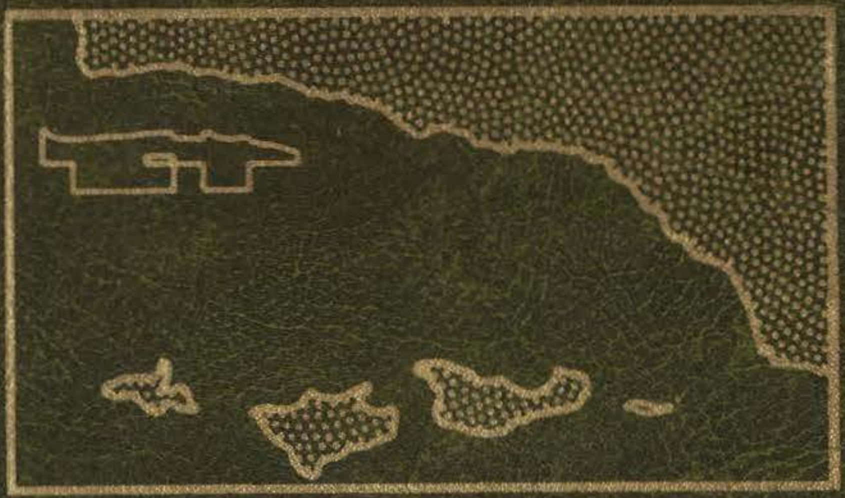
SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT



HUMBLE OIL & REFINING COMPANY

UNIT OPERATOR

APPENDIX VOL. 6

APPENDIX 6.1

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.1

Wave Statistics For Seven Deep Water Stations Along The California Coast

National Marine Consultants

December, 1960

WAVE STATISTICS FOR SEVEN DEEP WATER STATIONS ALONG THE CALIFORNIA COAST

Prepared for
DEPARTMENT OF THE ARMY
U. S. ARMY CORPS OF ENGINEERS DISTRICTS

Los Angeles, California
San Francisco, California

Santa Barbara, California
December 1960

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NATIONAL MARINE CONSULTANTS

WAVE STATISTICS FOR SEVEN DEEP WATER STATIONS ALONG THE CALIFORNIA COAST

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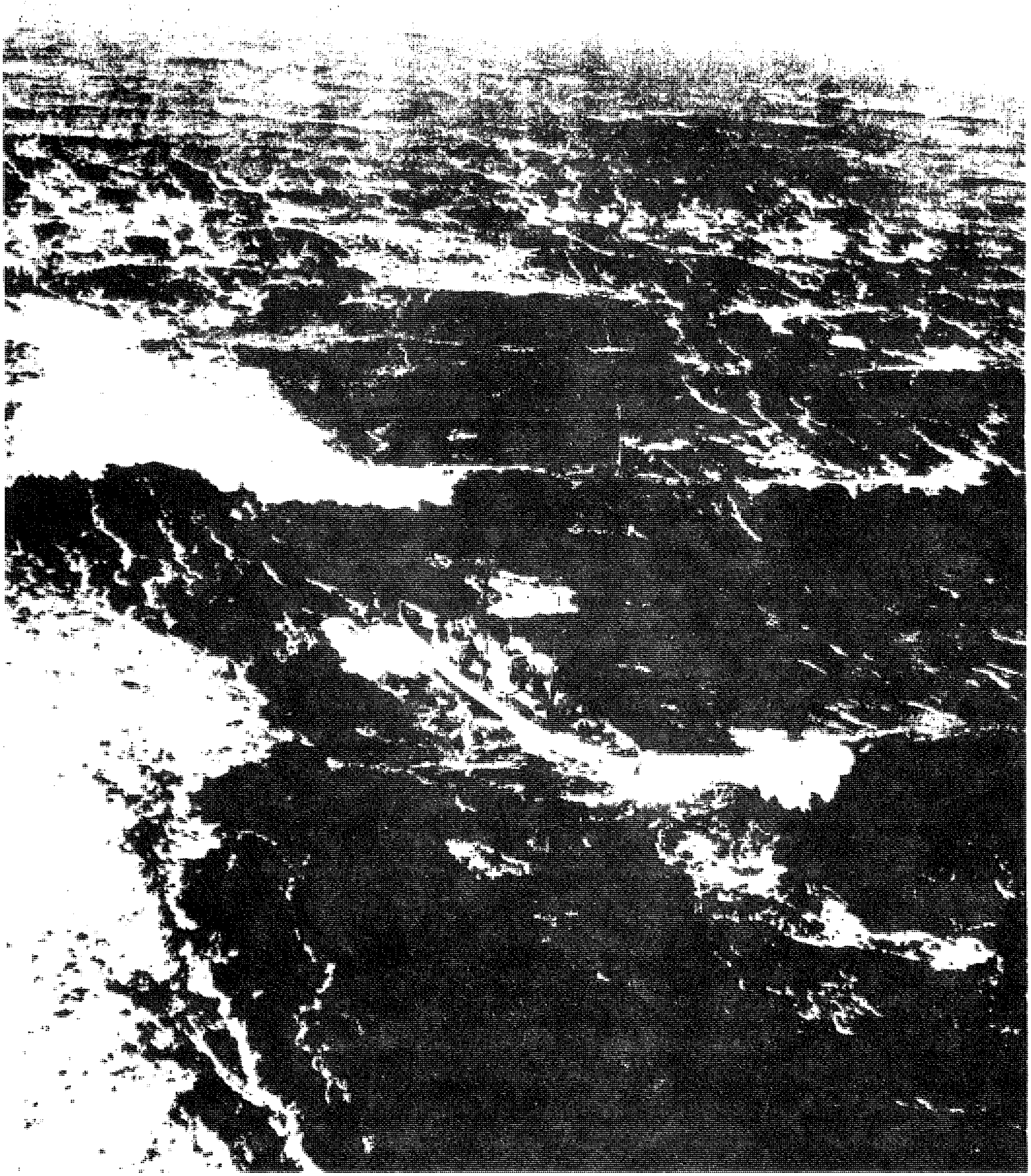
SANTA BARBARA, CALIFORNIA
DECEMBER 1960



STORM WAVES OFF SAN FRANCISCO, Feb. 1960 (H_s= 33 ft)

WAVE STATISTICS FOR SEVEN DEEP WATER STATIONS ALONG THE CALIFORNIA COAST

Prepared for

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS DISTRICT
Los Angeles, California

NATIONAL MARINE CONSULTANTS, INC.
Santa Barbara, California
DECEMBER 1960

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I. INTRODUCTION

The following study "Wave Statistics For Seven Deep Water Stations Along The California Coast" has been conducted under contract No. DA-04-353 CIVENG-59-160, dated 26 June 1959, between the U. S. Army Corps of Engineers, District Los Angeles and San Francisco and National Marine Consultants, Inc., Santa Barbara, California.

The work tasks covered in this report as provided for in Part I(a) of the above mentioned contract and amendments are, "To compile deep-water wave statistics based upon meteorological records and charts for the years 1956, 1957, and 1958. The statistics to be compiled are wave height, wave direction, and wave period and are to be presented as monthly and annual averages."

The general area of study covers the entire coast of California and is represented by seven carefully selected deep water stations, including the area from the California-Oregon border to San Nicolas Island; statistics on an eighth station are presented in a separate report.

The locations of the seven deep water stations considered in this study are shown in Figure 1, and are:

Station 1	42.0° N, 125.0° W
Station 2	39.6° N, 124.5° W

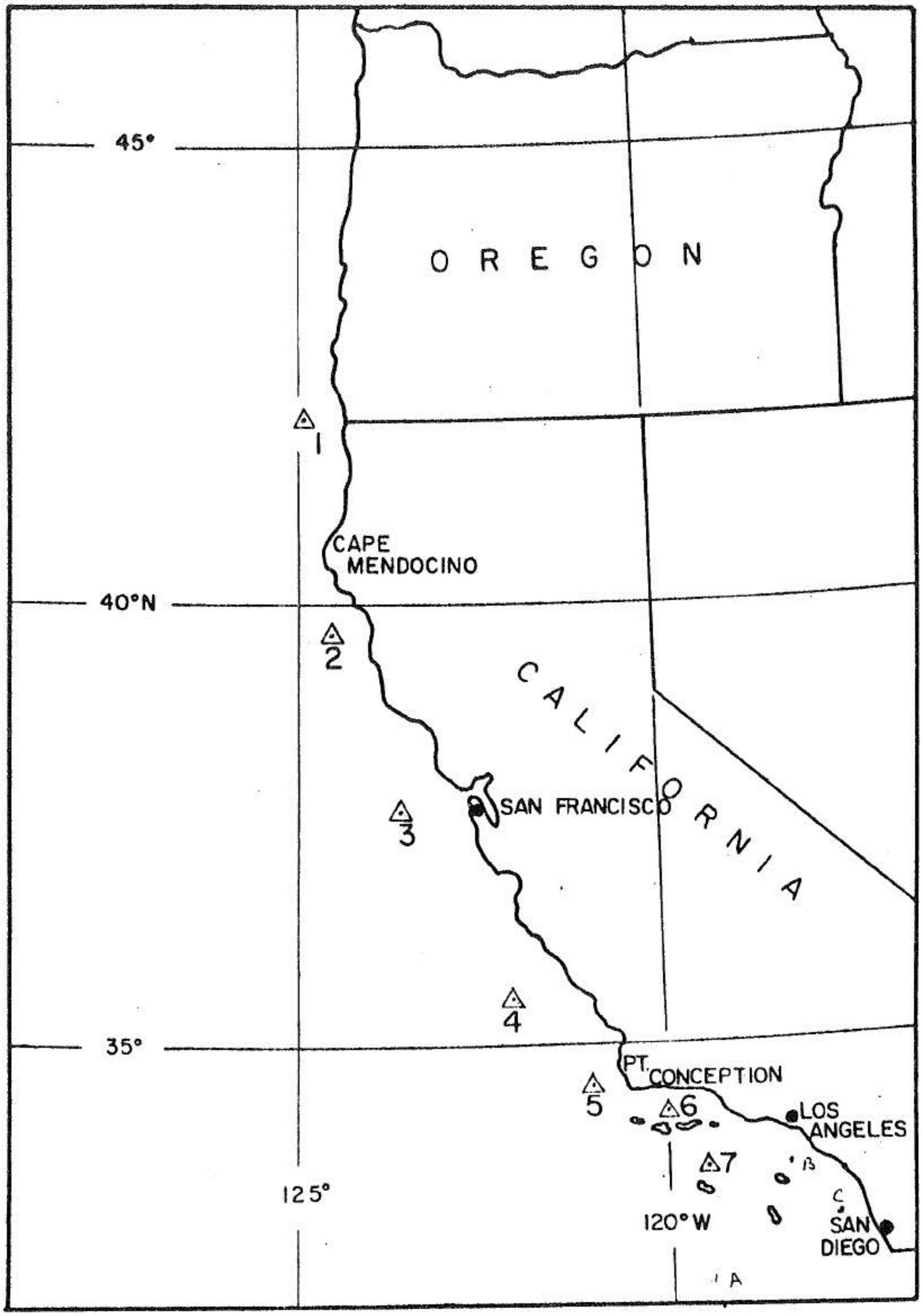

FIGURE 1: LOCATION OF HINDCAST STATIONS

Station 3	37.6° N, 123.5° W
Station 4	35.5° N, 122.0° W
Station 5	34.5° N, 121.0° W
Station 6	34.2° N, 120.0° W
Station 7	33.5° N, 119.5° W

II. METEOROLOGICAL ASPECTS OF THE WAVE REGIME ALONG THE CALIFORNIA COAST.

In the following paragraphs those meteorological situations which produce waves along the California coast will be discussed briefly:

A. PACIFIC HIGH

The Pacific anticyclone plays an important role in the generation of waves along the California Coast. This is particularly true during the summer months when it is the dominant feature of the meteorological circulation in the eastern North Pacific. During these months the predominant wave action (particularly in Southern California) is almost invariably generated by the prevailing west-northwest to north-westerly winds along the Pacific Coast of the United States. These wind strengths are dependent upon the offshore pressure gradient, and the gradient itself is dependent upon the interplay of the location of the Pacific High with the thermal trough over central

California and Nevada.

A very common situation, particularly in the spring, is the formation of a "Nevada low" centered over Southern Nevada. This occurs when a mass of cold air drops into Southern Nevada resulting in the formation of a rather intense surface low pressure system. As high pressure builds in behind the low, a tight pressure gradient develops resulting in extremely strong west-northwest to northwest winds along the coast.

B. EXTRATROPICAL CYCLONES

Extratropical cyclones represent the most important source of severe waves reaching the California Coast. Normally, these storms originate in the vicinity of Japan and proceed eastward across the Pacific to the Gulf of Alaska. Waves generated in the southwest sectors of these storms reach most of California but usually show a steady decrease in energy intensity southward along the coast. Very often, however, especially during the Winter and Spring, the Pacific anticyclone shifts southward, permitting the more intense extratropical cyclones to follow a more southerly course and affect the lower part of the state. When these storms approach the California Coast the topographic influence is such that the prefrontal southerly winds right on the coast tend to be somewhat more intense than the following westerlies. However, the opposite is true while the disturbances are still at sea, and an intense buildup of easterly directed wave energy results. As the storm approaches the coast the westerly winds normally will decrease slightly and the wave energy front will decay as it travels shoreward. The decay distance usually increases going to the south, but it is possible with some storms for the maximum wave energy to be centered upon Central or even Southern California.

Southern California generally experiences its most severe wave conditions when storms develop between Hawaii and the Pacific Coast. This occurs when the Polar front trails southwestward and approaches a col in the high pressure belt. Cyclogenesis results, and if the contrast between the warm tropical air and cold polar air is great enough, the storm will move with very strong westerly winds toward the coast. An example of such a storm is presented in Section IV.

C. TROPICAL CYCLONES

The West Coast of Mexico tropical cyclone is a regular, frequently occurring, meteorological phenomenon during the summer and early fall. A count of these storms occurring between 1910 and 1940 reveals an average annual frequency of at least six; however, only about one or two per year at the most tend to generate swell which is at all significant at any of the stations considered in this study. Station 7 is, of course, the most vulnerable with Stations 5 and 6 being affected to a much lesser extent due to interfering land masses. Generally speaking, these tropical storms follow one of two main tracks: (1) Gulf of Tehuantepec northward along the Mexican coast and then inland near Mazatlan, Mexico; (2) A more westerly origin and a west to west-northwest track toward Hawaii. Only five storms are known to have approached as far north as Southern California since 1900 and only one of these was of marked influence with respect to wind and waves (September 1939).

D. SOUTHERN HEMISPHERE EXTRATROPICAL CYCLONES

Wave measurements made during the summertime at La Jolla and Oceanside, California, indicate that swell often arrives at those locations from a southerly direction and with an exceptionally long period (13 to 20 seconds). Several factors suggest that this swell comes from extratropical cyclones proceeding from west to east across the

South Pacific Ocean between Australia and Chile. However, such swell has not been considered in this report owing to its minor significance, relative to North Pacific wave intensity, at any of the seven study stations. (For a discussion of Southern Hemisphere swell at Station 8 refer to report made under contract No. DA-04-353-CIVENG-60-32.)

III. CHOICE OF HINDCAST YEARS

Economic considerations restricted the hindcast study to the use of three years of data. This number of years was felt to be a minimum for any significance, and it is anticipated that additional years of data eventually will be averaged with these, to provide more stable statistics.

Since wave height-period-direction conditions at a given location are a function of weather patterns, and since such patterns are extremely variable, the choice of years for this study becomes very important. In terms of weather there is practically no such thing as an average year, and it would be defeating the purpose to choose three years which are "about" average or to select three years at random.

The years 1956, 1957 and 1958 therefore, were chosen for analysis for the following reasons:

1. These years were significantly different from one

another in terms of storm frequency, but different in such a manner as to have a compensating result; and it was felt that this result would be representative of an "average" year.

2. It was felt that recent years would (a) be more representative in view of gradual changes in world wide weather patterns and (b) contain reasonably accurate synoptic weather observations due to the increasing number of reports from ships at sea and proficiency in measuring techniques as compared to the pre-World War II period.
3. Consecutive years were chosen to maintain hindcastin continuity with the anticipation of adding subsequent contiguous years.

IV. HINDCAST METHODS

A. THEORY

Clearly, the optimum procedure for compiling accurate wave statistics of the nature considered herein would involve the use of accurate measured data. Unfortunately, such measurements are not yet available to the desired extent, with the consequence that hindcast techniques must be resorted to. Hindcast procedures, essentially, are based on semi-theoretical considerations of hydrodynamics.

Available solutions seldom are exact. However, it has been conclusively shown that careful application of wave forecast theory by experienced forecasters can produce reasonably accurate results.

Wave hindcast data presented in this study were computed in accordance with the theory of wave spectra and statistics as presented by Piersen, Neumann and James. However, one change was made to this theory. The equation for wave travel time was changed from $t = 0.66\ FR_o$ (Figure 3-16, H.O. Pub. 603) to $t = .495\ FR_o$; where t = travel time in hours, F = wave frequency, and R_o = decay distance.

The original equation does not appear to satisfy the observational verification of wave forecasts which have been made daily for sites along the Pacific Coast of California since 1957. On this basis, the travel time equation was modified and has proven to be successful.

We will not attempt to discuss the PNJ theory further in this report. If such information is desired, the reader is referred to the list of references given in Section VI.

B. PROCEDURE

Six-hourly U. S. Weather Bureau synoptic weather charts for the Pacific Ocean were used in making all wave hindcasts. On each weather map pertinent fetches were delineated and a complete record kept of the necessary hindcast parameters. In addition, a wind hindcast was made for local wind waves (hereafter termed "Sea") at each station. It should be pointed out that this condition often constituted a separate source of swell at some stations, inasmuch as a wave in the form of Sea at one station often will show up as Swell at an adjacent station which is not under the influence of the same wind system. For such cases special graphs were devised which provided Sea and Swell relationships between the various study stations.

It was a frequent occurrence, especially during the winter months, for two or more trains of swell to be arriving simultaneously at a given station. In fact, there were times when the number of simultaneously occurring wave trains totaled as many as seven. In order to maintain a realistic picture of the physical state of the sea then, as many trains as possible were left intact. However, in order that the statistics not become completely unwieldy the energies of two or more simultaneously occurring wave trains were added* when

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*Equivalent to adding the square root of the sum of the squares of the component wave height.

arriving from essentially the same direction (ie., WNW-NW, etc.) and differing in significant period by not more than three seconds. In certain cases, of course, when this condition exists the total energies from the different wave trains cannot be added. Specifically, this occurs when the energy leaving one fetch is in part contributed to by another fetch. In such cases only those different parts of the spectra arriving simultaneously at a station are additive.

In cases where very large waves in the form of Sea were being generated at a station coincidently in time with the arrival of a Swell train of less than 3 feet in height the Swell was neglected. For example, using the energy addition relationship, it is obvious that the sum $\left[E_\alpha + E_\beta\right]^{1/2}$ is not significantly influenced by the lesser of the two wave heights when $\alpha = 3$, $\beta = 10$.

C. ACCURACY

Without instrumental verification, it obviously is not possible to make any final statement as to the accuracy of a wave forecast. As stated previously, however, it can be concluded that the theory can provide reliable figures. Much of the requirement for success hinges upon the forecaster's experience. In this regard, the wave forecasting division of National Marine Consultants, Inc. have been applying both the SMB and PNJ theories continuously for the past four years for several locations along the California and Oregon coasts. These forecasts have had considerable checking out and verification by clients, using both instrumented and visual means, and have proven to be quite accurate for the most part.

In the conduction of this project, three to four experienced forecasters were used and their results cross checked frequently for minimization of procedural variations. Consequently, the resultant data are considered to be consistent from station to station and month to month.

D. EXAMPLE OF HINDCAST PROCEDURE

In order to familiarize the users of this report with the general techniques by means of which the data were obtained, a description of a typical hindcast, including the physical pattern is presented in this section of the report.

Figures 2 through 3 show a typical wintertime storm, originating between the Hawaiian Islands and the West Coast of California and then moving northeastward toward

Northern California. In such a case Southern California will receive the main force of the easterly directed Swell.

The example illustrates a case of a moving fetch with the storm front traveling at a speed slightly greater than the wave energy front. (This involves the use of "Filter M-V" as described in U. S. Navy Hydrographic Publication H.O.-603.) At the time of the 0000 Day 1 map the wind is assumed to have already blown for 15 hours at 30 knots. The fetch (shaded area) has been quasi-stationary. At this point the storm begins a fairly rapid rate of movement toward the coast.

The 0600 map shows that the wind speed has remained at 30 knots and the front of the fetch has moved approximately 100 miles. At this rate the wave energy front will also have moved 100 miles to coincide with the wind front. The 1200 map shows that the 30 knot winds have continued and moved eastward another 150 miles. The wave energy front has moved approximately 100 miles more and lies just slightly behind the wind front. The 1800 map shows that the storm system has weakened markedly and the wind has shifted in direction, thus the 30 knot westerly winds can be assumed to have continued at least three hours beyond the 1200 map; thus the hatched area as shown on Figure 3 shows the location of the wave energy

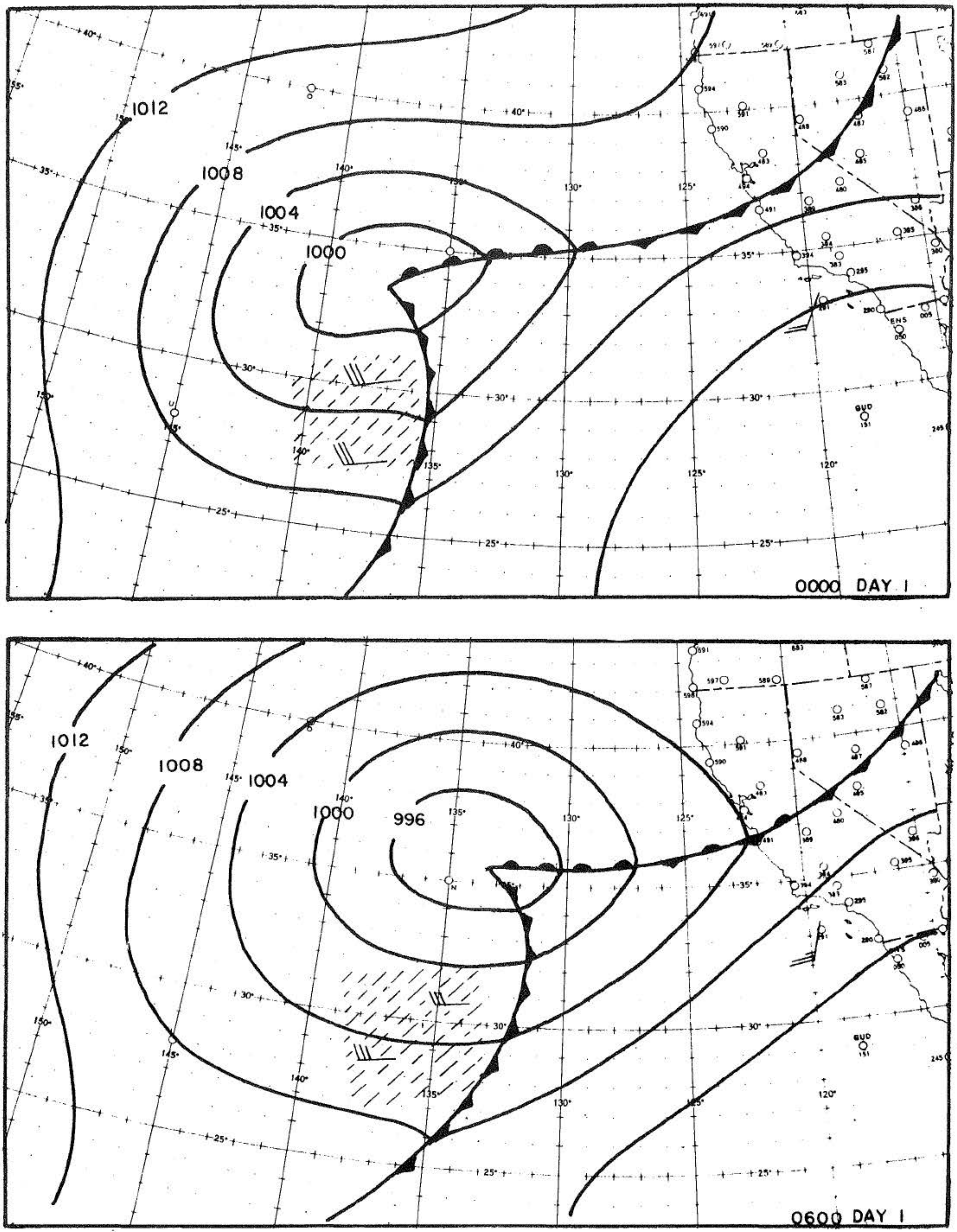

FIGURE 2: SYNOPTIC WEATHER CHART (HINDCAST EXAMPLE)

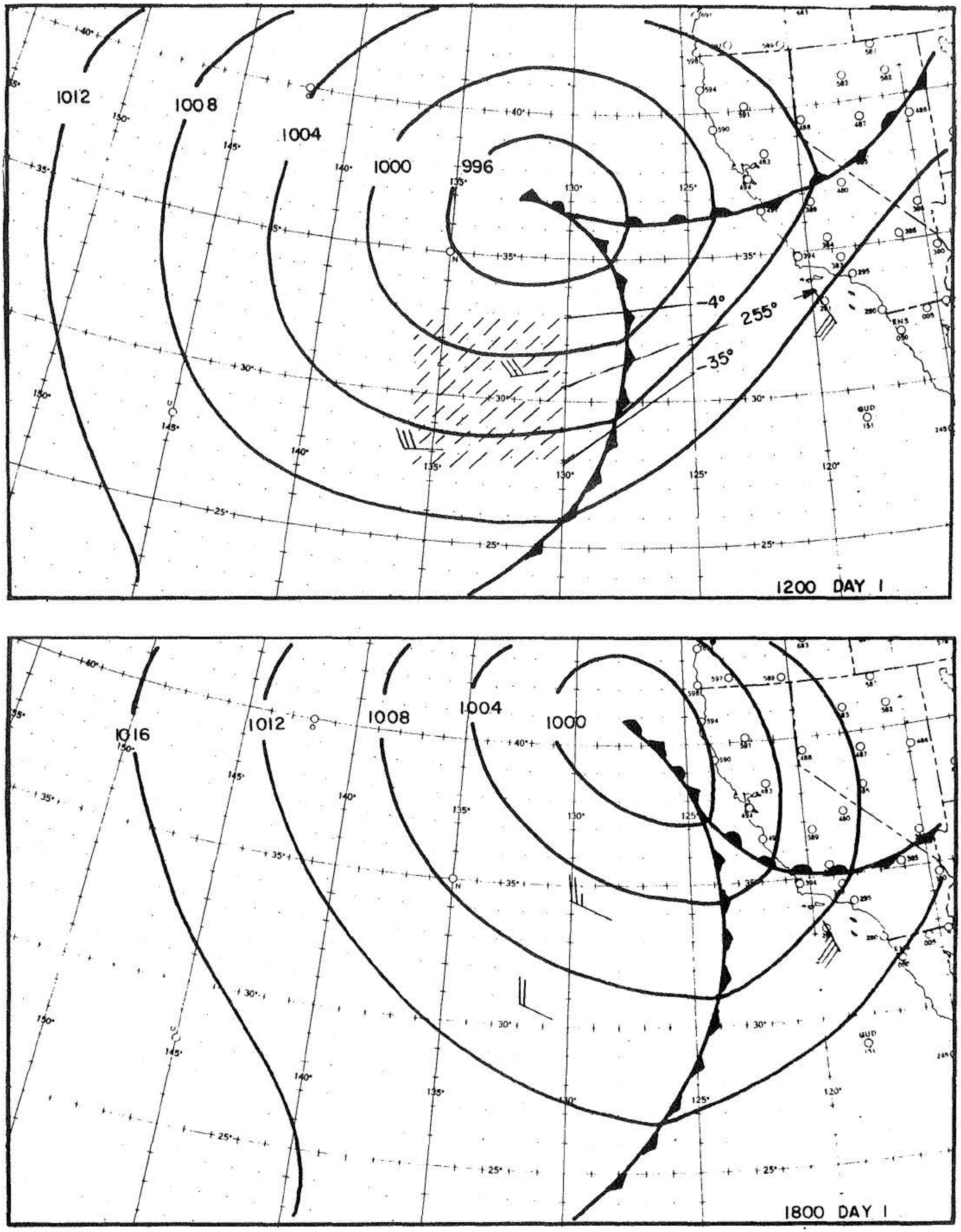

FIGURE 3: SYNOPTIC WEATHER CHART (HINDCAST EXAMPLE)

front as it existed at time 1500.

Owing to the eastward movement of the fetch the rear of the equal energy area (Fetch) extends 200 miles west of the energy front at 130°. Another 50 miles of equal energy area can be added to the 200 miles, owing to energy flux into the rear of the fetch because of the west-northwest to northwest winds. Summarizing, the parameters that exist at 1500 due to this moving storm are:

1.	Wind velocity	30 knots
2.	Wind duration	fully developed
3.	Fetch length (extent of equal energy spectrum)	250 miles
4.	Decay distance	550 miles
5.	Direction of waves	255°
6.	Dispersion angles (measured as shown from Figure 3)	$\alpha = -4^\circ$ $\beta = -35^\circ$

From the co-cumulative spectra (H.O. PUB. 603) it is seen that a fully developed 30 knot wind fetch will generate wave frequencies (f) ranging from 0.05 to 0.20 in magnitude.

