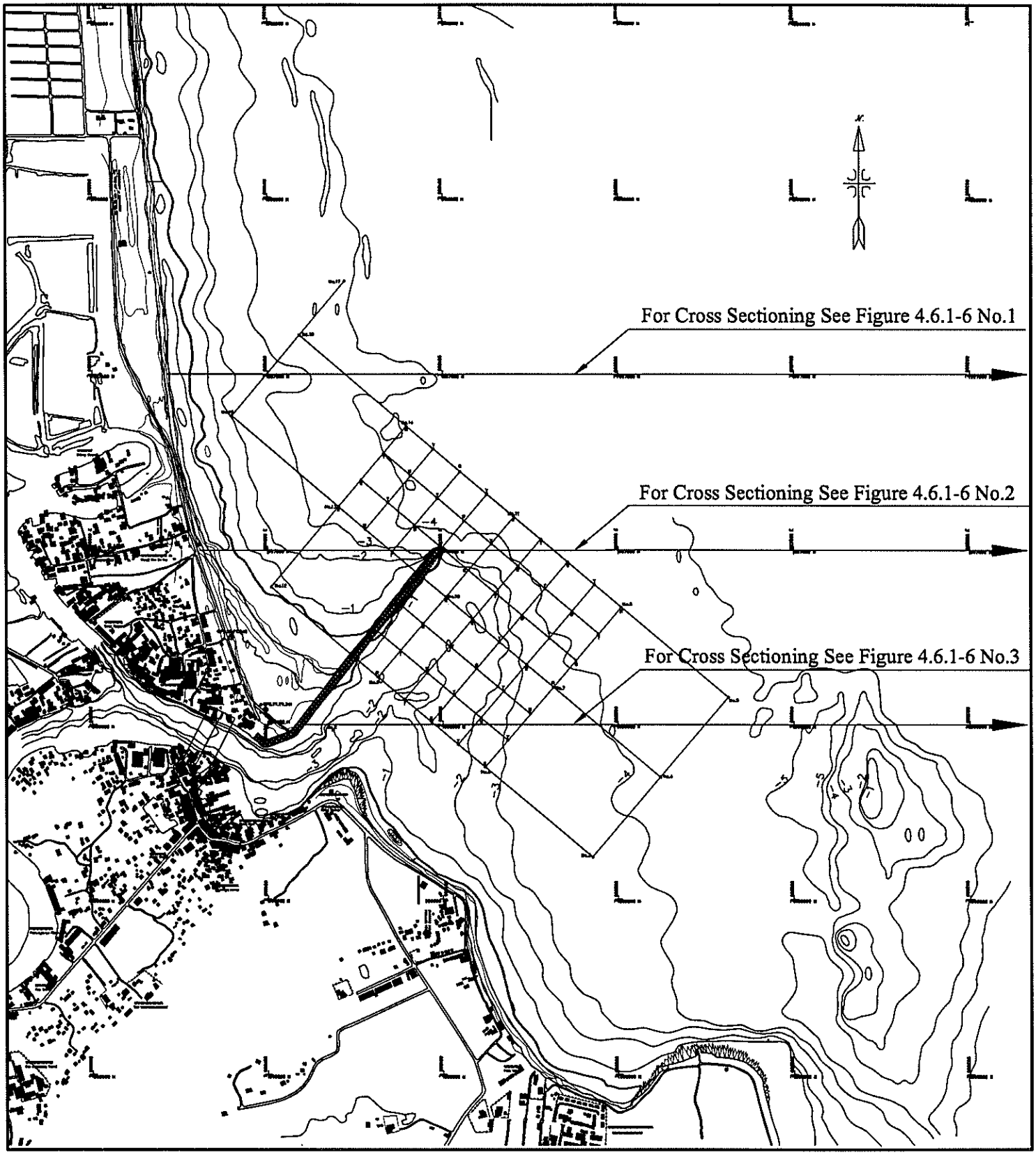


Figure 4.6.1-1 Topographic and Bathymetric Map in Sichon

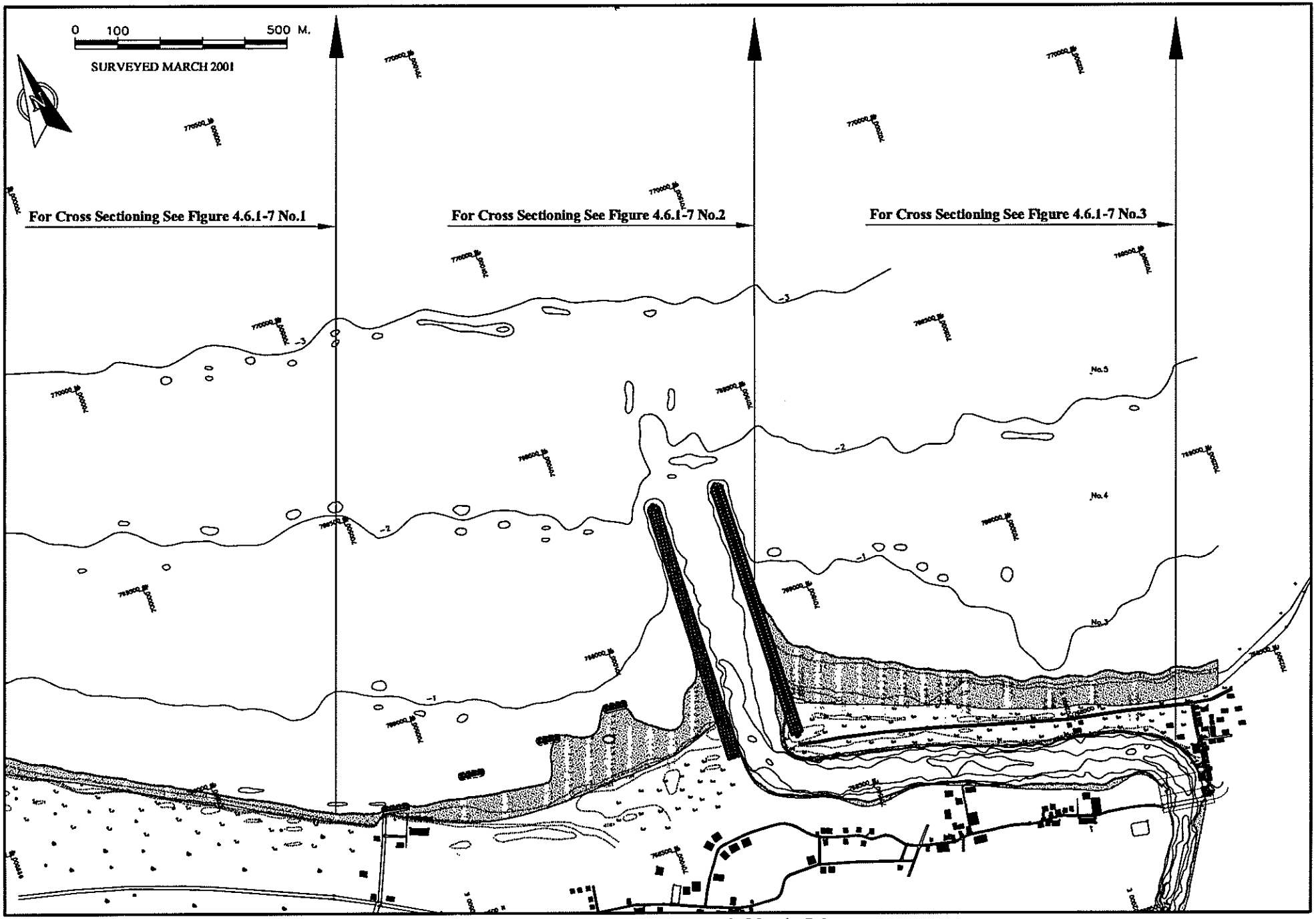


Figure 4.6.1-2 Topographic and Bathymetric Map in Sakom

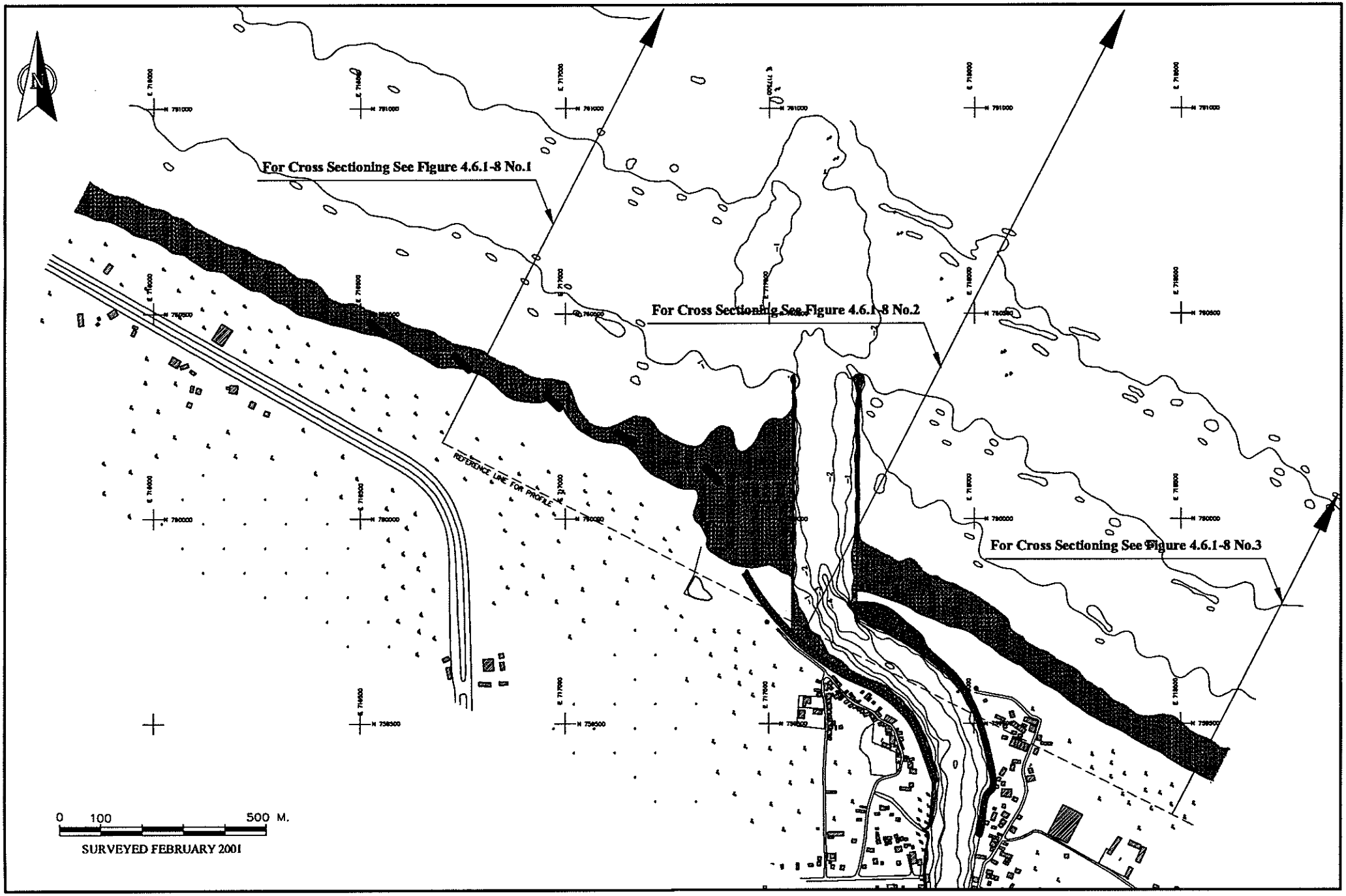


