Appendix I-4-12 Distribution of Significant Wave Height and Direction (%)

(Wind Wave)

March April

Direction / $H_{1/3}$(m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.00-0.49	3.5	0.0	0.0	0.0	0.0	2.6	2.6	1.9	1.0	3.6	5.5	2.3	2.9	0.3	0.0	0.0	9.9	36.1
0.50-0.99	0.0	0.0	0.0	0.0	0.0	5.5	0.6	7.5	4.5	1.9	6.8	12.0	8.8	0.0	0.0	0.0	0.0	47.7
1.00-1.49	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.6	7.5	6.8	0.0	0.0	0.0	0.0	15.6
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.6
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	3.5	0.0	0.0	0.0	0.0	8.1	3.9	9.4	5.5	5.5	13.3	21.8	18.8	0.3	0.0	0.0	9.9	100.0

May ~ Sep.

Direction / $H_{1/3}$(m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.00-0.49	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	1.5
0.50-0.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	1.5	6.2	3.4	0.6	0.0	0.0	0.0	12.0
1.00-1.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.3	5.1	18.2	11.4	0.5	0.0	0.0	0.0	36.5
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	13.6	13.7	0.8	0.0	0.0	0.0	31.5
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	5.4	6.8	0.6	0.0	0.0	0.0	13.4
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	2.0	0.1	0.0	0.0	0.0	3.9
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.6
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.3
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2
TOTAL	0.0	0.0	0.0	0.0	0.9	0.0	0.0	1.0	0.3	0.4	10.7	45.8	37.9	2.8	0.0	0.0	0.0	99.9

Oct. Nov.

Direction / $H_{1/3}$(m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.00-0.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	1.5	1.3	1.5	0.7	0.2	0.0	0.0	0.0	6.2
0.50-0.99	0.0	0.2	0.0	0.2	0.0	0.0	1.1	0.7	5.3	1.3	7.5	19.8	14.1	7.5	3.3	1.1	0.0	62.1
1.00-1.49	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.2	3.7	12.3	5.3	4.0	1.1	0.0	0.0	27.1
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	2.4	0.0	0.2	0.0	0.0	0.0	3.3
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.1
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.2	0.2	0.4	0.0	0.0	1.1	1.1	5.7	3.3	13.0	37.4	20.0	11.9	4.4	1.1	0.0	100.0

Dec. ～ Feb.

Direction / $H_{1/3}$(m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.00-0.49	0.0	0.2	0.0	0.2	0.2	6.3	6.5	1.9	1.1	0.9	1.3	2.8	1.7	5.6	3.9	0.2	0.0	32.8
0.50-0.99	0.4	0.9	0.4	1.3	1.7	18.4	17.9	1.3	1.1	0.4	0.0	0.2	0.4	1.5	1.1	0.9	0.0	47.9
1.00-1.49	0.0	0.4	0.0	0.0	0.9	9.5	5.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	18.4
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.9
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.4	1.5	0.4	1.5	2.8	34.6	29.8	4.1	2.2	1.3	1.3	3.0	2.2	7.3	6.5	1.1	0.0	100.0

Annual

Direction / $H_{1/3}$ (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.00-0.49	0.6	0.1	0.0	0.1	0.4	2.0	2.0	0.9	0.5	1.1	1.5	1.5	1.0	1.6	1.0	0.1	1.7	15.8
0.50-0.99	0.1	0.2	0.1	0.4	0.4	5.4	4.7	1.7	2.0	0.7	3.0	8.0	5.4	1.9	0.8	0.4	0.0	35.2
1.00-1.49	0.0	0.1	0.0	0.0	0.2	2.3	1.4	0.6	0.0	0.2	2.9	10.9	6.8	0.9	0.5	0.0	0.0	27.0
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.6	6.1	5.8	0.4	0.1	0.0	0.0	14.1
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.5	2.8	0.2	0.0	0.0	0.0	5.8
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.0	0.0	0.0	0.0	1.7
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.2
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4.00-..49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
TOTAL	0.6	0.4	0.1	0.4	1.1	9.9	8.2	3.2	2.5	1.9	9.2	29.8	22.9	5.0	2.3	0.5	1.7	100.0

Appendix I-4-13 Distribution of Significant Wave Height and Period (%)

(Wind Wave)

Annual

$T_{1/3}$ (sec) / $H_{1/3}$ (m)	0.0-0.9	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-11.9	12.0-12.9	13.0-13.9	14.0-14.9	CALM	TOTAL
0.00-0.49	1.0	0.1	0.5	2.2	5.1	4.5	0.4	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	1.7	15.8
0.50-0.99	0.1	0.0	0.0	1.0	9.5	16.5	4.3	1.4	1.7	0.8	0.1	0.0	0.0	0.0	0.0	0.0	35.2
1.00-1.49	0.0	0.0	0.0	0.0	1.3	12.5	10.2	2.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	27.0
1.50-1.99	0.0	0.0	0.0	0.0	0.0	1.6	6.8	3.2	1.5	0.6	0.4	0.1	0.0	0.0	0.0	0.0	14.1
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.7	1.6	0.6	0.5	0.1	0.0	0.0	0.0	0.0	5.8
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.8	0.2	0.2	0.0	0.0	0.0	0.0	0.0	1.7
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TOTAL	1.1	0.1	0.5	3.2	15.8	35.0	23.1	8.9	6.6	2.6	1.1	0.2	0.0	0.0	0.0	1.7	100.0

Appendix I-4-14 Distribution of Significant Wave Height and Direction (%)

(Overall Wave)

Annual

Direction / $H_{1/3}$ (m)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.00-0.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50-0.99	0.0	0.0	0.0	0.0	0.1	0.1	0.8	4.0	9.2	3.6	0.6	0.1	0.0	0.0	0.0	0.0	18.4
1.00-1.49	0.1	0.0	0.0	0.0	0.0	0.3	4.7	6.5	6.3	7.2	3.6	0.7	0.2	0.2	0.0	0.0	29.8
1.50-1.99	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	2.3	10.4	6.8	1.9	0.5	0.2	0.1	0.0	22.4
2.00-2.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.8	7.4	4.7	1.2	0.0	0.0	0.0	20.2
2.50-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.0	2.6	0.5	0.0	0.0	0.0	7.8
3.00-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.2	0.0	0.0	0.0	1.1
3.50-3.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2
4.00-4.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TOTAL	0.1	0.0	0.0	0.0	0.1	0.4	5.7	10.6	18.9	28.8	21.4	10.8	2.7	0.3	0.1	0.0	100.0

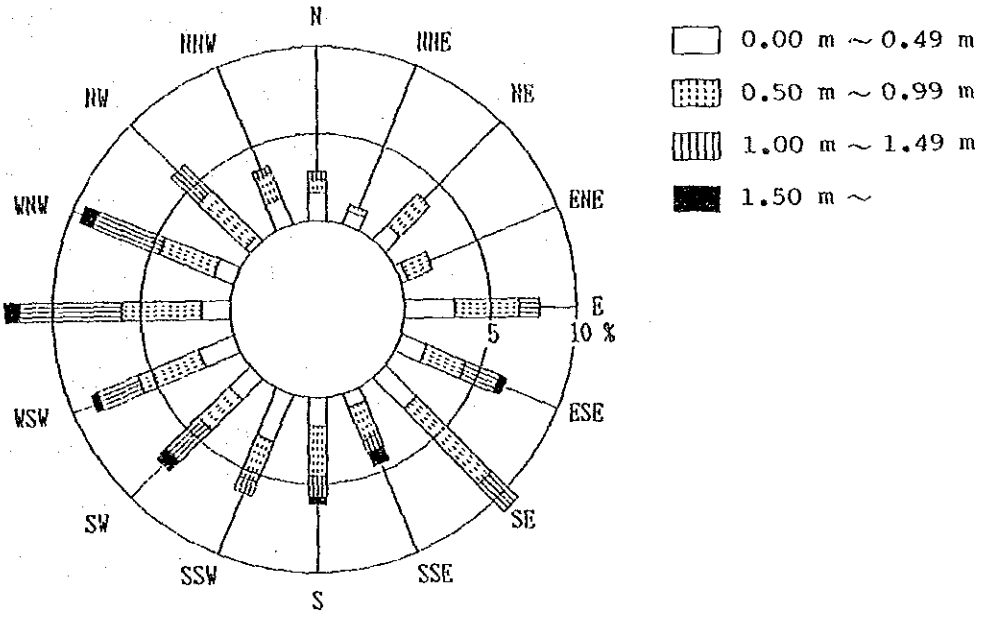
Appendix I-4-15 Distribution of Tidal Current (%)

Period : 12 Jun. 1990 ~ 21 Sep. 1990

V(cm/s) \ Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
0.0- 0.9	1.6	0.8	1.2	0.4	2.9	1.6	2.5	0.8	1.6	2.9	1.6	2.1	1.6	1.2	0.4	1.6	0.0	25.1
5.0- 5.9	0.8	0.4	2.5	1.6	3.7	2.5	6.2	2.1	2.9	2.5	2.5	3.7	4.5	3.3	3.7	1.6	0.0	44.4
10.0-10.9	0.4	0.0	0.0	0.0	1.2	2.1	2.1	0.8	1.2	0.8	2.5	2.5	5.8	4.1	2.1	0.4	0.0	25.9
15.0-15.9	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4	0.4	0.0	0.4	0.4	0.8	0.4	0.0	0.0	0.0	3.3
20.0-20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.0	1.2
25.0-25.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.0-30.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.0-35.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0-40.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.0-45.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50.0-50.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.0-55.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60.0-60.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65.0-65.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2.9	1.2	3.7	2.1	7.8	6.6	10.7	4.5	6.2	6.2	7.4	8.6	12.8	9.5	6.2	3.7	0.0	100.0

Appendix I-4-16 Distribution of Tidal Current

Period : 12 Jun. 1990 ~ 21 Sep. 1990



Appendix I-4-17 Result of Drilling

Borehole No.	Water Depth(m)	Drilling of Sediments(m)	Drilling of Rocks(m)	No. of S.P.T	No. of U.D.S
1	7.1	4.88	4.10	1	1
2	8.0	11.20	0.91	7	2
3	10.1	12.25	-	7	1
4	9.9	14.37	-	6	2
5	12.0	6.08	1.0	5	1
6	14.5	3.40	1.0	2	-
7	15.4	4.85	0.7	2	-
8	14.5	3.45	1.0	2	-
9	15.4	0.63	1.6	-	-
TOTAL	-	61.11m	10.34m	32	7

Appendix I-4-18 Coordinates of Boring Points

Borehole No.	Northing (m)	Easting (m)	Water Depth (m)
1	92,931.2	138,887.5	7.1
2	92,707.6	138,894.0	8.0
3	92,444.1	139,665.8	10.1
4	91,554.8	140,609.5	9.9
5	92,075.3	139,270.6	12.0
6	91,450.7	138,681.5	14.5
7	91,368.3	138,897.3	15.4
8	91,308.4	139,350.3	14.5
9	91,320.7	139,660.5	15.4

Appendix I-4-19(1) Boring Data

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION	JICA STUDY TEAM	BH 1

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF HATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG	
	7.10	7.10								
	8.10				No return of washings due to loose soft sediments	8.10	1			
	9.10	2.00			recovery).					
	9.70	0.60	—		Attempt to collect Undisturbed sample.					
	10.10	0.60			No washings					
	10.60	0.50	U/S	OH	black soft silty Organic clay. (U/S)					
	11.50	0.90	SPT	OH	Black soft silty organic clay. SPT sample.	11.10	0			
	11.98	0.48		SC	coarse to medium Qtz sand with sea shells	B E D		ROCK LEVEL		
	12.98	1.00	core	R	Fractured partially weathered Garnet Biotite Gneiss . CR = 15%	CORE DRILLING				NR
	13.28	0.30	core	R	Fractured do- Highly CR = 17%					
	13.68	0.40	core	R	-do - CR = 50%					
	14.48	0.80	core	R	Fractured ,partially altered Garnet Biotite Gneiss CR = 25%					
	14.68	0.20	core	R	-do- CR = 25%					NR
	16.08	1.40	core	R	Fractured partially altered Hornblende Biotite Gneiss. CR = 11%					
		BORE	HOLE	COMPLETED AT 16.08m BELOW		MSL				
	(Rock	from	13.28m	to	16.08 m is friable and					
		partially	weathered		with Chlorite alteration					

REMARKS: Loss of U/S at 9.10m due to very saturated loose soft material .
U/S collected from 10.10 to 10.60m

SCALE 1:

SHEET OF

NR - No return of water during coring

Appendix I-4-19(2)

PROJECT: GALLE PORT EXPANSION | CLIENT: JICA STUDY TEAM | BORE HOLE No.: BH2

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	N VALUE	NO. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	8.00	8.00							
				OH	Very soft loose sediment (No return of water) (No sample recovery)				
	9.20	1.20	S P T			9.20	4		
				OH	Black soft organic clay with pieces of coral and sea shells				
	10.00	0.80				10.20	0		
			S P T	OH	Dark grey very soft organic clay (pure clay) Highly compressible	11.20	1		
	12.20	2.20							
	12.80	0.60	U/S	OH	same as above				
			S P T	OH	Greenish grey slightly plastic soft organic clay (Highly compressible)	13.20	0		
	14.00	1.20							
			S P T	Pt	Black soft organic clay with Peat	14.20	0		
			S P T			15.20	2		
	15.50	1.50			Black soft Peat				
	16.20	0.70		CH	Bluish grey highly plastic clay				
	16.75	0.55	U/S	CH	same as above with some Kaolin				
			S P T	(WR) SC CL	Highly weathered rock disintegrating to Kaolin Chlorite with coarse to medium sand	17.20	21		
	17.50	0.75							
			S P T	(WR) SC CL	weathered rock disintegrating to brownish white Kaolin and medium to fine sand, with fresh rock gravel	18.20 15 – 10 –	>60 15 17	HB	
	19.20	1.70				BED ROCK LEVEL			
	20.14	0.94		R	Fractured partially weathered rock. No core recovery	CORE DRILLING			
			BORE HOLE COMPLETED AT 20.14m BELOW MSL						

REMARKS: HB – Hammer Rebouncing without penetration.
Bore Hole cased at 19.20m and core drilled with Diamond Bit down to 20.14m

SCALE 1:

SHEET OF

Appendix I-4-19(3)

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION	JICA STUDY TEAM	BH 3

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	10.10	10.10			SEA BED				
	10.90	0.80			No return of washings. very soft loose sediments				
	11.90	1.00	S P T	CH	Yellowish red plastic soft clay, with patches of Kaolin	10.90	1		
	12.30	0.40	U/S		Loss of U/S (Dropped)				
	13.90	1.60	S P T	CL	white fairly soft moderately plastic pure KAOLIN	12.90	1		
	14.15	0.25	U/S		No Penetration beyond25cm				
			S P T	SC CL	Kaolin and medium to very coarse angular Qtz sand.	14.90	12		
			S P T	GW	- do - with angular Qtz gravel	15.90	10		
	16.50	2.35	S P T	(WR) GW	weathered rock disintegrating to Qtz gravel, and coarse Qtz sand, with Kaolin. Traces mica	16.90	15		
	17.50			(WR) GW	Highly weathered rock disintegrating to Qtz gravel and Kaolin with coarse sand.	17.90	7		
	18.90	2.40							
	19.20	0.30	U/S		Loss of U/S (Dropped)				
			SPT	(WR) SC CL	Highly weathered rock disintegrating to brown soft clay and Kaolin with coarse Qtz sand.	19.90	2		
	21.00	1.80							
			SPT	(WR) CL	Highly weathered rock disintegrating to Kaolin and yellowish brown slightly plastic clay. Traces of mica	21.90	8		
	22.35	1.35							
			BORE HOLE COMPLETED AT 22.35m BELOW MSL						

REMARKS Loss of U/S at 11.90m due to saturated loose soft material.
At 14.15m the U/S tube cannot penetrate beyond 25cm

SCALE 1:

SHEET OF

Appendix I-4-19(4)

PROJECT: GALLE PORT EXPANSION

CLIENT: JICA STUDY TEAM

BORE HOLE No.: BH 4

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	N VALUE	No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	9.90	9.90			SEA BED				
	12.10	2.20			No return of washings. very loose soft sediments.	12.10	1		
	14.10	2.00	SPT	CH	Greyish brown soft plastic clay (pure clay). very little fine silty sand.	13.10	1		
	14.70	0.60	U/S	CH	same as above				
			SPT	CH	greenish grey soft plastic clay (pure clay)	15.10	1		
			SPT		with very little silt.	16.10	0		
			SPT			17.10	1		
	17.50								
	18.10	3.40		CH	same as above				
	18.90	0.80	U/S	CH	same as above				
			SPT		Greenish brown soft fairly plastic clay	19.10	1		
	19.90	1.00		CH	(pure clay)				
			SPT		Black fibrous soft Peat	20.10	1		
	21.50	1.60		Pt					
	22.40	0.90		SC	Medium to fine Qtz sand with grey slightly plastic clay	22.10	9		
				(WR)	weathered rock dis-integrating to medium to fine sand with clay.				
				SC	Some fine Mica				
	24.27	1.87				24.10	>60 (15-4) (2-10)	HB	
			BORE	HOLE	COMPLETED AT 24.27m BELOW MSL				

REMARKS: HB - Hammer Rebouncing without Penetration
Possible Hard Basement Rock or Hard weathered rock at 24.27m

SCALE 1:

SHEET OF

Appendix I-4-19(5)

PROJECT	CLIENT	BORE HOLE No.
COLOMBO PORT EXPANSION	JICA STUDY TEAM	BH 5

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 10 20 30 40 50 60)	SYMBOLIC LOG
	12.00	12.00			SEA BED				
	13.00	1.00			No return of washings. very loose soft sediments.	13.00	1		
	14.00	1.00	S P T	Pt	Black soft highly compressible Peat.				
	14.60	0.60	U/S	Pt	Black soft Peat.				
			S P T	Pt	Black soft highly compressible Peat mixed with soft Organic clay. (very soft stratum)	15.00	0		
			S P T			16.00	0		
			S P T			17.00			
	17.60	3.00							
	17.60 – 18.08		SPT	SC	Medium to coarse sand with Kaolin /mica	18.00 (08-8)	>60	HB	
	19.08	1.00		R	Fresh medium grained CHANOCKITE. Dense-rock. CR = 75%			CORE DRILLING	
		BORE HOLE COMPLETED AT 19.08m BELOW MSL							

REMARKS HB- Hammer Rebouncing without penetration.
Bore hole cased at 18.08m and core drilled with Diamond Bit down to 19.08m

SCALE 1:

SHEET OF

Appendix I-4-19(6)

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION PROJECT	JICA STUDY TEAM	BH 6

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	14.50				SEA BED				
	15.30	0.80			No return of washings. very loose soft sediments.	15.30 (15-19)	>60	HB	
	17.50		SPT	SC CL	Kaolin with medium to coarse grained Qtz sand. (Possibly very highly weathered rock)	16.30 17.30	2 34		
	17.90			CL	- do -	BED ROCK LEVEL			
	19.10	1.20		R	Fractured partially weathered rock. No core recovery. CR = 0%	CORE DRILLING			
	20.10	1.00		R	Highly fractured fresh CHARNOCKITE with zones of weathering CR=30%				
			BORE HOLE		COMPLETED AT 20.10m BELOW MSL				

REMARKS Bore Hole cased at 17.90m and core drilled with double tube core barrel with Diamond bit down to 20.10m

SCALE 1:

SHEET OF

Appendix I-4-19(7)

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION	JICA STUDY TEAM	BH 7

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	15.40	15.40			SEA BED				
	16.25	0.85			No return of washings very loose saturated sediments	16.25	18		
	17.50		S PT	SC	Fine sand with brown clay. Densely compacted with gravel below 17.25m	17.25	39		
			S PT	SC	Densely compacted fine sands, with gravel	18.25	>60	HB	
						15-10			
						10-12			
						19.25	>60	HB	
						10-10			
	20.25							BED ROCK LEVEL	
	20.55	0.30		R	DIOPSIDE GNEISS CR=67%				
	20.95	0.40		R	DIOPSIDE GNEISS CR=25%			CORE DRILLING	
			BORE HOLE COMPLETED AT 20.95m BELOW MSL						

REMARKS HB – Hammer Rebouncing without Penetration.
Bore Hole cased at 20.25m and core drilled with Diamond bit down to 20.95m. Rock core chloritized.

SCALE 1:

SHEET OF

Appendix I-4-19(8)

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION	JICA STUDY TEAM	BH 8

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	N VALUE	No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
	14.50	14.50			SEA BED				
	15.40	0.90			No Return of washing very loose soft sediments	15.40	3		
	17.45	2.05	SPT	(WR) GW	Partially weathered rock with cobbles and gravel of fresh rock. Some Qtz sand/clay	16.40	19		
			SPT	WR	No return of washings	17.40 (5-10)	>60	HB	
	17.95	0.50		WR	Partially weathered rock				
	18.95	1.00		R	coarse grained fresh Garnet Diopside GRANULITE CR = 55%				
					BORE HOLE COMPLETED AT 18.95m BELOW MSL				

BED ROCK LEVEL

CORE DRILLING

REMARKS: Bore hole cased at 17.95m and core drilled with Diamond Bit down to 18.95m

SCALE 1:

SHEET OF

Appendix I-4-19(9)

PROJECT	CLIENT	BORE HOLE No.
GALLE PORT EXPANSION	JICA STUDY TEAM	BH 9

ELEVATION	DEPTH m	THICKNESS m	SOIL SAMPLES	SOIL SYMBOL	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST: DEPTH OF TEST	STANDARD PENETRATION TEST: N VALUE	STANDARD PENETRATION TEST: No. OF BLOWS PER 30cm (0 20 40 60)	SYMBOLIC LOG
					SEA WATER				
	15.40	15.40			SEA BED				
	16.03	0.63			No return of washings. soft saturated sediments				
	16.83	0.80		R	Fresh fine grained BASIC CHANOCKITE CR = 57%		BED ROCK LEVEL	CORE DRILLING	
	17.63	0.80		R	Fresh fine grained CHARNOCKITE GNEISS CR = 90%				

REMARKS BORE HOLE COMPLETED AT 17.63m BELOW MSL

Bore Hole cased at 16.03m and core drilled with Diamond Bit down to 17.63m

SCALE 1:

SHEET OF

Appendix I-4-20(1) Laboratory Test Results

SOLL PROPERTIES

Bore Hole NO.	Depth	Natural Moisture Content(%)	Bulk Density (kg/m^3)	Specific Gravity	Atterberg Limits LL	PL
BH 1	10.10-10.60	62.9	1450	Not Possible	45.0	22.2
BH 2	12.2 -12.8	79.8	1448	Insufficient sample	40.8	29.9
BH 2	16.20-16.75	28.8	1856	2.68	Not possible	
BH 3	13.90-14.15	46.9	1675	2.68	Not possible	
BH 4	18.10-18.90	104	1396	2.64	43.6	18.0
BH 4	14.10-14.70	105	1474	Not done	Not done	
BH 5	14.0 -14.6	121	1373	2.50	Not done (Peat)	

UNCONFINED COMPRESSION TEST RESULTS : -

Sample No.	Strain at Failure (%)	Undrained Cohesion(Cu) (kN/m^2)
1. BH 2 16.20 - 16.75	5.97	54.8
2. BH 3 13.90 - 14.15	7.47	36.7
3. BH 4 18.10 - 18.90	7.47	26.0
4. BH 4 14.10 - 14.70	11.95	24.3
5. BH 5 14.0 - 14.6	5.9	28.2

Appendix I-4-20(2) Laboratory Test Results

TRIAXIAL TEST RESULTS

Sample Ref : BH2 depth 12.20 to 12.80 m.

Sample Type : Undisturbed

Soil Type : Gray Silty Clay with marine deposits

Specimen size : 38 mm diameter; 85 mm long.

Moisture content(%)	70.9	75.0	77.9
Bulk density (kg/m^3)	1,521.8	1,489.1	1,556.1
Cell Pressure (kpa)	50	100	150
Deviator stress at failure (Kpa)	60.5	68.9	76.5
Axial stress at failure (kpa)	110.5	168.9	226.5
Strain at failure (%)	9.1	7.5	7.5

Shear strength Parameters :

Cohesion = 24 kpa.

Angle of friction = 4 deg.

Appendix I-4-20(3) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH1 depth 10.10 - 10.60

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 1,450.9 kg/m^3

Moisture Content : 64.1%

Specific Gravity : 2.50 (assumed)

After Test : -

Moisture content : 57.0%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	2.4500
25	1.570	21.6825	3.140×10^{-3}	2.1792
50	0.266	23.1749	0.577×10^{-3}	2.1332
100	1.106	7.3056	1.296×10^{-3}	1.9425
200	2.670	2.4768	1.565×10^{-3}	1.4819
0	(-0.582)	-	-	1.5832

Appendix I-4-20(4) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH2 12.2 - 12.8 m

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 144.7 kg/m^3

Moisture Content : 83%

Specific Gravity : 2.65 (assumed)

After Test : -

Moisture content : 73.9%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	2.5314
25	0.745	2.826×10^{-5}	1.491×10^{-3}	2.3998
50	0.515	2.988×10^{-5}	1.069×10^{-3}	2.3089
100	0.969	1.459×10^{-5}	1.034×10^{-3}	2.1378
200	1.665	0.776×10^{-5}	0.934×10^{-3}	1.8438
0	(-0.675)	-	-	1.9630

Appendix I-4-20(5) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH2 16.20 - 16.75 m

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 1,808.2 kg/m^3

Moisture Content : 33.9%

Specific Gravity : 2.68

After Test : -

Moisture content : 33.2%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	0.9844
50	0.870	3.606×10^{-5}	8.70×10^{-4}	0.8981
100	0.228	3.9112×10^{-5}	2.383×10^{-4}	0.8755
200	0.402	2.288×10^{-5}	2.126×10^{-4}	0.8356
400	0.556	1.949×10^{-5}	3.005×10^{-4}	0.7804
0	(-0.589)	-	-	0.8388

Appendix I-4-20(6) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH4 14.10 - 14.70 m

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 1,502.9 kg/m^3

Moisture Content : 87.9%

Specific Gravity : 2.63 (assumed)

After Test : -

Moisture content : 68.7%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	2.2883
25	0.874	2.218×10^{-3}	1.748×10^{-3}	2.1446
50	0.435	1.895×10^{-3}	0.909×10^{-3}	2.0731
100	1.705	1.686×10^{-3}	1.824×10^{-3}	1.7927
200	1.623	1.386×10^{-3}	1.056×10^{-3}	1.5259
0	(0.483)	-	-	1.6053

Appendix I-4-20(7) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH4 18.10 - 18.90

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 1,409.2 kg/m^3

Moisture Content : 97.9%

Specific Gravity : 2.64

After Test : -

Moisture content : 79.6%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	2.970
25	0.881	2.2467×10^{-5}	1.762×10^{-3}	2.7951
50	0.551	5.8082×10^{-6}	1.152×10^{-3}	2.6857
100	1.025	5.9784×10^{-6}	1.104×10^{-3}	2.4822
200	2.027	3.1327×10^{-6}	1.155×10^{-3}	2.0092
0	(-0.655)	-	-	2.2099

Appendix I-4-20(8) Laboratory Test Results

CONSOLIDATION TEST RESULTS : -

Sample Reference : BH5 14.0 - 14.6

Sample Type : Undistrubed

Soil Type :

INITIAL CONDITION :

Specimen diameter : 50 mm

Specimen Thickness : 20 mm

Bulk Density : 1,344 kg/m^3

Moisture Content : 121.8%

Specific Gravity : 2.50

After Test : -

Moisture content : 98.3%

Pressure (kN/m^2)	Settlement (mm)	Cv (m^2/min)	Mv (m^2/kN)	Void Ratio:e
0	-	-	-	3.3583
25	1.113	7.359×10^{-4}	2.226×10^{-3}	3.1158
50	0.781	2.901×10^{-4}	1.654×10^{-3}	2.9456
100	1.317	2.386×10^{-4}	1.454×10^{-3}	2.6586
200	1.931	1.755×10^{-4}	1.154×10^{-3}	2.2378
0	(-1.106)	-	-	2.4788

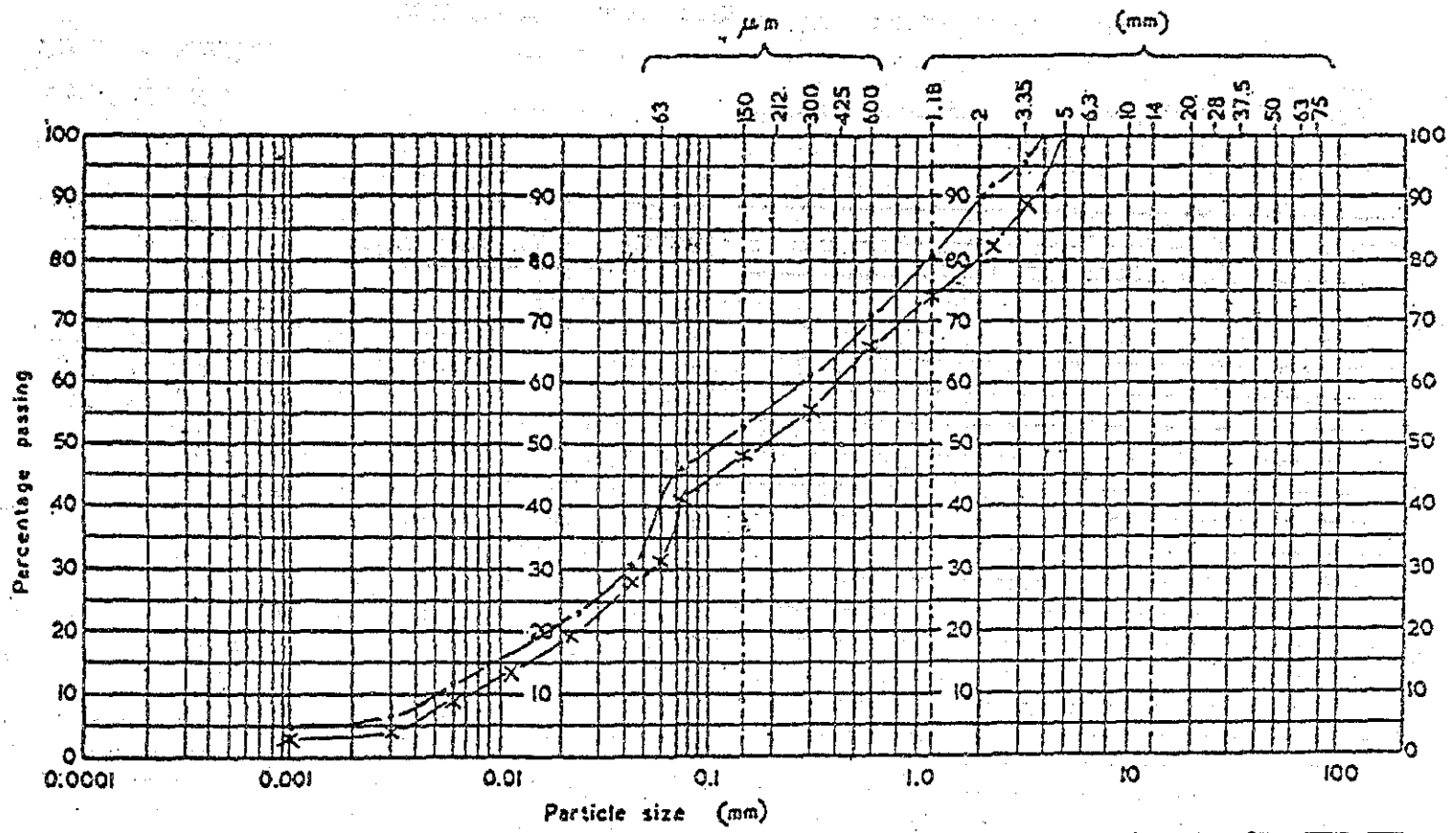
Appendix I-4-20(9) Laboratory Test Results

PARTICLE SIZE DISTRIBUTION

SIEVE ANALYSIS

Sample Ref.	BH 3 13.90-14.15m	BH 2 16.20-16.75m	BH 4 18.10-18.90m	BH 5 14.0-14.6m
Size (mm)		% FINER		
5.0	100	100		
3.35	88.07	95.51		
2.36	82.82	92.01		
1.18	74.7	81.47		
0.600	65.92	71.51		
0.300	55.34	61.83		
0.150	47.71	53.19		
0.075	41.65	46.35	100	100
HYDROMETER ANALYSIS				
.061	31	-	60	45.5
.045	-	30	52.5	37.8
.022	19	23	45	27.7
.012	13	-	35	22.7
.009	-	15	-	-
.006	9	12	27.5	17.6
.003	4	6.6	25	12.6
.001	3	5	15	10.1

Appendix I-4-20(10) Laboratory Test Results



Bore hole No. • —— • —— • —— • —— • BH 2 16.20 – 16.75

Depth of Sample: × —— × —— × —— × —— × BH 3 13.90 – 14.15

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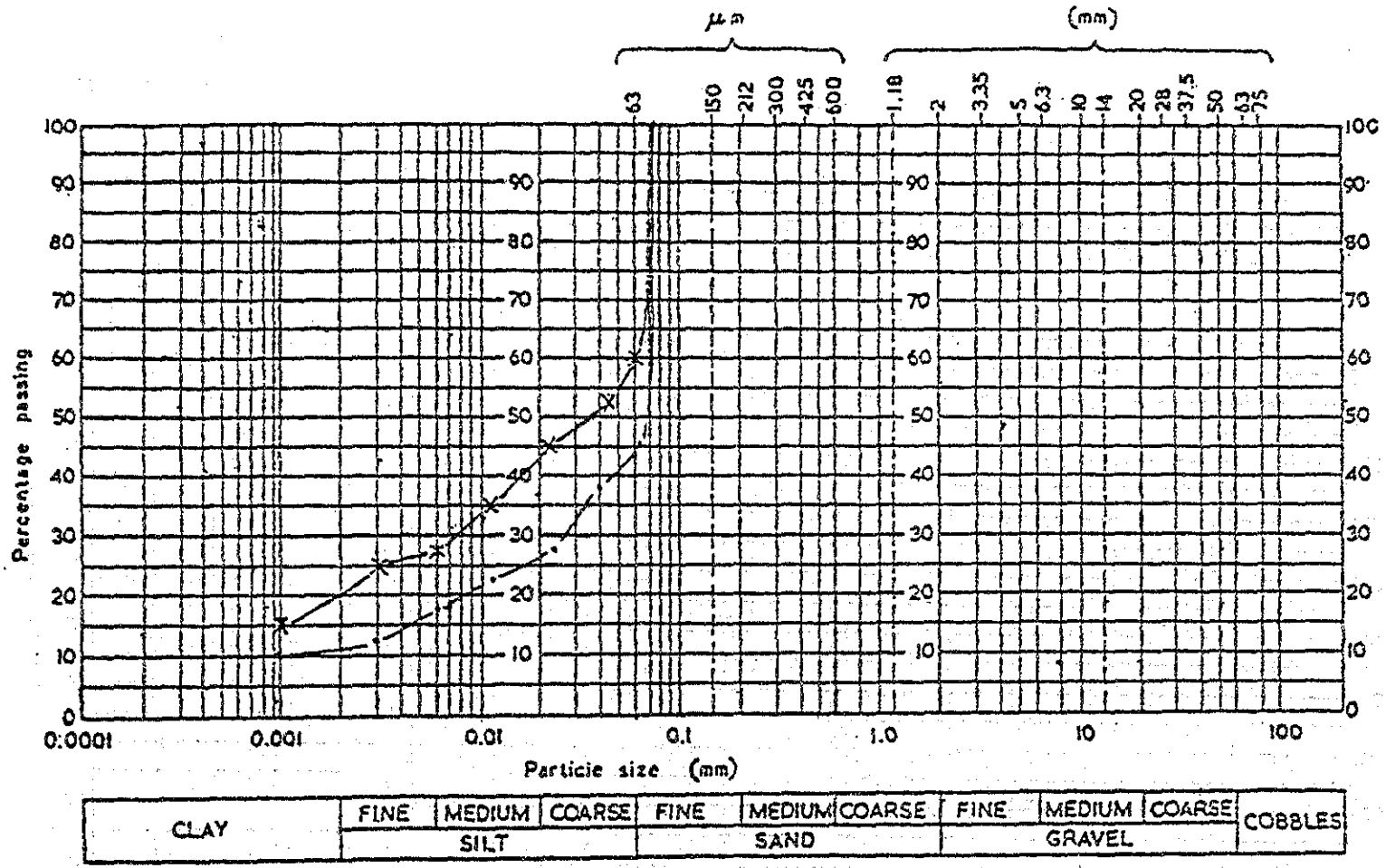


Bore hole No. — BH 4 18.10 - 18.90

Depth of Sample: — BH 5 14.0 - 14.6

Soil Testing Laboratory - University of Moratuwa

Appendix I-5-1 Container Service at JCT in Colombo Port

MAIN LINE SERVICE

LINE	SERVICE ROUTES	FREQUENCY	VESSELS DEPLOYED		FEEDER
			TYPE	TEUS	
A.P.L.	Kaohsiung-Singapore-Colombo-Fujairah-Colombo-Singapore-Kaohsiung	Weekly	Cellular & Gearless	2,800	Own Feeder Eagle Contr carrier
Yang Ming	Kaohsiung-Keelung-Yokohama-Kobe-Busan-Keelung-Kaohsiung-Hongkong-Singapore-Colombo-Jeddah-Genoa-Hamburg-Rotterdam-Felixstone-Antwerp-Le Havre-Genoa-Jeddah-Colombo-Singapore-Hongkong-Kcahsiung	Weekly	Cellular & Geraless	3,000 - 1,940	Seacon, India Steamship Sindbad, CSL P.N.C
	EUROPE				
C.S.C.	Karachi-Bombay-Colombo-Karachi-Suez-Port Said-Alexandria-Hamburg-Felixstowe-Rotterdam-Alexandria-Port Said-Suez-Karachi	Bi-Weekly	Cellular/Non Cellular Geared	1,328 - 1,074	Own Feeder
	FAR EAST				
	Colombo-Singapore-Yokohama-Nagoya-Kobe-Busan-Keelung-Hongkong-Singapore-Colombo	Two Sailings	Celluar &	537	Own Feeder
	RED SEA				
	Colombo-Khor Fakkan-Hodeidah-Jeddah-Aquaba-Khor Fakkan-Colombo	Three Saillings Monthly	Cellular & Geared/ Gearless	416 - 412	Own Feeder
	U.S.A. (C.S.C./MAERSK)				
	Colombo-Singapore-Los Angeles-Miami-Charleston-Baltimore-Philadelphia-New York	Weekly	Cellular/Non-Cellular Geared/Gearless	537 - 175	
	AUSTRALIA(C.S.C./P.N.L)				
	Colombo-Singapore-Brisbane-Sydney-Melbourne Colombo-Singapore-Fremantle-Adelaida	Every 10 days	-"-	-"-	
	SINGAPORE				
	Colombo-Singapore-Colombo	Week Shuttle	-"-	-"-	
EACON (DSR-POL)	Gdansk-Rostock-Hamburg-Antwerp-Lanarca-Khor Fakkan-Colombo-Singapore-Hongkong-Busan-Tokyo-Kobe-Hongkong-Singapore-Colombo-Kanarca-Antwerp-Hamburg-Rostock/Gdynia	Every 13 days For Europe & Every 24 days For Far East	Cellular & Gearless	1,633 - 918	Seacon
ODESSA OCEAN	Ilyichvsk-Genoa-Jeddah-Singapore-Hongkong-Singapore-Panang-Madras-Colombo-Naples-Genoa-Ilyichevsk	Every 18 days	Cellular & Gearless	800	Own Feeder (Haldia/Colombo) C.S.L.
U.A.S.C.	Busan-Keelung-Hongkong-Singapore-Colombo-Aquaba-Jeddah	Bi-weekly	Cellular & Gearless	2,000 - 800	-Nil-
S.S.L. (G.S.L.)	Nagoya-Yokohama-Kobe-Keelung-Hongkong-Singapore-Colombo-Eilat	Monthly	Cellular & Gearless	1,300 - 936	Seacon
Lloyd Triestion	Barcelona-Marseilles-La Spezia-naples-Mina Qaboos-Karachi-Bombay-Colombo	Every 3 weeks	Partly Cellular & Geared	585	Seacon & C.S.L.
	EAST BOUND ROUND-THE-WORLD FA/SOUTH AMERICA				
NedLloyd	Singapore-Hongkong-Keelung-Busan-Kobe-Nagoya-Yokohama-Cristobal-Willenstad-San Juan-Rio Hama/St. Lacia-Bridgetown-P.O. Spain-Fortaleza-Salvador-Rio de Janerio-Montevideo-Buenos Aires-Durban-Colombo-Singapore	Monthly	Geared Multi-Purpose Type	628	Sindba Seacon

MAIN LINE SERVICE

LINE	SERVICE ROUTES	FREQUENCY	VESSELS DEPLOYED		FEEDER
			TYPE	TEUS	
Ever Green	E/B Colombo-Port Klang-Singapore-Hongkong-Kaoshing-Keelung-Busan-Akata-Osaka-Nagoya-Simizu-Tokyo-Los Angles-Charistobal-Baltimare-New York-Lehaive-Antwerp-Roterdom-Felerbliur-Hambung-Colombo	Every 6 days	Cellular Gearless	3,607 2,884	Ever Green, Sea Consortium, B.L.T.
	W/B Colombo-Hamburg-Felexstow-Rotterdam-Antwerp-Lfwarve-New York-Norforlk-Charlston-Kingston-Los Angles-Tokyo-Nagoya-Osaka-Busan-Keelang-Kaohsing-Hongkong-Singapore-Clombo	Every 6 days	Cellular Gearless	3,607 2,884	Ever Green, Sea Consortium, B.L.T.
C.M.A	E/B LeHauvs-Rotterdam-hamburg-Felixsluir-Antwerp-Marseillus-Naples-Karchi-Bombay-Colombo	Every 8 days	Cellular Gearless	1,600 1,800	C.M.A.
	W/B Colombo-Manseilles-Barulina-Lehauve-Rotterdam-Hamburg-Felixsliur-Antwerp	-"-	-"-		
Maersk	Bharhair-Damman-Dubai-Colombo-Singapore-Hongkong-Yokohama-Nayoya-Aqata-Busan	2 Sails/month	Cellular Gearless	1,350 1,100	Maersk
C.G.M	Genvo-mareseilles-Algisera-Lapolis-Antwerp-Bunkerk-Leharve-Savana-Cristobal-Mururoa-Papaid-Naumea	Every 21 days	RoRo/LoLo	1,500	

FEEDER SERVICE

LINE	SERVICE ROUTES	FREQUENCY	VESSELS DEPLOYED		FEEDER
			TYPE	TEUS	
Sea Consortium	A XCL Colombo-Bombay-Cochin-Colombo	Every 14 days	Celluar & Geared	358	D.S.R. P.O.L. Y.M.L. L-T
	A XCL Colombo-Bombay-Karachchi-Dubai-Khor-Fakkan-Bombay-Cochin-Colombo	Every 14 days	-do-	584/388	Cobra P & OCL Sea land GSL E.M.C B.S.L.
	A XCL Colombo-Karachi-Colombo	Every 12 days	-do-	458	M.O.L. Nedloyd
	B XCL Colombo-Madras-Colombo	Weekly	-do-	325	
	B XCL Colombo-Chittagong-Mongla-Calcutta-Colombo	Every 9 days	-do-	375/359	
C.S.C.	CO Lombo-Tuticorn-Cochin-Mangalora-Colombo	Weekly	-do-	181	C.S.C Cobra Y.M.L.
	Khor Fakkan-Dubai-Damman-Kuwait Khor Fakkan-Muscat-Khor Fkkan-(Red Sea Service)-Colombo	Weekly	Non-Cellur & Gearless	175	
Sea Consortium/ C.S.L.	Colombo-Chittagong-Calcutte-Colombo	Every 10 days	Cellur & Geared	508	Cobra, Y.M.L. L-T Hoegh, Ever Green
	Coromondel Service Colombo-Madras-Colombo	Weekly	-do-	245	
A.P.L.	Colombo-Bombay-Cochin-Colombo Colombo-Madras-Colombo	Weekly Weekly	-do- -do-	245 250	A.P.L.
Sea land	Dubai-Colombo-Cochin (Mina Qaboos)	Every 14 days	-do-	550	Sea Land
M.O.L.	Singapore-Colombo-Karachi	Every 10 days	Non Cellular Geared	916	P & O.C.L
Ever Green	Colombo-Bombay-Cochin-Colombo	Every 14 days	Cellular & Geared	510	E/Green
C.M.A.	Sharjah-Abudabi-Baharain-Kawait-Dammam-Dubai-Minaquboos-Karachi-Bombay-Colombo	Every 18 days	Cellular	580	
B.T.L. Bengal Tiger Line	W/C: - Cochin- -Colombo- E/C: Madras-Colombo-Culcutta-Colombo	Weekly Every 10 days	Cellular & Geared	250	YML, E/Green APL

