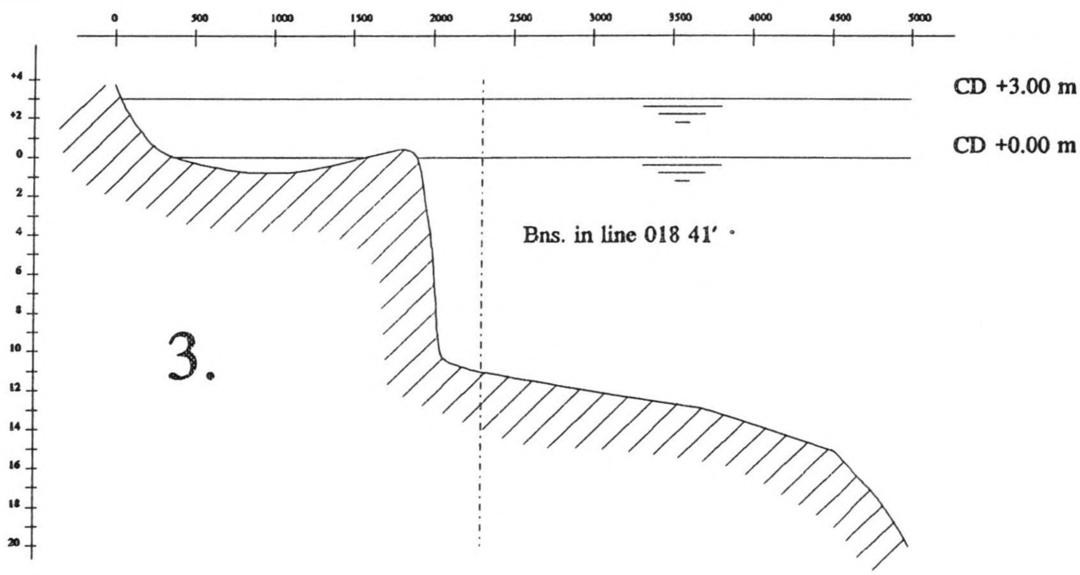
Pipavav Port Project
Appendices of Volume II

W.J. de Graaff

March 1994



Pipavav Port G0656-01-001
Cross sections of West Channel, drawn from Admiralty Chart 2034 (1964)
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Hydraulic Engineering Group

APPENDICES

Appendix I Maps of India and the Pipavav region.

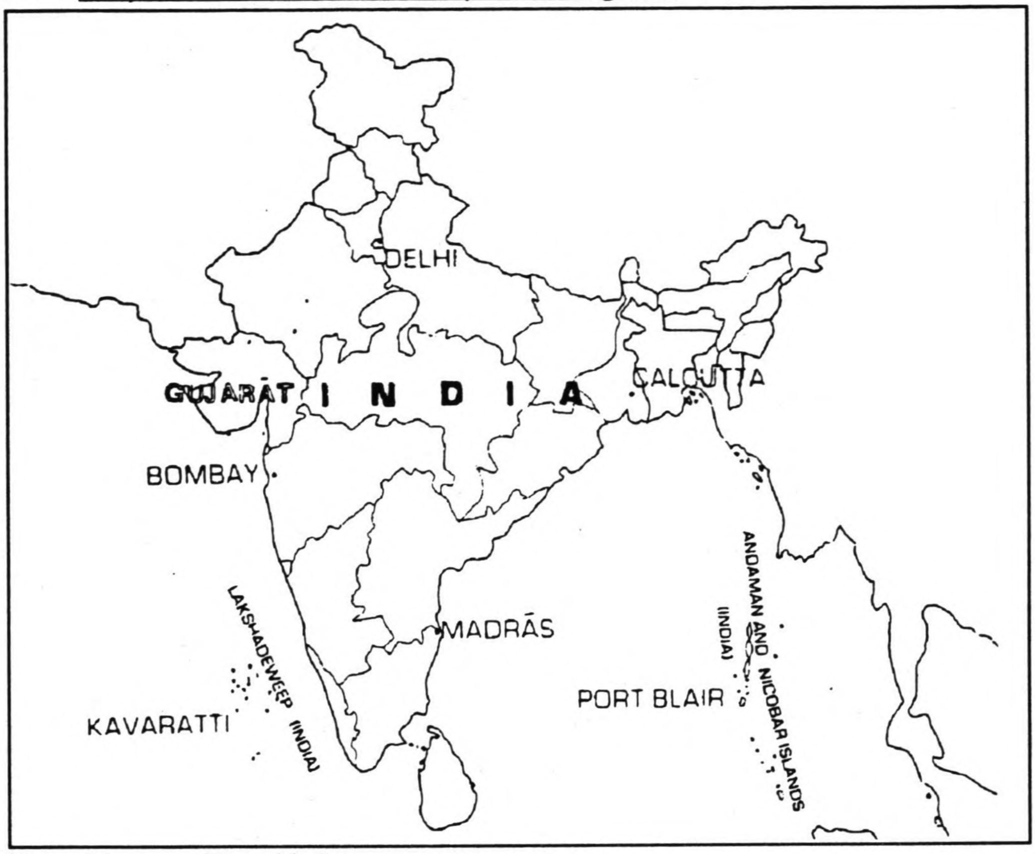


Figure I.1 Map of India.

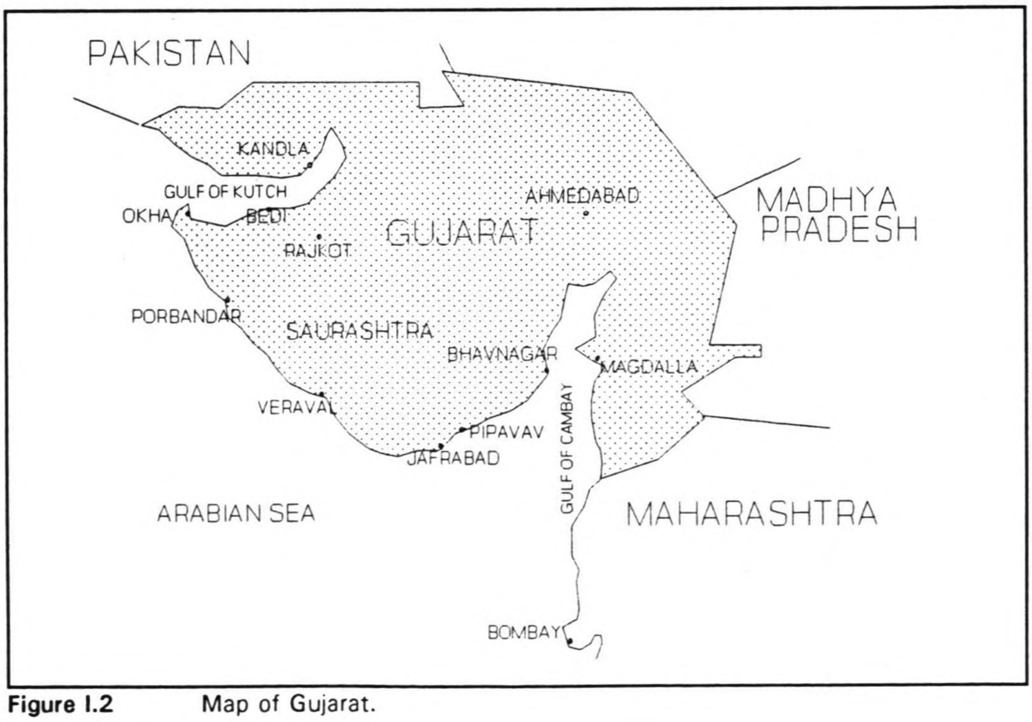


Figure I.2 Map of Gujarat.