Utilizing the above fetch parameters, the waves are "decayed" into the forecast site (Station 7) using

Filter III (H.O.PUB. 603) except that owing to modification of the decay graph equation, the travel times now are governed by:

1. $t_{ob} = \frac{.495}{f_2} R_o$

2. $t_{ob} = \frac{.495}{f_6} (R_o + F)$

where t_{ob} = Time of observation at forecast site

R_o = Decay distance

F = Extent of equal energy spectrum (fetch).

f_2 = Frequency arriving at the forecast site from the front of the fetch.

f_6 = Frequency arriving simultaneously at the forecast site from the rear of the fetch.

The percent of energy which remains within the frequency band (f_2 - f_6) arriving at the forecast site is computed via the dispersion angles α and β. Returning to the co-cumulative spectrum graph, the energies associated with f_2 and f_6 are picked off of the 30 knot curve and converted into wave heights. The final decayed wave energy spectrum for the target site is shown in detail in Table (8) every 6 hours beginning with the arrival of the first waves at 0900 on Day 2.

Not considered in the analysis are the waves arriving at the forecast site generated by the south to southeast winds ahead of the storm, nor the west-northwest to northwest waves arriving from the generating area behind the storm.

In the following table the final three columns give H_s, T_s, as a function of time and direction.

V. PRESENTATION OF STATISTICAL WAVE DATA

Results of the wave hindcast analysis for the seven deep-water sites are presented in the form of average monthly and average annual wave height-period-direction frequency distributions. The tabular data are given in the back of the report. The contents of the tables are discussed briefly in the following sections.

A. MONTHLY AVERAGE TABLES 1.1 to 1.12, 2.1 to 2.12, 3.1 to 3.12, 4.1 to 4.12, 5.1 to 5.12, 6.1 to 6.12, 7.1 to 7.12 INCLUSIVE.

These tables contain the average monthly frequency distributions of deep water wave height-period-direction for Swell (upper table) and Sea (lower table). Wave directions are the directions from which the waves approach; the wave height is in terms of significant height (H_s) in feet or that height representing the average of the upper one third of all waves; the wave period (T_s) in seconds is that average period assoc-

TABLE 8: WAVE CALCULATIONS FOR HINDCAST EXAMPLE

Direction, θ = 265°

Travel Time	f_2	f_6	E_2	E_6	%E	Arrival Time	H_s	T_s
18 Hrs	.069	.060	51	59	2.4	0900/2	4.5	16
24 Hrs	.090	.063	35	54	5.7	1500/2	6.8	14
30 Hrs	.112	.078	20	44	7.2	2100/2	7.7	12
36 Hrs	.134	.093	11	32	6.3	0300/2	7.4	10
42 Hrs	.156	.108	6.5	22	4.5	0900/3	6.0	9
48 Hrs	.178	.123	4.0	16	3.6	1500/3	5.5	8
54 Hrs	.200	.138	2.5	11	2.6	2100/3	4.6	7
60 Hrs	.200	.153	2.5	7	1.4	0300/4	3.3	7
66 Hrs	.200	.169	2.5	5	.8	0900/4	2.5	6
72 Hrs	.200	.183	2.5	3.5	.3	1500/4	1.5	5
78 Hrs	.200	.198	2.5	2.5	-	-	-	-
84 Hrs	.200	.200	2.5	2.5	-	-	-	-

LEGEND

θ	Dominant direction from which waves approach station
f_2	Minimum frequency present
f_6	Maximum frequency present
E_2	Energy associated with minimum frequency
E_6	Energy associated with maximum frequency
%E	$(E_2 - E_6)$ 30%
H_s	Significant wave height
T_s	Significant wave period

iated with the significant wave height.

Frequencies are given in monthly percent terms and are rounded to the nearest tenth of one percent. For example in Table 1.1 (Swell) consider a wave from the northwest with a height of 5 to 6.9 feet and a period of 8 to 10 seconds.* The frequency figure is 2.2. This means that during January (1956, 1957, 1958) at Station 1, a wave with the given specifications occurred 2.2 percent of the time or 16.4 hours, on the average. The total percent of Swell for a given month will not necessarily equal 100. The reason for this, as discussed earlier, is that the number of Swell trains arriving simultaneously at a station is variable; hence, the total number of Swell hours in a month may be greater than or less than the number of hours in the month. For convenience, the average total hours (averaged over the three years) of Swell for each month is printed at the upper left of each table.

In the case of Sea, on the other hand, the total percent will equal 100 when the category of <u>calm</u> is included. All directions were used which show an onshore wave or a wave parallel to the coast line. For Stations 1 through 4, offshore waves are grouped into <u>a separate category.</u> For Stations 5, 6, and 7, due to

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* In the period intervals of the tables, the top figure (lowest period) is inclusive.

the orientation of the coast line and the presence of offshore islands, two more directions are added: Northeast covers the sector between 011° and 090° and southeast covers the sector between 090° and 146°.

B. ANNUAL AVERAGE TABLES 1.13, 2.13, 3.13, 4.13, 5.13, 6.13, and 7.13.

The average annual wave height-direction-period frequency distributions for each station are given in Tables 1.13, 2.13, 3.13, 4.13, 5.13, 6.13, and 7.13. The data therein are to be interpreted identically with those in the Monthly Average Sea and Swell tables.

C. ANNUAL AVERAGE WAVE ROSES

The annual average wave roses are presented in combined rose and histogram form. The rose, which is in the center of each diagram, shows a frequency distribution of wave direction. The histograms surrounding the rose give a frequency distribution of wave height for each direction. Two such diagrams are presented for each station, one for Sea and one for Swell. Frequencies are given as percent of total time based on 365-1/3 days in a year.

VI. REMARKS

Because of east-west orientation of the coast line adjacent to Santa Barbara, it was necessary that Station

6 be treated somewhat differently than were the other stations. This requirement is brought about by the fact that Swell arriving at Station 6 from the prevailing west-northwest direction would have to be interpreted as having no effect upon the Santa Barbara - Upper Ventura Coast. This of course, is not true, since there is always a west or west-southwest component of Swell present in the Santa Barbara Channel except in cases of strong southeasterly winds. To take this fact into consideration two things were done: (1) The "West" direction category was extended to include 290°; (2) For west-northwest Swell arriving at angles greater than 290°, a westerly component was computed and included in the statistics. The significant height of this component Swell train was based on forecast experience (in the Santa Barbara area). The only inconsistency arising from such a method is the fact that a portion of the coast line south of Santa Barbara would receive the effect of both the west-northwest and the west Swell. However, the energy of the latter is small as compared to that of the former, and the resultant additional energy is of very little significance.

A second matter worthy of mention is the fairly high incidence of short period, southeast wave action at Station 6 and short period, northeast wave action at Station 7 during the months of November and December. This wave activity is the direct result of Santa Ana winds blowing over Southern California. Resultant waves are northeasterly at Station 7 but, because of angular dispersion in the wind and wave fields, are southeasterly at Station 6. Of course some of the southeast wave condition at Station 6 in November and December also is due to winter conditions, but this is of a somewhat larger period. (This action also extends through the spring whereas the Santa Ana does not.)

VII. REFERENCES

1. Arthur, R. S., "Variability in Direction of Wave Travel, Annals, New York Academy of Sc.Vol. 51, 1949.

2. Bretschneider, C. L., "Revised Wave Forecasting Curves and Procedures", Tech. Report No. 155-47, Inst. of Eng. Research, Univ. of Calif. Berkeley, Sept., 1951.

3. Forrest, D. R., "A Method of Estimating Wave Direction", Bulletin of the Beach Erosion Board, Vol. 4, No. 2.

4. Longuet-Higgins, M. S., "On the Statistical Distribution of the Heights of Sea Waves", Jour. of Marine Research, Vol. X, Dec., 1952

5. Mason, M. A., "Surface Water Wave Theories", Trans. AM. Soc.Civil Eng, Vol. 118, 1953.

6. National Marine Consultants, Wave Statistics and Wave Forecasting Files.

7. Neumann,G., "Notes on the Generation and Growth of Ocean Waves Under Wind Action", Proc. Third Conf. on Coastal Eng., Council on Wave Research, The Eng. Found., Berkeley, California, 1952.

8. Pierson, W. J., Jr., "A Unified Mathematical Theory for the Analysis, Propagation, and Refraction of Storm Generated Ocean Surface Waves, Part I and II", Research Div., College of Eng., New York University, 1952.

9. Todd, D. K., Wiegel, R. L., "Near-Coastal Storms and Associated Waves", Trans. Ameri. Geo. Union, Vol. 33, No. 2, April 1952.

10. Pierson, W. R., Neumann, G., and James, R., "Practical Methods for Observing and Forecasting Ocean Waves by Means of Wave Spectra and Statistics", Research Div., College of Eng., New York Univ., 1953.

TABLE 1.1 AVERAGEMonthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1083

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9	.5	.3	.5					1.1							1.3	1.8	4.8	.3				2.4	.5	1.1	.8	.8	.8		4.0	.5	.5		.3			1.3		.3					1.1	2.2	.8		.3			.3	1.0													29.6
3-4.9		.5	.5	.3				2.7		.5					2.4	2.7	1.8	.3				7.0	6.5	1.3	1.6	1.8	.5		4.6	3.2	1.1	.5	.3			2.4	1.8	.5	.5	.5			.5	1.1	.3	1.1				.5	1.1						.3							50.7
5-6.9		.3						.8	2.2	.8		.3	.3		1.6	1.1	1.3					1.1	5.1	3.2	1.6	1.6	.5		.8	2.4	1.8	1.1	.3	.3			1.3	1.1						.3	.8						.5													32.5
7-8.9									.8	.5	1.1	.3			.3	.8	1.1					.3	1.6	2.7	1.1	.8				1.6	.8	.3	.3				.3	.5	.3													.3												15.8
9-10.9									.5	.3							.3						1.1	.3	1.1	.3	.3			.8	.5	.3	.3																															6.1
11-12.9																	.5							.8	.8							.8																																2.9
13-14.9									.3	.3														.3	.8	.3					.5	.3																																2.8
15-16.9																								.3	.5	1.1																																						1.9
17-18.9										.3														.3	.3							.3		.3																														1.5
19-20.9																										.3																																						.3
21-22.9																										.3																																						.3
23-24.9																																.8	.3																															1.1
25-26.9																																																																
27 +																																																																
Σ	0.5	1.1	1.0	0.3				4.6	3.8	2.7	1.1	0.6	0.3		5.6	6.4	9.8	0.6				10.8	14.8	10.3	8.6	7.3	2.1		9.4	8.5	5.2	4.4	1.8	0.6		3.7	3.4	2.4	0.8	0.5			1.6	3.6	1.9	1.1	0.3			0.8	2.6	0.3					0.3							145.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	2.2					1.8					1.3	.3									.8	.3									1.3	.5				.8	.3				1.6	.3				.3							12.3
3-4.9		2.2					1.8					1.3					.3					1.6					1.6	.3				2.4	.5				1.8					2.2	1.3				.5						18.1
5-6.9		.3	.5					.5				.3					.3					.8						.3				.8					.5	.3				1.8	.3										6.7
7-8.9			.5					.5					.3										1.3					1.3				.3	2.9					2.2				.8	5.9					1.1					17.1
9-10.9			.3											.3														.5										.3					3.2										4.6
11-12.9													.3	.5														.3					.5					.3					1.3	.8				.3					4.3
13-14.9																							.5										.5	.5				.3	.3				1.6	2.7				.8	.3				7.5
15-16.9																																						.3					.3	.8									1.4
17-18.9																									.3										.8				.3					.8	.3								2.5
19 +																																								1.3			.3		.8								2.4
																																																			2.2	23.1	25.3
Σ	2.2	2.5	1.3			1.8	1.8	1.0			1.3	1.9	0.6	0.8			0.6				0.8	2.7	1.8		0.3		1.6	2.7			1.3	4.0	4.4	0.5	0.8	0.8	2.6	3.7	0.6	1.3	1.6	5.1	14.7	5.1	1.1	0.3	0.8	2.2	0.3		2.2	23.1	100.0

1 Based on 31 days

2 Includes waves of 0 to 0.9 feet

TABLE 1.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 672

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9	.3		4.6					1.1	2.0	3.7					1.7	.6			.6			3.7	2.8	.9	.9		.9				.3			.3		.3	.6	2.8	1.1	.3			.3		.9	.3																		31.0
3-4.9	.9	1.4	.6					2.8							2.8	2.6							3.7	5.2	1.7	1.7	2.6	.3		.6	.9	.9		.6	.3		.9	.3							.6	.3								.6													32.3
5-6.9	.3							.6	1.1	.3							2.6		.6	.6			2.0	4.0	3.7	2.0	.9			.3	1.7	.6	1.4	.9			.6	.6								.3	.6	.3						.3													26.3
7-8.9		1.1		.3					1.1	.9		.3					1.7					.3	1.7	1.7	.9	.3				1.1	1.4		.3				.6				.3																						14.0
9-10.9		1.1	.3							.6	.3	.3					.3	1.7	.3	.3				.9	.6	.3						.3	.3						.3	1.4																								9.3
11-12.9											1.4							.3	.6							.6									.3						.3	.6																								4.1
13-14.9											.3	.3															.3														.6	.6		.3																							2.4
15-16.9										.3	.3	.6	.3						.3								1.4															.3		.3																								3.8
17-18.9										.3	.3	.6																.6																	.3																								2.1
19-20.9																																																																	
21-22.9																																																																	
23-24.9																																																																	
25-26.9																																																																	
27 +																																																																	
Σ	1.5	3.6	5.5	0.3				4.5	5.4	7.5	1.8	0.6			4.5	6.1	4.0	1.5	1.5			9.7	14.6	10.6	6.7	3.8	1.2		0.9	3.7	3.5	2.0	1.8	0.6		1.8	2.4	5.4	2.6	0.6	0.6		0.9	0.6	1.5	0.6						0.9													125.3

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	1.7	.3				1.4					2.3					.3					.6										1.4										4.9	.3				1.1							16.3
3-4.9	.6	2.0					2.0				.6	3.4	.3			.3	.3				.6	3.1					.6	.3			.3	3.1				.6	1.1				.3	2.0	.3				.6						22.4
5-6.9		.6					.6																					.3				.3					1.1					1.4	.3										4.6
7-8.9		.3	.3					.6					.6											.6					.6					1.4	.6			.3	2.3				.3	2.8	.6				.3						11.6
9-10.9			.3											.3						.3																	.9				.8	.3				1.1					.6						4.6
11-12.9			.3																								.3											.3	.3				.3	1.1						.9				3.5
13-14.9			.3												.3																							.3	.6				.6	1.4						.6				4.1
15-16.9																																											.3	.8										1.1
17-18.9																																						.6					2.8	.3				.3				4.0
19 +																																						.3					.6	.3				.3				1.5
																																																			.3	28.0	28.3
Σ.	2.3	3.2	1.2			1.4	2.6	0.6			2.9	3.4	1.2	0.3		0.6	0.3		0.3		1.2	3.1	0.6					0.6	1.5			1.7	3.4	1.4	1.5		0.6	2.5	3.7	2.1		5.2	4.0	5.7	7.3	0.6	1.1	0.6	0.9	2.1		0.3	28.0	100.0

[1] Based on 28-1/3 days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 986

DIR.	NNW							NW							WNW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9		.3						1.6	3.5	.3	.5				1.8	1.6	.5		.8		
3-4.9								1.6	3.5	.8	.3	.3			4.6	2.7	.5	.5	.5	.5	
5-6.9									1.3	.5	.5				1.3	3.5	2.2	1.3	.5	.3	
7-8.9										1.1						1.8	.8	.3	.3		
9-10.9																.5	1.1	.3	.3	.5	
11-12.9																	.5	.8	.8	.3	
13-14.9																	.8		.3		
15-16.9																		.5			
17-18.9																		.3			
19-20.9																		1.6	.3	.3	
21-22.9																		.3			
23-24.9																					
25-26.9																					
27 +																					
Σ		0.3						3.2	8.3	2.7	1.3	0.3			7.7	10.1	6.4	5.9	3.8	1.9	

DIR.	W							WSW							SW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	1.3	3.8	4.3	1.3	1.3			1.3	1.6	2.2	1.3	1.1	.3		.5	4.6	2.2	.3			
3-4.9	4.6	2.9	3.5	4.0	.5	.5		1.3	1.3	1.8	.3	.3			1.8	1.3	.5				
5-6.9	.5	4.3	1.6	1.3				.5	.9	1.3						1.3	.8				
7-8.9		1.3	2.7	.3		.3										.3	.5		.3		
9-10.9		.8	1.1	1.1																	
11-12.9		.3	.3	.3																	
13-14.9			.5		.3																
15-16.9			.5	.3																	
17-18.9			.3		.3																
19-20.9				.5	.5	.3															
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	6.4	13.4	14.8	9.1	2.9	1.1		3.1	3.8	5.3	1.6	1.4	0.3		2.3	7.5	4.0	0.3	0.3		

DIR.	SSW							S							SSE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9								.8			.3											39.4
3-4.9								.8	.3	.3												41.8
5-6.9		.3						.3														24.5
7-8.9																						10.0
9-10.9																						5.7
11-12.9																						3.3
13-14.9																						1.9
15-16.9																						1.3
17-18.9																						0.9
19-20.9																						3.5
21-22.9																						0.3
23-24.9																						
25-26.9																						
27 +																						
Σ		0.3						1.9	0.3	0.3	0.3											132.6

SEA

DIR.	N					NNW					NW					WNW					W				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9	2.2	.3				1.1					.8	.8					.3				1.8	.5			
3-4.9	.3	4.0	.3				2.7	.3				4.3	.3			.3		.3			.3	2.4	.3		
5-6.9		1.3					1.1					1.8					.8					1.1			
7-8.9			1.3					1.3					.8												
9-10.9			.3																				.3		
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ	2.5	5.6	1.9			1.1	3.8	1.6			0.8	6.9	1.1			0.3	1.1	0.3			2.1	4.0	0.6		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	1.1					2.2					1.1					3.5					.3	.3						16.3
3-4.9		1.8				.3	4.6	.8				2.2	.3			1.1	3.8	.5										31.2
5-6.9		.3					1.1					.3					2.4						.3					10.5
7-8.9		.3	.8					2.4					.8				.3	4.3										12.3
9-10.9			1.1															1.6					.5					3.8
11-12.9														.5				.3	.5									1.3
13-14.9								.3	.3				.3	.3					.5									1.7
15-16.9														.3					.3									0.6
17-18.9																												0.0
19 +														.8														0.8
																										.6	20.9	21.5
Σ	1.1	2.4	1.9			2.5	5.7	3.5	0.3		1.1	2.5	1.4	1.9		4.6	6.5	6.7	1.3		0.3	0.3	0.8			0.6	20.9	100.0

1 Based on 31 days

2 Includes waves of 0 to 0.9 feet

TABLE 1.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 770

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		4.2						1.7	3.9	7.8					3.6	3.9	4.7	.8	.3			6.1	7.8	3.1	.6	.3	.3			2.2	.6	.6	.3			.8		2.5												.3	.8													57.2
3-4.9									.3	.5	1.1				2.2	4.4	3.1	1.4	.8			.3	5.0	3.3	2.2	.8	.6	.3								.3														.3	.3													27.2
5-6.9															.6	2.9	3.3	1.9					1.9	.6	.6	.3																								.3		.3												11.7
7-8.9																.3	.8	1.4					.6	.3			.3										.3													.3	.6													4.9
9-10.9																.8							.3															.3																										1.4
11-12.9																							.3	.8		.3																																						1.4
13-14.9																								.3	.3																																							0.6
15-16.9																								.8	.3																																							1.1
17-18.9																									.8																																							0.8
19-20.9																											.3																																					0.3
21-22.9																									.3																																							0.3
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		4.2						1.7	4.2	8.3	1.1				6.4	11.3	11.9	5.5	1.1			6.4	15.9	9.2	5.1	1.7	1.5	0.3		2.2	0.6	0.6	0.3			1.1	0.3	2.8												1.2	1.7	0.3												106.9

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	4.5	1.1				3.6	.8				5.8	.6				.3					1.1						.3				1.7	.3				.3					3.1					.3							23.8
3-4.9	.8	7.2	.6			.6	6.1	.3			.3	5.0	.3			.3	.3					.8					.3					.5	.3				.8				.8	1.4					.3						27.0
5-6.9		1.4					3.1	.3				1.7					.3															.5	.3									.6					.8	.3					9.3
7-8.9			2.2					2.2					.5															.5					1.4										.6										7.4
9-10.9			.6										.5																				.3					.3					.6										2.3
11-12.9																																																					
13-14.9																																						.3															0.3
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																				29.9	29.9
Σ	5.3	9.7	3.4			4.2	10.0	2.8			6.1	7.3	1.3			0.6	0.6				1.1	0.8					0.6	0.5			1.7	1.3	2.3			0.3	0.8	0.6			3.9	2.0	1.2			0.3	1.1	0.3				29.9	100.0

[1] Based on

[2] Includes waves of 0 to 0.9 feet

TABLE 1.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 784

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9		.8						1.6	2.9	8.1		.3			1.6	9.4	3.2	2.4	.3	.3		2.9	4.0	6.7	1.6	.3	.3			1.3	1.3	.5	.3				1.3	2.9					.8	1.6	1.6					.5	1.8	1.8												62.4
3-4.9								.3	1.6	.5	.5	.5				4.6	4.8	.8	.8	.5		2.4	5.6	2.9	1.1	1.1												.8						.5	.5					.3														30.1
5-6.9									.3	.5	.5	.3					.5	.5	.3				2.2	1.1		.5	.3																																					7.0
7-8.9																								.8	.5	.5	.3																							.3														2.4
9-10.9																								.5	.3	.5																									.3	1.1												2.7
11-12.9																								.3	.5																																							0.8
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		0.8						1.9	4.8	9.1	1.0	1.1			1.6	14.0	8.5	3.7	1.4	0.8		5.3	11.8	12.3	4.0	2.9	0.9			1.3	1.3	0.5	0.3				1.3	3.7					0.8	2.1	2.1					1.1	2.1	2.9												105.4

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	5.4	.8				2.7	.5				4.0	1.3				.3					1.1					.5					2.7	.3				.5					5.6	.3				.8	.5						27.3
3-4.9	.3	3.2	.3				3.2	.3			.5	2.7	.8				.5					.8					.8					1.3									.5	2.4					1.1						18.7
5-6.9	.3	4.3	1.6				2.7					1.3	.3																			.5										.8					.3						12.1
7-8.9		.8	1.3				.5	3.2				.3	2.7																				.3					.5					.3										9.9
9-10.9			1.1					1.1					.3																														.3										2.8
11-12.9																																																					
13-14.9																																																					
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																			.3	28.9	29.2
Σ	6.0	9.1	4.3			2.7	6.9	4.6			4.5	5.6	4.1			0.3	0.5				1.1	0.8				0.5	0.8				2.7	2.1	0.3			0.5		0.5			6.1	3.5	0.6			0.8	1.9				0.3	28.9	100.0

1 Based on 31 days

2 Includes waves of 0 to 0.9 feet

TABLE 1.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 743

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		.3						1.9	12.8	15.0	.6				4.7	4.7	5.3	1.7	1.7	1.7		1.4	3.9	3.3	1.4	.8			.3	1.1	.8					1.4	1.1																											65.9
3-4.9		.6						.6	4.2	2.5					2.8	6.4	6.4	3.1	1.4				1.1	1.7						.6	.3						.6																											32.3
5-6.9																1.9	.8	.8	.3																																													3.8
7-8.9																	.6	.6																																														1.2
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		0.9						2.5	17.0	17.5	0.6				7.5	13.0	13.1	6.2	3.4	1.7		1.4	5.0	5.0	1.4	0.8			0.3	1.7	1.1					1.4	1.7																											103.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM^2	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	2.8	1.9				2.5	1.7				7.2	1.1				.3					1.4					.3					1.7										2.2												23.1
3-4.9	1.7	5.3	.6			.8	4.4	.3			1.1	7.2					.6				.3	1.1					.3					.3									.8	.8				.3							25.9
5-6.9		1.7	1.4				4.7					1.7					1.1					.3					.6					2.2					.3																14.0
7-8.9			1.6				.3	4.4					.6					.3																																			9.2
9-10.9			1.1					1.4					.6																																								3.1
11-12.9				.6					.6																																												1.2
13-14.9																																																					
15-16.9				.3					.3																																												0.6
17-18.9																																																					
19 +																																																					
																																																			.6	22.3	22.9
Σ	4.5	8.9	4.7	0.9		3.3	11.1	6.1	0.9		8.3	10.0	1.2			0.3	1.7	0.3			1.7	1.4				0.3	0.9				1.7	2.5					0.3				3.0	0.8				0.3					0.6	22.3	100.0

1 Based on 30 days

2 Includes waves of 0 to 0.9 feet

TABLE 1.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 560

DIR.	NNW							NW							WNW							W							WSW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9								3.2	15.9	9.4	.5	.3			3.5	4.8	6.2	1.3	.3			2.2	1.8	2.9		.5			1.1	4.3	1.1	.3			
3-4.9								.3	1.1	.5		.3			.5	2.4	1.3	1.8				.5	2.2	1.3	.3					3.5		.5			
5-6.9										.3						.3	.3							.8											
7-8.9																																			
9-10.9																																			
11-12.9																																			
13-14.9																																			
15-16.9																																			
17-18.9																																			
19-20.9																																			
21-22.9																																			
23-24.9																																			
25-26.9																																			
27 +																																			
Σ								3.5	17.0	10.2	0.5	0.6			4.0	7.5	7.8	3.1	0.3			2.7	4.0	5.0	0.3	0.5			1.1	7.8	1.1	0.8			

DIR.	SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																													59.6
3-4.9																													16.5
5-6.9																													1.7
7-8.9																													
9-10.9																													
11-12.9																													
13-14.9																													
15-16.9																													
17-18.9																													
19-20.9																													
21-22.9																													
23-24.9																													
25-26.9																													
27 +																													
Σ																													77.8

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	14.3					6.7					1.4	.5				.3					.5				
3-4.9		8.9	.3			.3	7.8					5.6					.3								
5-6.9		2.4	1.3				3.5	1.1				.8	1.1	.3											
7-8.9			2.7	.3				2.7					2.7	.3											
9-10.9			.3	.5				1.8	.3				.3	.3											
11-12.9														.3											
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ	14.3	11.3	4.6	0.8		7.0	11.3	5.6	0.3		1.4	6.9	4.1	1.2		0.3	0.3				0.5				

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.3					.8										1.1	.3											26.2
3-4.9							.3					.5					.3											24.3
5-6.9							.3																					10.8
7-8.9																												8.7
9-10.9																												3.5
11-12.9																												0.3
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																										1.4	24.8	26.2
Σ	0.3					0.8	0.6					0.5				1.1	0.6									1.4	24.8	100.0

[1] Based on 31 days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 636

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	
1-2.9		.3						1.1	5.4	29.3	.5	.3			2.7	5.6	5.4	1.1	1.3			.8	.8	5.6		.3			.5		.3																																	61.3
3-4.9		1.1							1.3	1.6	.8				.3	4.8	4.0	1.6				.5	.8	.5	.8				.3	.5	.5																																	19.4
5-6.9										.5						1.3	1.3	.5				.3	.3																																									4.2
7-8.9																	.3								.3																																							0.6
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		1.4						1.1	6.7	31.4	1.3	0.3			3.0	11.7	11.0	3.2	1.3			1.6	1.9	6.1	1.1	0.3			0.8	0.5	0.8																																	85.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s / H_s	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12	4-6	6-8	8-10	10-12	12+			
1-2.9	3.3	.5				4.0					5.6					.8					1.8										1.3										.5												22.8
3-4.9	1.1	8.1	.5			1.6	7.8				1.3	6.5	.3				.3					.5										.3															.3						28.8
5-6.9		1.8	.8				1.6	.5				.5	1.6																																								6.8
7-8.9		.5	4.3				.3	3.8					2.2	.3																																							11.4
9-10.9			.5	.3				.5	.5				.3																																								2.1
11-12.9									.3																																												0.3
13-14.9																																																					
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																				27.8	27.8
Σ	4.4	10.9	6.1	0.3		5.6	9.7	4.8	0.8		6.9	7.0	4.4	0.3		0.8	0.3				1.8	0.5									1.3	0.3									0.5						0.3					27.8	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 1.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 September (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 727

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_S	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_S	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		.8	1.4					2.5	5.8	2.8	.3				.6	8.9	10.0	1.4		.3	.3	.6	3.1	1.4					.3									3.1							4.2							1.4												52.2
3-4.9		.5						2.8	2.8	.3	1.1	.6			1.7	6.1	1.9	1.1	.3	.3		.3	2.8	.6	.8	.3			.3	.3	.3																																	25.2
5-6.9									1.7	1.9	.6					2.2	2.5	1.7	.8	.8			.8			.3				.3	.6																																	14.2
7-8.9		.5								.6	.3					.8	1.4	2.5		.6					.3	.3																																						7.3
9-10.9																	.3	.6	.3				.3																																									1.5
11-12.9																																																																
13-14.9																								.3		.3																																						0.6
15-16.9																																																																
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		1.8	1.4					5.3	10.3	5.6	2.3	0.6			2.3	18.0	16.1	7.3	1.4	2.0	0.3	0.9	7.0	2.3	1.1	1.2			0.6	0.6	0.9							3.1							4.2							1.4												101.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_S	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_S	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	4.4	.3				3.9					3.3										.6					.3					3.6										4.2												20.6
3-4.9	1.4	4.4				1.7	3.3				1.1	.8									.6						.6				.6	.6	.3			.6	.3				1.7	1.9											19.9
5-6.9		1.4	.5				2.5					.3																				.3										.6											5.6
7-8.9			3.3					1.9																									.6					.3					1.1										7.2
9-10.9			2.2	1.1				1.4	.3																													.3					.3										5.6
11-12.9				.6					.6																																												1.2
13-14.9																																																					
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																				39.9	39.9
Σ	5.8	6.1	6.0	1.7		5.6	5.8	3.3	0.9		4.4	1.1									1.2					0.3	0.6				4.2	0.9	0.9			0.6	0.3	0.6			5.9	2.5	1.4									39.9	100.0