Appendix II-2-1 Greater Colombo Economic Commission --
Major Investor's Estimated Investment, Exports & Employment

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
1. A.J. Electronics Private Ltd.	19.855	129.400	168
2. A.J. Fishing Ind.(Pvt) Ltd.	3.200	6.898	109
3. A.J. Milton Lanka Ltd.	7.780	48.500	665
4. A.P.M. Magpec Export Ltd.	12.000	47.000	336
5. Abans Jungpoong (Pvt) Ltd	28.847	159.291	543
6. Ace Container Terminal Pvt.Ltd.	8.500	19.500	59
7. Activated Carbon Project	43.110	102.555	46
8. Agio Tobacco Proc Co. Pvt. Ltd.	41.259	318.775	500
9. Air Lanka Catering Serv.Ltd	132.362	252.443	710
10.Air Lanka Ltd.	1611.563	2485.000	2025
11.Aldridge Diamonds Ltd	4.000	14.700	114
12.Alitex Pvt Ltd	21.225	40.000	280
13.Alloy Fabricators Ltd.	19.689	36.000	102
14.Alternative Clothing Junc. Ltd	13.350	36.606	360
15.Ansell Lanka (Pvt) Ltd	857.000	1520.000	625
16.Appollo Electron (Pvt) Ltd	9.160	28.783	171
17.Aqua Dynamic (Pvt) Ltd	10.368	36.400	188
18.Asia Ltd	106.500	173.340	1382
19.Asian Cutting Lanka Pvt. Ltd.	5.230	37.400	70
20.Associated Motorways Ltd	35.862	184.320	182
21.Atlas Glove Colombo (Pvt) Ltd	52.592	337.718	1260
22.Atlas Gloves Ltd	55.332	292.412	1379
23.Austin Gloves Ceylon Ltd	5.500	26.500	233
24.Avatex Industries Ltd	28.500	43.200	445
25.Balab Lanka (Pvt) Ltd	15.810	25.500	35
26.Bensri Rubber Products Pvt Ltd	69.840	65.913	172
27.Bergougnan Lanka Ltd	74.636	104.494	331
28.Bhutani Export Project	19.826	149.000	406
29.Blanka Diamond Ltd	2.700	41.429	230

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
30. Blow Plast Ltd	3.250	23.538	58
31. Boland Marine Ltd	17.927	126.360	530
32. Bonaventure Textiles Lanka Ltd	65.672	215.500	1965
33. Bork Lanka Ltd	10.995	16.660	384
34. Boseang Cey-Latex (Pvt) Ltd	72.500	348.400	622
35. Bradbury Wilkinson Lanka Pvt. Ltd.	114.365	57.093	97
36. Bratex Pvt. Ltd	11.130	27.550	260
37. C & H Lanka Pvt. Ltd.	211.169	296.352	2430
38. C & H Lanka (Private) Limited	20.840	141.120	925
39. C N A Ltd.	9.909	177.843	888
40. CAN Gloves (Pvt) Ltd	22.989	45.424	124
41. Cane Furniture Ltd	1.110	2.320	44
42. Carnival World KO-LANKA Pvt. Ltd.	32.000	121.600	383
43. Caves Interpack Ltd	5.100	20.950	163
44. Ceramic Development Corp. Ltd	33.825	144.474	596
45. Ceramic World Private Ltd.	50.400	155.000	755
46. Ceylon Career Aparel Ltd.	26.964	80.725	344
47. Ceylon Floral Creations P Ltd.	7.937	78.970	522
48. Ceylon Mid-West Private Ltd	163.000	92.987	103
49. Ceylon Shipping (Pvt) Ltd.	0.120	12.180	357
50. Ceylon Theatres/Herbertson Ltd	15.405	57.562	82
51. Ceylon Tropica (Pvt) Ltd	4.750	8.700	52
52. Ceypack Garments Ltd	2.010	18.540	160
53. Chandrika Ayurvedic Soap Ltd.	4.174	37.980	167
54. Chinan Lanka (Pvt) Ltd.	3.372	9.790	214
55. Chinex Private Ltd.	12.000	127.037	139
56. Chuen Jing Ltd.	32.315	100.199	589
57. City Development Co. Ltd.	25.950	-	53
58. City of Jewellery Craftsmen	158.917	139.842	483

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
59. City Silk Synthetic Mills Ltd	106.200	71.000	520
60. Clubbemede Inc.	16.330	47.912	156
61. Cocoshell Activated C Co. Ltd	15.400	13.200	78
62. Col Trans. & Trading Co. Ltd	9.700	30.000	37
63. Colandium (Private) Ltd.	25.558	294.000	374
64. Colombo Dry Docks Ltd	1015.000	396.000	1005
65. Colombo Knitting Co. Ltd.	23.900	110.000	2053
66. Colombo Shipping Co Ltd	10.150	87.050	488
67. Commercial Engineerng Ltd	163.982	241.500	354
68. Commonwealth Garment Ltd	27.090	108.950	995
69. Computer Automation India Ltd	12.208	285.620	550
70. Computer Software Project	7.709	100.000	53
71. Computer Software Project	1.266	15.008	87
72. Cosmos Macky Ind. Ltd.	28.540	166.600	1159
73. Crasta Ltd.	40.610	43.510	161
74. Crest Lapidaries Ltd	1.970	55.500	311
75. Cruickshank & Partners Cey Ltd	24.791	76.044	79
76. Cutting & Polishing Diamonds	83.436	2.903	451
77. CYFRIF Technology Lanka Ltd	33.780	34.870	428
78. Dasa Group Footwear Fac Ltd	126.000	364.400	759
79. Data Pack (Private) Ltd	4.288	15.438	52
80. Davidov (Private) Ltd	26.680	261.900	138
81. Dial Textiles Ind. Ltd.	27.656	113.820	727
82. Dianus Lanka Ltd.	35.738	1032.209	535
83. Diunuwa Coir Ltd	35.900	140.960	378
84. Doubledee Sri Lanka Ltd.	4.000	14.700	114
85. Duraipanel Lanka Ltd.	148.300	93.000	228
86. Duratex Sri Lanka Ltd	9.050	34.800	167
87. Dutch Foliage Farm Ltd	4.794	8.300	24

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
88. Dutch Lanka Designs (Pvt) Ltd	5.965	16.960	136
89. East West Res. & Des. Pvt. Ltd	47.260	131.720	237
90. EL Steel Ltd	25.326	59.418	191
91. Electro Plastics Ltd	12.500	39.100	121
92. Elsuma (Private) Ltd	25.044	74.242	406
93. Eskimo Fashion Knitwear Ltd.	95.000	220.915	1087
94. Esquire Garments Ltd	10.830	84.040	694
95. Fairline Prec Diamond Pte Ltd	5.745	14.304	74
96. Fantasia Socks & Stockings Ltd	73.000	72.153	276
97. Fareast Engineering Co Pvt. Ltd	20.341	67.174	96
98. Fibretex Ltd.	30.000	21.420	988
99. Filotex Lanka (Pvt) Ltd	15.910	75.300	80
100 Floral Greens Mfg. Pvt Ltd	6.863	42.271	541
101 Formosa Industries Ltd	30.025	59.400	446
102 Fownes Brothers Inc	34.000	182.000	691
103 Free Lanka Cashew Exports Ltd	13.400	37.315	479
104 Free Lanka Granite & M Export Ltd	34.888	277.500	649
105 Friend Colombo Manuf. (Pvt) Ltd	20.400	114.200	538
106 Fritzpickle (Pvt) Ltd.	5.983	63.043	776
107 G Christie David	11.200	17.500	25
108 Gartex Inds. Lanka Pvt. Ltd	16.224	58.351	520
109 Genius Electronic Pvt Ltd	4.488	66.000	610
110 Genius Lanka (Pvt) Ltd.	10.000	92.400	513
111 German Lanka Summertimes Garde	2.985	20.000	122
112 Gherzie Ceylon Ltd	0.415	4.910	60
113 Gloweave Rubber Ltd	51.900	87.880	125
114 Golden Lanka (Pvt) Ltd	29.460	152.046	538
115 Granite Japan Internat. Ltd.	6.991	28.900	79
116 Green Farms Ltd	18.872	29.252	304

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
117. Green Leaf International Ltd	8.875	21.000	121
118. Guthrie Int Plantation Service	453.800	198.600	1651
119. Haarwerken Ltd	9.302	33.426	437
120. Handgar Indexport Ltd	14.710	37.460	487
121. Harris Corp (Bermuda) Ltd	404.982	975.240	1851
122. Hidaramani Garments (K) Ltd	5.000	89.800	447
123. I T C Ltd	21.986	20.108	109
124. Inayatali Abdulla	2.430	5.694	21
125. Industrial Clothing Ltd.	3.450	61.870	514
126. Information Sys Int Col P Ltd	15.735	-	44
127. Infotechs Overseas Pvt Ltd	6.000	50.500	61
128. Int Cosmetic Accessories Ltd.	22.187	78.535	549
129. Int. Cosmetic Exp Ltd	10.769	41.109	89
130. Int. National Cosmetic Brush Co.	5.347	99.000	459
131. Intec Ltd	2.668	10.674	47
132. Inter Fashion Co Ltd	108.161	405.588	2104
133. Inter National Enterprises Ltd.	36.019	-	189
134. Interbike Lanka Pvt Ltd	52.550	178.426	220
135. Intl Cosmetic Applicators Ltd	36.560	111.000	250
136. Isabella Pvt Ltd	76.093	133.650	510
137. Jaqalanka International Ltd	29.178	80.561	336
138. Jaqalanka Ltd	4.100	29.390	172
139. Jayen Socks & Allied Pr Ce Ltd	22.650	20.770	130
140. Jewelarts Exports Ltd	7.869	110.916	123
141. Jewelknit Ltd	19.000	55.600	286
142. Jinadasa Bros. Lapidary Ltd	8.530	138.350	423
143. K. J. Lanka Ltd	6.280	24.990	335
144. Kabool Textile Co Ltd	897.700	1612.900	3126
145. Kadirakama Kumarar Textile Ltd	33.800	30.460	193

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
146. Kaneko Lanka Marine Pvt Ltd	188.769	67.698	272
147. Katunayake Garments Ltd.	11.800	28.400	338
148. Kesri Leather & Cane Prod. Ltd	4.158	21.000	120
149. Kinetics Technology India Ltd	6.450	47.525	86
150. Kolbul Spinnning & Tex. Co. Ltd	897.700	1612.955	3126
151. Konoike Construction Co Ltd	16.000	-	-
152. KOR Cey Footwear Mfg Co. Ltd.	40.300	116.699	1098
153. Korea Lanka Garments Ltd	7.900	30.800	310
154. KorLanka Wood Exports (Pvt) Ltd	3.715	23.520	109
155. Kundanmal Garments Ltd	46.140	74.790	541
156. LA CAJOU & Allied Prod. Pvt. Ltd	4.300	52.760	82
157. La Monde Garments Ltd	9.592	27.000	59
158. Lambretta Ceylon Ltd	17.540	19.000	103
159. LAMSA Ltd	7.660	11.812	106
160. Lanka Coir Products Ltd	38.700	78.829	229
161. Lanka Dainichi Ceramic Co Ltd	14.059	30.000	358
162. Lanka Hiqu Ltd	18.700	129.800	384
163. Lanka Leather Fashion Ltd	12.243	84.000	164
164. Lanka Majolica Tiles Ltd	66.290	48.300	106
165. Lanka Metal Industries Ltd	18.000	38.800	722
166. Lanka Multi Moulds (Pvt) Ltd	50.000	128.000	101
167. Lanka Naigai (Pvt) Ltd	26.080	91.000	115
168. Lanka Polymer Ind Ltd.	6.503	27.500	234
169. Lanka Rubber Bands Ltd	7.319	7.959	65
170. Lanka S S (Private) Ltd	14.368	49.950	134
171. Lanka World (Pvt) Ltd.	40.514	360.000	506
172. Latex Fibre Sheets Ltd	4.200	3.600	35
173. Laws Eurotex Apparel (Pvt) Ltd	29.644	143.164	936
174. Laws Garments Knitwear Ltd	140.643	526.731	3056

NAME OF THE ENTERPRISES	TOTAL INVESTMENT (Rs.Mn.)	EXPORT CAPACITY (Rs.Mn.)	EMPLOYMENT CAPACITY (No.)
175. LISPO Pvt. Ltd	3.813	24.924	129
176. Luxoplast GMBH	45.100	44.715	45
177. M M Chemicals Ltd	15.520	18.290	66
178. M/s Nakagawa Corporation	19.842	45.324	303
179. Machinery Manufac. Corp. Ltd	113.869	120.707	332
180. Machinery Manufacture Project	12.100	42.550	52
181. MandarinKnit Garments Ltd	14.758	140.000	987
182. Manf. of All Type of Bags	40.000	123.370	385
183. Manf. of Leather Shoes	64.700	297.000	161
184. Mansel Garments Ltd.	3.900	235.000	761
185. Marcdamar Rock Industries Ltd	30.911	46.000	159
186. Marine Texiles (Private) Ltd	7.850	90.000	170
187. Mark Sails Ltd	4.400	241.900	160
188. Martin Emprex Ceylon Ltd.	24.877	80.500	495
189. Medison Private Ltd.	25.262	303.905	935
190. Meena International Inc.	26.200	130.600	351
191. Mercantile Enterprises Ltd	120.404	108.279	47
192. Mercs Diamond Manf. Ltd	83.436	2.903	451
193. Mercury Garments (Pvt) Ltd	19.562	63.104	248
194. Merst Lanka (Pvt) Ltd	4.630	61.135	166
195. Metropolitan Agencies Ltd	7.100	30.000	283
196. Mfg. Items of Chinees H/C & JE	12.000	50.000	57
197. Mfg. of All Types of Bags	40.000	251.000	385
198. Mfg. of Auto Sun Shields	10.386	21.926	39
199. Mfg. of Curled Coir Fibre Prod.	9.000	12.780	60
200. Mfg. of Dia. Shtudded Jewellary	308.200	2280.000	107

Road Distance between Principal Cities

(Unit: Kilometers)

From / To	Colombo	Trincomalee	Galle
Kandy	116	182	232
Nuwara Eliya	180	259	290
Badulla	230	277	256
Kalutara	43	301	72
Ratnapura	101	283	150
Batticaloa	303	138	381
Monaragala	254	261	285
Matara	160	418	45
Hambantota	238	367	124

Source: Road Map Sri Lanka

Statistics on Paddy Sector

No.	1		2	3	4	5	6	7	8
Item	Production		Area Sown	Area Harvested	Fertilizer Issues	4 / 2	Yield per Hectare	Imports Rice	Domestic Consumption Rice
	Paddy	Rice Equivalent							
Unit	000 Tons.	000 Tons.	Ha.	Ha.	000 Tons.	Kgs./Ha.	Kgs./Ha.	000 Tons.	000 Tons.
1980	2,133	1,451	850,598	821,591	145.1	170.6	2,927	129	1,608
1981	2,230	1,516	882,565	842,473	165.0	187.0	3,014	157	1,663
1982	2,156	1,466	844,648	746,000	167.1	197.8	3,260	161	1,616
1983	2,484	1,689	825,481	778,038	162.2	196.5	3,606	123	1,735
1984	2,413	1,645	990,488	886,087	186.9	188.7	3,076	26	1,816
1985	2,658	1,810	880,691	864,677	202.5	229.9	3,465	182	1,970
1986	2,584	1,760	896,037	835,371	232.6	259.6	3,500	220	1,841
1987	2,126	1,447	781,896	679,417	217.1	277.7	3,564	102	1,703
1988	2,477	1,684	867,810	815,561	226.2	260.7	3,413	189	
1989	2,063	1,404	726,958	689,753	227.6	313.1	3,374	292	

Source: 1) Agricultural Statistics of Sri Lanka and Statistical Pocket Book 1989, Department of Census & Statistics, Ministry of Policy Planning and Implementation

2) National Fertilizer Secretariat, Ministry of Policy Planning and Implementation

3) Review of the Economy and Annual reports, Central Bank of Sri Lanka

Wheat/Flour Handled at three (3) Ports

Year	Wheat Import		③	④= ③ x0.65	③ x 0.2	③x0.15	⑤	④+⑤	Flour		
	① Trincomalee	② Colombo	①+②	Flour Equivalent	Bran Equivalent	Others	Flour Import		from Trincomalee	to Colombo	to Galle
1980	0	88	88	57	18	13	315	372	0	0	0
1981	465	87	552	359	110	83	*0	359	99	*85	14
1982	414	42	456	296	91	68	*0	296	3	*3	0
1983	607	0	607	395	121	91	*18	395	60	*57	3
1984	595	0	595	387	119	89	*0	387	111	*94	17
1985	664	0	664	432	133	100	*0	432	149	*128	21
1986	670	0	670	436	134	101	11	447	246	179	30
1987	599	30	629	409	126	94	10	419	251	195	38
1988	534	11	545	354	109	82	34	388	152	165	37
1989	735	8	743	483	149	111	61	544	221	167	41

Source: Port Statistics, Sri Lanka Ports Authority

*: Values adjusted

Sugar Statistics

Year	Production (000 Tons)	Import (000 Tons)	Consumption (0000 Tons)	Per Capita Consumption (Kg)	Population (Million)
1980	27	209	244	16.6	14.7
1981	25	238	220	14.7	15.0
1982	24	123	198	13.0	15.2
1983	22	268	258	16.8	15.4
1984	20	236	275	17.6	15.6
1985	20	267	282	17.8	15.8
1986	35	324	361	22.4	16.1
1987	34	340	400	24.4	16.4
1988	54	319			16.6
1989	54	332			16.8

Source: 1) Agricultural Statistics of Sri Lanka
2) Central Bank of Sri Lanka
3) Public Investment 1989 - 1993

Statistics on Fertilizer Sector

(Unit: 000 Tonnes)

	Production	Import	Consumption	Tea	Rubber	Coconut	Paddy	Other Crops
1980	14.1	395.3		109.9	22.0	55.8	145.1	
1981	15.4	294.5		103.3	16.8	37.7	165.0	
1982	14.1	174.7	379.3	102.6	16.5	30.3	167.1	62.8
1983	15.7	215.5	403.8	115.5	18.5	34.5	162.2	73.1
1984	13.7	356.4	470.2	137.2	23.5	49.4	186.9	73.2
1985	17.2	508.2	493.3	149.9	24.2	41.0	202.5	75.7
1986	15.0	423.2	496.9	128.8	26.3	31.5	232.6	77.7
1987	21.2	382.2	505.5	136.7	23.2	41.3	217.1	87.2
1988	23.1	544.2	525.2	138.0	25.1	42.0	226.2	93.9
1989	24.5	364.9	505.9	124.6	21.7	37.5	227.6	94.5

Source: 1) National Fertilizer Secretariat, Ministry of Policy Planning and Implementation

2) Review of the Economy and Annual Report, Central Bank of Sri Lanka

Appendix II-3-6

Fertilizer Consumption by Crop in the Southern Province 1986, 1987

(Unit: Tons)

		Tea	Rubber	Coconut	Paddy	Other	Total
	Galle	16,785	3,078	1,344	11,995	3,961	37,172
1	Matara	16,337	1,637	758	8,541	1,310	28,583
9	Hambantota	805	87	249	7,126	737	9,004
8	Sub Total	33,927	4,811	2,351	27,662	6,008	74,759
6	Share(%)	26.3	18.3	7.5	11.9	7.7	15.0
	Sri Lanka	128,800	26,300	31,500	232,600	77,700	496,900
	Galle	21,728	2,392	1,813	8,272	3,557	37,762
1	Matara	18,791	664	1,370	7,905	1,779	30,509
9	Hambantota	18	0	417	14,362	402	15,199
8	Sub Total	40,537	3,056	3,600	30,539	5,738	83,470
7	Share(%)	29.7	13.2	8.5	14.1	6.6	16.5
	Sri Lanka	136,700	23,200	42,200	217,100	87,200	506,400

Source: National fertilizer Secretariat, Ministry of Policy Planning and Implementation

Appendix II-3-7

Cement Statistics

Year	Production (000 Tons)	Import (000 Tons)	Consumption (000 Tons)	Population (000)	Per Capita Consumption (Kg)
1983	506	440	946	15,416	61.4
1984	403	456	859	15,599	55.1
1985	380	363	743	15,837	46.9
1986	558	415	973	16,117	60.4
1987	641	362	1,003	16,361	61.3
1988	633	383	1,016	16,586	61.3
1989	596	387	983	16,806	58.5

Source: 1) Annual Report & Review of the Economy, Central Bank of Sri Lanka

2) Statistical Pocket Book of Sri Lanka, Department of Census & Statistics, Ministry of Policy Planning & Implementation

3) Port Statistics, Sri Lanka Ports Authority

Per Capita Consumption of Cement and per Capita GNP in the World

	1947	1955	1965	1975		1980		1986	
	Cement (Kg)	Cement (Kg)	Cement (Kg)	Cement (Kg)	GNP (US$)	Cement (Kg)	GNP (US$)	Cement (Kg)	GNP (US$)
Japan	16	106	313	565	4,490	704	9,870	666	12,840
U.S.A.	210	306	326	287	7,400	287	12,000	341	17,530
England	125	213	327	301	3,900	256	7,940	244	9,010
France	104	227	443	543	6,010	524	11,900	392	10,780
Germany	65	328	573	514	6,670	528	13,340	399	12,000
Italy	70	230	398	608	3,700	723	7,480	635	8,570
Belgium	215	321	450	594	6,040	570	12,410	415	9,330
Canada	161	275	377	401	7,330	352	10,710	301	14,160
U.S.S.R.	25	111	306	470		460		476	
Indonesia	1	6	7	21	210	36	470	57	490
Thailand	3	22	39	79	360	118	670	152	800
Taiwan	32	75	142	405		748		493	
Korea	1	5	52	243	580	345	1,630	490	2,550
China	2	7	22	54	180	80	300	153	310

Source: Cement- Concrete Journal Vol.27 No.1, Japan Concrete Institute
GNP- World Tables, the World Bank (IBRD)

The Volume of Other Break Bulk Cargo

(Unit: Tons)

	Potatoes	Onions	Chillies	Other Drycargo		Total
				Containerized	Conventional	
1980	10,642	14,387	12,369	91,088	797,222	925,708
1981	0	5,090	2,049	198,710	524,648	730,497
1982	2,046	2,288	612	276,719	481,481	763,146
1983	2,418	3,166	688	338,939	494,518	839,729
1984	2,858	48,499	3,786	370,408	635,186	1,060,737
1985	1,232	56,543	2,947	438,086	546,039	1,044,847
1986	0	51,100	2,400	526,194	617,461	1,197,155
1987	0	33,750	1,879	578,184	620,134	1,233,947
1988	0	32,007	13,042	650,588	618,706	1,314,343
1989	0	22,310	6,946	761,200	487,031	1,277,487

Source: Sri Lanka Ports Authority, Ministry of Ports & Shipping

Statisitics on Tea Sector

No.	1	2	3	4	5	6	7		8	9
Item	Production	Registered Extent under Tea	Fertilizer Issues	3 / 2	Yield per Hectare	Cost of Production	Average Price Colombo Net	Average Price Export F.O.B.	Exports	Domestic Consumption
Unit	000 Tons.	Ha.	000 Tons.	Kgs./Ha.	Kgs./Ha.	Rs./Kg	Rs./Kg	Rs./Kg	000 Tons.	000 Tons.
1980	191.0	244,714	109.9	449.1	781	18.71	17.73	33.41	184.3	20.6
1981	210.0	244.918	103.3	421.8	857	18.79	17.71	35.14	192.0	21.0
1982	187.8	242,141	102.6	423.7	776	22.68	22.52	35.03	181.0	21.3
1983	179.3	230,065	115.5	502.0	779	26.37	36.96	52.52	157.8	25.3
1984	208.0	227,875	137.2	602.1	913	34.00	46.45	77.20	204.0	24.5
1985	214.1	231,650	149.9	647.1	924	35.00	35.39	60.62	198.0	25.0
1986	211.3	222,905	128.8	577.8	948	N.A.	30.28	44.52	207.8	23.0
1987	213.3	221,498	136.7	617.2	963	N.A.	38.06	52.97	201.1	23.0
1988	226.9	221,683	138.0	622.5	1,024	43.98	41.59	55.95	219.8	22.7
1989	207.0	222,110	124.6	561.0	932	49.70	52.16	66.91	204.2	23.0

Source: 1) Annual Report 1988, Sri Lanka Tea Board

2) National Fertilizer Secretariat, Ministry of Policy Planning and Implementation

3) Review of the Economy and Annual Reports, Central Bank of Sri Lanka

Area under Tea Cultivation in the Southern Province

(Unit: Hectare)

	Galle	Matara	Hambantota	Southern Province	Share (%)	Sri Lanka
1982	15,292	15,877	117	31,286	12.9	242,141
1983	15,306	15,875	117	31,298	13.6	230,065
1984	15,480	16,217	117	31,814	14.0	227,875
1985	16,415	16,033	120	32,568	14.1	231,650
1986	16,554	16,156	129	32,839	14.7	221,905
1987						221,498
1988	16,823	16,342	135	33,300	15.0	221,683

Source: Ministry of Agriculture

Statistics on Rubber Sector

No.	1	2	3	4	5	6	7	8		9	10
Item	Production	Total Extent under Rubber	Area under Tapping	Fertil-izer Issues	4 / 3	Yield per Hectare	Cost of Production	Average Price Colombo RSS 1	Average Price Export F.O.B.	Exports	Domestic Consump-tion
Unit	Tons.	Ha.	Ha.	000 Tons.	Kgs./Ha.	Kgs./Ha.	Rs./Kg	Rs./Kg	Rs./Kg	Tons.	Tons.
1980	133,151	227,335	185,573	22.0	118.6	781	8.20	10.62	21.42	120,943	14,926
1981	123,945	205,605	175,855	16.8	95.5	705	8.92	10.04	21.80	132,523	16,216
1982	125,230	205,690	170,738	16.5	96.6	729	9.66	10.18	17.68	131,302	16,360
1983	139,997	205,650	170,482	18.5	108.5	818	9.90	13.95	22.77	125,230	16,449
1984	141,924	205,589	168,768	23.5	139.2	840	12.06	14.40	26.16	126,212	15,061
1985	137,493	204,293	154,436	24.2	156.7	894	13.67	15.90	21.34	120,448	15,089
1986	137,810	202,771	149,918	26.3	175.4	919	13.70	16.62	23.83	110,401	16,382
1987	121,806	201,861	147,484	23.2	157.3	826	13.95	19.87	27.63	106,048	19,357
1988	122,393	200,248	145,495	25.1	172.5	841	13.41	24.40	37.33	99,303	19,860
1989	110,742	199,648	144,416	21.7	150.3	767	15.01	22.63	36.17	86,020	20,875

Source: 1) Sri Lanka Rubber Statistics 1985-1986, Rubber Control Department
2) National Fertilizer Secretariat, Ministry of Policy Planning and Implementation
3) Department of Census & Statistics, Ministry of Policy Planning and Implementation
4) Review of the Economy and Annual Reports, Central Bank of Sri Lanka

Appendix II-3-13

Production of Rubber in the Sourtern Province

Year	Rubber		
	S/Province (000 Tons)	Sri Lanka (000 Tons)	Share (%)
1980		133.2	
1981		123.9	
1982	17.7	125.2	14.1
1983	19.3	140.0	13.8
1984	19.6	141.9	13.8
1985	18.8	137.5	13.7
1986	18.7	137.8	13.6
1987	16.5	121.8	13.5

Source: Marga Institute

Appendix II-3-14

Area under Tapping of Rubber in the Southern Province

(Unit: Hectare)

	Galle	Matara	Hambantota	Southern Province	Share (%)	Sri Lanka
1982	20,562	8,433	85	29,080	14.1	205,690
1983	20,229	8,084	85	28,398	13.8	205,650
1984	20,162	8,251	85	28,498	13.9	205,589
1985	19,927	8,350	87	28,364	13.9	204,293
1986	19,760	8,011	87	27,858	13.7	202,771

Source: Ministry of Agriculture

Statistics on Coconut Sector

No.	1	2	3	4	5	6	7
Item	Production	Extent under Coconut	Fertilizer Issues	Cost of Production	Ave.Price Export F.O.B.	Exports	Domestic Consumption
Unit	Mn.Nuts	Ha.	000 Tons.	Rs./Nut	Rs./Nut	Mn.Nuts	Mn.Nuts
1980	2,026	N.A.	55.8	0.40	3.15	239	1,784
1981	2,258	416,238	37.7	0.55	2.52	401	1,819
1982	2,521	N.A.	30.3	0.57	1.76	569	1,893
1983	2,312	N.A.	35.6	0.60	2.42	582	1,740
1984	1,942	419,201	50.0	0.63	4.75	327	1,660
1985	2,958	N.A.	41.0	0.64	2.55	935	2,027
1986	3,039	N.A.	31.6	0.66	1.46	1,105	1,877
1987	2,291	N.A.	42.2	0.73	2.64	538	1,731
1988	1,936	N.A.	42.0	0.81	4.00	224	1,701
1989	2,486	N.A.	37.5	0.85	3.35	572	N.A.

Source: 1) Sri Lanka Coconut Statistics 1988, Coconut Development Authority, Ministry of Coconut Industries
2) National Fertilizer Secretariat, Ministry of Policy Planning and Implementation
3) Review of the Economy and Annual Reports, Central Bank of Sri Lanka
4) Economic & Social Statistics of Sri Lanka, Central Bank of Sri Lanka

Production, Consumption & Exports of Coconuts & Coconut Products

Year	Export Volume				(Nuts per	Production		Consumption	
	Solid	Oil	Total						
	(Tons)	(Tons)	(Tons)	(Mn.Nuts)	Tons)	(Tons)	(Mn.Nuts)	(Tons)	(Mn.Muts)
1980	121,754	10,001	131,755	239	1,814	740,495	2,206	652,045	1,784
1981	146,692	17,203	163,895	401	2,447	825,290	2,258	664,838	1,819
1982	190,699	29,675	220,374	569	2,582	921,416	2,521	691,884	1,893
1983	193,633	31,404	225,037	582	2,586	845,027	2,312	635,963	1,740
1984	126,155	6,563	132,718	327	2,464	709,794	1,942	606,724	1,660
1985	242,041	57,662	299,703	935	3,120	1,081,138	2,958	740,861	2,027
1986	250,843	75,355	326,198	1,105	3,388	1,110,743	3,039	686,036	1,877
1987	180,431	7,940	188,371	538	2,856	837,352	2,291	632,674	1,731
1988	89,482	0	89,482	224	2,503	707,601	1,936	621,709	1,701
1989	227,372	2,400	229,772	572	2,489	908,623	2,486	662,645	1,813
Av.	176,910	23,820	200,731		2,736	868,748		659,538	

Ratio of Containerization in Sri Lanka (Import)

Year (X)	Breakbulk Cargo (000 Tons) ①	Container Cargo (000 Tons) ②	Container Ratio ②/①	Forecast ln(γ/Y(t) -1) (Y)		Estimated Results (%)
1980	2,051	91	4.44	2.8978303	γ =	9.31
1981	1,566	199	12.69	1.7400033	85	10.74
1982	1,472	277	18.81	1.2584737	α =	12.36
1983	1,882	339	18.00	1.3139706	323.110	14.17
1984	2,087	370	17.75	1.3323475	β =	16.19
1985	2,376	438	18.44	1.2836318	-0.1621	18.42
1986	2,526	526	20.83	1.1248241	r =	20.87
1987	2,524	578	22.91	0.9972177	0.816	23.53
1988	2,802	651	23.22	0.9787911		26.38
1989	2,756	761	27.62	0.7311317		29.42
1990	2,883	940				32.61
1995	3,151	1,562				49.58
1997	3,307	1,854				56.05
2001	3,617	2,421				66.93
2005	4,118	3,067				74.49
2010	4,969	3,974				79.98

Results of Correlation Analysis

Constant:	323.10990
Standard Error oh Y:	0.3686386
Coefficient of Determinants:	0.6660785
Number of Sumple:	10
Degree of Freedom:	8
Coefficient of X:	-0.162128
Standard Error of X:	0.0405857

Equation of the Logistic Curve

$Y = 85 / \{1+e^{(323.110 - 0.162128X)}\}$

Ratio of Containerization in Sri Lanka (Export)

Year (X)	Breakbulk Cargo (000 Tons) ①	Container Cargo (000 Tons) ②	Container Ratio ②/①	Forecast ln(γ/Y(t) -1) (Y)		Estimated Results (%)
1980	1,003	177	17.63	1.4788884	γ =	22.83
1981	986	330	33.49	0.6079352	95	27.45
1982	1,132	399	35.26	0.5271716	α =	32.58
1983	1,028	383	37.24	0.4387976	496.663	38.12
1984	1,035	470	45.45	0.0862162	β =	43.95
1985	1,037	506	48.74	-0.052184	-0.2503	49.89
1986	1,200	648	53.95	-0.273464	r =	55.75
1987	1,052	659	62.61	-0.658867	0.979	61.36
1988	987	652	66.09	-0.826911		66.58
1989	1,072	761	70.94	-1.081481		71.30
1990	1,232	930				75.47
1995	1,513	1,338				88.45
1997	1,659	1,508				90.92
2001	2,058	1,923				93.46
2005	2,559	2,416				94.43
2010	3,428	3,251				94.84

Results of Correlation Analysis

Constant:	496.66251
Standard Error oh Y:	0.1683033
Coefficient of Determinants:	0.9579851
Number of Sumple:	10
Degree of Freedom:	8
Coefficient of X:	-0.250258
Standard Error of X:	0.0185295

Equation of the Logistic Curve

$Y = 95 / \{1+e^{(496.663 - 0.250258X)}\}$

Tonnage per TEU and Ratio of Empty Containers

(Import)

	Port Handled (Tons)	Loaded (TEUs)	Empty (TEUs)	Weight of Loaded per TEU (Tons)	Weight of Total per TEU (Tons)	Ratio of Empty Containers (%)
1980	91,088	9,190	5,955	9.91	6.01	39.3
1981	198,710	13,960	12,394	14.23	7.54	47.0
1982	276,719	19,935	17,625	13.88	7.37	46.9
1983	338,939	26,903	11,838	12.60	8.75	30.6
1984	370,408	28,742	17,418	12.89	8.02	37.7
1985	438,086	33,054	19,688	13.25	8.31	37.3
1986	526,194	38,426	21,963	13.69	8.71	36.4
1987	578,184	42,074	23,100	13.74	8.87	35.4
1988	650,588	48,004	20,800	13.55	9.46	30.2
1989	761,200	55,062	23,339	13.82	9.71	29.8

Avrage Weight of Loaded Containers per TEU = 13.4 Tons

Avrage Weight of Total Containers per TEU = 8.8 Tons

Average Ratio of Empty Containers = 33.9 %

(Export)

	Port Handled (Tons)	Loaded (TEUs)	Empty (TEUs)	Weight of Loaded per TEU (Tons)	Weight of Total per TEU (Tons)	Ratio of Empty Containers (%)
1980	176,862	12,376	2,050	14.29	12.26	14.2
1981	330,249	21,494	2,139	15.36	13.97	9.1
1982	399,026	29,860	3,563	13.36	11.94	10.7
1983	382,863	29,692	8,576	12.89	10.00	22.4
1984	470,311	37,722	9,497	12.47	9.96	20.1
1985	505,639	41,024	9,547	12.33	10.00	18.9
1986	647,642	51,373	9,188	12.61	10.69	15.2
1987	658,638	53,466	10,436	12.31	10.31	16.3
1988	652,314	53,728	12,907	12.14	9.79	19.4
1989	760,637	60,444	20,135	12.58	9.44	25.0

Avrage Weight of Loaded Containers per TEU = 12.5 Tons

Avrage Weight of Total Containers per TEU = 10.0 Tons

Average Ratio of Empty Containers = 19.6 %

Future Volume of Containerizable Cargo in Bangladesh

(Unit: '000 tons)

Year	Import	Export	Total
1983	1,162	964	2,126
1984	1,389	864	2,253
*1985	1,432	877	2,309
*1986	1,478	889	2,367
*1987	1,525	902	2,427
*1988	1,573	915	2,488
1995	1,954	1,013	2,967
2000	2,705	1,224	3,929
2005	3,626	1,477	5,103

Source: F/S of Dhaka-narayanganj Port (1990), JICA

Note: Figures in the Year of "*" were estimated based on figures in the year of 1984 & 1995.

Containers Handled in Bangradesh

	Chittagong			
	TEU			Tonnage
	Loaded	Empty	Total	
1983	8,704	3,072	11,776	130,083
1984	14,045	4,334	18,379	175,152
1985			39,056	372,204
1986			50,133	477,767
1987	39,910	10,109	50,019	455,460
1988	47,285	8,107	55,392	548,679

Source: Containerisation International Year Book

Container Cargo Throughput in India

Year	West India		East India		Total	
	TEUs	Tons	TEUs	Tons	TEUs	Tons
1980	122,181	1,166,360	23,489	186,395	145,670	1,352,755
1981	164,721	1,364,508	43,132	367,507	207,853	1,732,015
1982	163,371	1,336,860	52,291	454,859	215,662	1,791,719
1983	173,702	1,466,209	60,912	451,721	234,614	1,917,930
1984	211,715	1,950,647	84,173	667,507	295,888	2,618,154
1985	255,128	2,220,728	138,217	1,144,151	393,345	3,364,879
1986	307,671	2,915,848	172,690	1,522,360	480,361	4,438,208

Containers Handled in East India

	Calcutta				Haldia			
	TEU			Tonnage	TEU			Tonnage
	Loaded	Empty	Total		Loaded	Empty	Total	
1977	67	546	613					
1978			558				1,318	
1979			2,048				2,430	
1980			7,838	58,326			7,630	54,328
1981			21,126	186,784			6,826	49,044
1982			28,353	231,341			5,013	35,583
1983	15,965	9,984	25,949	194,414	3,752	2,941	6,693	41,509
1984	20,169	9,054	29,223	248,065	5,869	3,805	9,674	76,927
1985	31,928	13,864	45,792	396,524	5,591	2,444	8,035	64,529
1986	37,773	16,993	54,766	488,523	10,269	5,124	15,393	124,641
1987	40,864	19,378	60,242	543,457	18,735	13,775	32,510	214,153
1988	46,715	25,920	72,635	638,973	17,857	11,875	29,732	204,782

Source: Containerisation International Year Book

Madras				Visakhapatnam			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
2,463	1,092	3,555	34,081				
		8,021	73,740				
10,660	4,420	15,080	131,100	50	50	100	579
13,431	5,126	18,557	185,062	197	171	368	2,873
21,558	6,569	28,127	215,183	36	107	143	615
33,358	11,797	45,155	341,502	88	33	121	1,013
64,857	19,005	83,862	680,111	248	280	528	2,987
84,153	16,547	100,700	890,286	1,211	620	1,831	18,910
64,323	21,905	86,228	902,581	639	580	1,219	9,685
71,788	18,864	90,652	960,009				

Containers Handled in West India

	Bombay				Cochin			
	TEU			Tonnage	TEU			Tonnage
	Loaded	Empty	Total		Loaded	Empty	Total	
1977	9,347	4,252	13,599	109,142				
1978	25,046	13,834	38,880	361,812	2,446	1,880	4,326	34,800
1979	59,997	17,835	77,832	857,392	8,063	5,766	13,829	116,400
1980	69,210	32,071	101,281	1,027,870	11,392	9,508	20,900	138,490
1981	98,541	33,359	131,900	1,169,805	15,115	12,363	27,478	138,605
1982	95,753	34,942	130,695	1,175,332	16,920	15,038	31,958	158,884
1983	104,600	36,728	141,328	1,280,487	19,023	12,279	31,302	180,250
1984	135,115	39,982	175,097	1,756,934	19,950	15,435	35,385	183,791
1985	155,945	58,746	214,691	1,983,802	22,548	14,703	37,251	211,275
1986	193,464	50,111	243,575	2,457,440	23,408	16,407	39,815	210,632
1987	211,823	44,795	256,618	2,718,875	22,886	16,036	38,922	211,574
1988	227,117	50,241	277,358	2,870,387	25,075	17,939	43,014	251,550

Source: Containerisation International Year Book

Kandla				Tuticorin			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
				3,840	1,503	5,343	56,098
				337	381	718	2,644
				577	495	1,072	5,472
				923	310	1,233	9,922
				1,944	1,242	3,186	25,651
		17,089	170,870	4,036	3,156	7,192	76,906
19,028	9,255	28,283	335,156	5,094	2,944	8,038	84,169
25,137	10,796	35,933	423,952	5,678	3,104	8,782	81,140

Appendix II-3-25

Containers Handled in Pakistan

	Karachi			
	TEU			Tonnage
	Loaded	Empty	Total	
1979			40,137	
1980	52,052	8,118	60,170	419,735
1981	70,044	19,468	89,512	806,301
1982	100,902	23,327	124,229	1,033,692
1983	107,741	32,629	140,370	1,301,631
1984			169,415	
1985	180,887	63,199	244,086	2,213,398
1986	220,695	71,473	292,168	2,713,595
1987	222,091	59,346	281,437	2,762,367

Source: Containerisation International Year Book

Appendix II-3-26

Container Cargo Throughput at 10 Ports
in the Gulf and Red Sea

Year	TEU	Tonnage	Tons/TEU
1977	395,646	2,712,289	6.86
1978	779,869	6,132,629	7.86
1979	1,087,679	8,728,666	8.03
1980	1,314,174	10,251,127	7.80
1981	1,592,141	12,157,154	7.64
1982	1,751,644	13,560,605	7,74
1983	1,969,814	14,977,855	7.60
1984	2,077,635	16,134,911	7.77
1985	1,945,692	15,918,337	8.18
1986	1,974,464	17,337,178	8.78
1987	2,108,670	19,265,548	9.14
1988	2,239,216	20,119,987	8.99

Note: Tons/TEU are including Empty Containers

Containers Hadled in Gulf and Red Sea

	Mina Sulman				Aqaba			
	TEU			Tonnage	TEU			Tonnage
	Loaded	Empty	Total		Loaded	Empty	Total	
1977	1,037	1,163	2,200	11,830	4,342	0	4,342	49,781
1978	20,129	18,824	38,953	324,940	10,076	0	10,076	93,567
1979	25,001	17,568	42,569	335,191	16,742	16,700	33,442	193,940
1980	41,339	18,857	60,196	496,054	21,256	20,500	41,756	258,662
1981			121,621	1,056,000	41,644	35,200	76,844	529,966
1982	48,412	30,515	78,927	1,185,399	54,175	49,523	103,698	719,753
1983	55,232	39,612	94,844	1,208,642	43,360	43,138	86,498	584,889
1984	66,597	45,212	111,809	1,395,096	52,420	50,065	102,485	669,703
1985	68,760	35,321	104,081	1,266,300	55,462	53,429	108,891	704,180
1986	49,725	30,668	80,393	1,026,445	62,430	59,184	121,614	742,874
1987	44,043	25,456	69,499	918,907	51,854	46,801	98,655	656,795
1988	43,975	22,819	66,794	922,340	62,132	54,540	116,672	776,254

