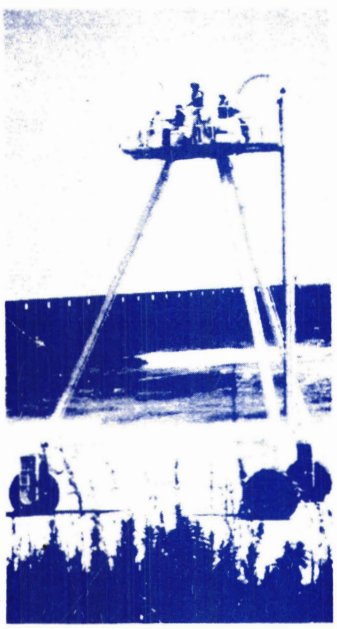
US Army Corps of Engineers



COASTAL ENGINEERING RESEARCH CENTER

PRELIMINARY DATA SUMMARY

FEBRUARY 1988

by

Field Research Facility
Coastal Engineering Research Center
U. S. Army Engineer Waterways Experiment Station
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U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

PRELIMINARY DATA SUMMARY

February 1988

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

PRELIMINARY DATA SUMMARY

CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

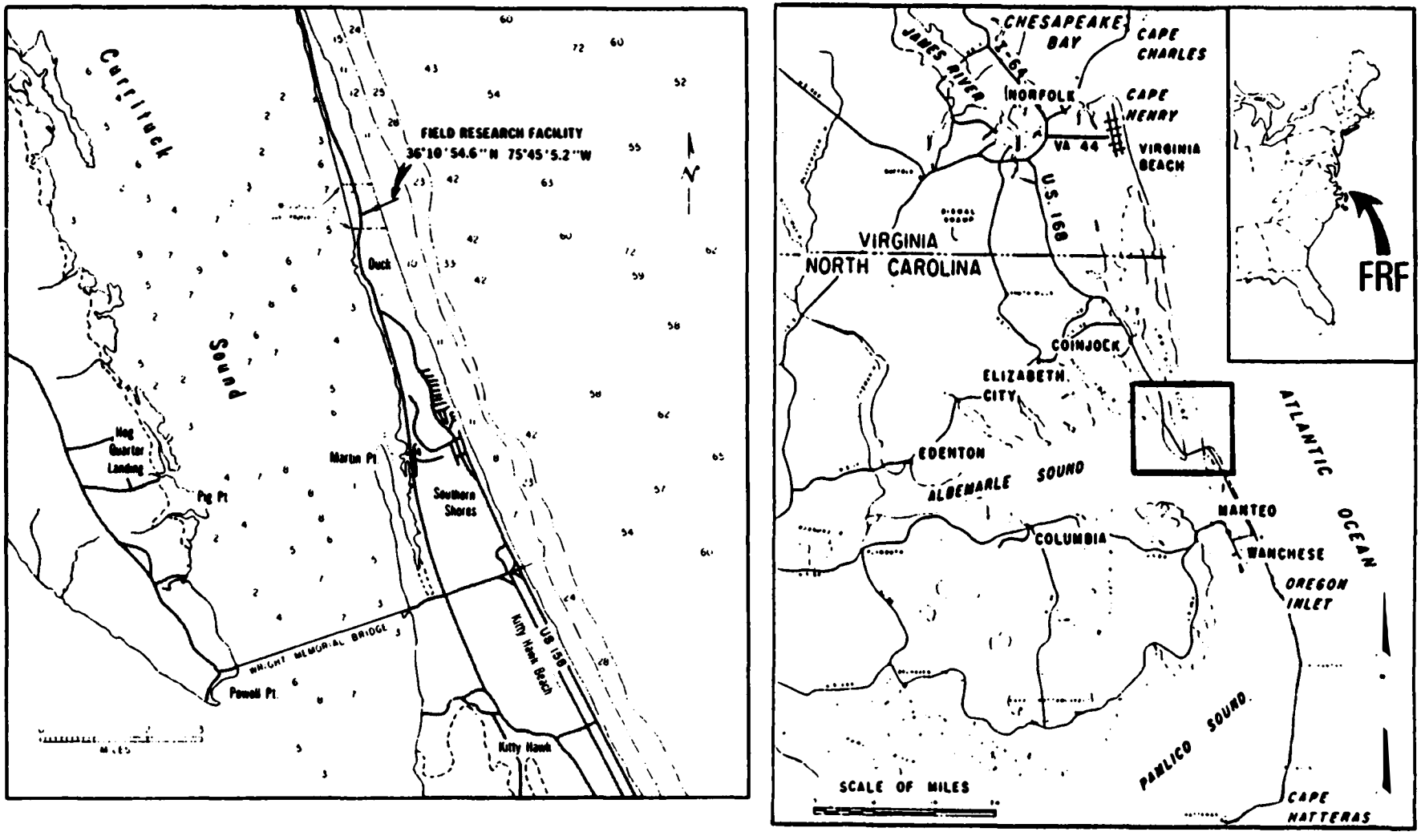

Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

FEB 1988

Gage ID	Description/Remarks	Depth at Sensor		Day of the month: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
616	Barometric Pressure		Gage Status	* *
			Data Collected	* *
			Analog Record	* *
604	Precipitation		Gage Status	* *
			Data Collected	* *
624	Air Temperature		Gage Status	* *
			Data Collected	* *
632	Anemometer on Laboratory Building Elevation 19 m (NGVD)		Gage Status	* *
			Data Collected	* *
			Analog Record	* *
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	* *
			Data Collected	* *
625	Baylor staff at station 19+00 on FRF pier	see Figure 7	Gage Status	* *
			Data Collected	* *
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	* *
			Data Collected	* *
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	* *
			Data Collected	* *
679	Current meter 500 m south of FRF pier (0.5 km offshore)	see Figure 7	Gage Status	* *
			Data Collected	* *
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	* / - - - - * *
			Data Collected	* / - - - - * *
Supplemental Observations (daily oceanographic and meteorological observations)			Daily observation	* *