[1] Based on 30 days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 September (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 727

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		.8	1.4					2.5	5.8	2.8	.3				.6	8.9	10.0	1.4		.3	.3	.6	3.1	1.4					.3									3.1							4.2							1.4												52.2
3-4.9		.5						2.8	2.8	.3	1.1	.6			1.7	6.1	1.9	1.1	.3	.3		.3	2.8	.6	.8	.3			.3	.3	.3																																	25.2
5-6.9									1.7	1.9	.6					2.2	2.5	1.7	.8	.8			.8			.3				.3	.6																																	14.2
7-8.9		.5								.6	.3					.8	1.4	2.5		.6					.3	.3																																						7.3
9-10.9																	.3	.6	.3				.3																																									1.5
11-12.9																																																																
13-14.9																								.3		.3																																						0.6
15-16.9																																																																
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		1.8	1.4					5.3	10.3	5.6	2.3	0.6			2.3	18.0	16.1	7.3	1.4	2.0	0.3	0.9	7.0	2.3	1.1	1.2			0.6	0.6	0.9							3.1							4.2							1.4												101.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	4.4	.3				3.9					3.3										.6					.3					3.6										4.2												20.6
3-4.9	1.4	4.4				1.7	3.3				1.1	.8									.6						.6				.6	.6	.3			.6	.3				1.7	1.9											19.9
5-6.9		1.4	.5				2.5					.3																				.3										.6											5.6
7-8.9			3.3					1.9																									.6					.3					1.1										7.2
9-10.9			2.2	1.1				1.4	.3																													.3					.3										5.6
11-12.9				.6					.6																																												1.2
13-14.9																																																					
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																				39.9	39.9
Σ	5.8	6.1	6.0	1.7		5.6	5.8	3.3	0.9		4.4	1.1									1.2					0.3	0.6				4.2	0.9	0.9			0.6	0.3	0.6			5.9	2.5	1.4									39.9	100.0

1 Based on 30 days

2 Includes waves of 0 to 0.9 feet

TABLE 1.10 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 901

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.5			.3				1.3	6.7	3.5	3.2	.5			2.4	7.8	2.9	.3	1.1			1.6	6.5	1.6					.5	1.6	.3					.3	1.8	.3													1.6	.5											47.1
3-4.9	2.1	1.1	.3	.3				3.5	4.0	4.0	1.1	.8			4.0	5.9	2.4	1.6	1.1	.5		2.7	4.3	2.4	.3		.3		.5	.3	1.1					.5	.3													.3	.3											45.0
5-6.9		.3	.5				1.3	.8	1.3					.3	1.8	2.7	1.8		.5			1.1	.3	.8	.5	.3		.3		.8					.3		.3																											16.0
7-8.9									.8						.3	.5	.8		.3	.3	.3		.5	1.1	.5	.3				.8						.3	.3																												7.1
9-10.9									.3	1.1							.5	.5							1.1																																									3.5
11-12.9											.3	.3	.3				.3	.5	.5	.5	.3						.5	.3																																			3.8
13-14.9																		.5	.5	.5						.3	.3																																					2.1
15-16.9																					.3																																												0.3
17-18.9																											.3																																				0.3
19-20.9																																																															
21-22.9																																																															
23-24.9																																																															
25-26.9																																																															
27 +																																																															
Σ	2.6	1.4	0.8	0.6				6.1	12.6	10.2	4.6	1.6			7.0	16.8	10.3	4.7	3.8	1.6	0.3	4.3	12.4	6.8	2.7	1.1	0.6		1.3	2.7	2.2					1.4	2.4	0.6													1.9	0.8											125.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	5.4	.8				2.2	.3				2.7					.3					.8										2.7	.3									3.2	1.6				.3							20.6
3-4.9	.5	6.5	.5			1.1	2.4				.8	2.9	.3				1.1	.3			.3	1.3				.3	.8				.3	2.7						1.1				.5	4.8	1.1										29.6
5-6.9		1.3	.5				.5					1.6					.3	.3				.3					.3					.3					.3					2.7											8.4
7-8.9		.3	1.1					.8					1.3	.3				.3	.3				.5					.5					1.1					.3					1.6	.3										8.7
9-10.9			.5					.3							.3				.3						.3				.3					.8	.5											.3											3.6
11-12.9														.5					.3																								.8		.5										2.1
13-14.9																																																				
15-16.9																																																				
17-18.9																																																				
19 +																																																				
																																																			.5	26.5	27.0
Σ	5.9	8.9	2.6			3.3	3.2	1.1			3.5	4.5	1.6	1.1		0.3	1.4	1.2	0.6		1.1	1.6	0.5	0.3		0.3	1.1	0.8			3.0	3.3	1.9	0.5			2.4	0.3			3.7	9.1	3.5	0.6	0.5	0.3					0.5	26.5	100.0

[1] Based on 31 days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1002

DIR.	NNW							NW							WNW							W						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	.3		.3						6.1	1.1		.3			1.4	4.4	.3	.8	2.2		.3	2.8	6.1	10.0	1.9	1.4	2.5	
3-4.9	.3	.6		.3				.8	3.1	.8	.6	.3	.6		1.9	10.6	3.1	1.7	.6	.3		4.4	3.9	3.6	.6	.3		
5-6.9		1.1	.6	.3					1.1	.6	.3	.3			.3	4.2	5.6	1.7	.8			1.1	1.4	.8				
7-8.9			.3						.3	1.1	.3		.3			2.5	1.4	1.4		.3			.8	.6	.3		.3	
9-10.9										.3		.3					1.1	.6	.6	.3		.3	.3	.8				
11-12.9			.6							1.1	.3		.3				.3	.6	.3				.3	.3	.3			
13-14.9											.3	.3													.3	.3		
15-16.9										.3							.3							.3				
17-18.9																			.3	.3					.3			
19-20.9																												
21-22.9											.6																	
23-24.9																												
25-26.9																												
27 +																												
Σ	0.6	1.7	1.8	0.6				0.8	10.6	5.3	2.4	1.5	1.2		3.6	21.7	12.1	6.8	4.8	1.2	0.3	8.6	12.8	16.4	3.7	2.0	2.8	

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9	.3	3.6	3.1	.8					3.3	.6													.3													56.2
3-4.9	.3	.8	.8																				.3													40.6
5-6.9		.3	.3	.3																																21.1
7-8.9			.8																																	10.7
9-10.9																																				4.6
11-12.9																																				4.4
13-14.9																																				1.2
15-16.9																																				0.9
17-18.9																																				0.9
19-20.9																																				
21-22.9																																				0.6
23-24.9																																				
25-26.9																																				
27 +																																				
Σ	0.6	4.7	5.0	1.1					3.3	0.6													0.6													139.2

SEA

DIR.	N					NNW					NW					WNW				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9	1.4					1.4					1.1									
3-4.9	.3	4.2	.3			.8	2.2					1.7					.3			
5-6.9		.8					.6					.6								
7-8.9			1.1					.8					.3							
9-10.9									.3											
11-12.9				.3										.3						
13-14.9									.3											
15-16.9									.3											
17-18.9																				
19 +																				
Σ	1.7	5.0	1.4	0.3		2.2	2.8	0.8	0.9		1.1	2.3	0.3	0.3			0.3			

DIR.	W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	1.7					.3	.3				2.2	.3				1.1					3.3	.3											13.4
3-4.9	.3	.3				.5	1.1	.3			1.1	1.9	.3			.3	.8				1.1	1.9											19.7
5-6.9		.5					.3					.3					.8					2.2											6.1
7-8.9																		.5					2.5										5.2
9-10.9																		.3					1.4										2.0
11-12.9																																	0.6
13-14.9																																	0.3
15-16.9																																	0.3
17-18.9																																	
19 +																																	
																															.6	51.8	52.4
Σ	2.0	0.8				0.8	1.7	0.3			3.3	2.5	0.3			1.4	1.6	0.8			4.4	4.4	3.9								0.6	51.8	100.0

[1] Based on 30 days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.12 AVERAGEMonthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1028

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9								2.2	2.7	1.1	1.3	.3			.5	2.4		.3	.8		.3	2.4	4.8	1.8	.8	.3	.3		.8	1.1	.5	.8	.8	.3		1.1		.3																										28.0
3-4.9								5.1	4.8	2.2	.3	.3			3.2	5.2	2.4	1.3	1.6	.5		2.7	6.7	2.4	1.8	.8	1.1	.5		2.4	1.1	.5	.3			.3	.5	.3													.3													48.5
5-6.9								.8	3.5	.5	.3	.3	.3		.8	2.7	2.9	2.7	.8			1.1	4.8	1.8	1.1	2.2	.8			.5			.3																															28.2
7-8.9									1.1	1.8	.8	.3	.3			1.6	1.8	1.1	.3				2.2	3.5	2.9	.8				.3	.3		.3																															19.4
9-10.9										.8	.3	.8				.8	1.6	.8	.3					1.3	.3							.3																																7.3
11-12.9											1.3					.3	.8		.3				.3	.3		.3					.5																																	4.1
13-14.9																	.5	.3						.5																																								1.3
15-16.9																		.5							.3																																							0.8
17-18.9																		.3								.3																																						0.6
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ								8.1	12.1	6.4	4.3	2.0	0.6		4.5	12.9	10.0	7.3	4.1	0.5	0.3	6.2	18.8	11.6	7.2	4.7	2.2	0.5	.8	4.3	2.4	1.6	1.7	0.3		1.4	0.5	0.6													0.3													138.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.6	.5				1.1	.3				.8					.5					2.2					.3					3.8					1.1					4.0					.3							16.5
3-4.9		1.6	.3				1.6				.5	1.1				.3	.3				.5	4.0				.3	.8	.3			1.3	4.8	.3			.5	.8				2.7	4.8											26.8
5-6.9				.8								.3										.8					.8					.3										3.5											6.5
7-8.9								.3									.3						1.8					1.8					1.3					.5					2.7										8.7
9-10.9																							.8										1.1					.5					1.1					.3					3.8
11-12.9																								.3					.5				.3	.3																			1.4
13-14.9																								.3															.3					.5									1.1
15-16.9																																						.3						.5									0.9
17-18.9																																																					
19 +																																							.3														0.3
																																																				34.1	34.1
Σ	1.5	2.1	0.3	0.8		1.1	1.9	0.3			1.3	1.4				0.8	0.6				2.7	4.8	2.6	0.6		0.6	1.6	2.1	0.5		5.1	5.1	3.0	0.3		1.6	0.8	1.3	0.6		6.7	8.3	3.8	1.0		0.3		0.3				34.1	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 1.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 1 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 10,[illegible]94.64

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9	13	58	81	.05				161	564	684	57	.21			215	466	361	.87	.78	18	.07	235	382	356	77	50	.42		76	1.42	.92	36	.21	.07		.48	1.06	1.25	.12	.02			18	.32	62	02	02			.09	.52	.30		.02										48.92
3-4.9	.19	48	.12	.08				171	222	118	48	26	.05		220	485	264	.127	59	.20		242	392	210	127	68	27	07	.66	1.15	.66	.15	.12	.02		.52	.40	.18	.04	04			.09	16	.07	09				.09	.31	.05	.02				.02							34.09
5-6.9	.02	14	09	.05				30	1.00	60	.18	10	.05		41	200	195	113	34	13		.51	216	116	62	53	16		16	51	45	25	.12	02		07	.27	18						07	12	.02				02	09	.02												15.96
7-8.9		13	05	.05					.34	50	21	.07	.05		.05	70	.89	.61	.08	10	.02	.05	79	1.12	59	25	10			.32	.28	.02	.07			.02	.15	08	02	02	02									05	.05	.02												7.83
9-10.9		09	.05						.12	23	.05	.09				20	.55	22	.15	.07		02	31	48	.26	.07	02			07	07	07	02				.02	.14													.02	09												3.46
11-12.9			05							20	.16	02	.02			05	24	21	.16	05			10	28	.20	.07					04	.09						02	05																									2.01
13-14.9									.03	.05	.05	.02					.15	07	07					.18	17	.05					.04	.02						05	05		.02																							1.04
15-16.9									.03		.05	.02					05	08	.02					27	12	.09												.02		02																								.77
17-18.9									03	.05	.05							.05	.02	02				.05	.17	.05						.02		.02					02																									.55
19-20.9																		13	.02	02					04	.07	02																																					.30
21-22.9											05							.02							.02	02																																						.11
23-24.9																																.07	02																															.09
25-26.9																																																																	
27 +																																																																	
Σ	34	142	1.13	17				362	941	965	185	.79	.17		481	1246	10.08	466	225	.77	.09	555	1110	9.20	4.25	2.40	.99	07	1.58	3.47	2.46	1.05	.56	13		1.09	1.90	1.92	.30	.10	.04		27	.55	.81	.13	.02			25	99	.48	.02	.02			.02							115.13

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	450	54				270	30				300	38				.26	.02				120	.07				.26	05				2.12	.14				.41	.02				3.10	.26				28	.07						19.68
3-4.9	.60	480	30			60	377	.10			50	354	19			10	36	05			.24	132	.05			.09	73	.12			32	1.90	.21			.17	.78	.02			.79	219	33			.02	26						24.45
5-6.9	.02	140	55	.07			174	.20				91	25	02			.23	02				.32					19	.05				.58	.02				27	.02				133	05				.10	05					8.39
7-8.9		20	181	.02			09	187				.02	1.00	07			02	05	02				35				.02	46				.02	95	05			.02	63				12	1.81	08				.12					9.80
9-10.9			60	16				50	.12				20	07			.05	02	02				.09	05				16					.18	.12				21	02				.80	02				.12					3.51
11-12.9			02	.13					12				.02	3					.02					.02				.05	.04				.07	.02				.05	.07				.22	.20	.05			.02	.07				1.32
13-14.9			02						.02					02									.05	.02									.07	.07				.07	.12				.17	.43				.07	.07				1.20
15-16.9				.02					.05																													.05	.02				.07	.20									41
17-18.9																									.02										.07				.07					.30	.05				.02				53
19 +																																							.12	.11			.02	.05	.09				.02				41
																																																			.50	29.80	30.30
Σ	512	694	330	40		330	590	267	31		350	485	166	.31		36	.68	.14	.06		1.44	1.71	.54	.09	.02	.35	.99	.84	.04		2.44	2.64	1.50	.26	.07	.58	1.09	1.05	.42	.11	3.89	3.90	3.47	1.28	.19	.30	.43	.38	.18		.50	29.80	100.00

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1147

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	1.3	1.1						1.8	1.3	4.8			.3		1.6	3.5	1.1	.8	.3			2.2	2.7	1.6	.8	1.1	.3	.3		2.4	.5	.5				.8	.8	1.8		.3											.3							.5						34.8
3-4.9	1.1	.8						1.3	3.8	1.1		.3	.3		1.8	7.8	4.3	1.1	.3			3.5	10.5	4.3	1.3	.3	.3		1.3	3.8	.5	.5	.5	.3		.8	1.3	.3	.3											.3	.3	.3						.3						55.0
5-6.9	.5	1.1							1.6	.8	.5		.3			4.0	4.6	.8				1.1	6.5	3.2	.8	.3	.5			2.9	2.2	.8	.5				1.3	.8	.5											.3								.5						30.4
7-8.9									.3	1.1		.3				.8	.8	.3					1.1	2.4	1.1	.8				.3	.5	1.3	.3					.3	.3																									12.0
9-10.9									.3							1.1	.5						.5	.5							.8		.5						.3																									4.5
11-12.9									.3								.8						.3	.5		.3					.3	.8																																3.3
13-14.9										.3							.8	.3	.3					.5	.3	.3						.3																																3.1
15-16.9											.3							.8						.3	.5		.3				.5	.3																																3.0
17-18.9										.3	.3																																																					0.6
19-20.9																									.3																																							0.3
21-22.9																									.3	.3																																						0.6
23-24.9																																																																	
25-26.9																										.3	.3																																					0.6
27 +																																																																
Σ	2.9	3.0						3.1	7.6	8.4	1.1	0.6	0.9		3.4	17.2	12.9	4.1	0.9			6.8	21.6	13.3	5.4	3.7	1.7	0.3	1.3	9.4	5.3	4.5	1.8	0.3		1.6	3.4	3.2	1.4	0.3										0.6	0.6	0.3						1.3						154.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.6					1.8					4.3										1.6					.3					1.6										1.3	.3				1.1							13.9
3-4.9		1.6				.3	1.6					2.4	.3			.3	.3					1.3	.3				2.2				.5	3.8					.8	.3			.8	2.9	1.1			.3	1.3	.8					23.2
5-6.9		.3	.5					.3	.5			.5	.3									.5				.3	.5					.8	.3				.3	.3				1.3	.3					.3					7.3
7-8.9			.8						.8				.3				.5	1.1				.3	.8					.8					1.8					.5					4.3					1.6	.3				13.9
9-10.9			.3																									.3				.5		.3				.3					1.3					1.8	.3				5.1
11-12.9													.3															.3					.5					1.1					2.2	1.3				1.8	1.1				8.0
13-14.9														.5																			.5						.5				.3	.5									2.3
15-16.9																																																					
17-18.9																																												.3									0.3
19 +																																								.3					.3								0.6
																																																			.5	24.3	24.8
Σ	1.6	1.9	1.6			2.1	1.6	0.3	1.3		4.3	2.9	1.2	0.5		0.3	0.8	1.1			1.6	2.1	1.1			0.6	2.7	1.4			2.1	5.1	3.1	0.3			1.1	2.5	0.5	0.3	2.1	4.5	9.5	2.1	0.3	1.4	1.3	6.3	1.7		0.5	24.3	100.0

[1] Based on 31 days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 912

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.3		.3	.3				.3	1.1	6.3	.3					3.1	2.6	.3	.6		.6	1.1	4.6	.9		.9	.3				.3			.3		.3	2.3	1.4	1.1	.3			.3		2.0						1.1													33.3
3-4.9	.3	1.7	1.1					.3	3.7	.3						4.6	.3	.3	1.4	1.1		4.0	5.4	2.0	1.4	.9			1.4	.6	.3	.3	.3	.3		.9							.6	.3																				33.8
5-6.9		1.1	.6					.3	2.3	.9	.6					.3	.6		.3			2.0	4.0	4.6	1.4	1.4				2.6	1.7	.9	.6			.9	.3							.6							.3													28.3
7-8.9			.3	.6					.6	3.1	.3					.9	.6	.6	.3				2.0	1.4	1.1					.9	.6	.3					.3	.6	.3																									14.8
9-10.9										1.7	1.7						.3	.3					.9	1.4	.8					1.6				.3			.9																											9.9
11-12.9										.6		.3											.3	.3						.3	.3																																	2.1
13-14.9										.8	.9												.6	.6	.3					.3	.6																																	4.1
15-16.9										.6														.3	.6									.3				.3																										2.1
17-18.9										1.1																						.3	.3						.3																									2.0
19-20.9																																						.3	.3																									0.6
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ	0.6	2.8	2.3	0.9				0.9	7.7	15.4	3.8	0.3				8.9	4.4	1.5	2.6	1.1	0.6	7.1	17.8	11.5	5.6	3.2	0.3		1.4	6.3	3.8	1.8	1.2	1.2		2.1	3.8	2.6	2.0	0.3			0.9	0.9	2.0						1.4													131.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.4					1.7					2.6										.9					.3					2.3										2.8	.3				1.4							13.7
3-4.9	.3	2.6	.3			.3	3.1	.9			.3	2.8	.3								.6	1.4					.3	.3			.3	2.0	.6				1.1	.3				2.3					.6	.3					21.0
5-6.9												.3						.3									.6	.3				.3					.3					.3					.3						2.7
7-8.9			1.7					1.4					.6					.3					.3					.6					.9	.6			.3	3.1				.3	3.1					.6	.3				14.1
9-10.9			.6					.9					.6																									1.4					1.4	.3				.3					5.5
11-12.9																																		.6									2.8	.3					1.1				4.8
13-14.9			.3					.6																															1.1				1.1	.9									4.0
15-16.9									.3																														.3				.9	.9				.3					2.7
17-18.9									.6																														1.1					1.4									3.1
19 +																																												.6					.3				.9
																																																			.3	27.2	27.5
Σ	1.7	2.6	2.9			2.0	3.1	3.8	0.9		2.9	3.1	1.5					0.6			1.5	1.4	0.3			0.3	0.9	1.2			2.6	2.3	1.5	1.2			1.7	4.8	2.5		2.8	3.2	9.3	4.4		1.4	0.9	1.5	1.7		0.3	27.2	100.0

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1 Based on 28-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		.5						4.6	4.3	1.3	1.6	.3	.5		4.3	3.2	3.5	1.1	.3	.5		4.0	2.2	3.2	1.1	1.1	.3		.8	4.0	1.8						4.6	.5	.3												.5													50.4
3-4.9		1.1						2.2	4.6	2.9	.3	.8			3.2	5.1	.5	.3	2.7	.8		2.9	5.1	1.8	2.7	1.1	.3		.8	2.4	1.3					.3	.8														.8													44.8
5-6.9									1.3	1.3	.8				2.2	3.2	2.9	2.4	.3			.5	3.5	2.2	1.1	.8				1.6	1.6					.3	.3	.3													.5	.3	.3											27.7
7-8.9									.3	.8		.3			.8	3.2	1.1	.3	.5				1.1	.8	.3												.3																										9.8
9-10.9									.3	.3	.3					1.3	1.1	.8	.3					.8	.3												.5																										6.0
11-12.9										.3						.3	.5	.8	.8				.3																																								3.0
13-14.9										.3	.3	.3					.5	.3		.3																																											2.0
15-16.9										.3		.3					.8							.3																																							1.7
17-18.9										.3	.3							1.1	.3						.3																																						2.3
19-20.9											.5							.5																																													1.0
21-22.9																																																															
23-24.9																																																															
25-26.9																																																															
27 +																																																															
Σ		1.6						6.8	10.8	7.8	4.1	2.0	0.5		10.5	16.3	10.9	.6	5.2	1.6		7.4	12.2	9.1	5.8	3.0	0.6		1.6	8.0	4.7					0.6	6.5	0.8	0.3												1.8	.3	.3											148.7

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.5	.8				1.3	.3				2.7	.3				.5					4.0	.5				.8					1.8					1.6					2.4					.5							18.0
3-4.9	.3	3.2	1.3				3.2	.5			.5	4.8				.3	.8	.3			.8	1.1					1.1				.5	2.4	.5				1.8				.3	3.2	.3				.5						27.7
5-6.9		2.7					.8					2.4					.5					1.1					.3					.8	.3				.3					1.3											10.5
7-8.9			2.2				.3	1.8					2.2					.3					1.1					.3					1.1					.5					2.4					.3					12.5
9-10.9			.3					.5																									.3										1.1					.5					2.7
11-12.9																																		.3					.3				.3										0.9
13-14.9																																																.3					0.3
15-16.9																																							.3														0.3
17-18.9																																																					
19 +																																							.5					.5									1.0
																																																			.3	25.8	26.1
Σ	0.8	6.7	3.8			1.3	4.6	2.8			3.2	7.5	2.2			0.8	1.3	0.6			4.8	2.7	1.1			0.8	1.4	0.3			2.3	3.2	2.2	0.3		1.6	2.1	0.5	1.1		2.7	4.5	4.1	0.5		0.5	0.5	1.1			0.3	25.8	100.0

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[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 832

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		1.7						.8	8.3	8.1	1.4		.3		2.8	6.1	4.2	1.7	.8	.3		1.4	10.0	2.5	1.1	.3	.6		.3	1.7	.3						1.1	2.2														.3												58.0
3-4.9									2.5	1.4	.3	.3	.3		1.1	7.8	3.9	2.5	1.7	.3		.8	.8	3.3	1.1	.8	.3		.3	1.1																																		30.6
5-6.9		.6							1.4	.6		.3			.6	2.5	3.3	1.9	.6		.3	.3	.8							.3																																		13.5
7-8.9																1.7	.6	1.7				.3	.6	.3	.6					.3																																		6.1
9-10.9																.3	.8						.3								.3																																	1.7
11-12.9																			.3				.3										.3																															1.2
13-14.9																		.3		.3			.6			.3						.3																																1.8
15-16.9																																																																
17-18.9																								.6			.3																																					0.9
19-20.9																		.3						.3																																								0.6
21-22.9																		.3							.6																																							0.9
23-24.9																										.3																																						0.3
25-26.9																																																																
27 +																																																																
Σ		2.3						0.8	12.2	10.1	1.7	0.6	0.6		4.5	18.4	12.8	8.7	3.4	0.9	0.3	2.8	13.4	7.0	3.4	1.7	1.2		0.6	3.4	0.6	0.3	0.3				1.1	2.2														0.3												115.6

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.6	1.1				1.8	.8				6.5	.6									.6										1.1	.3				.3					2.7												17.4
3-4.9		5.1	1.8			.3	4.6	.8			.6	5.4	.8			.3	.3					.3					.6					1.6	.3				.3				.3	1.3				.3	.6	.3					25.9
5-6.9		2.2					1.6					1.6															.3										.3					.8					.3						7.1
7-8.9		.3	4.3					4.0					2.9																				.8					.3					1.6					1.1					15.3
9-10.9			.8					2.9					1.1																				.3					.3										.3					5.7
11-12.9								.6	.8				.3															.3					.3										.3						.3				2.9
13-14.9																																	.3																				0.3
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																				25.4	25.4
Σ	1.6	8.7	6.9			2.1	7.0	8.3	0.8		7.1	7.6	5.1			0.3	0.3				0.6	0.3					0.9	0.3			1.1	1.9	2.0			0.3	0.6	0.6			3.0	2.1	1.9			0.3	0.9	1.7	0.3			25.4	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 740

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9									7.8	8.9		.8			1.8	14.2	7.0	1.6	.5		
3-4.9								.3	2.4	.8	.8	.3			1.3	5.4	4.0	1.6	1.3	.5	.3
5-6.9									.3	.8						2.4	.3	.3	.5		
7-8.9																.3	1.1	.5	.3	.3	
9-10.9																	.3	.3	.3	.3	
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ								0.3	10.5	10.5	0.8	1.1			3.1	22.3	12.7	4.3	2.9	1.1	0.3

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.3	1.8	.3	1.1				.5	2.7	2.4	.5	.3				1.3					
3-4.9	.3	1.8	.8	.8	.3			.5	1.1	1.1	.3					.5					
5-6.9		.3	.5						.5							.3	.8				
7-8.9			.5							.5											
9-10.9			.5		.5																
11-12.9			.3	.3																	
13-14.9					.3																
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	0.6	3.9	2.9	2.2	1.1			1.0	4.3	4.0	0.8	0.3				2.1	0.8				

DIR.	SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		2.2	.5					.8	2.7	1.3												61.3
3-4.9									.5	.3												27.3
5-6.9																						7.0
7-8.9																						3.5
9-10.9									.3	.3												2.8
11-12.9																						0.6
13-14.9																						0.3
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ		2.2	0.5					0.8	3.5	1.9												102.8

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	4.3	.5				3.8	.5				5.4	.8				.5						[illegible]			
3-4.9		3.2					4.0	.5			.3	5.4	.3				.3						.8		
5-6.9		1.8					2.2	.3				2.7													
7-8.9		.3	1.6				.3	4.3				.5	4.8												
9-10.9			.5					.8	.3				.8	.3											
11-12.9									.3					1.3											
13-14.9														.3											
15-16.9																									
17-18.9																									
19 +																									
Σ	4.3	5.8	2.1			3.8	7.0	5.9	0.6		5.7	9.4	5.9	1.9		0.5	0.3					0.3	0.8		

DIR.	WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.8					2.4	.3				1.1	.3				6.5	.5				1.3							29.3
3-4.9		.3					2.2					1.8					1.8					.5						21.4
5-6.9												.5					1.3											8.8
7-8.9												.3						.3					.3					12.7
9-10.9																												2.7
11-12.9																												1.6
13-14.9																												0.3
15-16.9																												
17-18.9																												
19 +																												
																										.5	22.7	23.2
Σ	0.8	0.3				2.4	2.5				1.1	2.9				6.5	3.6	0.3			1.3	0.5	0.3			0.5	22.7	100.0

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[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 603

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	.6		.6					1.4	10.8	10.6	1.4	.3			1.1	11.1	7.2	1.7	1.4	1.1	
3-4.9	.6	.8	.6					.6	5.0	1.7	.8	.3				6.4	3.3	1.9	1.1		
5-6.9																.6	2.2	1.1			
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.2	0.8	1.2					2.0	15.8	12.3	2.2	0.6			1.1	18.1	12.7	4.7	2.5	1.1	

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	.3	.6	3.1	1.1	.6																
3-4.9			.6							1.1											
5-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	0.3	0.6	3.7	1.1	0.6					1.1											

DIR.	SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9																						55.0
3-4.9																						24.8
5-6.9																						3.9
7-8.9																						
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ																						83.7