Source: Containerisation International Year Book

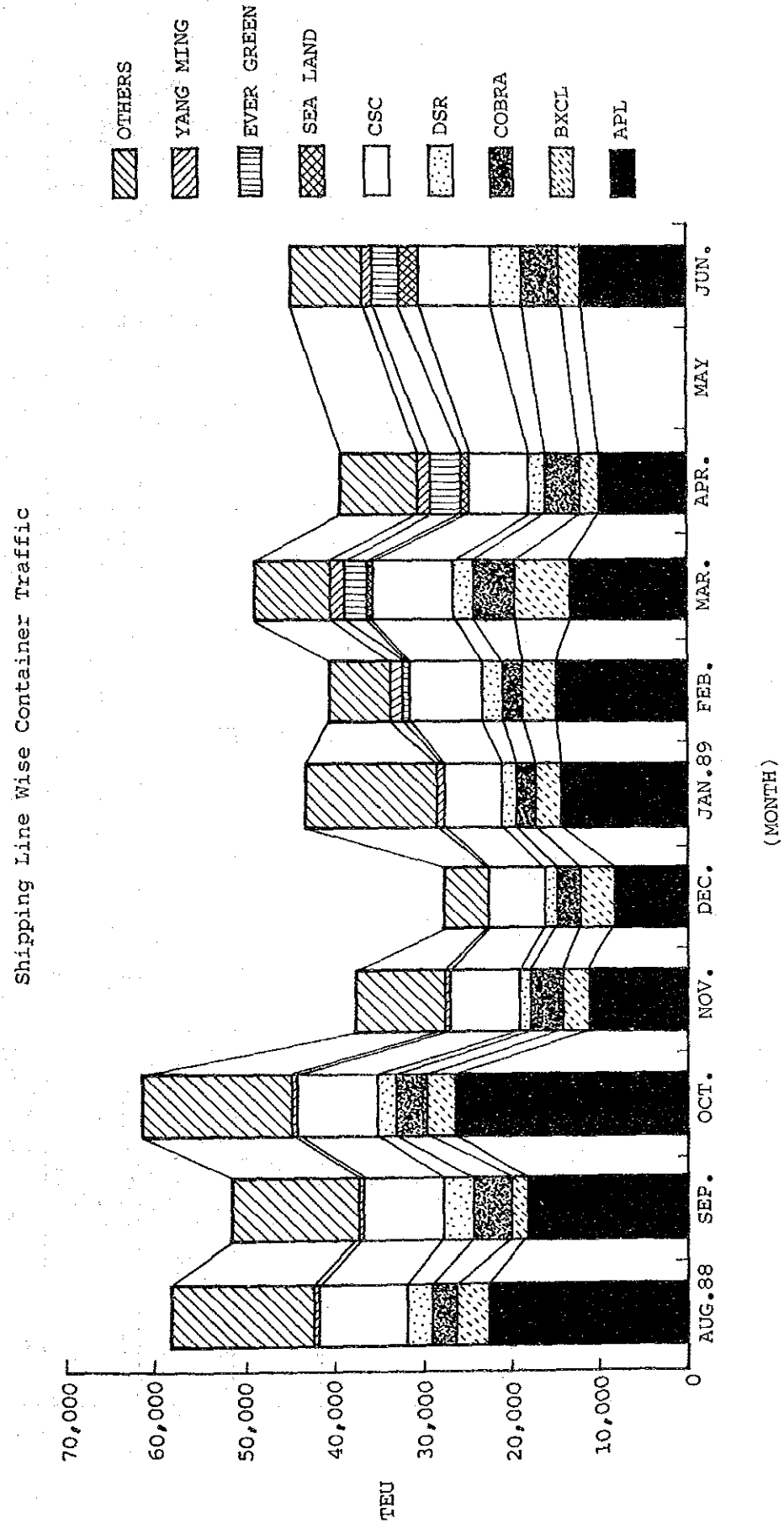
Shuwaikh				Shuaiba			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
19,038	40,336	59,374	166,010				
47,613	43,633	91,246	414,574				
64,511	57,745	122,256	852,543				
91,256	79,540	170,796	908,556				
114,543	108,683	223,226	1,153,762				
121,418	106,476	227,894	1,080,020	21,003	22,178	43,181	273,039
55,723	48,898	104,621	514,561	76,291	68,665	144,956	774,098
68,880	59,311	128,191	636,300	69,757	59,985	129,742	708,195
71,707	57,437	129,144	671,991	57,058	49,591	106,649	579,560
60,661	48,860	109,521	761,547	52,112	38,966	91,078	530,843
66,126	45,284	111,410	818,670	50,981	37,643	88,624	562,899
		117,178	684,120	61,138	41,605	102,743	679,683

Mina Qaboos				Dammam			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
						55,264	359,209
		4,566	52,100			158,445	932,103
6,390	5,557	11,947	83,100			211,250	1,392,375
9,577	8,960	18,537	127,021			250,956	1,650,935
15,270	13,638	28,908	187,660			286,510	1,936,546
23,359	20,753	44,112	293,817			344,062	2,270,588
36,257	29,644	65,901	430,602			400,273	2,640,362
52,705	37,470	90,175	619,689			363,741	2,446,348
65,955	45,641	111,596	798,387			253,288	1,895,242
71,572	39,063	110,635	829,725			206,707	1,793,615
112,502	26,754	139,256	1,183,021	154,578	68,052	222,630	1,983,400
117,813	30,069	147,882	1,113,785	148,471	59,807	208,278	1,927,313

Jeddah				Port Rashid			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
		219,128	1,445,806	35,254	20,084	55,338	679,653
		340,537	2,644,449	81,888	54,158	136,046	1,670,896
		496,390	3,785,752	98,195	71,630	169,825	2,085,765
		562,792	4,241,261			209,141	2,568,638
		618,012	4,420,585	137,697	99,323	237,020	2,872,635
		688,398	4,728,227	139,306	82,066	221,372	3,009,762
396,711	378,548	775,259	5,270,589	191,463	105,363	296,826	3,552,567
413,465	391,151	804,616	5,459,465	187,172	107,476	294,648	3,618,896
367,384	310,474	677,858	4,683,386	247,290	124,342	371,632	4,383,997
349,097	255,951	605,048	4,390,258	257,968	125,221	383,189	4,672,394
329,546	267,376	596,922	4,357,319	375,151	147,994	523,145	6,479,830
353,892	241,139	595,031	4,405,216	435,131	122,390	557,521	6,847,389

Appendix II-3-27
(Continued)

Fujairah				Khor Fakkan			
TEU			Tonnage	TEU			Tonnage
Loaded	Empty	Total		Loaded	Empty	Total	
121	515	636	1,545				
38,261	13,967	52,228	581,219				
66,450	16,103	82,553	935,294				
64,600	18,679	83,279	960,170			183,000	1,629,307
		188,129	1,651,295	50,676	19,724	70,400	653,412
145,073	57,820	202,893	1,684,500	86,351	37,873	124,224	1,079,387


Shipping Line Wise Container Traffic
OTHERS
YANG MING
EVER GREEN
SEA LAND
CSC
DSR
COBRA
BXCL
APL
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
TEU
AUG.88
SEP.
OCT.
NOV.
DEC.
JAN.89
FEB.
MAR.
APR.
MAY
JUN.
(MONTH)

Shipping Line Wise Container Traffic (Monthly)

(UNIT: TEU)

SHIPPING LINES	ITEMS	AUG.88	SEP.	OCT.	NOV.	DEC.	JAN.89	FEB.	MAR.	APR.
APL	NO.OF VESSELS	18	14	15	10	10	14	16	17	21
	NO.OF CONTAINERS	22,804	18,720	27,022	11,842	9,029	15,315	15,864	14,187	10,971
	SHARE(%)	39%	36%	43%	31%	32%	35%	38%	28%	27%
	PER VESSEL	1,267	1,337	1,801	1,184	903	1,094	992	835	522
BXCL	NO.OF VESSELS	9	4	7	8	9	11	11	17	7
	NO.OF CONTAINERS	3,848	1,642	3,170	3,128	3,868	2,843	3,760	6,112	1,966
	SHARE(%)	7%	3%	5%	8%	14%	6%	9%	12%	5%
	PER VESSEL	428	411	453	391	430	258	342	360	281
COBRA	NO.OF VESSELS	3	5	3	4	5	4	3	10	7
	NO.OF CONTAINERS	2,657	4,612	3,292	3,651	2,716	2,133	2,278	4,873	4,104
	SHARE(%)	5%	9%	5%	9%	10%	5%	5%	10%	10%
	PER VESSEL	886	922	1,097	913	543	533	759	487	586
DSR	NO.OF VESSELS	6	6	5	3	3	6	5	5	5
	NO.OF CONTAINERS	2,904	3,187	2,108	987	1,474	1,551	2,191	2,262	1,726
	SHARE(%)	5%	6%	3%	3%	5%	4%	5%	5%	4%
	PER VESSEL	484	531	422	329	491	259	438	452	345
CSC	NO.OF VESSELS	14	13	16	11	11	12	12	15	12
	NO.OF CONTAINERS	9,839	9,140	9,184	8,310	6,465	6,628	8,003	9,172	6,724
	SHARE(%)	17%	18%	15%	22%	23%	15%	19%	18%	17%
	PER VESSEL	703	703	574	755	588	552	667	611	560
SEA LAND	NO.OF VESSELS	2	2	1	1		2	2	2	3
	NO.OF CONTAINERS	442	381	296	478		469	309	327	1,120
	SHARE(%)	1%	1%	0%	1%		1%	1%	1%	3%
	PER VESSEL	221	191	296	478		235	155	164	373
EVER GREEN	NO.OF VESSELS							3	10	11
	NO.OF CONTAINERS							717	2,738	3,242
	SHARE(%)							2%	5%	8%
	PER VESSEL							239	274	295
YANG MING	NO.OF VESSELS						6	9	9	9
	NO.OF CONTAINERS						451	1,344	1,481	1,574
	SHARE(%)						1%	3%	3%	4%
	PER VESSEL						75	149	165	175
OTHERS	NO.OF VESSELS	58	42	54	38	39	48	49	49	50
	NO.OF CONTAINERS	16,282	14,289	17,096	10,108	5,023	14,655	7,160	8,874	8,885
	SHARE(%)	28%	27%	27%	26%	18%	33%	17%	18%	22%
	PER VESSEL	281	340	317	266	129	305	146	181	178
TOTAL	NO.OF VESSELS	110	86	101	75	77	103	110	134	125
	NO.OF CONTAINERS	58,776	51,971	62,168	38,504	28,575	44,045	41,626	50,026	40,312
	SHARE(%)	100%	100%	100%	100%	100%	100%	100%	100%	100%
	PER VESSEL	534	604	616	513	371	428	378	373	322

Appendix II-4-1 Newly Introduced Vessels with More Than 3000 TEU in 1989

Operator	TEU	ROUTE
K LINE	3,450	FE, J/E
ditto	3,450	ditto
MAERSK	4,000	FE/PSW/ECNA/E
ditto	4,200	ditto
ditto	4,200	ditto
NOL	3,502	FE, J/E
ditto	3,300	ditto
OOCL	3,800	ditto
ditto	3,494	ditto
P & OCL	3,610	J, KO,TW,HK/E
ditto	3,610	TW,HK,SP,MY/E

Note:

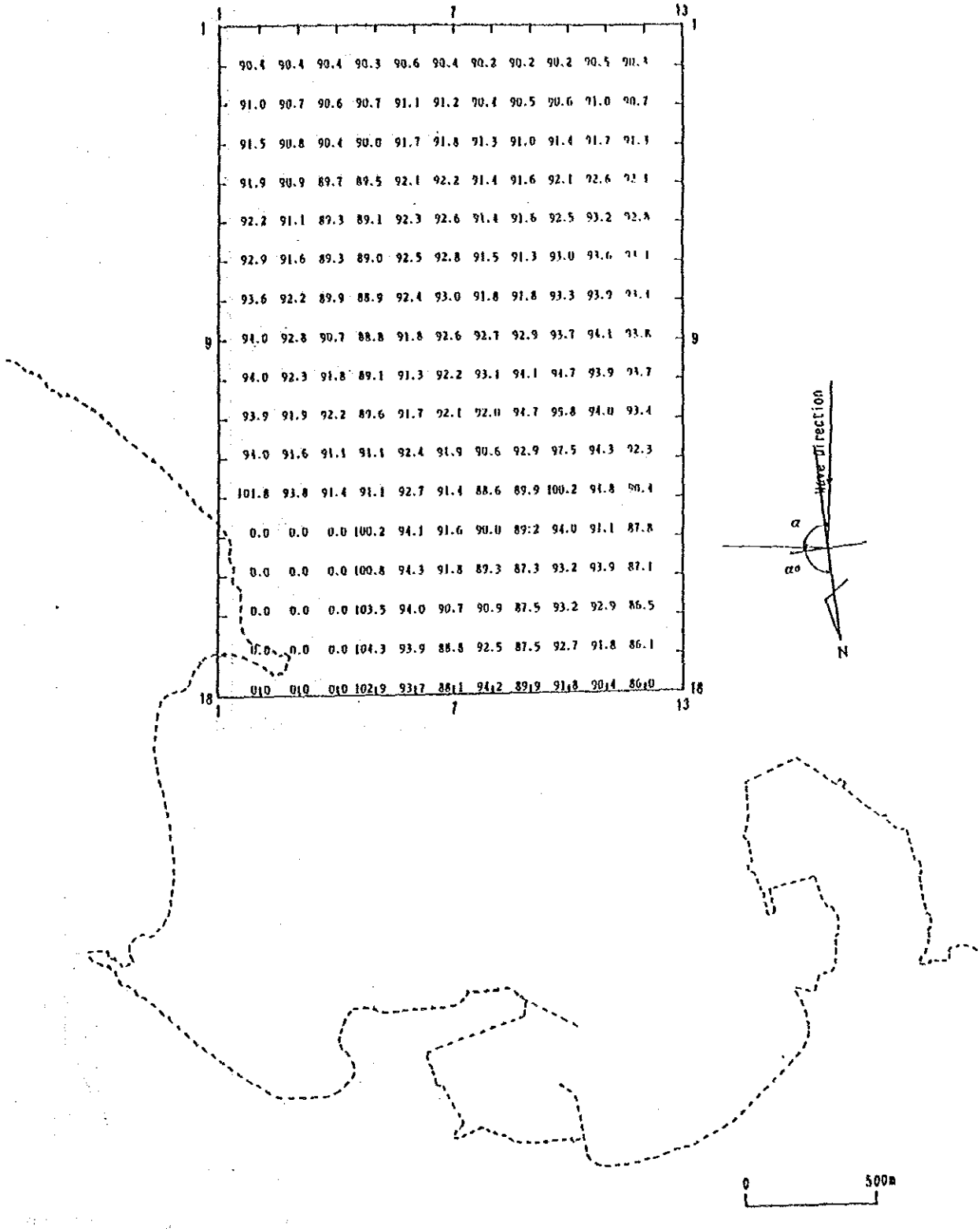
FE: Far East
J: Japan
E: Europe
PSW: Pacific South West
ECNA: East Coast of North America
KO: Korea
TW: Taiwan
HK: Hong Kong
SP: Singapore
MY: Malaysia

Appendix II-4-2 New Building Orders of Container Vessel by Size

	1987			1988			1989		
TEU Class	VSL (%)	DWT	TEU (%)	VSL (%)	DWT	TEU (%)	VSL (%)	DWT	TEU (%)
Under 1000	35 (47)	436,310	15,995 (13)	21 (34)	234,136	12,321 (13)	29 (22)	463,560	14,528 (6)
1000 ~1999	6 (8)	174,200	11,080 (9)	20 (33)	315,810	21,498 (22)	56 (42)	1,081,820	73,319 (32)
2000 ~2999	19 (26)	741,840	46,930 (37)	10 (16)	385,000	27,140 (28)	30 (23)	1,224,760	78,300 (34)
3000 ~3999	11 (15)	563,400	38,484 (31)	7 (12)	322,587	24,550 (25)	11 (8)	547,860	37,100 (16)
4000 ~over	3 (4)	165,000	12,000 (10)	3 (5)	181,917	12,000 (12)	6 (5)	330,000	26,425 (12)
Total	74 (100)	2,080,750	124,489 (100)	61 (100)	1,439,450	97,509 (100)	132 (100)	3,648,000	229,672 (100)