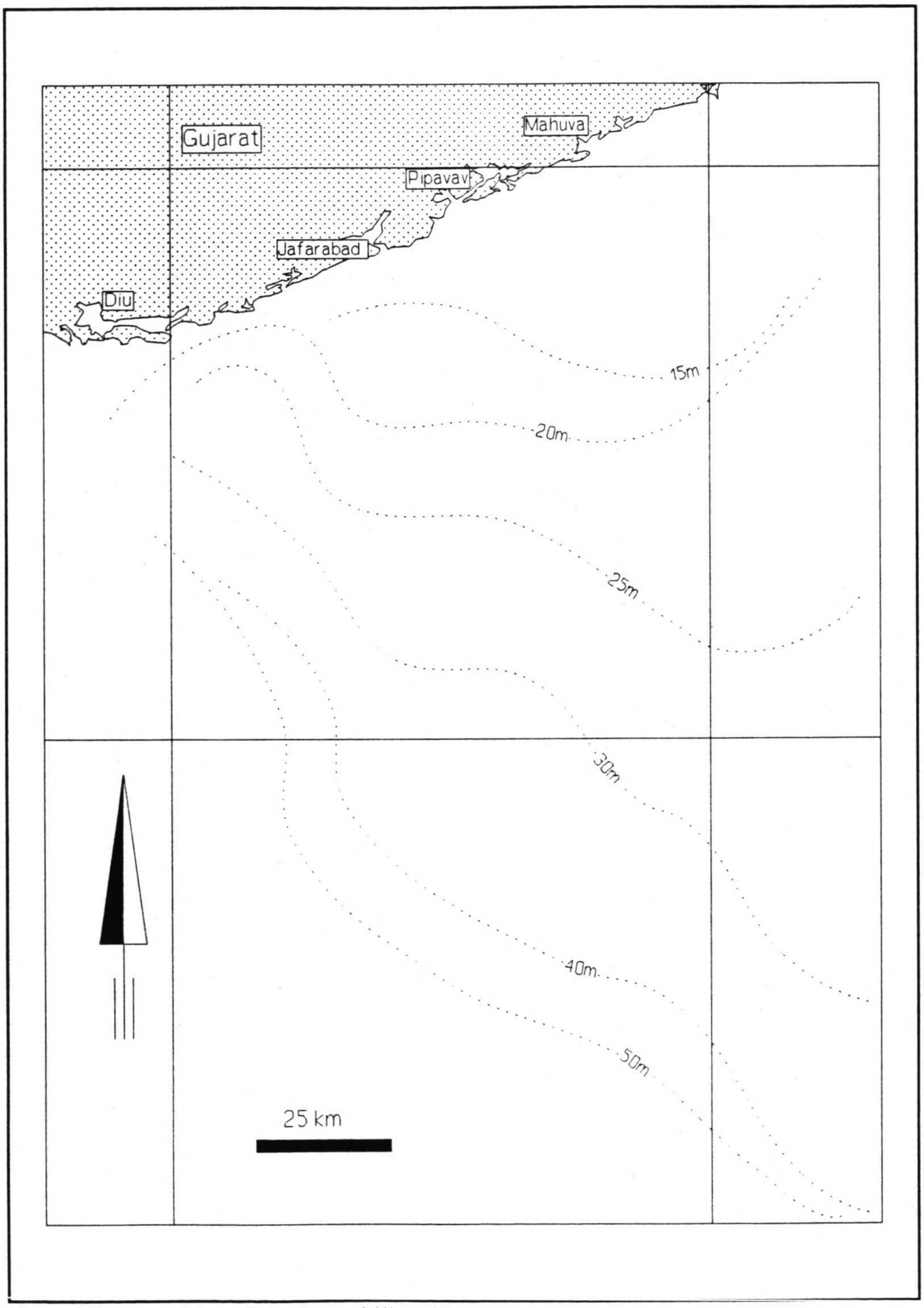
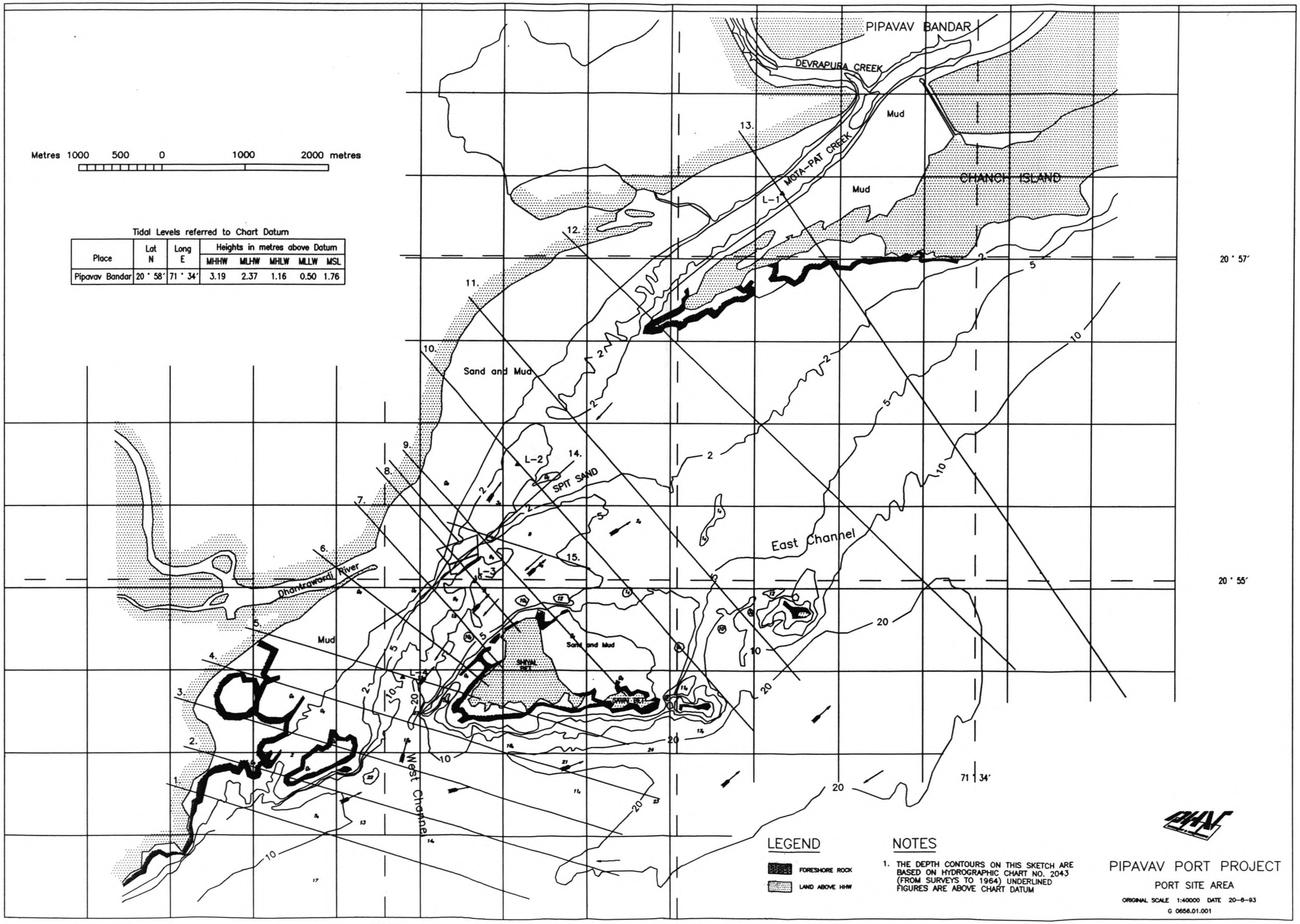


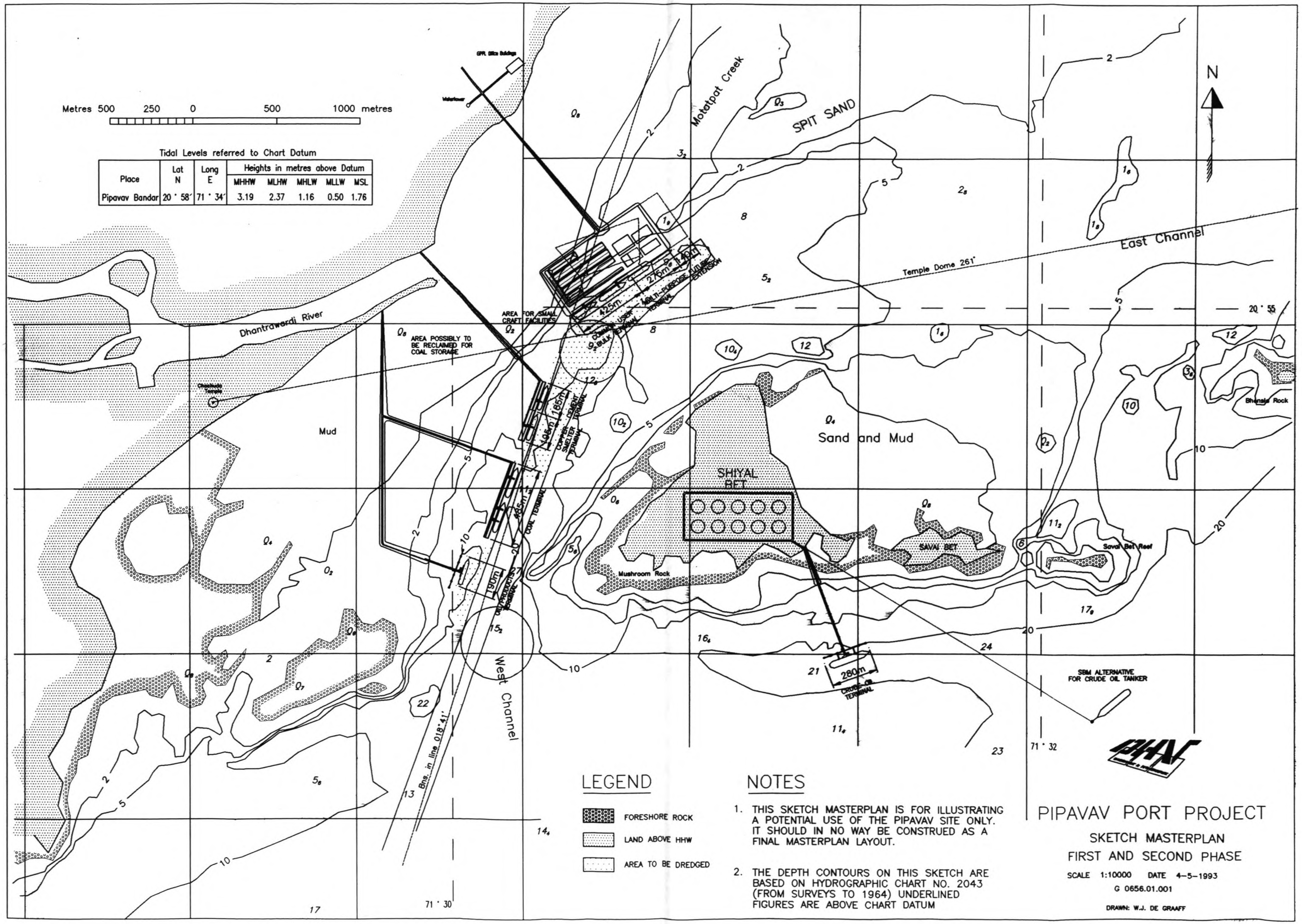
Figure I.3 Map of the bay of Khambhat.



Tidal Levels referred to Chart Datum

Place	Lat N	Long E	Heights in metres above Datum				
			MHHW	MLHW	MHLW	MLLW	MSL
Pipavav Bandar	20° 58'	71° 34'	3.19	2.37	1.16	0.50	1.76

Bestandsnaam: pipa



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Appendix II <u>Calculation of deep water wave climate.</u>

In the tables below the wave climate for May and April for the directional sectors 200°-220° and 230°-250° is listed.