SEA

DIR.	N					NNW					NW					WNW					W				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9	.8	.6				2.8	.6				7.8	.8									3.3	.3			
3-4.9	.3	.8				.8	3.9	.8			1.1	7.0	.6			.3					.3	.6			
5-6.9		1.1	.6				4.4	1.7				3.6	2.2				1.4					.3			
7-8.9			4.2					6.7					5.3												
9-10.9			2.8					3.3					.3												
11-12.9			1.1	.8				.8	.6																
13-14.9				.3					.3																
15-16.9				.3					.6					.3											
17-18.9									.3																
19 +																									
Σ	1.1	2.5	8.7	1.4		3.6	8.9	13.3	1.8		8.9	11.4	8.4	0.3		0.3	1.4				3.6	1.2			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	.6					1.7					.3					1.9												21.5
3-4.9		.6				.3	.6				.3	.3					.3											18.9
5-6.9		.3					.3																					15.9
7-8.9																												16.2
9-10.9																												6.4
11-12.9																												3.3
13-14.9																												0.6
15-16.9																												1.2
17-18.9																												0.3
19 +																												
																											15.7	15.7
Σ	0.6	0.9				2.0	0.9				0.6	0.3				1.9	0.3										15.7	100.0

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1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 498

DIR.	NNW							NW							WNW							W						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9		1.1						.8	28.0	11.0	1.1	.8			.5	2.9	.5	.8	.3			.8	4.0	.5				
3-4.9									4.6	1.8	1.1					1.8	.8	.3				.5	.8	1.1				
5-6.9																								1.1				
7-8.9																												
9-10.9																												
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19-20.9																												
21-22.9																												
23-24.9																												
25-26.9																												
27 +																												
Σ		1.1						0.8	32.6	12.8	2.2	0.8			0.5	4.7	1.3	1.1	0.3			1.3	4.8	2.7				

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																																				53.1
3-4.9																																				12.8
5-6.9																																				1.1
7-8.9																																				
9-10.9																																				
11-12.9																																				
13-14.9																																				
15-16.9																																				
17-18.9																																				
19-20.9																																				
21-22.9																																				
23-24.9																																				
25-26.9																																				
27 +																																				
Σ																																				67.0

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	5.6	.8				6.7	1.1				15.1	.3									.3				
3-4.9	.8	4.0				.8	4.8	.5			1.1	12.9	.5								.3	.5			
5-6.9		.8	.3				3.5	.5				2.2	1.6	.5											
7-8.9			1.8				.5	5.6					6.2	.3											
9-10.9			1.6	.3				1.8	.3				.3	.3											
11-12.9				.5				.3	.5				.3	.5											
13-14.9				.8					.5					.3											
15-16.9				.3					.3																
17-18.9																									
19 +																									
Σ	6.4	5.6	3.7	1.9		7.5	9.9	8.7	1.6		16.2	15.4	8.9	1.9							0.6	0.5			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						.3										.5												30.7
3-4.9						.3	.5										.5											27.5
5-6.9												.3																9.7
7-8.9																												14.4
9-10.9																												4.6
11-12.9																												2.1
13-14.9																												1.6
15-16.9																												0.6
17-18.9																												
19 +																												
																											8.8	8.8
Σ						0.6	0.5					0.3				0.5	0.5										8.8	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 606

DIR.	NNW							NW							WNW							W						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9		3.5							15.9	21.8	1.6	.8			.3	5.6	2.4	1.6	.3				1.1	2.9				
3-4.9		1.1							4.6	1.8	1.3	.3			.5	4.6	3.8	1.1					.3	.3				
5-6.9			.5						.5	.8	.3					1.1	.5											
7-8.9																.3												
9-10.9																												
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19-20.9																												
21-22.9																												
23-24.9																												
25-26.9																												
27 +																												
Σ		4.6	0.5						21.0	24.4	3.2	1.1			0.8	11.6	6.7	2.7	0.3				1.4	3.2				

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9																																				57.8
3-4.9																																				19.7
5-6.9																																				3.7
7-8.9																																				0.3
9-10.9																																				
11-12.9																																				
13-14.9																																				
15-16.9																																				
17-18.9																																				
19-20.9																																				
21-22.9																																				
23-24.9																																				
25-26.9																																				
27 +																																				
Σ																																				81.5

SEA

DIR.	N					NNW					NW					WNW					W				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9	3.8	.3				5.1	.3	.3			11.0	.3				1.8					.8				
3-4.9		4.6	.3			1.6	8.1	.3			1.1	11.0	1.3				.5					.3			
5-6.9		2.2	.3				2.4					1.3	2.2												
7-8.9		.3	1.8				.3	5.6				.5	4.6												
9-10.9			.5	.3				.8	.5				.3	.8											
11-12.9									.3																
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ	3.8	7.4	2.9	0.3		6.7	11.1	7.0	0.8		12.1	13.1	8.4	0.8		1.8	0.5				0.8	0.3			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9																												23.7
3-4.9		.3					.3										.3					.3						30.3
5-6.9																												8.4
7-8.9																												13.1
9-10.9																												3.2
11-12.9																												0.3
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																										.3	20.7	21.0
Σ		0.3					0.3										0.3					0.3				0.3	20.7	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 September (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 725

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	1.7	2.5	1.7	.3	.3			.6	7.0	11.7	.8				.8	6.7	3.9	1.4	.8		.3	.8	1.4	.6	.3					.8	1.1						2.5	1.7							.8						1.1													51.6
3-4.9		2.2	1.9	.3				.6	3.6	1.1		.3			1.4	7.2	2.5	1.1	.3	.6	.3	.6	1.1	.6	.3																																							26.0
5-6.9		2.2							.8	.6		.6				1.9	2.8	1.7	.8				.8																																									12.2
7-8.9		1.1	1.4							1.4	.6						2.5	.6	.3	.3				.3	.3	.3																																						9.1
9-10.9																		.3	.6				.3																																									1.2
11-12.9																																																																
13-14.9																								.3		.3																																						0.6
15-16.9																																																																
17-18.9																																																															
19-20.9																																																															
21-22.9																																																															
23-24.9																																																															
25-26.9																																																															
27 +																																																															
Σ	1.7	8.0	5.0	0.6	0.3			1.2	11.4	14.8	1.4	0.9			2.2	15.8	11.7	5.1	2.8	0.9	0.6	1.4	3.6	1.8	0.9	0.6				0.8	1.1						2.5	1.7							.8						1.1													100.7

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.7					5.0					3.1					1.1					.6					1.4					2.2					1.1					1.9	.3											18.4
3-4.9	1.1	3.6				4.4	5.0				3.3	2.8									.6	.3				.8	.6				4.4	.6	.3			.8	.3				.6	.3					.3						30.1
5-6.9		3.6					3.6																																			.3											7.5
7-8.9		1.4	1.9				.3	3.9					.3																				.6					.3					.6										9.3
9-10.9			.6					3.1					.6																									.3					.6										5.2
11-12.9																																																					
13-14.9									.3																																												0.3
15-16.9									.3																																												0.3
17-18.9																																																					
19 +																																																					
																																																			.3	28.6	28.9
Σ	2.8	8.6	2.5			9.4	8.9	7.0	0.6		6.4	2.8	0.9			1.1					1.2	0.3				2.2	0.6				6.6	0.6	0.9			1.9	0.3	0.6			2.5	0.9	1.2				0.3				0.3	28.6	100.0

[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 2.10 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)^1 STATION 2 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1023

DIR.	NNW							NW							WNW							W						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	.3	1.1		.3				2.9	7.3	6.5	4.6	1.3	.5		.8	14.8	8.1	.8	.5	.8		.8	4.0	.5		.3		
3-4.9	.5	1.8	.8					1.8	12.4	5.4	3.5	1.3		.3	.3	8.1	3.5	1.1	.8	.5		.8	1.6	1.3		.3		.3
5-6.9			.3					.3	2.4	1.3	.8	.8				1.8	2.2	1.3	.8			.3	.8	.8	.5		.3	
7-8.9									.5	1.6	.3		.3			1.8	.5						.5	.5	.5	.5		
9-10.9										.8	1.3	1.1					.5	.3	.3				.3					
11-12.9										.8			.3				.3							.8	.5			
13-14.9											.3	.3						.5							.3	.3		
15-16.9																												
17-18.9																												
19-20.9																												
21-22.9																												
23-24.9																												
25-26.9																												
27 +																												
Σ	0.8	2.9	1.1	0.3				5.0	22.6	16.4	10.8	4.8	1.1	0.3	1.1	26.5	15.1	4.0	2.4	1.3		1.9	7.2	3.9	1.8	1.4	0.3	0.3

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9		1.3	1.3	.8																																59.6
3-4.9			.3																																	46.7
5-6.9			.5																																	15.2
7-8.9																																				7.0
9-10.9																																				4.6
11-12.9																																				2.7
13-14.9																																				1.7
15-16.9																																				
17-18.9																																				
19-20.9																																				
21-22.9																																				
23-24.9																																				
25-26.9																																				
27 +																																				
Σ		1.3	2.1	0.8																																137.5

SEA

DIR.	N					NNW					NW					WNW					W				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9	2.9	.3				3.2	.5				4.8	.3				.5	.3				1.6	.3			
3-4.9		4.8				1.1	4.8				.8	5.9	.3				1.3					.8			
5-6.9		1.3					1.6					1.1										.3	.5		
7-8.9			1.8					2.4					1.8	.3				.5					.8		
9-10.9			.3					.8					.3	.3											
11-12.9														.3					.3						
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ	2.9	6.4	2.1			4.3	6.9	3.2			5.6	7.3	2.4	0.9		0.5	1.6	0.5	0.3		1.6	1.4	1.3		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM^2	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	.8					4.8					.5					2.4					.5	.3						24.0
3-4.9	.3	.3					2.7	.3				.3				.3	3.8	.5			.3	.3						28.9
5-6.9												.3					1.1											6.2
7-8.9			.3					.5										2.2				.3						10.9
9-10.9			.5															.5	.3									3.0
11-12.9																		.5										1.1
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																											25.9	25.9
Σ	1.1	0.3	0.8			4.8	2.7	0.8			0.5	0.6				2.7	4.9	3.7	0.3		0.8	0.9					25.9	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1012

DIR.	NNW							NW							WNW						
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.3	2.2	.3	.6				.8	6.4	5.6	.6		.3		.3	7.8	1.1	.6	.8	.3	
3-4.9	.3	.8	2.2	1.4				.3	8.6	1.1	1.1	.3	.3		.8	8.6	4.2	1.9	1.1	.5	.3
5-6.9		.8							3.1	5.0	1.4	.8	.3	.3		3.1	3.3	.8	.8	.3	
7-8.9			.8						.3	1.7	.6	.3	.3			.8	2.8	1.9	.3		
9-10.9										.8	.3					.3	.8	1.7	.8	.3	
11-12.9											.3	.3					.6	.3			
13-14.9										.6		.3	.3				.3				
15-16.9											.3	.3									
17-18.9																		.3			
19-20.9											.3										
21-22.9											.3										
23-24.9																					
25-26.9																					
27 +																					
Σ	0.6	3.8	3.3	2.0				1.1	18.4	14.8	5.2	2.3	1.5	0.3	1.1	20.6	13.1	7.5	3.8	1.4	0.3

DIR.	W							WSW							SW						
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.8	12.8	3.3	1.4	1.4				2.8	3.1	.3					2.2					
3-4.9	.6	2.8	3.6	.6					1.4	.3	.3										
5-6.9		.6	.3	.3						.3											
7-8.9				.3																	
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.4	16.2	7.2	2.6	1.4				4.2	3.7	0.6					2.2					

DIR.	SSW							S							SSE							
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																						56.1
3-4.9																						43.4
5-6.9																						21.5
7-8.9																						10.1
9-10.9																						5.0
11-12.9																						1.5
13-14.9																						1.5
15-16.9																						0.6
17-18.9																						0.3
19-20.9																						0.3
21-22.9																						0.3
23-24.9																						
25-26.9																						
27 +																						
Σ																						140.6

SEA

DIR.	N					NNW					NW					WNW					W				
Ts	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
Hs	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	1.4					2.8					3.9					.6					1.1				
3-4.9	.3	2.5	.8			.6	1.7				1.1	2.5					.8				.3	.6			
5-6.9		2.5					1.4					.3													
7-8.9		.3	2.8				.3	2.2					.6												
9-10.9			.3					.6																	
11-12.9				.6										.3											
13-14.9				.3					.3																
15-16.9									.3																
17-18.9																									
19 +																									
Σ	1.7	5.3	3.9	0.9		3.4	3.4	2.8	0.6		5.0	2.8	0.6	0.3		0.6	0.8				1.4	0.6			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
Ts	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
Hs	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						2.2										2.8												14.8
3-4.9	.3	.8				.3	1.1					.8				.8	2.5	.3				.6						18.7
5-6.9							.3					.3					1.7											6.5
7-8.9								.3									1.4	.6										8.5
9-10.9																												0.9
11-12.9																												0.9
13-14.9																												0.6
15-16.9																												0.3
17-18.9																												
19 +																												
																										.3	48.5	48.8
Σ	0.3	0.8				2.5	1.4	0.3				1.1				3.6	5.6	0.9				0.6				0.3	48.5	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 2 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1226

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		1.3	.5					2.7	10.8	1.6	.8	.8			.5	6.7	.5	.5	1.3	.3	.8		12.1	2.9	1.8	.8	.5		.5	1.1	1.6	1.1	.3																															51.8
3-4.9								1.3	11.3	2.7	1.3	1.3	1.1		.5	9.1	2.7	.5	2.2	1.3	.3		8.9	1.5	1.3	.8	1.1			.8	.8																				.3													51.2
5-6.9									4.3	2.4	1.1	.5	.3		.3	5.1	3.5	2.7	2.4	.5		.3	1.8	3.2	1.5	.8	.3			.5			.3																															31.8
7-8.9									.8	1.6	1.1	.8	.3			1.6	2.7	2.9					.3	1.6	1.8					.5			.3																															16.3
9-10.9									.3	1.3	.3	.3				.5	1.8	.5	.5				.3		1.1	.3					.3	.3																																7.8
11-12.9											.3					.5	.8	.5	.3												.3																																	2.7
13-14.9										.5							.3	.3	.3					.3	.3							.3																																2.3
15-16.9																	.3	.3								.3																																						0.9
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ		1.3	0.5					4.0	27.5	10.1	4.9	3.7	1.7		1.3	23.5	12.6	8.2	7.0	2.1	1.1	0.3	23.4	9.6	7.8	3.0	1.9		0.5	2.9	3.0	1.7	0.9																		0.3													164.8

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.8					1.6					3.5					.8					2.4					1.1	.3				3.2	.3				.5					4.0					.5							20.0
3-4.9	.5	1.6	.3			.8	2.2				.3	1.6	.3			.3	.8				.5	.3	.3				.3	.5			.3	3.2	.5			.5	.3				1.1	2.9	.3				.5						20.2
5-6.9		.3					.3					1.3										.3										1.1										1.6					.3						5.2
7-8.9			.8					.5					.5					.5					.8					1.3					1.6										2.2					.5					8.7
9-10.9			.3																														.3					.3					1.1										2.0
11-12.9														.3															.3									.3															0.9
13-14.9																																																					
15-16.9																																																					
17-18.9																																							.3														0.3
19 +																																																					
																																																				42.7	42.7
Σ	2.3	1.9	1.4			2.4	2.5	0.5			3.8	2.9	0.8	0.3		1.1	0.8	0.5			2.9	0.6	1.1			1.1	0.6	1.8	0.3		3.5	4.6	2.4			1.0	0.3	0.6	0.3		5.1	4.5	3.6			0.5	0.8	0.5				42.7	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2.13   AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1]   STATION 2   (1956,1957,1958)

SWELL   AVERAGE TOTAL HOURS [illegible]

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-2.9	26	126	40	.12	.02			139	9.08	8.18	118	.44	.16		1.23	7.14	351	103	.66	.27	.14	1.04	477	186	.72	54	17	02	18	139	103	.27	05	02		.09	1.23	.63	.12	.05			.02	.18	27					.07	47	.13						.04						5183
3-4.9	.16	.88	.60	.14				.72	558	184	.87	.48	.17	.02	91	657	282	114	107	47	.10	1.16	326	177	79	37	17	02	36	93	47	.12	.07	05		.17	.22	.02	.02				.05	.02						02	16	05						.02						3463
5-6.9		43	20					.05	150	120	.46	.20	.07	.02	.26	217	218	108	.54	07	.02	37	159	132	.44	.27	.07			.70	.52	14	12			.10	.18	.16	.04					.05						.02	07	02	.02					04						1669
7-8.9		.09	.20	.05					.23	.94	.24	.14	.07		.07	95	1.05	73	.14	.05		02	47	.65	50	13				.17	13	13	05				.05	.07	.05																									137
9-10.9									.07	.41	32	.12				.29	51	.35	23	.05			.22	27	.18	07				.13	12	.02	.04	.02			.12		02												02	02												360
11-12.9									.02	.14	.05	.05	.02			.07	.25	13	12				10	16	05	02				.02	07	07	.02																															1.36
13-14.9										.21	.12	.07	.02				16	14	05	05			.10	14	.10	.12				.02	.05	07																																1.42
15-16.9										07	05	.05					.09	.09						.07	.09	02	.02				.04	.02		02				.02																										.65
17-18.9										.14	.05							.12	.02					05	.02		02					.12	.02						02																									.48
19-20.9											.07							.07						02	.02													.02	02																									.22
21-22.9											.02							.02							.07	.02																																						.13
23-24.9																										.02																																						.02
25-26.9																										.02	.02																																					.04
27 +																																																																
Σ	.42	266	140	.31	.02			216	1648	1313	343	1.55	.51	.04	247	1699	1057	490	283	.96	.26	259	1051	631	298	1.60	.47	.04	.54	336	243	.86	.37	.11		.36	180	92	.29	05			.07	.25	.27					[illegible]	.72	22	02					10						118.44

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9	228	.77				313	.34	.02			587	.28				48	.02				146	09				.51	.02				196	07				45	.02				243	.09				47	.02						20.78
3-4.9	27	280	40			91	392	36			.87	535	.43	.02		.12	42	02			.28	.69	05			12	57	07			.57	178	.21			13	65	05			35	.84	18			05	46	12					24.06
5-6.9		150	.14				181	23	04			1.44	.52	.04			.16	02				.21	.04			02	.22	02				27	.05				22	02				.81	05				07	02					7.92
7-8.9		.22	214				.17	322	.07			.08	250	.05			04	.22				.02	32					.27					.63	.05			.05	39				14	126				0.	37	05				12.28
9-10.9			.74	.05				130	09				.36	.14														07				.04	.07	02				22					59	05				24	02				4.00
11-12.9			.09	.16				.14	21				.07	.22					.02									05	02				07	07				12	02				60	13				15	21				2.35
13-14.9			.02	.12				05	.12					.09																			07						13				12	12				02					.86
15-16.9				.05					15					.02																									05				07	07				.02					.43
17-18.9									.07																														12					14									.33
19 +																																							.04	02				39	02				.02				.19
																																																			.21	26.59	26.80
Σ	255	529	353	.38		404	624	532	75		674	7.15	388	.58		.60	.64	26	.02		174	1.01	41			.65	.81	.48	02		253	216	1.10	.14		58	94	.80	36	.02	278	288	287	.60	02	52	57	94	.30		.21	26.59	100.00

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1129

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	1.1	1.8	1.3	.5		.3		.8	1.6	4.8		.3			2.2	4.0	.3		.3	.3		2.9	3.5	2.7	1.6	1.1	.3	.3	.3	.8	1.3	.3					.3																							35.0
3-4.9	1.1	.8	1.6	.5		.3		.8	1.8	1.6	.5				4.0	8.9	5.4	2.7	1.1	.5		2.7	5.9	1.6	.8	.8			1.8	1.3	.5	.3				.8						.5	.8						.5														49.9
5-6.9		.8	.3	.3	.5			.3	1.1			.3			.5	6.5	6.2	1.1	1.3			1.6	6.2	3.5	.5	.5	.5		.3	1.3	1.1	.3											.3						.3														35.6
7-8.9		.3	.5	.3					.5	.8					.5	2.9	.8	.3				2.2	1.3	2.2	.3				.3		.3																		.3		.3												14.1
9-10.9			.5					.3	.3					.5	.8		.3				.8	1.8	.8	.3				.3	.3																		.3													7.3
11-12.9									.3	.5					.5	.8		.3			.3	3.8	.5						.3																														7.3
13-14.9																.8	.3				.3																																									1.4
15-16.9																							.3																																									0.3
17-18.9																																																																
19-20.9																								.3		.3																																						0.6
21-22.9																																																																
23-24.9																										.3																																						0.3
25-26.9																																																																
27 +																																																																
Σ	2.2	3.7	4.2	1.6	0.5	0.6		1.9	5.3	7.8	1.0	0.6			6.7	20.4	16.1	6.2	3.6	1.1		7.2	18.9	15.3	6.7	3.0	1.4	0.3	2.4	3.7	3.2	1.8				0.8	0.3					0.5	1.1					0.8	0.3	0.3	0.3										151.8

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						2.7					6.5					.5					2.8	.3				.3					1.6										3.5					2.4							20.6
3-4.9							2.7					5.6						.5	.3			.8	1.6						1.8				.5	4.0	.3				.8				.8	2.4	.3			.5	2.2	.5					25.6
5-6.9							.5	.3						.3				.5						.5						.8						.3	.5				.3	.3				.8						1.8						6.9
7-8.9														1.3				.3	1.1						.8						.5				.3						.5	1.1						1.6				.8	1.6					9.9
9-10.9																																								.3									.8					1.1
11-12.9																																							.3							1.1						.3				1.7
13-14.9																																								.3							.8						.3	.5				1.9
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																			2.7	29.6	32.3
Σ						2.7	3.2	0.3			6.5	5.6	1.6			0.5	1.3	1.4			3.6	2.4	0.8			0.3	2.6	0.5			2.1	4.6	0.8				1.6	1.7	0.6		4.3	3.2	1.9	1.9		2.9	4.8	3.2	0.8		2.7	29.6	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 3.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 892

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9								.9	2.6	7.5	.3	.3	.3		1.7	2.0	1.7				.9	2.3	1.4	.6	.3		.3		.3	.9	.3	.3	.6			.3	1.4	.9					.3																					28.4
3-4.9								3.1	4.9	1.1	.3				1.1	2.8	1.4	.3	1.4	1.4		5.2	4.6	2.0	1.4	2.0	.6		2.6	1.4	1.7	1.1				.3	.3						.3							.3														41.6
5-6.9									1.7	1.1	.3	.3				2.8	.9	.3	.9			.6	6.3	3.4	2.8	1.7	.3		.3	3.1	.3					1.1		.3																								28.5
7-8.9									.6	2.0	.3	.3				1.1	1.1	.3					1.1	2.0	2.6	.6				1.1	.3	.3					.3	.6																								14.6
9-10.9										.6	.9	.3							.3					.3	.9	.3					.3	.9	.3		.3			.6																										6.0
11-12.9										.6	.3	.3												.3	.3						.6	1.1																																3.5
13-14.9										.6	1.1													.3	.3						.3																																2.6
15-16.9																									.3	.3						.3	.3		.3																												1.5
17-18.9																									.6								.3	.3																														1.2
19-20.9																																		.3																															0.3
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ								4.0	9.8	13.5	3.5	1.5	0.3		2.8	8.7	5.1	1.2	2.3	1.4	.9	8.1	14.0	10.4	8.0	4.3	1.2		3.2	7.4	5.2	2.9	0.9	0.6		0.6	3.7	1.5	0.3				0.6							0.3														128.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						3.7					6.3	.3				.6					1.4					.3					4.0	.3									1.7					1.4								20.0
3-4.9						.9	2.6				.9	3.4				.3	.3				.6	1.4					.3					4.0					.9				.6	2.6	.3				.9	.3					20.3
5-6.9							.3					.9													.3					.3		.3			.9					.9												3.9
7-8.9								1.7						.3				.3	.3						.3					.3					1.1					1.1					5.4				1.1	.3	.3				12.5
9-10.9								.6						.6																							.3					.6	.3				.9					3.3
11-12.9									1.1																											.3	.6				1.1										3.1
13-14.9									1.7						.3																.6						1.4				.6	1.1								5.7
15-16.9																																									.3	.3										0.6
17-18.9									.6																													.6														1.2
19 +																																																
																																													1.3	28.1	29.4
Σ						4.6	2.9	2.3	3.4		7.2	4.6	0.9	0.3		0.9	0.6	0.3			2.0	1.4	0.3			0.3	0.6	0.3			4.0	4.6	1.1	0.9			1.8	1.7	2.6		2.3	3.5	8.3	1.7		1.4	2.0	1.5	0.3		1.3	28.1	100.0

[1] Based on 28-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 3.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1110

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.3	.3						3.2	9.4	2.7	1.6		.3		2.9	4.3	6.2	1.6	1.1	.8		3.2	3.8	3.5	2.2	.8	.3		4.0	2.2	.5	.5																		.3														56.0
3-4.9		.8						4.0	4.0	2.2	1.3	.5	.5	.3	2.4	6.2	2.2	.3	.3	1.3		3.2	7.8	3.5	1.8	.3	.5			.8	.5	.3												.3						.3	.3													45.9
5-6.9									2.9	2.4	.8	.5	.3			1.6	3.8	1.6	1.1		.3		4.3	3.5	1.6	1.1	.3																	.3			.3				.5			.3										27.5
7-8.9									.8	2.2	.3	.5					.5	.5	.3	.5			.3	.8	.5																				.3	.3					.3	.3												8.4
9-10.9									.5	1.6	.8	.9	.3											.3																																								4.4
11-12.9										.3			.5										.3	.5	.3	.5																																						2.4
13-14.9										.3	1.3	.5																																																				2.1
15-16.9												.3							.5					.3																																								1.1
17-18.9											.5														.3	.3																																						1.1
19-20.9																										.3																																						0.3
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ	0.3	1.1						7.2	17.6	11.7	6.6	3.2	1.9	0.3	5.3	12.1	12.7	4.0	3.3	2.6	0.3	6.4	16.5	12.4	6.7	3.3	1.1		4.0	3.0	1.0	0.8												0.6	0.3	0.3	0.3			0.6	1.1	0.3		0.3										149.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						3.2					8.0	.3	.3			1.3					4.0	.3				1.1					2.9										3.2					1.3							26.5
3-4.9						.8	3.0				2.4	11.3	.3			.3	1.6				.8	1.3				.3	1.1				1.1	1.1	.3			.3	.8				.3	1.6											28.7
5-6.9							1.1					2.2										.3															.3					.8					.5						5.2
7-8.9								1.1					5.1					.5															1.3										1.1										9.1
9-10.9								.6	.3				1.1																				.3															.3					2.6
11-12.9									.3																			.3															.3	.3									1.2
13-14.9																																																	.3				0.3
15-16.9																																																	.3				0.3
17-18.9																																												.3									0.3
19 +																																																					
																																																		1.6	24.2	25.8
Σ						4.0	4.1	1.7	0.6		11.0	13.8	6.8			1.6	1.6	0.5			4.8	1.9				1.4	1.1	0.3			4.0	1.1	1.9			0.3	1.1				3.5	2.4	1.4	0.6		1.3	0.5	0.3	0.6		1.6	24.2	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 736

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9		1.7						2.8	5.3	6.7	.6	.6	.3		3.6	5.0	1.1	.8	1.1	.3	.3
3-4.9								1.4	5.3	2.5	1.4	.8	.3		1.7	7.2	5.3	2.5	1.7	1.1	
5-6.9		.3							2.5	1.7	1.1				.3	1.1	1.7	1.7	.6		
7-8.9										.6						.6	.8	.8		.3	
9-10.9																.3	.3				
11-12.9																	.3		.3	.3	
13-14.9																	.3				
15-16.9																		.3			
17-18.9																	.3				
19-20.9																				.3	
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ		2.0						4.2	13.1	11.5	3.1	1.4	0.6		5.6	14.2	10.1	6.1	3.7	2.3	0.3

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	1.9	1.9	3.6	.3				.8	.6							2.2	1.1				
3-4.9	1.1	.6	.8	.3	.6			.3	1.4												
5-6.9		.6	.3																		
7-8.9	.3	.6	.6						.3	.3											
9-10.9		.3	.3																		
11-12.9		.3		.3						.3											
13-14.9																					
15-16.9			.6																		
17-18.9																					
19-20.9				.3																	
21-22.9				.3																	
23-24.9				.6	.3																
25-26.9																					
27 +																					
Σ	3.3	4.3	6.2	2.1	0.9			1.1	2.3	0.6						2.2	1.1				

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																						42.6
3-4.9																						36.3
5-6.9																						11.9
7-8.9																						5.2
9-10.9																						1.2
11-12.9																						1.8
13-14.9																						0.3
15-16.9																						0.9
17-18.9																						0.3
19-20.9																						0.6
21-22.9																						0.3
23-24.9																						0.9
25-26.9																						
27 +																						
Σ																						102.3

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						1.6	.8				7.8	.8				4.6					.8	.6			
3-4.9						.9	5.8				2.5	11.7	.6			2.5	1.4				.6	1.1			
5-6.9							1.6	.6				3.1				.8									
7-8.9								4.7				.3	8.9										.8		
9-10.9									.6				1.9												
11-12.9								.3	1.4				.3	.6											
13-14.9														.3											
15-16.9																									
17-18.9																									
19 +																									
Σ						2.5	8.2	5.6	2.0		10.3	15.9	11.7	0.9		7.9	1.4				1.4	1.7	0.8		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.8					.6	.3				.3					1.9					.6							21.5
3-4.9	.6	.3	.3			.6	1.1				.3	.3				.6	1.4	.3			.3	.8						34.0
5-6.9								.3									.6					.3						7.3
7-8.9			.8					.3					.8					.6					1.1					18.3
9-10.9																		.3										2.8
11-12.9			.6					.3																				3.5
13-14.9																												0.3
15-16.9																												
17-18.9																												
19 +																												
																										.6	11.7	12.3
Σ	1.4	0.3	1.7			1.2	1.4	0.9			0.6	0.3	0.8			2.5	2.0	1.2			0.9	1.1	1.1			0.6	11.7	100.0