Deep Water Wave Direction S 6°W

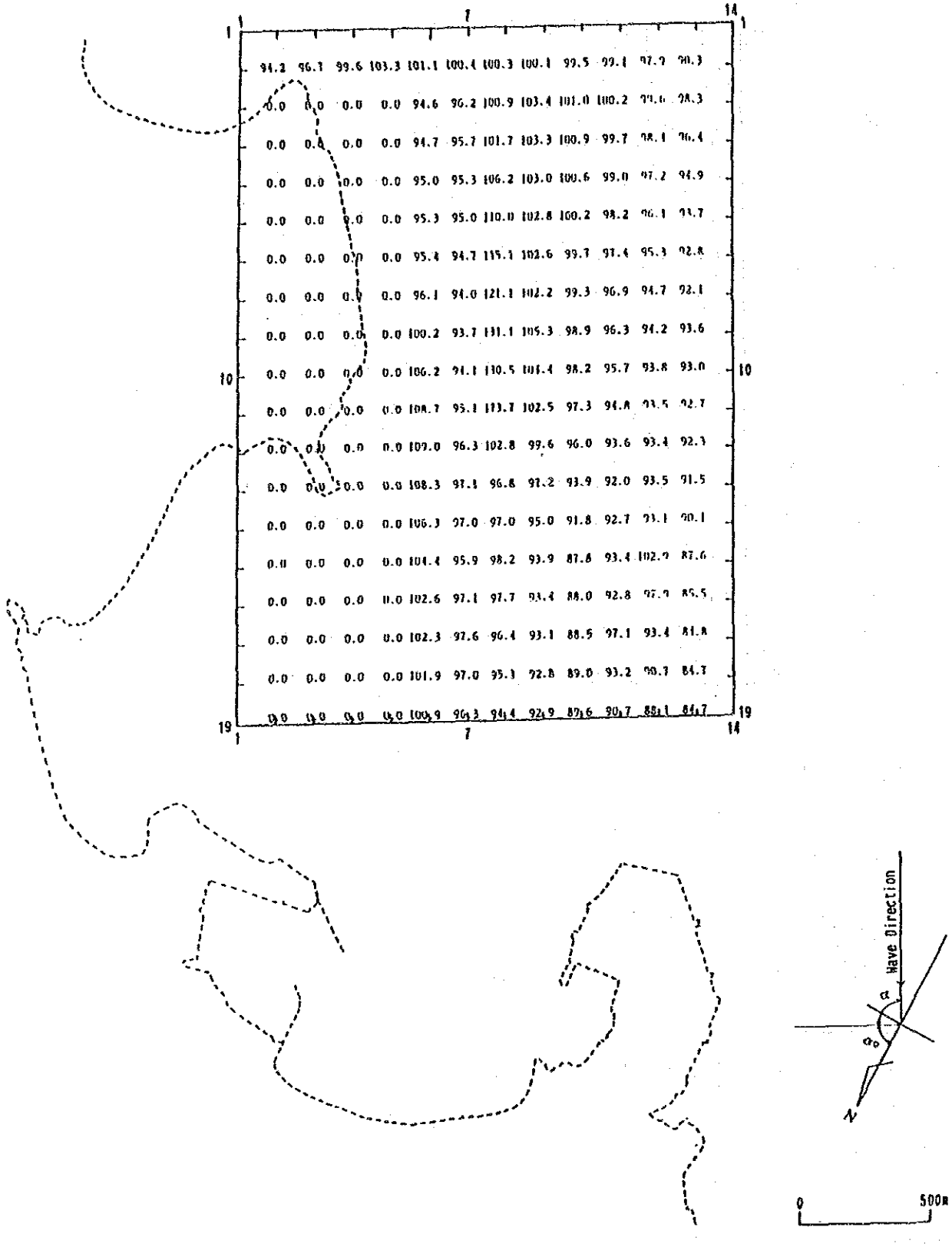
$T_{1/3}$=13.0sec, α_0=99.0°



Appendix II-4-3(1) Refraction Diagram

Deep Water Wave Direction ESE

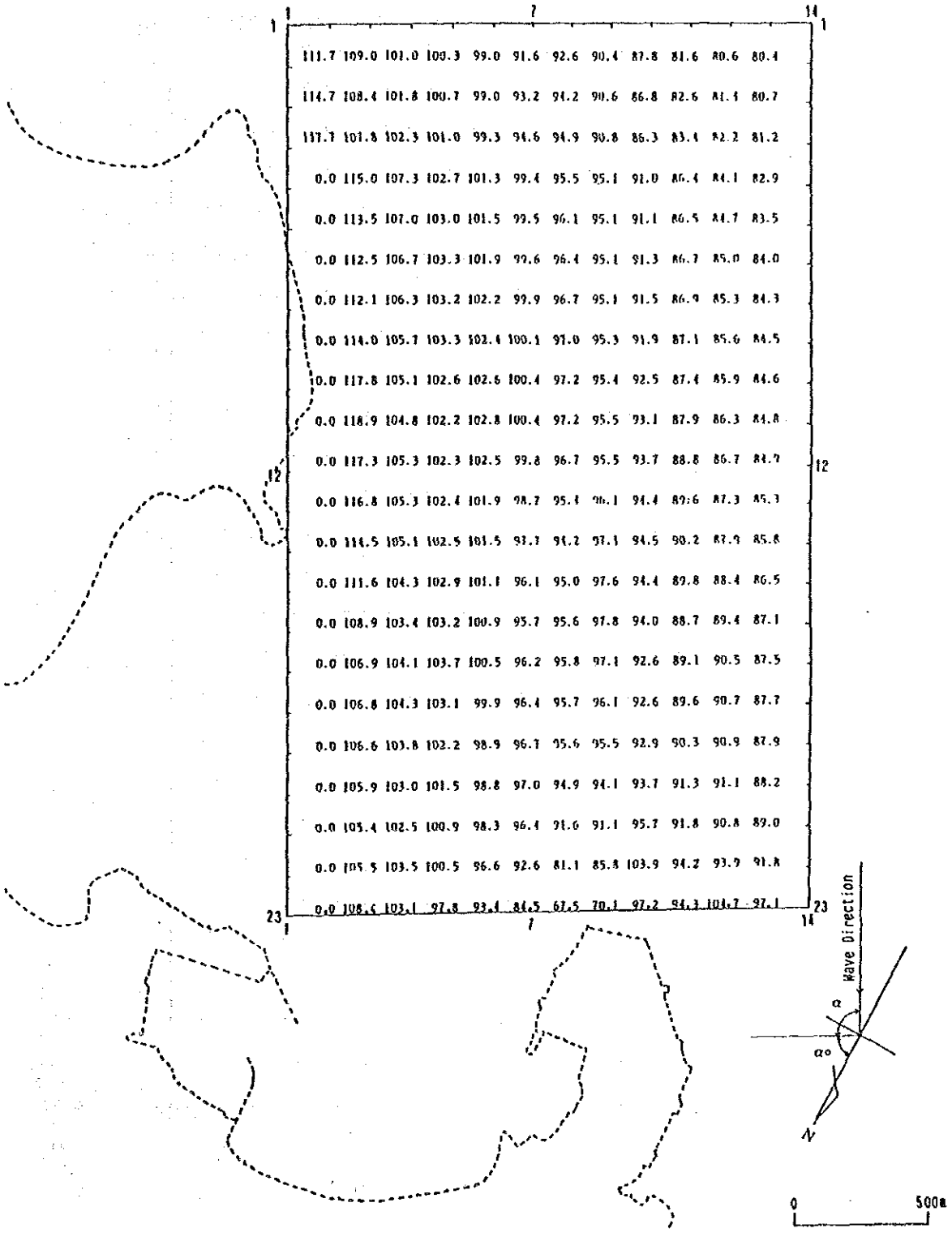
$T_{1/3}$= 7.0sec, α_0=61.0°



Appendix II-4-3(2) Refraction Diagram

Deep Water Wave Direction SE

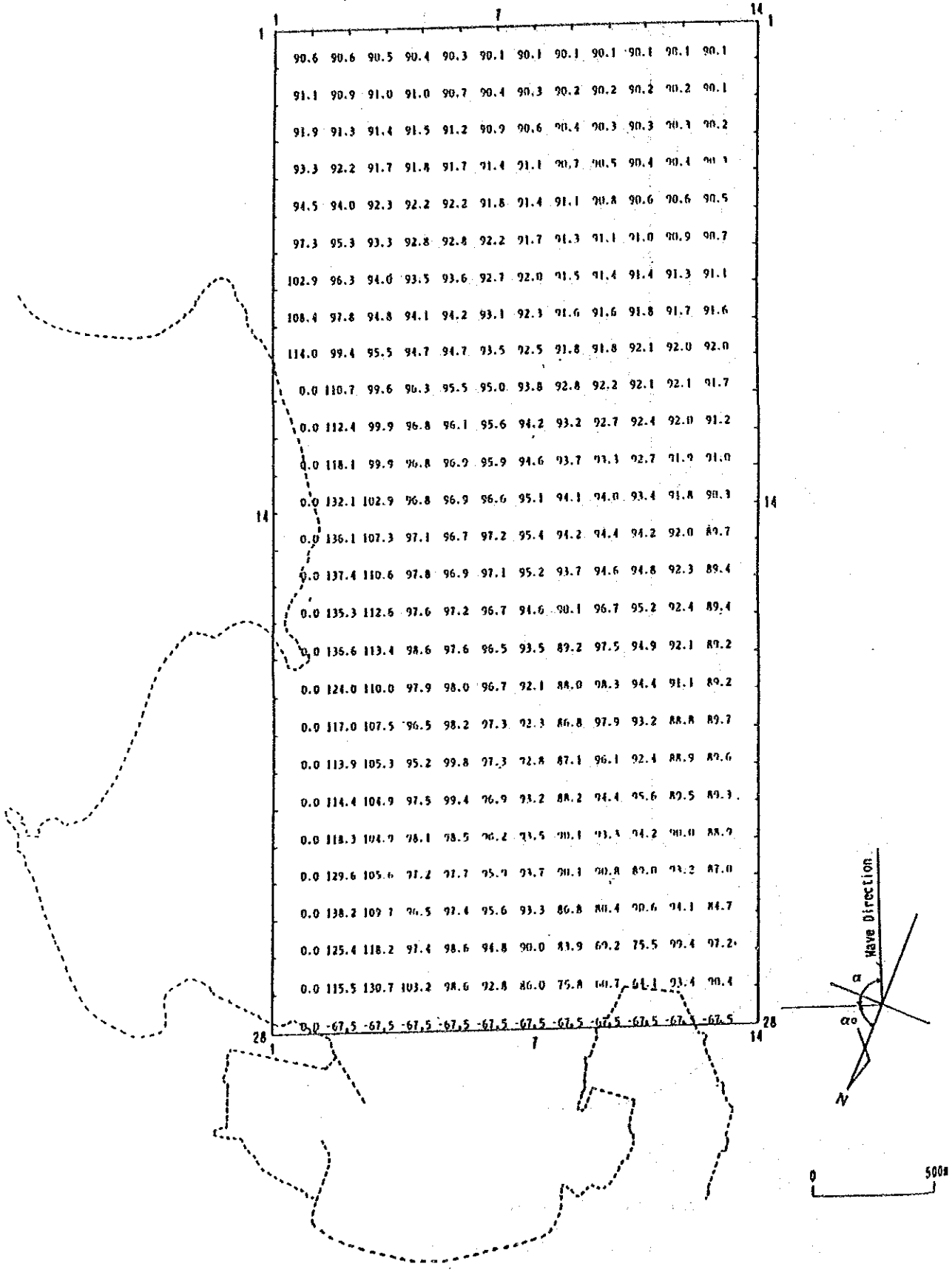
$T_{1/3}$= 7.0sec, α_0=62.0°



Appendix II-4-3(3) Refraction Diagram

Deep Water Wave Direction SSE

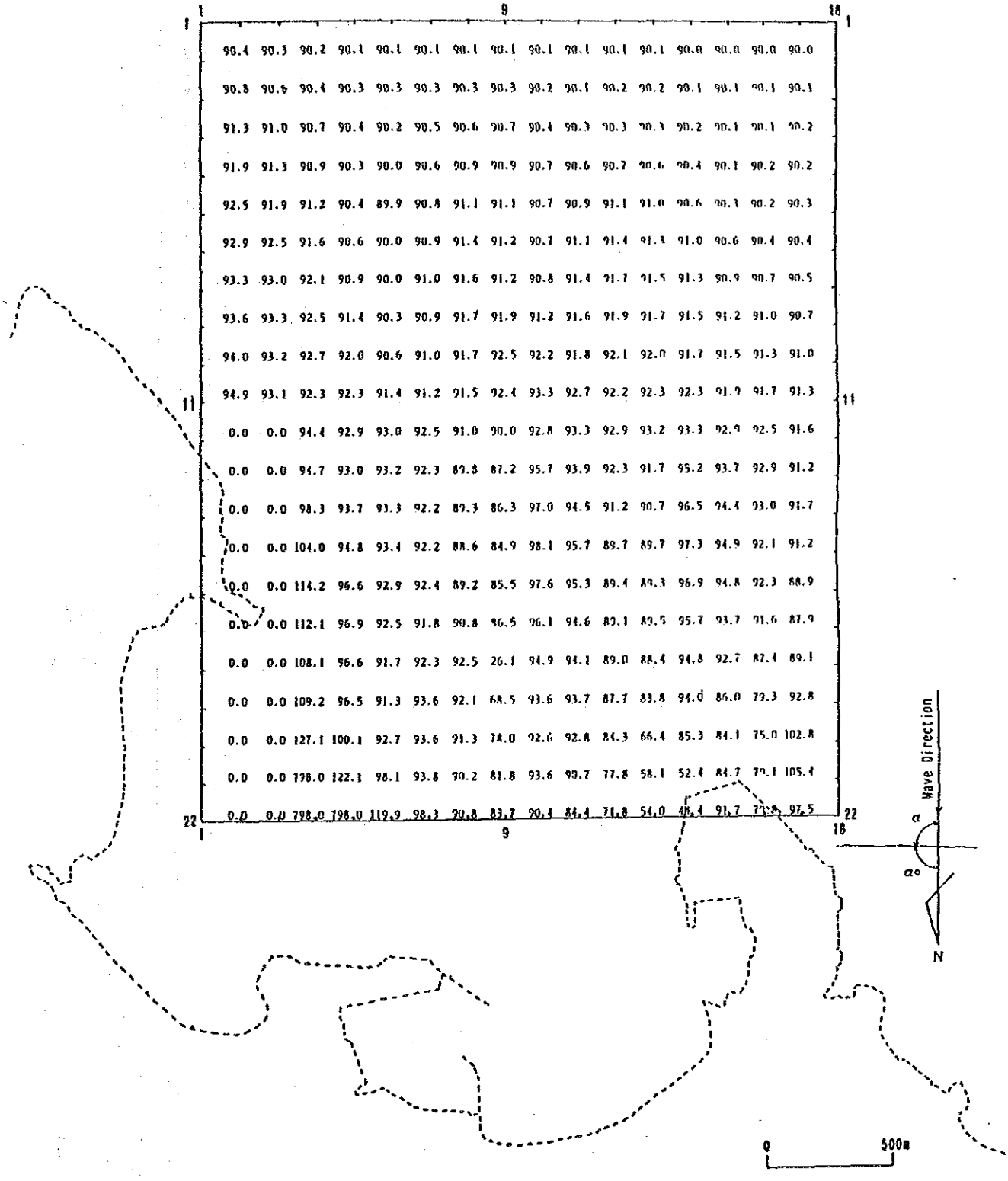
$T_{1/3}$= 7.0sec, α_0=67.5°



Appendix II-4-3(4) Refraction Diagram

Deep Water Wave Direction S

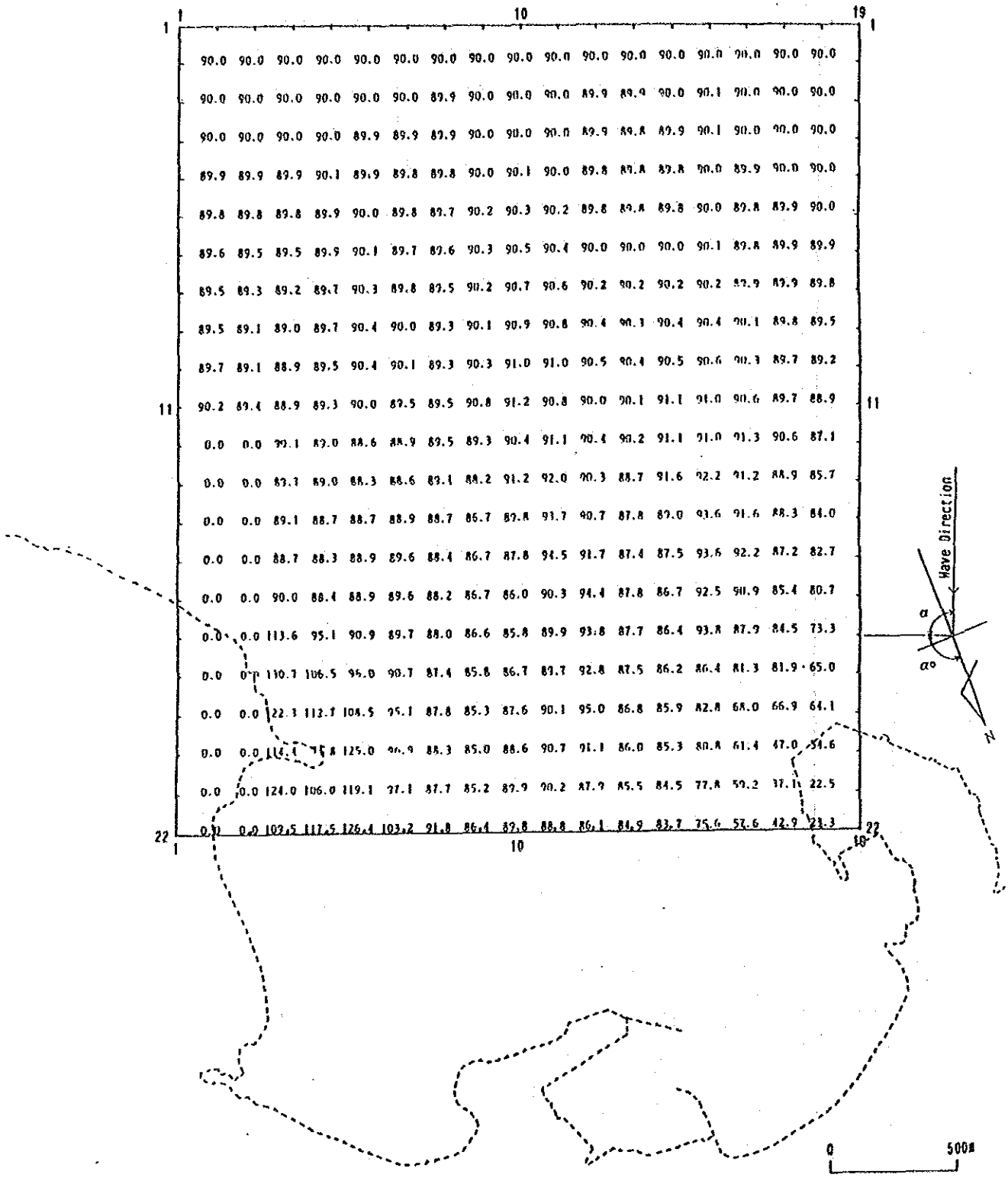
$T_{1/3}$=13.0sec, α_0=90.0°



Appendix II-4-3(5) Refraction Diagram

Deep Water Wave Direction SSW

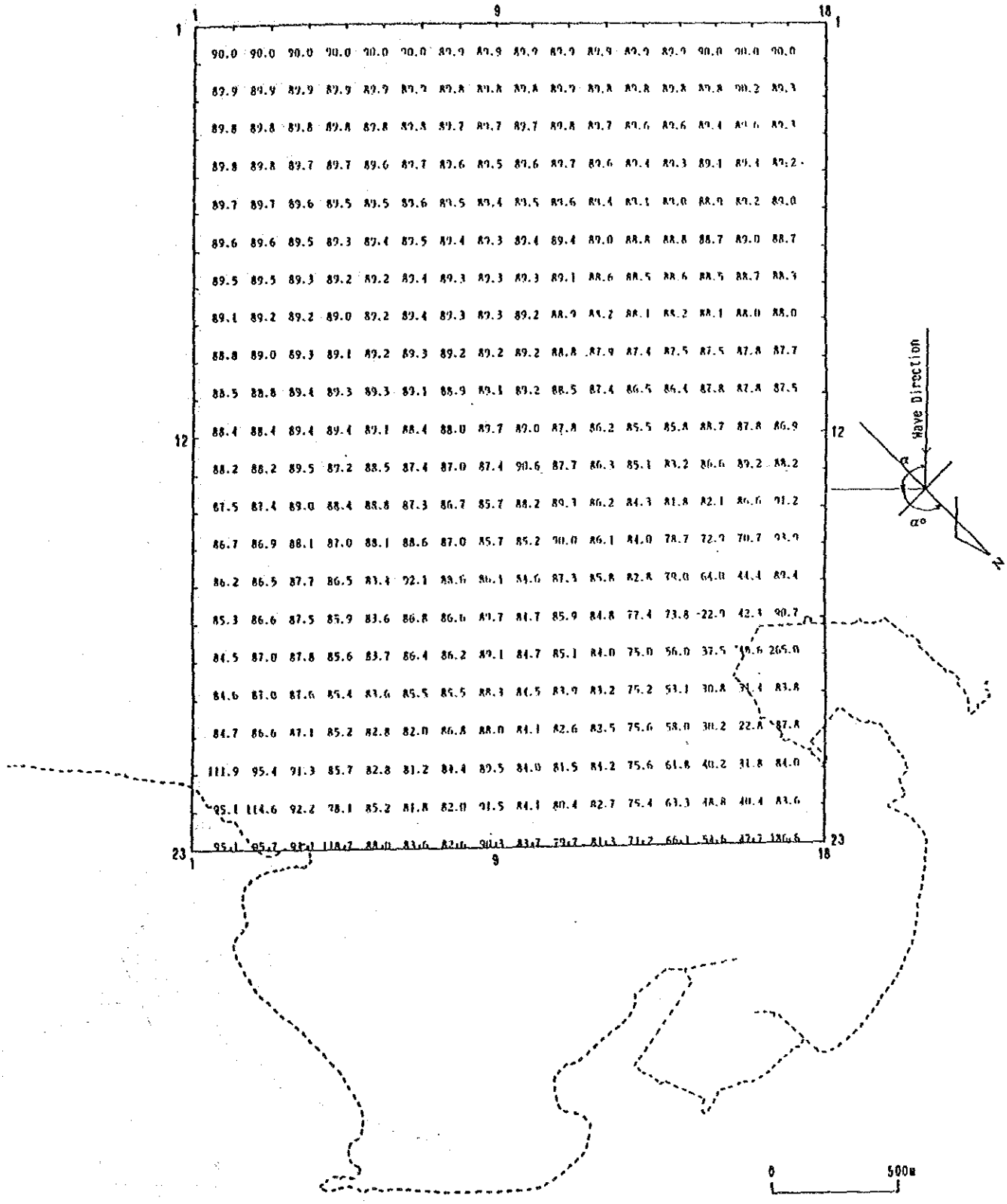
$T_{1/3}$= 7.0sec, α_0=112.5°



Appendix II-4-3(6) Refraction Diagram

Deep Water Wave Direction SW

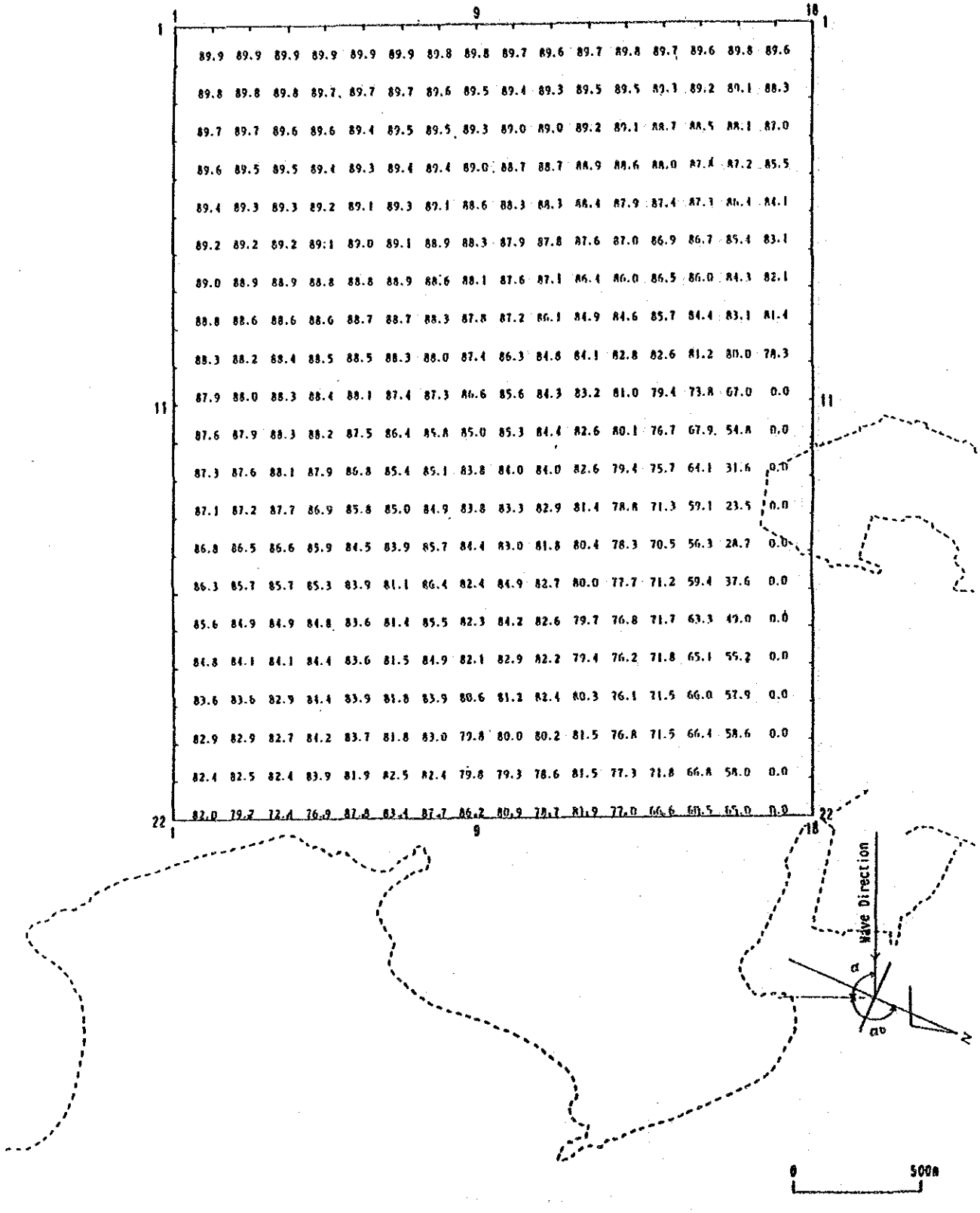
$T_{1/3}$= 7.0sec, α_0=135.0°



Appendix II-4-3(7) Refraction Diagram

Deep Water Wave Direction WSW

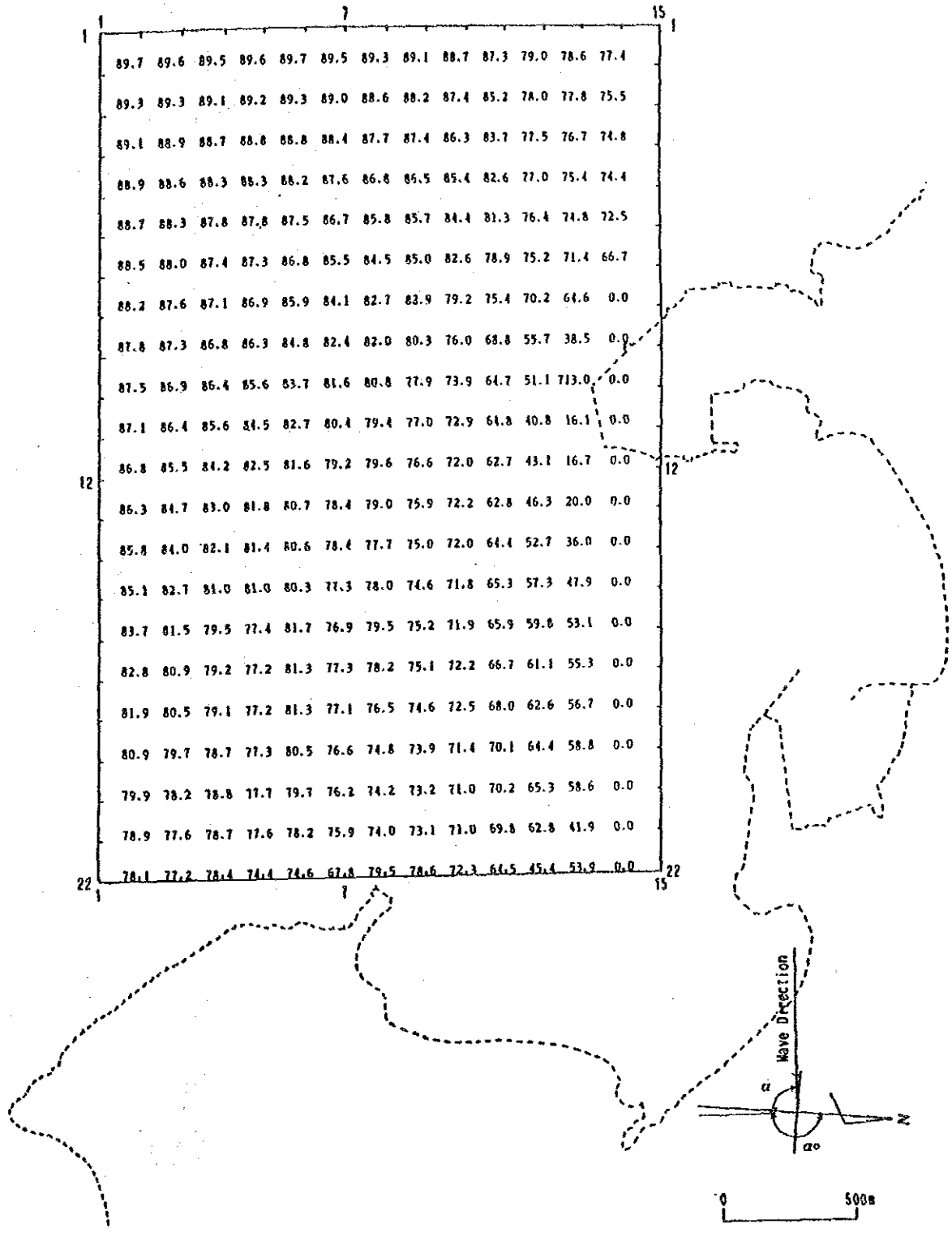
$T_{1/3}$= 7.0sec, α_0=157.5°



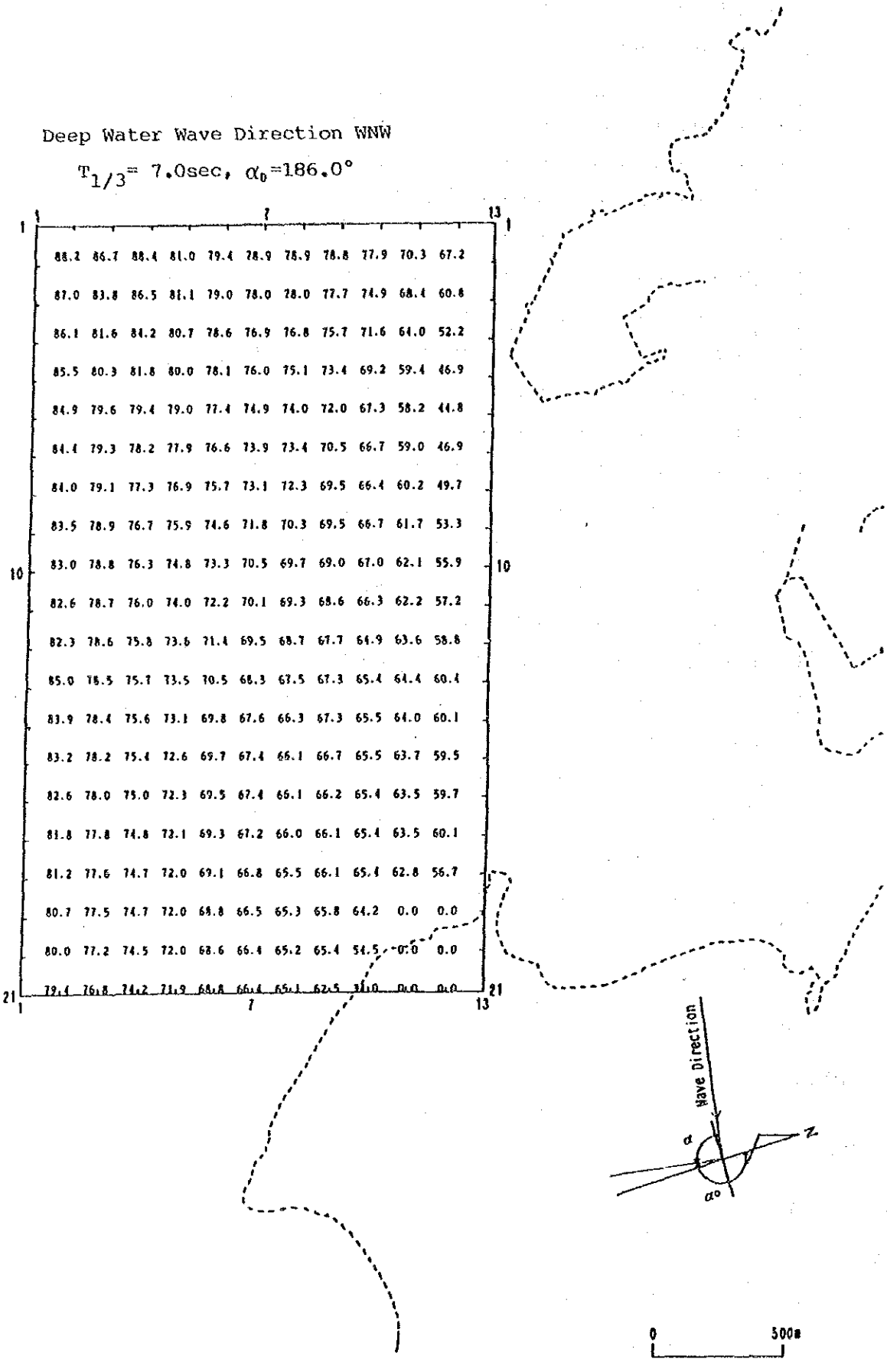
Appendix II-4-3(8) Refraction Diagram

Deep Water Wave Direction W

$T_{1/3}$= 7.0sec, α_0=175.0°



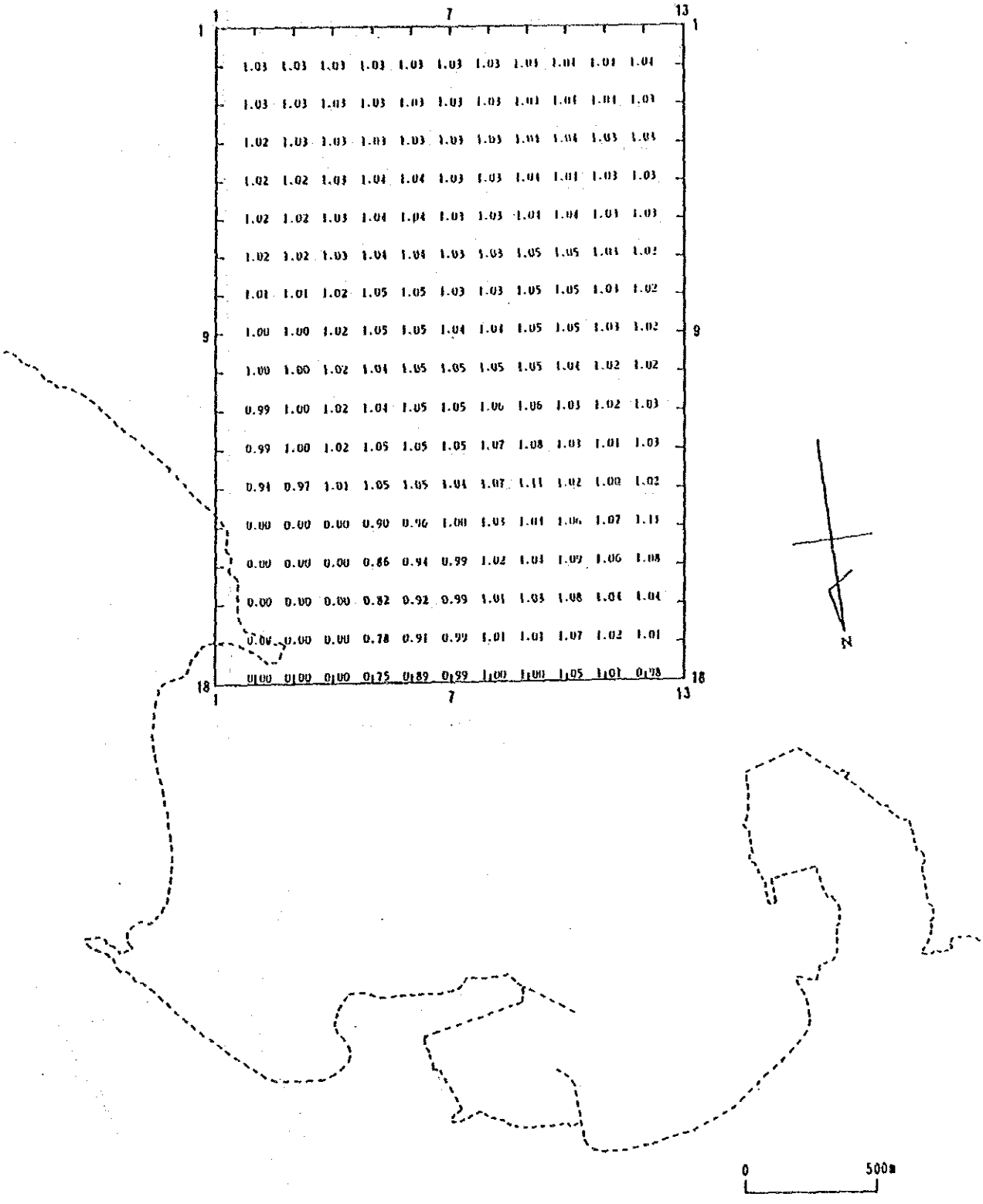
Appendix II-4-3(9) Refraction Diagram



Appendix II-4-3(10) Refraction Diagram

Deep Water Wave Direction S 6°W

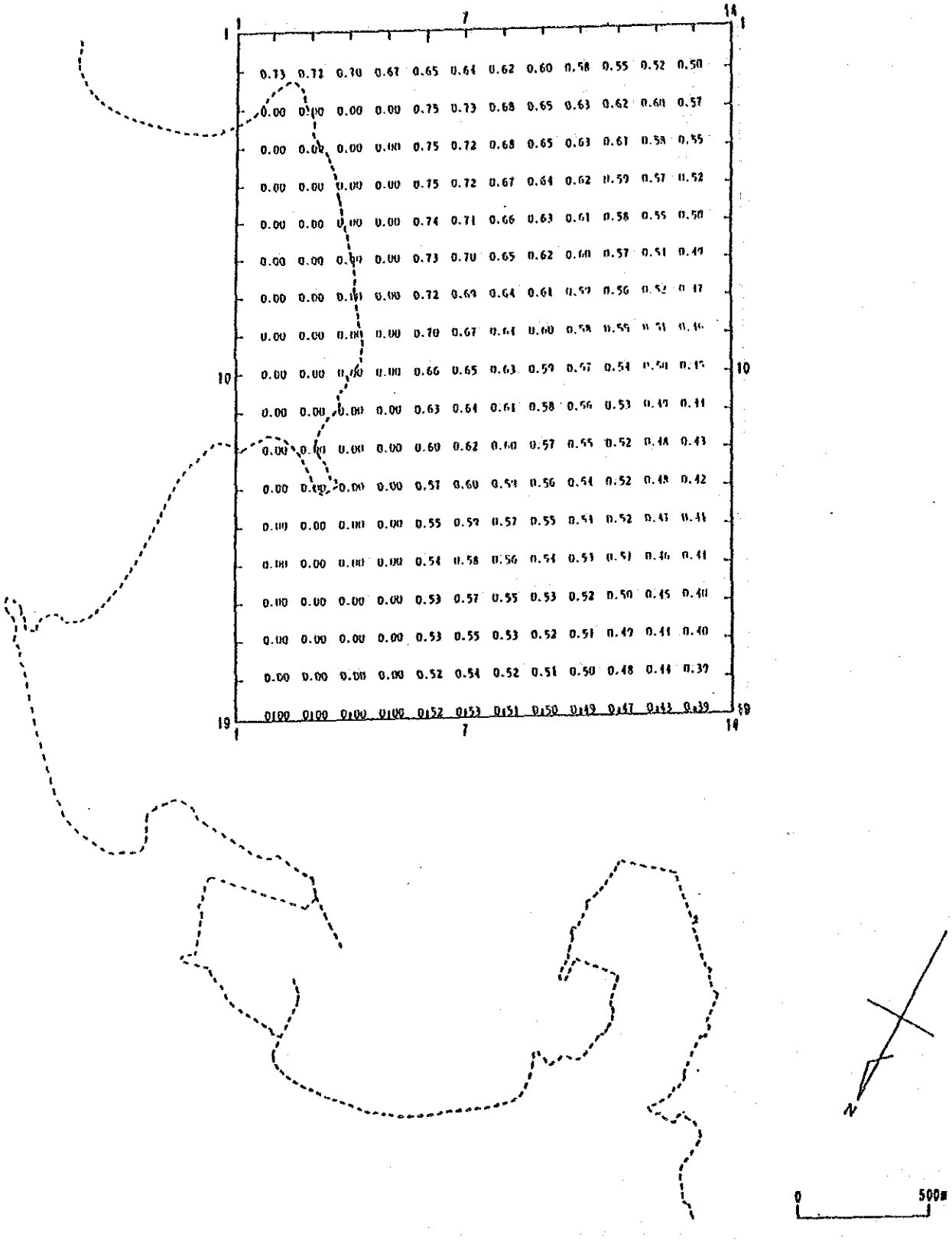
$T_{1/3}$=13.0sec



Appendix II-4-4(1) Coefficient of Refraction

Deep Water Wave Direction ESE

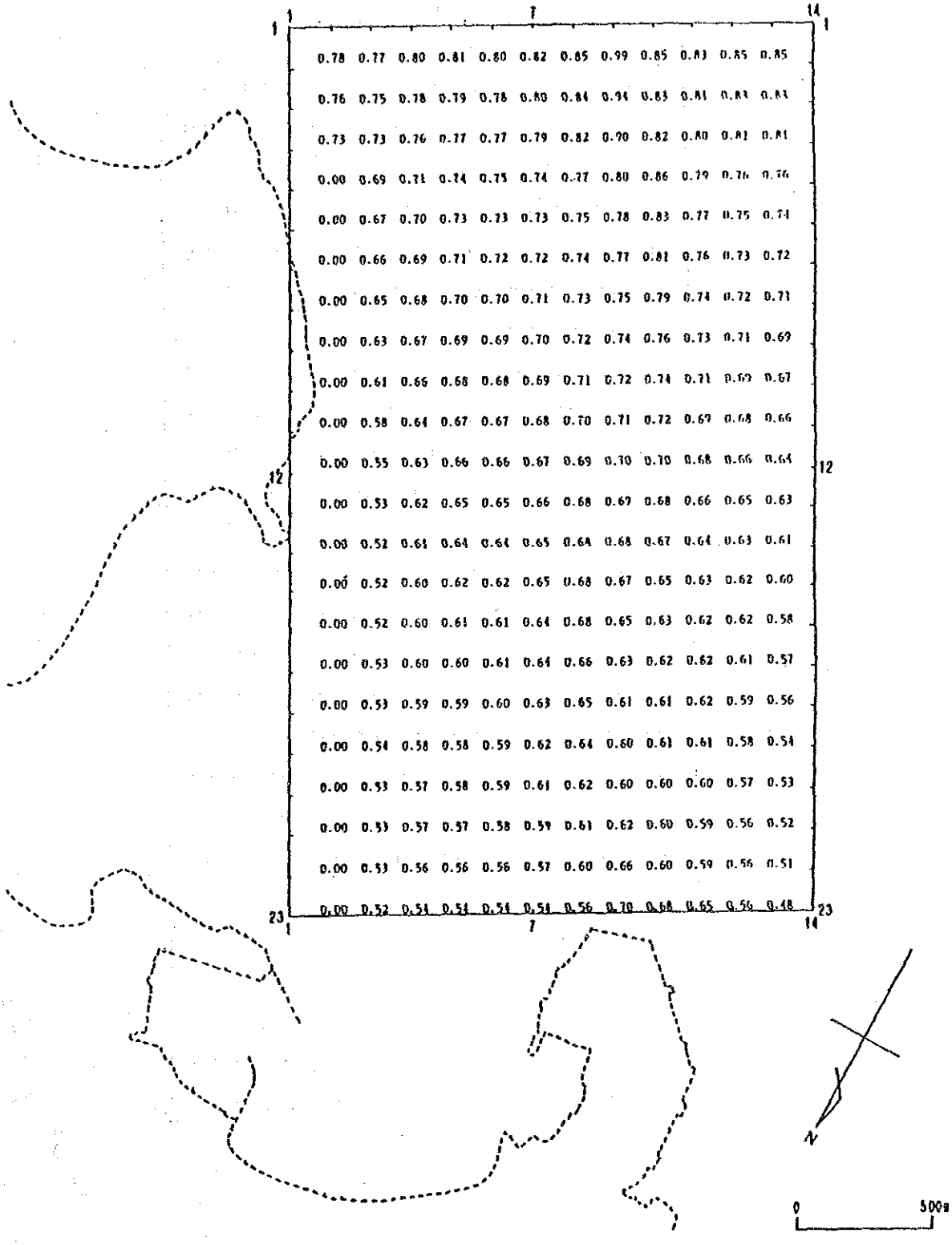
$T_{1/3}$= 7.0sec



Appendix II-4-4(2) Coefficient of Refraction

Deep Water Wave Direction SE

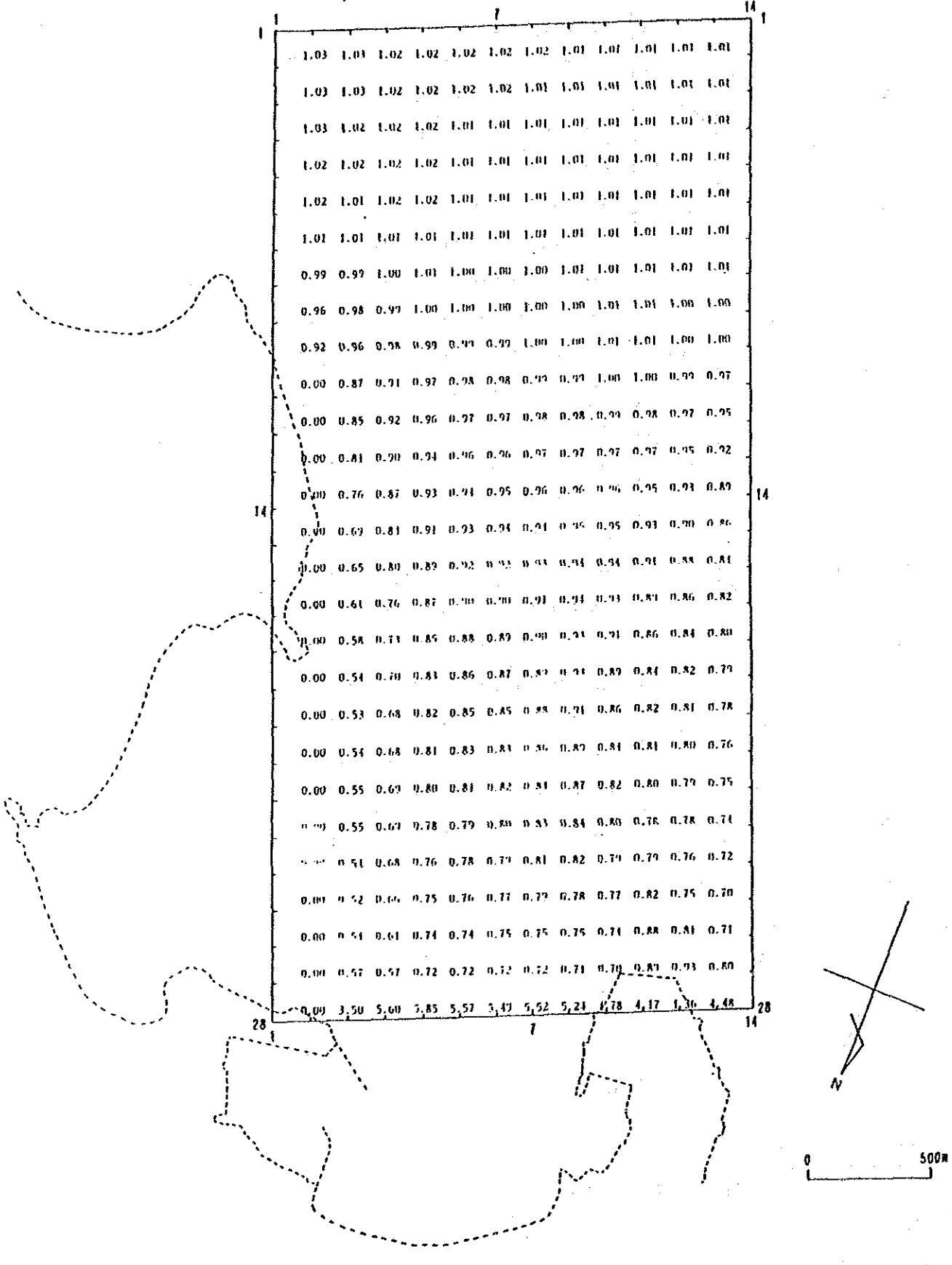
$T_{1/3}$= 7.0sec



Appendix II-4-4(3) Coefficient of Refraction

Deep Water Wave Direction SSE

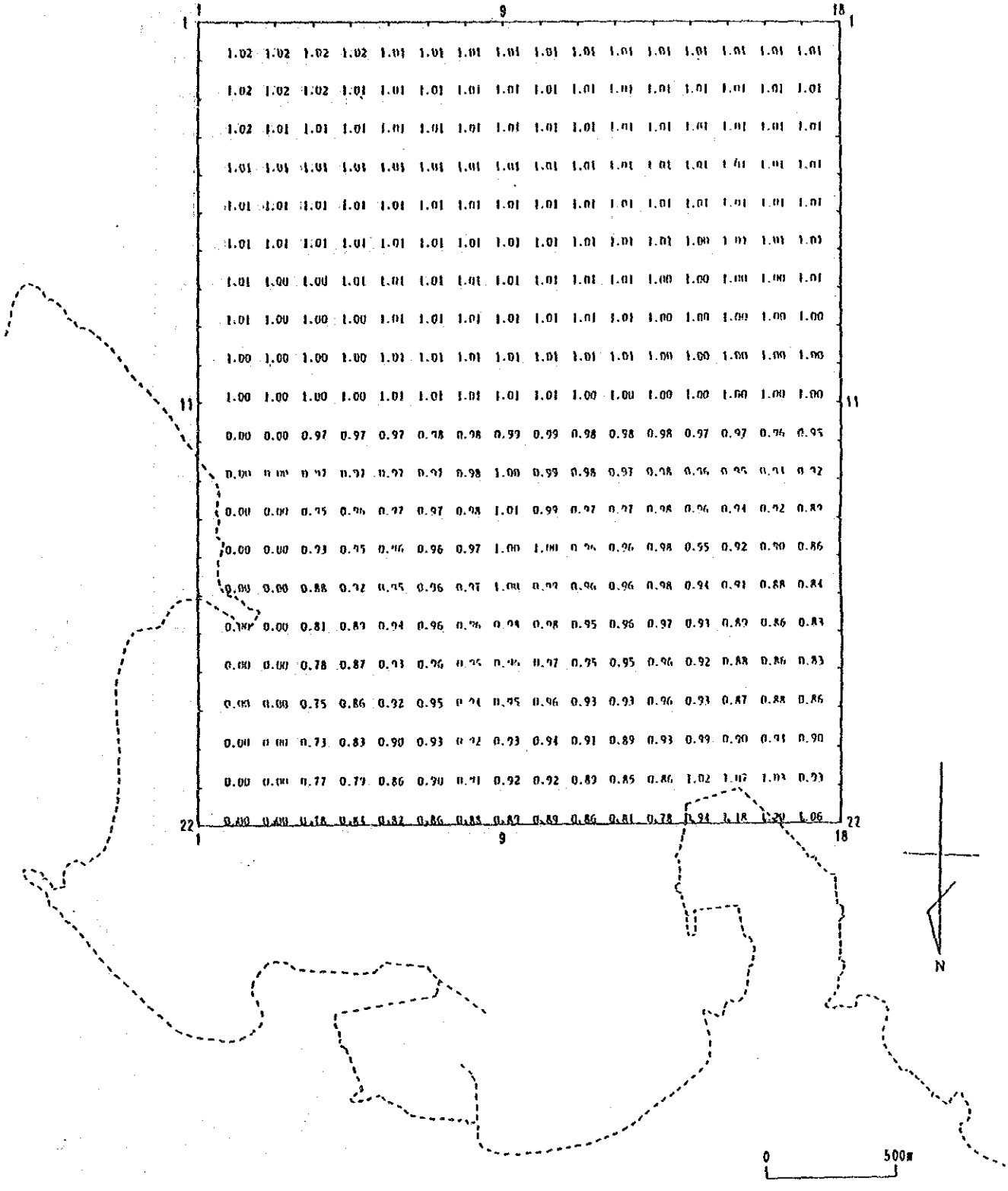
$T_{1/3}$= 7.0sec



Appendix II-4-4(4) Coefficient of Refraction

Deep Water Wave Direction S

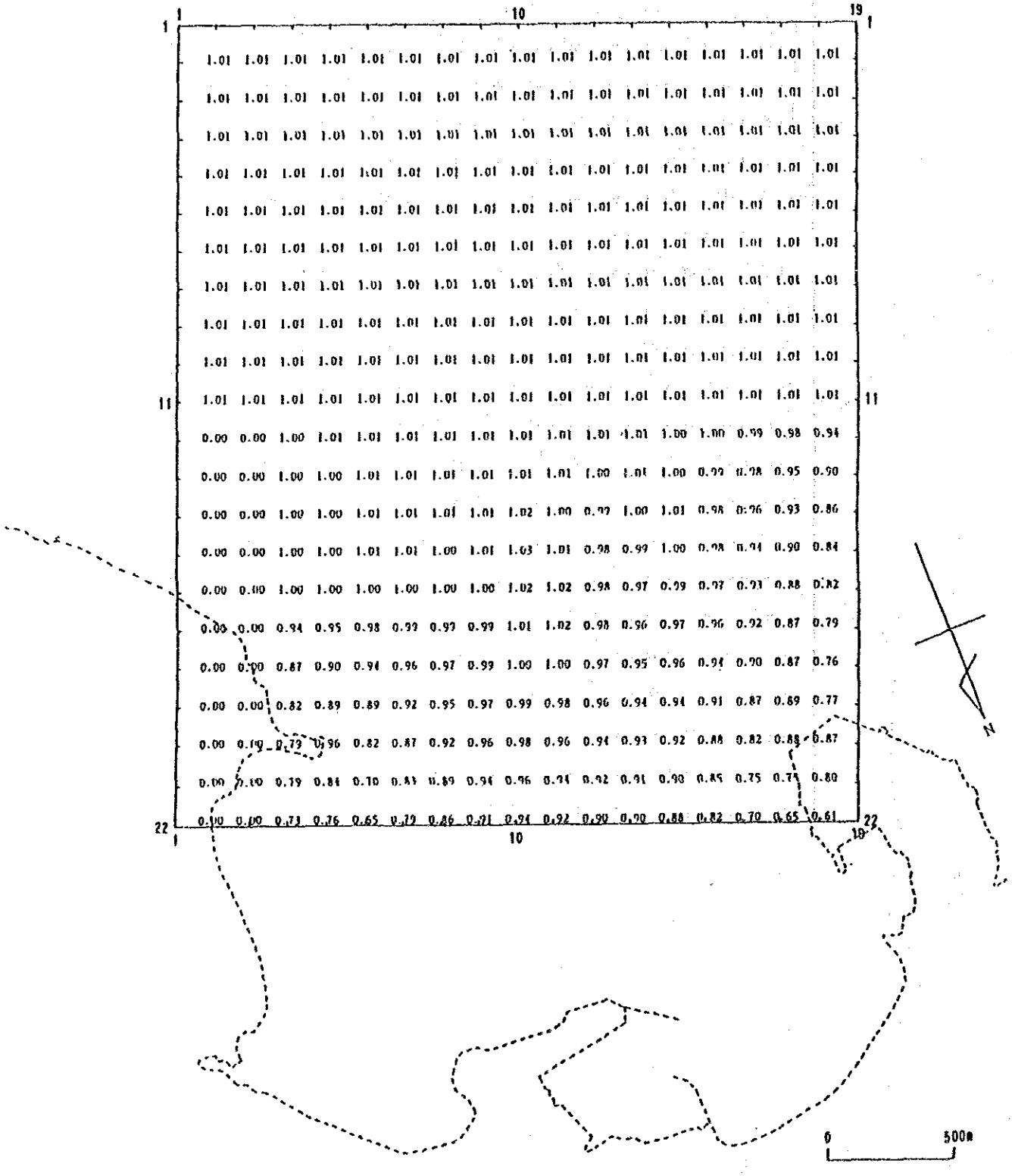
$T_{1/3}$=13.0sec



Appendix II-4-4(5) Coefficient of Refraction

Deep Water Wave Direction SSW

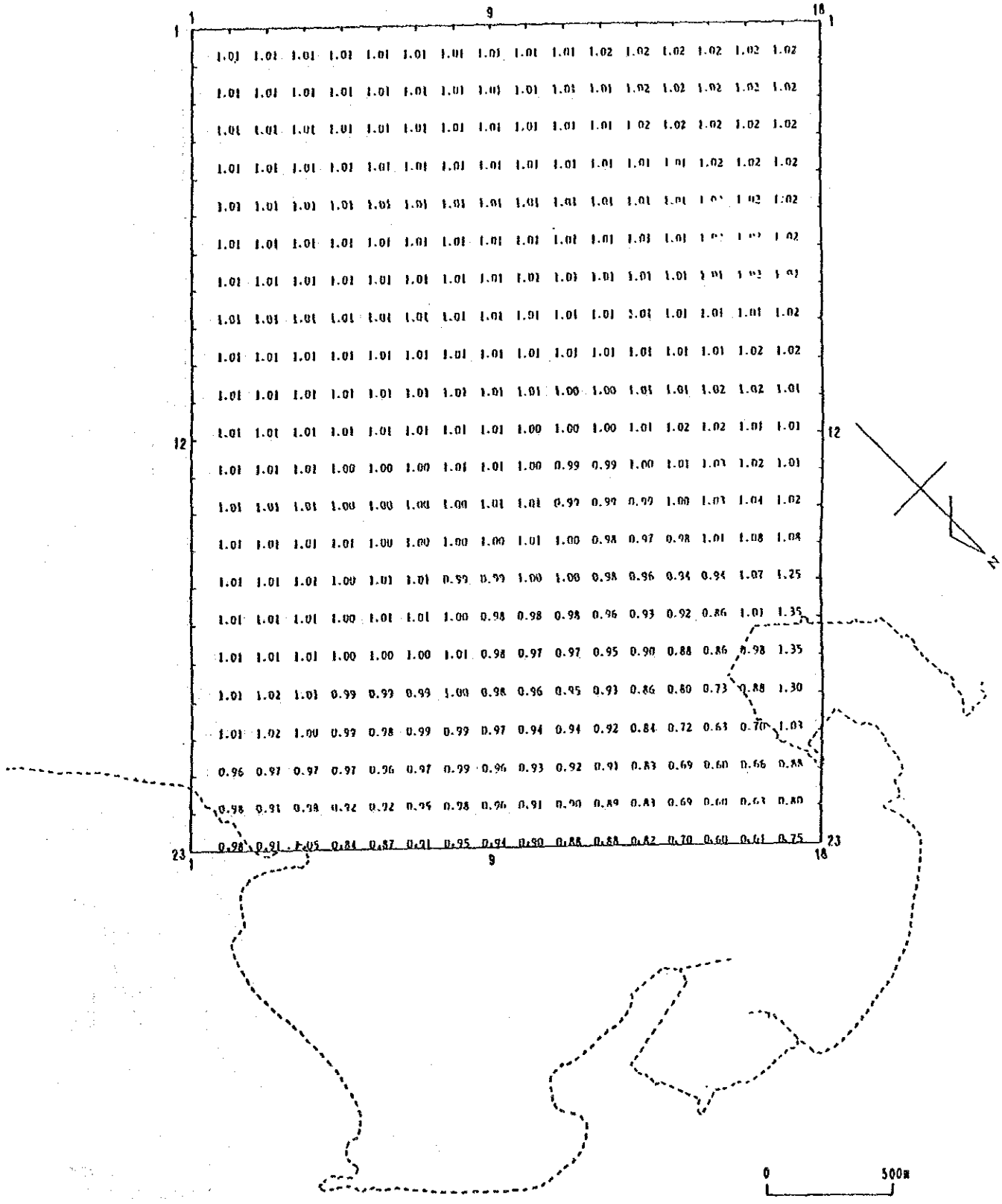
$T_{1/3}$= 7.0sec



Appendix II-4-4(6) Coefficient of Refraction

Deep Water Wave Direction SW

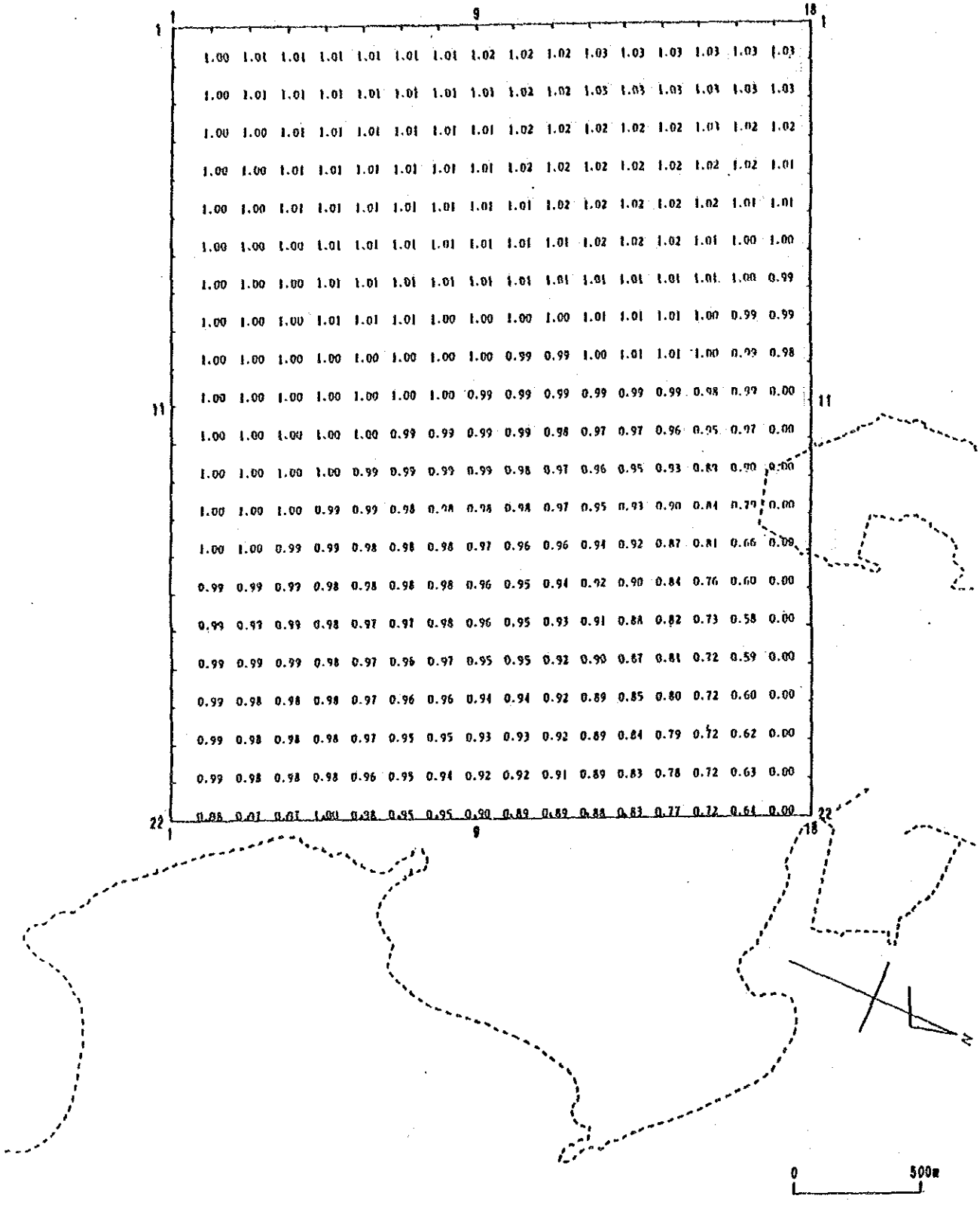
$T_{1/3}$= 7.0sec



Appendix II-4-4(7) Coefficient of Refraction

Deep Water Wave Direction WSW

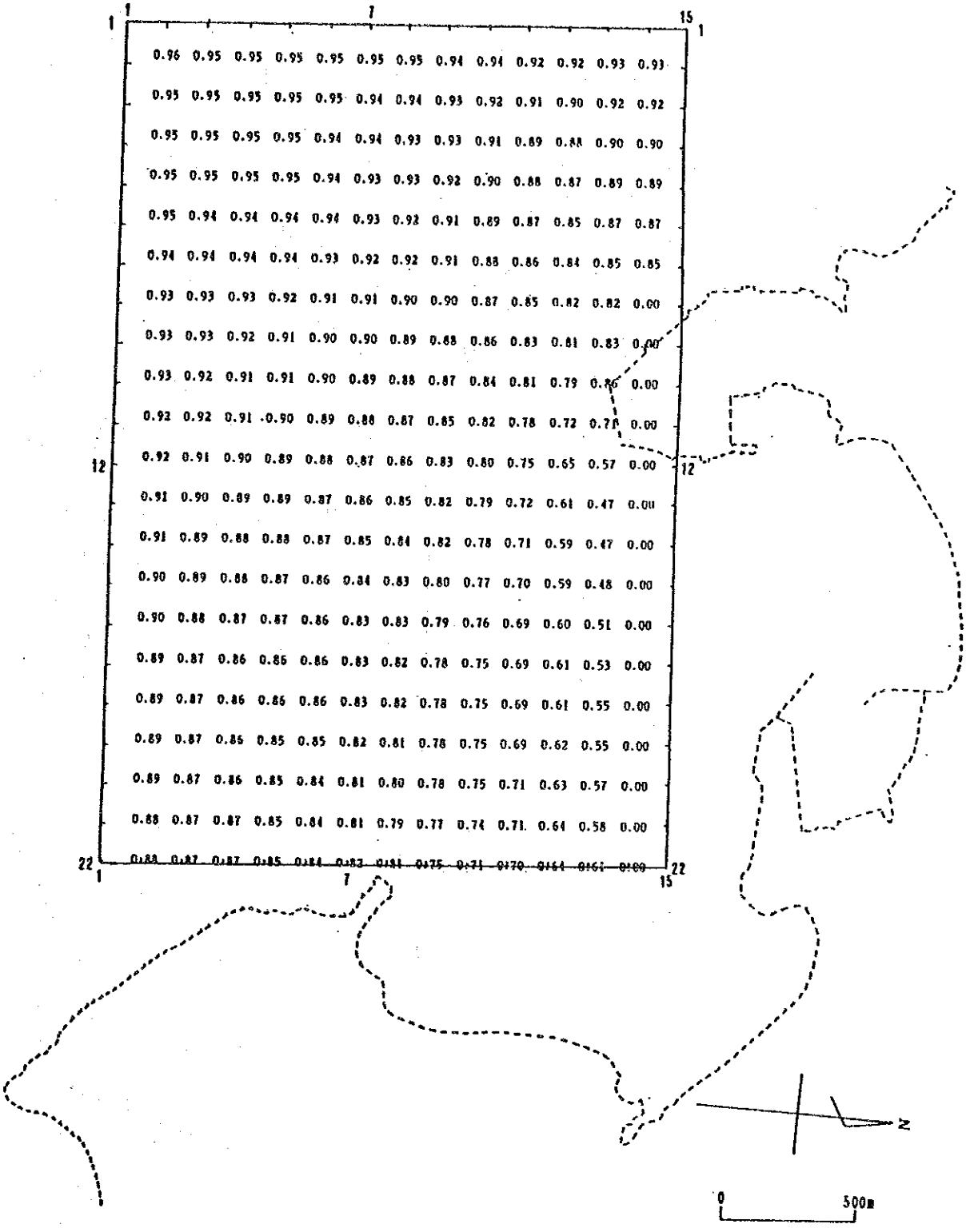
$T_{1/3}$= 7.0sec



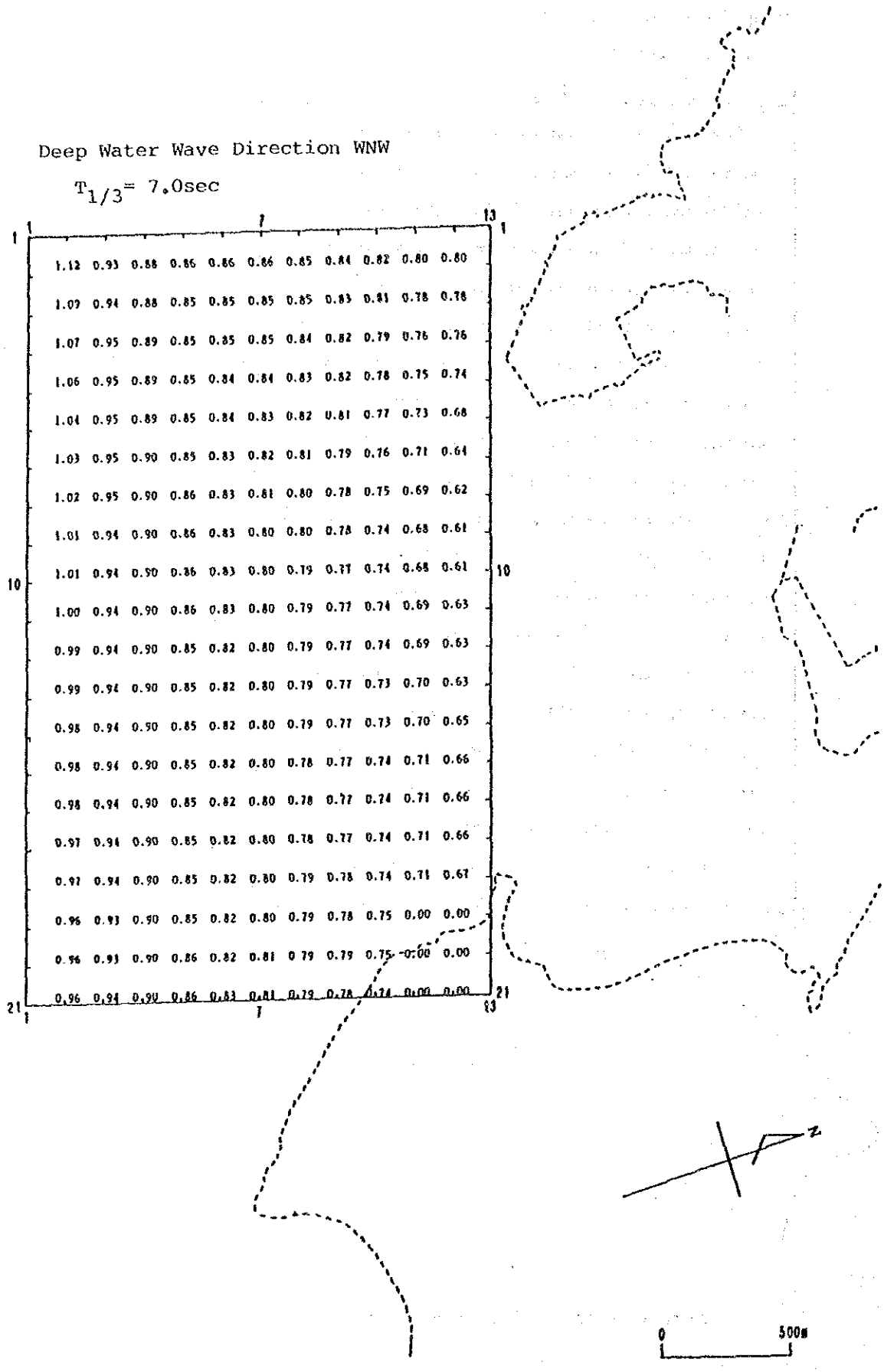
Appendix II-4-4(8) Coefficient of Refraction