Figure 4.6.1-3 Topographic and BAthymetric Map in Thepha

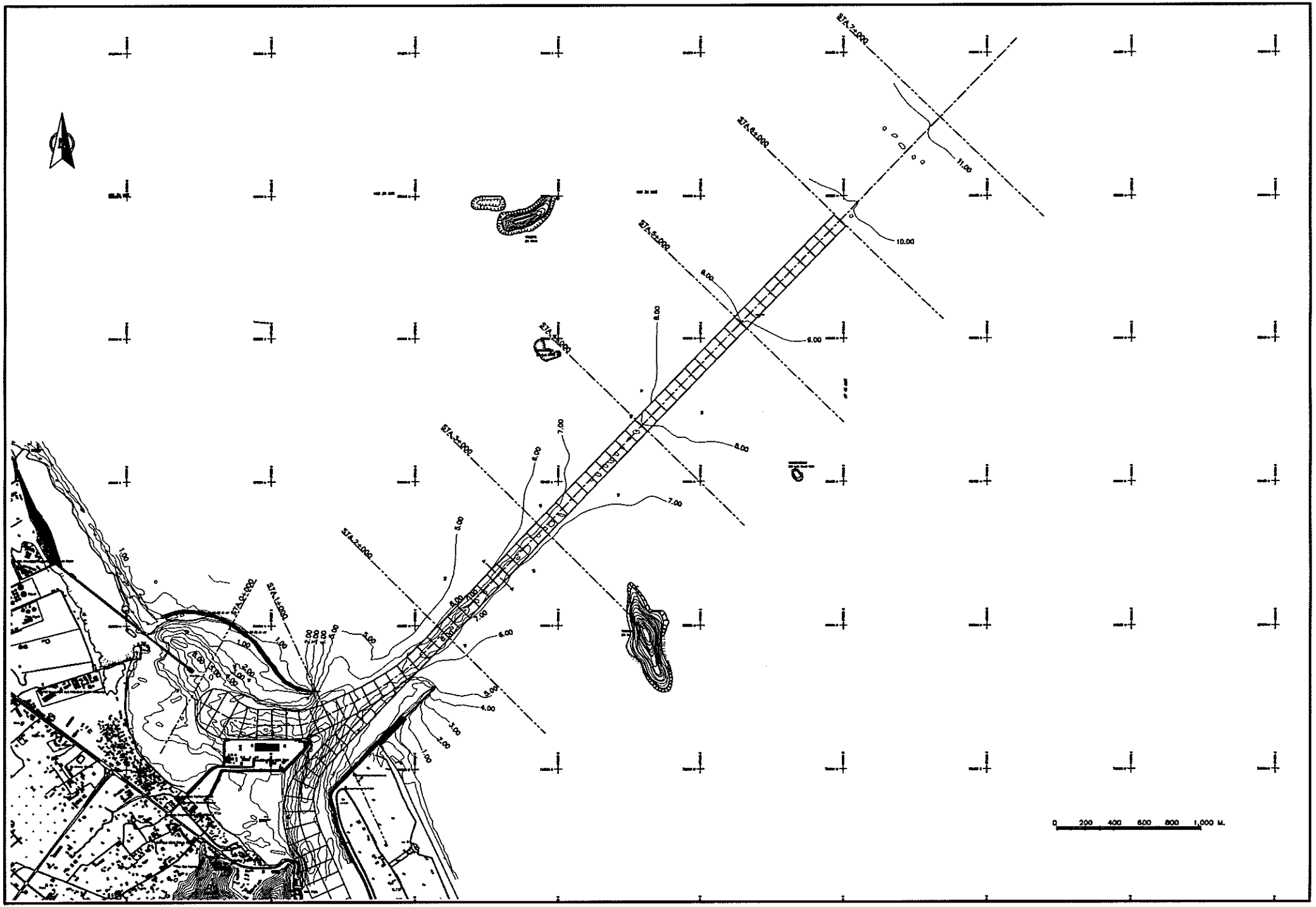


Figure 4.6.1-4 Topographic and Bathymetric Map in Songkhla

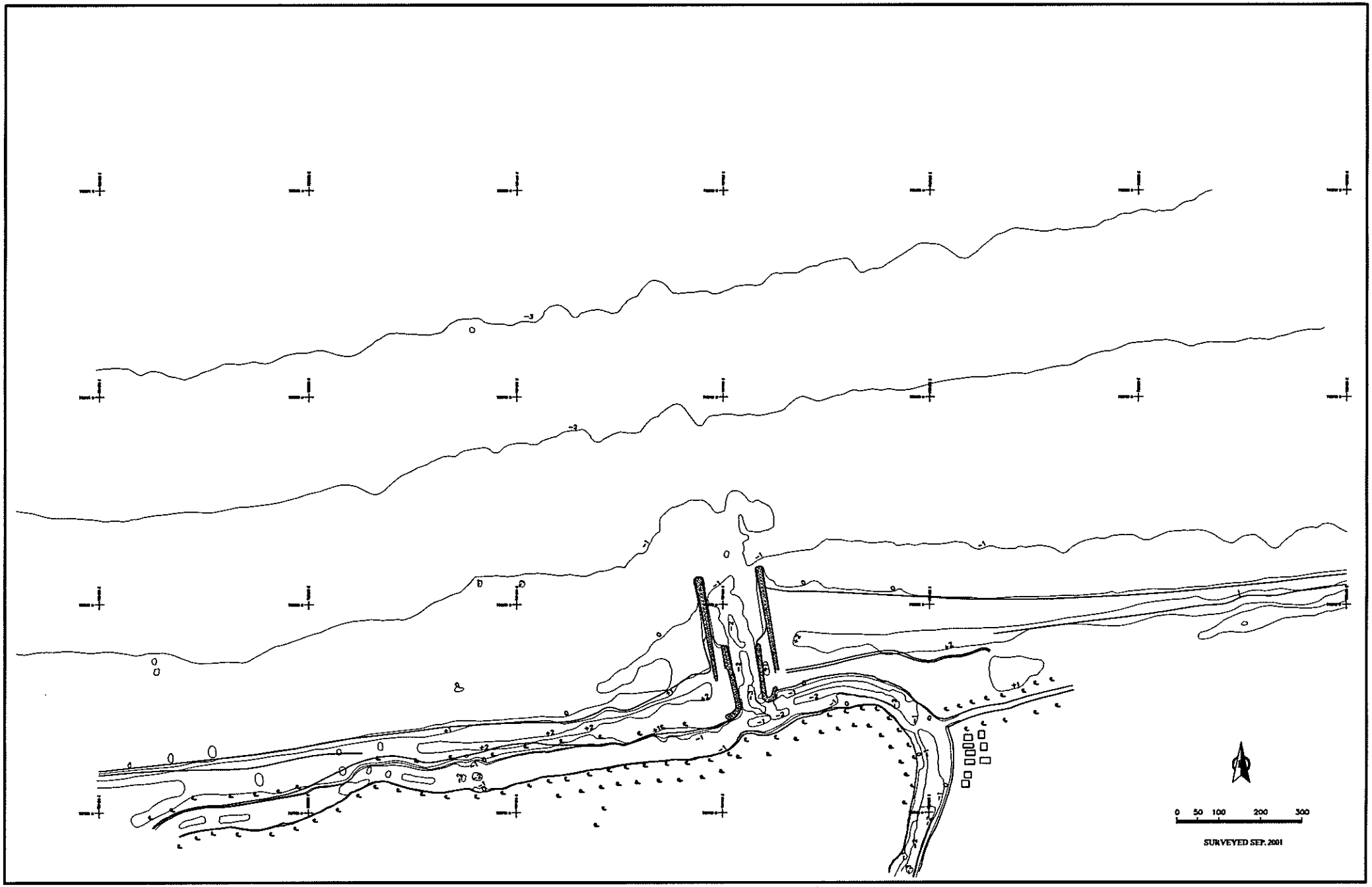
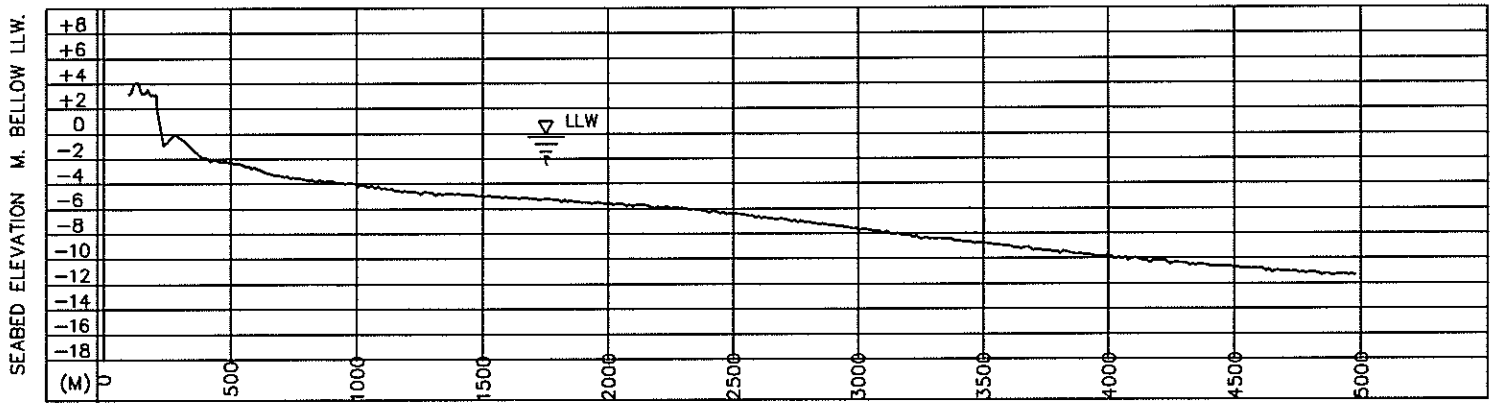
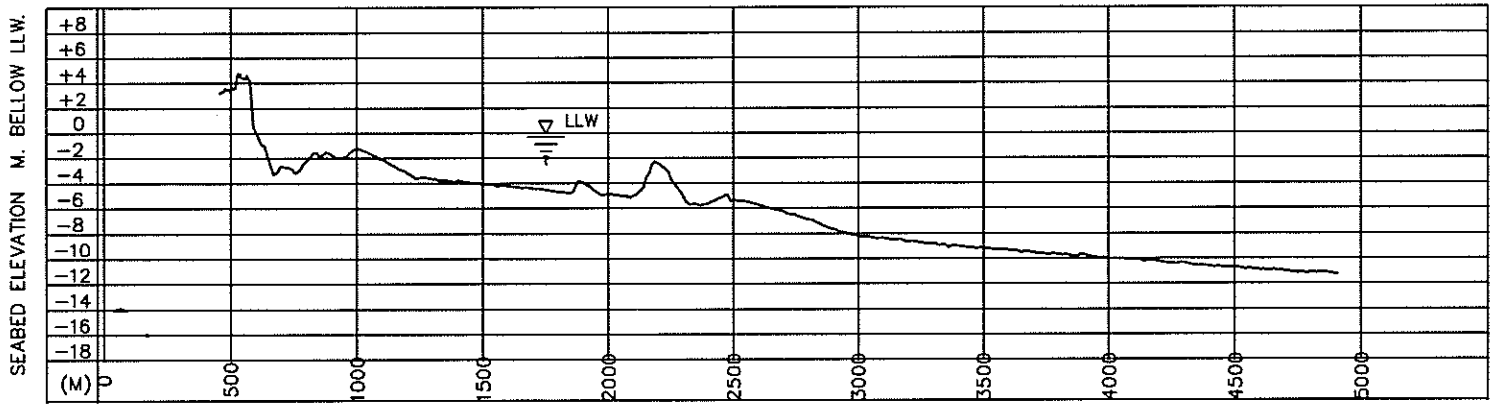