Month: April, Wave direction sector: 200°-220°

	Wave period (seconds)							
	0-5	6-7	8-9	10-11	12-13	>13	UND	TOTAL
W 0.0								0
A 0.5	1							1
V 1.0		1	1				2	4
E 1.5						1		1
2.0								0
H 2.5								0
E 3.0		1						1
I 3.5								0
G 4.0								0
H 4.5								0
T 5.0								0
5.5								0
6.0								0
6.5								0
7.0								0
7.5								0
8.0								0
8.5								0
9.0								0
9.5								0
10.0								0
>10.0								0
UND							1	1
TOTAL	1	2	1	0	0	1	3	8

Month: April, Wave direction sector: 230°-250°

	Wave period (seconds)							
	0-5	6-7	8-9	10-11	12-13	>13	UND	TOTAL
0.0	1							1
0.5	3						4	7
1.0	2		1		1			4
1.5		2						2
2.0	2							2
2.5								0
3.0								0
3.5								0
4.0								0
4.5								0
5.0								0
5.5								0
6.0								0
6.5								0
7.0								0
7.5								0
8.0								0
8.5								0
9.0								0
9.5								0
10.0								0
>10.0								0
UND							2	2
TOTAL	8	2	1	0	1	0	6	18

Month: May, Wave direction sector: 200°-220°

	Wave period (seconds)							
	0-5	6-7	8-9	10-11	12-13	>13	UND	TOTAL
0.0								0
0.5	1							1
1.0	3	5	4					12
1.5			2				5	7
W 2.0		2	2				2	6
A 2.5		1						1
V 3.0			1					1
E 3.5								0
4.0								0
H 4.5				2				2
E 5.0								0
I 5.5								0
G 6.0								0
H 6.5								0
T 7.0								0
7.5								0
8.0								0
8.5								0
9.0								0
9.5								0
10.0								0
>10.0								0
UND							1	1
TOTAL	4	8	9	2	0	0	8	31

Month: May, Wave direction sector: 230°-250°

	Wave period (seconds)							
	0-5	6-7	8-9	10-11	12-13	>13	UND	TOTAL
0.0	1							1
0.5	5						2	7
1.0	7	14	6				9	36
1.5	4	9	2	1		1	2	19
2.0	1	5	5				31	42
2.5							2	2
3.0		1						1
3.5								0
4.0			1	1	1			3
4.5				1				1
5.0								0
5.5								0
6.0								0
6.5								0
7.0								0
7.5								0
8.0								0
8.5								0
9.0								0
9.5								0
10.0								0
>10.0								0
UND							6	6
TOTAL	18	29	14	3	1	1	52	118

The following calculations are performed by DHV, to get an orderly presentation of the deep water wave climate and to make calculations with this 'new' climate of the nearshore and port wave climate. The transformation is presented here only the sake of consistency. The results of this transformation are summarized in appendix III. The calculated frequencies can be used in making an exceeding curve.

In the period April to May of 61 days, a total of 1146 observations have been done by ships. For the directional sector 200°-220° 8+31=39 observations have been done. Of these, 2 observations were done of waves of undetermined height and undetermined period. These are subtracted from the total of 39. In this period 2 observations have been done of 0.5m. To calculate the number of days per year a wave in the range of 0.25m-0.75m occurs goes as follows:

$$\frac{2}{37} \times \frac{39}{1146} \times 61 = 0.11 \; \textit{days/year}$$

Waves in the range of 0.75m-1.25m which have been observed 16 times in this period, the frequency in days per year is:

$$\frac{16}{37} \times \frac{39}{1146} \times 61 = 0.90 \; \textit{days/year}$$

In the same way the frequency of the other wave heights in this directional sector as well as for the other directional sectors and the period June to September can be obtained.
The now obtained frequency has to be divided in sea and swell. As stated in section 2.6.1 a close relation exists between wave height and period for sea conditions, depending on wind speed and duration in the local wind field. This relation can be found in the graphs for the determination of the significant wave height H and the wave period T in sea state from the wind speed U and the duration t or the fetch F which can be found in various text books like the Shore Protection Manual. If one assumes unlimited fetch and duration the following relation between H and T can be found:

Wave height	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
Wave period	3	4	5	6	6.5	7	7.5	8	8.5	9	9.5	10	12

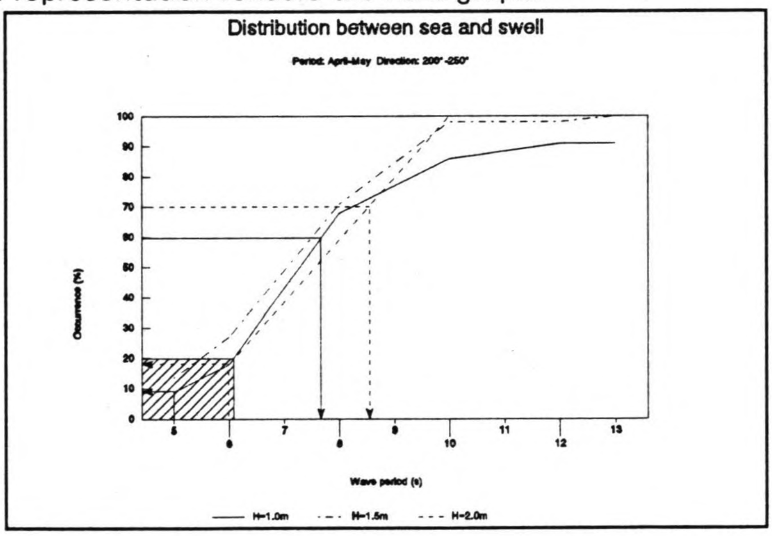
Table II.3 Relation between wave height and period unlimited fetch and duration.

When the wave climate for the total period April to May and for both directional sectors is summarized and expressed in percentages one gets the following table.

Month: April-May Wave direction sector: 200°-250°

	Wave period [seconds]							
	0-5	6-7	8-9	10-11	12-13	>13	UND	TOTAL
0.0	100	100	100	100	100	100		100
0.5	100	100	100	100	100	100		100
W 1.0	27	71	98	98	100	100		100
A 1.5	18	68	86	91	91	100		100
V 2.0	18	59	100	100	100	100		100
E 2.5	0	100	100	100	100	100		100
3.0	0	67	100	100	100	100		100
H 3.5	0	0	0	0	0	0		0
E 4.0	0	0	33	67	100	100		100
I 4.5	0	0	0	100	100	100		100
G 5.0	0							0
H .		.						.
T .			.					.
10.0				.				0
>10.0					.			0
UND						0		0
TOTAL	1	2	1	0	0	1	3	8

Graphical representation renders the next graph:



A wave of 1.0m, with a period of 5s covers a region of 2*10% = 20% of the total time. The remaining 80% is covered by swell. The period of this swell then amounts to 7.5s. The same applies for the other sea and swell periods rendering the following values. These values are used in tables III.1 and III.2.

H_s (m)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
T (s) SEA	0.0	3.0	4.0	5.0	6.0	6.5	7.0	7.5	8.0	8.5
% SEA	100%	100%	20%	20%	40%	100%	100%	100%	100%	100%
T (s) SWELL			7.5	7.5	8.5					
% SWELL	0%	0%	80%	80%	60%	0%	0%	0%	0%	0%

Table II.5 Division of the wave field over sea and swell.

Appendix III Wave climate for SW-monsoon and Hot-season.

Hot season
April - May: 61 days

Frequency in days per year

Area: 17,0° N - 10,9° N
69,0° E - 71,9° N

H(m)	120°	150°	180°	210°					240°				
				SEA		SWELL		TOTAL	SEA		SWELL		TOTAL
				T(s)	Freq	T(s)	Freq	Freq	T(s)	Freq	T(s)	Freq	Freq
0									3.0	0.11			0.11
0.5				3.0	0.02	7.5	0.09	0.11	3.0	0.16	7.5	0.64	0.80
1.0				4.0	0.18	7.5	0.72	0.90	4.0	0.29	7.5	1.99	2.28
1.5				5.0	0.18	8.5	0.27	0.45	5.0	0.46	8.5	0.68	1.14
2.0				6.0	0.34		-	0.34	6.0	2.51		-	2.51
2.5				6.5	0.06		-	0.06	6.5	0.11		-	0.11
3.0				7.0	0.11		-	0.11	7.0	0.06		-	0.06
3.5				7.5	-		-	-	7.5	-		-	-
4.0				8.0	-		-	-	8.0	0.17		-	0.17
4.5				8.5	0.11			0.11	8.5	0.06		-	0.06
5.0					-		-			-		-	
5.5					-		-			-		-	
6.0					-		-			-		-	
TOTAL	0.27	0.21	0.64		1.00		1.08	2.08		3.93		3.31	7.24

Other directions/Calm: 50,56 days during hot season.