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

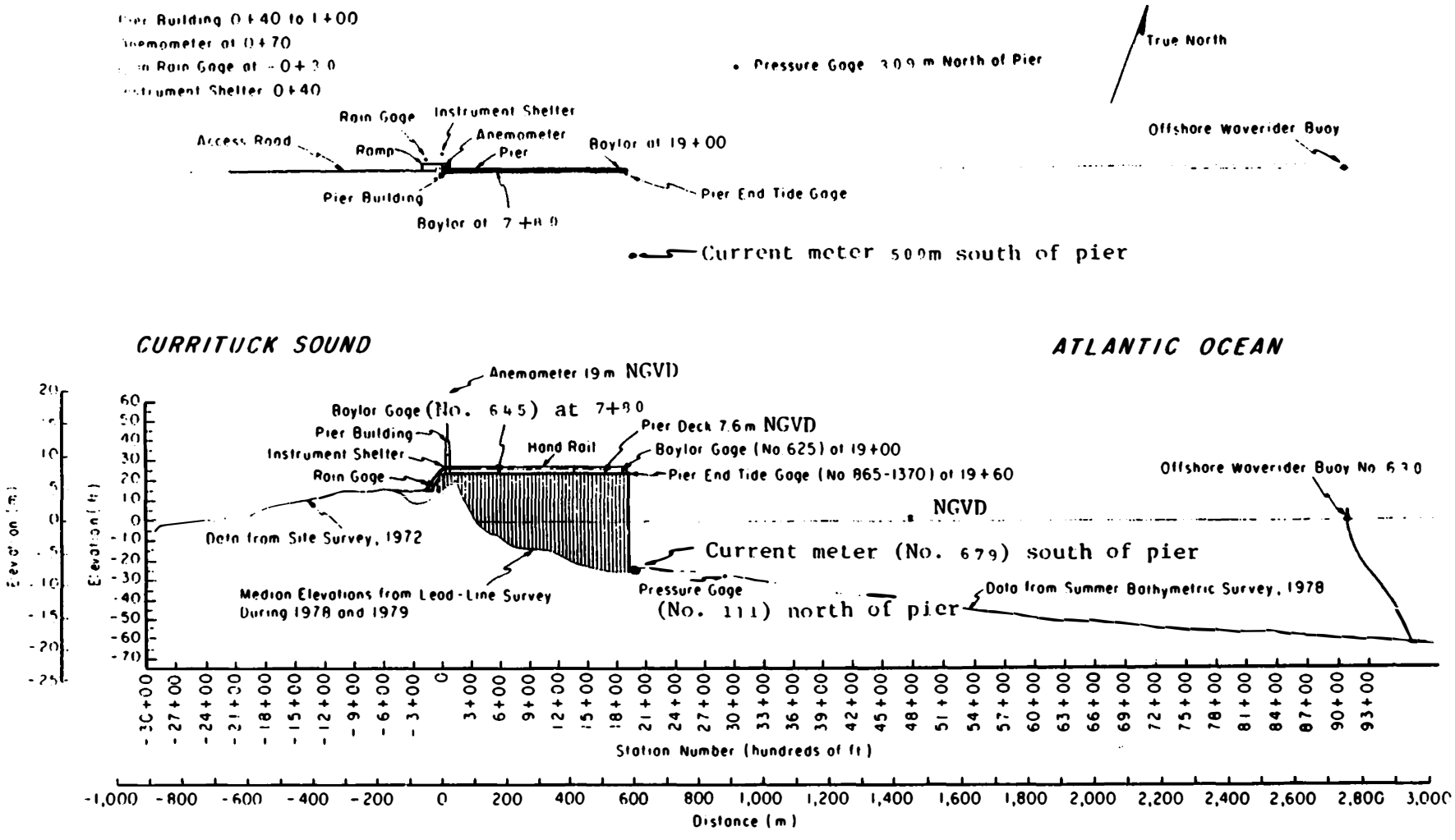

Figure 2. Instrument locations at FRF

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -
   mm x .03937 = in

2. Millibars (mb) to inches of mercury (in Hg) -
   mb x 0.02953 = in Hg

3. Degrees Celsius (C) to degrees Fahrenheit (F) -
   (C x 9/5) + 32 = F

4. Meters per second (m/s) to knots (kn) -
   m/s x 1.943 = kn

Table 2: Meteorological Data

FEB 1988

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	5	196	11.7	1028.7	0
	700	2	179	11.1	1029.1	0
	1300	4	185	20.0	1027.4	0
	1900	6	185	15.4	1026.0	0
2	100	4	193	14.1	1025.7	0
	700	5	200	13.6	1025.0	0
	1300	8	202	19.2	1020.9	0
	1900	8	201	16.3	1019.6	0
3	100	9	342	8.0	1019.6	5
	700	12	13	6.7	1024.0	7
	1300	10	8	7.1	1025.7	0
	1900	8	6	7.1	1025.3	0
4	100	3	83	7.6	1020.6	0
	700	3	199	9.3	1014.5	0
	1300	7	251	10.0	1010.8	2
	1900	11	349	6.2	1015.5	0
5	100	9	333	1.8	1020.9	0
	700	7	359	1.3	1024.3	0
	1300	3	47	2.7	1024.0	0
	1900	2	172	2.1	1024.3	0
6	100	8	293	2.8	1023.6	0
	700	13	4	-1.9	1027.0	0
	1300	9	344	-2.9	1028.4	0
	1900	4	320	-3.4	1029.4	0
7	100	6	311	-4.2	1032.4	0
	700	8	355	-5.0	1036.8	0
	1300	2	32	-3.2	1036.2	0
	1900	3	167	-3.8	1033.5	0
8	100	4	221	-0.1	1030.4	0
	700	2	221	0.8	1029.1	0
	1300	1	318	7.4	1027.0	0
	1900	5	42	4.0	1026.7	0
9	100	4	25	5.0	1023.6	0
	700	7	45	5.8	1025.0	0
	1300	5	20	6.9	1023.6	0
	1900	6	36	5.9	1023.0	0
10	100	5	354	5.8	1021.3	0
	700	7	11	5.6	1023.3	0
	1300	10	2	6.6	1026.0	0
	1900	7	45	5.6	1027.4	0
11	100	8	36	5.9	1026.7	0
	700	9	37	6.4	1026.0	0
	1300	10	66	8.1	1021.6	0
	1900	7	126	8.6	1017.5	0
12	100	6	163	14.8	1010.8	12
	700	6	277	7.7	1006.7	13
	1300	4	236	6.6	1003.7	0
	1900	9	261	4.8	1004.0	0
13	100	12	271	-1.3	1009.1	0
	700	12	269	-3.9	1012.5	0
	1300	11	261	-1.1	1012.1	0
	1900	11	256	0.0	1015.2	0
14	100	9	281	-1.4	1020.3	0
	700	5	296	-3.1	1024.7	0
	1300	3	88	3.3	1024.3	0
	1900	5	158	0.8	1023.6	0
15	100	5	152	4.5	1020.3	0
	700	5	139	7.2	1017.5	0
	1300	10	168	16.6	1010.1	0
	1900	5	179	14.1	1005.4	10
16	100	3	181	12.3	999.6	8
	700	8	329	8.8	1003.7	0
	1300	6	332	8.2	1012.1	0
	1900	3	98	5.5	1017.9	0

(Continued)

Table 2: Meteorological Data

FEB 1988

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	4	167	3.8	1020.9	0
	700	3	207	5.8	1023.3	0
	1300	2	245	11.9	1023.0	0
	1900	4	140	7.4	1021.3	0
18	100	2	170	6.4	1019.6	0
	700	3	250	6.4	1018.9	0
	1300	2	83	11.9	1018.9	0
	1900	4	360	7.8	1020.6	0
19	100	6	41	7.9	1019.2	0
	700	9	63	8.0	1015.9	0
	1300	4	63	8.7	1010.8	5
	1900	6	136	10.2	1004.0	0
20	100	5	237	12.4	1003.0	0
	700	7	241	10.9	1004.7	0
	1300	7	224	11.7	1002.6	0
	1900	8	217	12.1	1003.7	4
21	100	7	241	10.3	1005.4	0
	700	7	282	7.6	1009.4	0
	1300	9	17	4.5	1013.1	0
	1900	6	13	2.4	1019.2	0
22	100	3	91	1.7	1023.0	0
	700	4	158	1.8	1028.0	0
	1300	6	178	10.4	1024.3	0
	1900	6	184	9.9	1021.3	0
23	100	7	220	8.9	1019.6	0
	700	7	222	8.8	1019.2	0
	1300	10	205	16.3	1013.1	0
	1900	7	201	13.0	1012.8	0
24	100	5	343	7.9	1015.9	0
	700	3	302	7.0	1016.9	0
	1300	4	68	9.1	1015.5	0
	1900	7	29	3.8	1018.2	0
25	100	7	311	1.2	1019.6	0
	700	5	300	1.1	1020.9	0
	1300	2	54	3.5	1018.6	0
	1900	5	48	3.5	1018.6	0
26	100	5	353	2.2	1020.6	0
	700	6	328	0.0	1023.0	0
	1300	6	14	2.8	1021.9	0
	1900	4	137	2.0	1019.9	0
27	100	8	217	4.8	1016.2	0
	700	8	221	4.7	1011.8	0
	1300	3	206	12.5	1005.4	0
	1900	7	319	8.4	1007.0	0
28	100	10	333	4.4	1010.1	0
	700	16	8	4.9	1013.8	0
	1300	10	354	3.8	1017.2	0
	1900	4	12	3.6	1018.6	0
29	100	1	248	0.8	1018.6	0
	700	4	197	3.0	1018.6	0
	1300	4	234	10.3	1016.5	0
	1900	3	220	9.0	1016.5	0
		Resultant 1	311	Mean 6.2	Mean 1018.9	Total 66

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs (more frequently during storms) near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