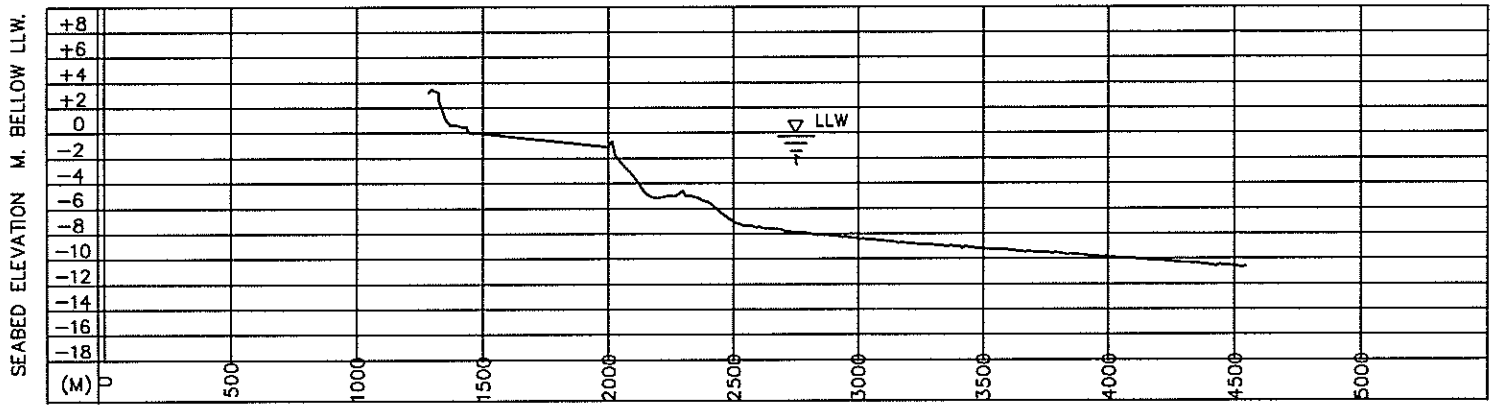
Figure 4.6.1-5 Topographic and Bathymetric Map in Bang Ra Pha



No.1 Cross Section



No.2 Cross Section



No.3 Cross Section

Figure 4.6.1-6 Longitudinal Profile of Coastal Area in Sichon

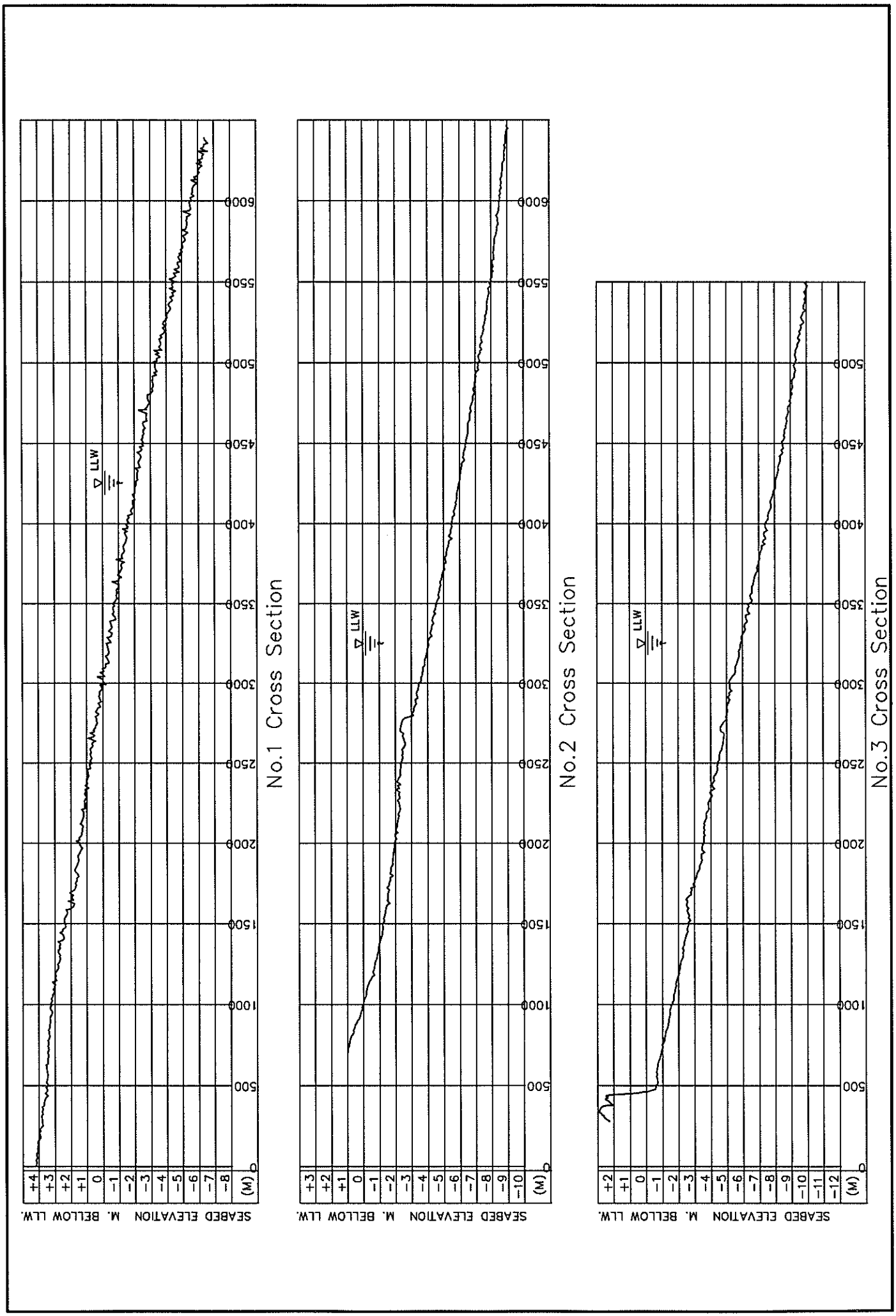
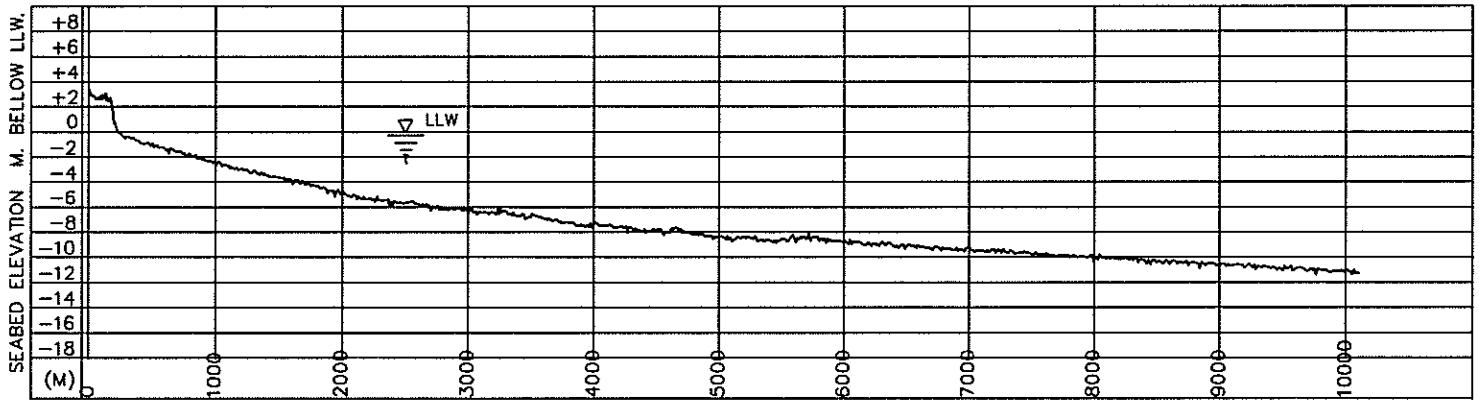
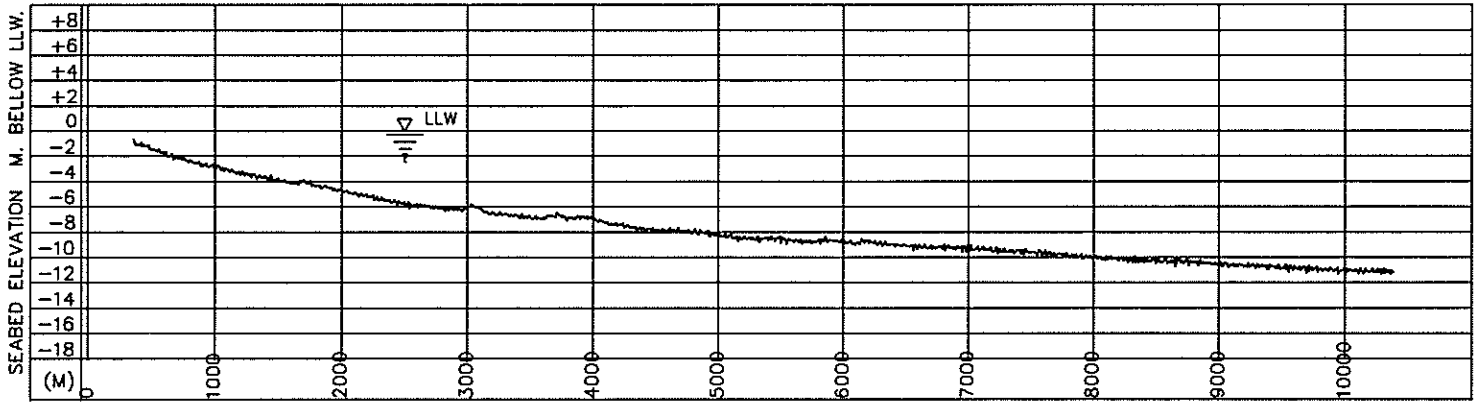