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[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 3.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 759

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9								.8	9.9	7.0	.8	.3			5.1	7.3	4.6	3.2	.3	.3	.5
3-4.9									3.8	.8	1.1	.8			.8	6.5	3.5	2.2	.5	1.1	.3
5-6.9									1.3	.8	.3					1.3	1.8			.3	.3
7-8.9																	1.3	.8	.8	.3	
9-10.9																	.3	1.1			
11-12.9																		.3			
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ								0.8	15.0	8.6	2.2	1.1			5.9	15.1	11.5	7.6	1.6	2.0	1.1

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	1.3	2.2	2.4	1.6	.3			1.8	1.3	1.8		.3			.8	1.3	.5				
3-4.9	.8	.5	1.3					.5	1.6	.8	.3				.5						
5-6.9		.3	.8						.5	.3	.3					.3	.3	.3			
7-8.9										.5								.3			
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	2.1	3.0	4.5	1.6	0.3			2.3	3.4	3.4	0.6	0.3			1.3	1.6	0.8	0.6			

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9		.8						.3	.5	.5												57.8
3-4.9									.5	.8						.3						29.3
5-6.9																						9.2
7-8.9																						4.0
9-10.9																						1.4
11-12.9																						0.3
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ		0.8						0.3	1.0	1.3						0.3						102.0

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						2.1					9.7	.5				2.9					3.8				
3-4.9						.3	1.1				1.3	8.9	.3			.8	2.7	.3			.8	.3			
5-6.9							1.4	.8				3.5	.8				.5								
7-8.9								1.6				.3	9.7					.3							
9-10.9													3.5												
11-12.9									.3				.3	.3											
13-14.9														.3											
15-16.9																									
17-18.9																									
19 +																									
Σ						2.4	2.5	2.4	0.3		11.0	13.2	14.6	0.6		3.7	3.2	0.6			4.6	0.3			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.8					3.8					.3					5.6					1.6							31.1
3-4.9	.3	.3				.8	1.8				.3	.5				.8	1.8					.3						23.7
5-6.9							.3					.3					.3											7.9
7-8.9													.3					.5										12.7
9-10.9																												3.5
11-12.9																												0.9
13-14.9																												0.3
15-16.9																												
17-18.9																												
19 +																												
																										.3	19.6	19.9
Σ	1.1	0.3				4.6	2.1				0.6	0.8	0.3			6.4	2.1	0.5			1.6	0.3				0.3	19.6	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 621

DIR.	NNW							NW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.6	.8						4.2	8.9	16.1	.8	1.1		
3-4.9								.8	6.1	12.5	1.4	.3		
5-6.9									1.7	.8	.6			
7-8.9														
9-10.9														
11-12.9														
13-14.9														
15-16.9														
17-18.9														
19-20.9														
21-22.9														
23-24.9														
25-26.9														
27 +														
Σ	0.6	0.8						5.0	16.7	29.4	2.8	1.4		

DIR.	WNW							W						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	4.7	10.1	2.8	1.7	2.5	1.1		.6	1.7	.6	1.1			
3-4.9		2.5	4.4	1.9	1.1				1.9	.8				
5-6.9														
7-8.9														
9-10.9														
11-12.9														
13-14.9														
15-16.9														
17-18.9														
19-20.9														
21-22.9														
23-24.9														
25-26.9														
27 +														
Σ	4.7	12.6	7.2	3.6	3.6	1.1		0.6	3.6	1.4	1.1			

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																																				59.4
3-4.9																																				23.7
5-6.9																																				3.1
7-8.9																																				
9-10.9																																				
11-12.9																																				
13-14.9																																				
15-16.9																																				
17-18.9																																				
19-20.9																																				
21-22.9																																				
23-24.9																																				
25-26.9																																				
27 +																																				
Σ																																				86.2

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						.6					12.0	.8				1.1					3.1				
3-4.9						.6	1.7	.3			3.3	12.0				.6	.8				1.1	.3			
5-6.9							.6	.3				15.0	1.1				1.9					.3			
7-8.9								2.5					17.5					.6							
9-10.9								.6					3.1	.8											
11-12.9									1.1					1.1											
13-14.9														.3											
15-16.9									.5					.6											
17-18.9																									
19 +																									
Σ						1.2	2.3	3.7	1.6		15.3	27.8	21.7	2.8		1.7	2.7	0.6			4.2	0.6			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	1.1					1.1										.8												20.6
3-4.9	.6	.3				.6										.3												22.5
5-6.9																												19.2
7-8.9																												20.6
9-10.9																												4.5
11-12.9																												2.2
13-14.9																												0.3
15-16.9																												1.1
17-18.9																												
19 +																												
																											9.0	9.0
Σ	1.7	0.3				1.7										1.1											9.0	100.0

1 Based on 30 days

2 Includes waves of 0 to 0.9 feet

TABLE 3.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 498

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9								1.1	27.4	9.1	2.4	.5			1.6	8.3	.5	.3					.5		.5																																							52.2
3-4.9								.3	5.9	2.9	.3				.8	.5	1.6	.3						.5																																								13.1
5-6.9									1.1	.5																																																						1.6
7-8.9																																																																
9-10.9																																																																
1-12.9																																																																
3-14.9																																																																
5-16.9																																																																
7-18.9																																																																
9-20.9																																																																
1-22.9																																																																
3-24.9																																																																
5-26.9																																																																
7 +																																																																
Σ								1.4	34.4	12.5	2.7	0.5			2.4	8.8	2.1	0.6					0.5	0.5	0.5																																							66.9

EA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
Ts	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
Hs	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
-2.9						1.4					18.0	.5				1.3	.3				.8										.8																						23.1
-4.9						.6	.3				2.7	28.5	.5			.3	1.3														.3						.3																34.8
-6.9							.3	.3				5.1	3.5																																								9.2
-8.9								1.6					6.7																																								8.3
-10.9								1.6					2.2	.3																																							4.1
1-12.9													.5	.5																																							1.0
3-14.9														.3																																							0.3
5-16.9														.8																																							0.8
7-18.9																																																					
9 +																																																					
																																																				18.4	18.4
Σ						2.0	0.6	3.5			20.7	34.1	13.4	1.9		1.6	1.6				0.8										1.1						0.3															18.4	100.0

Based on 31 Days

Includes waves of 0 to 0.9 feet

TABLE 3.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 569

DIR.	NNW							NW							WNW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9		.5						1.6	17.8	21.8	2.7	.5			2.2	3.5	1.3	.8	.3		
3-4.9								1.8	7.0	4.6	.8	.5			.5	1.8	1.3	1.1			
5-6.9									.3	.5	.3					.5	.3	.3			
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ		0.5						3.4	25.1	26.9	3.8	1.0			2.7	5.8	2.9	2.2	0.3		

DIR.	W							WSW							SW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9			.5																		
3-4.9			.3																		
5-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ			0.8																		

DIR.	SSW							S							SSE							
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-2.9																	.5	.3	.3			54.6
3-4.9																						19.7
5-6.9																						2.2
7-8.9																						
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ																	0.5	0.3	0.3			76.5

SEA

DIR.	N					NNW					NW					WNW					W				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9						2.1					16.7	.8				4.3					.8				
3-4.9						.3	3.1				1.6	25.0				.8	5.1	.3			.3	1.1			
5-6.9							.8					1.6	5.1				1.3	.3				.3	.3		
7-8.9								.8					8.1												
9-10.9													.8	.5											
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						2.4	3.9	0.8			18.3	27.4	14.0	0.5		5.1	6.4	.6			1.1	1.4	0.3		

DIR.	WSW					SW					SSW					S					SSE							
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +	OFFSHORE	CALM[2]	Σ
1-2.9																.5												25.2
3-4.9																												37.6
5-6.9																												9.7
7-8.9																												8.9
9-10.9																												1.3
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																											17.3	17.3
Σ																0.5											17.3	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 3.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 September(1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 815

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	1.1	2.5	.3	.8	.6			1.7	8.6	12.3	1.7	1.4			2.5	9.7	5.3	2.5	.3	.3	
3-4.9		1.9	1.4	.6	.6			1.1	5.6	4.7	.3				.8	3.9	1.7	.3		.8	
5-6.9		.5	1.1	1.1					3.6	3.1		.6	.3			1.9	1.9	1.4	1.1	.3	
7-8.9										.3	1.1	.8	.3				.3		.3		
9-10.9																		.3			
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.1	4.9	2.8	2.5	1.2			2.8	17.8	20.4	3.1	2.8	0.6		3.3	15.5	9.2	4.5	1.7	1.4	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	1.1	.8	3.1	1.1	.3				.3	.8						6.4					
3-4.9	.3	1.7	.6	.8																	
5-6.9			.3																		
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.4	2.5	4.0	1.9	0.3				0.3	0.8						6.4					

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																						65.5
3-4.9																						27.1
5-6.9																						17.2
7-8.9																						3.1
9-10.9																						0.3
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ																						113.2

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	.3					.9					14.5					3.1					4.4				
3-4.9	.3	.3				.6	2.2				2.8	12.0				.6	1.4				1.1	1.4			
5-6.9		.3					.9					1.4													
7-8.9								1.1					4.4												
9-10.9								.3					.6												
11-12.9									.3					.6											
13-14.9																									
15-16.9														.3											
17-18.9																									
19 +																									
Σ	0.6	0.6				1.5	3.1	1.4	0.3		17.3	13.4	5.0	0.9		3.7	1.4				5.5	1.4			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.6					2.5										.8					.6							27.4
3-4.9							.6					.3					.3											23.3
5-6.9																	.3	.3										2.9
7-8.9																		.3										5.8
9-10.9																		.3										1.2
11-12.9																												0.9
13-14.9																												
15-16.9																												0.3
17-18.9																												
19 +																												
																										.3	37.9	38.2
Σ	0.6					2.5	0.6					0.3				0.8	0.6	0.9			0.6					0.3	37.9	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.10 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 October (1956,1957,1958)

AVERAGE TOTAL HOURS 1061

IR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
.9	1.8	1.6			.3			8.3	8.1	5.1	3.5	2.7			3.8	15.3	5.6	1.6	.8	.3		.5	2.4	2.7	.3				.5																																		65.2
9		1.3	.5	.5				2.7	9.4	4.0	3.5	1.1	.3		3.2	4.0	4.0	2.2	1.1	1.1			1.8	3.8					.3	.3																																	45.1
9								.3	3.5	3.2	.5		.5			1.8	2.4	1.0	.5	.3			.3	.3	.3	.5	.5			.3	.3	.3																															27.4
9									1.1	2.2			.3			.5	1.0	.8					.3			.3					.3																																7.4
.9										.8	.3	1.3	.3				.3		.5					.8																																							4.3
2.9										.8	1.3						.3																																														2.4
4.9																		.3	.5																																												0.8
6.9																																																															
8.9																																																															
0.9																																																															
2.9																																																															
4.9																																																															
6.9																																																															
+																																																															
Σ	1.8	2.9	0.5	0.5	0.3			11.3	22.1	16.1	9.1	5.1	1.4		7.0	21.6	14.2	6.5	3.4	1.7		0.5	4.8	7.6	0.6	0.8	0.5		0.8	0.6	0.6	0.3																																	142.8

R.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
9						1.8					13.7	1.6				2.2					4.6	.3				.8					3.8										2.2					1.1							32.1
9							1.9				1.8	14.2	.3			.5	1.8	.3			.5	.8					.3					1.3				.3					.3	1.6	.3				1.3						27.5
9												2.9	1.1				.3					.3																				.3	.3										5.2
9								.8				.5	4.6					.3															.3										1.1				.3						7.9
.9																																																					
2.9																																																					
4.9																																																					
6.9																																																					
8.9																																																					
-																																																					
																																																				27.3	27.3
						1.8	1.9	0.8			15.5	19.2	6.0			2.7	2.1	0.6			5.1	1.4				0.8	0.3				3.8	1.3	0.3			0.3					2.5	1.9	1.7			1.1	1.6					27.3	100.0

ed on 31 Days

ludes waves of 0 to 0.9 feet

TABLE 3.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1012

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.6	.3				.3		2.8	10.8	6.4	.3	1.1		.3	1.4	8.9	.6	.8	.3	.3	
3-4.9	.3	1.1		.3	.3	.3		1.4	7.5	2.2	2.5	.8	.8			7.2	4.2	4.2	.8	.6	.3
5-6.9		.3							4.4	1.7	1.7	.8	.6	.3		1.7	3.1	2.5	1.1	.6	
7-8.9			.3						1.7	2.2	.8	.3	.3			.8	1.4	.6	.3		
9-10.9			.3							1.1	.6					.3	1.4	.3			
11-12.9									.3		.8	.6	.3				.3				
13-14.9											.3	.3					.3				
15-16.9											.3							.6			
17-18.9											.3										
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	0.9	1.7	0.6	0.3	0.3	0.6		4.2	24.7	13.6	7.6	3.9	2.0	0.6	1.4	18.9	11.3	9.0	2.5	1.5	0.3

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	1.4	10.3	3.1	1.4	1.1				3.9	.6											
3-4.9	.8	4.2	4.4	.8																	
5-6.9	.3	.6	.8	.3																	
7-8.9			.6																		
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	2.5	15.1	8.9	2.5	1.1				3.9	0.6											

DIR.	SSW							S							SSE						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	1
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	
1-2.9																					
3-4.9																					
5-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ																					

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						3.7	.3				10.6	.6				.6					2.2				
3-4.9						.6	2.0	.3			2.2	7.8	.6				.8				.8	.6			
5-6.9							1.7					.8	.6												
7-8.9								2.5					1.1												
9-10.9								.6					.3				.3								
11-12.9									.3																
13-14.9														.3											
15-16.9																									
17-18.9																									
19 +																									
Σ						4.3	4.0	3.4	0.3		12.8	9.2	2.6	0.3		0.6	1.1				3.0	0.6			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.3					1.7					.8					2.2					1.4							24.4
3-4.9	.3	.6				.6					.3						1.7					.3						19.5
5-6.9																												3.1
7-8.9																												3.6
9-10.9																												1.2
11-12.9																												0.3
13-14.9																												0.3
15-16.9																												
17-18.9																												
19 +																												
																										.5	47.1	47.6
Σ	0.6	0.6				2.3					1.1					2.2	1.7				1.4	0.3				0.5	47.1	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1129

DIR.	NNW							NW							WNW						
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.3	2.2	.5	.3				5.1	6.2	1.8	1.3	1.1			3.2	4.8	2.9	1.3	1.6	.5	1.3
3-4.9								1.8	8.9	4.0	1.6	1.1	.5		2.4	8.3	2.9	1.8	3.2	.8	.3
5-6.9								.3	2.4	2.2	1.3	.8				4.0	4.3	2.4	1.6	1.3	
7-8.9									.5	.5	1.3	.8				1.6	3.8	2.9	.8		
9-10.9										.3	.3					.3	.8	1.3	.3		
11-12.9																	.8				
13-14.9										.3	.3										
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	0.3	2.2	0.5	0.3				7.2	18.0	9.1	6.1	3.8	0.5		5.6	19.0	15.5	9.7	7.5	2.9	1.

DIR.	W							WSW							SW						
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	3.2	7.0	3.5	1.8	1.3	.3			.3	1.1	.3	.3									
3-4.9	2.7	3.8	2.2	.5	.5		.3														
5-6.9	.3	2.4	.3	.5	.5																
7-8.9		.8	1.3	.5	.5																
9-10.9		.3	.5	1.1	.3																
11-12.9			.5	.3	.3	.3															
13-14.9				.8	.3																
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	6.2	14.3	8.3	5.5	3.7	0.6	0.3		0.3	1.1	0.3	0.3									

DIR.	SSW							S							SSE							Σ
Ts	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
Hs	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																						53.5
3-4.9								.3	.3	.5	.3											49.0
5-6.9																						24.6
7-8.9																						15.3
9-10.9																						5.5
11-12.9																						2.2
13-14.9																						1.7
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ								0.3	0.3	0.5	0.3											151.8

SEA

DIR.	N					NNW					NW					WNW					W				
Ts	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
Hs	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						2.4					9.7					1.3					3.2				
3-4.9						1.4	2.3				2.4	5.4	.5			.3	.8				.5	.3			
5-6.9							.3					1.6													
7-8.9								.8					.8					.3					.5		
9-10.9													.5												
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						3.8	2.6	0.8			12.1	7.0	1.8			1.6	0.8	0.3			3.7	0.3	0.5		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
Ts	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
Hs	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.3					2.9					.8					1.6					2.2							24.4
3-4.9						.3	1.6				.3	.3				.5	1.1				.5	1.6						20.1
5-6.9							.5										.3					.3						3.0
7-8.9			.3					.8															.3					3.8
9-10.9																												.5
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																										4.0	44.2	48.2
Σ	0.3		0.3			3.2	2.1	0.8			1.1	0.3				2.1	1.4				2.7	1.9	0.3			4.0	44.2	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 3.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 3 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 10,753.56

DIR.	NNW							NW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.43	96	.17	.13	.02	05		2.76	9.68	8.41	1.33	.82	.04	.02
3-4.9	.12	.49	29	.16	.07	.05		159	5.83	275	1.29	45	.20	.02
5-6.9		.16	.12	.12	.09			07	220	149	.57	27	.14	
7-8.9		.02	.07	.02					.43	.90	32	.22	.07	
9-10.9			.07						.07	.39	.24	.21	.05	
11-12.9									.02	.17	.24	.07	.07	
13-14.9										.10	.25	.07		
15-16.9											.02	.02		
17-18.9											.07			
19-20.9														
21-22.9														
23-24.9														
25-26.9														
27 +														
Σ	.55	1.63	.72	.43	.18	.10		4.42	18.23	14.21	4.33	2.13	.60	.04

DIR.	WNW							W						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	2.92	6.95	2.74	1.22	.83	35	.25	1.53	2.96	2.19	1.02	.41	10	.02
3-4.9	147	4.98	3.16	1.64	.89	.72	.07	1.40	2.73	1.82	53	.35	.10	.02
5-6.9	.07	193	220	1.07	.61	23	05	.23	1.75	1.10	.50	.36	.13	
7-8.9		42	1.14	.62	23	.09		.02	.44	55	.48	.14		
9-10.9		.09	.32	.27	.09				.12	38	.18	.05		
11-12.9			.18	.09	.02	.05			.10	.42	.12	.07	.02	
13-14.9			.05	.09	.07					.05	.10	.02		
15-16.9				.07	.04					.13	.02			
17-18.9			.02							.05	.05	.02		
19-20.9						.02					.05	.02	.02	
21-22.9														
23-24.9											.05	.02	.02	
25-26.9														
27 +														
Σ	14.46	14.35	9.80	5.07	2.79	1.46	.37	3.18	8.10	6.69	3.10	1.46	.39	.04

DIR.	WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.64	.86	.53	.12	.10			.09	.94	.23				
3-4.9	.46	.57	.29	.17				.07	.09					
5-6.9	.05	.43	.17	.07					.12	.02	.05			
7-8.9		.14	.12	.05					.02	.05	.02			
9-10.9		.02	.10	.05		.02			.05					
11-12.9		.05	.12	.02										
13-14.9			.02											
15-16.9			.02	.02		.02								
17-18.9				.02	.02									
19-20.9				.02										
21-22.9														
23-24.9														
25-26.9														
27 +														
Σ	1.15	2.07	1.37	.54	.12	.04		.16	1.22	.30	.07			

DIR.	SSW							S								
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10
1-2.9	.02							.02	.04	.04						
3-4.9	.07	.16						.12	.07	.11	.02					.02
5-6.9		.05			.02			.05	.02			.02				
7-8.9			.02	.02					.07		.02					
9-10.9									.02	.05						
11-12.9																
13-14.9																
15-16.9																
17-18.9																
19-20.9																
21-22.9																
23-24.9																
25-26.9																
27 +																
Σ	.09	.21	.02	.02	.02			.19	.22	.20	.04	.02				.02

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9	.02					2.18	.09				11.17	.52	.02			1.98	.02				2.66	.12			
3-4.9	.02	.02				.58	2.39	.05			1.99	12.14	.23			.58	1.54	.10			.66	.85			
5-6.9		.02					.79	33				3.17	1.04			.07	.37	.02				.14	.02		
7-8.9								1.51				.09	5.71				.05	.28					.20		
9-10.9								.34	.17				1.22	.13			.02								
11-12.9								.02	.45				.09	.26											
13-14.9														.15											
15-16.9									.09					.14											
17-18.9																									
19 +																									
Σ	.04	.04				2.76	3.27	2.22	.71		13.16	15.92	8.31	.68		2.63	2.00	.40			3.52	1.11	.22		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.53					2.14	.05				.18					1.99					.05							24.72
3-4.9	.17	.42	.02			.40	1.29	.05			.15	.36				.35	1.25	.10			.11	.62	.07					26.49
5-6.9		.09					.12	.07	.02			.14	.02				.33	.05				.24						7.05
7-8.9			.16				.02	.32				.04	.21					.88				.18	.27	.02				9.94
9-10.9								.02					.09	.02				.10	.02				.17					2.27
11-12.9			.07					.02					.05	.05				.14	.12					.02				1.29
13-14.9									.05					.14				.05	.16				.02	.07				.64
15-16.9														.05				.02	.02					.02				.34
17-18.9																			.02									.02
19 +																												
																										.94	26.30	27.24
Σ	.70	.51	.25			2.54	1.48	.48	.07		.33	.54	.57	.26		2.34	1.56	1.34	.34		1.16	1.04	.53	.13		.94	26.30	100.00

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1161

DIR.	NNW							NW							WNW							W							WSW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	2.2	1.1	.3	.3		.3		1.8	1.3	5.9	.3	.8	.3	.3	3.5	3.5	.8		.8	.3		4.8	2.2	3.5	.3	.5									
3-4.9	1.8	1.8	.8			.3		2.9	4.0	3.5	1.3	1.1			6.7	8.3	7.3	2.7	.5	1.1		3.8	5.9	3.5	1.3	.5	.3		.8	.5					
5-6.9		.5	1.1	.3		.5		.5	1.1	.5	.5					4.6	5.6	1.6	1.6	.5		.5	5.6	3.8	1.1	1.3			.3						
7-8.9			.5						.8	1.1	1.1	.3				1.6	1.6	1.3	.3			.3	1.6	2.2	1.8	.3			.3	.5					
9-10.9										.5	.3						2.4	1.3					.5	.5	.5										
11-12.9																							.3	.8				.3							
13-14.9																								.5											
15-16.9																								.3											
17-18.9																											.3								
19-20.9																									.3										
21-22.9																																			
23-24.9																																			
25-26.9																																			
27 +																																			
Σ	4.0	3.4	2.7	0.6		1.1		5.2	7.2	11.5	3.5	2.2	0.3	0.3	10.2	18.0	17.7	6.9	3.2	1.9		9.4	16.1	15.1	5.3	2.6	0.6	0.3	1.4	1.0					

DIR.	SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.5		.3					.3																					36.2
3-4.9	.3	.5	.5					.5								.3													62.8
5-6.9																													31.5
7-8.9									.3																				15.9
9-10.9									.3																				6.3
11-12.9											.3																		1.7
13-14.9										.3																			.8
15-16.9																													.3
17-18.9																													.3
19-20.9																													.3
21-22.9																													
23-24.9																													
25-26.9																													
27 +																													
Σ	0.8	0.5	0.8					0.8	0.6	0.3	0.3					0.3													156.1

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						3.2					9.7	.5									.8				
3-4.9							.8				1.1	9.7									.5	1.1			
5-6.9							.3					1.6													
7-8.9								.5					1.3												
9-10.9								.3					.3					.3					.3		
11-12.9														.3											
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						3.2	1.1	0.8			10.8	11.8	1.6	0.3				0.3			1.3	1.1	0.3		

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						.8										1.8					3.5	.3						20.6
3-4.9	.3	1.1				1.6	1.8					.5				.5	2.2					2.4						23.6
5-6.9		.3										1.1	.3									.8						4.4
7-8.9			.3										.5				.3	1.1				.3	1.1					5.4
9-10.9																		.3					.8					2.3
11-12.9																							.5	.5				1.3
13-14.9																												
15-16.9																			.3									.3
17-18.9																												
19 +																												
																										.5	41.6	42.1
Σ	0.3	1.4	0.3			2.4	1.8					1.6	0.8			2.3	2.5	1.4	0.3		3.5	3.8	2.4	0.5		0.5	41.6	100.0

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1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 846

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9								.6	3.7	8.4					1.1	.9	.3	.3	.3	.9		1.4	3.1	1.1		.6	1.1			1.1						.6	.6	1.7							.3																			2
3-4.9								2.6	3.4	1.1	.6				3.7	4.3	.8	.6	2.3	1.1	.6	3.1	2.6	3.7	2.0	2.0	.3		1.1	.3								.9												.3														3
5-6.9									1.4	.6		.3				4.3	4.9	1.7	.6				7.2	2.3	1.1	1.1			.9	.9		.3					.3																											2
7-8.9									1.1	1.7	.6	.3	.3				1.1	1.1					1.4	2.3	.9	.6	.3			1.4	.6						.3																											1
9-10.9										.9	.9	.9											2.6	1.7	.9	.3																																						8
11-12.9										.3	.9												.6	.6	.6																																							3
13-14.9																								.6	1.1		.3																																					2
15-16.9																								.6	.3																																							0
17-18.9																																																																
19-20.9																																																																
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ								3.2	9.6	13.0	3.0	1.5	0.3		4.8	9.5	7.1	3.7	3.2	2.0	0.6	4.5	17.5	12.9	6.9	4.6	2.0		2.0	3.7	0.6	0.3				0.6	1.2	2.6							0.3					0.3														12

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						2.3					8.6	.3				.3					1.1					1.7					1.7	.3									1.7					1.1							19.1
3-4.9						.9	2.9				2.6	7.0				.3	.6				.6	.6					.9					3.4				.3	.3				.6	1.1	.3				2.0						24.4
5-6.9							.9					1.4															.6	.3									.3					2.0					.6	.3					6.4
7-8.9								1.7					2.6					.3					.3										.9										1.7					1.4					8.9
9-10.9								.3	.3																																		.3					.3					1.2
11-12.9									.3					.6																								.6	.3				.3	.3									2.4
13-14.9									.6					.6																									.6									.9					2.7
15-16.9														.3																									.3										.3				0.9
17-18.9									.3																																												0.3
19 +																																																					
																																																			.3	33.4	33.7
Σ						3.2	3.8	2.0	1.5		11.2	8.7	2.6	1.5		0.6	0.6	0.3			1.7	0.6	0.3			1.7	1.5	0.3			1.7	3.7	0.9			0.3	0.6	0.6	1.2		2.3	3.1	2.6	0.3		1.1	2.6	2.9	0.3		0.3	33.4	100.0

[1] Based on 28-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 4.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1111

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.5	.5						6.2	8.9	7.0	4.0	.8	1.1		2.7	2.4	2.7	1.1	1.8	.8		3.8	1.6	4.6	.5	.8	.3		1.1	2.2	.5	.8	.3	.3									.3							.3							.3							58.2
3-4.9		.5						3.8	6.5	4.3	2.7	.8	.5	.3	3.5	9.9	1.8	2.7	.5	.8		2.7	2.9	1.3	.8	.3			.3	.8	.8		.3										.5							.3							.3							49.9
5-6.9								.5	3.5	2.9	2.4	.5	.8			2.7	3.8	1.6	.8	.3		.3	.5									.3							.3					.3							.3		.3												22.1
7-8.9									.8	.8	1.1	.8					1.1	.5					1.3			.3	.3											.5							.5							.3													8.3
9-10.9										1.1	.5	1.3	.3										.3	.8	1.1																				.3							.3													6.0
11-12.9										.5	.8													.3	.3	.3																																						2.2
13-14.9										.3	.8	.3												.3																																								1.7
15-16.9																								.3		.3																																						0.6
17-18.9																																																																
19-20.9																									.3																																							0.3
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ	0.5	1.0						10.5	19.7	16.9	12.3	4.5	2.7	0.3	6.2	15.0	9.4	5.9	3.1	1.9		0.8	6.6	7.6	3.0	2.0	0.6		1.4	3.0	1.3	1.1	0.6	0.3				0.5	0.3				0.8	0.3	0.8					0.6	0.3	0.6	0.3				0.6							149.3

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						.5					6.7	.8				.5					2.2					.3					2.2										3.2					.8							17.2
3-4.9						1.9	4.8				9.9	15.1	.3			.3	.5				.5	.8					.3				.3		.3			.3					.3	1.6					.8						38.0
5-6.9							1.3					5.4																				.3															.5	.3					7.8
7-8.9								1.8				.3	4.3					.3															.8					.3					.3					.8					8.9
9-10.9								.3					1.1	.3																													.5										2.2
11-12.9									1.1					.5																																			.5				2.1
13-14.9																																																	.3				0.3
15-16.9														.3																																							0.3
17-18.9																																																					
19 +																																																					
																																																			.8	22.4	23.2
Σ						2.4	6.1	2.1	1.1		16.6	21.6	5.7	1.1		0.8	0.5	0.3			2.7	0.8				0.3	0.3				2.5	0.3	1.1			0.3		0.3			3.5	1.6	0.8			0.8	1.3	1.1	0.8		0.8	22.4	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 4.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 888

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9								2.2	12.3	5.6	1.1	2.2	.6		2.8	10.0	5.8	2.8	.6	.6	.3
3-4.9								.8	10.8	4.4	2.2	.8			.6	2.2	3.3	2.5	1.7	.6	.3
5-6.9									1.9	2.5	2.8					1.4		.3			
7-8.9									.3	.6						.6	.8	.3		.3	
9-10.9																.3	.3		.6		
11-12.9																	.3	.3			
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ								3.0	25.3	13.1	6.1	3.0	0.6		3.4	14.5	10.5	6.2	2.9	1.5	0.6