FEB 1988

Day	Hour	645 Baylor at 7+60 Hmo,m	645 Baylor at 7+60 T,sec	625 Baylor at 19+00 Hmo,m	625 Baylor at 19+00 T,sec	111 Pressure Gage Hmo,m	111 Pressure Gage T,sec	630 Farshr Wvrdr Hmo,m	630 Farshr Wvrdr T,sec
1	0100	0.31	12.19	0.50	8.83	0.49	9.14	0.59	10.67
	0700	0.38	5.12	0.56	10.24	0.56	10.24	0.79	5.69
	1300	0.36	12.19	0.59	9.14	0.58	9.48	0.74	5.57
	1900	0.40	13.47	0.60	13.47	0.56	12.80	0.75	6.74
2	0100	0.38	14.22	0.56	9.14	0.54	9.85	0.75	9.85
	0700	0.48	12.19	0.65	15.06	0.69	8.83	0.88	5.82
	1300	0.48	9.48	0.70	9.85	0.66	9.85	0.91	10.24
	1900	0.50	15.06	0.69	10.24	0.75	9.85	0.99	9.85
3	0100	0.46	15.06	0.67	15.06	0.66	15.06	0.88	9.85
	0700	1.61	6.24	1.95	6.74	2.12	6.56	2.35	6.40
	1300	1.08	7.31	1.69	8.26	1.77	7.53	1.88	7.53
	1900	1.27	8.53	1.61	8.00	1.78	8.00	1.80	7.53
4	0100	1.08	7.76	1.39	8.83	1.63	8.53	1.51	8.26
	0700	1.02	9.48	1.55	9.14	1.57	9.14	1.55	9.14
	1300	0.85	9.48	1.19	9.85	1.17	10.24	1.20	9.85
	1900	0.86	9.85	1.26	10.24	1.21	10.24	1.45	10.24
5	0100	1.14	6.09	1.51	6.09	1.65	6.09	2.07	5.69
	0700	1.27	6.56	1.39	6.56	1.39	5.82	1.68	6.24
	1300	0.90	5.82	1.00	9.14	1.01	10.24	1.03	10.24
	1900	0.65	6.74	0.82	9.85	0.86	8.83	0.92	9.85
6	0100	0.39	10.24	0.61	9.85	0.65	9.48	0.69	9.85
	0700	1.48	6.40	1.72	6.24	1.88	6.09	2.14	6.40
	1300	1.11	6.74	1.48	6.92	1.62	6.74	1.82	6.74
	1900	0.99	5.69	1.04	6.24	1.03	5.69	1.28	6.24
7	0100	0.93	5.33	0.88	5.69	0.93	5.45	1.00	5.45
	0700	1.28	5.95	1.36	5.95	1.40	6.09	1.72	6.09
	1300	1.05	5.45	0.94	5.95	0.96	6.09	1.07	5.82
	1900	0.73	5.12	0.73	5.69	0.79	5.57	0.78	5.69
8	0100	0.45	5.69	0.54	15.06	0.60	16.00	0.59	9.85
	0700	0.28	15.06	0.43	15.06	0.48	15.06	0.45	14.22
	1300	0.27	15.06	0.44	15.06	0.50	15.06	0.46	15.06
	1900	0.44	10.67	0.66	10.24	0.69	10.24	0.70	10.67
9	0100	0.54	12.19	0.83	11.64	0.87	11.64	0.82	11.13
	0700	0.81	11.13	1.01	11.13	0.99	11.13	1.01	10.67
	1300	0.69	10.67	0.99	11.13	1.00	11.13	1.05	11.13
	1900	0.73	11.13	0.96	11.13	0.95	11.13	1.01	10.67
10	0100	0.55	10.67	0.88	10.24	0.94	9.48	0.93	9.48
	0700	0.59	9.85	0.83	9.85	0.80	10.24	0.93	10.24
	1300	0.81	4.83	1.30	5.33	1.27	5.12	1.49	5.33
	1900	1.04	5.57	1.46	6.24	1.43	5.82	1.60	6.74
11	0100	0.88	5.22	1.30	8.53	1.40	8.26	1.52	8.00
	0700	1.03	5.02	1.60	9.48	1.61	5.45	1.72	5.95
	1300	1.14	5.95	1.70	6.56	1.75	6.24	1.93	6.40
	1900	1.09	6.40	1.50	7.31	1.51	6.92	1.68	6.56
12	0100	1.31	8.83	2.04	8.53	2.09	8.26	2.41	8.83
	0700	1.23	9.48	2.17	9.14	2.17	9.48	2.40	9.14
	1300	0.89	9.14	1.48	9.14	1.45	9.48	1.55	8.53
	1900	0.59	9.14	1.04	9.48	1.02	8.26	1.17	8.53
13	0100	0.62	9.85	0.91	9.14	0.89	10.67	1.15	8.83
	0700	0.76	5.69	0.89	10.67	0.89	9.85	1.23	10.24
	1300	0.46	11.64	0.66	10.67	0.65	9.85	0.91	10.67
	1900	0.30	11.13	0.43	12.80	0.43	11.13	0.75	2.94
14	0100	0.40	12.19	0.55	12.19	0.47	12.80	0.67	3.56
	0700	0.62	4.00	0.67	12.19	0.63	12.80	0.74	6.74
	1300	0.39	12.19	0.62	6.56	0.56	11.64	0.68	5.69
	1900	0.38	2.64	0.50	12.19	0.46	11.64	0.69	5.69
15	0100	0.24	12.19	0.38	11.13	0.40	11.64	0.45	10.67
	0700	0.20	13.47	0.32	12.80	0.33	12.19	0.34	12.19
	1300	0.69	3.71	0.69	3.46	0.73	3.46	0.85	5.57
	1900	0.65	7.53	0.76	7.76	0.88	8.00	1.15	7.53
16	0100	0.84	9.48	0.99	9.48	1.06	9.48	1.43	9.14
	0700	0.71	9.48	0.98	9.48	1.04	9.85	1.28	10.67
	1300	0.98	6.24	1.29	5.69	1.38	5.57	1.54	5.82
	1900	0.85	6.56	1.10	9.85	1.10	9.85	1.29	9.48

* Electronic problems

(Continued)