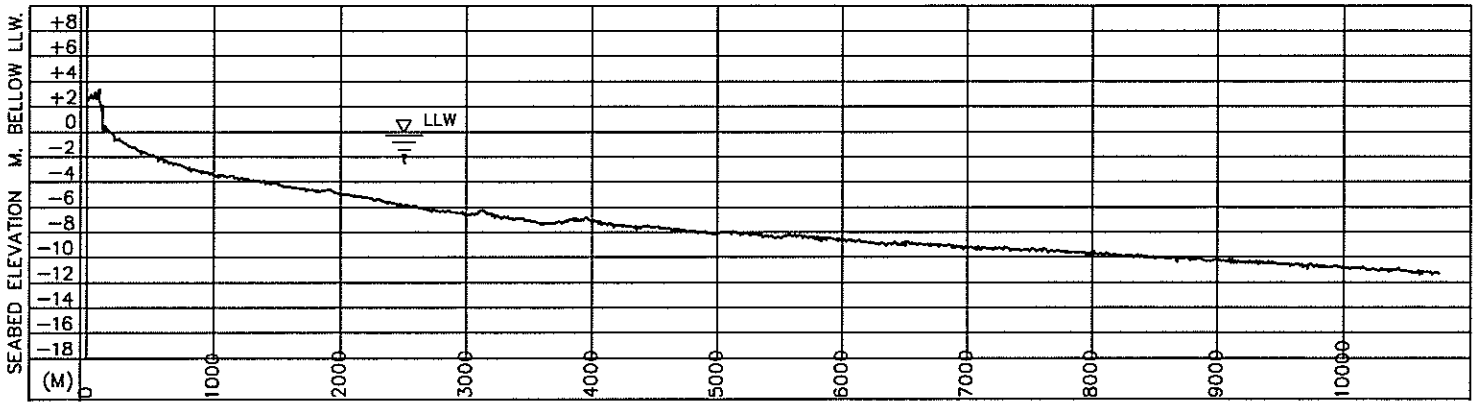
Figure 4.6.1-7 Longitudinal Profile of Coastal Area in Sakom



No.1 Cross Section



No.2 Cross Section



No.3 Cross Section

Figure 4.6.1-8 Longitudinal Profile of Coastal Area in Thepha

4.6.2 Seabed Materials

Location of sampling points of seabed materials in Sichon, Sakom and Thepha areas is shown in Figures 4.6.2-1 to 4.6.2-3, Pak Phanang and Pattani channels in Figure 4.6.2-4, and Songkhla and Bang Ra Pha in Figure 4.6.2-5.

1) Physical Characteristics

Physical tests of samples were performed for grain size distribution, specific gravity and water contents.

The median grain sizes obtained from sieve analysis are summarized in Tables 4.6.2-1 to 4.6.2-3. Figures 4.6.2-6 to 4.6.2-8 show soil profiles of channel and basin in Songkhla. Figures 4.6.2-9 and 4.6.2-10 show distribution of grain sizes of bottom materials in Sichon, Sakom, Thepha areas and Pak Nakhon, Pak Phanang, Pattani channels, respectively.

2) Chemical Character

Chemical tests of samples were performed for the following. The results of chemical analysis are summarized in Table 4.6.2-4.