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	2.5	1.9	1.4	.8		.3		1.7	1.7		.6										
3-4.9	1.1	3.1	1.1	.8	.3	.3		1.1	.8	1.1											
5-6.9	.3	1.1							.3							.3					
7-8.9		.8	.6			.3			.6	.6											
9-10.9			1.1	.8		.3															
11-12.9			1.1	.3	.3																
13-14.9			.6	.3	.3					.3	.3										
15-16.9																					
17-18.9			.3	.3																	
19-20.9					.6																
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	3.9	6.9	6.2	3.3	1.5	1.2		2.8	3.4	2.0	0.9					0.3					

DIR.	SSW							S							S		
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12
1-2.9																	
3-4.9									.3								
5-6.9																	
7-8.9																	
9-10.9																	
11-12.9																	
13-14.9																	
15-16.9																	
17-18.9																	
19-20.9																	
21-22.9																	
23-24.9																	
25-26.9																	
27 +																	
Σ									0.3								

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						2.0	.6				8.1	.8				.3					1.4	.3			
3-4.9						.3	4.2				9.5	18.1	.8			.6	.3					.6			
5-6.9							1.1					3.1										.3			
7-8.9								.8					7.2					.3					.3		
9-10.9								.3					2.2												
11-12.9									.8				.3	.8											
13-14.9									.3					.6											
15-16.9																									
17-18.9																									
19 +																									
Σ						2.3	5.9	1.1	1.1		17.6	22.0	10.5	1.4		0.9	0.3	0.3			1.4	1.2	0.3		

DIR.	WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						.6					.6										.8							15.5
3-4.9	.3	.3				1.4	1.1				.6	.8				1.9	1.7				.6	.8	.3					44.2
5-6.9		.3					.3					.3					.8											6.2
7-8.9			.3					.8										.8					.6					11.1
9-10.9																												2.5
11-12.9																												1.9
13-14.9																												0.9
15-16.9																												
17-18.9																												
19 +																												
																											17.7	17.7
Σ	0.3	0.6	0.3			2.0	1.4	0.8			1.2	1.1				1.9	2.5	0.8			1.4	0.8	0.9				17.7	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 715

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9								1.1	11.0	9.4	3.2	.5	.3		2.4	8.6	5.1	.8	.8	.5	.3
3-4.9								.3	5.9	1.6	.5	.5	.3		.5	4.6	2.9	1.6	.8	.5	.3
5-6.9									.8	1.1	1.3	.3				1.1	1.3	.3		.3	
7-8.9																	1.6	.8	.3	.3	
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ								1.4	17.7	12.1	5.0	1.3	0.6		2.9	14.3	10.9	3.5	1.9	1.6	0.6

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.8	.8	1.8	1.1				1.3	2.2	.5					1.8						
3-4.9	.8	2.4	1.8	.5	.5			.3	.5												
5-6.9		.3	.5						.3												
7-8.9			1.1	.3					.3	.5											
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.6	3.5	5.2	1.9	0.5			1.6	3.3	1.0					1.8						

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9								.5			.3											55.1
3-4.9								.3	.3	.5												28.2
5-6.9																						7.6
7-8.9																						5.2
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ								0.8	0.3	0.5	0.3											96.1

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						3.0					12.1	.3					.3				1.8				
3-4.9						.6	2.1				1.8	11.3				.5	.3				.8	.3			
5-6.9							.8					4.6	4.3												
7-8.9								.3					11.8												
9-10.9													2.2												
11-12.9													.5	.8											
13-14.9														.3											
15-16.9														.3											
17-18.9																									
19 +																									
Σ						3.6	2.9	0.3			13.9	16.2	18.8	1.4		0.5	0.6				2.6	0.3			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						2.4										.5					2.2							22.6
3-4.9		.5				2.4						.5									.3	.5						21.9
5-6.9																	.8											10.5
7-8.9																												12.1
9-10.9																												2.2
11-12.9																												1.3
13-14.9																												0.3
15-16.9																												0.3
17-18.9																												
19 +																												
																											28.8	28.8
Σ		0.5				4.8						0.5				0.5	0.8				2.5	0.5					28.8	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 618

DIR.	NNW							NW							WNW							W						
T_s	6	8	1C	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	1C	12	14	16	18	+	8	1C	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9								3.1	15.6	17.8	3.3	2.8				4.7	4.4	2.8	2.5	1.1		1.1						
3-4.9								.3	13.1	2.8	1.7	.3				.3	1.7	.3				1.1	1.1	2.5				
5-6.9									1.1	.3																		
7-8.9																												
9-10.9																												
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19-20.9																												
21-22.9																												
23-24.9																												
25-26.9																												
27 +																												
Σ								3.4	29.8	20.9	5.C	3.1				5.C	6.1	3.1	2.5	1.1		2.2	1.1	2.5				

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	1C	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																																				59.2
3-4.9																																				25.2
5-6.9																																				1.4
7-8.9																																				
9-10.9																																				
11-12.9																																				
13-14.9																																				
15-16.9																																				
17-18.9																																				
19-20.9																																				
21-22.9																																				
23-24.9																																				
25-26.9																																				
27 +																																				
Σ																																				85.8

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	1C	12	4	6	8	1C	12	4	6	8	1C	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9											6.7	2.2									.6				
3-4.9						.3	.3				14.2	20.0	.3			.3					.8				
5-6.9												12.0	1.7												
7-8.9								.6					19.5												
9-10.9								.6					1.9	1.9											
11-12.9									1.1				.3	.6											
13-14.9														.3											
15-16.9									.6																
17-18.9																									
19 +																									
Σ						0.3	0.3	1.2	1.7		20.9	34.2	23.7	2.8		C.3					1.4				

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	1C	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9							.3									.3												10.1
3-4.9	.3																											36.5
5-6.9																												13.7
7-8.9																												20.1
9-10.9																												4.4
11-12.9																												2.0
13-14.9																												0.3
15-16.9																												0.6
17-18.9																												
19 +																												
																											12.3	12.3
Σ	0.3						C.3									C.3											12.3	100.0

[1] Based on 3C Days

[2] Includes waves of 0 to C.9 feet

TABLE 4.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1160

DIR.	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	Σ
T_s	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	6 8 10 12 14 16 18	
H_s	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	8 10 12 14 16 18 +	
1-2.9		1.1 40.9 12.1 2.9 .5	.3 1.1 .5 .3							59.7
3-4.9		.3 7.8 2.2	.3 .5 .5							11.6
5-6.9		.8 .3								1.1
7-8.9		.5								0.5
9-10.9										
11-12.9										
13-14.9										
15-16.9										
17-18.9										
19-20.9										
21-22.9										
23-24.9										
25-26.9										
27 +										
Σ		1.4 50.0 14.6 2.9 0.5	0.3 1.4 0.5 1.0 0.3							72.9

SEA

DIR.	N	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	OFFSHORE	CALM[2]	Σ
T_s	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12			
H_s	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12 +	6 8 10 12	6 8 10 12 +			
1-2.9		.3 .3	27.4 .5	.3					.3				29.1
3-4.9		.3 .3	8.6 27.7	.8 .3	.5								38.5
5-6.9		.5	4.8 3.2										8.5
7-8.9			8.9										8.9
9-10.9			1.1 .3										1.4
11-12.9			.3 .5										0.8
13-14.9													
15-16.9													
17-18.9													
19 +													
												12.8	12.8
Σ		0.6 1.1	36.0 33.0 13.5 0.8	1.1 0.3	0.5				0.3			12.8	100.0

[1] Based on 31 days

[2] Includes waves of 0 to 0.9 feet

TABLE 4.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 564

DIR.	NNW							NW							WNW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9								1.3	25.8	22.4	1.8	1.1			.5	3.2	1.1	.3	.5		
3-4.9									6.2	4.0	.8	1.3			.3	1.2	.5	.5			
5-6.9									.5	.5											
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ								1.3	32.5	26.9	2.6	2.4			0.8	4.4	1.6	0.8	0.5		

DIR.	W							WSW							SW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9																					
3-4.9																					
5-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ																					

DIR.	SSW							S							SSE							
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-2.9															.3	.5						58.8
3-4.9																.3	.3	.3	.3			16.0
5-6.9																						1.0
7-8.9																						
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ															0.3	0.8	0.3	0.3	0.3			75.8

SEA

DIR.	N					NNW					NW					WNW					W				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9						.5					15.6	2.2				.5					.3				
3-4.9						.5	1.6				7.3	32.3				.5					.3				
5-6.9							.3					3.2	5.1				.3								
7-8.9								.3				.8	5.9	.3											
9-10.9													.8												
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						1.0	1.9	0.3			22.9	38.5	11.8	0.3		1.0	0.3				0.6				

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM^2	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9																												19.1
3-4.9																												42.5
5-6.9																												8.9
7-8.9																												7.3
9-10.9																												0.8
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																											21.4	21.4
Σ																											21.4	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 4.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 September(1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 781

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9	.3	1.8	1.1	.5	.3	.3		3.2	16.9	15.1	1.6	1.1	.3		1.1	5.9	3.8	2.4	.8		
3-4.9		1.3	.8	.5	.5			.8	5.6	7.8	1.3	1.1		.3	.3	2.7	2.4	.5		.3	
5-6.9			.8	.8					1.6	2.2	1.3	1.1	.3			.8	.8	.3	.5		
7-8.9										.3	.8	.3									
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	0.3	3.1	2.7	1.8	0.8	0.3		4.0	24.1	25.4	5.0	3.6	0.6	0.3	1.4	9.4	7.0	3.2	1.3	0.3	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-2.9		1.3	4.0		.5				2.2	1.3						1.3					
3-4.9				.3	.3																
5-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ		1.3	4.0	0.3	0.8				2.2	1.3						1.3					

DIR.	SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9																.3	.3	.5	.5		.3	69.0
3-4.9																		.3	.3	.3		27.7
5-6.9																						10.5
7-8.9																						1.4
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ																0.3	0.3	0.8	0.8	0.3	0.3	108.6

SEA

DIR.	N					NNW					NW					WNW					W				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-2.9						.3					17.0	.8				.6					.8				
3-4.9						.6	.9				12.3	12.6				1.1					.3	.6			
5-6.9							.6					2.5													
7-8.9								.8					2.8												
9-10.9								.3					.3												
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						0.9	1.5	1.1			29.3	15.9	3.1			1.7					1.1	0.6			

DIR.	WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9	.3					.6										.8					.8							22.0
3-4.9																	.3					.6						29.3
5-6.9																												3.1
7-8.9																												3.6
9-10.9																												0.6
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																											41.4	41.4
Σ	0.3					0.6										0.8	0.3				0.8	0.6					41.4	100.0

[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 4.10 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 903

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9		.5	1.1	.8	.3			5.1	10.2	6.2	4.3	4.3	.5		1.8	9.7	6.5	.5	.5	.3	
3-4.9								3.5	9.7	3.2	3.8	2.2	.3	.3	.3	2.9	2.4	1.1	.3	.5	.3
5-6.9								.5	4.3	5.1	1.8	.5	.5			.5	1.1	.8	.3	.5	
7-8.9									1.6	1.3	1.1	1.6	.3				.5	.5	.5		
9-10.9									.8	.5	1.1	.3	.3								
11-12.9										.3											
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ		0.5	1.1	0.8	0.3			9.1	26.6	16.6	12.1	8.9	1.9	0.3	2.1	13.1	10.5	2.9	1.6	1.3	0.3

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-2.9	1.3	1.6	1.3	.3				.8	.8	.3	.5										
3-4.9	.3	.5						.3		.3											
5-6.9		.8	.5						.3	.5											
7-8.9		.5	.5																		
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19-20.9																					
21-22.9																					
23-24.9																					
25-26.9																					
27 +																					
Σ	1.6	3.4	2.3	0.3				1.1	1.1	1.1	0.5										

DIR.	SSW							S							SSE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-2.9																						59.5
3-4.9																						32.2
5-6.9																						18.0
7-8.9																						8.4
9-10.9																						3.0
11-12.9																						0.3
13-14.9																						
15-16.9																						
17-18.9																						
19-20.9																						
21-22.9																						
23-24.9																						
25-26.9																						
27 +																						
Σ																						121.4

SEA

DIR.	N					NNW					NW					WNW					W				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-2.9						.8	.5				14.2	1.8				.5					1.1				
3-4.9						.3	1.6				7.0	20.7	.8			.5									
5-6.9							.3					4.0	.5									.3			
7-8.9								.3					5.6												
9-10.9													.3	.3											
11-12.9																									
13-14.9																									
15-16.9																									
17-18.9																									
19 +																									
Σ						1.1	2.4	0.3			21.2	26.5	7.2	0.3		1.0					1.1	0.3			

DIR.	WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9						1.6										1.3	.3				1.3	.3						23.7
3-4.9							1.3										.3	.3				1.3						34.1
5-6.9																						.3						5.4
7-8.9																							.5					6.4
9-10.9																												0.6
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 +																												
																											29.8	29.8
Σ						1.6	1.3									1.3	0.6	0.3			1.3	1.9	0.5				29.8	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 936

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9				.3		.6		3.1	13.4	6.4	.3	1.1	.6		1.1	7.0	1.1	1.9	.3	.8		.6	5.3	7.8	1.7	.3																																						53.7
3-4.9					.6			.8	13.1	5.3	1.7	1.4	1.1		.8	2.8	6.7	2.5	.3		.3	.8	1.4	1.1	.3																																							41.0
5-6.9									3.9	6.1	3.1	1.7	.3			1.9	1.9	1.7	.8	.3	.3			.8																																								23.1
7-8.9										2.2	.8		.3	.3		.3	1.1	.3	.3																																													5.6
9-10.9									.3	.6	.8	1.1	.3				.3		.3																																													3.7
11-12.9										1.1							.3																																															1.4
13-14.9																		.6																																														0.6
15-16.9											.3		.3																																																			0.6
17-18.9												.3																																																				0.3
19-20.9																																																																
21-22.9																																																															
23-24.9																																																															
25-26.9																																																															
27 +																																																															
Σ				0.3	0.6	0.6		3.9	30.7	21.7	7.0	5.6	2.9	0.6	1.9	12.0	11.4	7.0	2.0	1.1	0.6	1.4	6.7	9.7	2.0	0.3																																						130.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE							
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	OFFSHORE	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						.6	.3				12.3	.8				.6					.3					.3					.3															.3							15.8
3-4.9						2.0	2.5				6.4	7.2	.3																												.6												19.0
5-6.9							.8					1.9																																									2.7
7-8.9								1.4					1.9																																								3.3
9-10.9								.3					.3																																								0.6
11-12.9														.3																																							0.3
13-14.9								.3						.3																																							0.6
15-16.9																																																					
17-18.9														.3																																							0.3
19 +														.3																																							0.3
																																																			.8	56.3	57.1
Σ						2.6	3.6	2.0			18.7	9.9	2.5	1.2		0.6					0.3					0.3					0.3										0.6					0.3					0.8	56.3	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1151

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-2.9	2.2	2.7	1.6	1.1	.3			4.6	5.9	2.7	1.1	.8			3.2	6.7	2.9	2.2	1.8	1.1	1.3	1.8	5.1	2.9	1.8	.8	.3																																					54.9
3-4.9	.5	1.1	.5	.5				2.4	8.6	4.3	1.3	.5	.5		3.2	9.9	4.3	2.7	4.0	1.8	.3	1.3	.5	1.1	.3	.3																	.8			.3																			51.0
5-6.9		.3	.3		.3	.3			1.8	1.6	1.6	.8	.3			4.8	7.5	5.4	3.2	.5			1.1	.8	.5																			.3	.5																			31.9
7-8.9			.8	.5					.3	.8	1.3					.8	2.2	.8					.5	1.1	1.3																																								10.4
9-10.9										.3	.3						1.6	1.1	1.1					.3																																									4.7
11-12.9										.3							.3							.3	.3																																								1.2
13-14.9																		.3																																															0.3
15-16.9																		.3																																															0.3
17-18.9																																																																	
19-20.9																																																																	
21-22.9																																																																	
23-24.9																																																																	
25-26.9																																																																	
27 +																																																																	
Σ	2.7	4.1	3.2	2.1	0.6	0.3		7.0	16.6	10.0	5.6	2.1	0.8		6.4	22.2	18.8	12.8	10.1	3.4	1.6	3.1	7.2	6.5	4.2	1.1	0.3																0.8	0.3	0.5	0.3																			154.7

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12	4 6	6 8	8 10	10 12	12 +			
1-2.9						1.9					10.5	.5				.3					2.7										1.3										1.3					1.3							19.8
3-4.9						.5	2.2				6.2	7.0				.3						.3					.3					.5									.3	.8	.3			.3	1.3						20.3
5-6.9												1.1					.3																																				1.4
7-8.9								.6					.8																																			.3					1.7
9-10.9																																																.3					0.3
11-12.9									.3																																												0.3
13-14.9																																																					
15-16.9																																																					
17-18.9																																																					
19 +																																																					
																																																			.3	55.9	56.2
Σ						2.4	2.2	0.6	0.3		16.7	8.6	0.8			0.6	0.3				2.7	0.3					0.3				1.3	0.5									1.6	0.8	0.3			1.6	1.3	0.6			0.3	55.9	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 4.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 4 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 10,168.32

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-2.9	.45	.55	.34	25	.07	.10		2.78	13.82	9.91	1.99	1.33	.31	.05	1.71	5.31	2.87	1.30	.92	.53	.16	1.51	1.91	2.36	.54	.29	.17		.41	.85	.22	.16	.02	.02		.16	.22	.19	.04				.05		.02					.06			.02				.02	.09	.02	.04	.04		.02	54.18
3-4.9	.19	.39	.17	.08	.09	.02		1.54	7.89	3.71	1.49	.83	.22	.07	1.66	4.12	2.88	1.52	.87	.56	.17	1.25	1.70	1.34	.52	.35	.07		.32	.24	.18		.02			.05	.19	.14					.08							.07	.07	.04						.05	.02	.05	.04	.02		35.28
5-6.9		.07	.18	.09	.02	.07		.12	1.89	1.97	1.23	.46	.16	.02		1.84	2.24	1.14	.65	.20	.02	.09	1.38	.72	.22	.20			.10	.15	.04	.05					.07	.04	.02					.02							.02		.02											15.51
7-8.9			.11	.04					.45	.75	.57	.25	.07	.02		.27	.83	.47	.12	.05		.02	.51	.65	.36	.10	.07		.02	.23	.14						.02	.04						.02	.04							.02												6.22
9-10.9									.09	.32	.32	.30	.07			.02	.38	.20	.17				.18	.31	.27	.02	.02																	.02	.02							.02												2.89
11-12.9										.21	.14						.07	.02					.07	.26	.12	.05		.02																		.02																		.98
13-14.9										.02	.07	.02						.07						.17	.12	.02	.02				.02	.02													.02																			.57
15-16.9											.02		.02					.02						.10	.02	.02																																						.20
17-18.9												.02															.02																																					.04
19-20.9																									.05	.05																																						.10
21-22.9																																																																
23-24.9																																																																
25-26.9																																																																
27 +																																																																
Σ	.62	1.01	.80	.46	.18	.19		4.44	24.14	16.87	5.83	3.21	.85	.16	3.57	11.56	9.27	4.74	2.75	1.34	.35	2.87	5.85	5.97	2.22	1.10	.37	.02	.85	1.47	.60	.25	.04	.02		.21	.50	.41	.06				.13	.06	.10	.02				.13	.09	.28	.04				.02	.14	.04	.09	.08	.02	.02	115.97

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					OFFSHORE	CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12		6	8	10	12	+			
1-2.9						1.28	.14				12.40	.96				.32	.02				1.09	.02				.22					.98	.02				.19	.07				.93	.02				1.01	.05						19.72
3-4.9						.68	2.02				7.24	15.71	.20			.43	.17				.32	.40				.07	.28				.47	.67	.02			.07	.48	.02			.35	.67	.07			.10	.81	.02					31.27
5-6.9							.57					3.80	1.25				.05					.05					.10	.02				.05					.02	.04				.30					.18	.05					6.46
7-8.9								.76				.09	6.05	.02				.07					.05					.05					.21					.10				.02	.32				.02	.39					8.15
9-10.9								.20	.02				.87	.23				.02					.02																				.09					.12					1.57
11-12.9									.30				.09	.37																													.02	.02				.04	.09				.93
13-14.9								.02	.07					.17																																		.07	.02				.35
15-16.9									.07					.05																														.02					.02				.16
17-18.9														.02																																							.02
19 +														.02																																							.02
																																																			22	31.13	31.35
Σ						1.96	2.75	.98	.46		19.64	20.56	8.44	.88		.75	.24	.09			1.41	.47	.07			.29	.38	.07			1.45	.74	.23			.26	.57	.16			1.28	1.04	.50	.04		1.11	1.06	.69	.13		22	31.13	100.00

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1114

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9				.3						4.0	.8						1.6			.3	
2-2.9	.8	.3	.3			.3		1.6	2.9	2.4	.8	.5			2.2	1.6	.5	.5	.3	.5	
3-3.9	.5	.5	.5		.3			2.4	3.8	1.1					3.8	6.5	1.8	1.6	1.1	.5	
4-4.9	.3	.8		.3				.3	1.8	1.8					.8	5.6	3.8	1.1	.8	.5	
5-5.9		.5	.8	.3	.3				.8	.5		.3			.3	4.6	3.5	1.6	.8	.3	
6-6.9			.8						.5		.5					2.2	1.6	1.6	1.1		
7-8.9			.3						.3	1.1	.3	.8	.3			.8	4.0	1.1	.3		
9-10.9										.5	.3						1.1	.5			
11-12.9											.3	.5									
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	1.5	2.1	2.7	0.9	0.6	0.3		4.3	10.1	11.4	3.0	2.1	0.3		7.1	21.3	17.9	8.0	4.4	2.1	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9			1.3																		
2-2.9	1.3	4.8	1.1	1.3	.8	.8	.3	1.1	.3												
3-3.9	1.1	3.2	1.8	1.6	.8			.8		.3											
4-4.9	.3	2.9	3.2	.5	.3	.3		.5	.5	.3											
5-5.9	.3	1.3	1.8	.5	.8			.3		.5											
6-6.9		.5	.5	.3	.3			.3	.3	.3											
7-8.9	.3	1.1	.5	1.8					1.1		.3										
9-10.9		.3	.3	.3			.3		.3												
11-12.9		.3	.8								.3										
13-14.9			.3							.3											
15-16.9			.5			.3															
17-18.9					.3																
19 +																					
Σ	3.3	14.4	12.1	6.3	3.3	1.4	0.6	3.0	2.5	1.7	0.6										

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																						8.3
2-2.9																						27.3
3-3.9									.3													34.3
4-4.9																						26.7
5-5.9																						20.1
6-6.9																						10.8
7-8.9																						14.4
9-10.9																						3.9
11-12.9																						2.2
13-14.9																						0.6
15-16.9																						0.8
17-18.9																						0.3
19 +																						
Σ									0.3													149.7

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	1.5										3.2										.3									
2-2.9	2.3										4.9	.4				.3					.5					.3				
3-3.9											2.9	4.0										.3				.3				
4-4.9		.5					.3					7.5					.8					.5					.3			
5-5.9												4.7																		
6-6.9		.5	.3				.3					2.6	1.3														.5			
7-8.9			.8					.3					5.1					.3												
9-10.9																							.3							
11-12.9																														
13-14.9																														
15-16.9																														
17-18.9																														
19 +																														
Σ	3.8	1.0	1.1				0.6	0.3			11.0	19.2	6.4			0.3	0.8	0.3			1.1	0.8	0.3			0.6	0.8			

DIR.	SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9											.3										.9											6.2
2-2.9	.8										.5										1.3											11.3
3-3.9											.3										.5	.4										9.0
4-4.9		1.1										.5										.9				.5						12.9
5-5.9																						.8										5.5
6-6.9								.5				.5	.3									.6	.3									7.7
7-8.9			.3															.3					1.6									8.7
9-10.9																						.3	1.3									1.9
11-12.9																								.3	.3							0.6
13-14.9																																
15-16.9																																
17-18.9																																
19 +																																
																															36.2	36.2
Σ	0.8	1.1	0.3					0.5			1.1	1.0	0.3					0.3			2.7	3.0	3.2	0.3	0.3	0.5					36.2	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 836

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									1.7	8.6		.3								.3							.3			.6																																		11.8
2-2.9								1.7	1.4	.3	.6				.9	.3	.3		.9	.6		3.1	2.8	2.0		2.0	.6		.3	.9								.3																										19.0
3-3.9								.5	2.6				.3		2.3	2.3	.6	.3	.3	.6	.3	1.1	3.7	2.3	2.0	.3			.3	.6								.6																										21.0
4-4.9									1.4	.6	.3	.3			.6	3.4	2.0	1.7	.9	.9	.3	1.4	1.4	.3	.3	.9	.3				.3																																	17.3
5-5.9									.9	.9		.3				1.4	1.4	1.4	.6			.3	2.6	3.7	1.1																																							14.6
6-6.9									.3	1.4	.6	.3	.3			.3	1.7	.6					2.8	2.0	.3	.3																																						10.9
7-8.9									.9	1.1	.6	.6				2.0	1.1	1.4					2.3	2.3	1.1	.6																																						14.0
9-10.9										.9	.6					.6	.6						1.4	1.1	.9	.3																																						6.4
11-12.9										.3	.6													.6	.9	.3																																						2.7
13-14.9																								.6	.9	.3																																						1.8
15-16.9																									.6																																							0.6
17-18.9																																																																
19 +																																																																
Σ								2.2	9.2	14.1	3.3	1.8	0.6		3.8	10.3	7.7	5.4	2.7	2.4	0.6	5.9	17.0	14.9	8.1	5.0	1.2		0.6	2.1	0.3							0.9																										120.1

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.4										3.1					.3					.4										.4										.8										1.0											6.4
2-2.9	.5	.2									4.7	.3				.3					.5					.3					.7	.3									1.2										1.6	.3										10.9
3-3.9		.3				.3	.4				1.4	3.9					.5				.3										.3											.5										.6										8.5
4-4.9		.3					.7					7.6					1.0					.3					.6															.8					.3					1.1					.3					13.3
5-5.9		.2					.6					4.2					.5																									.4					.3					.8										7.0
6-6.9		.2					.3					1.5	.3				.3										.3	.3					.3														.3					.4	.3									4.5
7-8.9			.9					.9					4.9					.9															.3					.3				.3	.6										1.1									10.2
9-10.9								.6					.6																									.3															1.1									2.6
11-12.9														.3																														.6									.3	.3								1.5
13-14.9														.8																																							.3	.9								2.0
15-16.9																																																														
17-18.9														.6																																																0.6
19 +																																																													
																																																														32.5	32.5
Σ	0.9	1.2	0.9			0.3	2.0	1.5			9.5	17.5	5.8	1.7		0.6	2.3	0.9			1.2	0.3				0.3	0.9	0.3			1.4	0.3	0.6					0.6			2.0	2.0	0.6	0.6			0.9				2.6	3.2	3.1	1.2			0.3				32.5	100.0

[1] Based on 28-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 5.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1062

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9								.3	1.8	4.8	1.3	.8	.3				.5	.3	.3				.8	1.3						1.1																																			13.6
2-2.9	.5	.8						4.6	5.6	2.4	.8	1.8	.5		3.8	4.0	2.7	1.1	1.1	.5	.3	3.2	3.2	1.1	1.3	1.1	.3		.5							.3														.5								.5						42.5
3-3.9		.3						2.2	4.8	2.7	1.1	2.7	.8		1.6	4.3	1.3	.8	.5	1.1		.3	1.6				.3		.3	.5						.3														.3														27.8
4-4.9								.5	4.3	2.2	2.7	.5			.3	2.9	1.6	1.3	1.6			.5	.3	.5	.5	.3				.3	.5																				.3													21.1
5-5.9									2.2	2.2	1.3	1.1	.5			1.6	1.1	.8	.3			.3	.3	.3	.5											.3															.3													13.1
6-6.9									.8	.5	.8	.3		.3		.3	.5	.3					1.1					.3									.3															.3												5.8
7-8.9									.8	1.6	2.2	.8	.3			.3	.3	.3					1.6	1.1		.3												.3	.3																									10.2
9-10.9										.3	.5	.5				.3			.3					.5	1.1														.3																									3.8
11-12.9										.3	.8	.3				.3	.3							.3		.3	.3																																					2.9
13-14.9											.8						.3																																															1.1
15-16.9																		.3																																														0.3
17-18.9																	.3	.3																																														0.6
19 +																																																																
Σ	0.5	1.1						7.6	20.3	17.0	12.3	8.8	2.4	0.3	5.7	14.0	8.9	5.5	4.1	1.6	0.3	4.3	8.9	5.1	3.4	2.0	0.9	0.3	0.8	1.9	0.5					0.9	0.3	0.3	0.6											0.8	0.6	0.3						0.5						142.8

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9											2.2										.7																				1.9																					4.8
2-2.9	.5					.5					3.4	.3				.5					1.1					.3					.5										2.9										.3											10.3
3-3.9	.5					.8	.5				5.9	3.6										.3										.3									.3	.3										.5										13.0
4-4.9		.5					1.2					7.0					.5					.5										.5					.3					.5										1.1										12.1
5-5.9							.9					6.0					.3																																			.7										7.9
6-6.9							.6					5.6																				.3															.3					.3										7.1
7-8.9			.8					4.0				.8	10.2																																							.3	.8									16.9
9-10.9								.5				.3	2.4	.3				.3																									.3					.3					.3									4.7
11-12.9									.5					2.7																													.3																			3.5
13-14.9									.5				.3	1.3																																																2.1
15-16.9														.5																																																0.5
17-18.9																																																														
19 +																																																														
																																																														17.1	17.1
Σ	1.0	0.5	0.8			1.3	3.2	4.5	1.0		11.5	23.6	12.9	4.8		0.5	0.8	0.3			1.8	.8				0.3					0.5	1.1					0.3				5.1	0.8	0.6				0.3	0.3			0.3	2.9	1.1								17.1	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 753