SW - monsoon
June - September: 122 days

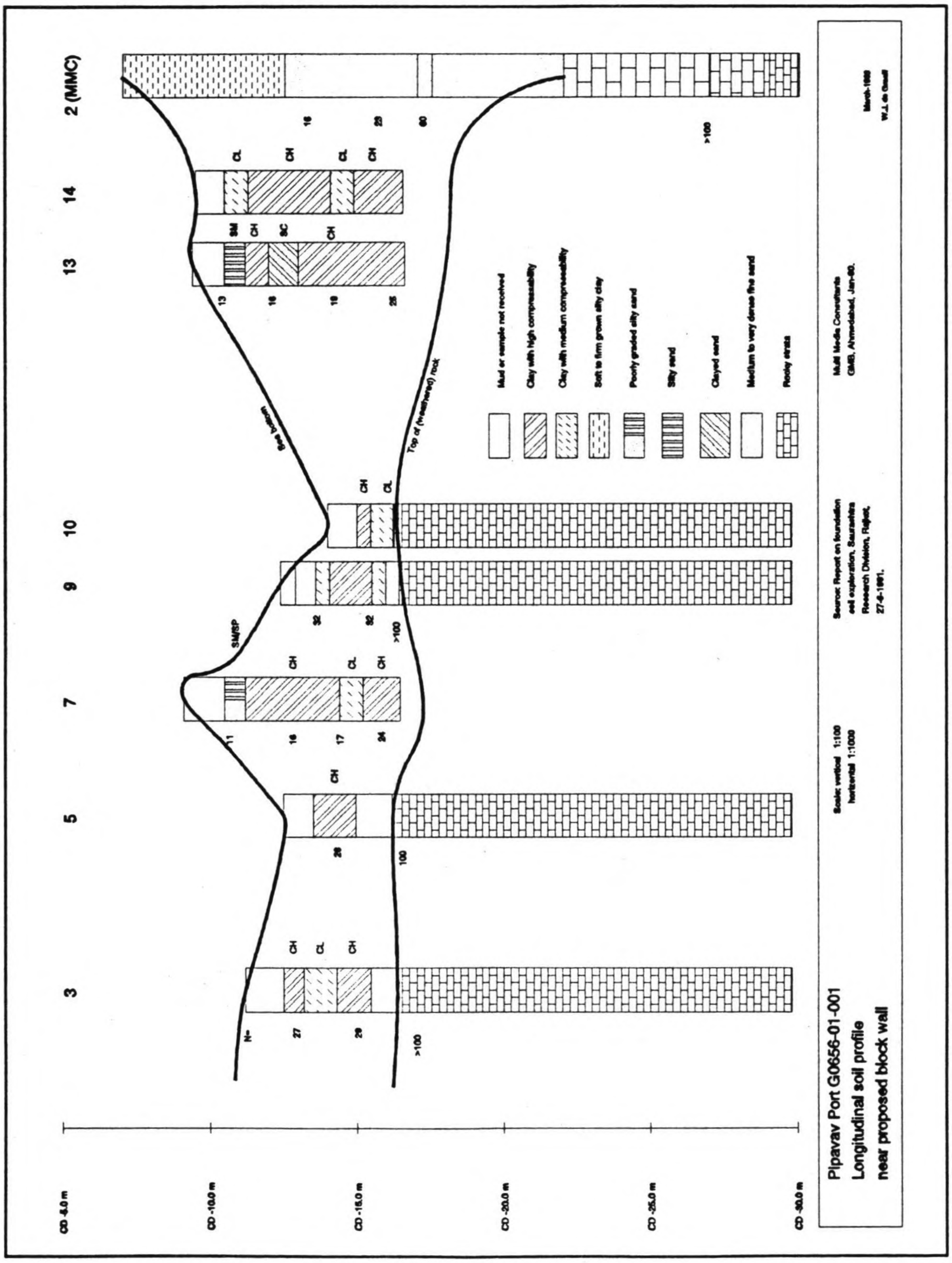
Frequency in days per year

Area: 17,0° N - 10,9° N
69,0° E - 71,9° N

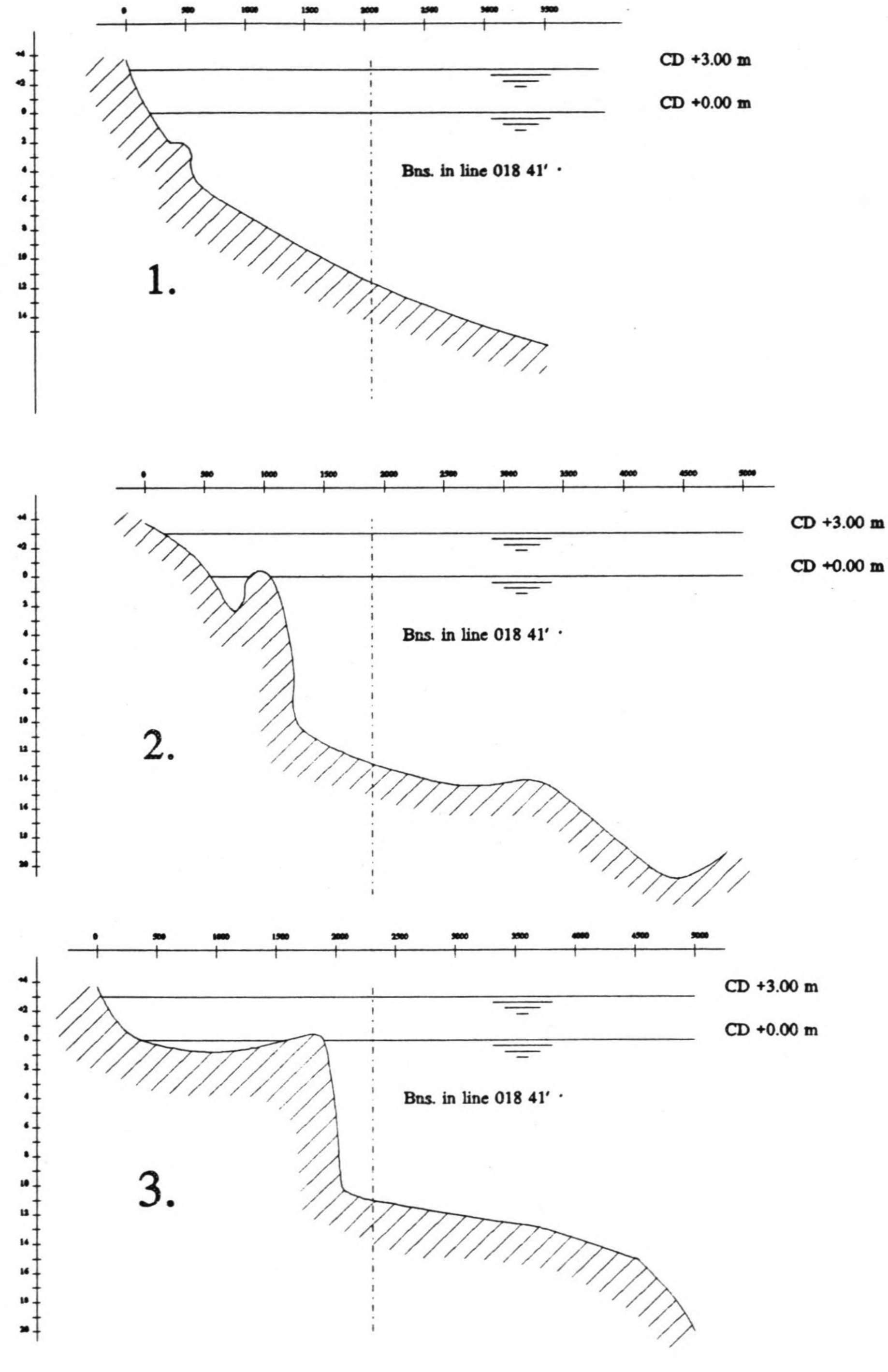
H(m)	120°	150°	180°	210°					240°				
				SEA		SWELL		TOTAL	SEA		SWELL		TOTAL
				T(s)	Freq	T(s)	Freq	Freq	T(s)	Freq	T(s)	Freq	Freq
0													
0.5				3.0	0.21	8.0	0.20	0.41	3.0	0.44	8.0	0.34	0.78
1.0				4.0	0.37	8.5	1.50	1.87	4.0	1.03	8.5	4.10	5.13
1.5				5.0	1.30	9.0	1.29	2.59	5.0	3.16	9.0	3.15	6.31
2.0				6.0	0.93	9.5	0.85	1.78	6.0	3.98	9.5	3.68	7.66
2.5				6.5	0.57	9.5	1.46	2.03	6.5	2.61	9.5	6.70	9.31
3.0				7.0	0.88	9.5	1.31	2.19	7.0	4.39	9.5	6.58	10.97
3.5				7.5	0.55	10.0	0.50	1.05	7.5	2.58	10.0	2.39	4.97
4.0				8.0	0.44	11.0	0.94	1.38	8.0	1.47	11.0	3.11	4.58
4.5				8.5	0.25	10.5	0.24	0.49	8.5	1.35	10.5	1.25	2.60
5.0				9.0	0.47	12.0	0.18	0.65	9.0	1.59	12.0	0.62	2.21
5.5				9.5	-		-	-	9.5	0.24		-	0.24
6.0				10.0	-		-	-	10.0	0.63		-	0.63
>6.0				12.0	0.08		-	0.08	12.0	0.48		-	0.48
TOTAL	0.22	0.58	1.16		6.05		8.47	14.52		23.95		32.01	55.96

Other directions/Calm: 49.56 days during SW - monsoon

Appendix IV Soil profile near proposed block wall.



Appendix V Cross sections of the tidal basin.