Ig. Loss, COD
Cu, Cd, As, Cr, Pb, Ni, Zn, Fe, Hg, Mn, CN
Ammonia, Sulphide
N, P

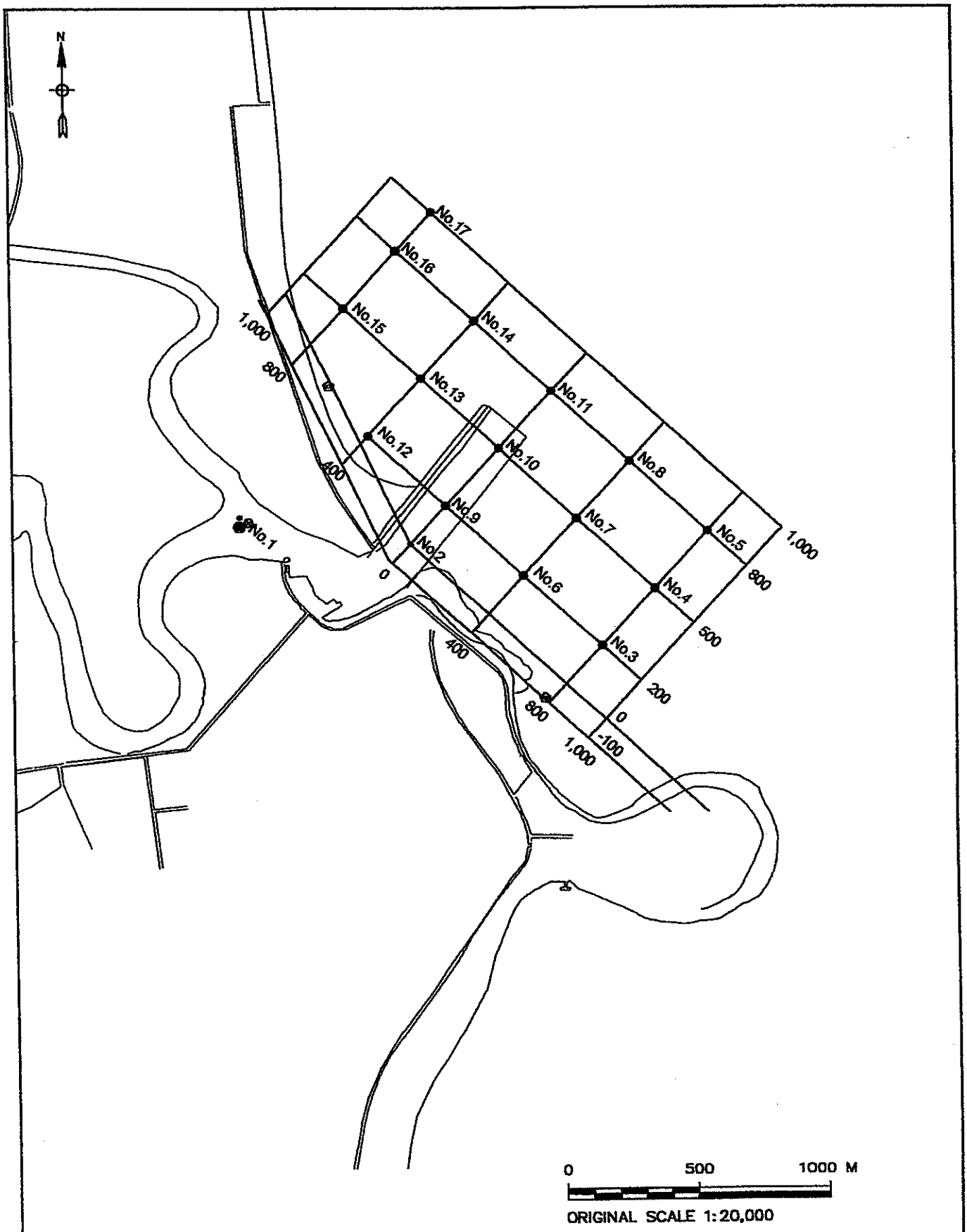


Figure 4.6.2-1 Location Map of Sampling Points of Seabed Materials in Sichon

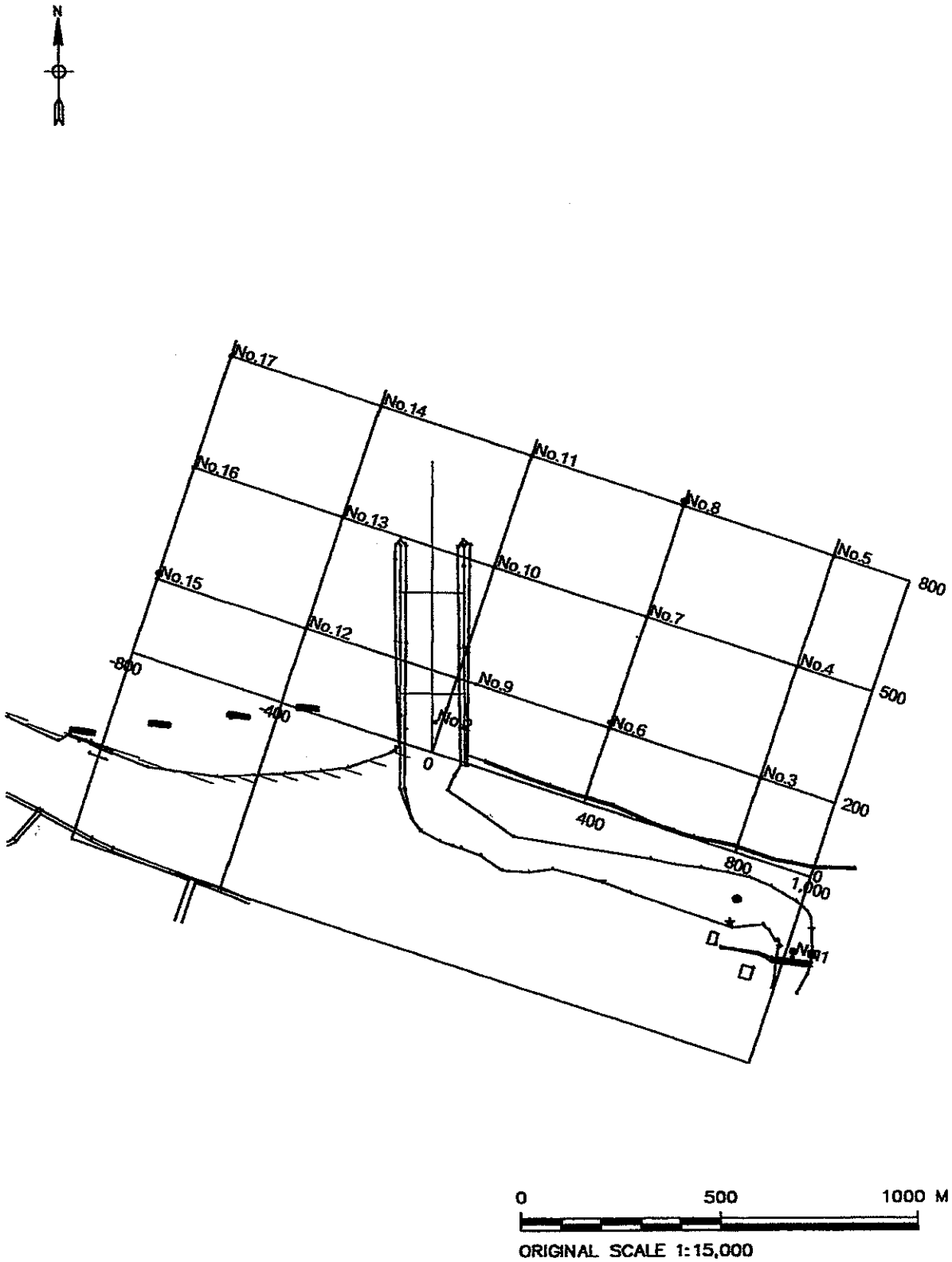


Figure 4.6.2-2 Location Map of Sampling Points of Seabed Materials in Sakom

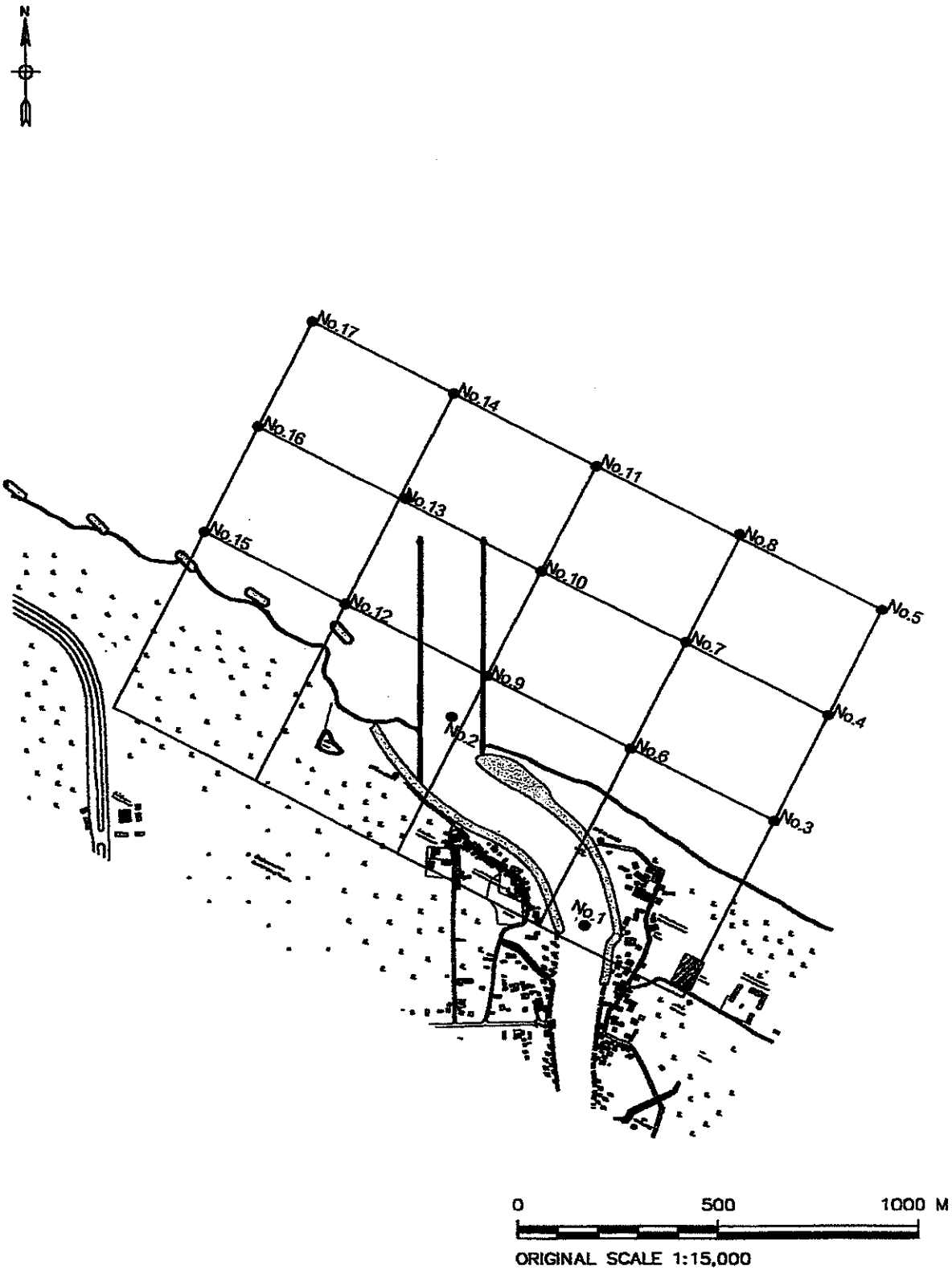
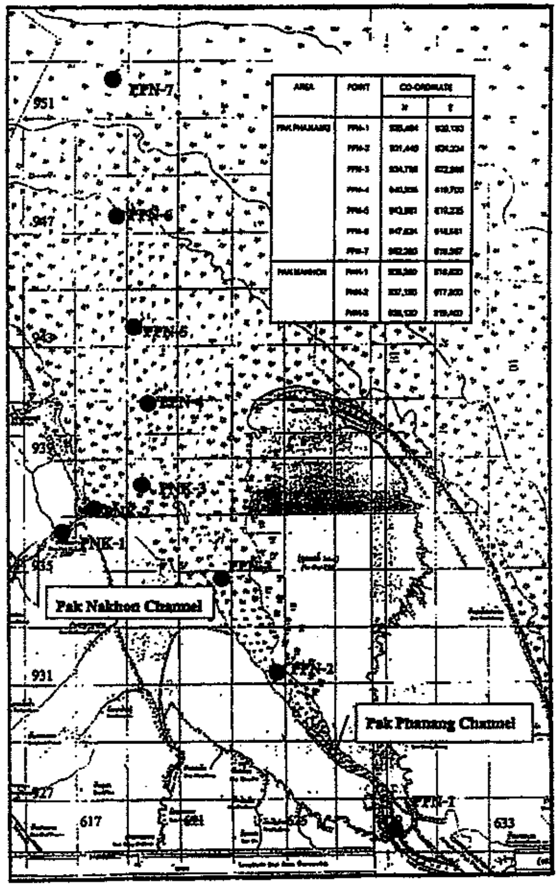