Deep Water Wave Direction W

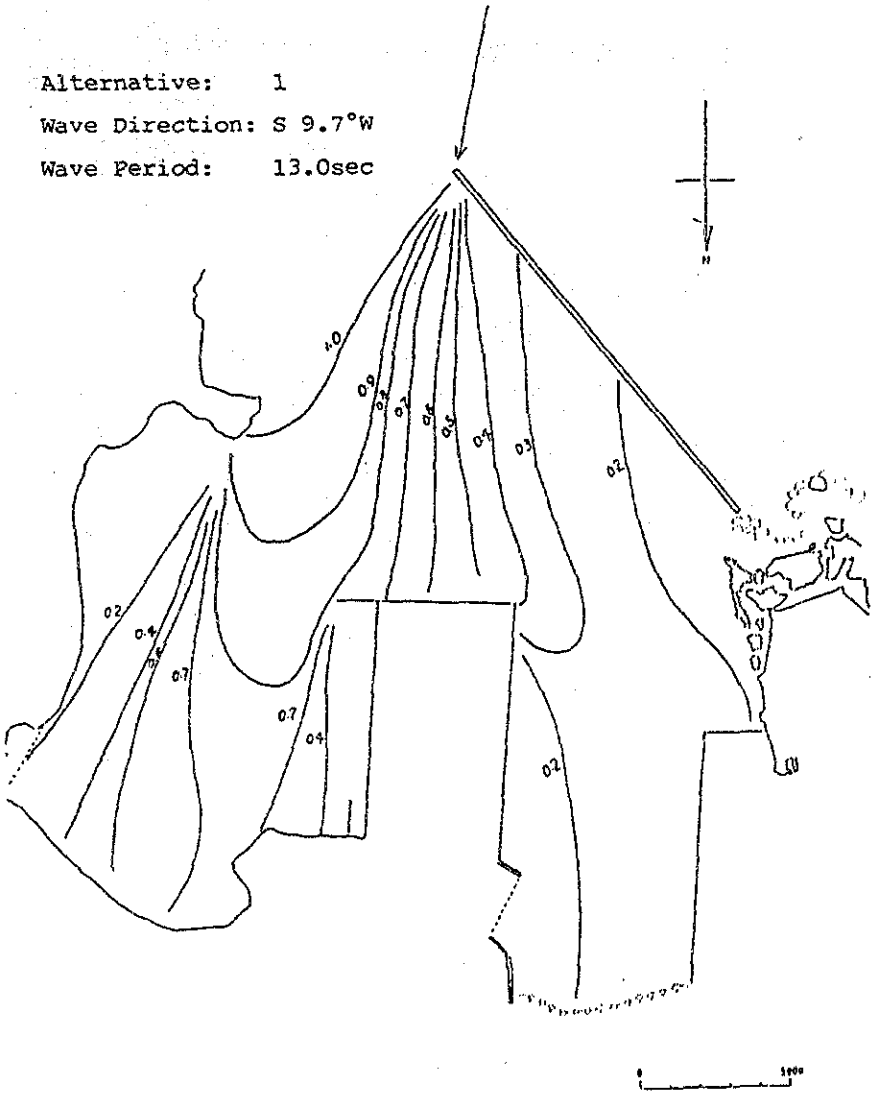
$T_{1/3}$= 7.0sec



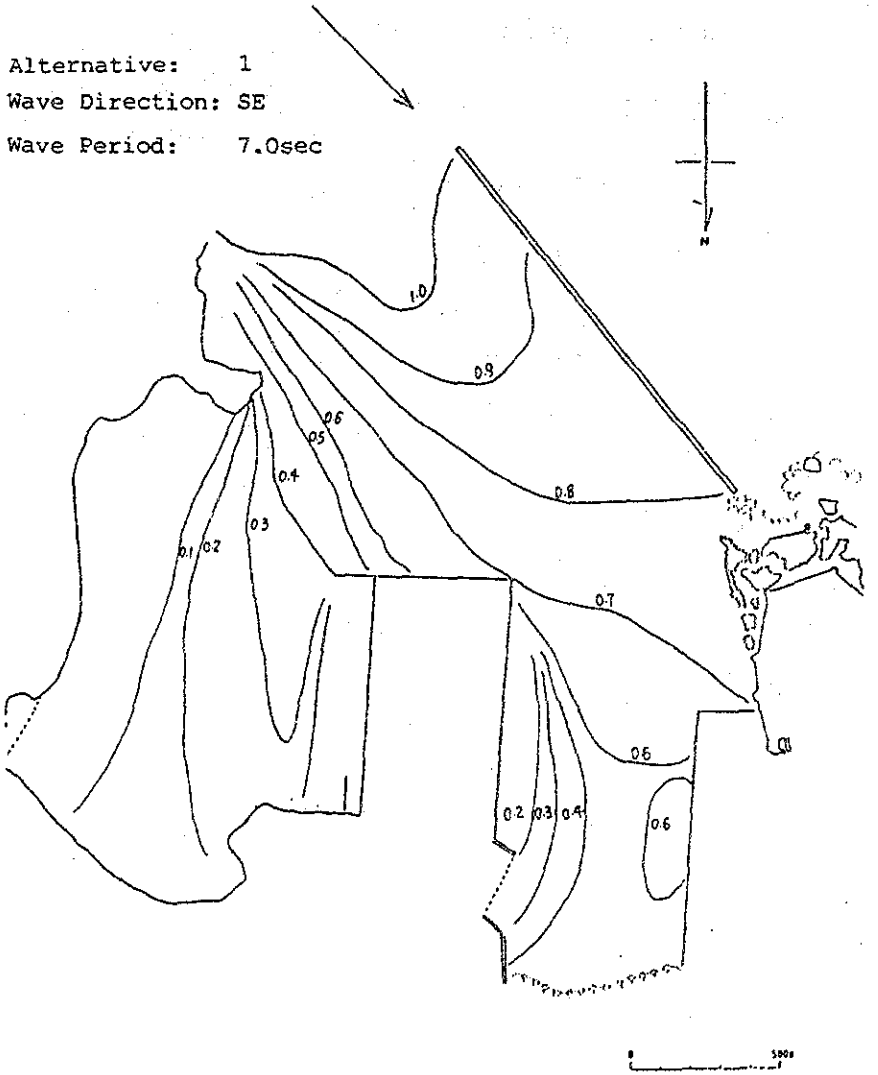
Appendix II-4-4(9) Coefficient of Refraction



Appendix II-4-4(10) Coefficient of Refraction



Appendix II-4-5(1) Wave Height Ratio



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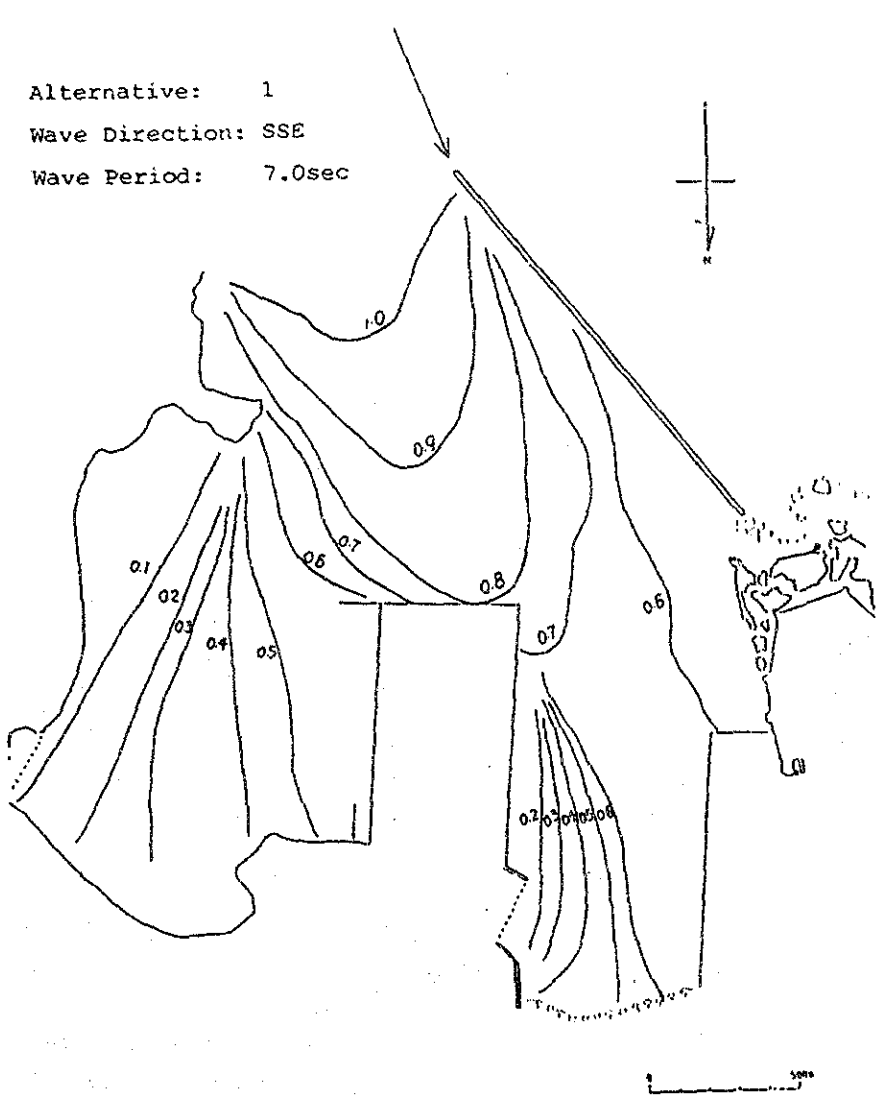

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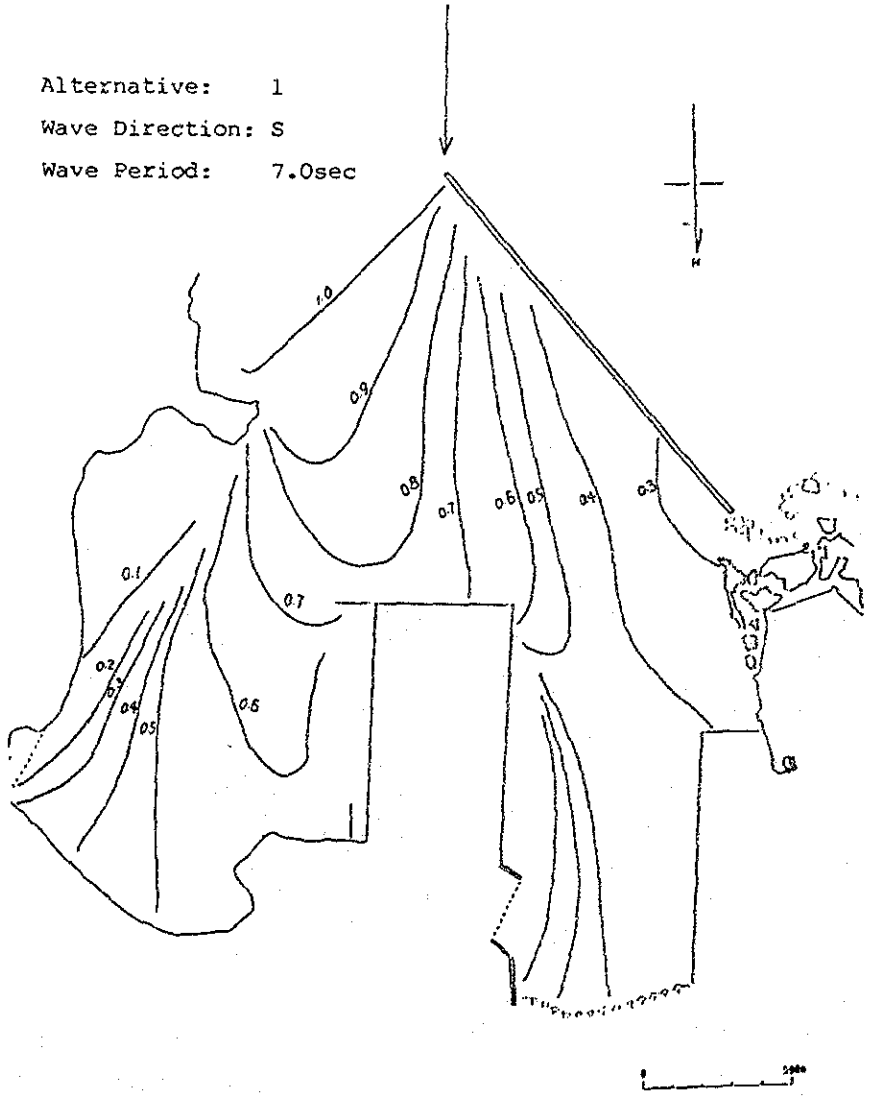
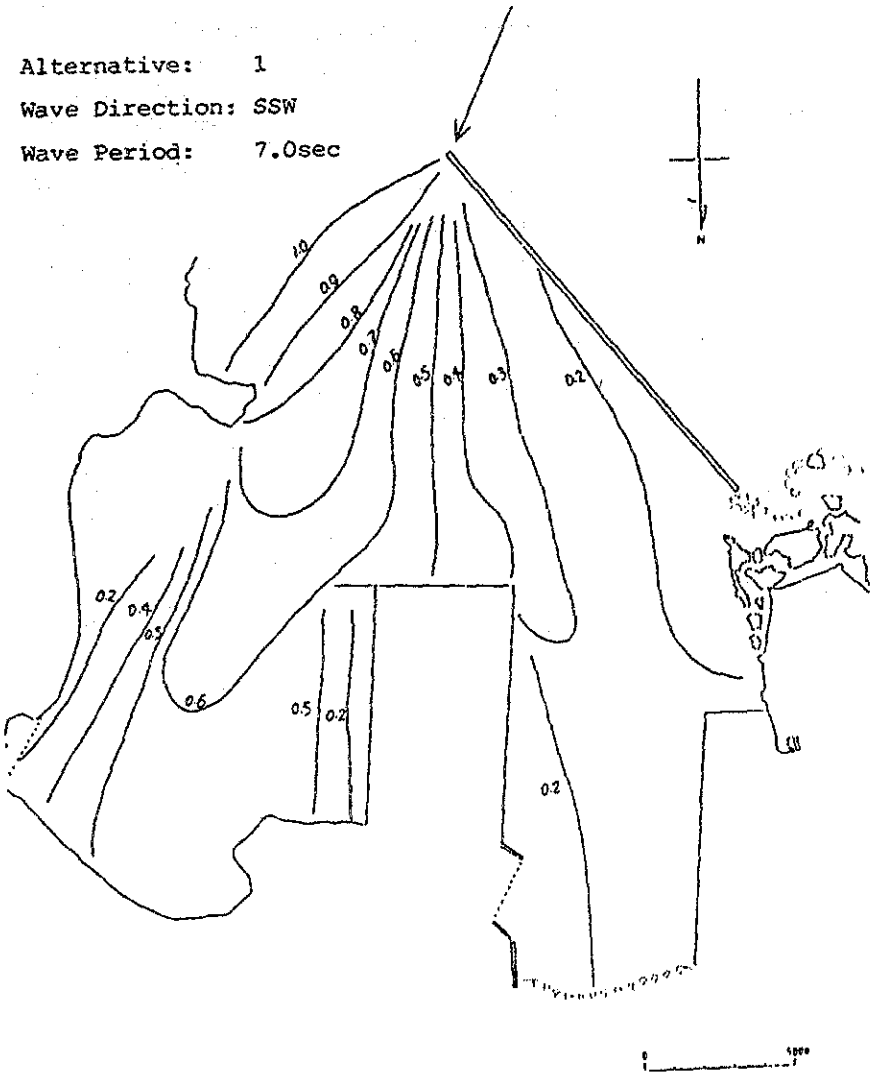
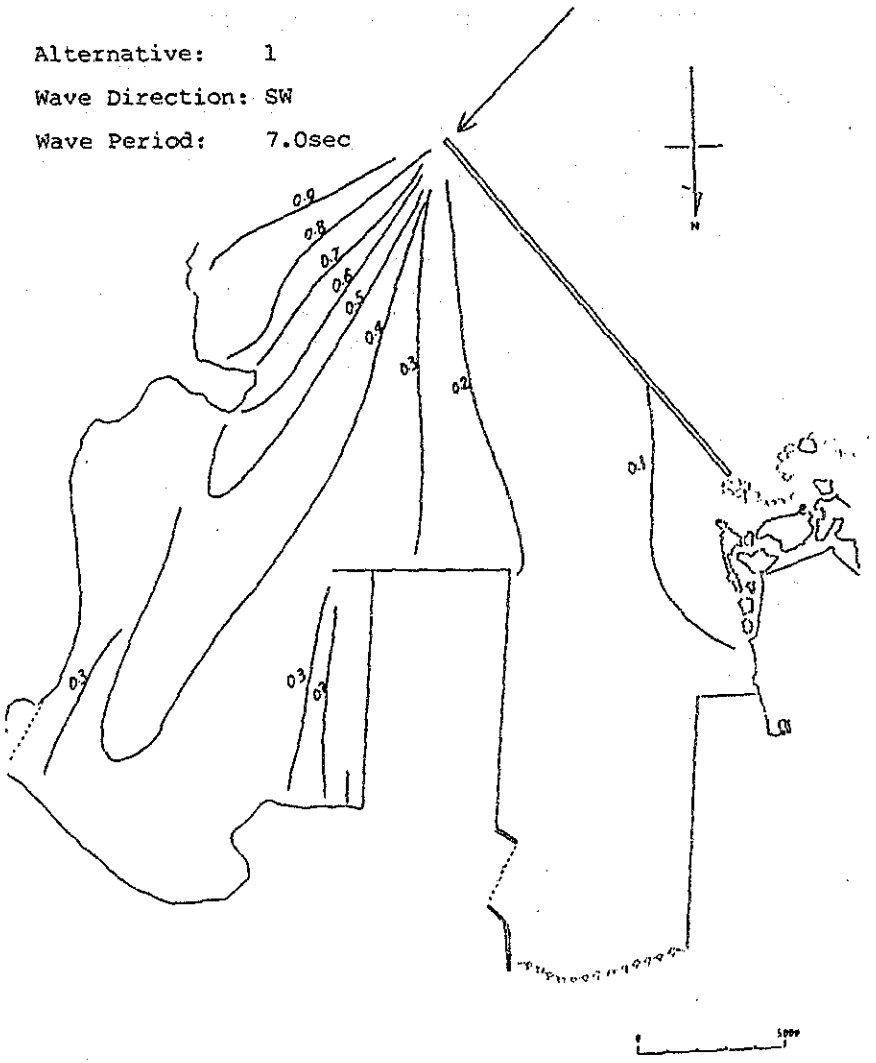


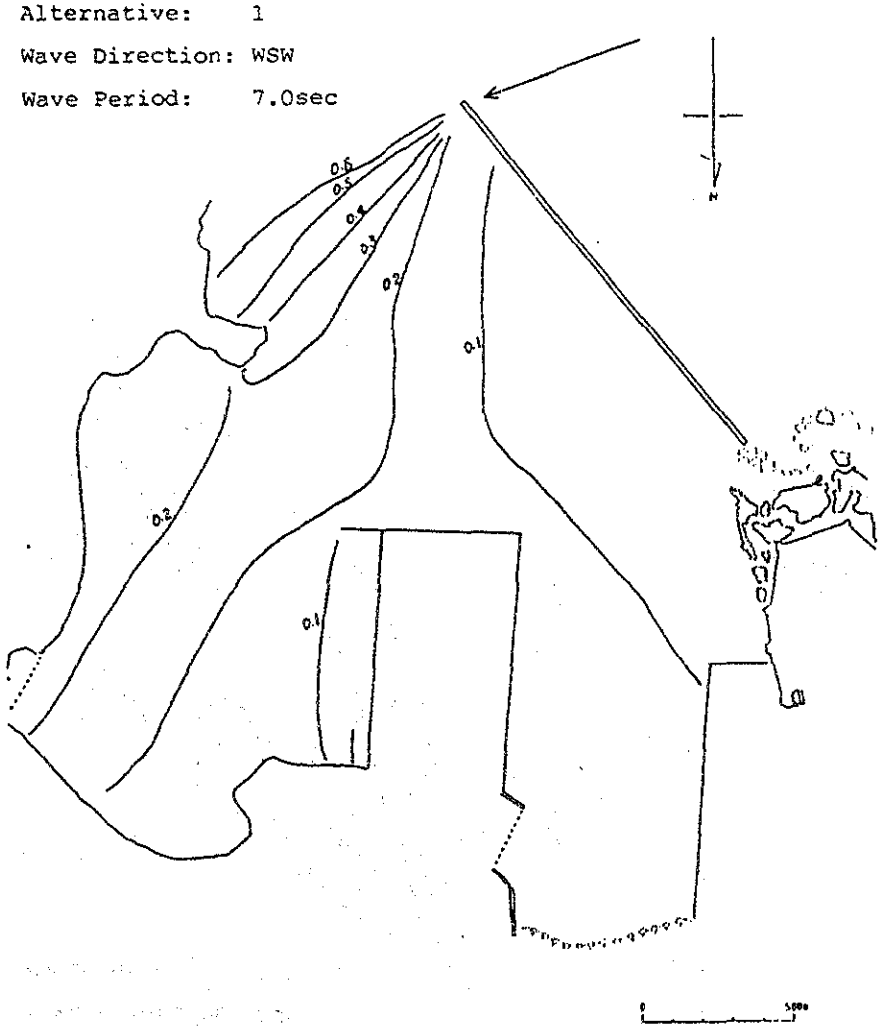
Appendix II-4-5(4) Wave Height Ratio



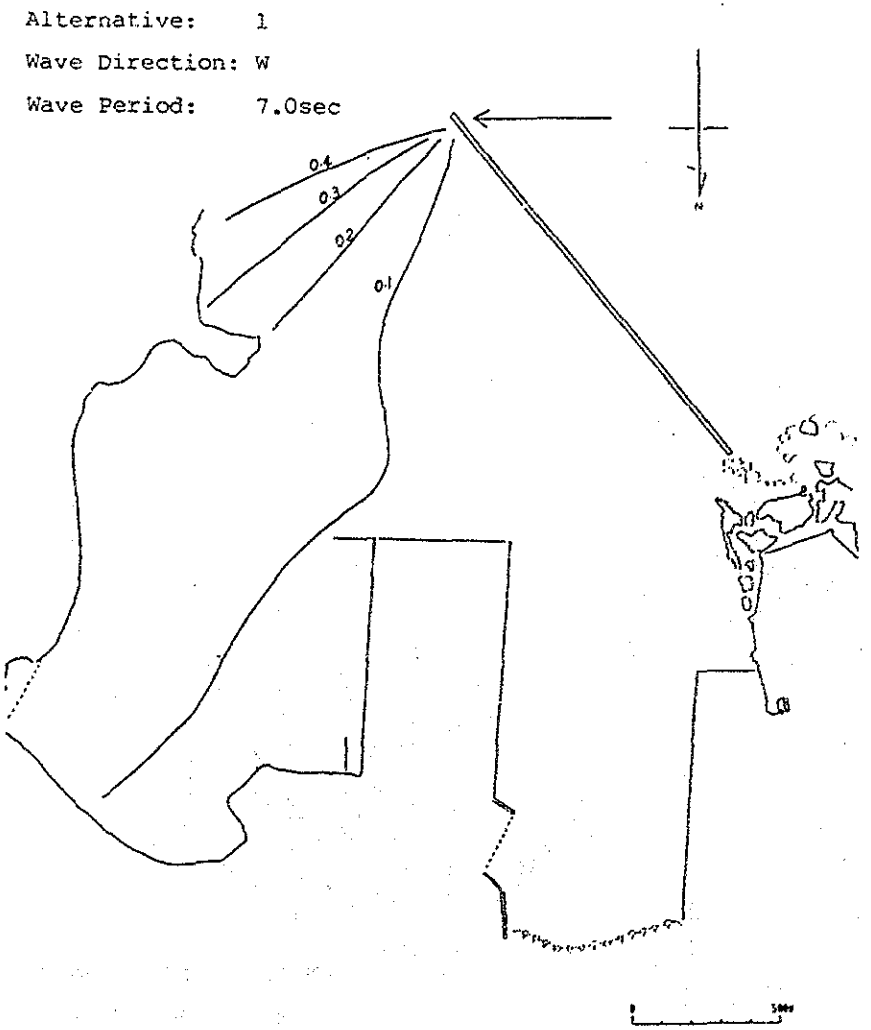
Appendix II-4-5(5) Wave Height Ratio



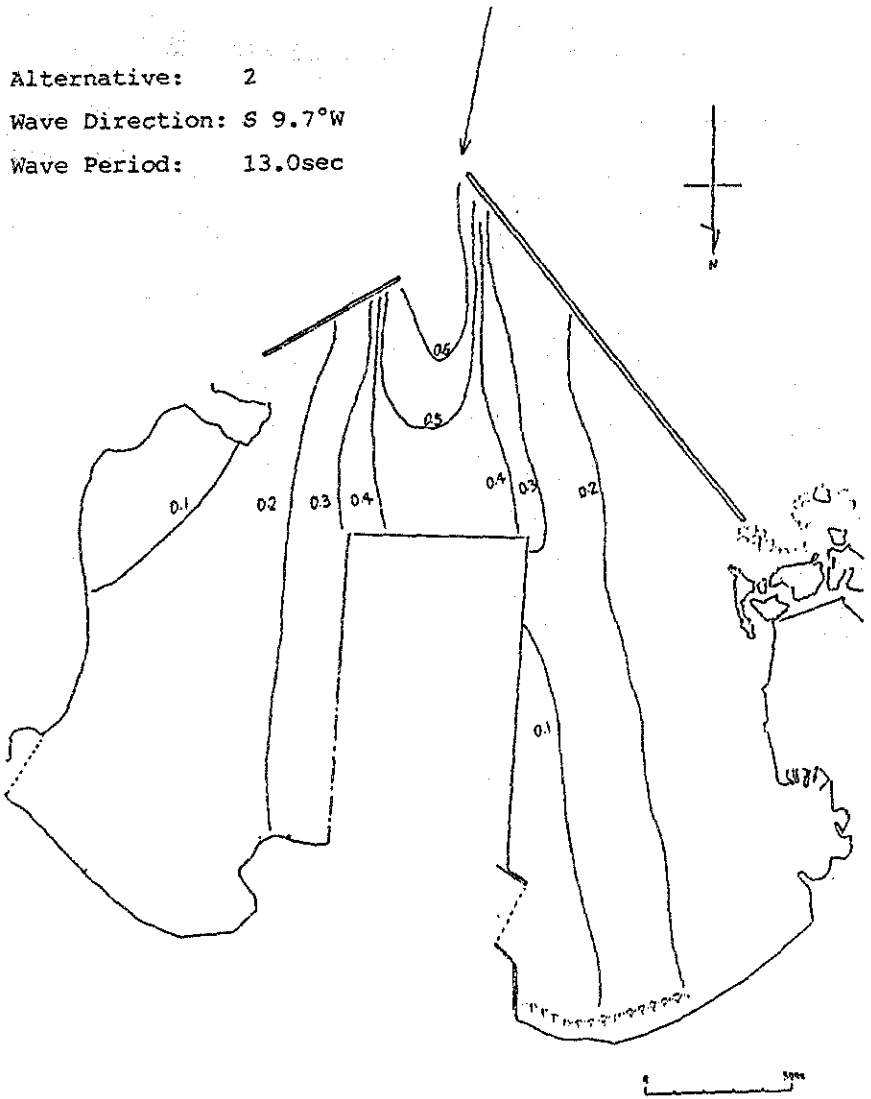
Appendix II-4-5(6) Wave Height Ratio



Appendix II-4-5(7) Wave Height Ratio



Appendix II-4-5(8) Wave Height Ratio



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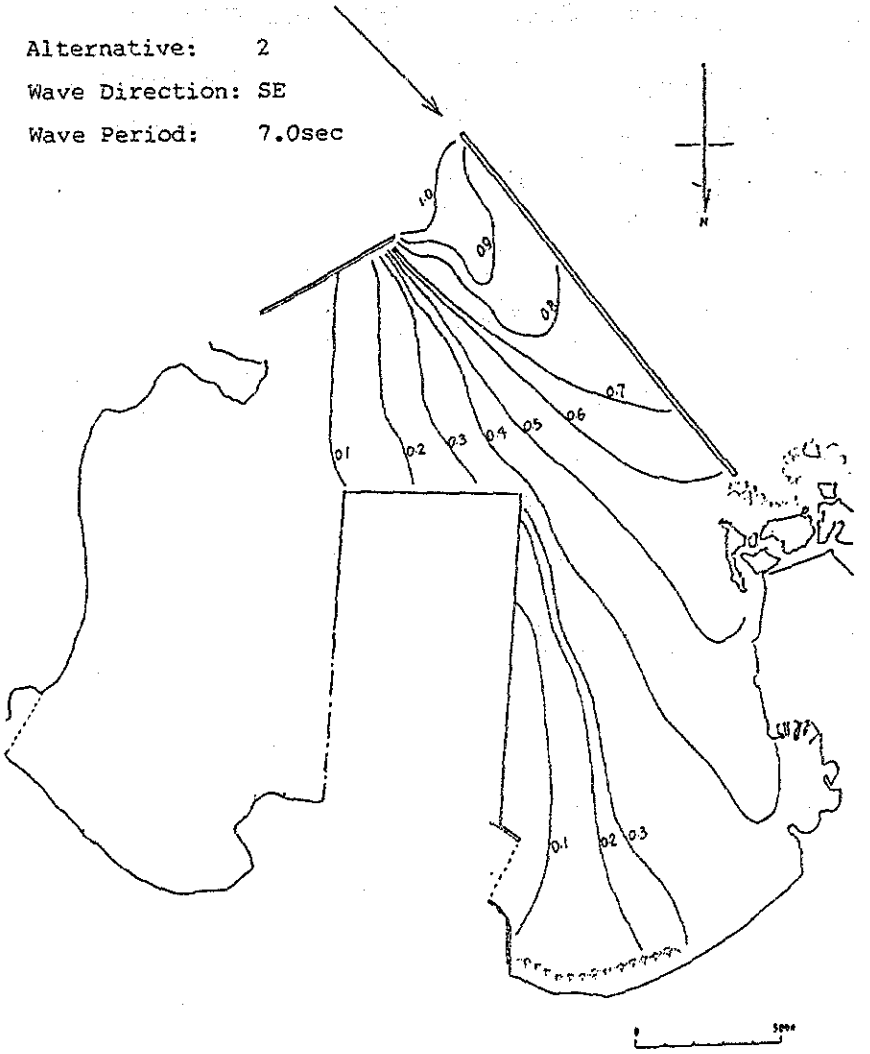

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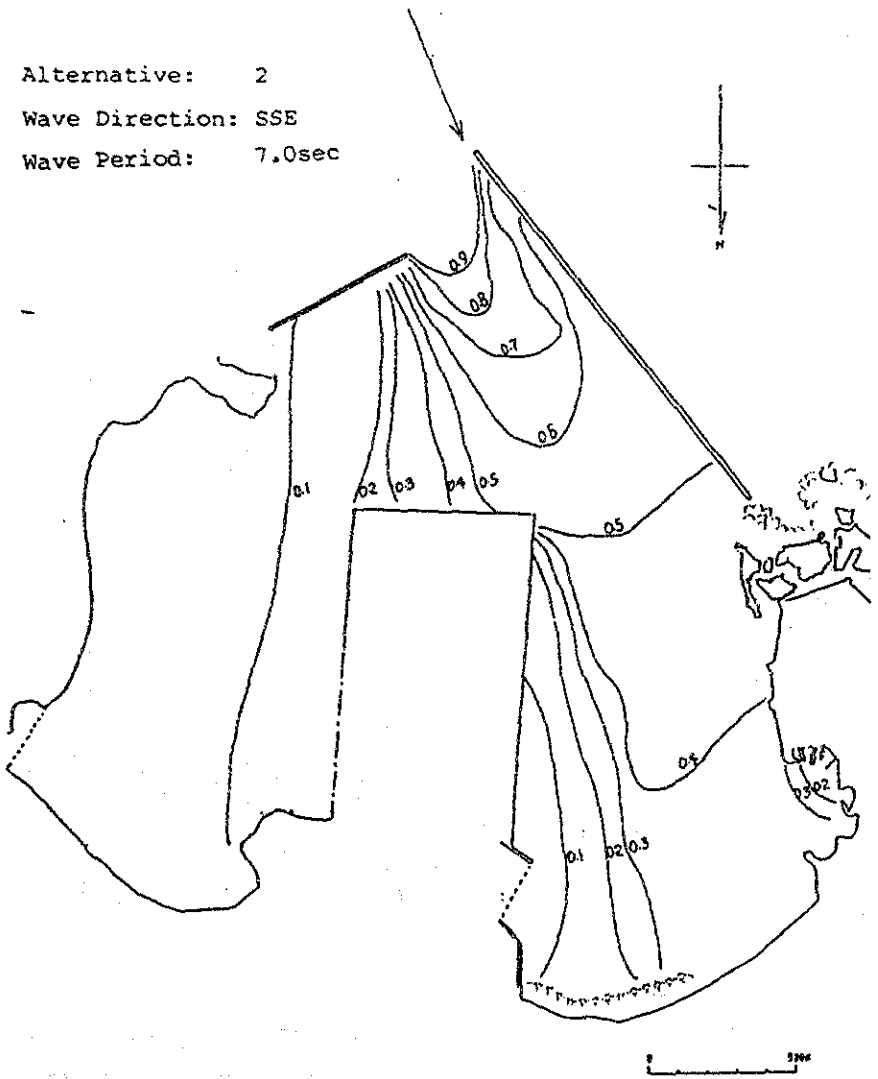

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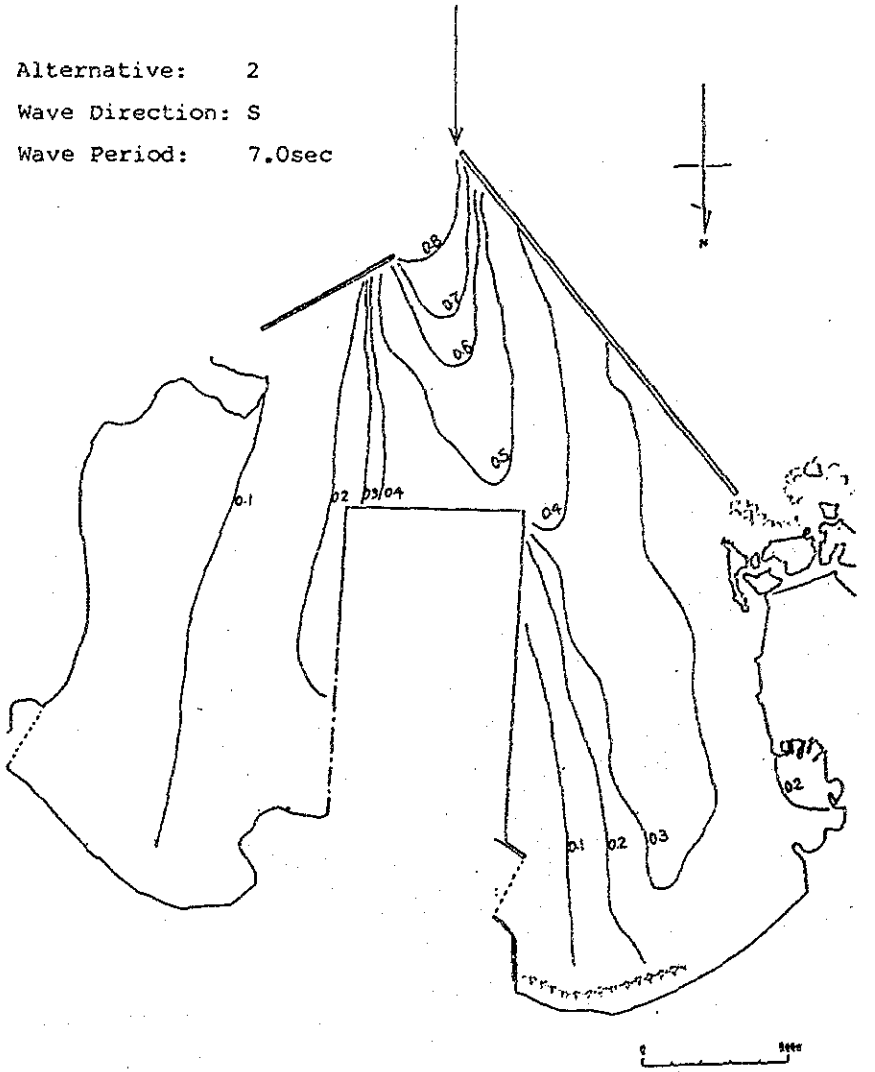
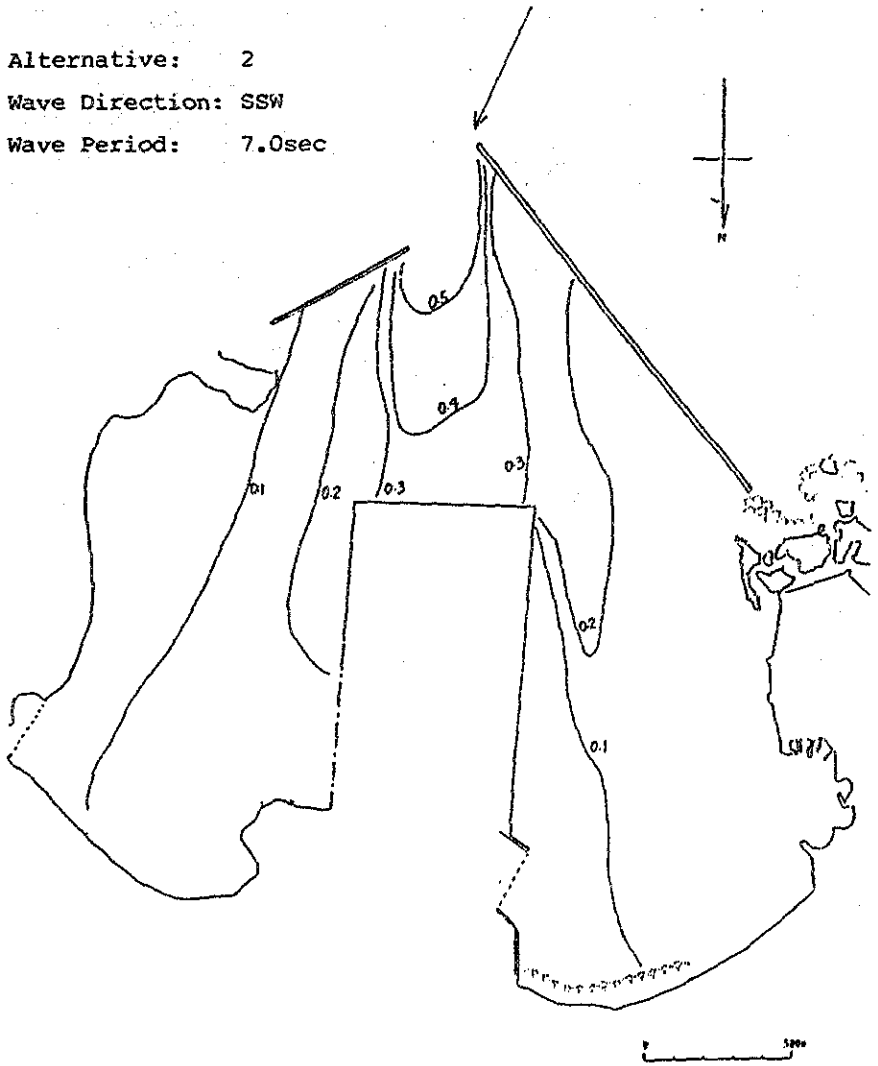
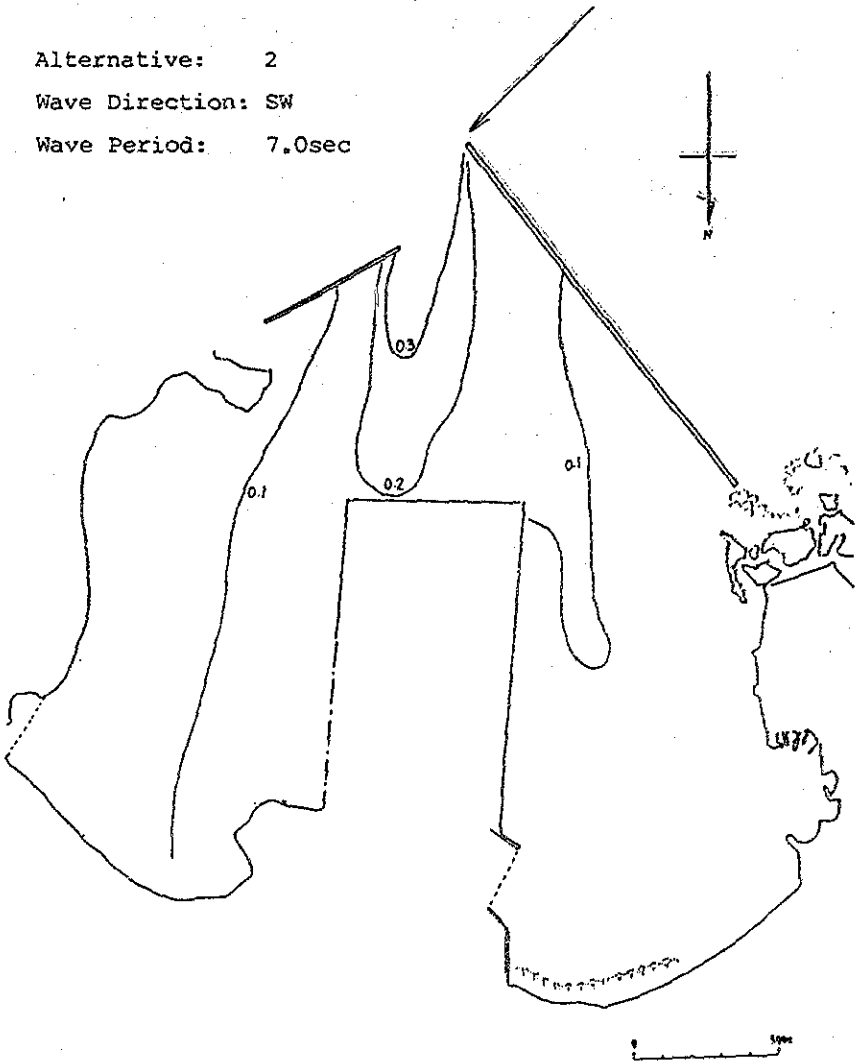