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Cross sections of West Channel, drawn from Admiralty Chart 2034 (1964)
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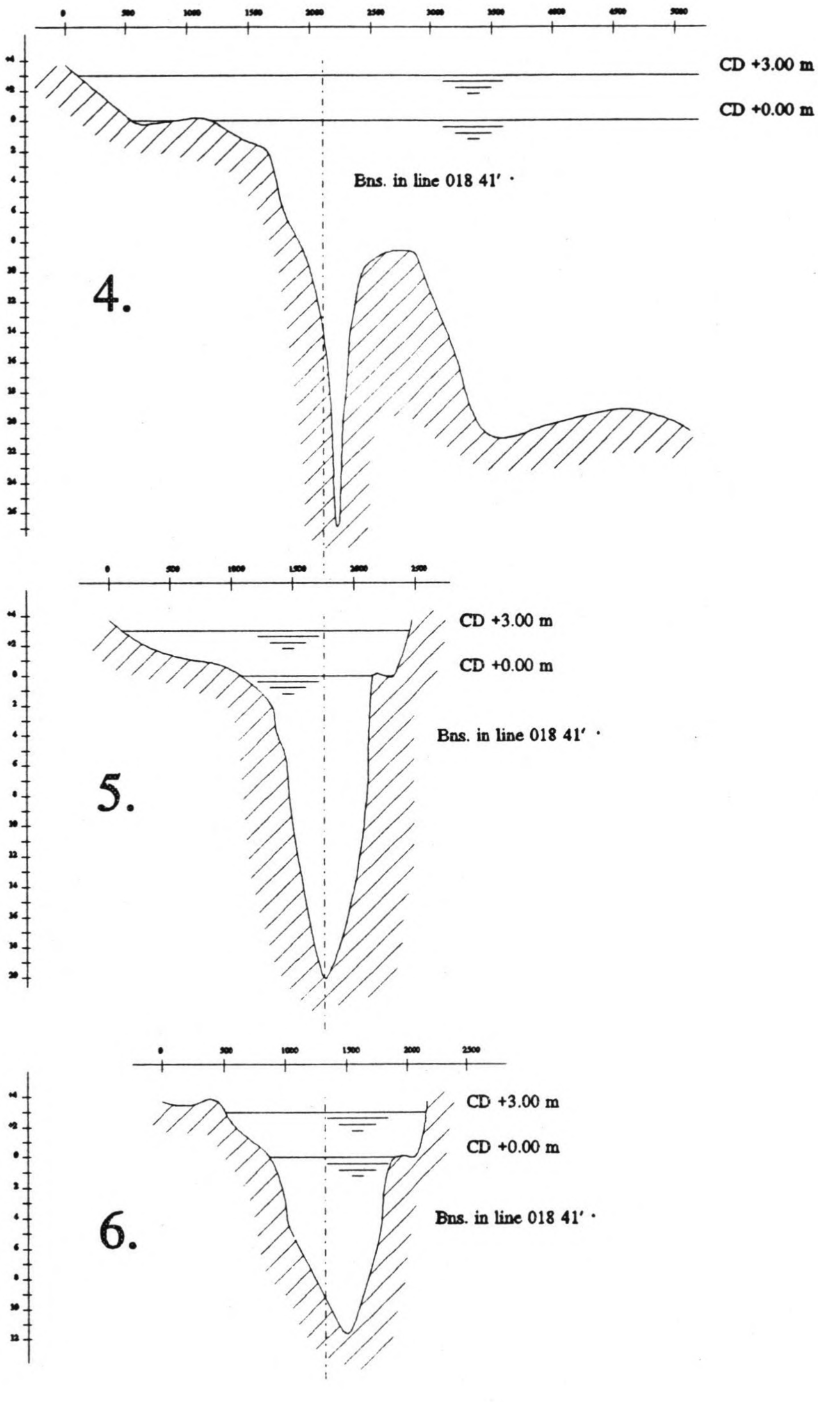

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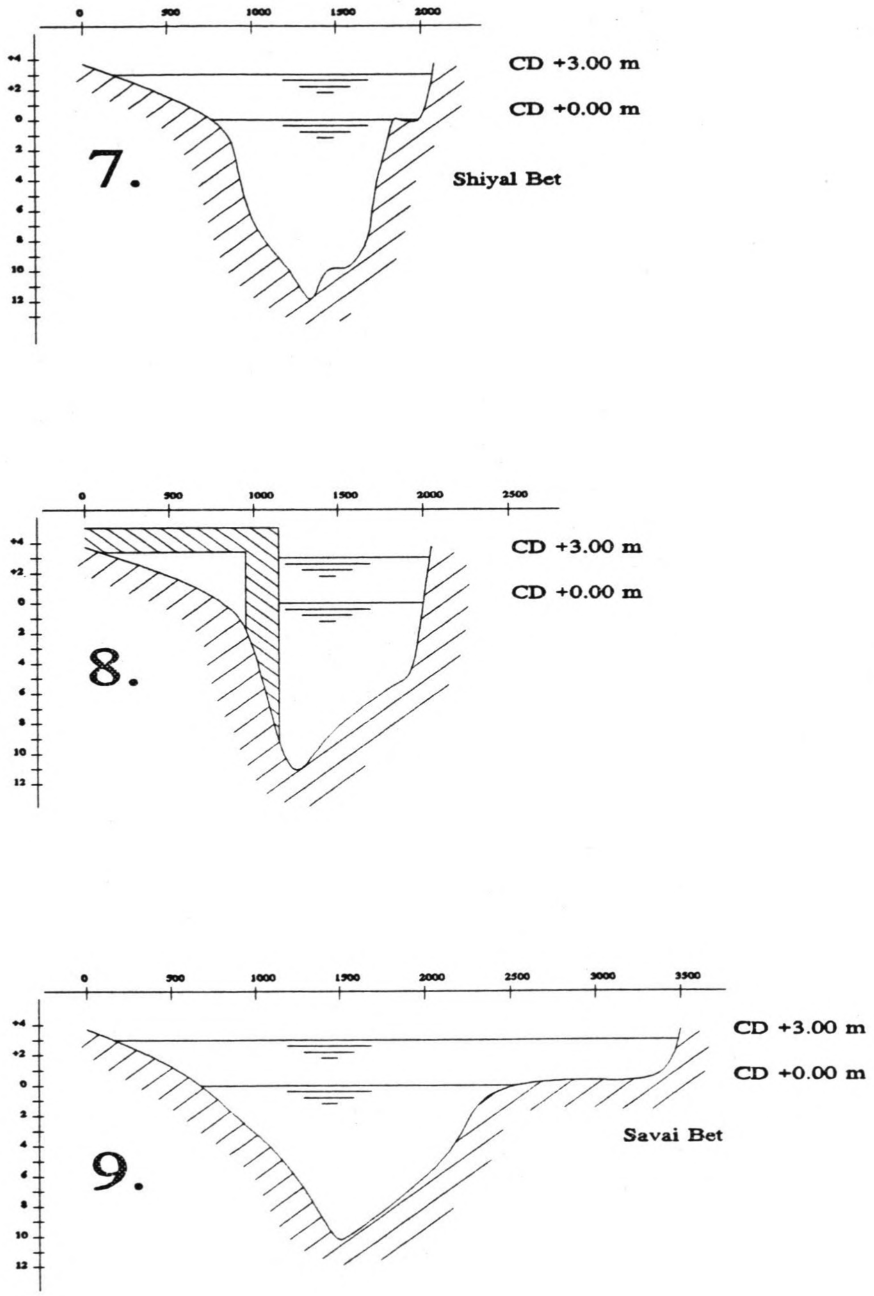

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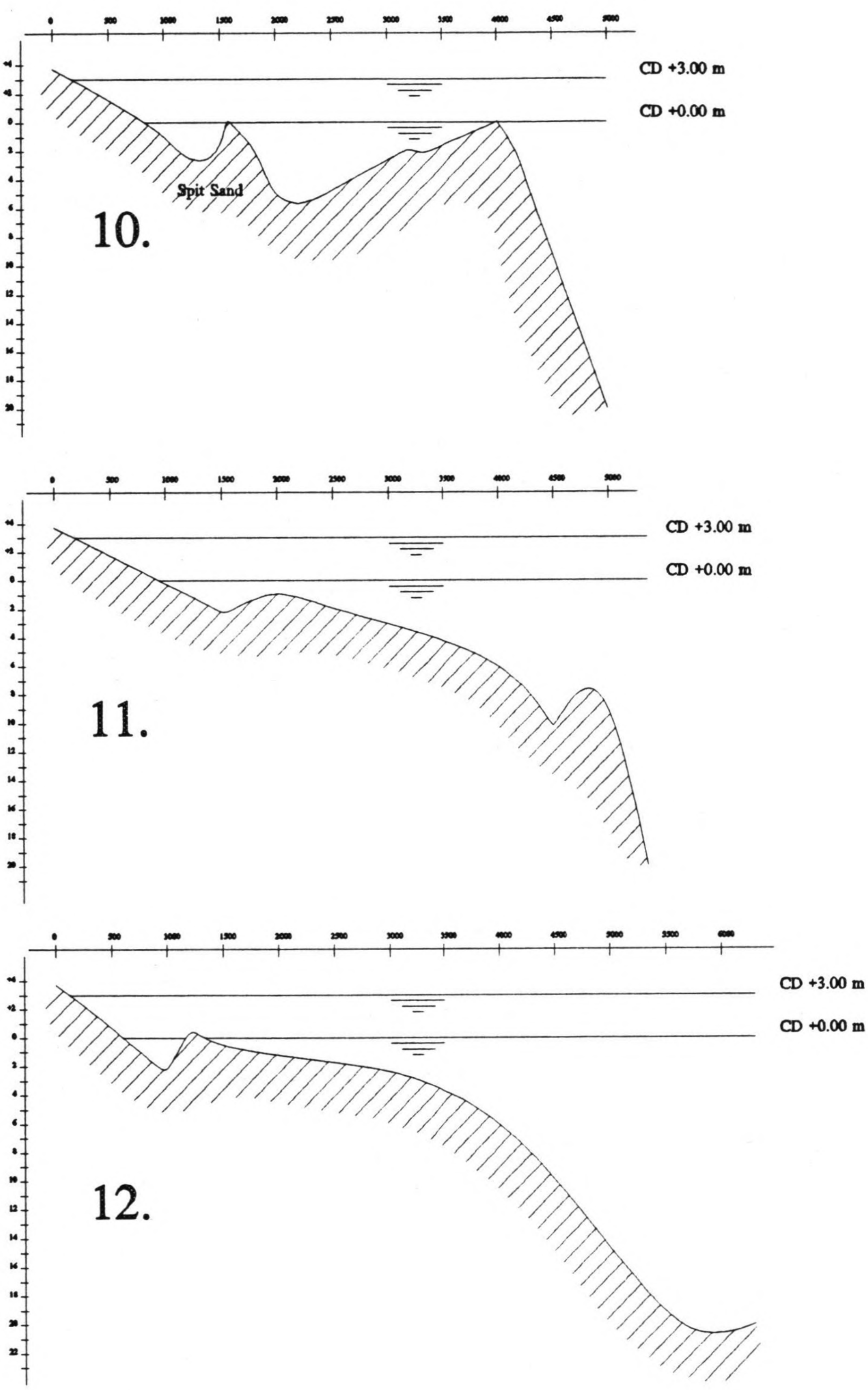