TABLE 3: WAVE DATA

FEB 1988

Day	Hour	645 Baylor at 7+80 Hmo,m	645 Baylor at 7+80 T,sec	625 Baylor at 19+00 Hmo,m	625 Baylor at 19+00 T,sec	111 Pressure Gage Hmo,m	111 Pressure Gage T,sec	630 Farshr Wvrdr Hmo,m	630 Farshr Wvrdr T,sec
17	0100	0.56	9.85	0.88	10.24	0.91	9.85	0.99	9.85
	0700	0.50	9.85	0.73	9.85	0.74	9.48	0.85	10.24
	1300	0.38	9.85	0.74	8.83	0.82	9.14	0.86	9.48
	1900	0.48	8.83	0.76	9.48	0.80	8.83	0.83	9.48
18	0100	0.28	12.19	0.62	12.19	0.71	12.19	0.73	8.26
	0700	0.38	11.64	0.61	11.64	0.66	11.13	0.67	11.13
	1300	0.23	12.19	0.51	11.13	0.56	10.67	0.61	9.14
	1900	0.35	8.53	0.56	8.83	0.63	8.26	0.63	8.53
19	0100	0.42	7.53	0.65	8.00	0.58	8.53	0.69	9.14
	0700	0.75	3.88	0.90	3.77	0.92	4.00	1.01	7.76
	1300	0.78	5.82	1.16	5.82	1.23	5.69	1.35	5.82
	1900	0.91	6.09	1.29	6.74	1.41	6.56	1.49	6.09
20	0100	0.73	7.31	1.11	7.76	1.08	6.92	1.29	7.76
	0700	0.62	6.92	0.90	7.31	0.94	7.31	1.03	6.92
	1300	0.43	7.31	0.65	7.76	0.68	7.53	0.77	7.11
	1900	0.37	8.26	0.50	8.53	0.58	8.53	0.78	8.53
21	0100	0.26	8.53	0.40	8.53	0.45	9.48	0.62	8.53
	0700	0.26	9.14	0.38	8.00	0.39	9.14	0.50	8.83
	1300	0.62	3.77	0.76	3.88	0.73	3.66	0.86	4.27
	1900	0.99	5.82	1.01	5.45	1.10	5.57	1.24	5.22
22	0100	0.72	6.09	0.81	5.95	0.86	6.09	1.01	5.82
	0700	0.45	5.33	0.58	5.33	0.55	5.69	0.69	5.45
	1300	0.34	2.64	0.47	8.83	0.38	9.48	0.62	3.24
	1900	0.33	2.94	0.39	6.56	0.36	6.56	0.53	2.64
23	0100	0.34	4.57	0.43	9.14	0.41	5.02	0.55	5.57
	0700	0.22	3.66	0.30	8.53	0.36	6.40	0.55	2.39
	1300	0.28	3.88	0.35	12.80	0.34	11.64	0.69	2.88
	1900	0.37	3.56	0.39	3.82	0.42	3.77	0.64	5.02
24	0100	0.27	4.34	0.35	4.66	0.36	6.24	0.54	4.92
	0700	0.27	3.01	0.37	6.40	0.35	12.19	0.49	5.82
	1300	0.31	4.57	0.48	4.27	0.46	4.34	0.52	4.57
	1900	0.86	4.66	0.99	4.83	1.01	4.83	1.11	4.57
25	0100	0.48	4.57	0.60	4.66	0.62	4.66	0.73	4.74
	0700	0.56	4.57	0.70	5.02	0.69	4.92	0.89	4.20
	1300	0.44	4.49	0.51	5.02	0.56	4.49	0.69	4.57
	1900	0.43	2.19	0.48	4.57	0.51	8.00	0.59	4.41
26	0100	0.30	2.88	0.42	8.26	0.38	4.83	0.53	8.26
	0700	0.67	4.27	0.78	4.41	0.78	4.57	1.24	4.57
	1300	0.73	5.02	0.83	5.12	0.90	4.92	1.07	4.92
	1900	0.51	4.83	0.54	4.74	0.58	4.83	0.65	5.12
27	0100	0.30	8.83	0.51	8.53	0.53	8.53	0.65	8.53
	0700	0.27	9.85	0.48	9.48	0.54	9.14	0.72	9.48
	1300	0.31	9.48	0.46	8.83	0.48	8.83	0.57	8.53
	1900	0.42	12.80	0.73	11.64	0.74	12.19	0.78	11.13
28	0100	1.29	5.45	1.69	12.80	1.78	5.22	2.01	5.45
	0700	1.66	6.40	2.32	12.19	2.60	12.19	2.74	5.82
	1300	1.35	8.00	2.46	9.48	2.76	9.48	2.63	9.48
	1900	1.65	12.19	2.29	12.19	2.50	12.19	2.18	12.19
29	0100	1.56	12.19	2.12	11.64	2.23	11.64	1.81	11.64
	0700	1.08	12.19	1.79	11.64	2.07	11.64	1.76	11.13
	1300	1.07	12.19	1.69	11.64	1.66	11.64	1.51	11.64
	1900	0.71	11.13	1.39	11.13	1.46	11.64	1.32	11.64
Mean		0.68	8.01	0.93	8.80	0.97	8.64	1.09	7.78
Std dev		0.36	3.28	0.50	2.79	0.54	2.79	0.53	2.59

* Electronic problems

(Sheet 2 of 2)

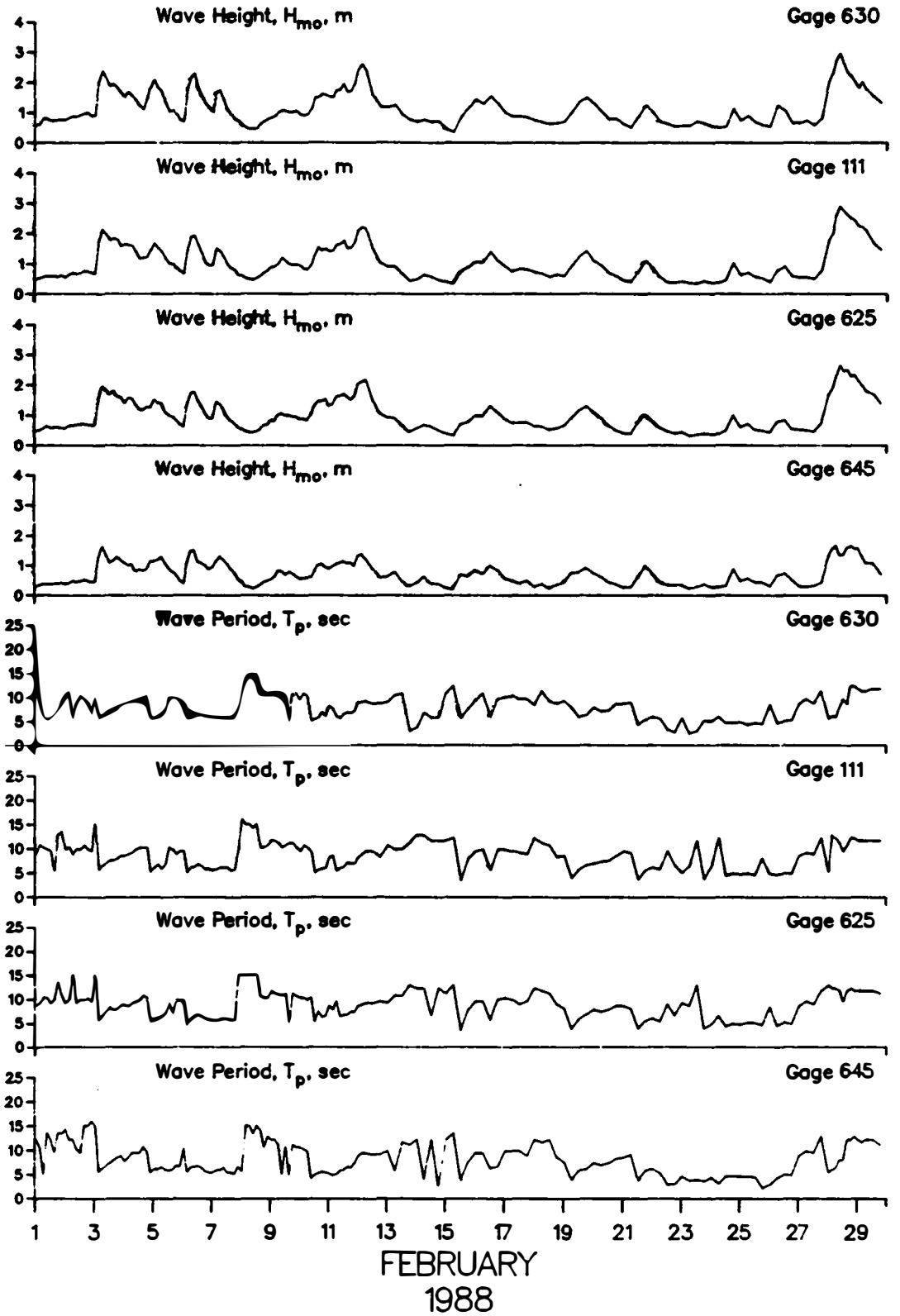

Figure 3. Time history of wave heights and periods

PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

TABLE 4: Current Data
FEB 1988

Day	Alongshore / Cross-shore / Resultant / Time	Pier Measurements: Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Beach Measurements (500m updrift): Dye 12m offshore (surface) Location	Speed	Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Speed	Dir
1	0100-Along									10	N
	Cross									4	on
	Result									11	318
1	0700-Along	15	N		41	N		26	N	6	N
	Cross	7	off	152	6	off	South			3	on
	Result	16	7		41	349				7	313
1	1300-Along									6	N
	Cross									3	on
	Result									7	313
1	1900-Along									7	N
	Cross									2	on
	Result									7	324
2	0100-Along									4	N
	Cross									4	on
	Result									6	295
2	0700-Along	29	N		38	N		26	S	9	N
	Cross	9	off	152	2	off	North			3	on
	Result	30	357		38	343				9	322
2	1300-Along									15	N
	Cross									5	on
	Result									16	322
2	1900-Along									13	N
	Cross									5	on
	Result									14	319
3	0100-Along									3	N
	Cross									2	on
	Result									4	306
3	0700-Along	55	S		10	S		119	S	35	S
	Cross	3	on	152	2	on	North			3	off
	Result	55	163		10	171				35	155
3	1300-Along									31	S
	Cross									3	off
	Result									31	154
3	1900-Along									28	S
	Cross									0	
	Result									28	160
4	0100-Along									22	S
	Cross									1	on
	Result									22	163
4	0700-Along	6	S		34	N		49	S	13	S
	Cross	2	off	152	12	off	South			2	on
	Result	7	143		36	359				13	169
4	1300-Along									13	S
	Cross									1	on
	Result									13	164
4	1900-Along									40	S
	Cross									5	off
	Result									40	153
5	0100-Along									37	S
	Cross									3	off
	Result									37	155
5	0700-Along	38	S		61	S		61	S	23	S
	Cross	2	on	152	18	on	North			4	off
	Result	38	163		64	177				23	150
5	1300-Along									11	S
	Cross									2	on
	Result									11	170
5	1900-Along									2	N
	Cross									3	on
	Result									4	284