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	16	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									1.7	5.8	.3		.3			1.9	.3	.3					1.1																																									11.7
2-2.9								4.4	8.1	2.2	.9	3.1			.8		5.8	1.3	1.1	.8		2.8	1.9	.6	1.3	.3																																						35.4
3-3.9								1.1	5.0	3.3	1.7	.3			.3	2.2	1.3	.6	.6			1.7	1.9	.6	.3			.3	.3								.3														.3													22.1
4-4.9									3.9	3.6	.6	.6			.3	1.1							.8		.6																																							11.5
5-5.9									.8	.6	2.2	.3				1.4						.6	.3			.3			.3								.3																											7.1
6-6.9									.8	1.4						.6							.8																																									3.6
7-8.9										.3				.3		.8			.3				.8	.3		.3	.3			.3																																		3.7
9-10.9										.3	.3	.3					.6	.3					.3	.6						.3	.6																																	3.6
11-12.9																	.6		.3					1.1	.6	.3																																						2.9
13-14.9																.3	.3						.3		.3																																							1.2
15-16.9																			.3					.3																																								0.6
17-18.9																								.6		.3																																						0.9
19 +																									.3																																							0.3
Σ								5.5	20.3	17.5	6.0	4.6	0.3	0.3	1.4	8.3	8.9	2.5	2.6	0.8		5.1	8.2	4.1	3.4	1.5	0.3	0.3	0.6	0.6	0.6						0.6														0.3													104.6

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.6										.9																				.3										.6										.3											2.7
2-2.9	.8	.4									1.3	1.1				.3					.3	.3				.3					.5					.3					.8					.3					.5											7.2
3-3.9		1.3				.3					8.1	6.0				.3					.8					.3					.8										1.7										.6											20.2
4-4.9		2.0	.6				.6					10.8					.3					1.1					.3					.3										.6					.3					.6	.3									17.8
5-5.9												7.5																																																		7.5
6-6.9												5.0	.3																			.3										.6					.3															6.5
7-8.9			1.4					1.1					7.8				.3	.3					.3										.3										.3					.3					.6									12.7
9-10.9									.3				3.3																																								.3									3.9
11-12.9									.6				.3	1.4																																																2.3
13-14.9									.6					1.7																																																2.3
15-16.9														.3																																																0.3
17-18.9																																																															
19 +																																																															
																																																														16.6	16.6
Σ	1.4	3.7	2.0			0.3	0.6	1.1	1.5		10.3	30.4	11.7	3.4		0.6	0.6	0.3			1.1	1.4	0.3			0.6	0.3				1.6	0.6	0.3			0.3					3.1	1.2	0.3			0.3	0.6	0.3			1.4	0.6	1.2								16.6	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 729

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									3.2	6.7	1.1	.3	.3			2.2	2.4	.3						1.1	.3												.5																											18.4
2-2.9								1.3	8.9	3.2	1.3	.5	1.3	.3	4.0	6.5	1.3	1.1	.5			.5				.3			.8	2.9	1.1						.5						.5																					36.8
3-3.9									4.8	3.5	2.2	.8	.3		1.1	2.2	1.8	1.3				1.3	1.1	.8		.3			.5														.3																					22.3
4-4.9									2.2	.5		.3	.3			1.6	.5			.3		.3	.8	.3	.3																																							7.4
5-5.9									1.3	.8	.5	.5				.3	.3					.3		.3	.3					.3													.3			.3																		5.5
6-6.9										.8	.5					.3	.5			.3			.3	.3	.3																			.3	.3																			3.9
7-8.9										.3	.3						.5	.5	.5				.5	.3						.3	.5																																	3.7
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ								1.3	20.4	15.8	5.9	2.4	2.2	0.3	5.1	13.1	7.3	3.2	1.0	0.6		2.4	2.7	3.1	1.2	0.6			1.3	3.5	1.6						1.0						1.1	0.3	0.3	0.3																				98.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.3					.6					4.4					.7					.6										.3																				.6											7.5
2-2.9	.5					1.0	.4				6.6	.3				1.1					.7	.8									.5										.5					.3	.3				.7					.5						14.2
3-3.9						.3	1.0					2.3					.3				2.2	.3									.3										.3																					7.0
4-4.9		.3				.3	1.5					4.3					.8																									.3										.3										7.8
5-5.9							1.3					4.0					.6																																													5.9
6-6.9		.3					1.1					3.6	2.2				.4	1.3				.3										.3																				.3	.3									10.1
7-8.9			.8				.3	1.6					10.5					.5																																			.8									14.5
9-10.9													2.2	.8				.5																																												3.5
11-12.9								.3					.5	2.4																																																3.2
13-14.9																																																														
15-16.9														.8																																																0.8
17-18.9																																																													
19 +																																																													
																																																														25.5	25.5
Σ	0.8	0.6	0.8			2.2	5.6	1.9			11.0	14.5	15.4	4.0		1.8	2.1	2.3			3.5	1.4									1.1	0.3									0.8	0.3				0.3	0.3				1.3	0.6	1.1			0.5					25.5	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 574

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									3.1	8.9	.8	1.9					1.1	.6																																															16.4
2-2.9								4.7	8.3	3.6	3.1	1.4			.6	4.4	1.1	.6	1.9	.8			1.9	.8		.3																																							33.5
3-3.9									9.5	2.2	.6	.6			.6	1.1	4.2	1.9	.8				.6																																									22.1
4-4.9									4.4	.8	.6						.3																																															6.1
5-5.9									.3	.6																																																						0.9
6-6.9										.8																																																						0.8
7-8.9																																																																
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ								4.7	25.6	16.9	5.1	3.9			1.2	5.5	6.7	3.1	2.7	0.8			2.5	0.8		0.3																																							79.8

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9											2.8										.3																																									3.1
2-2.9	.3										4.2	.5				.6	.3				.5					.3															.3										.3											7.3
3-3.9						.3					7.5	5.2														.3																																				13.3
4-4.9						.3						10.0					.3																																													10.6
5-5.9												9.3																																																		9.3
6-6.9												8.8	2.8					.3																																												11.9
7-8.9								.3				.6	17.8																																																	18.7
9-10.9								.6					5.3	2.2																																																8.1
11-12.9									.6				.3	3.9																																																4.8
13-14.9									.3					.6																																																0.9
15-16.9									.3					1.1																																																1.4
17-18.9																																																														
19 +																																																															
																																																															10.6	10.6
Σ	0.3					0.6		0.9	1.2		14.5	34.4	26.2	7.8		0.6	0.6	0.3			0.8					0.6															0.3										0.3										10.6	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 535

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									26.6	11.6	1.6								.3																																													40.1
2-2.9									11.3	3.8	1.8				1.6	.5	.3	.3																																														19.6
3-3.9									5.4	2.9	.3					.5	.3	.3																																														9.7
4-4.9									.3							.3	.3																																															0.9
5-5.9									.5																																																							0.5
6-6.9									.8	.3																																																						1.1
7-8.9																																																																
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ									44.9	18.6	3.7				1.6	1.3	0.9	0.6	0.3																																													71.9

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.4										6.7																																																			7.1
2-2.9	.7										10.0	1.3				.5					.5										.3																				.3											13.6
3-3.9		.4									3.8	8.3				.3																																														12.8
4-4.9		1.0										15.3					.8					.3																																								17.4
5-5.9		.4										8.7																																																		9.1
6-6.9		.3					.3					2.3	4.6					.3																																												7.8
7-8.9								.8					10.2																																																	11.0
9-10.9													2.7																																																	2.7
11-12.9														.5																																																0.5
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																															18.0	18.0
Σ	1.1	2.1					0.3	0.8			20.5	35.9	17.5	0.5		0.8	0.8	0.3			0.5	0.3									0.3																				0.3										18.0	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 551

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9									16.9	7.8	.3																																															.3						25.3
2-2.9									14.0	10.2	2.7	1.1			.8	.5		.3	.3																																					.5							30.4
3-3.9									6.5	3.2	1.1					.8	.5	.3																																							.5		.3	.3			13.5
4-4.9									1.1	2.7																																															.3						4.1
5-5.9									.5	.3																																																					0.8
6-6.9																																																															
7-8.9																																																															
9-10.9																																																															
11-12.9																																																															
13-14.9																																																															
15-16.9																																																															
17-18.9																																																															
19 +																																																															
Σ									39.0	24.2	4.1	1.1			0.8	1.3	0.5	0.6	0.3																																					0.5	1.1		0.3	0.3			74.1

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					ME					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9											5.6					.3																																														5.9
2-2.9	.3										8.3	.9				.5					.3																																									10.3
3-3.9	.3	.4				.5					4.4	7.5				.3					.3																																									13.7
4-4.9		.7					.8					14.1										.3																																								15.9
5-5.9												8.4																																																		8.4
6-6.9							.3					2.8	4.2																																																	7.3
7-8.9												2.2	12.8	.3																																																15.3
9-10.9													1.9																																																	1.9
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														21.3	21.3
Σ	0.6	1.1				0.5	1.1				18.3	35.9	18.9	0.3		1.1					0.6	0.3																																							21.3	100.0

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1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 September(1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 518

DIR.	NNW							NW							WNW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9		.8	.6					.3	10.8	14.7	.8	.3				.8	.8				
2-2.9		.8	.8	.3	.3			2.2	7.0	7.0	1.4	.8			.6	5.0	3.3	1.4	.3		
3-3.9		.6		.3	.3			.8	5.0	.6	.8			.6	.3	.8	1.1	.8	.3		
4-4.9		.6	1.1	.3					2.2	2.8	.8	.3	1.1				.3	.6			
5-5.9									.3	2.8	2.5	1.1	.6								
6-6.9									1.9	.3	.8	.3									
7-8.9											.3										
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ		2.8	2.5	0.9	0.6			3.3	27.2	28.2	7.4	2.8	1.7	0.6	0.9	6.6	5.5	2.8	0.6		

DIR.	W							WSW							SW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9	.6	1.9	3.9						1.7	.8						.6					
2-2.9																					
3-3.9																					
4-4.9																					
5-5.9																					
6-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	0.6	1.9	3.9						1.7	0.8						0.6					

DIR.	SSW							S							SSE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9																						39.4
2-2.9																.3	.3	.6	.6		.3	33.3
3-3.9																	.3	.3	.3			13.2
4-4.9																				.3		10.4
5-5.9																						7.3
6-6.9																						3.3
7-8.9																						0.3
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																0.3	0.6	0.9	0.9	0.3	0.3	107.2

SEA

DIR.	N					NNW					NW					WNW				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9											6.3					.3				
2-2.9						.3					9.6	.3				.5				
3-3.9						1.9	1.2				7.0	4.9								
4-4.9							2.3					9.6					.3			
5-5.9		.6					2.7					6.6								
6-6.9		.3					2.9					3.9								
7-8.9							.8	1.9					2.2							
9-10.9								.6					1.1							
11-12.9									.3											
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ		0.9				2.2	9.9	2.5	0.3		22.9	25.3	3.3			0.8	0.3			

DIR.	W					WSW					SW					SSW				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9																				
2-2.9	.3					.3					.6									
3-3.9																				
4-4.9																				
5-5.9																				
6-6.9																				
7-8.9																				
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	0.3					0.3					0.6									

DIR.	S					SSE					SE					NE					CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9																						6.6
2-2.9	.3										.3											12.5
3-3.9																						15.0
4-4.9																						12.2
5-5.9																						9.9
6-6.9																						7.1
7-8.9																						4.9
9-10.9																						1.7
11-12.9																						0.3
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					29.8	29.8
Σ	0.3										0.3										29.8	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.10 AVERAGEMonthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 883

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9									.8	2.9		2.7	.3			1.8	1.6				
2-2.9	.5	1.1		.5				6.7	12.6	4.3	2.9	2.7	.8		.8	4.8	2.7	.8	.3	.8	
3-3.9			.8	.3				2.2	5.6	2.7	2.4	1.6	.8		.8	1.3	2.4	.8	.5	.3	
4-4.9								.3	4.3	7.5	2.4	.5		.3		.8			.3	.3	
5-5.9									1.3	.8	.3	.5	.3			.3	1.1	.5			
6-6.9									.3	1.3	.3	.3	.3				.5	.3	.3		
7-8.9									.5	1.8	1.3	1.3							.3		
9-10.9									.3	.3	.5	.3									
11-12.9										.5											
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	0.5	1.1	0.8	0.8				9.2	25.7	22.1	10.1	9.9	2.5	0.3	1.6	9.0	8.3	2.4	1.7	1.4	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9																					
2-2.9	1.3	1.1	1.6	.5					.8	.5	.3										
3-3.9		.8	.5	.3																	
4-4.9		.5																			
5-5.9		.3		.3																	
6-6.9		.3	.8																		
7-8.9		.3	.3																		
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	1.3	3.3	3.2	1.1					0.8	0.5	0.3										

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9		.8																				10.9
2-2.9																						48.4
3-3.9																						24.1
4-4.9																						17.2
5-5.9																						5.7
6-6.9																						4.7
7-8.9																						5.8
9-10.9																						1.4
11-12.9																						0.5
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ		0.8																				118.7

SEA

DIR.	N					NNW					NW					WNW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	.9										4.3									
2-2.9	1.3										6.5	.3				.3				
3-3.9											4.0	6.1								
4-4.9		1.3	.3			.5						12.2					.5			
5-5.9												8.6								
6-6.9							.3					5.1	.8							
7-8.9			.3									.5	7.8							
9-10.9													1.6							
11-12.9														.5						
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	2.2	1.3	0.6			0.5	0.3				14.8	32.8	10.2	0.5		0.3	0.5			

DIR.	W					WSW					SW					SSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	.5										.6									
2-2.9	.6										.7									
3-3.9																				
4-4.9		.3										.3								
5-5.9																				
6-6.9		.3																		
7-8.9																				
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	1.1	0.6									1.3	0.3								

DIR.	S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.5										.7											7.5
2-2.9	.6										1.1											11.4
3-3.9												.3										10.4
4-4.9												.5										15.9
5-5.9												.5										9.1
6-6.9												.3										6.8
7-8.9													.5									9.1
9-10.9																						1.6
11-12.9																						0.5
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					27.7	27.7
Σ	1.1										1.8	1.6	0.5								27.7	100.0

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[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 5.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 888

DIR.	NNW							NW							WNW							W						
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+
1-1.9									8.6	6.4						3.1		.3					1.1	4.2				
2-2.9								3.1	3.6	.3	.8	1.1	.8		3.3	8.6	2.2	3.6	1.4	.5	.3		.3	.5				
3-3.9								1.7	8.1	2.5	1.4	.8	.5	.5	.8	2.5	4.4	1.7										
4-4.9								.3	3.1	3.1	1.7	.8	.3	.3	.3	1.1	4.2	1.9										
5-5.9									1.9	3.6	2.5	1.1	.3			1.9	1.7				.3							
6-6.9									.8	.8	.6	.5	.3			.3	.6	.3		.3								
7-8.9									.5	1.4	.8	.3		.3				1.4	.8									
9-10.9										1.4	.8	.5	.3															
11-12.9										.3																		
13-14.9											.3		.3															
15-16.9																												
17-18.9																												
19 +																												
Σ								5.1	26.6	19.8	8.9	5.1	2.8	1.1	4.4	17.5	13.1	9.2	2.2	0.8	0.6		1.4	4.7				

DIR.	WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	
1-1.9																																				23.7
2-2.9																																				30.4
3-3.9																																				24.9
4-4.9																																				17.1
5-5.9																																				13.3
6-6.9																																				4.5
7-8.9																																				5.5
9-10.9																																				3.0
11-12.9																																				0.3
13-14.9																																				0.6
15-16.9																																				
17-18.9																																				
19 +																																				
Σ																																				123.3

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s / H_s	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+
1-1.9	.4										3.8										.3									
2-2.9	.7	.3				.3					5.7	.9									.3									
3-3.9	.3	.3				1.1	.6				5.3	4.0																		
4-4.9		.8					1.3					7.2																		
5-5.9		.3					.9					4.7																		
6-6.9		.3					.6					2.4																		
7-8.9		.3						.5				.3	3.1																	
9-10.9								.3					1.4																	
11-12.9									.8				.3	.3																
13-14.9														.6																
15-16.9									.3																					
17-18.9																														
19 +														.3																
Σ	1.4	2.3				1.4	3.4	0.8	1.1		14.8	19.5	4.8	1.2							0.6									

DIR.	SW					SSW					S					SSE					SE					ME					CALM[2]	Σ
T_s / H_s	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+		
1-1.9											.5																					5.0
2-2.9	.3										.6					.3					.3											9.7
3-3.9											.6																					12.2
4-4.9																																9.3
5-5.9																																5.9
6-6.9												.3																				3.6
7-8.9																																4.2
9-10.9																																1.7
11-12.9																																1.4
13-14.9																																0.6
15-16.9																																0.3
17-18.9																																
19 +																																0.3
																															45.8	45.8
Σ	0.3										1.7	0.3				0.3					0.3										45.8	100.0

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1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1089

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9									2.7	1.3						2.2					.3
2-2.9	2.2	4.6	.3	.5	.3			2.2	3.8	1.3	1.6	1.1			1.8	5.4	1.3	1.1	2.2	1.3	.8
3-3.9	.3	1.3	.3	.5		.3		.5	4.0	2.2	1.3	.3	1.1		2.7	7.5	3.5	.8	2.7	1.1	.8
4-4.9		.5	.3					.3	2.9	1.3	.8	.5			.8	4.8	.8	1.8	.8	.5	.3
5-5.9		.3	.3		.3				1.8	3.5	1.3	.5				1.6	4.6	2.2	1.1		
6-6.9				.5	.5				.5	.5	1.3					1.3	2.9	2.7	.5		
7-8.9									.3	1.1	1.1	.8				1.1	2.2	.5	.3	.3	
9-10.9										.5	.3	.3					.8	1.1			
11-12.9																	.3	.3	.3		
13-14.9																		.3			
15-16.9																					
17-18.9																					
19 +																					
Σ	2.5	6.7	1.2	1.5	1.1	0.3		3.0	16.0	11.7	7.7	3.5	1.1		5.3	23.9	16.4	10.8	7.9	3.2	2.2

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9		.5	.5	.3																	
2-2.9	.8	2.9	2.7	1.6	.5	.3															
3-3.9	.8	1.1	.5	.8	.3																
4-4.9		.8																			
5-5.9		.3	.3	.3																	
6-6.9		.3	.8																		
7-8.9			.8	.8																	
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	1.6	5.9	5.6	3.8	0.8	0.3															

DIR.	SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																						7.8
2-2.9	.3	.3																				41.2
3-3.9		.3																				35.0
4-4.9		.3																				17.5
5-5.9		.3																				18.7
6-6.9		.3		.3																		12.4
7-8.9			.3																			9.6
9-10.9																						3.0
11-12.9																						0.9
13-14.9																						0.3
15-16.9																						
17-18.9																						
19 +																						
Σ	0.3	1.5	0.3	0.3																		146.4

SEA

DIR.	N					NNW					NW					WNW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	.3					.3					3.8									
2-2.9	.5		.3			.5					5.6	.3				.3				
3-3.9		.5				.8					7.3	3.1				.3				
4-4.9		.6	.3				.3					5.8								
5-5.9		.5										4.2								
6-6.9		.5					.5					2.7								
7-8.9		.5	.3					.3				.8	1.6							
9-10.9													.3							
11-12.9				.3										.3						
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	0.8	2.6	0.9	0.3		1.6	0.8	0.3			16.7	16.9	1.9	0.3		0.6				

DIR.	W					WSW					SW					SSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	.5																			
2-2.9	.6										.3									
3-3.9						.3														
4-4.9																				
5-5.9																				
6-6.9																				
7-8.9			.5										.3							
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	1.1		0.5			0.3					0.3		0.3							

DIR.	S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.6																					5.5
2-2.9	1.0										.5						.3					10.2
3-3.9	.3										.3	.3										13.2
4-4.9		.3										.5	.3									8.1
5-5.9												.3										5.0
6-6.9							.3					.3										4.3
7-8.9													.8									5.1
9-10.9													.3									0.6
11-12.9																						0.6
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					47.3	47.3
Σ	1.9	0.3					0.3				0.8	1.4	1.4				0.3				47.3	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 5.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 5 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 9,717.60

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ	
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18		
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+		
1-1.9		.07	05	02				.05	649	696	58	52	.10			1.00	.72	.12	05	05	.02	05	45	1.02	05		.02			.28	.07						.09							.07														.02						18.92	[illegible]
2-2.9	.53	.65	12	.11	.05	02		271	729	342	156	117	.28	.02	176	347	179	101	86	48	12	1.08	1.57	87	30	44	17	02	.22	.41	13	02				.02	.04	.02					.07	.02						.04							.04	07	.02	.05	.05		02	33.09	[illegible]
3-3.9	.07	22	13	09	05	.02		.95	542	224	107	.59	.32	.09	119	247	195	93	57	30	.09	.52	1.7	54	.42	14	02	02	.18	09	02					.02	02	.05					.02	.02						.02	.05							.04	02	.05	.05			22.42	74
4-4.9	02	16	12	.05				14	266	224	82	32	17	05	26	180	115	70	37	.21	05	.21	62	.36	18	12	05		.04	07	.09													.02							.02							.02				.02		13.11	[illegible]
5-5.9		.07	09	02	.05				105	138	88	.47	14			109	114	54	23	02	.02	.15	42	53	25	09			.05	.02	.04					.02	02						.02	02		.02					.02													8.86	[illegible]
6-6.9			.07	04	.04				56	.67	.45	.14	.07	02		43	.69	48	.16	.05			51	37	.07	.05		.02	02	02	.02						02							.05	.02	.02						.02												5.08	
7-8.9			02						27	.72	.57	38	.05	05		42	67	.43	.21	.02		.02	54	.46	.33	07	.02			.14	.04	.02						02	02						.02																			5.51	
9-10.9									.02	35	.27	.16	.02			.07	.26	16	.02				.17	21	.19	.02		.02		.05	05								02																									2.06	
11-12.9										12	14	.07				.02	.10	.03	.05				02	.23	12	07	02					.02																																1.00	
13-14.9											.09		02			.02	.05	.02					02	07	10	.02					.02																															.43	
15-16.9																		05						.07	05		.02																																					.19	
17-18.9																	.02	02						.05		.05																																						.14	
19 +																										.02																																						.02	
Σ	.42	1.15	.60	33	.19	.04		385	2576	1810	645	382	1.17	.23	321	1099	852	446	252	1.13	.50	205	549	478	226	109	32	.08	.51	1.08	.48	.06				.06	.19	09	04				.11	20	04	04				.06	.09	02					.04	.15	.04	.10	.10	.02	02	110.83	

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ	
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12			
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+			
1-1.9	.40					.07					392					.13					32										.13										.43										.29											5.69	
2-2.9	70	.07	.02			.22	.03				589	57				42	02				56	09				15					43	02				02					72					.07	.02				.60	.02				.04	02					10.70	16.4
3-3.9	09	27				.52	.31				480	491				.10	.07				.26	07				10					12	.02									29	07									.12	.17										12.29	28.7
4-4.9		.66	.10			09	75				.02	928					44					27					10					.18					.02					25					05					42	05			04	.02					12.74	41.4
5-5.9		.17					.53					641					11																									03					.02					.26										7.53	48.9
6-6.9		.20	.02				.60					386	137				06	16				05					.07	.02				.07	02				.04					.12	02				.10					18	.07									7.03	55.9
7-8.9		07	.44				.09	.97				43	783	02			02	.17					09										.07					02				.02	07					05				.02	.52									10.90	66.8
9-10.9								.22	02			.02	190	.27				.07																				.02					02					.02				.02	.27									2.85	69.7
11-12.9				.02				02	23				12	102																													02	.05									.02	.05	.02							1.57	71.3
13-14.9									.12				.02	42																																							.02	.07								.65	72.
15-16.9									.05					22																																																.27	72.3
17-18.9														.05																																																.05	
19 +														.02																																																.02	
																																																													27.71	27.71	
Σ	1.19	1.44	.58	.02		.90	231	121	42		1465	2548	1124	242		65	.72	40			1.14	48	.09			.25	.17	.02			.68	.29	09			.02	.06	.04			1.44	49	.13	.05		.07	.19	07			1.01	1.09	95	12	02	.08	04				27.71	100.00	

[1] Based on 365-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1131

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9																3.1	.5				
2-2.9															2.2	8.5	5.1	.8	1.3	.5	
3-3.9															1.1	5.4	3.5	.8	.5	.3	
4-4.9															.3	2.2	2.7	2.2	1.3		
5-5.9																1.6	.5	.3	.5		
6-6.9																.3	.8	.5	.5		
7-8.9																	2.0	.8	.5		
9-10.9																	.3	.3			
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															3.6	21.1	16.3	5.7	4.6	0.8	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9	1.0	4.3	6.0																		
2-2.9	3.3	7.6	7.6	1.8	2.4	.8	.3		1.1												
3-3.9	1.6	10.2	3.8	2.2	.5	.3			.8												
4-4.9	.5	8.9	4.0	2.4	.3				.3												
5-5.9		2.9	3.2	1.6	.3	.5		.3													
6-6.9		1.6	1.8	.3	.8	.3		.3	.3												
7-8.9		.3	1.8	1.6	.3				.3		.3										
9-10.9			.8	.5	.3																
11-12.9			.8																		
13-14.9					.3																
15-16.9			.3		.3																
17-18.9																					
19 +																					
Σ	6.4	35.8	30.1	10.4	5.2	2.2	0.3	0.6	2.8		0.3										

DIR.	SSW							S							SE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																.3						15.2
2-2.9																2.1						45.4
3-3.9																2.4						33.4
4-4.9															.3	.8						26.2
5-5.9																						11.7
6-6.9																						7.5
7-8.9																						8.8
9-10.9																						2.2
11-12.9																						0.8
13-14.9																						0.3
15-16.9																						0.6
17-18.9																						
19 +																						
Σ															0.3	5.6						152.1

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9											1.0					.3					.9									
2-2.9											2.3					.5					2.0					.3				
3-3.9		.3									1.9	2.3					.5					1.7								
4-4.9		.5					.3				1.5	4.3					1.0					3.8				.3	.3			
5-5.9												2.9					.8					2.1								
6-6.9												1.5					.6					.5					.3			
7-8.9												.8						.3					1.1							
9-10.9																							.3							
11-12.9																														
13-14.9																														
15-16.9																														
17-18.9																														
19 +																														
Σ		0.8					.3				6.7	11.8				0.8	2.9	0.3			2.9	8.1	1.4			0.6	0.6			

DIR.	SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.3										.4										.4											3.3
2-2.9	.3										.7										.9											7.0
3-3.9												.5									.3	1.1										8.6
4-4.9						.3						.8									.3	2.5					.3					16.2
5-5.9																						1.3										7.1
6-6.9																						.5										3.4
7-8.9																		.5				.3	1.3									4.3
9-10.9																		.3					1.1									1.7
11-12.9																																
13-14.9																																
15-16.9																																
17-18.9																																
19 +																																
																															48.4	48.4
Σ	0.6					0.3					1.1	1.3						0.8			1.9	5.7	2.4				0.3				48.4	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 956

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9																		.6	.6		
2-2.9															.6	2.8	.6	.6			
3-3.9															.3	2.8	1.4	.3			
4-4.9																1.1	2.8	.6	.6	.3	
5-5.9																	.9	1.1			
6-6.9																	.3	.3			
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															0.9	6.7	6.0	3.5	1.2	0.3	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9	1.8	5.0	12.1			.3															
2-2.9	1.9	4.8	9.7	2.8	2.6	.9		1.4	.6	1.4											
3-3.9	1.4	8.1	2.0	1.7	2.0			.6	.9												
4-4.9	.9	4.9	4.0	2.3	1.1	1.1			.3												
5-5.9		4.0	4.3	1.7	2.0	0.3															
6-6.9		2.0	1.7	1.1	.9	.6															
7-8.9		4.3	3.4	4.0																	
9-10.9		.3	3.1	.3		.3															
11-12.9		.6	.9		.3																
13-14.9			1.1	1.4	.3																
15-16.9																					
17-18.9																					
19 +																					
Σ	6.0	34.0	42.3	15.3	9.2	3.5		2.0	1.8	1.4											

DIR.	SSW							S							SE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																						20.4
2-2.9															.9	.9						32.5
3-3.9															.6	.3						22.4
4-4.9																.3						20.3
5-5.9																.3						14.6
6-6.9																						6.9
7-8.9																						11.7
9-10.9																						4.0
11-12.9																						1.8
13-14.9																						2.8
15-16.9																						
17-18.9																						
19 +																						
Σ															1.5	1.8						137.4

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9											.7					.6					1.2									
2-2.9											1.6					1.2					2.5									
3-3.9		.3									2.0	2.4				.8	.5				1.2	1.1								
4-4.9	.3	.6				.3					2.6	5.1				.3	1.0				.3	2.2				.3	.3			
5-5.9												3.9					.9					1.1								
6-6.9												2.7					1.4	.3				.5								
7-8.9												.3					.3	1.1					.6							
9-10.9																		.3												
11-12.9																		.3												
13-14.9																														
15-16.9																														
17-18.9																														
19 +																														
Σ	0.3	0.9				0.3					6.9	14.4				2.9	4.1	2.0			5.2	4.9	0.6			0.3	0.3			