Figure 4.6.2-3 Location Map of Sampling Points of Seabed Materials in Thepha



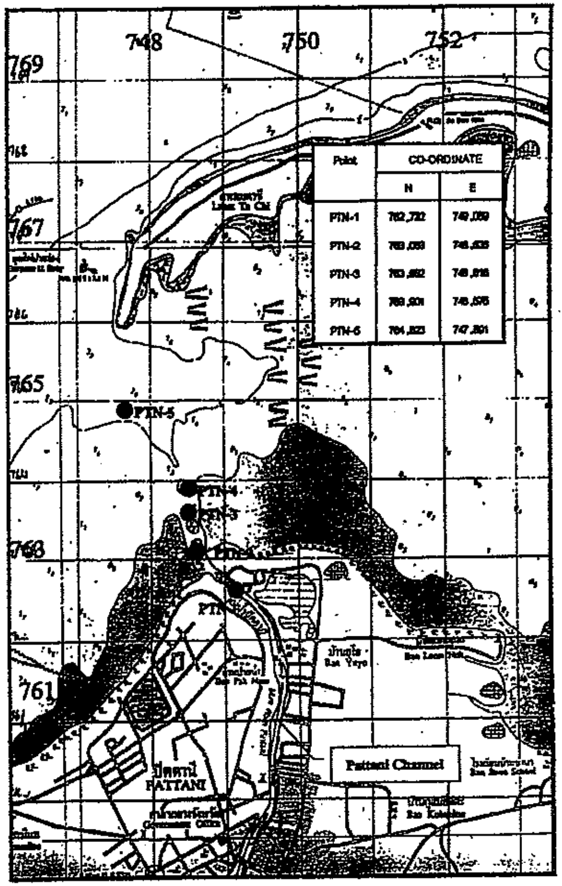
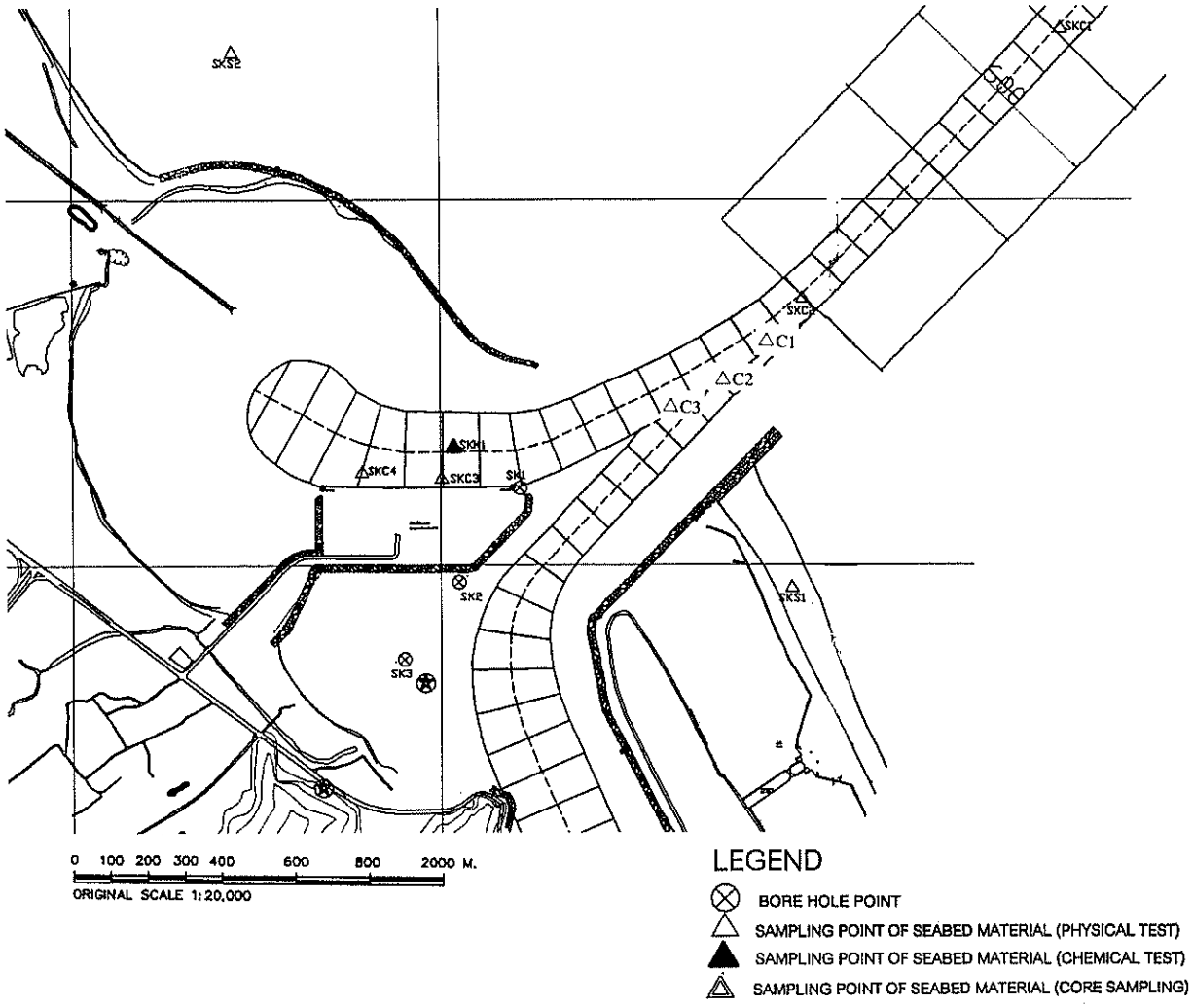


Figure 4.6.2-4 Location Map of Sampling Points of Seabed Materials and Sea Water in Pak Phanang and Pattani Channels

Songkhla



Bang Ra Pha

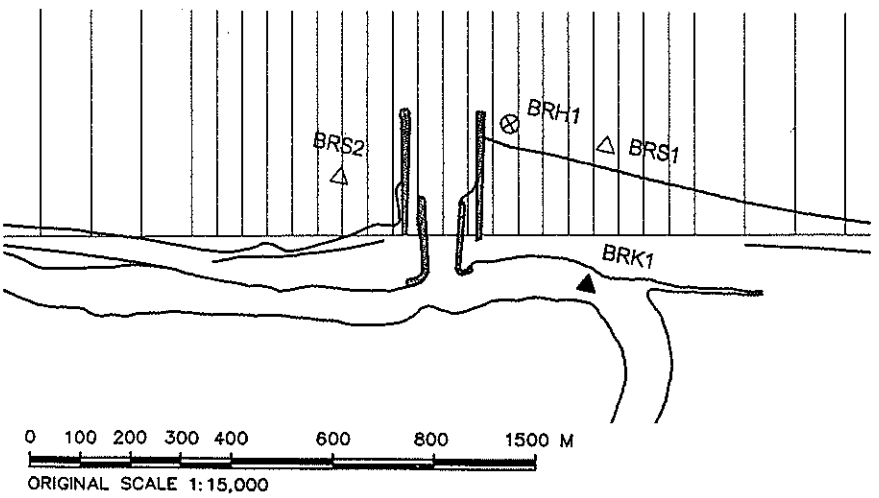


Figure 4.6.2-5 Location Map of Sampling Points of Seabed Materials and Soil Investigation in Songkhla and Bang Ra Pha

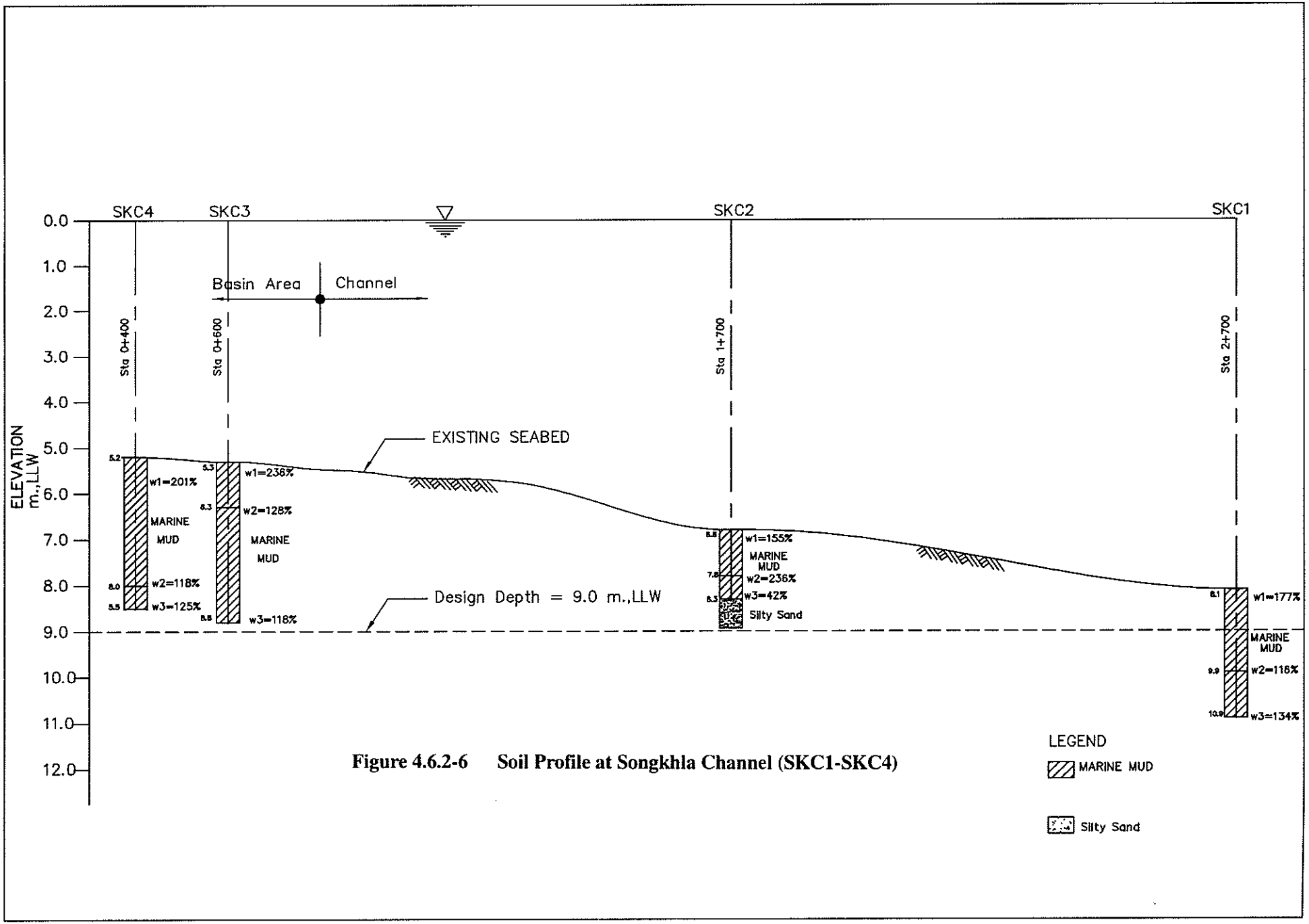


Figure 4.6.2-6 Soil Profile at Songkhla Channel (SKC1-SKC4)