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TABLE 4: Current Data
FEB 1988

Day	Alongshore / Cross-shore / Resultant / Time	Pier Measurements: Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Beach Measurements (500m Updrift) Dye 12m offshore (surface) Location	Speed	Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Speed	Dir
6	0100-Along									6	N
	Cross									4	on
	Result									7	306
6	0700-Along	76	S		122	S		133	S	32	S
	Cross	0		152	0		North			3	off
	Result	76	160		122	160				32	155
6	1300-Along									31	S
	Cross									4	off
	Result									31	153
6	1900-Along									10	S
	Cross									5	off
	Result									11	133
7	0100-Along									11	S
	Cross									2	off
	Result									11	150
7	0700-Along	38	S		87	S		90	S	27	S
	Cross	0		152	0		North			2	off
	Result	38	160		87	160				27	156
7	1300-Along									16	S
	Cross									1	off
	Result									16	156
7	1900-Along									7	S
	Cross									1	off
	Result									7	152
8	0100-Along									2	N
	Cross									2	on
	Result									3	295
8	0700-Along	20	N		21	N		8	S	11	N
	Cross	6	off	140	3	off	South			3	on
	Result	21	357		21	349				11	325
8	1300-Along									7	N
	Cross									2	on
	Result									7	324
8	1900-Along									0	
	Cross									0	
	Result									0	
9	0100-Along									9	S
	Cross									3	off
	Result									9	142
9	0700-Along	15	S		23	S		37	S	7	S
	Cross	3	on	152	10	on	North			2	off
	Result	15	171		25	184				7	144
9	1300-Along									13	S
	Cross									3	off
	Result									13	147
9	1900-Along									10	S
	Cross									1	off
	Result									10	154
10	0100-Along									14	S
	Cross									3	off
	Result									14	148
10	0700-Along	36	S		41	S		6	N	12	S
	Cross	7	on	152	8	off	North			2	off
	Result	37	171		41	149				12	151
10	1300-Along									25	S
	Cross									3	off
	Result									25	153
10	1900-Along									18	S
	Cross									4	off
	Result									18	147

KEY = All speeds in CM/SEC
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on = onshore off = offshore

TABLE 4: Current Data
FEB 1988

Day	Time / Alongshore / Cross-shore / Resultant	Pier Measurements: Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface): Distance from Baseline (m)	Speed	Dir	Beach Measurements (500m Updrift): Dye 12m offshore (surface) Location	Speed	Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679: Speed	Dir
11	0100-Along									16	S
	Cross									3	off
	Result									16	149
11	0700-Along	32	S		41	S		12	N	20	S
	Cross	10	on	152	2	off	North			4	off
	Result	33	177		41	157				20	149
11	1300-Along									20	S
	Cross									3	off
	Result									20	151
11	1900-Along									13	S
	Cross									0	
	Result									13	160
12	0100-Along									8	S
	Cross									1	off
	Result									8	153
12	0700-Along	0			76	N		9	S	11	S
	Cross	0		152	0		South			4	off
	Result	0	0		76	340				12	140
12	1300-Along									7	S
	Cross									1	on
	Result									7	168
12	1900-Along									13	S
	Cross									8	off
	Result									15	128
13	0100-Along									20	S
	Cross									0	
	Result									20	160
13	0700-Along	25	S		29	S		26	S	16	S
	Cross	19	off	140	15	off	North			1	off
	Result	32	123		32	133				16	156
13	1300-Along									6	S
	Cross									1	on
	Result									6	169
13	1900-Along									2	S
	Cross									1	on
	Result									2	187
14	0100-Along									14	N
	Cross									4	on
	Result									15	324
14	0700-Along	2	S		20	S		26	S	10	N
	Cross	2	off	152	3	off	North			1	on
	Result	3	112		21	151				10	334
14	1300-Along									13	N
	Cross									0	
	Result									13	340
14	1900-Along									9	N
	Cross									3	on
	Result									9	322
15	0100-Along									12	N
	Cross									5	on
	Result									13	317
15	0700-Along	36	N		32	N		15	N	8	N
	Cross	2	off	140	0		South			3	on
	Result	36	343		32	340				9	319
15	1300-Along									28	N
	Cross									3	on
	Result									28	334
15	1900-Along									8	N
	Cross									3	on
	Result									9	319

KEY = All speeds in CM/SEC
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on = onshore off = offshore

TABLE 4: Current Data
FEB 1988

Day	Time	Alongshore / Cross-shore / Resultant	Pier Measurements: Dye at (579 m) (surface) Speed	Pier Measurements: Dye at (579 m) (surface) Dir	Pier Measurements: Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Pier Measurements: Dye at Mid-Surf Zone (surface) Speed	Pier Measurements: Dye at Mid-Surf Zone (surface) Dir	Beach Measurements (500m Updrift) Dye 12m offshore (surface) Location	Beach Measurements (500m Updrift) Dye 12m offshore (surface) Speed	Beach Measurements (500m Updrift) Dye 12m offshore (surface) Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Speed	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Dir
16	0100	Along									10	N
		Cross									3	on
		Result									10	323
16	0700	Along	47	S		34	N		56	S	8	N
		Cross	7	off	152	2	off	South			1	on
		Result	47	151		34	343				8	333
16	1300	Along									20	S
		Cross									4	off
		Result									20	149
16	1900	Along									12	S
		Cross									3	off
		Result									12	146
17	0100	Along									2	S
		Cross									5	off
		Result									5	92
17	0700	Along	7	N		19	N		30	S	4	N
		Cross	9	off	140	3	off	South			1	on
		Result	12	30		19	349				4	326
17	1300	Along									4	N
		Cross									1	off
		Result									4	354
17	1900	Along									5	N
		Cross									3	on
		Result									6	309
18	0100	Along									2	S
		Cross									3	off
		Result									4	104
18	0700	Along	11	N		6	N		11	S	6	N
		Cross	3	off	140	2	off	South			1	on
		Result	12	357		6	2				6	331
18	1300	Along									1	N
		Cross									1	off
		Result									1	25
18	1900	Along									1	N
		Cross									3	on
		Result									3	268
19	0100	Along									11	S
		Cross									8	off
		Result									14	124
19	0700	Along	0			24	N		18	S	10	S
		Cross	9	on	152	7	on	South			4	off
		Result	9	250		25	323				11	138
19	1300	Along									10	S
		Cross									5	off
		Result									11	133
19	1900	Along									4	S
		Cross									0	
		Result									4	160
20	0100	Along									6	S
		Cross									2	on
		Result									6	178
20	0700	Along	5	N		32	N		89	S	1	N
		Cross	6	on	152	8	off	North			3	on
		Result	7	290		33	354				3	268
20	1300	Along									8	S
		Cross									1	off
		Result									8	153
20	1900	Along									5	N
		Cross									2	on
		Result									5	318

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N = Northward, Shore parallel
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on = onshore off = offshore