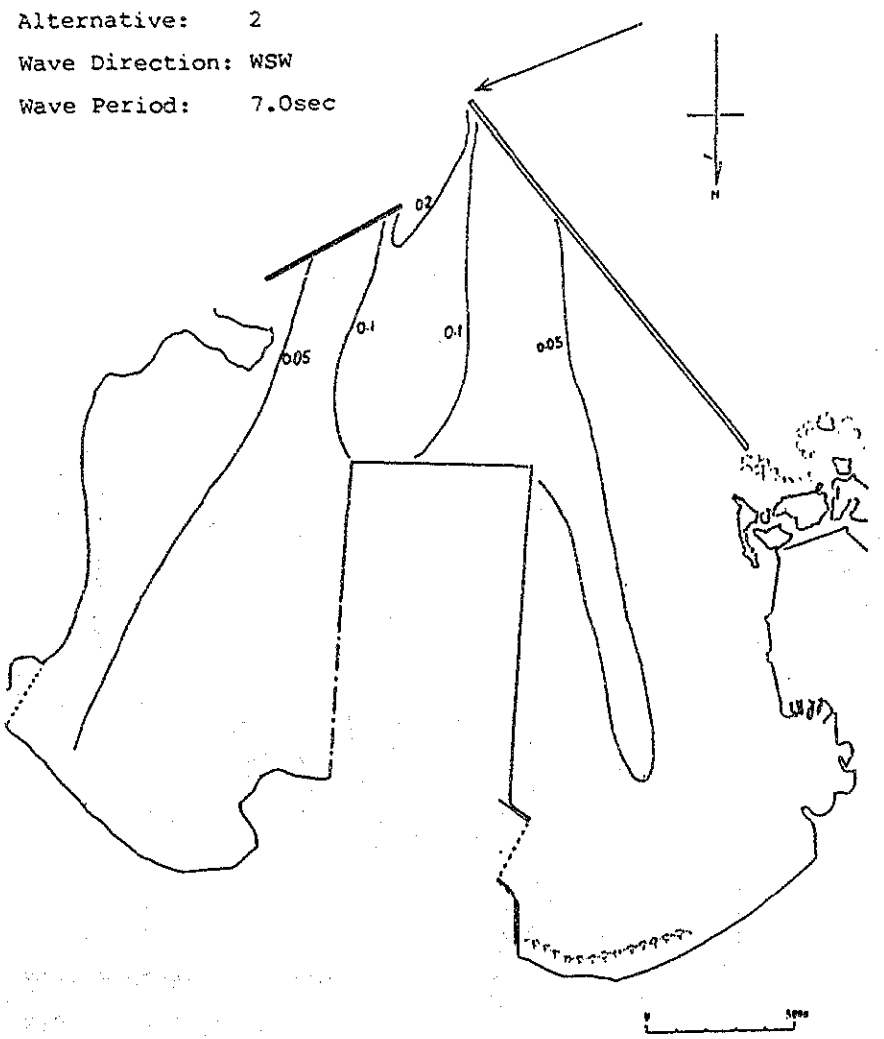
Appendix II-4-6(4) Wave Height Ratio



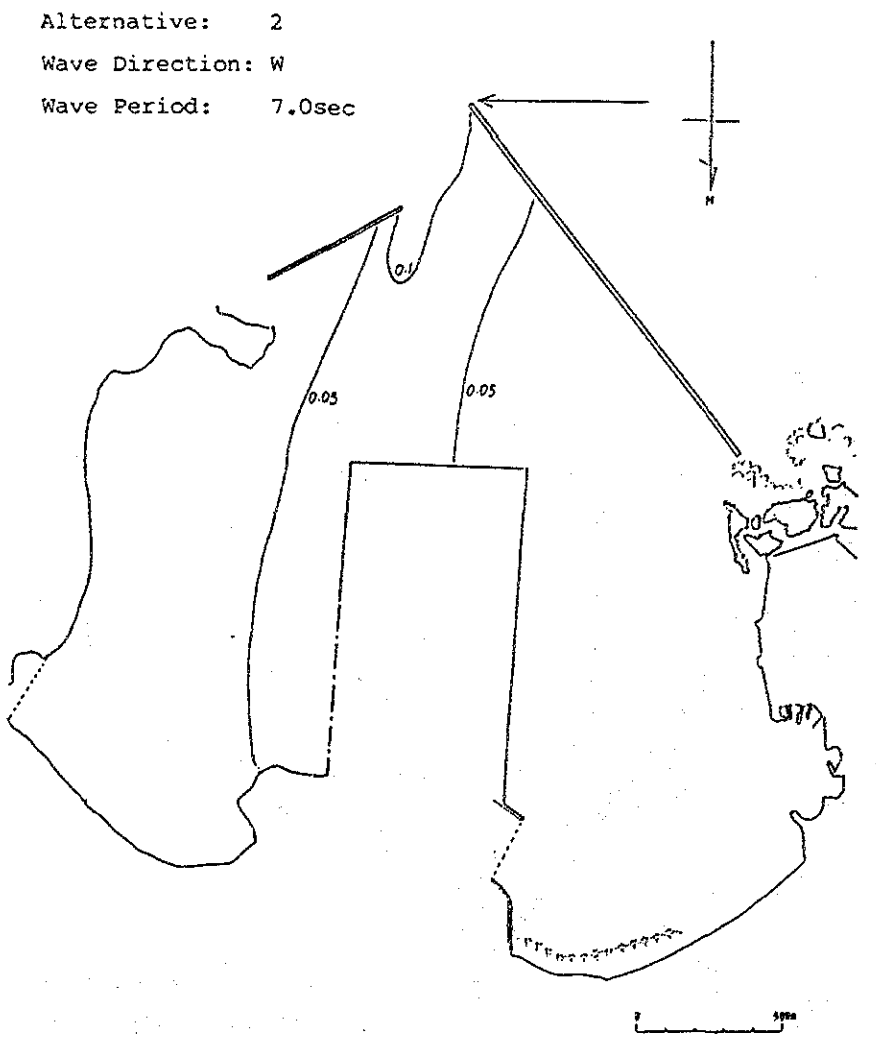
Appendix II-4-6(5) Wave Height Ratio



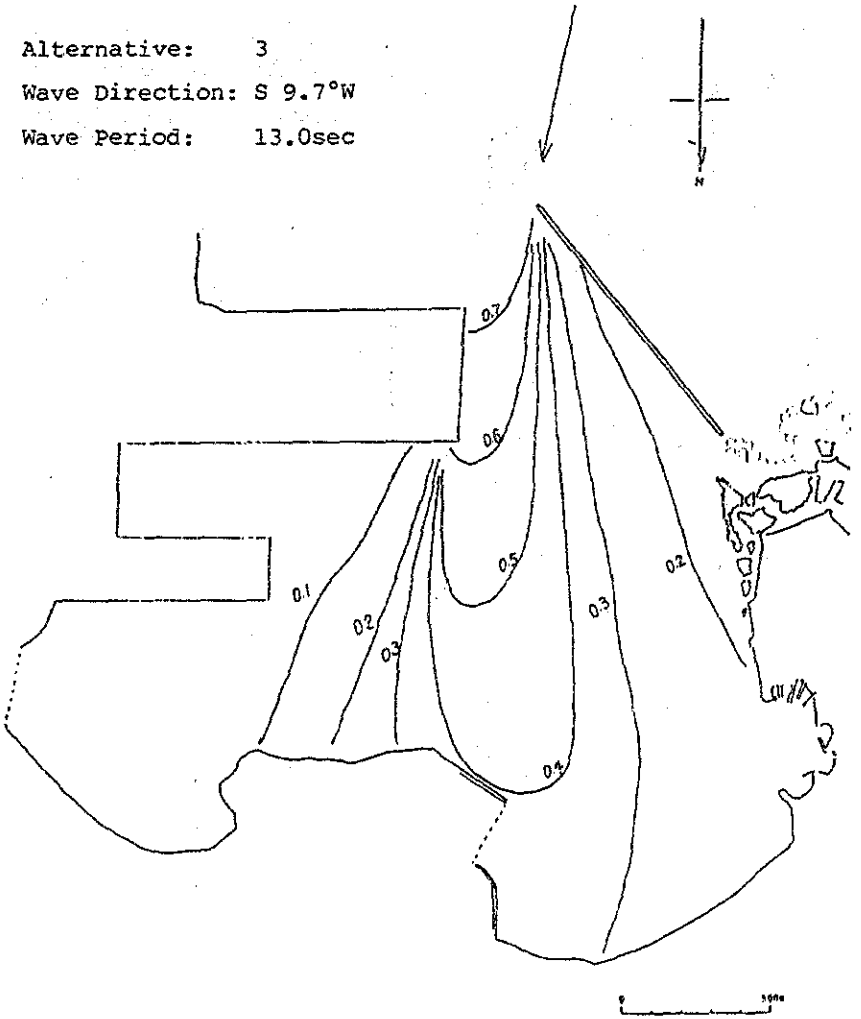
Appendix II-4-6(6) Wave Height Ratio



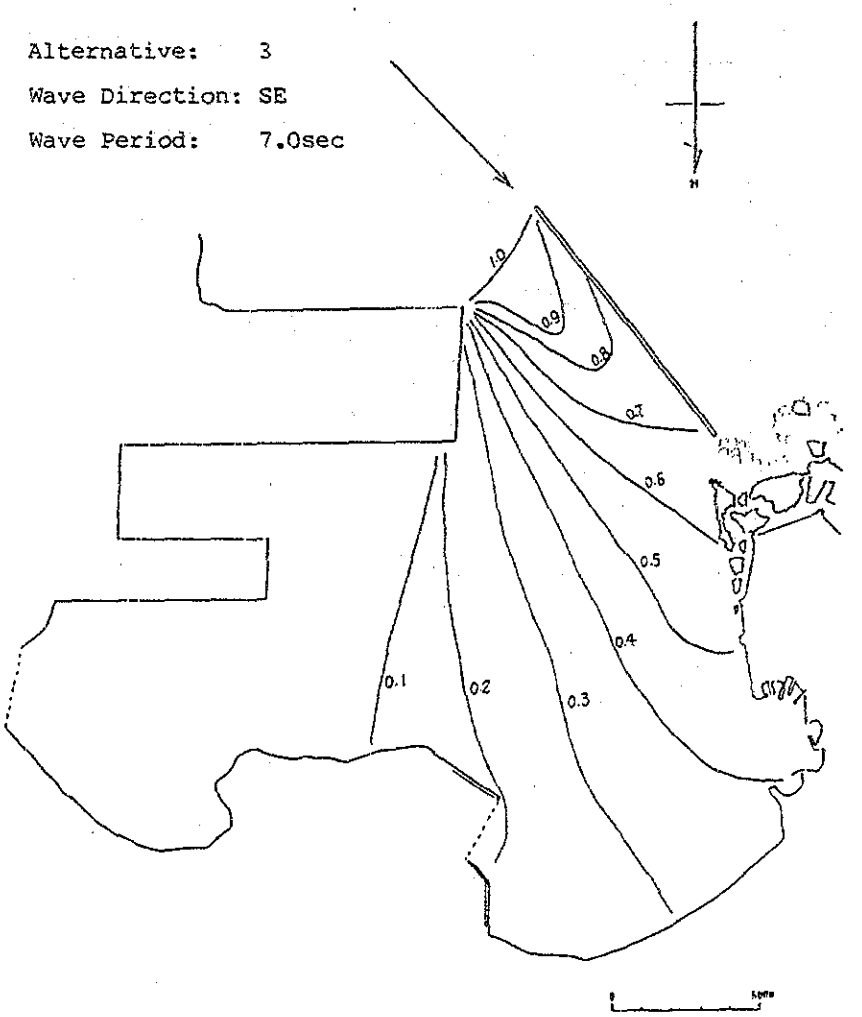
Appendix II-4-6(7) Wave Height Ratio



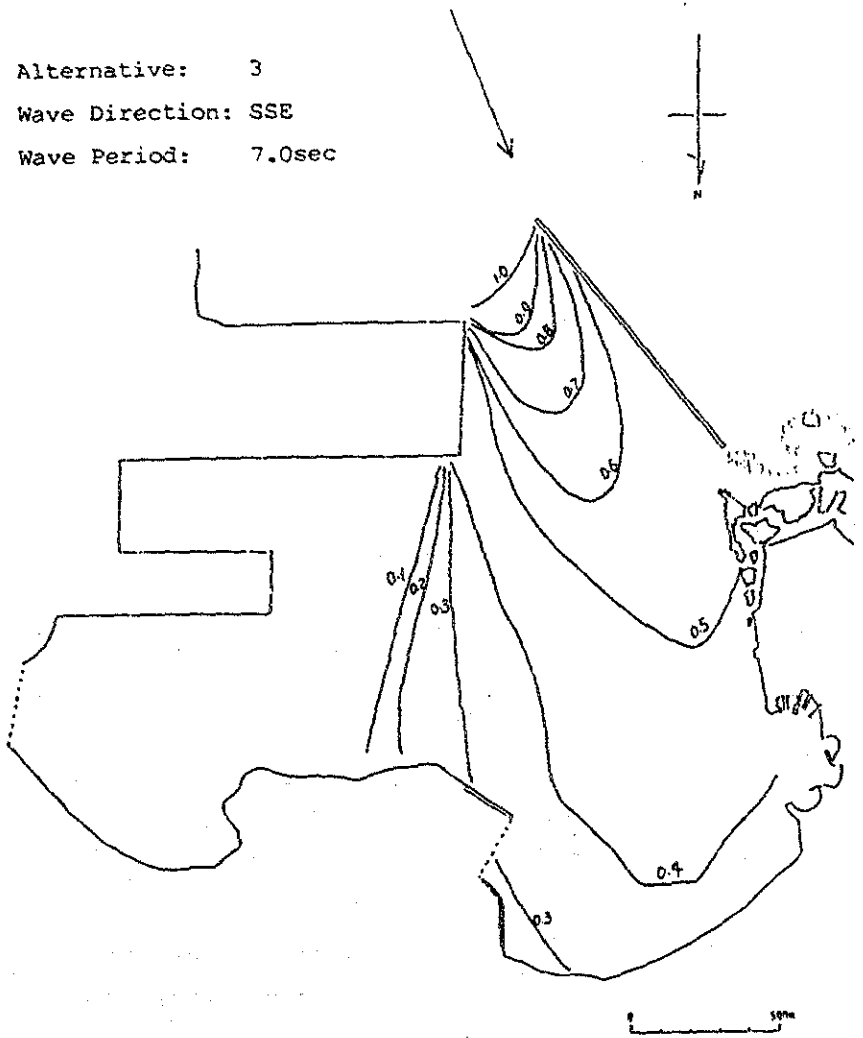
Appendix II-4-6(8) Wave Height Ratio



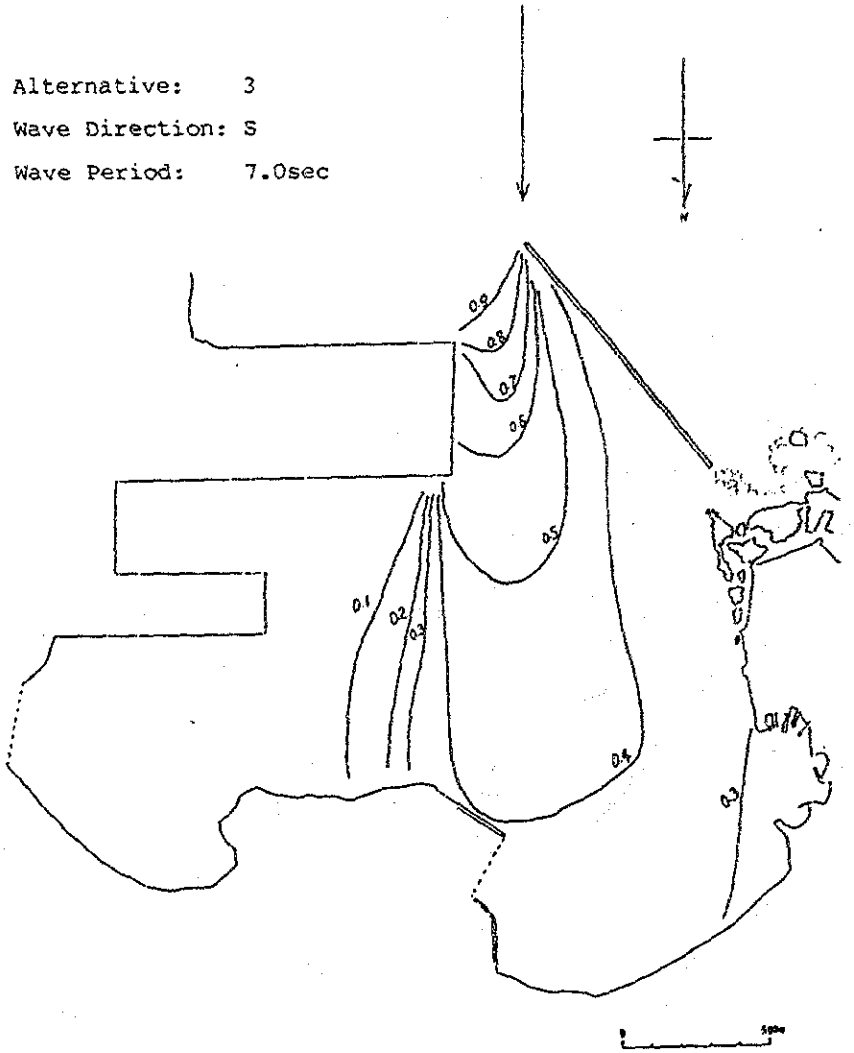
Appendix II-4-7(1) Wave Height Ratio



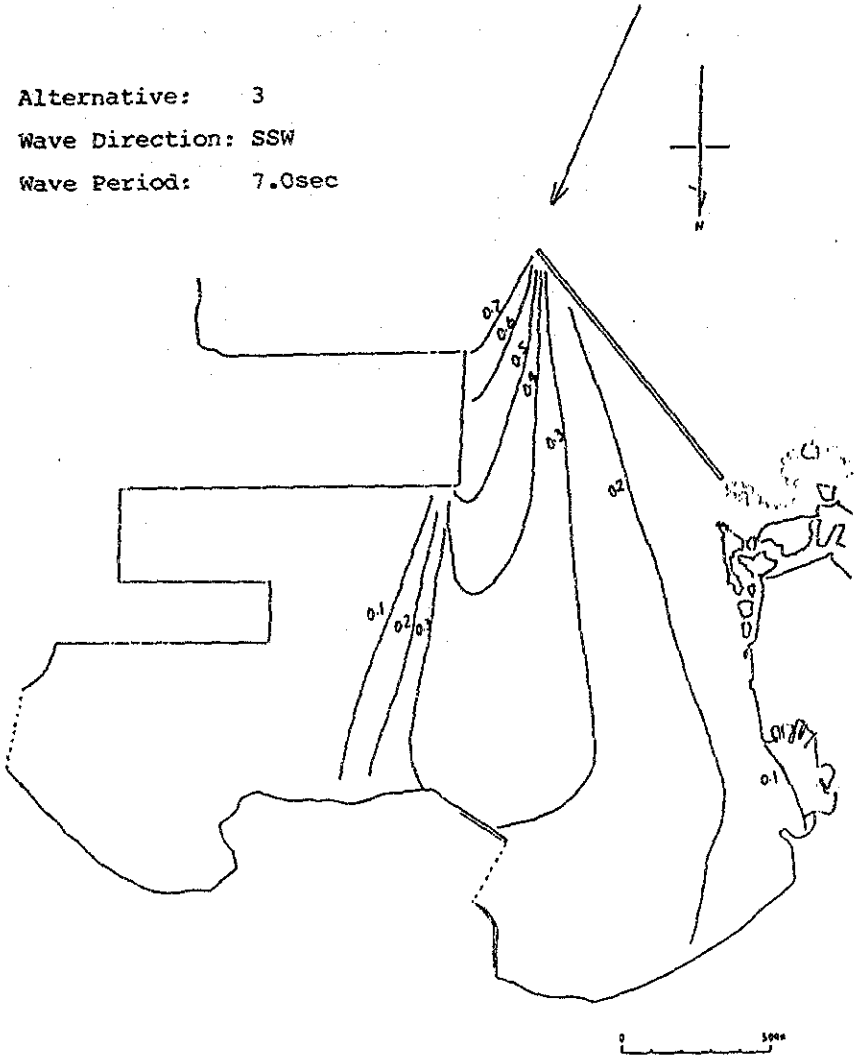
Appendix II-4-7(2) Wave Height Ratio



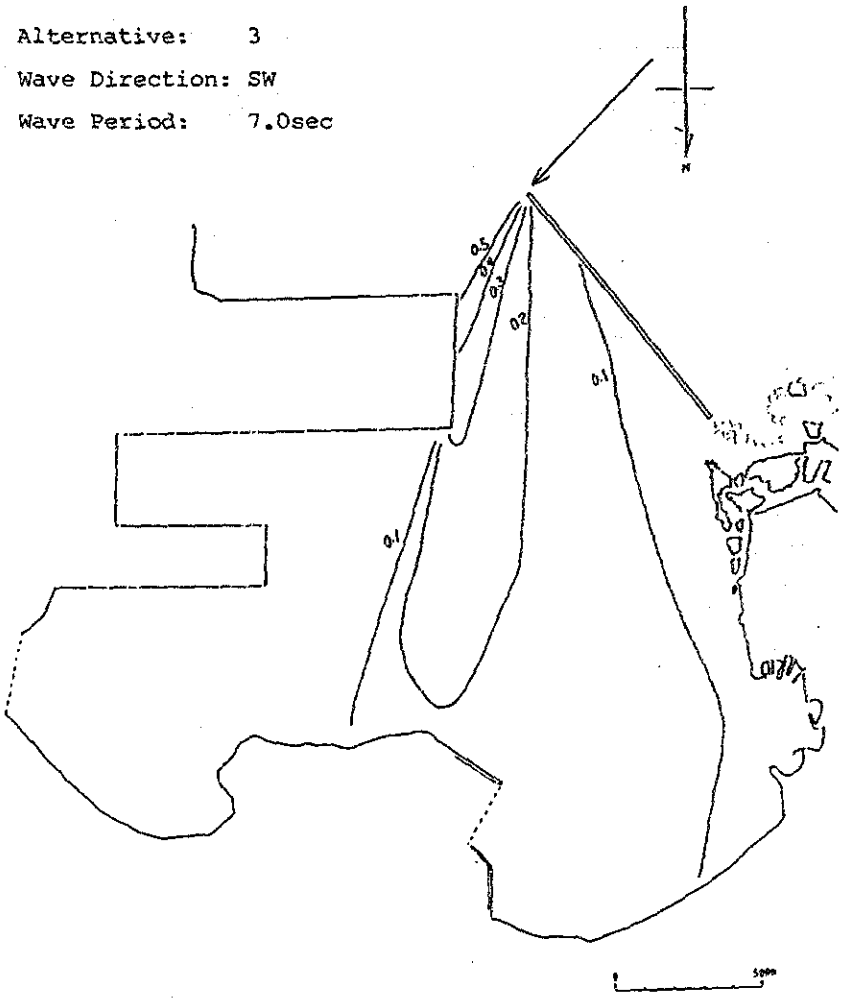
Appendix II-4-7(3) Wave Height Ratio



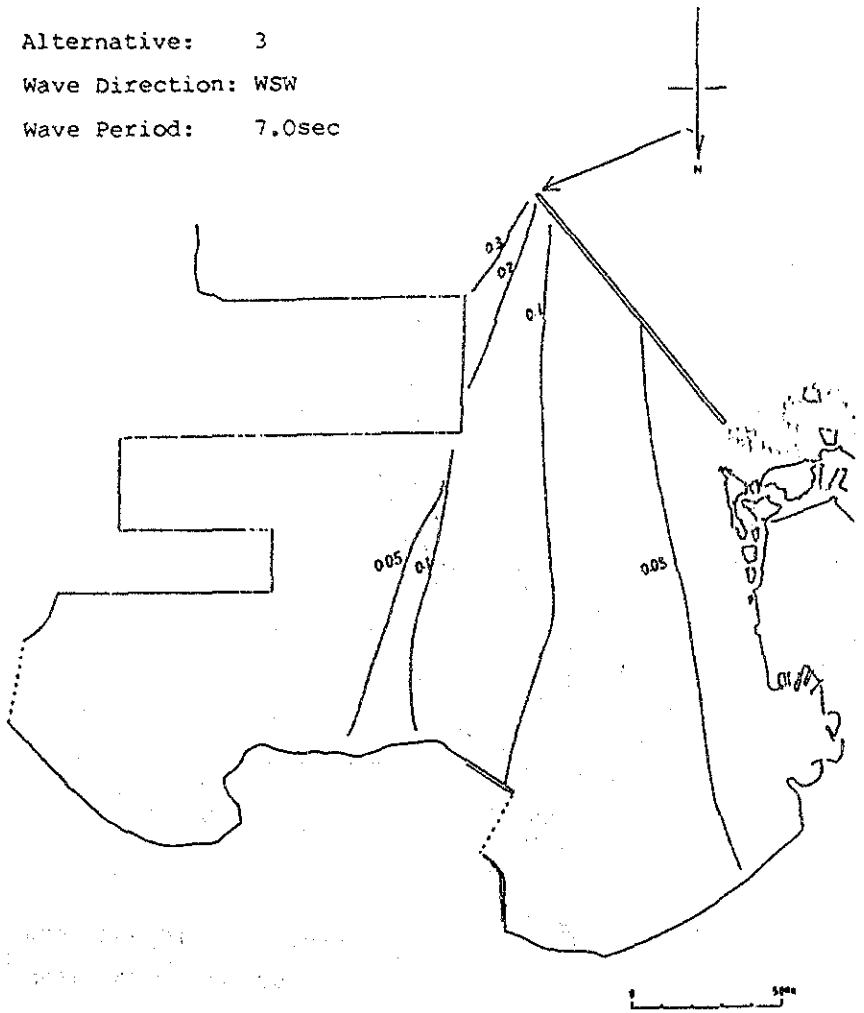
Appendix II-4-7(4) Wave Height Ratio



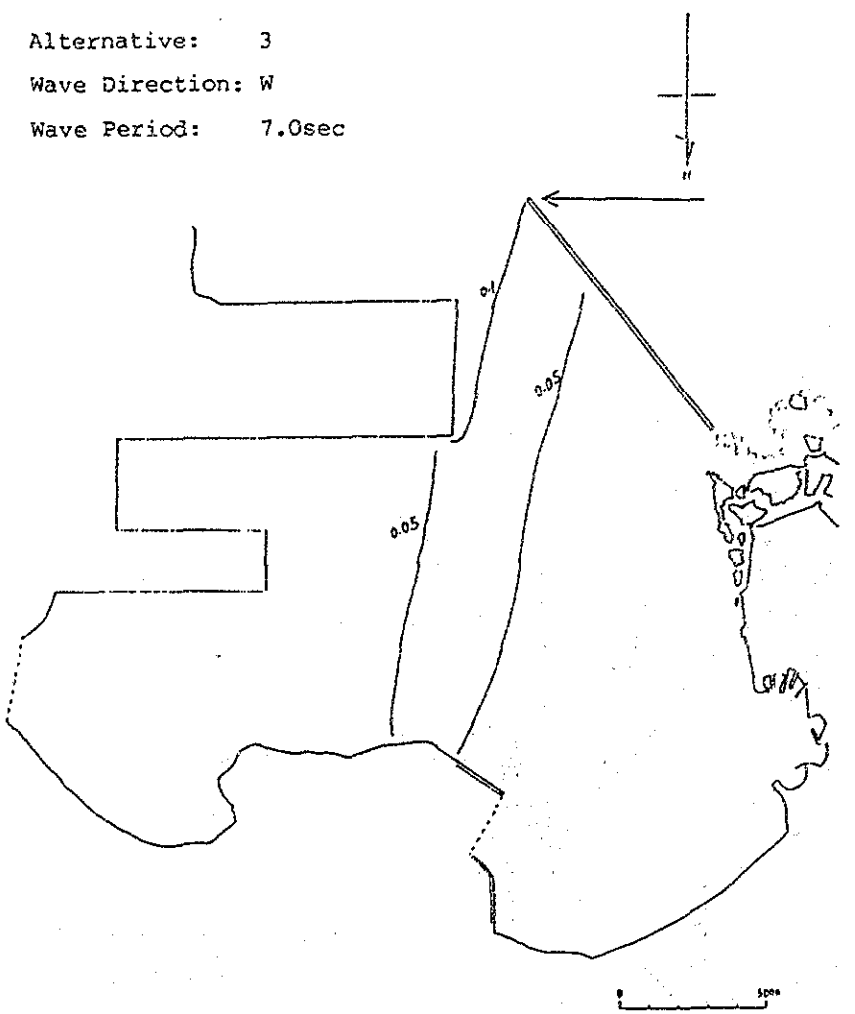
Appendix II-4-7(5) Wave Height Ratio



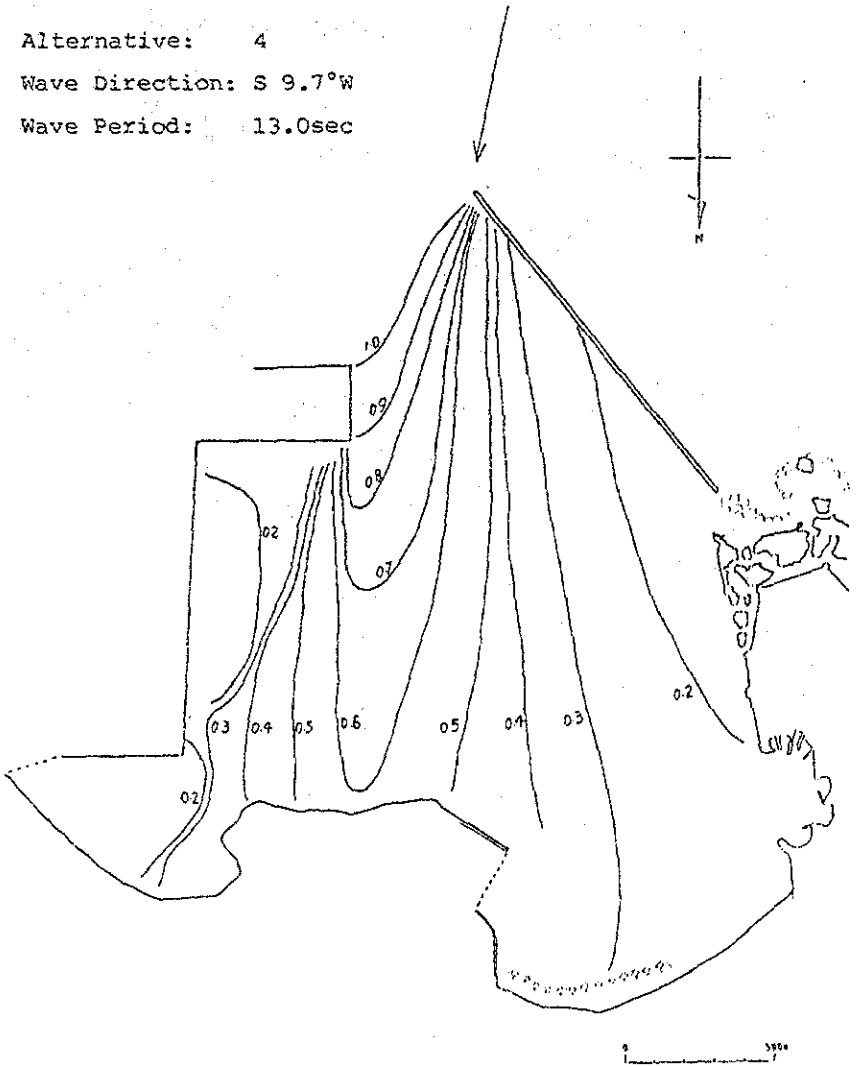
Appendix II-4-7(6) Wave Height Ratio



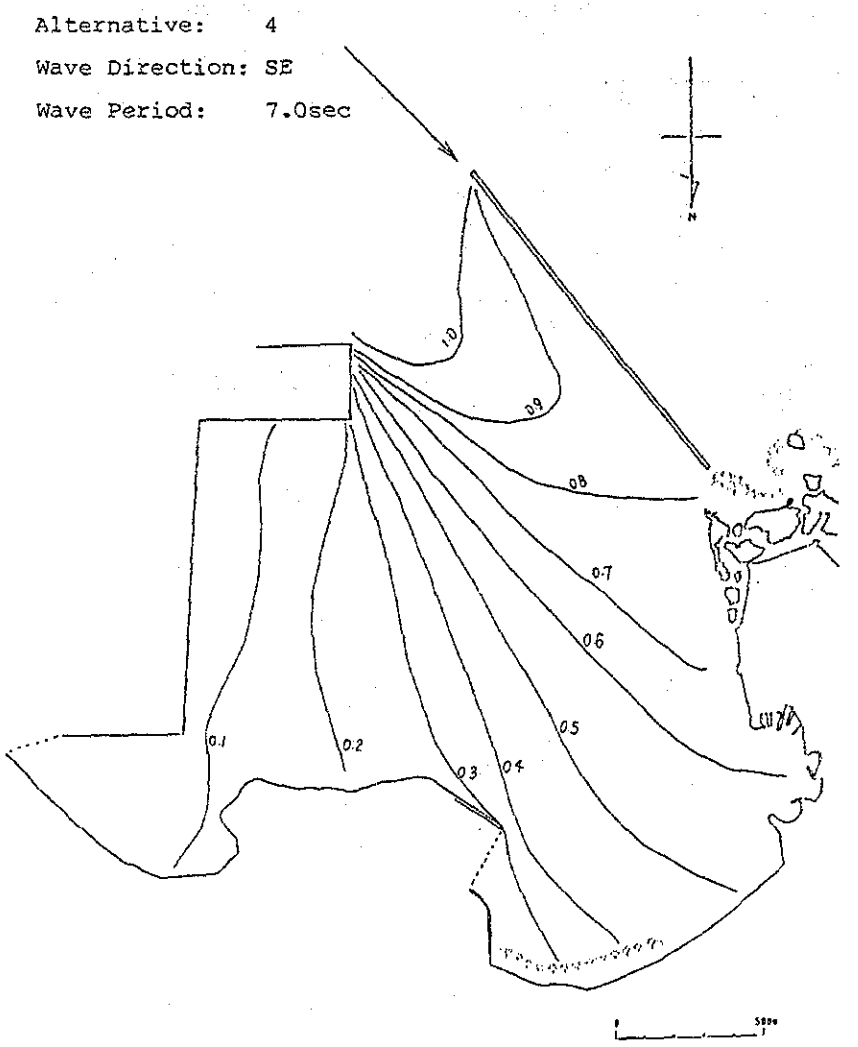
Appendix II-4-7(7) Wave Height Ratio



Appendix II-4-7(8) Wave Height Ratio



Appendix II-4-8(1) Wave Height Ratio



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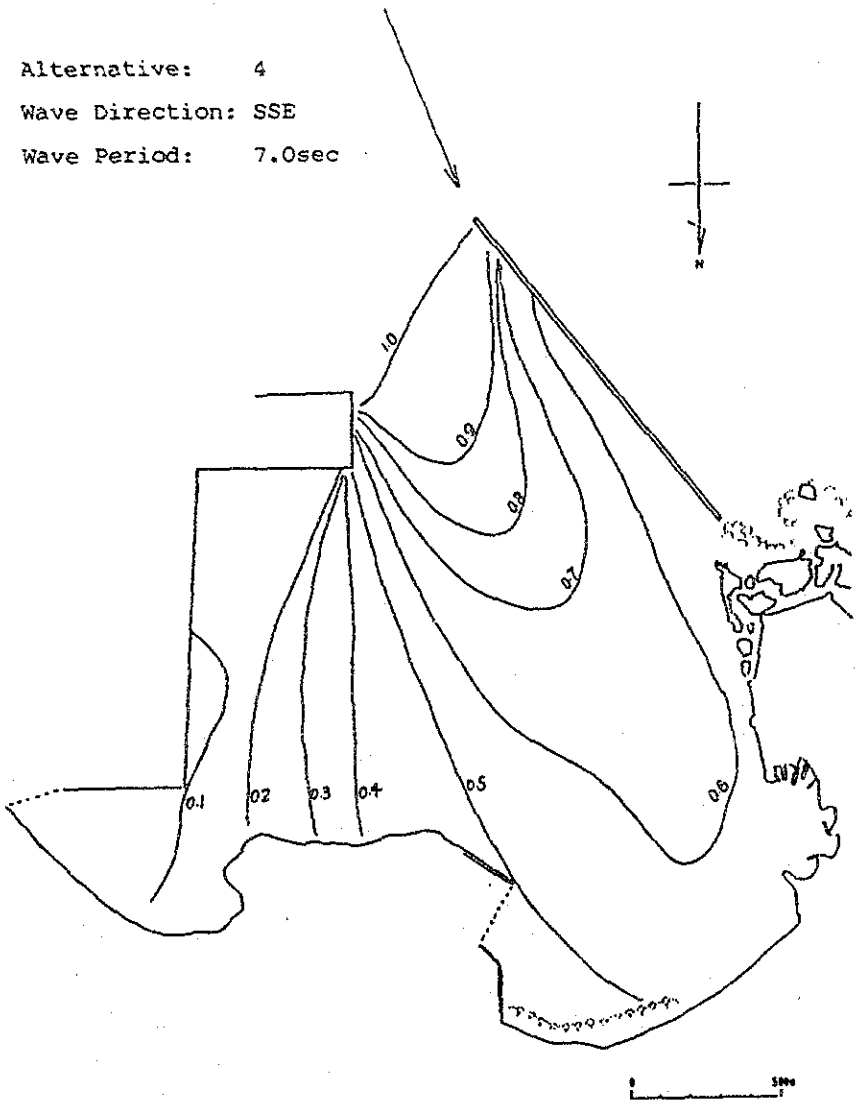
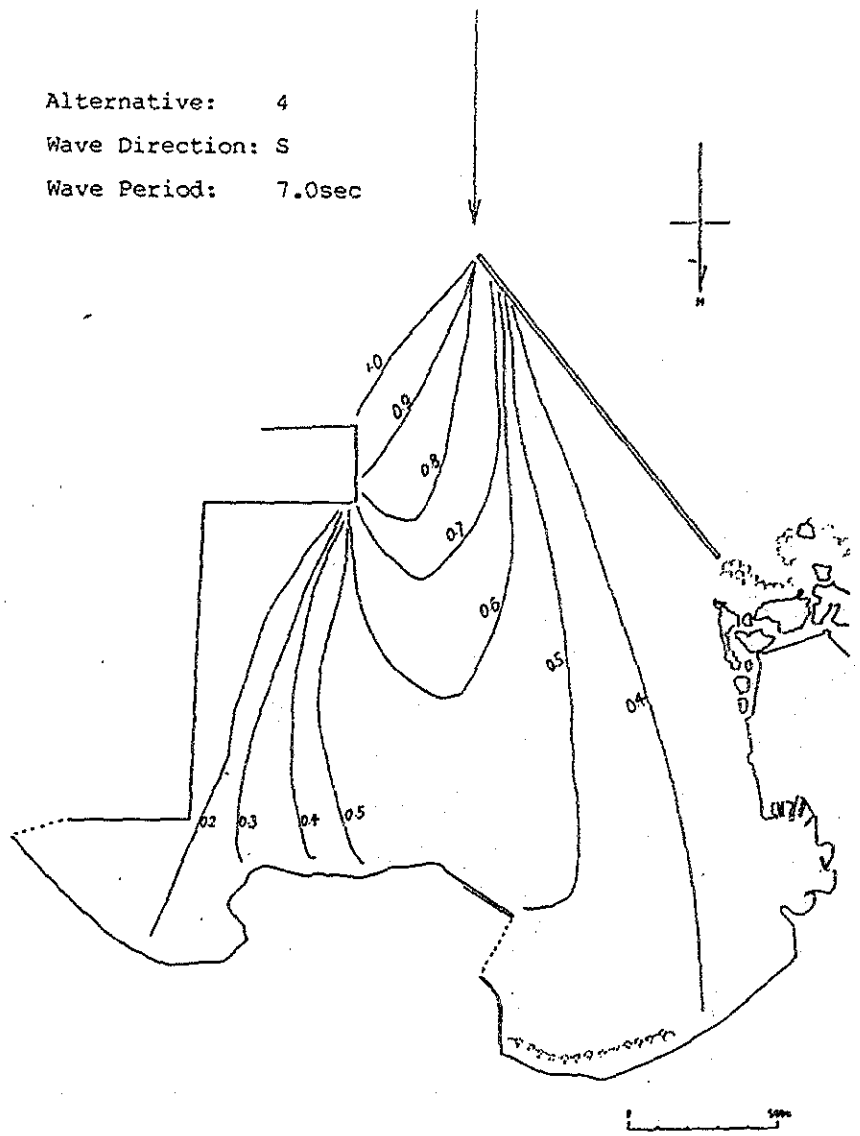
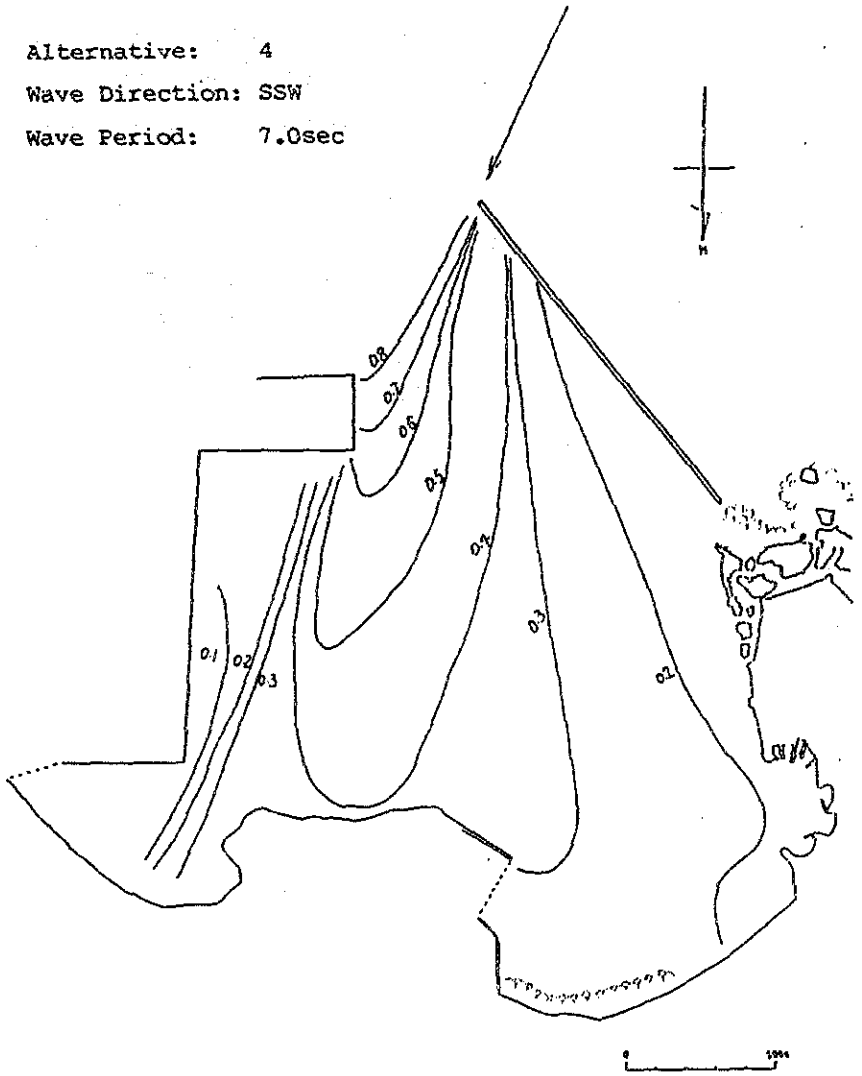