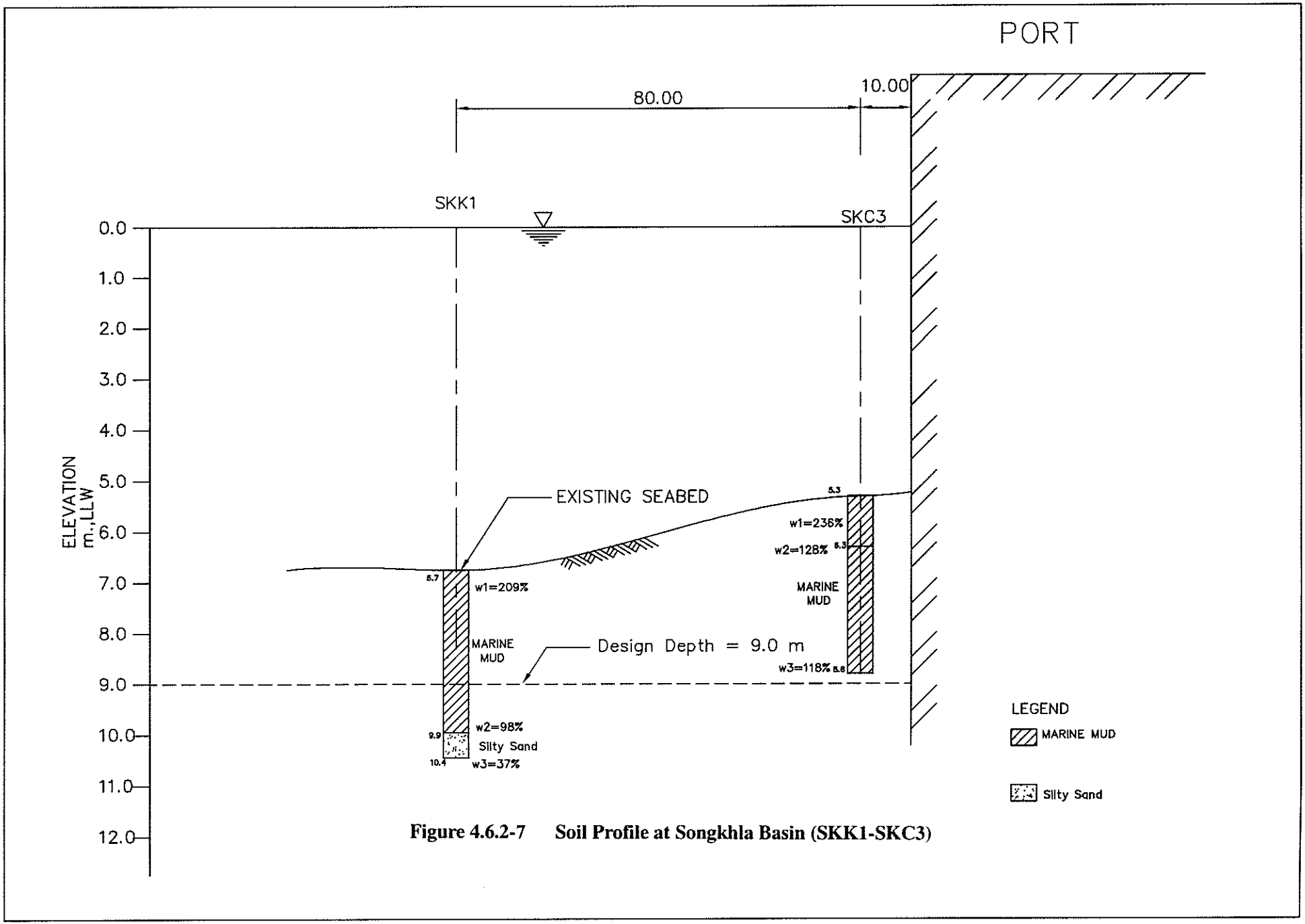


Figure 4.6.2-7 Soil Profile at Songkhla Basin (SKK1-SKC3)

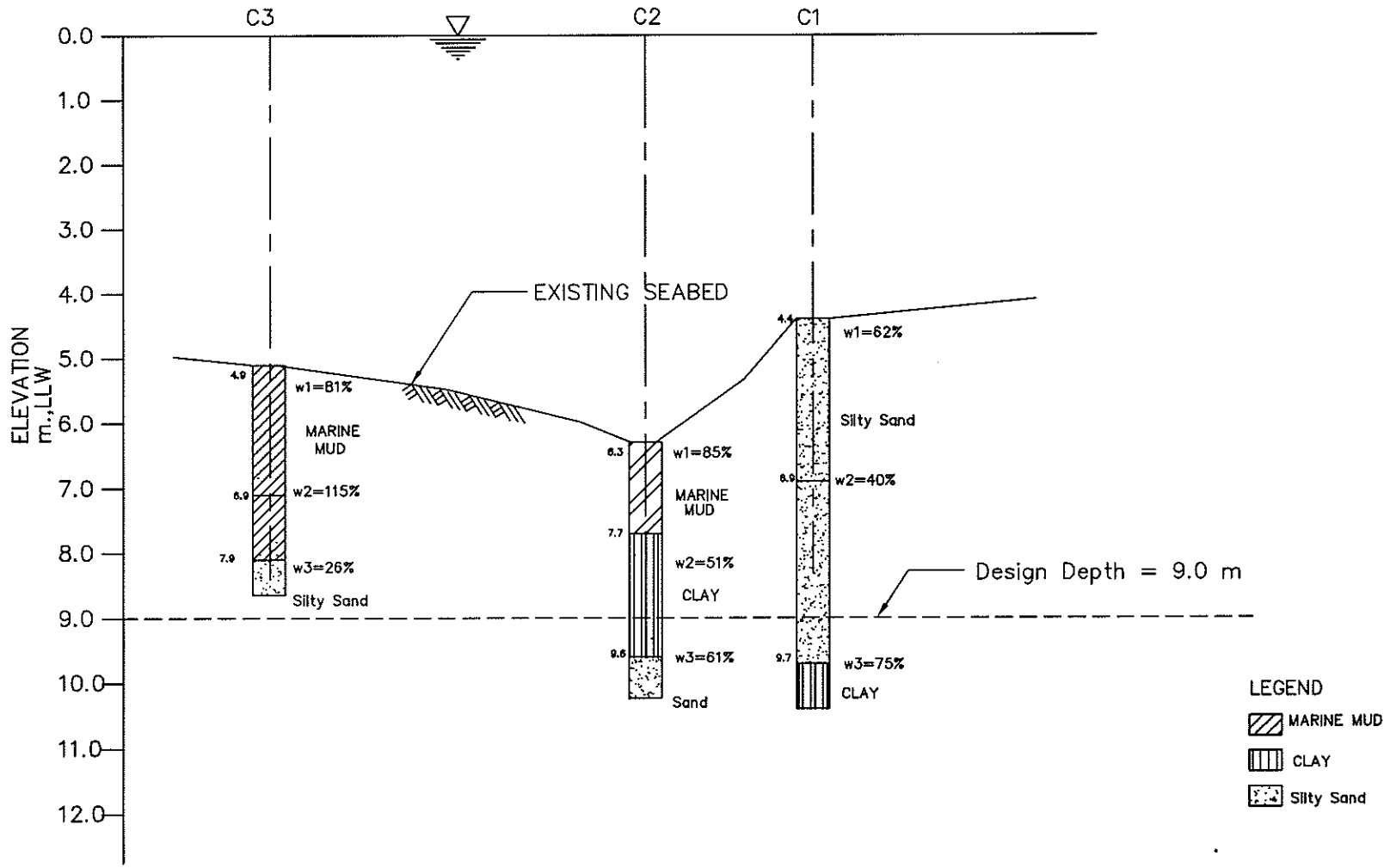


Figure 4.6.2-8 Soil Profile at Songkhla Channel (C1-C3)

Table 4.6.2-1 List of Median Grain Sizes of Bottom Materials in Sichon, Sakom and Thepha

unit : mm

Station No.	Sichon	Sakom	Thepha
No. 1	0.02 (0.500)	0.0023 (0.0060)	0.0020 (0.055)
No. 2	0.950 (1.500)	0.0015 (0.012)	0.0022 (0.018)
No. 3	0.700 (0.600)	0.110 (0.100)	0.100 (0.085)
No. 4	0.010 (0.015)	0.090 (0.095)	0.002 (0.003)
No. 5	0.015 (0.012)	0.060 (0.075)	0.0015 (<0.001)
No. 6	0.350 (0.250)	0.065 (0.090)	0.030 (0.045)
No. 7	0.035 (0.022)	0.060 (0.090)	0.030 (0.007)
No. 8	0.012 (0.027)	0.032 (0.070)	0.028 (0.005)
No. 9	0.300 (1.500)	0.140 (0.080)	0.140 (0.180)
No. 10	0.400 (0.400)	0.090 (0.036)	0.160 (0.150)
No. 11	0.030 (0.160)	0.020 (0.055)	0.020 (0.003)
No. 12	0.200 (0.200)	0.210 (0.065)	0.200 (0.140)
No. 13	0.120 (0.140)	0.100 (0.085)	0.200 (0.100)
No. 14	0.007 (0.006)	0.006 (0.100)	0.180 (0.200)
No. 15	0.120 (0.150)	0.018 (0.025)	0.008 (0.060)
No. 16	0.012 (0.006)	0.012 (0.022)	0.150 (0.100)
No. 17	0.005 (0.004)	0.025 (0.020)	0.003 (0.004)

Note : ( ) means values at the second sampling

Table 4.6.2-2 List of Median Grain Sizes of Bottom Materials in Pak Nakhon, Pak Phanang, Pattani, Songkhla and Bang Ra Pha

unit : mm

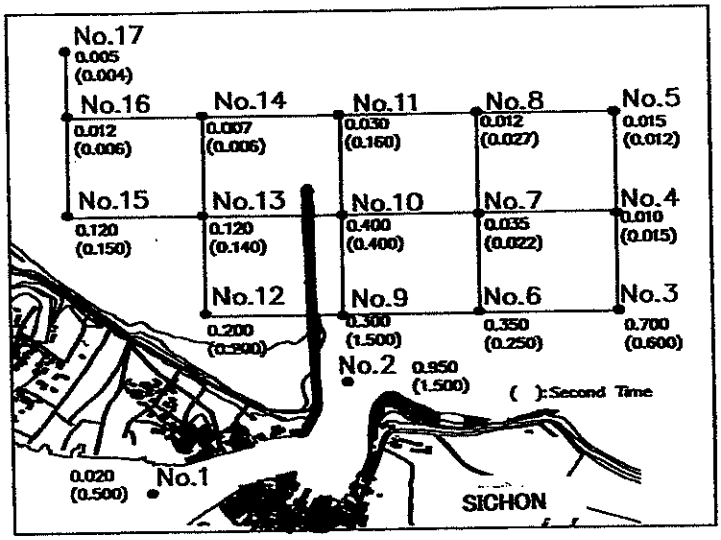
Station No.	Pak Nakhon	Pak Phanang	Pattani
No. 1	0.160	0.003	0.0017
No. 2	0.040	0.025	0.0055
No. 3	0.015	0.010	0.002
No. 4	-	0.015	0.001
No. 5	-	0.100	0.003
No. 6	-	0.012	-
No. 7	-	0.003	-