TABLE 4: Current Data
FEB 1988

Day	Alongshore / Cross-shore / Resultant ---- Time	Pier Measurements: Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Beach Measurements (500m Updrift) Dye 12m offshore (surface) Location	Speed	Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Speed	Dir
21	0100-Along									2	S
	Cross									3	on
	Result									4	216
21	0700-Along	4	S		5	S		5	S	6	N
	Cross	7	off	152	3	off	North			3	on
	Result	8	97		6	129				7	313
21	1300-Along									18	S
	Cross									4	off
	Result									18	147
21	1900-Along									20	S
	Cross									9	off
	Result									22	136
22	0100-Along									11	S
	Cross									6	off
	Result									13	131
22	0700-Along	32	N		55	N		9	S	8	N
	Cross	0		152	0		South			3	on
	Result	32	340		55	340				9	319
22	1300-Along									7	N
	Cross									5	on
	Result									9	304
22	1900-Along									15	N
	Cross									5	on
	Result									16	322
23	0100-Along									11	N
	Cross									5	on
	Result									12	316
23	0700-Along	34	N		41	N		12	S	15	N
	Cross	8	off	140	4	off	South			2	on
	Result	35	354		41	346				15	332
23	1300-Along									15	N
	Cross									2	on
	Result									15	332
23	1900-Along									10	N
	Cross									4	on
	Result									11	318
24	0100-Along									3	N
	Cross									1	off
	Result									3	358
24	0700-Along	20	S		15	N		26	S	4	S
	Cross	6	off	152	2	off	South			0	
	Result	21	143		15	349				4	160
24	1300-Along									10	S
	Cross									3	off
	Result									10	143
24	1900-Along									13	S
	Cross									3	off
	Result									13	147
25	0100-Along									8	S
	Cross									1	off
	Result									8	153
25	0700-Along	55	S		12	S		30	S	17	S
	Cross	0		177	5	off	North			2	off
	Result	55	160		13	138				17	153
25	1300-Along									17	S
	Cross									10	off
	Result									20	130
25	1900-Along									12	S
	Cross									5	off
	Result									13	137

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TABLE 4: Current Data
FEB 1988

Day	Alongshore Cross-shore Resultant / Time	Pier Measurements: Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Beach Measurements (500m apart): Dye 12m offshore (surface) Location	Speed	Dir	Current Meter at South Tripod Depth -4.8m (NGVD) ID #679 Speed	Dir
26	0100-Along									13	S
	Cross									3	off
	Result									13	147
26	0700-Along	55	S		41	S		61	S	20	S
	Cross	0		152	12	off	North			0	
	Result	55	160		42	143				20	160
26	1300-Along									17	S
	Cross									2	on
	Result									17	167
26	1900-Along									11	S
	Cross									0	
	Result									11	160
27	0100-Along									1	N
	Cross									2	on
	Result									2	277
27	0700-Along	14	N		25	S		5	S	6	N
	Cross	21	off	152	4	off	South			5	on
	Result	25	36		26	151				8	300
27	1300-Along									4	N
	Cross									3	on
	Result									5	303
27	1900-Along									12	S
	Cross									7	off
	Result									14	130
28	0100-Along									36	S
	Cross									4	off
	Result									36	154
28	0700-Along	102	S		122	S		124	S	53	S
	Cross	0		152	0		North			10	off
	Result	102	160		122	160				54	149
28	1300-Along									52	S
	Cross									9	off
	Result									53	150
28	1900-Along									25	S
	Cross									2	off
	Result									25	155
29	0100-Along									3	S
	Cross									1	off
	Result									3	142
29	0700-Along	17	N		76	N		46	N	3	N
	Cross	3	off	152	4	off	South			1	off
	Result	17	349		76	343				3	358
29	1300-Along									25	N
	Cross									2	off
	Result									25	345
29	1900-Along									6	N
	Cross									2	on
	Result									6	322

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PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves). The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

FEB 1988

Day	Time	Wave Approach Angle at Pier End deg from True N Primary	Secondary	Radar Wave Angle deg from True N	Width of Surf Zone,m	Water Characteristics at Pier End Temp.,C	Density g/cc	Secchi Vis.,m
1	0720	110			32	6.2	1.0247	1.8
2	0700	90			52	7.5	1.0250	2.4
3	0850	40		50	180	7.2	1.0250	0.3
4	0745	90	50		87	7.2	1.0248	0.6
5	0750	40			96	5.3	1.0222	2.1
6	0740	10		40	64	4.5	1.0235	1.5
7	0735	60		40	61	2.8	1.0231	2.4
8	0745	100			52	3.4	1.0230	2.4
9	0737	40		70	98	5.0	1.0238	2.1
10	0735	90	40		76	5.0	1.0237	2.4
11	0800	70		90	169	5.0	1.0210	1.5
12	0745	100			258	5.6	1.0224	0.3
13	1020	70	10	65	58	4.0	1.0226	0.6
14	0920	70	30		75	3.9	1.0228	2.7
15	0920	none visible			55	5.9	1.0237	3.0
16	0800	none visible		100	79	5.6	1.0248	1.2
17	0730	40	90		56	5.6	1.0248	2.1
18	0745	100	40		9	6.0	1.0246	3.0
19	0800	90		50	59	6.7	1.0246	1.5
20	0646	90			49	6.7	1.0244	3.0
21	0630	95	0		7	5.9	1.0244	3.0
22	0740	50			47	5.6	1.0232	3.4
23	0730	none visible			52	6.1	1.0243	3.0
24	0800	none visible			52	6.4	1.0238	6.4
25	0820	30			61	6.1	1.0225	4.0
26	0816	40		60	85	5.6	1.0210	3.0
27	0630	80			7	5.8	1.0240	2.4
28	0655	20		70	195	5.6	1.0260	0.9
29	0815	60	90		257	5.6	1.0234	1.2

PART VI: WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours) and contains a list of selected mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

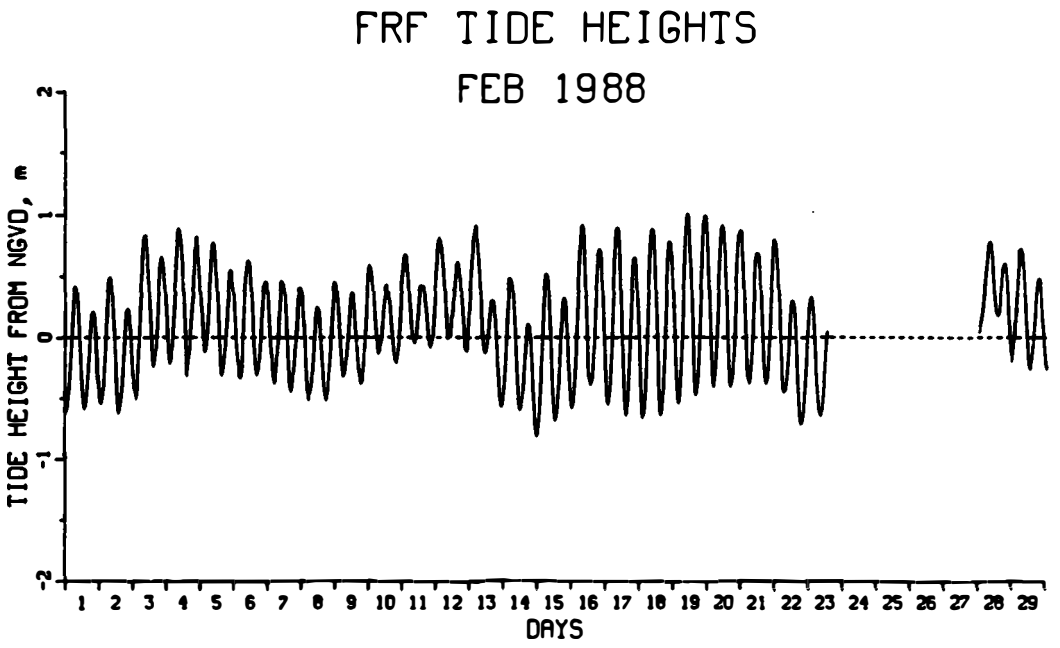


Figure 4. Time history of mean water levels

MONTHLY WATER LEVELS (METERS NGVD)

EXTREME LOW	=	-0.82 ON DAY 14 AT 2242 HR
EXTREME HIGH	=	1.00 ON DAY 19 AT 824 HR
MONTHLY MEAN	=	0.09
MEAN LOW	=	-0.43
MEAN HIGH	=	0.58
MEAN RANGE	=	1.02