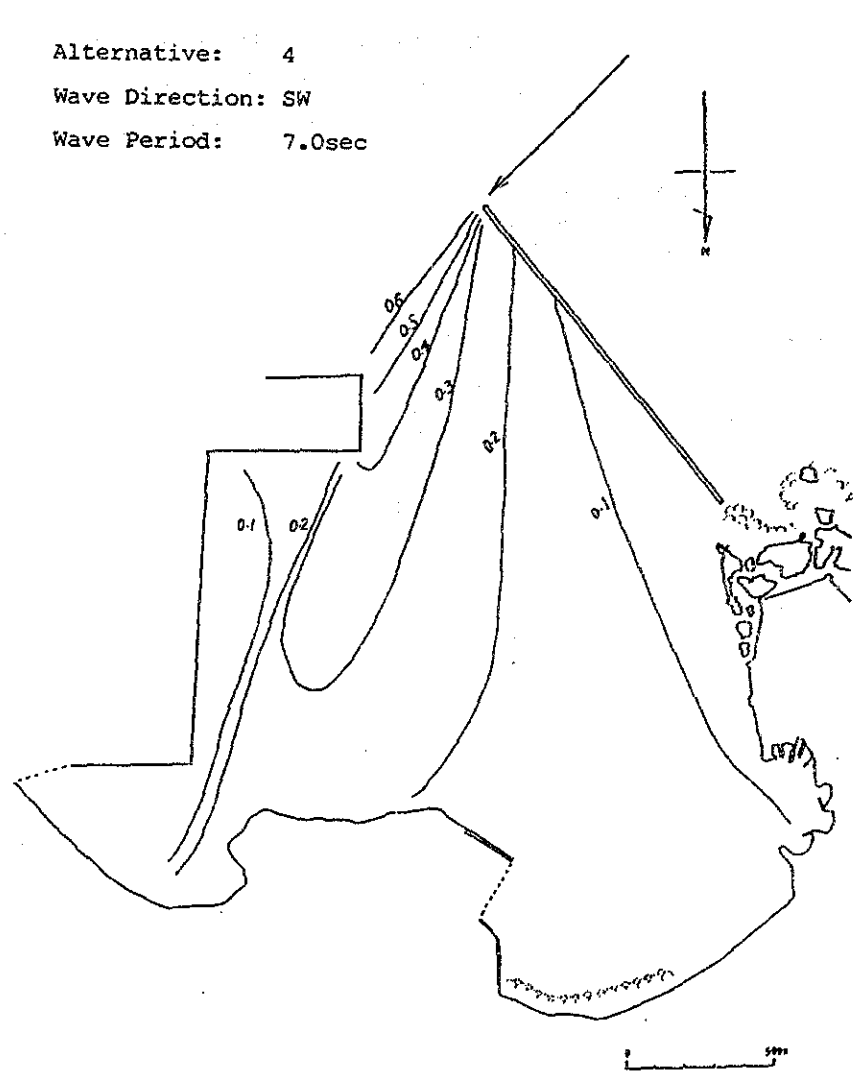
Appendix II-4-8(3) Wave Height Ratio



Appendix II-4-8(4) Wave Height Ratio

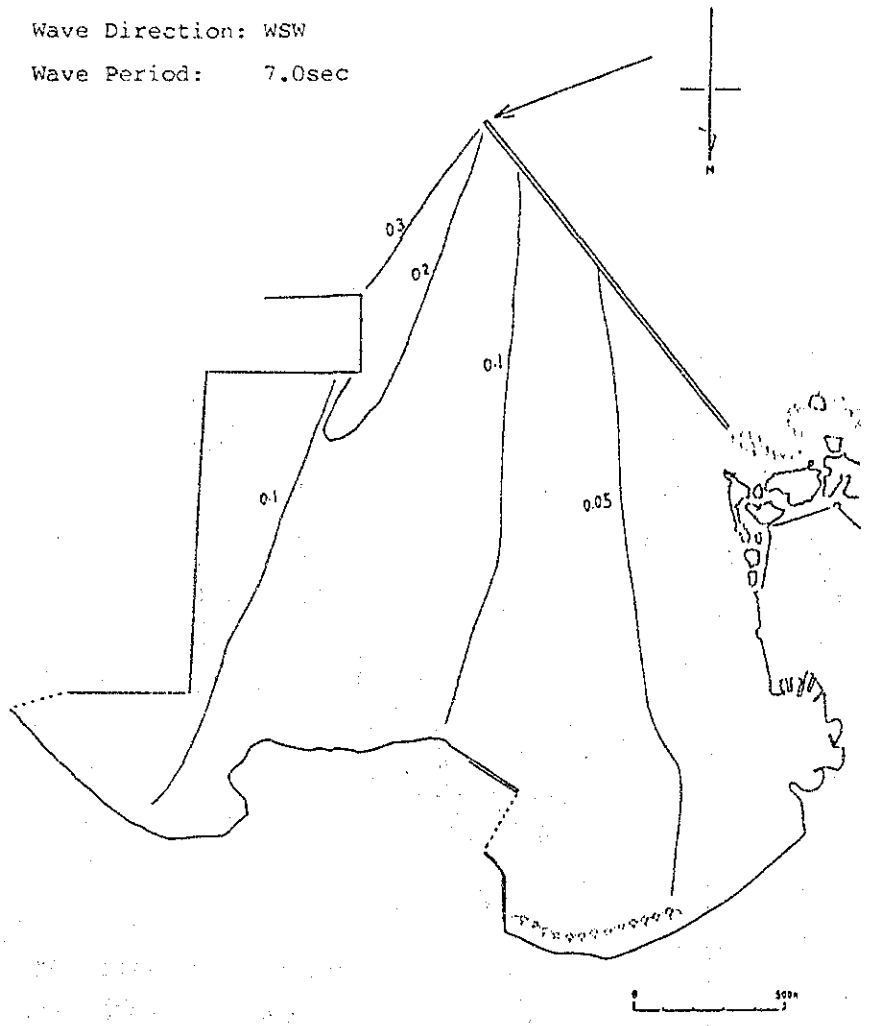


Appendix II-4-8(5) Wave Height Ratio



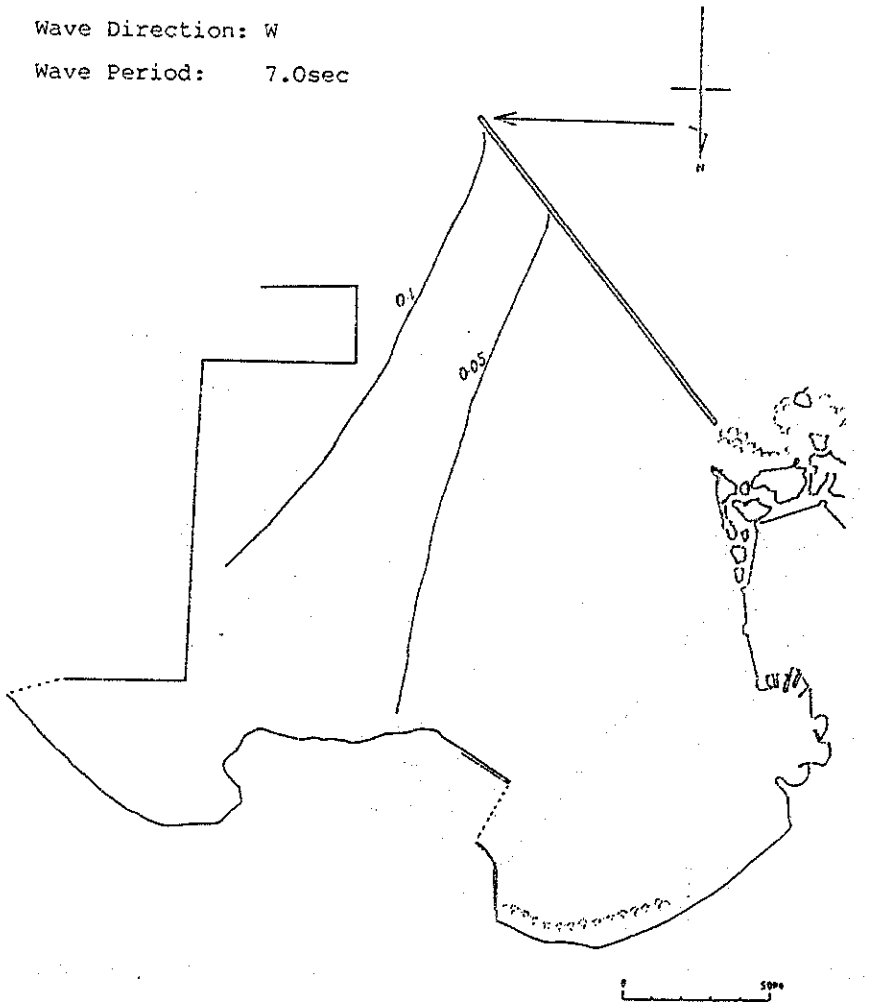
Appendix II-4-8(6) Wave Height Ratio

Alternative: 4
Wave Direction: WSW
Wave Period: 7.0sec

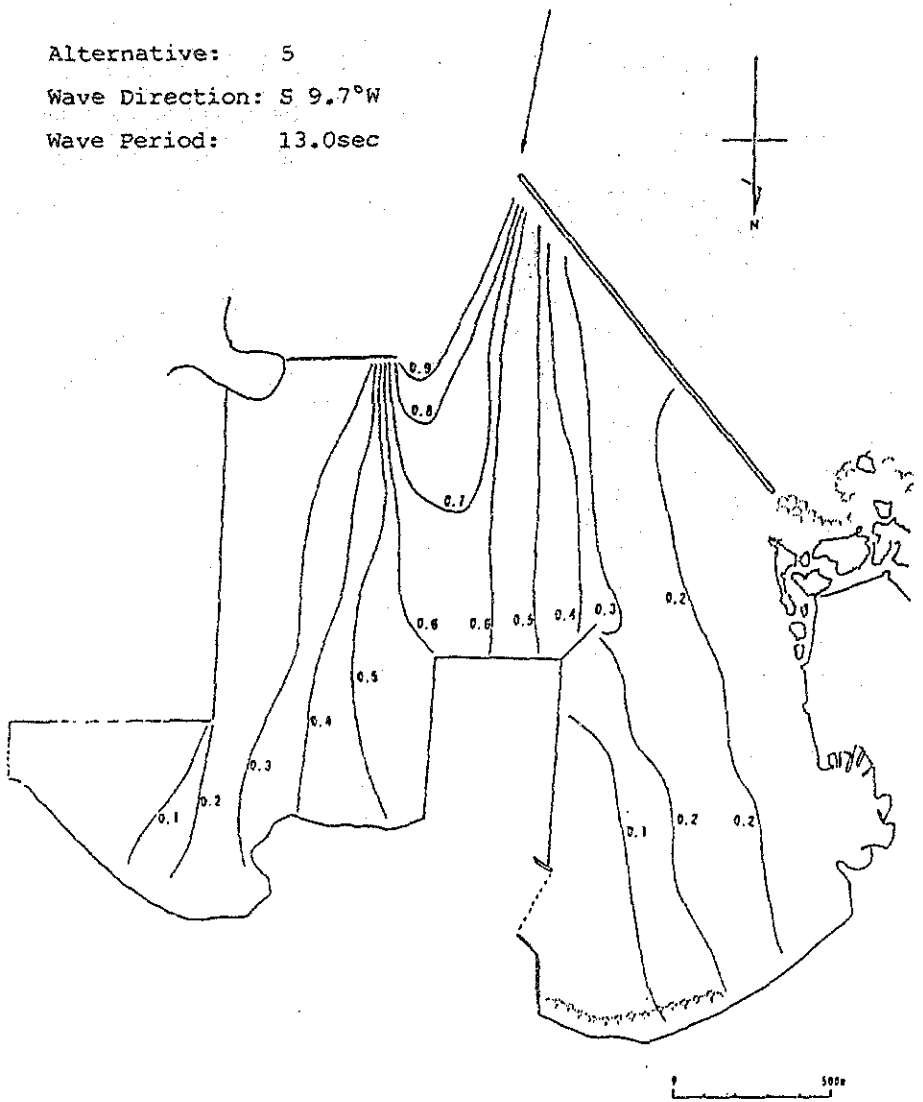


Appendix II-4-8(7) Wave Height Ratio

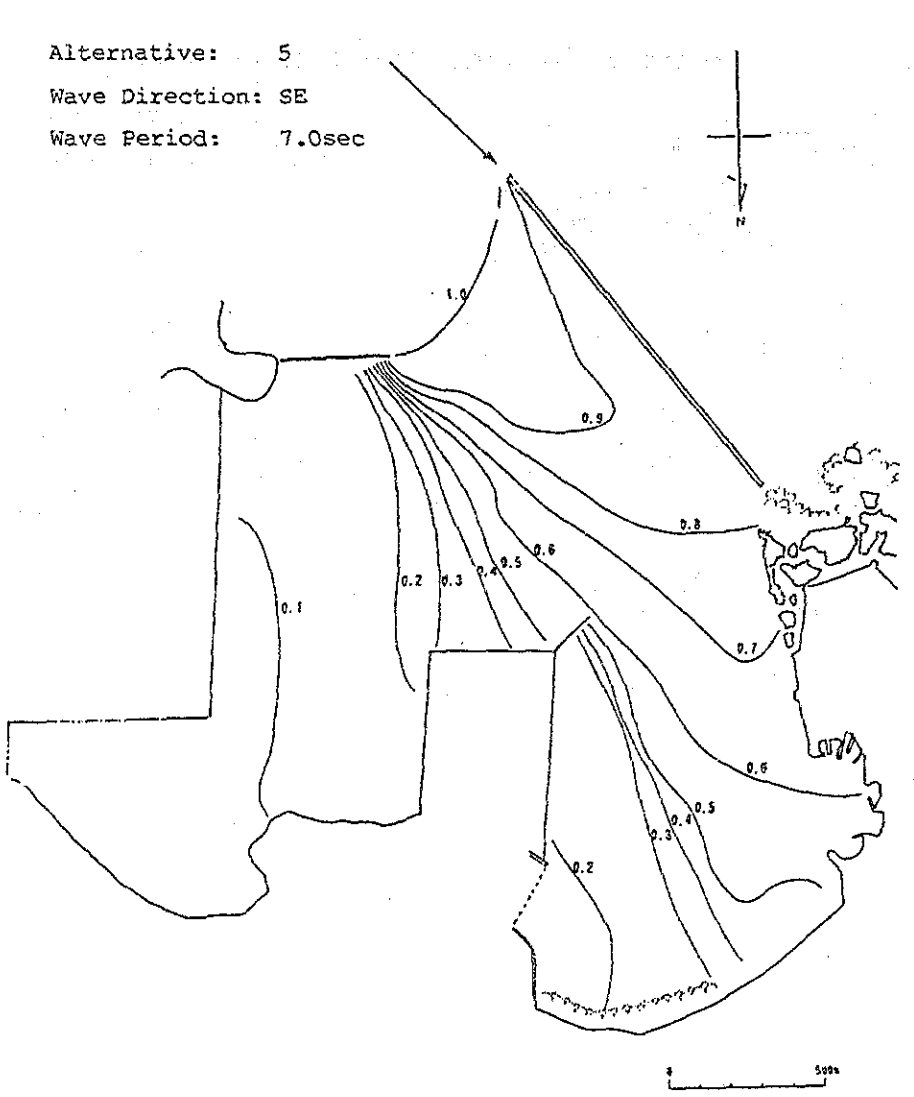
Alternative: 4
Wave Direction: W
Wave Period: 7.0sec



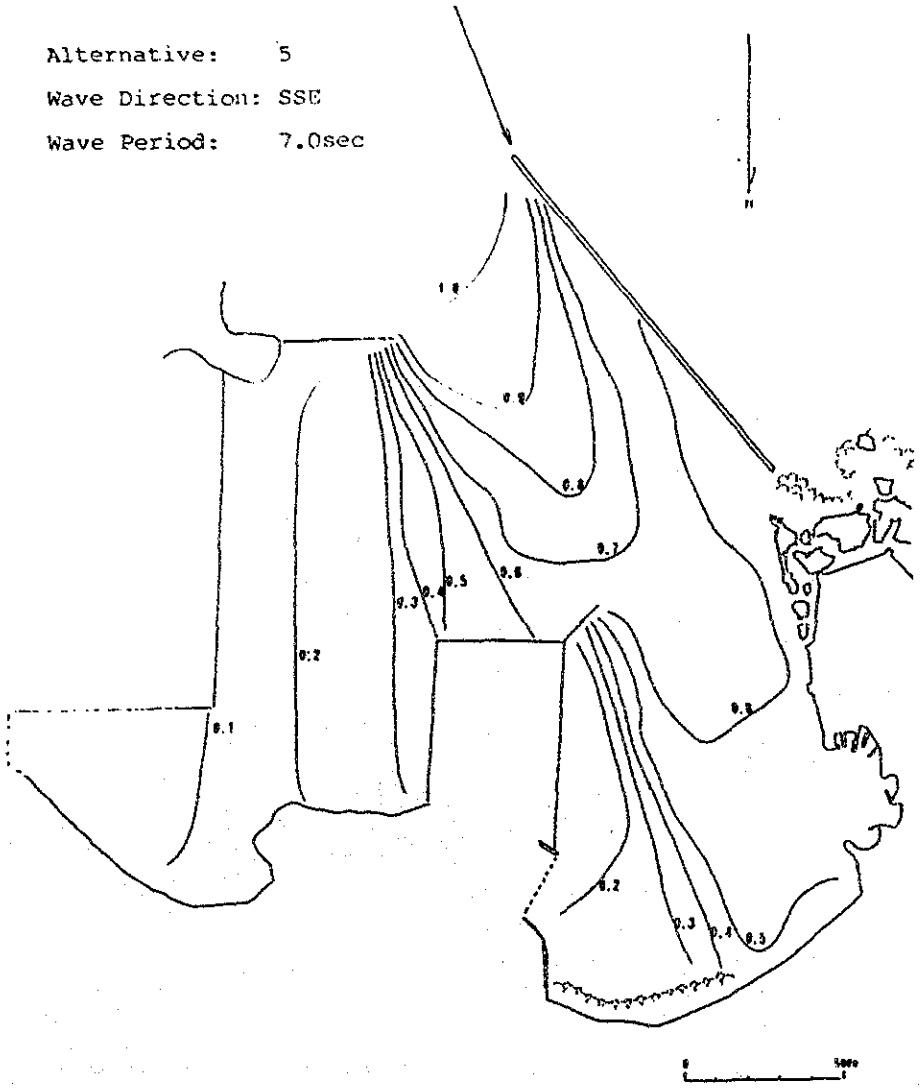
Appendix II-4-8(8) Wave Height Ratio



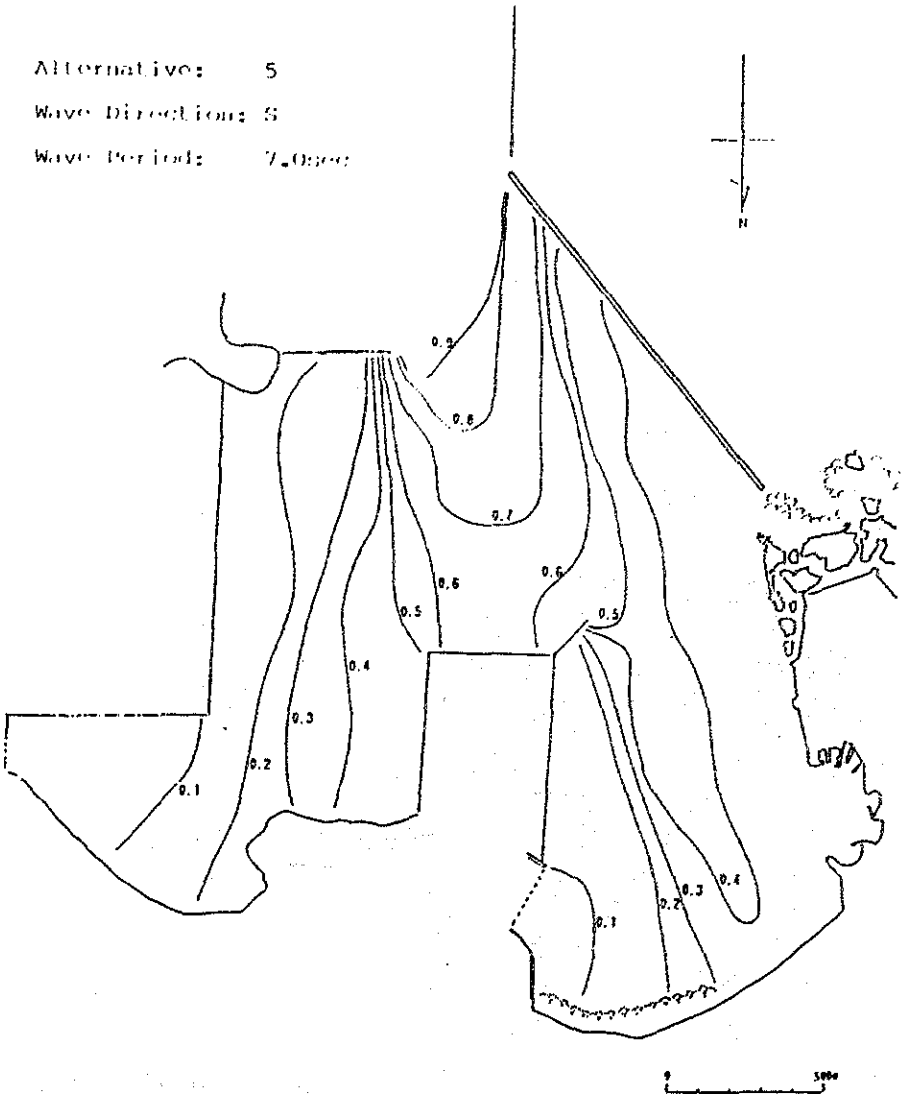
Appendix II-4-9(1) Wave Height Ratio



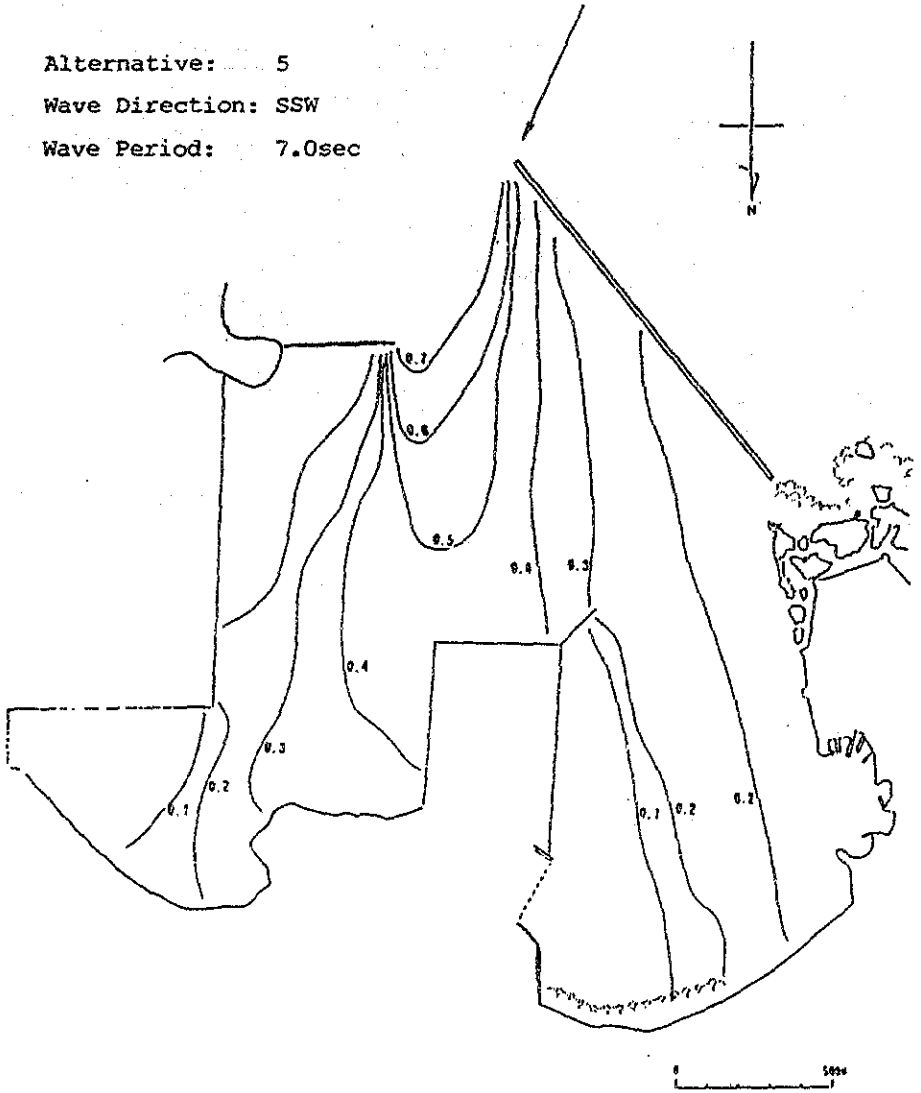
Appendix II-4-9(2) Wave Height Ratio



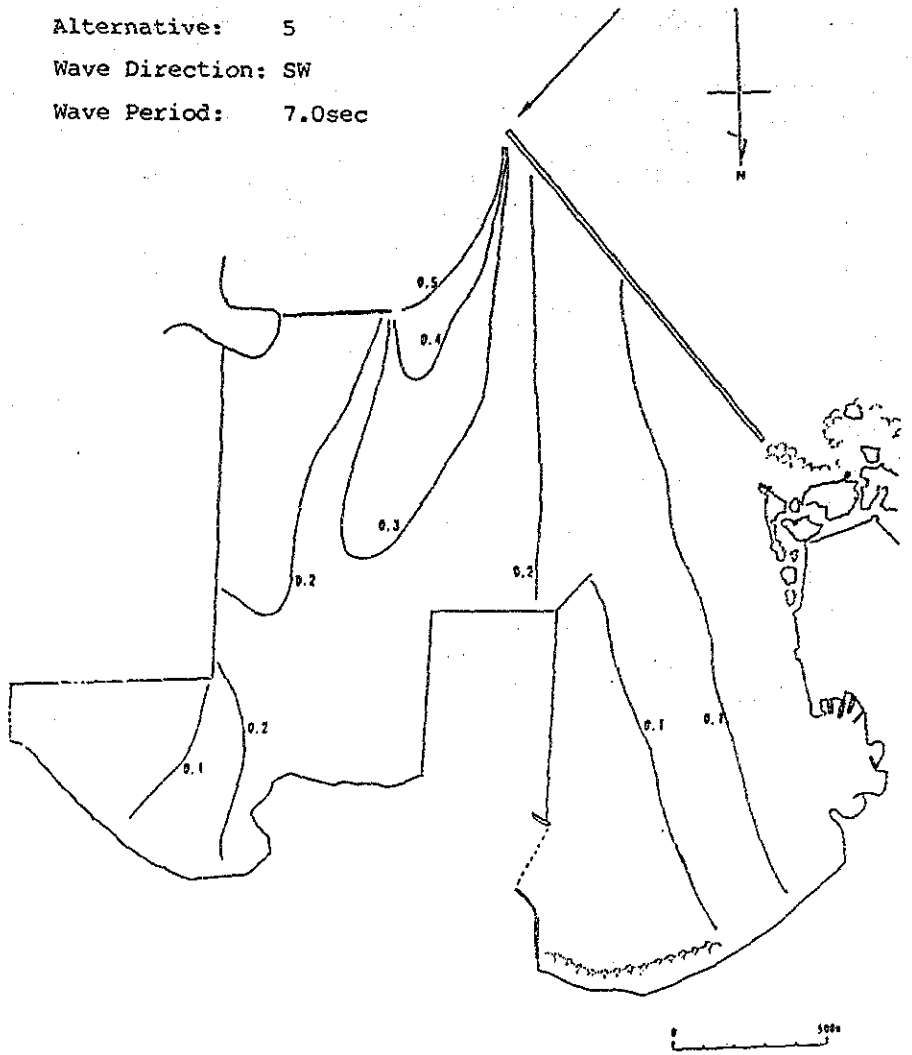
Appendix II-4-9(3) Wave Height Ratio



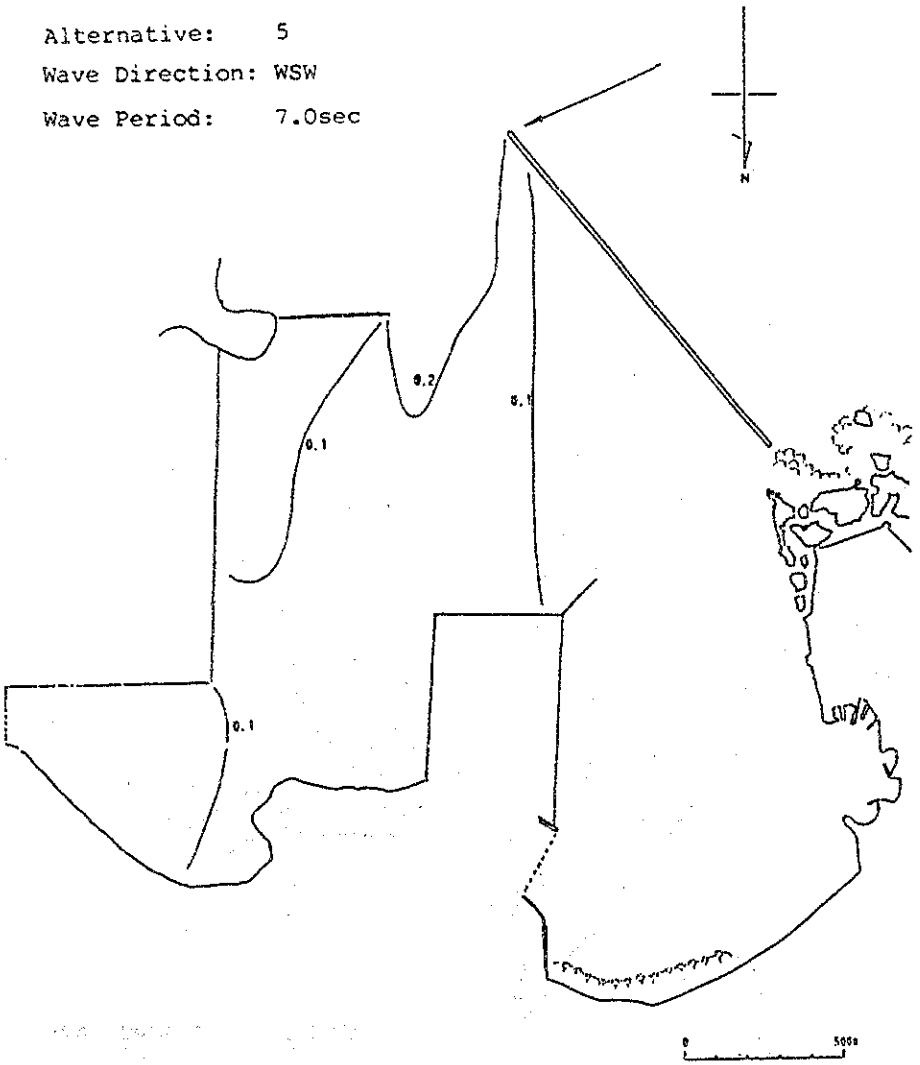
Appendix II-4-9(4) Wave Height Ratio



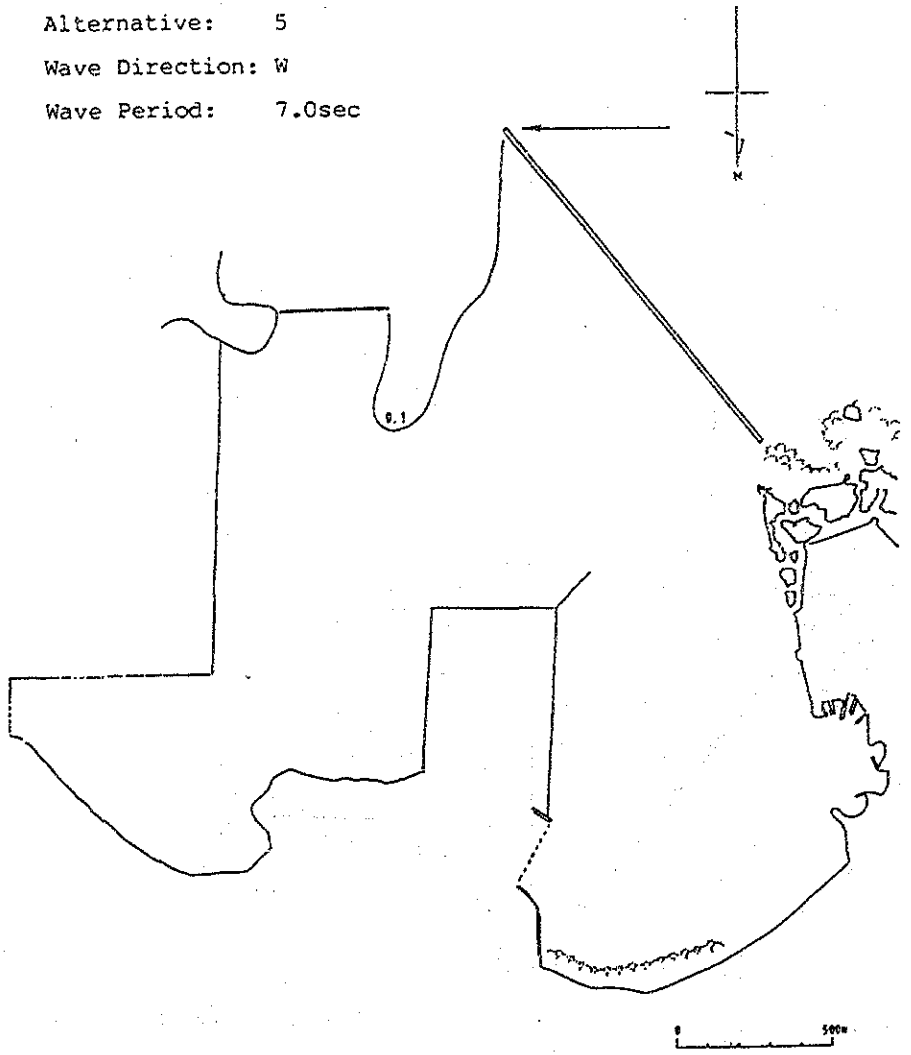
Appendix II-4-9(5) Wave Height Ratio



Appendix II-4-9(6) Wave Height Ratio



Appendix II-4-9(7) Wave Height Ratio



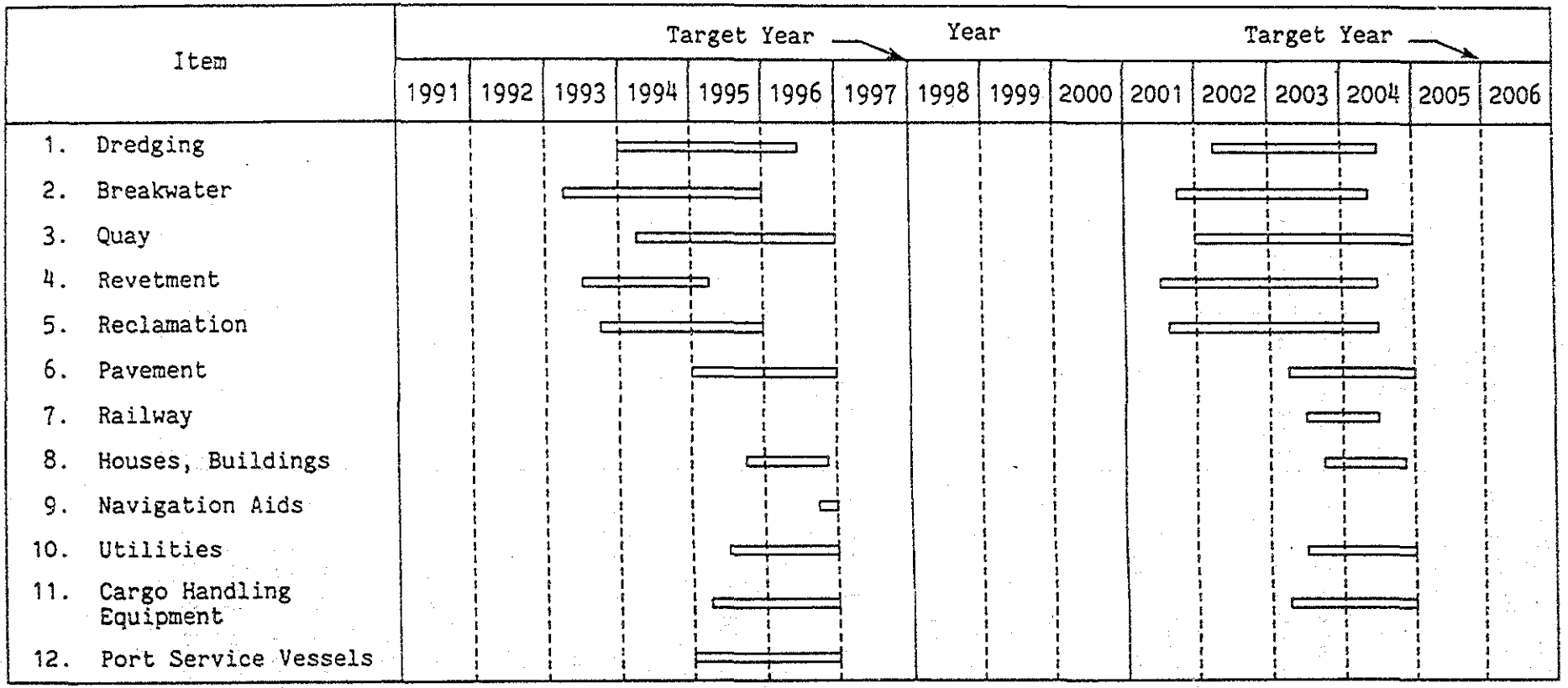
Appendix II-4-9(8) Wave Height Ratio

Appendix II-4-10 Rough Cost Estimates of Master Plan Project (2005)
(Alternative No.5)

Facility	Quantity		Cost (Million US$)
1. Dredging			
Rock Material	525,000	m^3	36.73
Other Material	2,920,000	m^3	16.57
2. Breakwater			
Southwest Breakwater	1,480	m	95.61
East Breakwater	350	m	29.96
3. Quays			
Container	1,150	m	74.76
Grain (Wheat)	270	m	24.77
General/Bulk Cargo	240	m	17.37
Bunker Oil	1	Sum	4.43
4. Revetment	1,520	m	39.86
5. Reclamation (Filling)	5,955,000	m^3	65.08
6. Pavement	631,000	m^2	48.10
7. Rail Way	1,000	m	1.08
8. Houses Buildings	1	Sum	11.76
9. Navigation Aids	1	Sum	0.70
10. Utilities (Water and Electric)	1	Sum	25.00
11. Cargo Handling Equipment			
Container	1	Sum	69.35
Grain	1	Sum	25.71
Fertilizer	1	Sum	7.56
Cement	1	Sum	1.50
Bunker Oil (Loading arm)	1	Sum	1.30
12. Port Service Vessels	2	Nos	6.48
13. Contingency (6%)			36.32
Grand Total (1~12)			640.00

Appendix II-4-11 Implementing Steps for The Master Plan

(Alternative No.5)



Appendix III-1 URGENT PLAN

1 Necessity of Urgent Plan

The Southern Province which consists of Galle, Matara and Hambantota districts has some basic problems as follows:

-Per capita GDP is rather low (78% of national value);
-The unemployment rate of 26% is rather high compared with the national level of 18%;
-Agricultural cultivation is behind in terms of mechanization compared with the rest of the country, even though it is the principal industry in the province;
-The level of manufacturing activity is low and its structure is relatively undiversified.

The above problems should be solved by degrees through further investment in the Southern Province. While the residents of the Southern Province have problems, as described in Chapter 3 of Part I, in their daily life, these difficulties appear based on regional socioeconomic differential, which is derived from above basic problems. Solving these problems should be considered a priority: they deal directly with basic human needs such as a stable society and a stable livelihood for the individual. An improvement in the transport sector would prove highly effective in opening distribution channels, thereby improving the economy as well as the quality of life in the province.

1-1 People's Daily Problems in the Southern Provinces

(1) Shortage of Commodities

According to the Ceylon Fertilizer Corporation, which has a fertilizer mixing plant in Weligama, there often has been a shortage of raw materials (component) of fertilizer because of transportation problem between Colombo and Galle.

Transportation by rail is generally delayed three or four days

(sometimes a week), because passenger transportation has priority over cargo transportation. Further, cargo is sometimes stolen on the way to Galle when shipped via road transportation. In the worst case, 65% of bagged fertilizer has been replaced with other materials on the way to Galle. Policing the road between Colombo and Galle, it appears, has been difficult.

Now, in April 1991, the supply of kieserite (a component of fertilizer) from Colombo has been cut off for two months, because of insufficient stock in Colombo. This shortage has interfered with mixing several kinds of fertilizer. As another example of the shortages, the supply of potash (a important component of fertilizer) from Colombo was cut off for two months during November-December 1990. At that time, it depressed the cultivation of paddy, tea, rubber and palm oil in the Southern Province because of poor supply of fertilizer to farmers. Not surprisingly, the average farmer was hit the hardest by the shortage. Although a few rich farmers could afford to go fertilizer hunting to Colombo, other common farmers couldn't.

The principal reasons the above situations occurred is that economic activities in the Southern Province are too dependent on the state of affairs in Colombo and that the transportation connecting these two areas is too weak to cope with these situations.

(2) Higher Retail Prices

Retail prices of some important foods such as flour and rice are controlled by the Government to some extent. However, retail prices of rice in the Southern Province are higher than those in Colombo as shown in Table 1-1.

This table shows retail prices of rice in Colombo and each district of the Southern Province from 1975 to 1989. Prices in the province are the weighted average value in consideration of each district's population. Consequently, it also shows that average retail price in the province for the period to 1989 was 5.1% higher than that in Colombo.

Meanwhile, according to "Price and Wage Statistics 1986" issued by Central Bank of Sri Lanka, average daily wage rates for key

agricultural production and building construction in the Southern Province was 6.9% lower than that in Colombo. Therefore, this means that substantial living expenses in the province was 12.9% higher than those in Colombo.

This is the very regional differential between Colombo and the Southern Province, and it is difficult to dissolve this differential without the development of the province, which is spearheaded by the improvement of infrastructures in the transport sector.

Table 1-1 Retail Prices of Rice

(Unit: Rs/Kg)

Year	① Colombo	Southern Province	② Galle	② Matara	② Hambantota	②/①-1 (%)
1975	4.12	4.34	4.10	4.19	4.95	5.39
1980	6.15	6.66	6.61	6.45	7.01	8.25
1983	8.49	8.96	8.97	8.72	9.26	5.54
1984	11.44	11.72	11.51	12.15	11.51	2.46
1985	10.84	11.15	11.04	10.81	11.77	2.83
1986	10.58	11.04	10.74	10.72	11.95	4.31
1987	11.73	12.54	12.29	11.64	14.16	6.93
1988	11.92	12.71	12.51	12.11	13.82	6.59
1989	14.66	15.16	15.00	15.13	15.46	3.40

Source: Bulletin of Selected Retail Prices, Department of Census & Statistics, Ministry of Policy Planning & Implementation

(3) At Emergency

Sri Lanka has been afflicted with ethnic problems for a long time and civil disturbances have occurred continually since 1983. During these civil disturbances, especially during April, August and September 1988 and November and December 1989, delivery shortage of many imported goods for the Southern Province occurred. These goods, which consist of consumer staples such as rice, flour, sugar, milk foods and so on, and intermediate goods such as fertilizer, petroleum and so on, have a strong relationship with people's livelihoods in the province.

A serious distribution shortage of essential food in the Southern Province was averted, because the province maintains a three month stock. However, even though the Provincial Council attempted to restrict against a rise in prices with the release of stock and the help of "price control law" by the Government, prices still rose dramatically, particularly in the Southern Province. Table 1-2 shows retail prices of rice in Colombo and each district of the Southern Province from January to December 1989. It can be found that the price in rise during November-December is remarkable.

Table 1-2 Retail Prices of Rice in 1989

(Unit: Rs/Kg)

Year	Month	① Colombo	Southern Province	② Galle	Matara	Hambantota	②/①-1 (%)
1989	JAN	16.17	13.71	12.50	13.50	16.00	-15.24
	FEB	13.79	13.83	13.00	14.00	15.00	0.29
	MAR	12.25	13.84	14.00	13.50	14.00	12.94
	APR	12.83	13.96	14.00	13.50	14.50	8.81
	MAY	12.83	14.13	14.00	14.00	14.50	10.09
	JUN	13.00	14.29	14.00	14.50	14.50	9.92
	JUL	13.08	14.29	14.00	14.50	14.50	9.25
	AUG	14.67	14.88	15.00	15.00	14.50	1.40
	SEP	14.88	15.25	15.50	15.50	14.50	2.49
	OCT	16.04	15.71	16.00	15.50	15.50	-2.06
	NOV	17.58	18.42	19.00	18.00	18.00	4.78
	DEC	18.83	19.58	19.00	20.00	20.00	3.98

Source: Bulletin of Selected Retail Prices, Department of Census & Statistics, Ministry of Policy Planning & Implementation

While as for fertilizer, the fertilizer mixing plant, as mentioned earlier, stopped operation for two or three months in each disturbance because of traffic suspension between Colombo and Galle.

These disturbances had a bad effect on not only socioeconomic activity in the Southern Province but also that in all island (of

course including Colombo). It is because almost all of marketing routes concentrate on Colombo. These situations would be easily avoided by providing a powerful channel for input of goods into the Southern Province.

1-2 Roles to be Played by the Port of Galle

The Port of Galle was constructed in 1971 and has quaywalls with a depth of nine meters and a length of 400 meters, where two 9,000 DWT class vessels are capable of being moored at the same time. Considerable volumes of commodities such as rice and sugar have been handled at the port. According to the development of the Port of Colombo, however, the quantity has gradually decreased for the past 10 years, except for clinker for cement production. To take some examples, the volume of rice handled at the Port of Galle was a scant 4,000 tons in 1989, compared with 30,000 tons in 1980. Sugar has not been handled at all for the past three years. The volume of loaded cargo was 1,400 tons in 1989, compared with 5,900 tons in 1980.

It is quite correct that the principal reason for the decrease in the handling of above cargoes results from the lack of a safe maneuvering area for vessels calling at the port.