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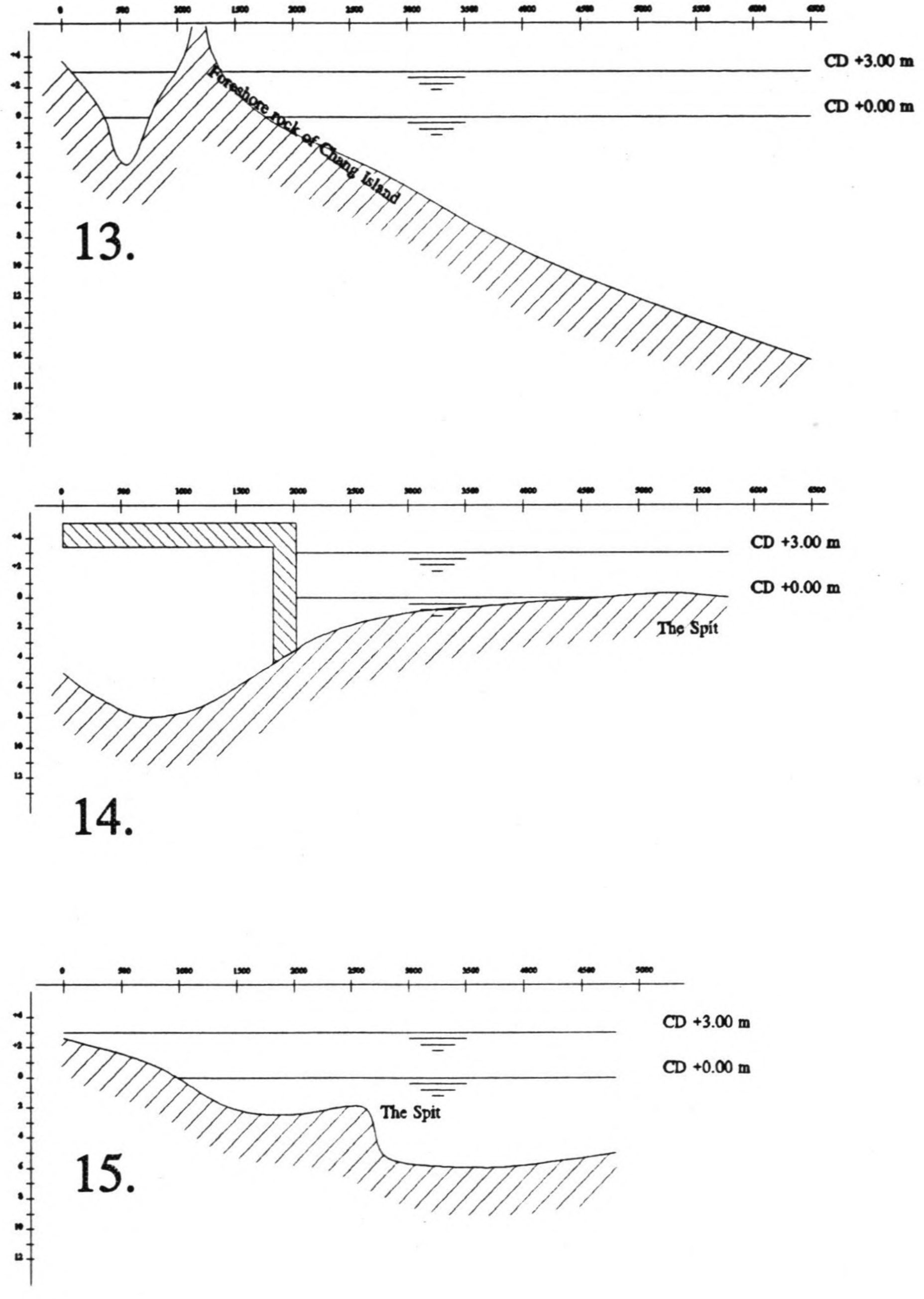

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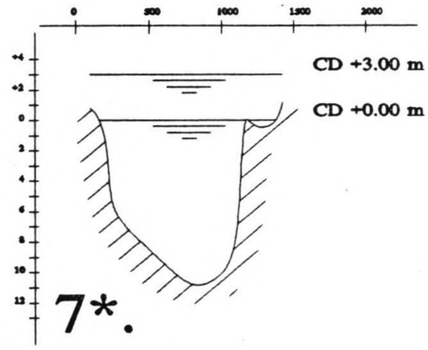

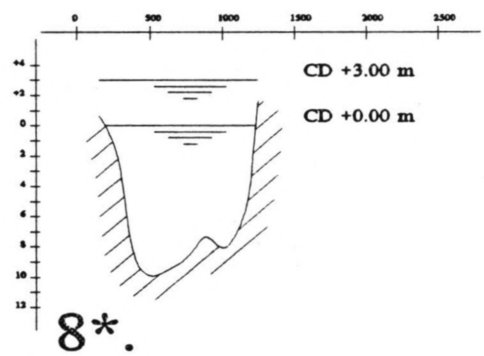

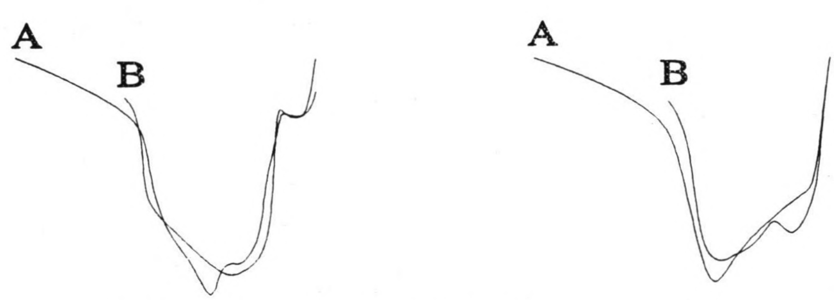

Dsn. 7 and 8, from Admiralty Chart 2034, 1964
Dsn. 7* and 8*, from Pipavav Port Survey, April 1985

Pipavav Port G0656-01-001
Cross sections of West Channel, drawn from Admiralty Chart 2034 (1964)
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Appendix VI Wave height and ship movement literature summary.

Design ship	* 10,000 DWT	Berth type	Loading device	Acceptable wave height: Velsink 7s-12s	Velsink berthing no swell	Velsink berthing with swell	Velsink loading/ discharge	Per Bruun movements	Survey 1974	Thoresen Port Design
A Ex	30	common bulk	contin. loader	1.5					0.80	0.8
A Im	40	common bulk	grab cranes	1.0					0.80	0.8
D GC	25	gencarg/cont/ro-ro	ships gear	1.0					0.85	0.7
D GC	20	gencarg/cont/ro-ro	quay crane	1.0					0.85	0.7
B Ce	20	cement	contin. loader	1.5					0.80	0.8
B CSEx	10	copper smelter	flexible devices	1.5						1.0
B CSIm	25	copper smelter	grab cranes	1.0					0.80	0.8
B Co	60	coal	grab cranes	1.0						0.9
C Ex	25	oil products	flexible devices	1.5	1.5-2.0	1.0-1.5	2.0-3.0			1.0
C ImJ	100	fixed oil jetty	flexible devices	1.5	1.5-2.0	1.0-1.5	2.0-3.0	0.3		1.0
C ImS	100	crude oil, SBM	flexible devices	2.5	2.0-3.0	2.0-3.0	4.0-6.0	2.0		1.7

Terminal		Limiting ship motions: Velsink start of movement hard-	Velsink soft-mooring	Velsink surge	Velsink sway	Velsink roll	Agerschou surge	Agerschou sway/yaw	Agerschou roll	Agerschou pitch/heave
A Ex	common bulk						hold length	hold width < loading	wide range	dust control
A Im	common bulk									
D GC	gencarg/cont/ro-ro	± 0.1	± 0.2	± 1.0	± 0.6	± 3.0				
B Ce	cement						hold length	hold width	wide range	dust control
B CSIm	copper smelter							less than loading limits		
B Co	coal							less than loading limits		

Design ship	* 10,000 DWT	Berth type	Limiting ship motions: F.R.Harris surge	sway	heave	yaw	pitch	roll	Per Bruun surge	sway	heave	yaw
A Ex	30	common bulk	± 1.0	± 1.0	± 0.5	± 1.0	± 1.0	± 3.0	± 0.5	+ 0.5	± 0.3	not important
A Im	40	common bulk	± 0.5	± 0.5	± 0.5	± 1.0	± 1.0	± 1.0	± 0.5	+ 0.5	± 0.3	not important
D GC	25	gencarg/cont/ro-ro	± 0.5	± 0.5	± 0.5	± 1.0	± 1.0	± 1.0	± 0.5	+ 0.3	± 0.1	0
D GC	20	gencarg/cont/ro-ro	± 0.5	± 0.5	± 0.5	± 1.0	± 1.0	± 1.0	± 0.5	+ 0.3	± 0.1	0
B Ce	20	cement	± 1.0	± 1.0	± 0.5	± 1.0	± 1.0	± 3.0	± 0.5	+ 0.5	± 0.3	not important
B CSEx	10	copper smelter							± 2.0	+ 0.5	± 0.5	1.0
B CSIm	25	copper smelter	± 0.5	± 0.5	± 0.5	± 1.0	± 1.0	± 1.0	± 1.5	+ 1.0	± 0.5	not important
B Co	60	coal	± 0.5	± 0.5	± 0.5	± 1.0	± 1.0	± 1.0	± 1.5	+ 1.0	± 0.5	not important
C Ex	25	oil products							± 2.0	+ 0.5	± 0.5	1.0
C ImJ	100	fixed oil jetty							± 2.0	+ 0.5	± 0.5	1.0
C ImS	100	crude oil, SBM							± 2.0	+ 0.5	± 0.5	1.0