Table 6: WATER LEVELS, METERS NGVD *

FEB 1988

MID-DAY	CYCLE TIME	LOW	HIGH	MEAN	RANGE
1	612	-0.62	0.42	-0.12	1.04
1	1837	-0.59	0.21	-0.22	0.80
2	703	-0.63	0.49	-0.03	1.12
2	1928	-0.62	0.23	-0.18	0.86
3	753	-0.51	0.84	0.27	1.35
3	2018	-0.23	0.66	0.20	0.89
4	843	-0.33	0.89	0.34	1.21
4	2109	-0.17	0.83	0.30	0.99
5	934	-0.32	0.78	0.27	1.10
5	2159	-0.34	0.55	0.10	0.89
6	1024	-0.34	0.63	0.16	0.97
6	2249	-0.38	0.46	0.06	0.84
7	1115	-0.45	0.46	0.02	0.91
7	2340	-0.52	0.41	-0.03	0.93
8	1205	-0.53	0.25	-0.16	0.77
9	30	-0.36	0.45	0.03	0.81
9	1255	-0.38	0.37	-0.03	0.75
10	121	-0.26	0.59	0.19	0.86
10	1346	-0.21	0.43	0.10	0.64
11	211	-0.12	0.68	0.29	0.80
11	1436	-0.09	0.42	0.18	0.52
12	301	-0.02	0.81	0.42	0.83
12	1527	-0.12	0.62	0.27	0.74
13	352	-0.13	0.91	0.44	1.04
13	1617	-0.58	0.30	-0.07	0.88
14	442	-0.61	0.48	-0.02	1.09
14	1707	-0.82	0.11	-0.33	0.93
15	532	-0.79	0.52	-0.08	1.31
15	1758	-0.69	0.33	-0.19	1.01
16	623	-0.57	0.92	0.21	1.48
16	1848	-0.56	0.72	0.10	1.28
17	713	-0.64	0.90	0.18	1.53
17	1938	-0.67	0.66	-0.01	1.32
18	804	-0.65	0.88	0.14	1.53
18	2029	-0.64	0.78	0.11	1.43
19	854	-0.55	1.00	0.25	1.55
19	2119	-0.46	0.99	0.29	1.45
20	944	-0.41	0.91	0.26	1.33
20	2210	-0.37	0.88	0.27	1.25
21	1035	-0.38	0.69	0.15	1.08
21	2300	-0.45	0.80	0.20	1.26
22	1125	-0.72	0.30	-0.17	1.02
22	2350	-0.71	0.33	-0.16	1.05
23	1216				
24	41				
24	1306				
25	131				
25	1356		Gage Inoperative		
26	222				
26	1447				
27	312				
27	1537				
28	402				
28	1628	-0.14	0.60	0.31	0.75
29	453	-0.22	0.73	0.28	0.94
29	1718	-0.27	0.48	0.09	0.75

* All water level data for February are questionable because of a partially clogged well orifice.

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in January and the two surveys in February on profile line 188, located 517 m south of the pier. The first survey in February shows significant accretion on the foreshore (60 to 140 m) accompanied by a 50-m seaward migration of the nearshore bar (140 to 280 m). The last survey shows the foreshore continuing to accrete while the nearshore bar remains stationary. Only minor changes are visible on the remainder of the profile.

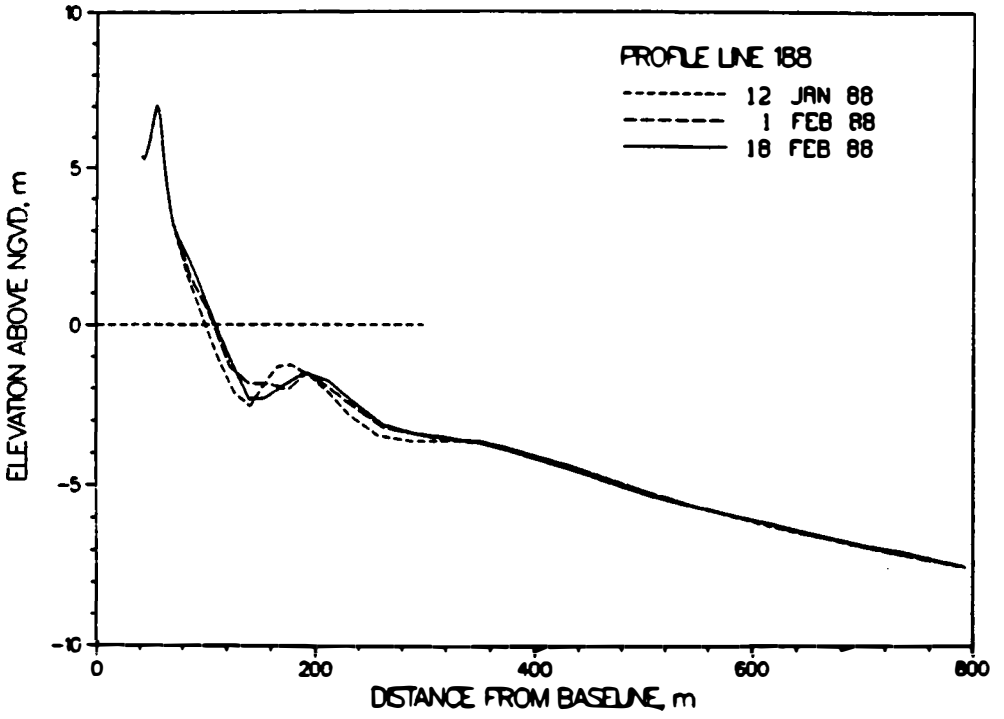


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1988. The only significant change (160 m) represents the seaward migration of the nearshore bar.