Meanwhile, there is another problem at the coastal area of the city of Galle. The main shopping area is located at the east side of Galle Station, and some part exists along the "Marine Drive" which runs just behind the seashore. Although the "Marine Drive" is protected by a revetment made of rubble stones, it is always attacked by waves because there is no beach in front. Wave spray crashing on rubble stones has hindered the lives of people working on the sea side of the road.

According to interviews held with people living in this area, they have some trouble walking on the sea side of the road two to three months of the year. They also said that it was impossible to use the coastal side of the road as business parking spaces during those months.

To solve the problems that the people in the Southern Province have in their daily life, it is of urgent necessity to ease the situation of excessive concentration of the distribution function of goods on

Colombo by strengthening channels for input of goods into the province. From this viewpoint, it is considered to be most economical and effective to improve the Port of Galle by executing an urgent improvement plan described in the following section.

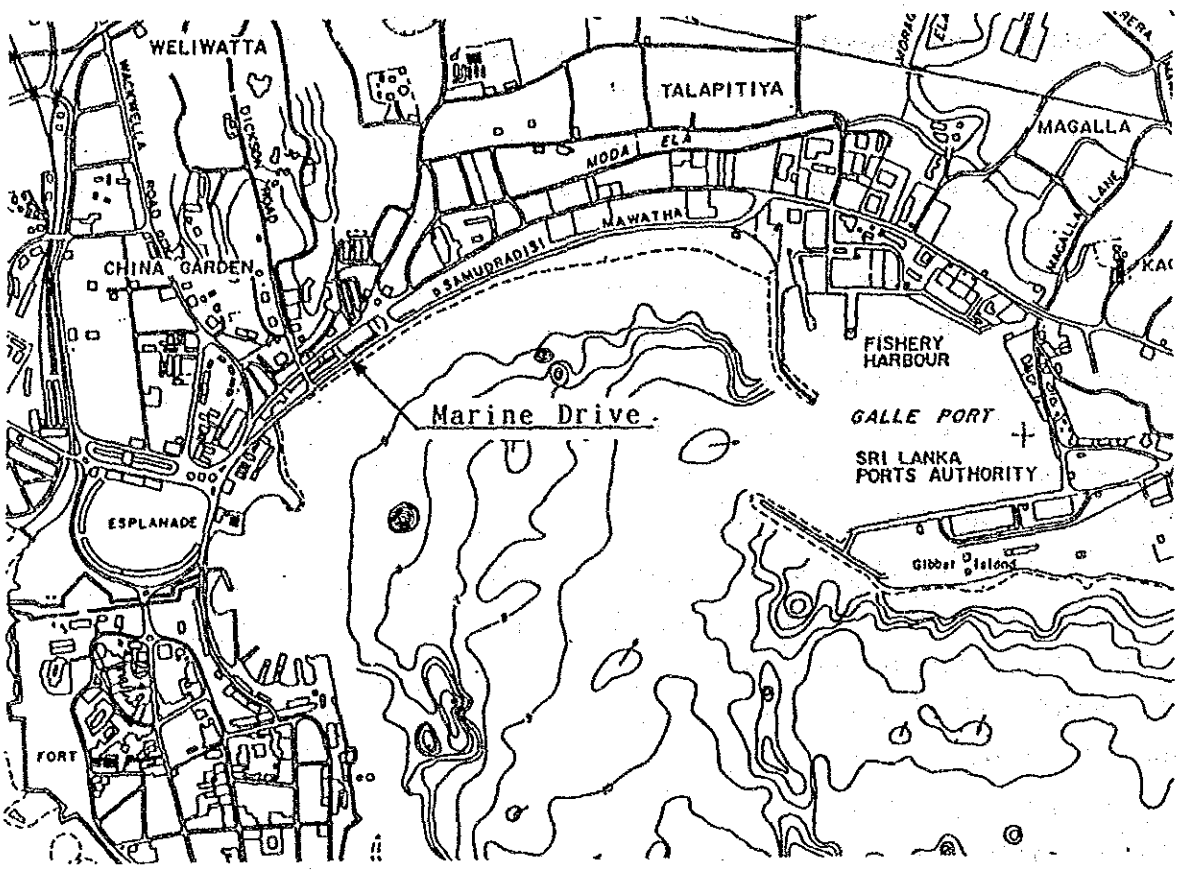


Figure 1-1 Coastal Area of Galle Bay

1-3 Problems of Existing Facilities

It is clarified in the former section that the Port of Galle, which is the gateway for the Southern Province as well as a fundamental base for providing transportation services to residents of the province, should implement its functions fully.

In fact, however, although the Port of Galle is located in a prime location on World Shipping Routes and is also the port to have been first developed in Sri Lanka, it is currently in a situation of stagnation. Therefore, even its small-scale handling facilities, composed only of berthing facilities 400m long and two warehouses, are not well utilized.

There are several reasons for this situation at Galle. Recently, dominant trends in world shipping have been towards the enlargement of vessel size, higher handling speed due to the introduction of containerization and so on. The Port of Galle, however, hasn't responded to these trends at all, an important point that needs to be indicated at the outset. It will take a long time to solve this problem, because it is necessary to undertake a full scale reconstruction of the wharves, basin and so on.

However, the most important issue for the time being will remain the problem of safety. In particular, the channel outside the port poses serious safety questions.

1-4 Present Condition of Safety in the Channel

(1) Maneuvering Condition

1) The Entrance of the Port

Fig.1-2, 1-3 show the maneuvering of vessels in arriving and departing respectively. According to these figures, some turning activities are carried out in the area just outside the port. In the case of arrivals, the vessel has to turn more than 90 degrees outside the existing port and stop in a very short space just

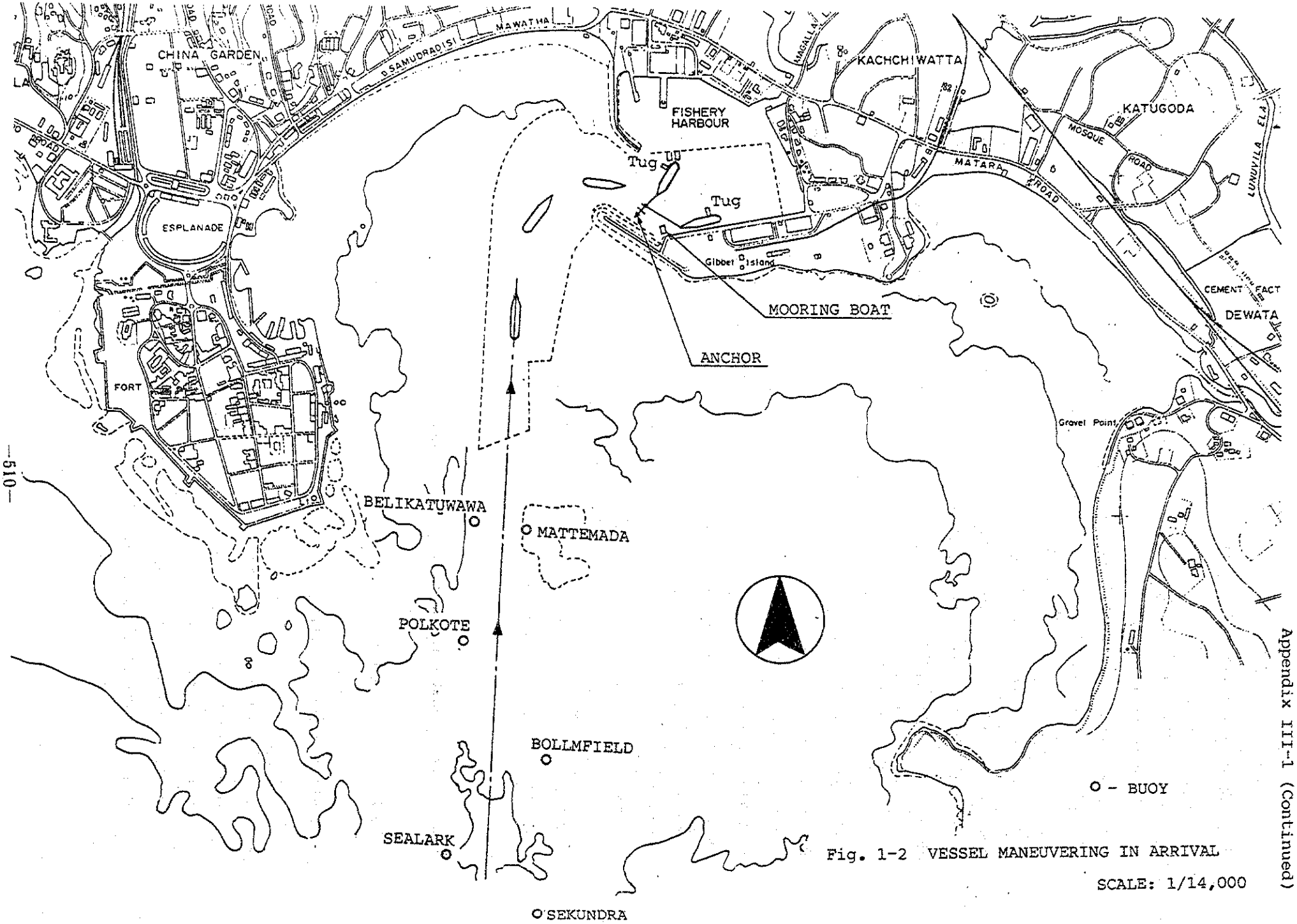


Fig. 1-2 VESSEL MANEUVERING IN ARRIVAL

SCALE: 1/14,000

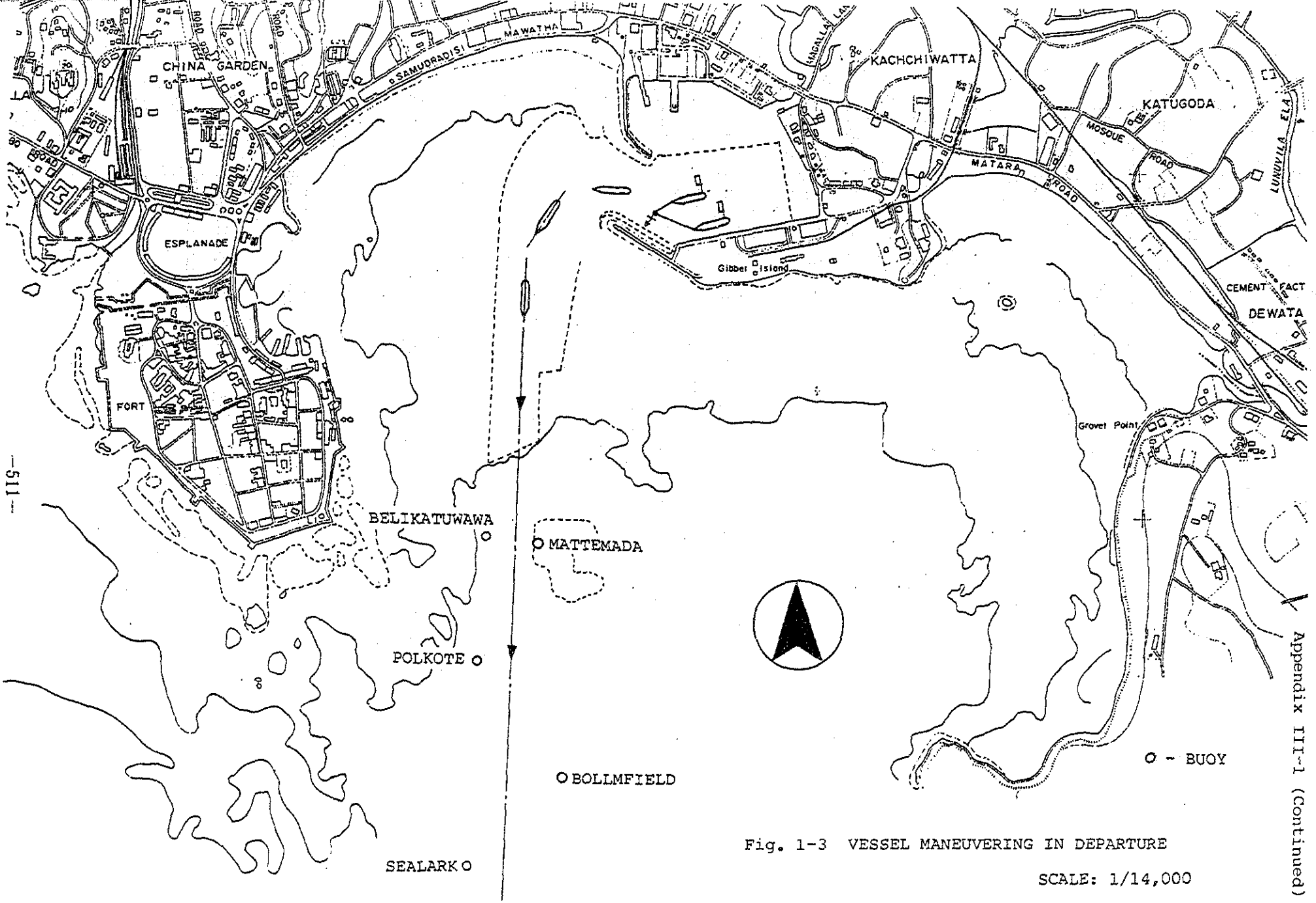


Fig. 1-3 VESSEL MANEUVERING IN DEPARTURE

SCALE: 1/14,000

Appendix III-1 (Continued)

after entering the basin. In these conditions, ships are easily affected by external forces such as waves and winds. Therefore, sharp technique by the maneuvering vessel is required, and it is difficult to conduct smooth entrance into the existing port even with the assistance of tug boats. Although the turning area is wide enough, it does not meet the criterion for calmness. This area sometimes suffers rough conditions mainly because of south swells.

2) Channel

This channel is located outside of the existing port and the depth is set at 9.8 meters, which is 0.9m deeper than that of the basin in the port. The narrowest width of the channel is about 150m, judging from the map. There are many parts which are shallower than 9.8m along the channel. According to the sounding results, there are shallow areas between the Fort and the channel in the western side of the channel. There are also some shallow areas corresponding immediately east of the channel. At the same time, there are some shallow points along the channel in the deep area. Although these shallow areas or points are marked with buoys, there are strong possibilities that vessels may inadvertently near these shallow areas because of high waves and strong winds. In fact, there have been accidents in this area, as is described later.

(2) Wave Conditions

Wave conditions of Galle Bay were already described in Chapter 4 of Part I. The main features are as follows:

Swells:

* Directions are substantially constant at SSE to SSW throughout the year.
* Waves with a height of over 0.5m attack the port throughout the year, percentage of 1.5m or over in height is 47% during the southwest monsoon season.

Wind waves:

* The influence of wind waves is most significant during the southwest monsoon season with waves of 1.5m or more in height generated with a frequency of nearly 50%.

The following table 1-3 shows the degree of calmness at three points in the central channel shown in Figure 1-4. In this table, the number shows the frequency of occurrence of the wave height that exceeds each critical wave height Hc.

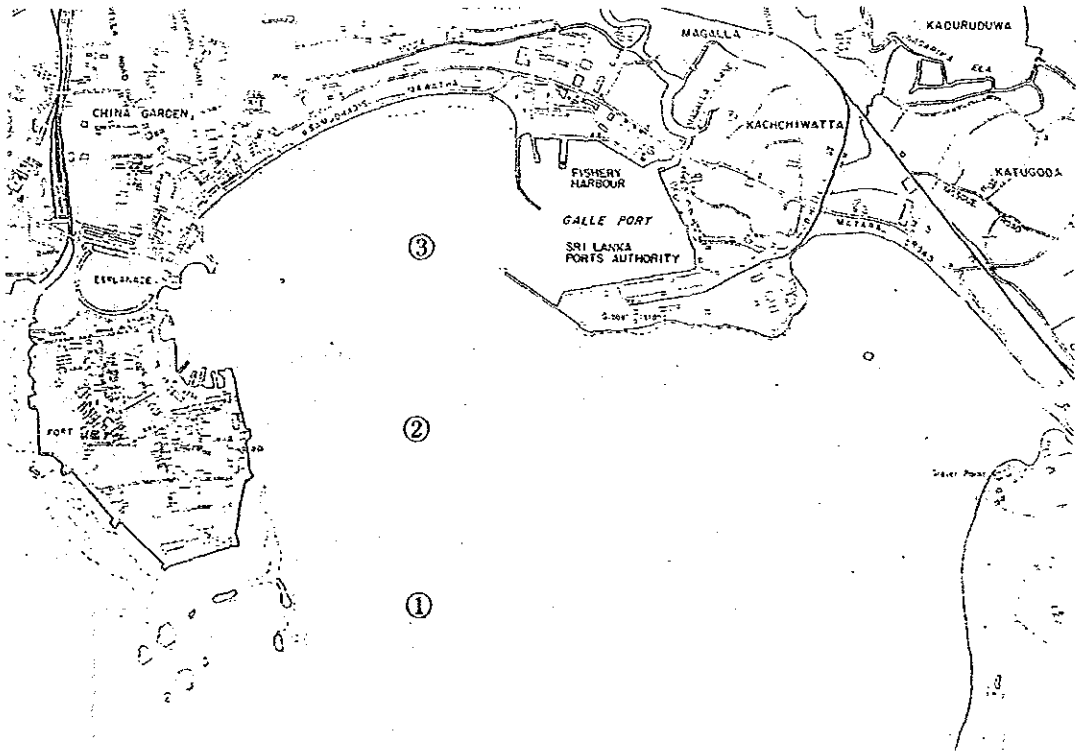


Fig. 1-4 Points of Calmness Estimation

Table 1-3 Degree of Calmness in the Channel

Unit: %

Hc / Point	0.7m	1.0m	1.5m	2.0m
1	>90	67.4	42.7	18.7
2	>90	62.7	27.0	5.9
3	>90	56.6	21.8	2.2

From this table, it is understood as follows:

* The entrance of the bay (point 1), for 42.7% of the year, namely 165 days, is attacked by the waves of 1.5m or more in height.
* Even the entrance of the existing port (point 3), which exists at the inner most part of the bay,is attacked by the wave of 1.5m or more in height for more than 20% of the year.

(3) Some Accident Examples Caused by Waves

1) Parting of Buoys

Because of these wave conditions in this water area, buoys lose their sinkers every year. The location of parting is shown in Fig.1-5. In the last two years, four buoys were parted from their sinkers, i.e.,breakage occurred twice a year. According to the harbour master, the reason for this is assumed to be waves. This problem is not a frequent occurrence in bays other than Galle.

Parting of Buoys in the Galle Bay

YEAR	DATE	NAME OF PARTED BUOY
89	7/4	SEKUNDRA
89	8/20	MATTEMADA
90	5/17	MATTEMADA
90	6/24	BELIKATUWAWA

2) Marine Accidents

Fatal marine accidents have also happened in this area. In the

last 10 years, two marine accidents, namely ships sinking, took place. The table describes the content of accidents and the figure 1-5 shows the location of the accidents. This shows that the accident places are just alongside the channel. Although there are three ports in Sri Lanka, there have been no cases of ships sinking except for these two cases in these 20 years.

Incidents of Sinking Ships

	Incident one	Incident two
Name of Vessel	TONJOO	Extraco 1
Nature of Incident	Grounding	Grounding
Date	1978.9.18	1988.10.28
Position		
GRT	4,690	-
NRT	3,110	-
Port of Registry	Singapore	-
Length of Vessel	420 feet	-
Draft	26 feet	-
Piloted or Selftaker	Piloted	-
Number of Tugs used	250 HP tug	-
Cargo carried	Rice	-

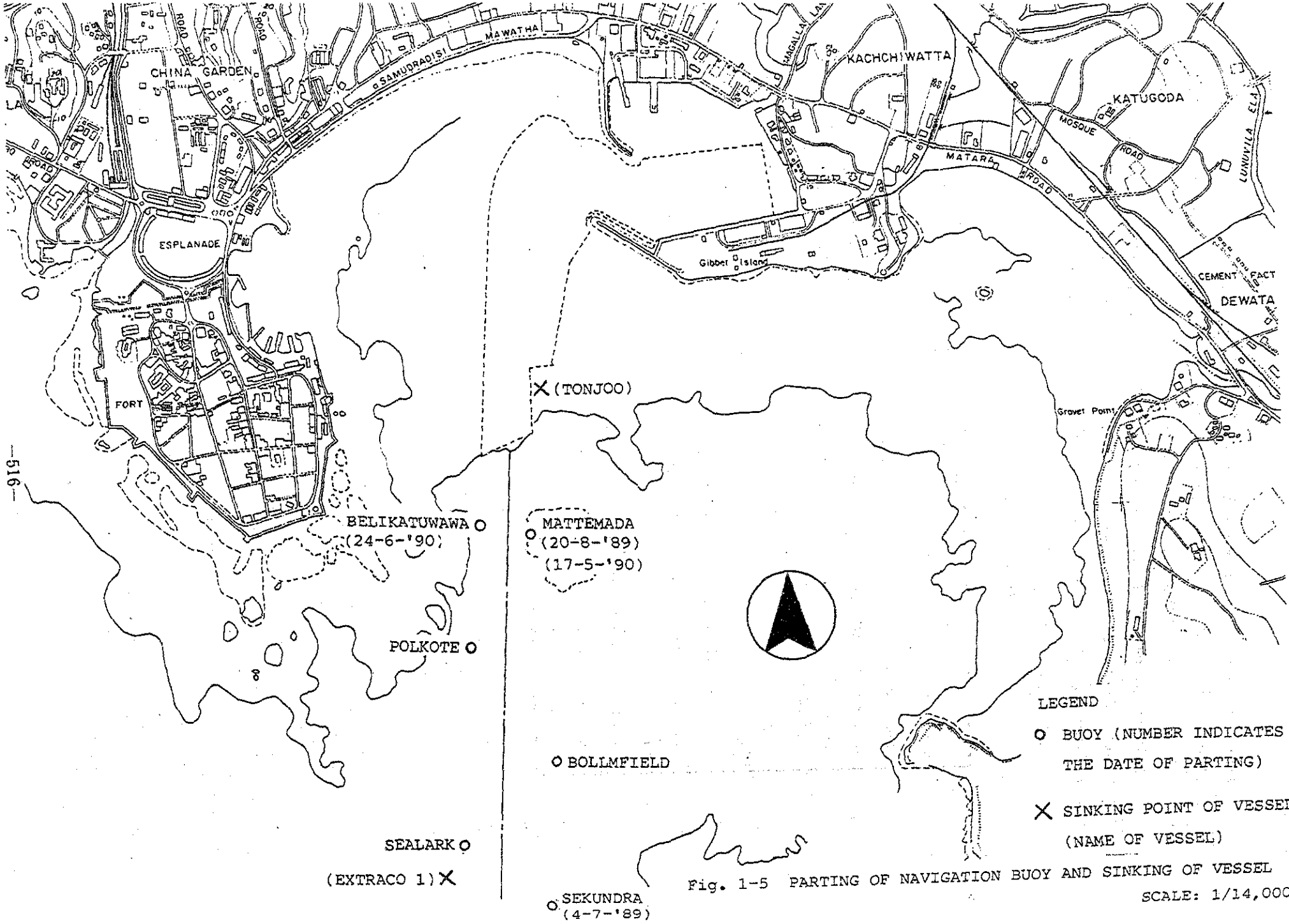


Fig. 1-5 PARTING OF NAVIGATION BUOY AND SINKING OF VESSEL

SCALE: 1/14,000

2 Basic Design

2-1 Site and Layout Plan

(1) Objectives of the Plan and Necessary Measures

The objective of the Urgent Plan is to provide a safe gateway to the Southern Province as the Port of Galle. To attain it, it is necessary mainly to secure safety for maneuvering of vessels. This is divided into two parts:

1) To increase the safety of maneuvering at the entrance of the existing port where vessels have to turn more than 90 degrees.

2) To increase the safety of maneuvering at the approaching channel where the vessel tends to be pushed towards shallower areas along it by waves and winds.

For these objectives, the following measures are considered:

1) To construct a breakwater as protection from high waves

2) To dredge the shallow area along the channel to widen the deep area

It is ideal to take both measures simultaneously, but it is considered difficult because of the high expense and long construction period.

If dredging of the shallow area is conducted after the completion of the breakwater, it then can be done easily and cheaply because water conditions will be calmer. Therefore, it is better to construct the breakwater first. Even only the construction of the breakwater will be very effective for improving condition of safety. At the same time, the construction of the breakwater will also reduce the influence of wave spray mentioned previously.

Accordingly, construction of the breakwater should be selected as a content of the Urgent Plan. So, a minimum required length of breakwater against the southwest monsoon is planned.

(2) Construction Site

As described above, it is necessary to attain the two objectives simultaneously by constructing a breakwater. The construction site of the breakwater should be the entrance of the bay to increase the calmness at the shallow points along the channel where the marine accidents have occurred. Therefore, it is most appropriate to construct the breakwater from the foot of the Fort. Considering the existing of rocks in front of the Fort, it would be suitable to select the site between rocks and the edge of the channel.

(3) Layout Plan

1) Alignment

The alignment of the breakwater shall be planned taking into consideration the wave direction, the ample width of the existing channel and the influence of reflected waves from the breakwater on vessels running along the channel.

2) Required Calmness

The maneuvering condition of vessels in the channel of Galle Bay is assumed to be similar to that of entering the port. Presented below are the results of interviews held with pilots in Japan on the maneuvering conditions of vessels entering the port. From the interviews, it was observed that tolerant limits of wave height at the entrance of the port for maneuvering vessels are as follows:

Direction of wave to vessel	90 deg.	45 deg.	0 deg.
Wave height	1.8m	1.9m	2.1m

From these results, it can be understood that 1.8m is the maximum wave height and when waves are smaller than that, it is possible to maneuver a vessel when attacked by waves from the side. 2.1m is observed to be the maximum wave height for waves from the front.

These are averages of all the figures based on answers by pilots,

excluding the impact of other forces such as winds and tides.

However, in the real situation during the southwest monsoon season in Sri Lanka, the wind blows hard simultaneously when high waves attack the bay. Therefore, in consideration of other forces, lower figures should be taken into account as the limit wave height for maneuvering ships.

As described in 4-3-1 of Part I and 4-6-3 of Part II, swells mainly come from the south. In the case of wind waves, they mainly come from between the south and west-southwest around the central channel because most of the waves are fairly refracted there. Accordingly, it is possible to assume that vessels plying along the channel will be attacked mainly from the rear by waves while they are attacked from the side at the entrance of the existing port. In consideration of these elements, the criteria for required calmness are assumed to be as follows:

The entrance of the port	1.5m
Channel	2.0m

The criterion of frequency is set at 95% considering a usual port planning criteria for calmness.

3) Study of Calmness

There are many exposed rocks in front of the Fort and these rocks work as a breakwater. Therefore, it is appropriate to start construction of the breakwater from the Southeast tip of these rocks.

On the other hand, the head of the breakwater to be constructed shall be set with a necessary allowance from the edge of the existing channel, if that channel is maintained to be used as is. On the assumption that 200m is secured as the width of the channel, the length of the breakwater would be 350m. As such, the maximum length of the breakwater would be 350m.

Figure 2-2 to Figure 2-17 show wave height ratio in the inner harbor by wave direction.

The table below shows the result of computer-aided simulation analysis of the effect of both a 300m and a 350m breakwater on calmness.

Table 2-1 Degree of Calmness (Critical Wave Height 0.5m)

Unit: %

Critical wave height	1.5m			2.0m		
Length of breakwater	0m	300m	350m	0m	300m	350m
Point 1	57.3	71.4	76.0	81.3	93.1	95.1
Point 2	73.0	77.9	84.0	94.1	96.4	97.6
Point 3	78.2	93.3	95.3	97.8	99.5	99.7

The following is observed from these results:

-With a 300m breakwater, the frequency of waves less than 1.5m is 93.3% at the point of 3 and that of waves less than 2.0m is 93.1% at the point of 1.

-On the other hand, if the breakwater is 350m, the frequency of waves less than 1.5m at the point of 3 and that of waves less than 2.0m at the point of 1 are more than 95%.

4) Layout Plan

Through the examinations described above, the breakwater with a length of 350m as shown in Figure 2-1 is being planned on an urgent basis.

On the completion of the construction of this breakwater, the Port of Galle will become a fully utilized port due to the enhancing of safety for maneuvering vessels in the central channel.

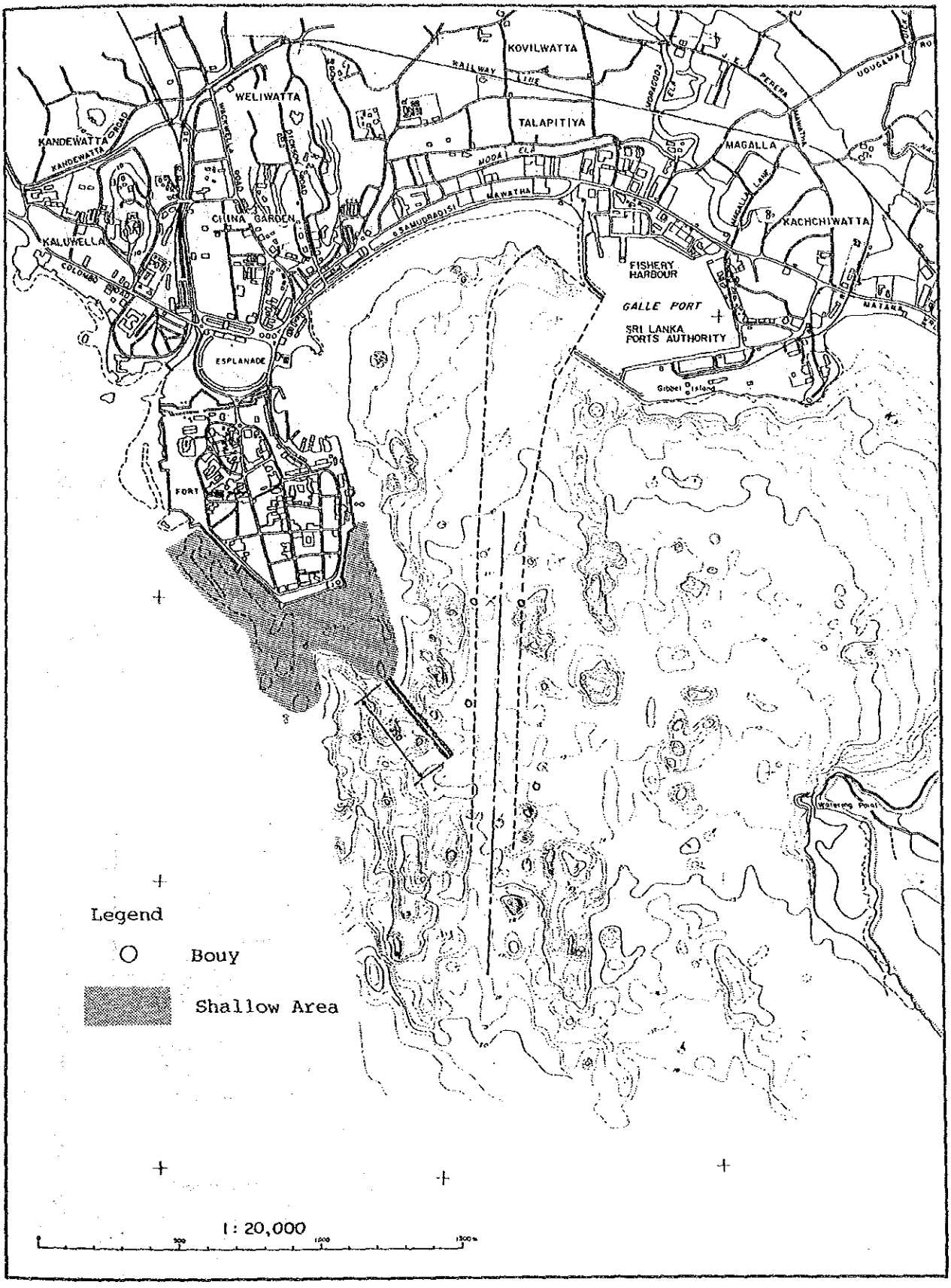


Fig. 2-1 Layout of Urgent Plan

Present
Wave Direction : S 7.0° W
Wave Period : 13.0 sec

Fig. 2-2 Wave Height Ratio

Present
Wave Direction : SE
Wave Period : 7.0 sec

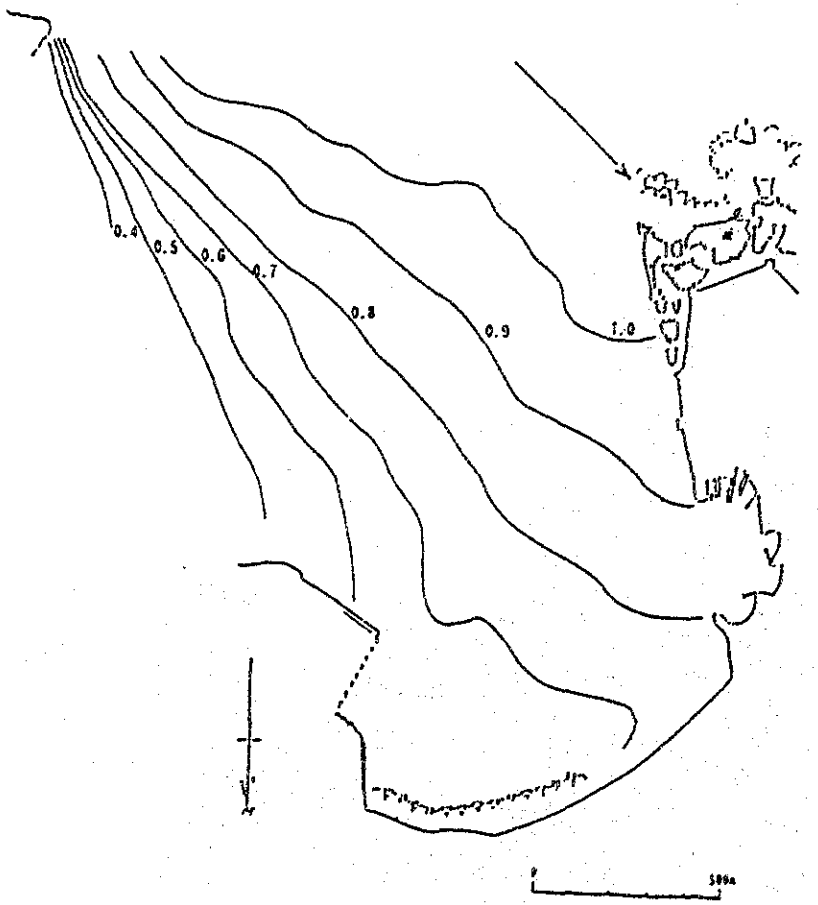


Fig. 2-3 Wave Height Ratio

Present
Wave Direction : SSE
Wave Period : 7.0 sec

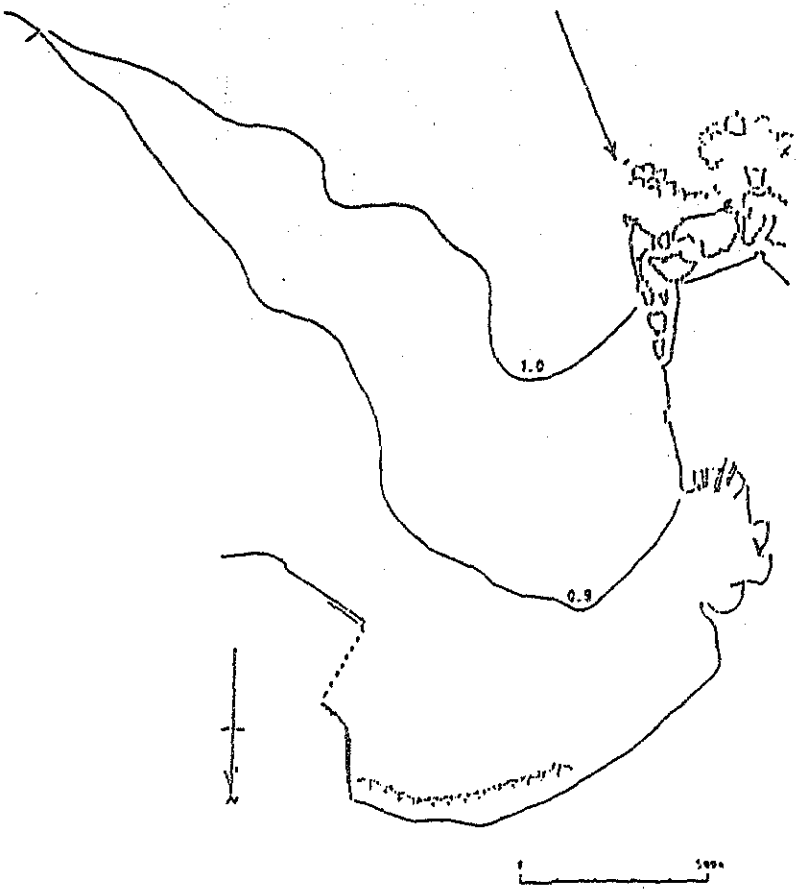


Fig. 2-4 Wave Height Ratio

Present
Wave Direction : S
Wave Period : 7.0 sec

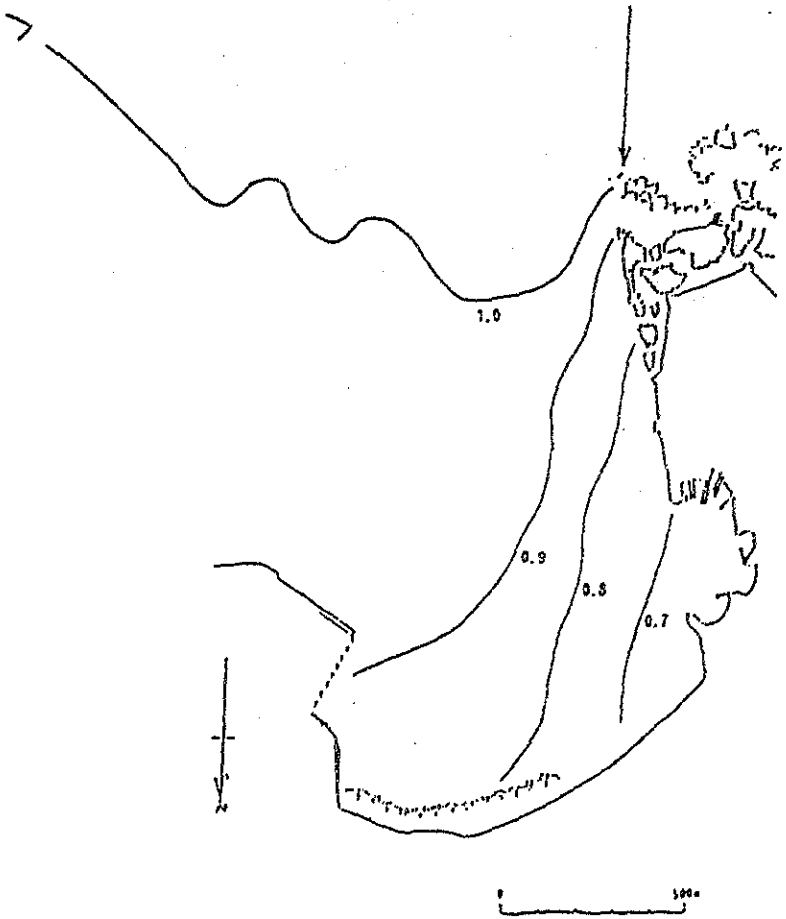


Fig. 2-5 Wave Height Ratio

Present
Wave Direction : SSW
Wave Period : 7.0 sec

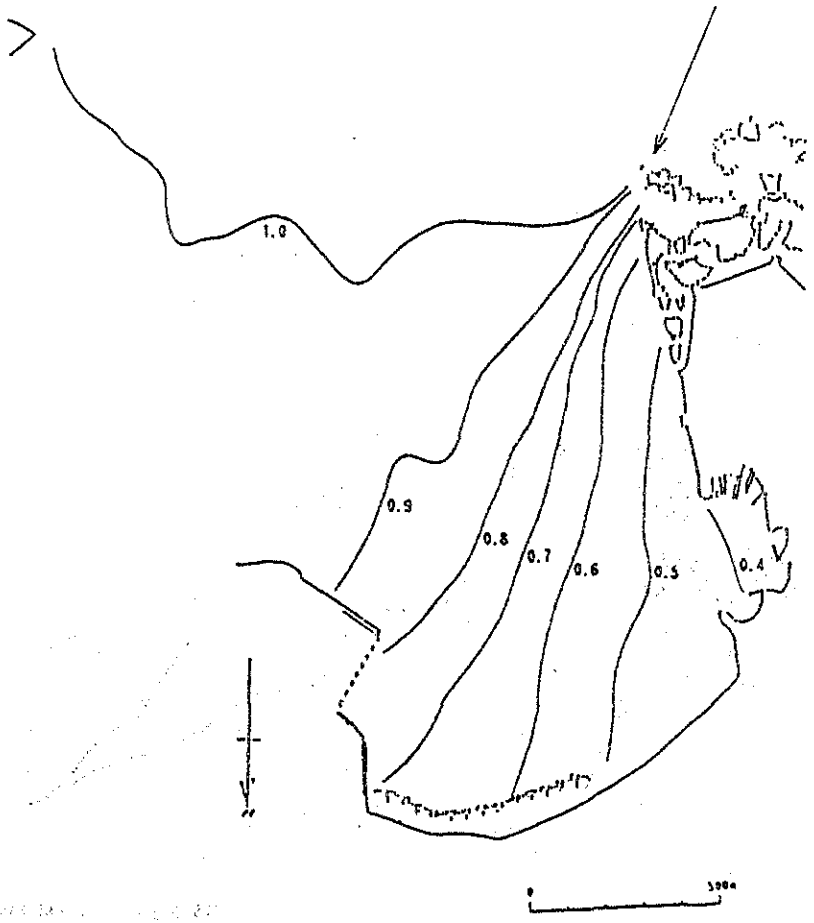


Fig. 2-6 Wave Height Ratio

Present
Wave Direction : SW
Wave Period : 7.0 sec

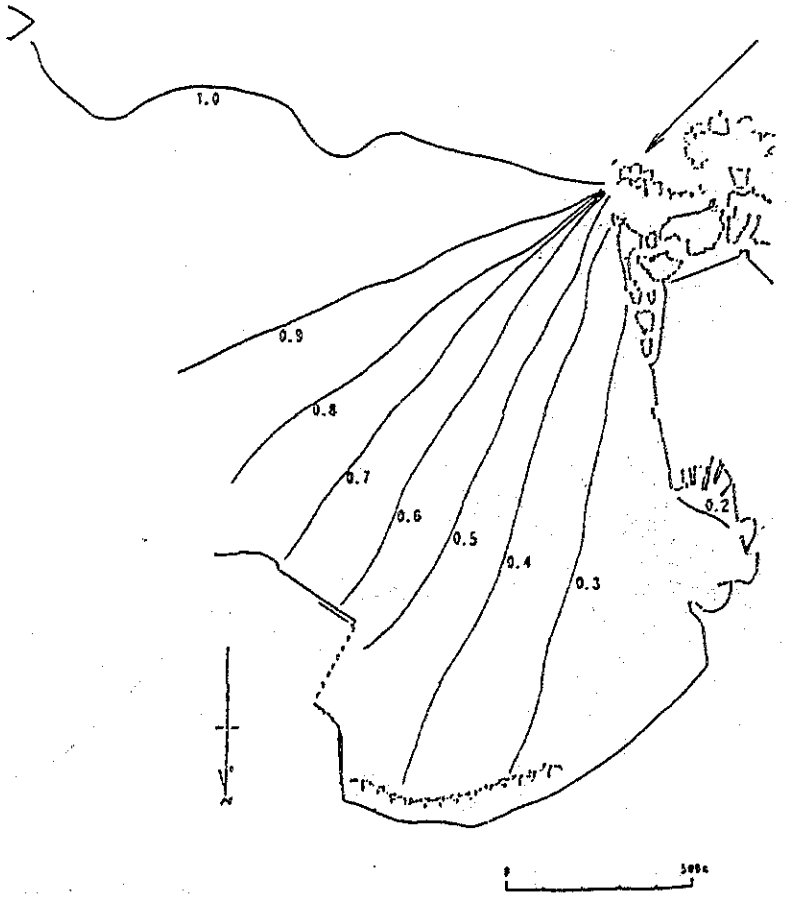


Fig. 2-7 Wave Height Ratio