Terminal		Limiting ship motions: Criteria ref to PIANC surge	sway	heave	yaw	pitch	roll	Survey 1974 surge	sway	heave	roll	pitch	yaw
A Im	common bulk	1.0-2.0	1.2-1.5	0.8-1.2	2-4	1-2	3-5						
D GC	gencarg/cont/ro-ro	1.0-2.0	1.2-1.5	0.6-1.0	1-3	1-2	2-3						
B Ce	cement							1.05	0.55	0.9	0.7	1.25	0.95
B CSEx	copper smelter							1.05	0.55	0.9	0.7	1.25	0.95
B CSIm	copper smelter	1.0-2.0	1.2-1.5	0.8-1.2	2-4	1-2	3-5						

Terminal		Limiting ship motions: Port Design, Thoresen surge	sway	heave	yaw	pitch	roll	Model measurements: CWPRS 2756 surge	sway	heave	yaw	pitch	roll
D GC	gencarg/cont/ro-ro	± 0.50	± 0.30	± 0.30	0.50			3.060	0.969	0.230	2.260	0.331	0.389
D GC	gencarg/cont/ro-ro	± 0.50	± 0.30	± 0.30	0.50								
B Ce	cement	± 1.00	+ 1.50	± 0.60	2.0-4.0	1.0-2.0	3.0-5.0						
B Co	coal	± 1.50	± 1.00	± 0.50	0.50								
C ImJ	fixed oil jetty	± 2.00	± 0.50	± 0.50	1.00								
C ImS	crude oil, SBM	± 2.00	± 0.50	± 0.50	1.00								

Appendix VII The ray averaging technique used in PORTRAY.

Ray methods have been a traditional tool for engineers to determine the effect of refraction and shoaling of sea waves as they approach the shoreline. These methods are restricted to modelling linear wave phenomena and do not incorporate internal diffraction processes. Harbour models based on finite-difference or finite-element techniques or the parabolic method can incorporate some linear effects as well. However, a minimum number of grid points per wave length are required to resolve the waves, which can result in excessively high data preparation time, computing storage and run time. Ray methods, on the other hand, can use far larger element sizes per wave length, which is far more practical for harbour and coastal wave disturbance problems.

The computational process of a forward ray method involves plotting sets of rays over the sea area of interest, with each set of rays representing one wave train.
In principle, the determination of the wave field at any point is simple. The wave amplitude of one wave train is calculated from the condition of conservation of energy flux between neighbouring rays. At points where there are two or more intersecting wave trains, the total wave field is calculated from the linear superposition of the component waves.In practice, however, a typical ray diagram shows a mess of rays with many crossings and caustics, and the interpretation of these diagrams presents a difficult problem.

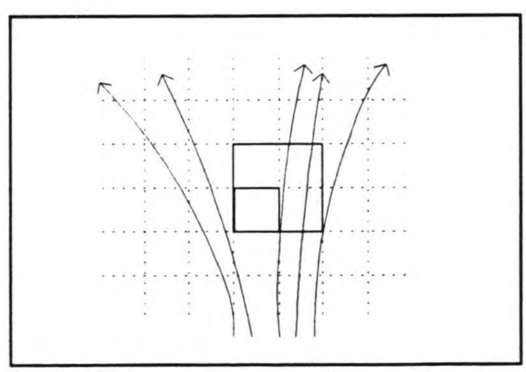
Figure VII.1 Ray averaging squares.

As a general rule, it is preferable to use some kind of spatial averaging of rays to attempt to take account of the trends of bundles of rays rather than the behaviour of individual rays. A ray averaging technique consists of a grid composed of square elements superimposed over the sea area of interest, and the effects of rays passing through each square element are averaged, see figure VII.1. This technique turns out to have a number of favourable features. The most important one is that, near caustics and ray crossings, it has the effect of smoothing out the rapid variation of wave height usually obtained from single ray methods.

It is also possible to perform spatial averaging of rays over a line instead of a square. This method is used by PORTRAY to calculate wave heights on a given boundary.

In both the square- and line-averaging methods the idea of a 'region of influence' of a ray is used. If one imagines two lines drawn on either side of a ray midway between it and its neighbouring rays, the region of influence of a ray is the area between these two lines. Consider several wave trains crossing an averaging square. The average wave amplitude can now be obtained by solving the equation:

$$A_{av}=\frac{1}{d}\left(\sum_{\substack{All\\rays}}\frac{qE}{c_g}\right)^{1/2}$$

where d	is the length of the side of the square
q	is the length of the ray in the averaging square
E	is the energy flux constant
c_g	is the group velocity.

The same arguments are used in deriving the formula for the wave amplitude for sets of rays crossing an averaging line.

There is a considerable scope for choosing the size of the averaging square. In making this choice the following criteria should be borne in mind:

* Squares should be small enough to follow anticipated important fluctuations in wave height.
* Squares should be sufficiently large that at no stage does the ray separation exceed the sides of the squares.

Appendix VIII <u>Listing of control files.</u>

Listing of portcon; the PORTRAY control file for the near shore wave climate

MXREFL	IRESID	HBR	RFTEST	LINHT	
3	0	0.0	0.1	1	
SMAX	SEP				
187500	375				
WINC	PERIOD	DIRCTN	ANGXRN	TIDE	DMIN
1.414	8.5	240	126	2.0	0.5
IRFRIC	FCOEF	BRCOEF			
0	0	0.8			
MXPLOT					
3					
IPL1	IPL2	IPL3	IPL4	IPL5	IPLSB
1	1	1	1	1	1
SC	XUP	YUP	PLSIZE		
750000	187500	142500	29.7		
RUNMODE					
C					
IGMAIN	XBWTR	YBWTR	ETA	RBWTR	ZETA
1	75	0	0	1.0	180.0
DALPHA	DCOSEC	SHADMX	UVLIM	ANGWED	
1	1	1	1	1	
MXTIP					
0					

Listing of portcon.ins; the PORTRAY control file for the port wave climate

MXREFL	IRESID	HBR	RFTEST	LINHT	
3	0	0.0	0.1	1	
SMAX	SEP				
9400	4				
WINC	PERIOD	DIRCTN	ANGXRN	TIDE	DMIN
4.596	12	180	90	1.76	0.1
IRFRIC	FCOEF	BRCOEF			
0	0	0			
MXPLOT					
100					
IPL1	IPL2	IPL3	IPL4	IPL5	IPLSB
1	1	1	1	1	1
SC	XUP	YUP	PLSIZE		
20000	4700	4300	29.7		
RUNMODE					
C					
IGMAIN	XBWTR	YBWTR	ETA	RBWTR	ZETA
1	75	0	0	1.0	180.0
DALPHA	DCOSEC	SHADMX	UVLIM	ANGWED	
1	1	1	1	1	
MXTIP					
0					

Listing of offshore.his; the HISWA control file for the near shore wave climate

```
$
$************************HEADING**********************************
$
PROJECT 'PIPAVAV SHORE' 'OS'
 'CALCULATION OF NEAR SHORE WAVE CLIMATE'
 'NO WIND, NO CURRENTS'
$
$************************MODEL INPUT ******************************
$
$      Water level = MSL +2.0m
SET LEVEL = 2.0
$      Geographic location, size and orientation of computational grid
GRID 140000.,150000.,120., 80,40,12 ROTATING 93750,75000
$      Geographic location, size and orientation of bottom input grid
INPUT BOTTOM 0.,0.,0., 125,100, 1500.,1500.
READ BOTTOM 'offshore.bot' 1.,1,0 FREE
$      Geographic location, size and orientation of current input grid
$INPUT CURRENT 35250.,31500.,45., 13,13, 9375,3750
$READ CURRENT 'pipa-fld.cu2' 1,2,0 FREE
$READ CURRENT 'pipa-ebb.cu2' 1,2,0 FREE
$      4 Beaufort = 20 km/h = 11.11 m/s; SW = 45°
$WIND 11,45
$      Wave field at the up-wave boundary of the computational grid
$      [Hs,Ts,dir,ms] (270-210=)60 - -34 = 94 (180=124, 210=94, 240=64)
INC PAR 5,9,94,2
$
$************************ OUTPUT REQUESTS ************************
$
FRAME 'RESGRID' 45000.,45000.,60000.,90000.,0., 30, 30
FRAME 'DETAIL' 20000,20000,65000,105000,0,50,50
CURVE 'UPWAVE-B'73490,119130,20,70175,116895
LINE $UPWAVE-B$ 73490,119130, 70175,116895
CURVE '10 km' 65000,105000,4,68000,105700,4,71000,106800,4,74000,108600&
              4,77000,111400,2,78500,113400,1,79250,115225,1,80000,120000
LINE $10 km$  65000,105000,68000,105700,71000,106800,74000,108600    &
              77000,111400,78500,113400,79250,115225,80000,120000
CURVE '2 km'  69000,115000,2,69776,115102,2,70500,115402,2,71121,115879&
        2,71598,116500,2,71898,117224,2,72000,118000
LINE $2 km$   69000,115000,69776,115102,70500,115402,71121,115879&
        71598,116500,71898,117224,72000,118000
$TABLE 'UPWAVE-B'     PAPER HSIGN PER DIR DEPTH DIST
$TABLE '10 km'        PAPER HSIGN PER DIR DEPTH
$TABLE '2 km'         PAPER HSIGN PER DIR DEPTH
PLACE 'Tidal Basin'   69375.,117000.,0.2,1
PLACE 'Pipavav'       69000.,127500.,0.2,1
$SHOW 'BOTTGRID'      'Location of grids' LOC PLA LINE
SHOW 'BOTTGRID'       'Depth contours offshore Pipavav' BOT 10,0,80 PLA
$SHOW 'COMPGRID'      'Iso-lines in CompGrid' BOT PLA
PLOT 'BOTTGRID' H-ISO lines for 5m, 9s, 210° waves' ISO HS .5,0,5 VEC TDI PLA
STOP NORUN
```