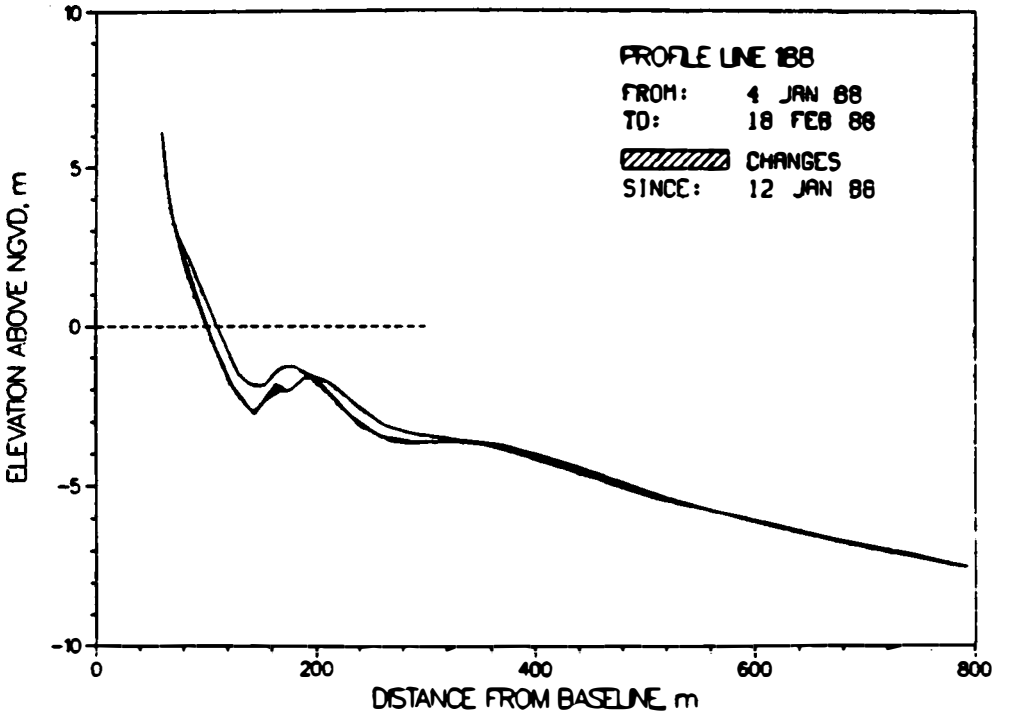
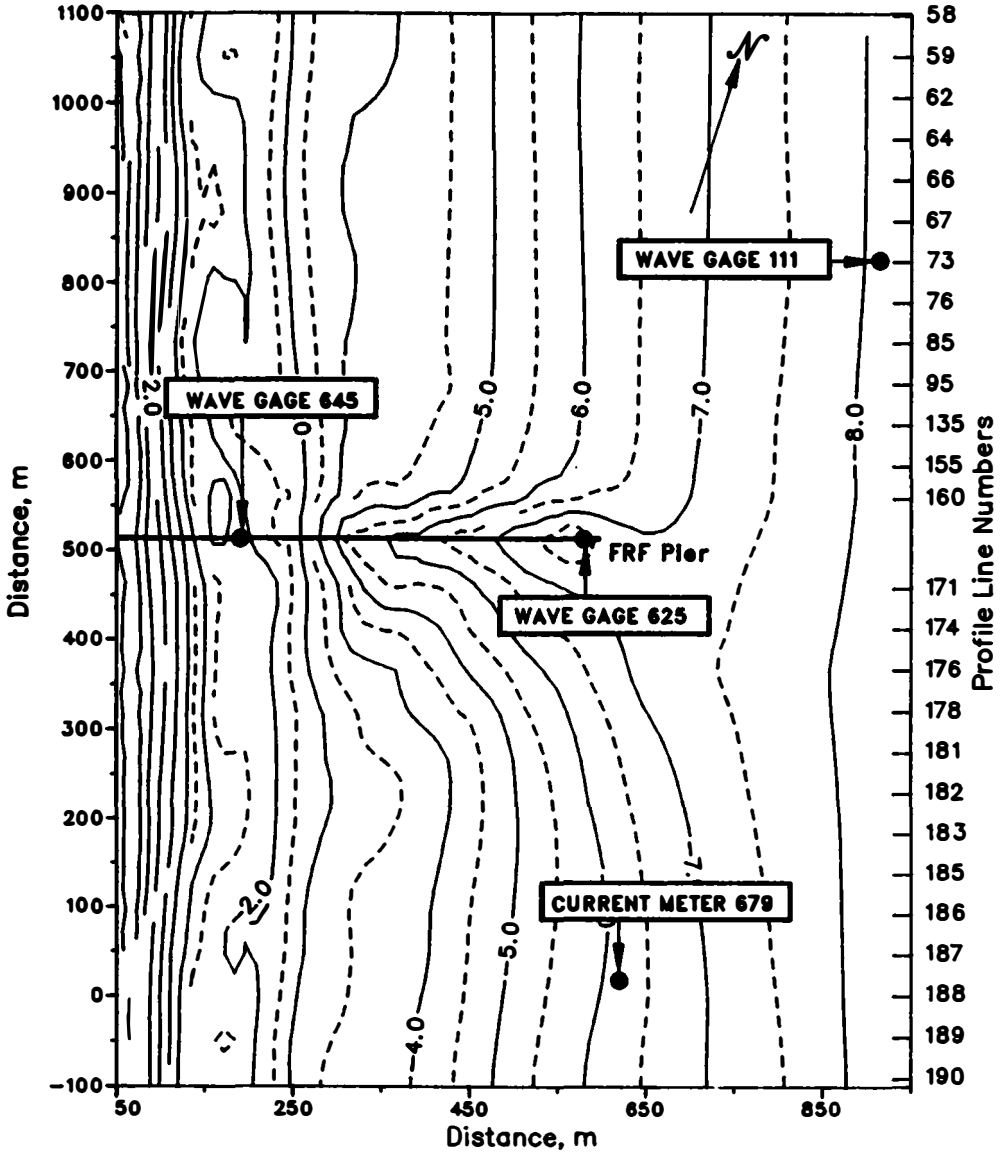
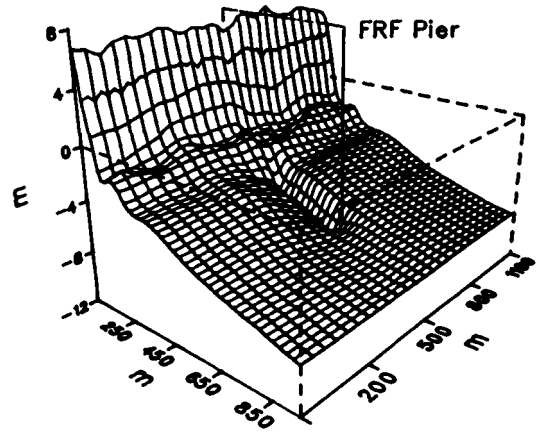


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey conducted on 2 February. Wide contour lines on the change diagram represent areas which eroded; thin lines indicate accretion.





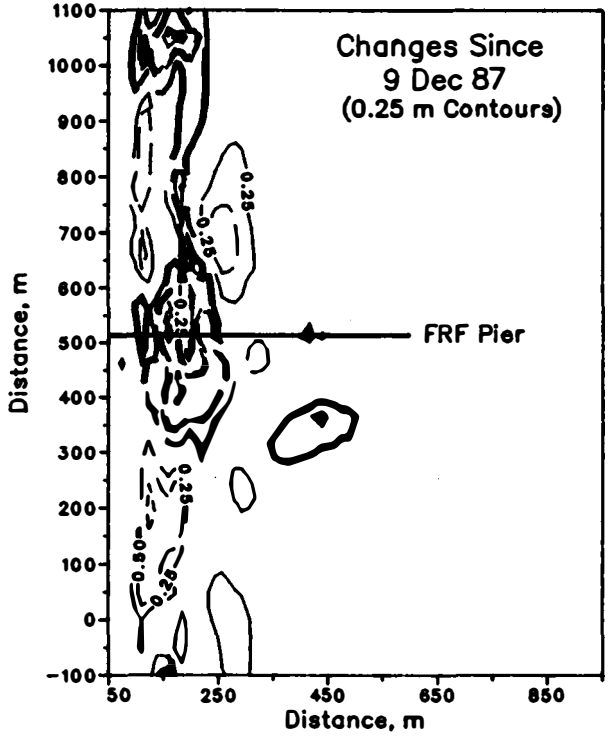


FIGURE 7. FRF BATHYMETRY 2 Feb 88
(Depths Relative to NGVD)

PART VIII: SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by Gage 625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every three hours:

Start	End
12 Feb (0100)	12 Feb (0808)
28 Feb (0508)	29 Feb (0542)

B. Storm Synopsis.

12 February - This storm formed over Texas early on 10 February and rapidly intensified as it moved to the north-northeast. By 12 February, it was located over Lake Erie and two weak secondary lows formed in the Atlantic (one off Cape Hatteras, NC). All three lows merged over New England by 13 February. Maximum onshore winds (from east-northeast) approached 7 m/s at 0134 hr on 12 February followed several hours later by the maximum H_{mo} of 2.25 m (T_p = 9.14 sec). Minimum barometric pressure was 1006.8 mb and precipitation totaled 25 mm.

28 February - Generically known as an "Alberta Clipper," this storm roared out of Canada on 26 February and was located off Cape Hatteras, NC by 28 February. Northerly winds exceeded 16 m/s early on the 28th with the maximum H_{mo} of 2.76 m (T_p = 8.00 sec) recorded the same morning. The minimum barometric pressure of 1004.4 mb occurred at 1442 hr on 27 February. There was no measurable precipitation with this storm.

Distribution List

Government Agencies:

OCE
BERH
NAO
NASA/Wallops Flight Center
NOAA (NOS, NWS)
SAD
SAW
U.S. Geological Survey
U.S. National Park Service
U.S. Naval Academy
U.S. Naval Civil Eng. Lab
U.S. Naval Fac. Eng. Com.
U.S. Naval Oceanographic Off.
U.S. Naval Research Lab

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East Carolina University
Florida Inst. of Tech.
Harvard University
Naval Post Graduate School
NC State University
Old Dominion University
Oregon State University
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Scripps Inst. of Oceanography
Southern Illinois University
Stockton State College
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Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)