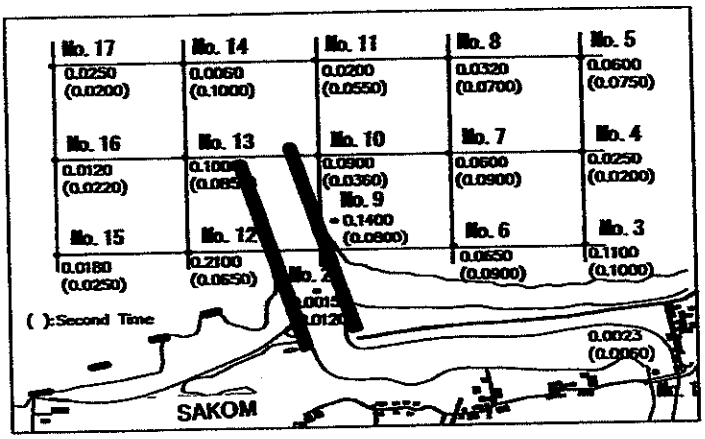
Table 4.6.2-3 Results of Physical Tests of Seabed Materials in Songkhla and Bang Ra Pha

Area	Station No.	Grain Sizes (mm)			Specific Gravity	Water Content
		D16	D50	D84		
Songkhla	SKS1	0.090	0.113	0.260	2.67	1.20 (%)
	SKS2	0.150	0.160	0.210	2.64	30.20
	SKC1	-	-	0.015	2.46	116.90
	SKC2	-	-	0.0026	2.31	100.80
	SKC3	-	0.0015	0.0047	2.49	128.70
	SKC4	-	0.0039	0.0092	2.49	118.60
	SKK1	-	-	-	2.24	98.50
Bang Ra Pha	BRS1	-	0.02	-	2.54	122.30
	BRS2	-	-	-	2.63	36.00
	BRK1	-	0.0019	0.034	2.24	121.30

Note : Values of SKC1 to SSKC4 and SKK1 at Songkhla are values of medium layers from core samples.

unit : mm





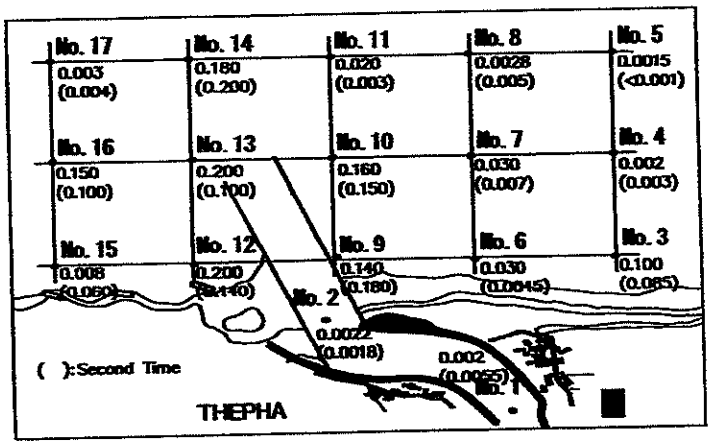


Figure 4.6.2-9 Grain Size Distribution of Seabed Materials in Sichon, Sakom and Thepha (Median Grain Size)

unit : mm

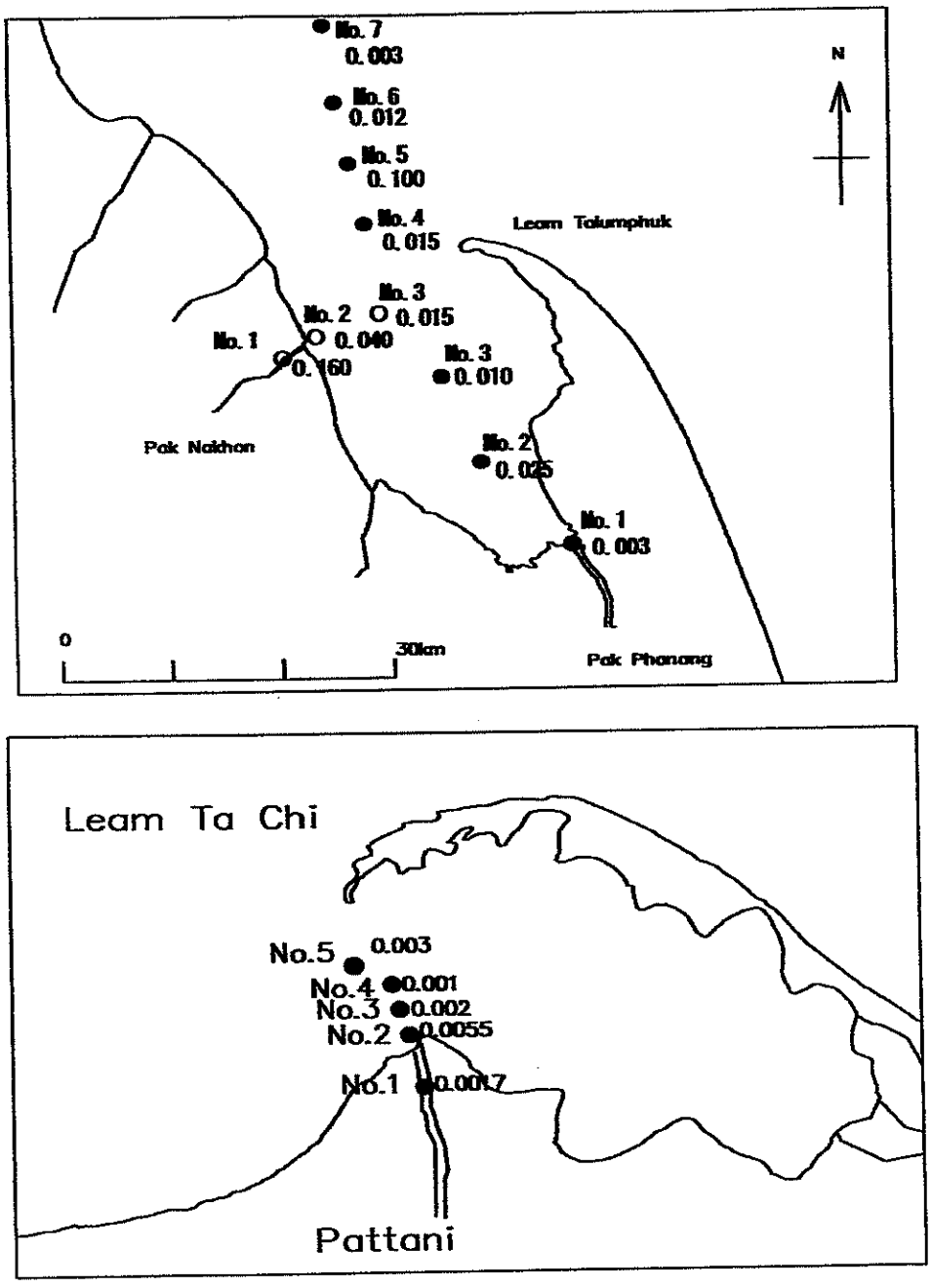


Figure 4.6.2-10 Grain Size Distribution of Seabed Materials in Pak Nakhon, Pak Phanang and Pattani (Median Grain Size)

Table 4.6.2-4 Summary of Chemical Analysis of Seabed Materials

Parameter	Sichon	Sakom	The-pha	Pak Nakhon	Pak Phanang	Pattani	Song-khla	Bang Ra Pha
Ig.Loss (%)	1 - 5	8 - 9	6 - 9	6 - 7	2 - 9	6 - 10	2.76	6.28
COD (10^3mg/kg)	0.4 – 24.0	37.9– 40.2	37.5– 48.5	25.8– 33.2	17.5– 33.8	38.0– 46.7	66.0	85.0
Cu(mg/kg)	1 - 14	21 - 23	15 - 22	1 - 18	4 - 14	21 - 36	2.22	2.90
Cd (mg/kg)	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	ND	ND
As (mg/kg)	0.01 – 2.2	6.3 – 11.8	5.5 – 11.4	2.2 – 3.4	0.2 – 3.2	4.7 – 13.2	ND	0.61
Cr (mg/kg)	< 5.0	13 - 18	15 - 22	17 - 21	6 - 24	14 - 22	4.39	4.81
Pb (mg/kg)	4 - 5	41 - 49	50-210	20 - 150	14 - 38	70 - 112	2.28	4.35
Ni (mg/kg)	4 - 13	30 - 32	24 - 35	24 - 30	12 - 39	28 - 36	1.72	1.83
Zn (mg/kg)	10 - 50	38 - 65	60 - 90	45 - 98	37 - 68	93 - 147	6.45	7.86
Fe (10^3mg/kg)	28.5– 33.8	30.2– 48.2	28.5– 33.8	15.1– 29.1	16.7– 41.8	26.5– 36.9	3.14	3.85
Hg(mg/kg)	1.2 – 2.6	1.8 – 4.5	1.0 – 4.2	2.5 – 4.1	0.2 – 2.3	5.2 – 66.8	ND	ND
Mn(mg/kg)	20 – 70	290 – 520	240 – 590	345 – 695	480 – 620	270 – 560	88.40	58.31
CN (10^{-3}mg/kg)	1 - 5	1 - 5	< 1	< 1	1 - 5	< 1	ND	ND
Ammonia (mg/kg)	< 0.4	0.4 – 0.9	0.4 – 2.4	1.4 – 1.7	0.4 – 4.6	0.4 – 9.5	-	-
Sulphide (mg/kg)	0. 7 – 0.8	0.7 – 4.0	0.7 – 3.1	0.7 – 1.2	0.7 – 1.2	0.7 – 1.3	ND	ND
N (10^3mg/kg)	0.3 – 0.9	1.2 – 1.9	1.3 – 2.0	0.9 – 1.3	1.1 – 1.9	1.5 – 1.8	5.3	3.6
P (mg/kg)	32 – 350	450 – 645	440 – 560	400 – 525	275 – 475	355 – 870	53.0	47.7