Listing of port1.his; the HISWA control file for the 1st phase port wave climate

```
$
$************************* HEADING *********************************
$
PROJECT 'PIPAVAV PORT ' '1'
 'CALCULATION OF PORT WAVE CLIMATE, 1st PHASE OF MASTERPLAN'
 'NO WIND, NO CURRENTS'
$
$************************* MODEL INPUT ******************************
$
$      Water level = MSL +2.0m
SET LEVEL = 2.0
$      Geographic location, size and orientation of computational grid
GRID 4300,6200,120, 200,100,12 FIXED 6325,500,90 $ ROTATING 3000,2500
$      Geographic location, size and orientation of bottom input grid
INPUT BOTTOM 625,500,0, 47,43,100,100
READ BOTTOM 'port-1.bot' 1,1,0 FREE
$      Geographic location, size and orientation of current input grid
$INPUT CURRENT 0, 0, 0, 21,19,257.5,257.5
$READ CURRENT 'port-fld.cu2' 1,2,0 FREE
$READ CURRENT 'port-ebb.cu2' 1,2,0 FREE
$      4 Beaufort = 20 km/h = 11.11 m/s; SW = 45°
$WIND 11,45
$BOUNDARY
$      Wave field at the up-wave boundary of the computational grid
$      [Hs,Ts,dir,ms] (270-210)=60--34=94
INC PAR 0.85,10,98
$
$************************* OUTPUT REQUESTS *************************
$
FRAME 'PROBLEMGRID'7000,6000,0,0,0
$CURVE 'UPWAVE'      625,0,26,5325,0
LINE $COPPSMEL$      3535,3090,3602,3273
LINE $CEMTERMI$      3614,3306,3677,3480
LINE $MULTPURP$      3825,3855,4395,4250
LINE $CHANAXIS$      2700,500,3900,3790,4605,4265
CURVE 'COPPSMEL'     3535,3090,10,3602,3273
CURVE 'CEMTERMI'     3614,3306,10,3677,3480
CURVE 'COMMBULK'     3825,3855,10,4177,4093
CURVE 'GENCARGO'     4177,4093,10,4405,4247
CURVE 'CHANAXIS'     2700,500,7,3900,3790,2,4605,4265
$TABLE 'COPPSMEL'    PAPER HSIG PER DIR DEPTH
$TABLE 'CEMTERMI'    PAPER HSIG PER DIR DEPTH
$TABLE 'COMMBULK'    PAPER HSIG PER DIR DEPTH
$TABLE 'GENCARGO'    PAPER HSIG PER DIR DEPTH
$TABLE 'CHANAXIS'    PAPER HSIG PER DIR DEPTH DIST
$TABLE 'UPWAVE'      PAPER HSIG PER DIR DEPTH DIST
BLOCK 'RESGRID'      PAPER HSIGN DIR
PLACE 'Shiyal Bet'   4650,2650,0.2,2
PLACE 'The Spit'     4375,4350,0.2,1
PLOT 'BOTTGRID'      ISO HS 0.1,0,0.9 VEC TDI PLA LINE
$SHOW 'PROBLEMGRID'  'Location of Compugrid, Curgrid and Resline' LOC PLA LINES
$SHOW 'BOTTGRID'     'Depth contours of Pipavav Port' BOT 5,0,20 PLACES LINE
SHOW 'PROBLEMGRID'   LOC PLA LINE
$SHOW 'BOTTGRID'     'Direction and strength of currents' VEL 0.4
STOP $NORUN
```

Listing of pp0.man; the SHIPMA control file containing the desired manoeuvre

```
*******************************************************************
**    GENERAL INPUT DATA AND DESCRIPTION OF DESIRED MANOEUVRE     *
*******************************************************************
**                                                  *
** FILE      : PIPAVAV.MAN                                 *
** PROJECT   : PIPAVAV PORT PROJECT                             *
** CLIENT    : W.J. DE GRAAFF                               *
** COMMENT   : PPO.MAN FILE.                                 *
**                                                  *
**************************** DELFT HYDRAULICS **** OCTOBER 1990***
**
**                    IDENTIFICATION.
** Record 1a: Title.                      Maximum = 70 characters
PIPAVAV PORT PROJECT, ENTRANCE MANOEUVRE.
**-----------------------------------
** Record 1b: Project identification.        Maximum = 8 characters
MT
**=========================================
**                    TRACK DATA.
** Record 2a:
** Number of track lines.            (a)     Minimum = 2
** Starting point for distances along the track. (SP)          [m]
2  0.
**-----------------------------------
** Record 2b: Track co-ordinates.                        [m]
** Total number of co-ordinate pairs = (a)+1    Minimum = 3
** Specify the co-ordinates in the direction the ship sails.
2700 -500 3900 -3790 4605 -4265
**-----------------------------------
** Record 2c: Radii between two adjacent track lines.          [m]
** Total number of values = (a)-1          Minimum = 1
1100
**=========================================
** Record 3 : Orientation of the North in the SHIPMA co-ordinate system.
** Angle between the SHIPMA x-axis and the North (clockwise = +).  [deg]
-90
**=========================================
**                   START VALUES.
** Record 4a:  0 = Equilibrium values calculated by SHIPMA.
**            1 = Values specified by the user.
0
**-----------------------------------
** Record 4b: Start values for the calculation. (if record 4a = 0)
**       x co-ordinate (in SHIPMA co-ordinate system).        [m]
**       y co-ordinate (in SHIPMA co-ordinate system).        [m]
**       Propeller revolutions.                       [1/s]
**  x      y      n
  2718   -550    .8
**=========================================
** Record 5: Time-step.                              [s]
**          Maximum number of time-steps.    Minimum = 2        [-]
6.   500
**=========================================
**                    TRACK SECTIONS.
**             For propeller revolution control.
** Record 6a: Number of track sections.      Minimum = 1        [-]
8
**-----------------------------------
** Record 6b: Start position of track sections.              [m]
```

```
0  1000  2000  2800 3000  3400  3600 4000
**.-----------------------------------
** Record 6c: Propeller revolutions per track section.        [1/s]
.7  .6   .4  -.4  .2   -.5  .2  -.7
**.-----------------------------------
** Record 6d: Power bursts allowed?   0 = no.  (inactivate record 6e)
**                                    1 = yes. (  specify record 6e)
0
**======================================================================
**                      STOP CRITERION.
** Record 7: Minimum forward speed for terminating the run.      [m/s]
.1
**======================================================================
**  SELECTION OF THE DESIRED MANOEUVRE AND/OR AUTOPILOT SETTING.
** Record 8: Kind of manoeuvre.
**     1 = Track keeping.   (specify record 8.1)
**     2 = Turning circle.  (specify record 8.2)
**     3 = Zig-zag.         (specify record 8.3)
1
**.-----------------------------------
** Record 8.1a: Track keeping.              (if record 8 = 1)
** Anticipation distance expressed in overall ship's length.       [-]
1.25
**.- - - - - - - - - - - - - - - - - - - - - - - - -
** Record 8.1b: Autopilot setting.          (if record 8 = 1)
**     coefficient rudder.              (A)            [-]
**     coefficient rudder rate.         (B)            [-]
**     coefficient course angle.        (C)            [-]
**     coefficient cross-track deviation. (D)          [-]
**     coefficient rate of turn.        (E)            [-]
**     coefficient cross-current.       (F)            [-]
**     coefficient turn acceleration.   (G)            [-]
**     constant rudder angle.           (H)            [deg]
**  A    B    C    D    E    F    G    H
   1.   0.  11.4  5.5  8.3  11.4  0.   0.
**======================================================================
```

Listing of pp0.run; the SHIPMA control file describing the input files

```
**********************************************************************
**                  DEFINE INPUT FILES                 *
**********************************************************************
**                                              *
** FILE      : PPO.RUN                               *
** PROJECT   : PIPAVAV PORT PROJECT                         *
** CLIENT    : W.J. DE GRAAFF                          *
** COMMENT   : PPO.RUN FILE                             *
**                                              *
**************************** DELFT HYDRAULICS ***** OCTOBER 1990 **
MAN,\SHIPMA\PIPAVAV\PPO\PPO.MAN
SHP,\SHIPMA\SHIPS\BUL242A.SHP
CFT,\SHIPMA\SHIPS\BUL242A.CFT
BOT,\SHIPMA\PIPAVAV\PIPAVAV.BOT
CUR,\SHIPMA\PIPAVAV\NO.CUR
WIN,\SHIPMA\PIPAVAV\NO.WIN
WAV,\SHIPMA\PIPAVAV\NO.WAV
BNK,\SHIPMA\SHIPS\BUL242A.BNK
TUG,\SHIPMA\PIPAVAV\NO.TUG
PRI,\SHIPMA\PIPAVAV\PPO\PPO.PRI
**********************************************************************
```