DIR.	SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.3																				.7											3.5
2-2.9	.3																				1.3	.5										7.4
3-3.9		.3																			.6	1.2										10.4
4-4.9																					.3	2.0										15.6
5-5.9																						1.1										7.0
6-6.9																						.4										5.3
7-8.9																						.6	2.8									5.7
9-10.9																							2.0									2.3
11-12.9																							.9	.6								1.8
13-14.9																								.6								0.6
15-16.9																							.6									0.6
17-18.9																																
19 +																																
																															39.8	39.8
Σ	0.6	0.3																			2.9	5.8	6.3	1.2							39.8	100.0

[1] Based on 28 - 1/3 days

[2] Includes waves of C to C.9 feet

TABLE 6.3 AVERAGE M-nthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1063

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9																		.3			.5		6.9	3.6																																				.3						11.6
2-2.9															.5	4.8	1.1	1.1	.5	1.1	.8	1.3	23.2	6.4	4.0	1.8	.8		.3																														1.1						48.8
3-3.9																3.8	2.7	1.3		1.3		.8	16.9	2.7	.8	.5	.3		.3																														.5						31.9
4-4.9																2.4	2.4	1.1	1.3	.3		.3	6.7	2.9	.8	.5	.3		.3	.3																													.5						20.1
5-5.9																	2.2	.5	1.1				6.7	2.7	.5	.3																																							14.0
6-6.9																	.5	.3					1.8	2.2	.8					.3																																			5.9
7-8.9																	.3	.3	.3				.8	2.4		.5	.3				.3	.3																																	5.5
9-10.9																							.8	1.8	.8	.3						.3																																	4.0
11-12.9																																																																	
13-14.9																							.3	.3		.3																																							0.9
15-16.9																									.3																																								0.3
17-18.9																																																																	—
19 +																																																																—
Σ															0.5	11.0	9.2	4.9	3.2	2.7	1.3	2.4	64.1	25.0	8.0	4.2	1.7		0.9	0.6	0.3	0.6																													2.4						143.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9											.9					.3					1.7																														1.2											4.1
2-2.9											2.1					.7					3.6																														2.3											8.7
3-3.9		.3									3.8	2.0				1.5	1.2					.7																													1.4	.8										11.7
4-4.9		.3									6.0	3.8				2.1	2.1					1.3										.3																			.2	1.5										17.6
5-5.9											2.8	3.8				1.0	1.8					1.0																														1.0										11.4
6-6.9												4.4					1.6	.3				.6																														.7										7.6
7-8.9																		1.8					1.1																													.3	2.4									5.6
9-10.9																							1.6																														.8									2.4
11-12.9																																																					.5									0.5
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																													30.4	30.4
Σ		0.6									15.6	14.0				5.6	6.7	2.1			5.3	3.6	2.7									0.3																			5.1	4.3	3.7								30.4	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 6.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 940

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																	.6						13.1	8.9	1.7	1.1																																							25.4
2-2.9															3.1	9.2	2.5	.6	.3	.3		.8	16.7	7.8	1.9	1.1	.8																																						45.1
3-3.9																1.7	2.2	1.1	.6	.6		1.1	11.4	2.8	1.1	.8	.3																														.3	.3						24.3
4-4.9																	1.4		.3			.3	9.2	1.9	.3	.3																																						13.7
5-5.9																		1.4					3.6	1.1		.3																																						6.4
6-6.9																						.3	2.5	.8																																								3.6
7-8.9																							1.1	3.3	.3		.3																																					5.0
9-10.9																								1.9	.8	.3	.6																																					3.6
11-12.9																								.8	.8	.3																																						1.9
13-14.9																								.3																																								0.3
15-16.9																								.3		.3																																						0.6
17-18.9																									.3																																							0.3
19 +																										.3																																						0.3
Σ															3.1	10.9	6.7	3.1	1.2	0.9		2.5	57.6	29.9	7.2	4.8	2.0																														0.3	0.3						130.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.3										.6					.6					.8										.3																				.7											3.3
2-2.9	.5										1.2					1.3					1.6	.2				.3					.3																				1.3											6.7
3-3.9											1.9	1.8				1.7	1.3				1.0	1.5																													.9	.3										10.4
4-4.9	.3	.3									2.6	3.4				2.2	2.7				.2	3.1					.3																								.6	.9										16.6
5-5.9											1.4	4.6				1.1	1.7					2.4																														.8										12.0
6-6.9		.3									.3	4.6					.4					1.6	.6																													.5										8.3
7-8.9												.3						1.7					3.6																														1.1									6.7
9-10.9																							2.2																														.8									3.0
11-12.9																							.3																														.3									0.6
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																												32.4	32.4
Σ	1.1	0.6									8.0	14.7				6.9	6.1	1.7			3.6	8.8	6.7			0.3	0.3				0.6																				3.5	2.5	2.2								32.4	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 6.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 987

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9																2.8	1.1				
2-2.9															.8	6.1	1.6	2.9	1.6	1.8	.5
3-3.9																1.8	.8	1.3	.5	.3	
4-4.9																1.1	.8	.3			
5-5.9																	1.3	.3	.3		
6-6.9																	.3	.8	.5		
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															0.8	11.8	5.9	5.6	2.9	2.1	0.5

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9		16.8	13.1						1.3												
2-2.9	.5	15.5	7.1	2.7	.8	1.1			1.8	.5											
3-3.9	.3	15.1	1.6		.8				1.1	.3											
4-4.9		7.3	2.2	.8	.3																
5-5.9		4.8	.3																		
6-6.9		1.6	4.3		.3																
7-8.9			.3																		
9-10.9			.5																		
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	0.8	61.1	29.4	3.5	2.2	1.1			4.2	0.8											

DIR.	SSW							S							SE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																						35.1
2-2.9																						45.3
3-3.9																						23.9
4-4.9																						12.8
5-5.9																						7.0
6-6.9																						7.8
7-8.9																						0.3
9-10.9																						0.5
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																						132.7

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9											.4					.5					2.7					.6				
2-2.9											.6					1.0					5.6	.3				.7				
3-3.9		.3									1.1	.5				1.2	1.4				3.1	1.3					.3			
4-4.9		.3									2.5	1.0				1.3	2.8				.7	2.4					.3			
5-5.9												1.0					2.8					1.3								
6-6.9												.9					1.0	1.4				.3	.3							
7-8.9																		4.0					.8							
9-10.9																			.5					.3						
11-12.9																														
13-14.9																														
15-16.9																														
17-18.9																														
19 +																														
Σ		0.6									4.6	3.4				4.0	8.0	5.4	0.5		12.1	5.6	1.1	0.3		1.3	0.6			

DIR.	SW					SSW					S					SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9	.3																				.7											5.2
2-2.9	.5										.3										1.2											10.2
3-3.9																					.7											9.9
4-4.9																					.3	.7										12.3
5-5.9																						.3										5.4
6-6.9																						.3	.5									4.7
7-8.9																							.3									5.1
9-10.9																																0.8
11-12.9																																
13-14.9																																
15-16.9																																
17-18.9																																
19 +																																
																															46.4	46.4
Σ	0.8										0.3										2.9	1.3	0.8								46.4	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 6.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 814

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																0.9	3.2						14.0	1.0																																								19.1
2-2.9																2.2	2.6	2.2	2.2	.6			19.9	3.4																																								33.1
3-3.9																.3							16.4	2.8																																								19.5
4-4.9																							19.2	.6																																								19.8
5-5.9																							7.0	1.9																																								8.9
6-6.9																							1.9	4.7																																								6.6
7-8.9																							.3	4.4																																								4.7
9-10.9																								1.4																																								1.4
11-12.9																																																																	
13-14.9																																																																	
15-16.9																																																																	
17-18.9																																																																	
19 +																																																																	
Σ																3.4	5.8	2.7	2.2	0.6			78.7	20.2																																								113.1

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE						
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9											1.9					.2					.7										.3																				.5											3.6
2-2.9											3.5					.4					1.3					.3					.5																				.6											6.6
3-3.9											7.8	1.9				2.1	1.4				1.0	.6																																								14.8
4-4.9											12.2	4.0				3.8	2.7				.6	1.3				.3																										.3										25.2
5-5.9												1.9					2.5					.7																																								5.1
6-6.9												4.0					2.5	.8				.2	.6																																							8.1
7-8.9																		1.4					1.9																																							3.3
9-10.9																			.3																																											0.3
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														33.0	33.0
Σ											25.4	11.8				6.5	9.1	2.2	0.3		3.6	2.8	2.5			0.6					0.8																				1.1	0.3									33.0	100.0

[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 720

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																							32.5	20.5																																								53.0
2-2.9															.5	1.1	.3	.3	.3				12.2	6.1																																								20.8
3-3.9																.3	.5	.3					8.3																																									9.4
4-4.9																							9.1	.3																																								9.4
5-5.9																							4.0	1.3																																								5.3
6-6.9																								1.8																																								1.8
7-8.9																								.3																																								0.3
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															0.5	1.4	0.8	0.6	0.3				66.1	30.3																																								100.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9											1.8					.9					1.4					.3					1.1																				.3											5.8
2-2.9											4.2					1.5					2.7					.6					1.4																				.5											10.9
3-3.9											4.4	1.3				1.3	1.7				2.0	1.2				.4																																				12.3
4-4.9											4.8	2.6				1.0	3.3				1.2	2.4				.3																										.3										15.9
5-5.9												2.0					2.4					1.8																																								6.2
6-6.9												1.8					1.5	.5				1.3	1.1																																							6.2
7-8.9												.3						.3																																												0.6
9-10.9																																																														
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																													42.1	42.1
Σ											15.2	8.0				4.7	8.9	0.8			7.3	6.7	1.1			1.6					2.5																				0.8	0.3									42.1	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 757

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9															.3						
2-2.9																1.1	2.2	.5			
3-3.9																					
4-4.9																					
5-5.9																					
6-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															0.3	1.1	2.2	0.5			

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9		16.0	22.2																		
2-2.9		13.8	11.4	.8																	
3-3.9		11.6																			
4-4.9		16.9	1.1																		
5-5.9		1.1																			
6-6.9		1.1	1.1																		
7-8.9			.5																		
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ		60.5	36.3	0.8																	

DIR.	SSW							S							SE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																						38.5
2-2.9																						29.8
3-3.9																						11.6
4-4.9																						18.0
5-5.9																						1.1
6-6.9																						2.2
7-8.9																						0.5
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																						101.7

SEA

DIR.	N					NNW					NW					WNW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9											1.0					1.0				
2-2.9						.3					2.6					2.1				
3-3.9											1.8	2.1				1.3	1.1			
4-4.9											1.7	4.4				.8	2.2			
5-5.9												2.5					1.2			
6-6.9												1.4					.6			
7-8.9												.5								
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ						0.3					7.1	10.9				5.2	5.1			

DIR.	W					WSW					SW					SSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9	2.2										.3									
2-2.9	4.2										.5									
3-3.9	2.6	1.1																		
4-4.9	.9	2.4																		
5-5.9		1.4																		
6-6.9		.5	.3																	
7-8.9		.3	.5																	
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	9.9	5.7	0.8								0.8									

DIR.	S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9																						4.5
2-2.9																						9.7
3-3.9																						10.0
4-4.9																						12.4
5-5.9																						5.1
6-6.9																						2.8
7-8.9																						1.3
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					54.2	54.2
Σ																					54.2	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 September (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 842

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9																.8	1.1	.3			
2-2.9															.3	8.3	3.3	1.1	.8	.6	
3-3.9																5.3	1.1	.6	.3	.6	
4-4.9																2.2	.8	1.7	.3		
5-5.9																.3					
6-6.9																.6	.3				
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															0.3	17.5	6.6	3.7	1.4	1.2	

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9		26.6	20.8																		
2-2.9	1.1	10.4	13.4	1.9	.6	.3															
3-3.9		1.5	.6	.8																	
4-4.9		3.3	.3																		
5-5.9		.8																			
6-6.9			.6																		
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	1.1	42.6	35.7	2.7	0.5	0.3															

DIR.	SSW							S							SE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																.5	.5	.8	.8		.3	52.5
2-2.9																						42.1
3-3.9																				.3		11.1
4-4.9																						8.6
5-5.9																						1.1
6-6.9																						1.5
7-8.9																						
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																0.5	0.5	0.8	0.8	0.3	0.3	116.9

SEA

DIR.	N					NNW					NW					WNW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9											1.3					.8				
2-2.9						.3					2.9					1.3				
3-3.9											4.1	2.5				1.7	1.3			
4-4.9						.3					5.3	5.2				1.8	2.8			
5-5.9												3.2					1.7			
6-6.9												1.3					.6			
7-8.9																		1.1		
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ						0.6					13.6	12.2				5.6	6.4	1.1		

DIR.	W					WSW					SW					SSW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9	1.2					.5														
2-2.9	2.4					.6					.3									
3-3.9	1.2	.7																		
4-4.9	.2	1.5					.3													
5-5.9		.8																		
6-6.9		.3	.3																	
7-8.9			.3																	
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	5.0	3.3	0.6			1.1	0.3				0.3									

DIR.	S					SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9											.3											4.1
2-2.9											.5											8.3
3-3.9																						11.5
4-4.9																						17.4
5-5.9																						5.7
6-6.9																						2.5
7-8.9																						1.4
9-10.9																						
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					49.1	49.1
Σ											0.8										49.1	100.0

[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.1C AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 922

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9															.5	2.1	.5	.3				18.8	24.0																																									46.2
2-2.9															1.7	3.8	1.3	.5	.5	.3	.3	13.2	10.7	.8		.3	.8			.5																													.3							35.0
3-3.9															1.1	1.3	1.1	.3	.5	.5		11.0																																					.5							16.3
4-4.9															.3	.5	1.1	1.3	.5			9.7	1.1			.3	.3																																							15.1
5-5.9																.3						2.2	1.1	.3																																										3.9
6-6.9																.3	.8	.3				1.8	1.1				.3																																							4.6
7-8.9																.3	.8					.3	1.1			.3																																								2.8
9-10.9																																																																	
11-12.9																																																																	
13-14.9																																																																	
15-16.9																																																																	
17-18.9																																																																	
19 +																																																																	
Σ															3.6	8.6	5.6	2.7	1.5	0.8	0.3	57.0	39.1	1.1		.9	1.4			0.5																													0.8							123.9

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9											2.0					.4					3.6										.5																				.7											7.2
2-2.9											2.9					1.0					8.4					.3					.6																				1.1											14.3
3-3.9											2.5	.7				.7	1.3				4.3	.8																														.3										10.6
4-4.9											2.0	1.4				.6	2.7				.1	1.6																														.3										8.7
5-5.9												1.7					1.9					1.0																														.4										5.0
6-6.9												2.1					1.0	.5				.6																														.4										4.6
7-8.9																	.3	1.1					.8																													.3	.5									3.0
9-10.9																																																														
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																													46.6	46.6
Σ											9.4	5.9				2.7	7.2	1.6			16.4	4.0	0.8			0.3					1.1																				1.8	1.7	0.5								46.6	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 6.11 AVERAGE MonthlyHEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1018

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																3.6	1.6	.3					8.9	19.0																																	1.4							34.8
2-2.9															1.1	9.0	2.6	3.1	1.1	.3	.3		14.2	6.9	3.3	1.4	.6																														2.2	1.9						48.0
3-3.9																3.9	3.1	.8	.6		.3		13.9	4.2	1.1	.3																																5.0						33.2
4-4.9																1.9	2.2	2.2	.3				3.6	2.8	.3																																	1.9						15.2
5-5.9																.6	.6		.3				1.4	.3																																								3.2
6-6.9																	.6			.3			.6	.8																																								2.3
7-8.9																	.3	.3	.6					1.9	1.1																																							4.2
9-10.9																																																																
11-12.9																								.6																																								0.6
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															1.1	19.0	11.0	6.7	2.9	0.6	0.6		42.6	36.5	5.8	1.7	0.6																														3.6	8.8						141.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE						
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9											.8					.6					1.1																														.3											2.8
2-2.9											1.7					1.0					2.1																														.6					.3						5.7
3-3.9											2.2	.8				.7	.8				1.2	.6																													.7											7.0
4-4.9						.3	.3				3.1	1.4				.4	1.6				.3	1.2																													.3	.3										9.2
5-5.9												1.7					.8					.8																																								3.3
6-6.9												2.7					.2	.3				.2	.3																																							3.7
7-8.9												.5						1.1				.5	1.1																																							3.2
9-10.9																		.3					.3																																							0.6
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														64.5	64.5
Σ						0.3	0.3				7.8	7.1				2.7	3.4	1.7			4.7	3.3	1.7																												1.9	0.3				0.3					64.5	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 6.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 1260

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9																2.0						.5	12.3	9.0	.3	.3		.3																													.6							25.3
2-2.9															2.4	6.9	.8	.3	1.6	1.1	.3	2.4	14.8	10.1	2.9	2.4	.5	.5		.5																											4.0	6.2						57.7
3-3.9															.8	9.9	1.3	2.2	2.2	.3	.3		11.6	5.4	1.8	1.3	.8	.3		.3																												2.9						41.4
4-4.9																2.9	3.5	1.6	1.1				3.5	1.1	1.1	.5	.8																															1.8						17.9
5-5.9																.8	3.8	1.3	1.1				1.1	2.2		.3				.3	.3																											.8						12.0
6-6.9																.3	1.3	1.1	.5				.8	1.6	1.4					.3																																		7.3
7-8.9																.5	1.3	.6		.3			.5	.5	.8	.3					.3																																	5.0
9-10.9																	.3	.3						.3	.3	.5																																						1.7
11-12.9																		.5	.3	.3																																												1.1
13-14.9																																																																	
15-16.9																																																																	
17-18.9																																																																	
19 +																																																																	
Σ															3.2	23.3	12.3	7.8	6.8	2.0	0.6	2.9	44.6	30.2	8.6	5.6	2.1	1.1		1.4	0.6																											4.6	11.7						169.4

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9						.3					1.2					.4					1.3										.3																				.5											4.0
2-2.9		.3				.3					2.3					.9					2.5										.3																				.9											7.5
3-3.9						.3					2.9	1.0				.5	.3				1.6	.4																													.4	.3										7.7
4-4.9		.3				.3					3.2	2.1				.3	.6				.7	1.0																													.3	.6										9.4
5-5.9												2.0					.6					.6																														.4										3.6
6-6.9		.3										1.6					.7					.4																														.3	.3									3.6
7-8.9																	.3	.3					.8																														1.1									2.5
9-10.9																							.3																														.3									0.6
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														61.1	61.1
Σ		0.9				1.2					9.6	6.7				2.1	2.5	0.3			6.1	2.4	1.1								0.6																				2.1	1.6	1.7									61.1	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 6.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 6 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 11,394.00

DIR.	NNW							NW							WNW						
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +
1-1.9															.06	1.27	.32	.15	.05		.04
2-2.9															1.10	5.32	2.40	1.17	.85	.55	.18
3-3.9															.27	3.04	1.47	.75	.43	.32	.05
4-4.9															.05	1.19	1.47	.92	.47	.05	
5-5.9																.30	.77	.41	.28		
6-6.9														—		.12	.41	.27	.12	.02	
7-8.9																.07	.47	.16	.12	.02	
9-10.9																	.05	.05			
11-12.9																		.04	.02	.02	
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															1.48	11.31	7.36	3.92	2.34	.98	.27

DIR.	W							WSW							SW						
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +
1-1.9	.27	14.59	15.26	.17	.12	.02	.02		.11												
2-2.9	.94	13.84	2.47	1.84	1.11	.57	.07	.14	.37	.16											
3-3.9	.43	11.35	2.16	.56	.52	.14	.02	.07	.26	.05											
4-4.9	.16	8.52	1.86	.67	.21	.21		.02	.05												
5-5.9		3.96	1.55	.34	.27	.04		.02	.02												
6-6.9	.02	1.31	1.87	.30	.17	.10		.02	.07	.02											
7-8.9		.65	1.66	.65	.12	.05			.02	.02	.05										
9-10.9		.10	.82	.22	.12	.05				.02	.02										
11-12.9		.05	.26	.07	.05																
13-14.9		.02	.14	.12	.05	.02															
15-16.9			.05	.02	.05																
17-18.9				.02																	
19 +																					
Σ	1.82	53.49	32.08	5.78	2.85	1.20	.11	.27	.90	.27	.07										

DIR.	SSW							S							SE								
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +	6-8	8-10	10-12	12-14	14-16	16-18	18 +	Σ	Σ
1-1.9															.12	.09	.04	.07	.07		.02	31.26	
2-2.9															.64	1.05						40.37	
3-3.9															.05	.97				.02		23.21	
4-4.9															.05	.47						16.43	
5-5.9																.09						7.37	
6-6.9																						4.82	11.31
7-8.9																						4.04	6.49
9-10.9																						1.45	2.45
11-12.9																						.51	1.00
13-14.9																						.35	.49
15-16.9																						.12	[illegible]
17-18.9																						.02	.02
19 +																							
Σ															.86	2.67	.04	.07	.07	.02	.02	129.95	

of year!

SEA

DIR.	N					NNW					NW					WNW				
T_s / H_s	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +
1-1.9	.02					.02					1.15					.62				
2-2.9	.04	.02				.07					2.52					1.19				
3-3.9		.10				.02					3.05	1.61				1.52	1.12			
4-4.9	.05	.19				.07	.07				3.96	5.22				1.46	2.25			
5-5.9											.35	2.60				.17	1.71			
6-6.9		.05									.02	2.42					1.08	.34		
7-8.9												.24					.05	1.18		
9-10.9																		.05	.07	
11-12.9																		.02		
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	.11	.36				.18	.07				[illegible]	[illegible]				4.76	6.21	1.59	.07	

DIR.	W					WSW					SW					SSW				
T_s / H_s	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +
1-1.9	1.57					.16					.31									
2-2.9	3.03	.02				.21					.42									
3-3.9	1.67	.83				.03	.05					.02								
4-4.9	.49	1.05				.10	.10					.02				.02				
5-5.9	.06	1.34																		
6-6.9		.67	.29				.02													
7-8.9		.23	1.05																	
9-10.9			.39	.02																
11-12.9			.02																	
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	6.82	[illegible]	1.75	.02		.50	.17				.73	.04				.02				

DIR.	S					SSE					SE					NE							
T_s / H_s	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	4-6	6-8	8-10	10-12	12 +	CALM[2]	Σ	
1-1.9	.03										.53											4.39	
2-2.9	.08										.93	.04				.02						8.39	
3-3.9		.04									.42	.33										10.59	
4-4.9		.07									.19	.78					.02					14.89	
5-5.9												.44										6.67	
6-6.9												.26	.07									5.22	
7-8.9								.04				.12	.79									3.70	
9-10.9								.02					.42									.97	
11-12.9													.14	.05								.23	
13-14.9														.05								.05	
15-16.9													.05									.05	
17-18.9																							
19 +																							
																					44.85	44.85	55.15
Σ	.11	.11						.06			2.07	1.97	1.47	.10		.02	.02				44.85	100.00	

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[1] Based on 365-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 7.1 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 January (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 908

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																4.6	7.5																																															12.1
2-2.9															4.8	6.7	2.4	1.6	1.3	.8		2.2	2.7	.5	.8	1.1	.5	.3	.3	.3	.8	.3																																27.4
3-3.9															2.7	11.3	4.5	2.2	1.1	.5		.8	1.8	1.6	1.3	.3		.3	.8	.8																																		30.0
4-4.9																7.8	3.5	2.4	1.6	.5		.3	.8	.3	.5	.5			.3	.5																																		19.0
5-5.9																4.0	2.9	.5	.3	.5		.3	.5	1.1						.5	.3																																	10.9
6-6.9																.5	4.0	1.1	1.1				.3	1.3	.3	.3				.3																																		9.2
7-8.9																.5	3.2	1.8	.8				.5	.8	1.3					.3	.3	.3																																9.8
9-10.9																		.3						.8	.5	.3					.5																																	2.4
11-12.9																										.3	.3																																					0.6
13-14.9																								.3	.3																																							0.6
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															7.5	35.4	28.0	9.9	6.2	2.3		3.6	6.6	6.7	5.0	2.8	0.8	0.6	1.4	2.7	1.9	0.6																																122.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.8					.8					3.8					.5					.4					.3					.3										.5					.3					.4						.3					8.4
2-2.9	1.4					1.7					5.6					.8					.7					.5					.5					.3					.8					.5					.7						.5					14.0
3-3.9	.3	.3				.3					.8	3.7				.3	.3														.3	.3									.3										.3	.3				.8	1.3					9.6
4-4.9		.8					.5					6.5					1.0					.3					.5					.3					.5					.5										.7				.3	1.1					13.0
5-5.9							.3					3.6					.4																									.3					.3					.3					.5					5.7
6-6.9							.3					1.2	3.2				.2	.3									.3										.3					.3					.3					.3										6.7
7-8.9												.3	2.2					.5																				.5															.3									3.8
9-10.9													.3					.3																																												0.6
11-12.9													.5																																																	0.5
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														37.7	37.7
Σ	2.5	1.1				2.8	1.1				10.2	15.3	6.2			1.6	1.9	1.1			1.1	0.3				0.8	0.8				1.1	0.6				0.3	0.8	0.5			1.6	1.1				0.8	0.6				1.4	1.6	0.3			1.1	3.7				37.7	100.0

1 Based on 31 Days 3.9

2 Includes waves of 0 to 0.9 feet

TABLE 7.2 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 February (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 798

DIR.	NNW							NW							WNW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9																6.0	4.0		.3	.3	
2-2.9															3.1	5.4	6.9	1.1	1.7	.9	.3
3-3.9															1.7	6.3	2.3	1.4	.6		.3
4-4.9															.3	2.8	4.0	3.1	2.0	1.1	
5-5.9																2.3	2.0	2.3			
6-6.9																2.0	2.6	.6	.3		
7-8.9																.3	2.0	1.1	.6		
9-10.9																	.9	.9			
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															5.1	25.1	24.7	10.5	5.5	2.3	0.6

DIR.	W							WSW							SW						
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9		1.7			.3																
2-2.9	.9	1.4	1.7	.6	.9			.3													
3-3.9	1.4	2.0	1.7	1.4		1.1			.3												
4-4.9	.6	2.0	1.1	.3	.6	.3			.3												
5-5.9	.3	.9	1.4	1.1	.9					.3											
6-6.9		2.0	.6	.3	.3																
7-8.9		1.4	2.0	1.1	.3																
9-10.9		.3	1.4	1.1	.6																
11-12.9			1.7	.3	.6																
13-14.9			.3	.8																	
15-16.9																					
17-18.9																					
19 +																					
Σ	3.2	11.7	11.9	7.0	4.5	1.4		0.3	0.6	0.3											

DIR.	SSW							S							SSE							
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																						12.5
2-2.9																						25.2
3-3.9																						20.5
4-4.9																						18.5
5-5.9																						11.5
6-6.9																						8.7
7-8.9																						8.8
9-10.9																						5.2
11-12.9																						2.6
13-14.9																						1.1
15-16.9																						
17-18.9																						
19 +																						
Σ																						114.7

SEA

DIR.	N					NNW					NW					WNW				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9	.6					.6					3.0					.3				
2-2.9	.8					.8					4.5	1.1				.3				
3-3.9		.3				.3	.6				.9	2.8	.9				.5			
4-4.9		.9					.8					7.8	.3				1.0			
5-5.9							.5					2.0					.7			
6-6.9							.4					1.1	.3				.4			
7-8.9												.3	7.0					.9		
9-10.9													.9	.3						
11-12.9													.3	.6						
13-14.9														.9						
15-16.9																				
17-18.9																				
19 +																				
Σ	1.4	1.2				1.7	2.3				8.4	15.1	9.7	1.8		0.6	2.6	0.9		

DIR.	W					WSW					SW					SSW				
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9	.3					.4														
2-2.9	.3	.6				.5	.6				.3	.8					.3			
3-3.9						.3	.6					.5								
4-4.9		.3										.4					.3			
5-5.9							.3					.3								
6-6.9												.3								
7-8.9													.3					.9		
9-10.9																		.3		
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	0.6	0.9				1.2	1.5				0.3	2.3	0.3				0.6	1.2		

DIR.	S					SSE					SE					NE						
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9	1.1					.4					.4					.3						7.4
2-2.9	1.7					.5					.5						1.1					14.7
3-3.9		.3										.3					.9					9.2
4-4.9		.6					.3										.6					13.3
5-5.9												.3					.3					4.4
6-6.9																						2.5
7-8.9			.9					.3														10.6
9-10.9			.9										.6									3.0
11-12.9													.3									1.2
13-14.9																						0.9
15-16.9																						
17-18.9																						
19 +																						
																					32.8	32.8
Σ	2.8	0.9	1.8			0.9	0.3	0.3			0.9	0.6	0.9			0.3	2.9				32.8	100.0

[1] Based on 28-1/3 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 7.3 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 March (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 774

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9																5.9	1.3	1.6	.5		.3
2-2.9															5.1	8.9	7.8	1.1	2.7	1.6	.3
3-3.9															2.9	7.3	2.9	1.1		1.6	.3
4-4.9																3.2	3.5	2.4	1.8	.3	
5-5.9																2.2	3.5	1.3	.3		
6-6.9																.5	1.1	.5	.3		
7-8.9																.3	1.3	.3			
9-10.9																.3			.3		
11-12.9																.3					
13-14.9																	.3	.3			
15-16.9																			.3		
17-18.9																					
19 +																					
Σ															8.0	28.9	21.7	8.0	6.2	3.5	0.9

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9					.3																
2-2.9	2.4	5.9	.5	1.6	.8	.8		.3													
3-3.9		2.2	.8	.3				.3													
4-4.9	.5	1.6	.3					.3													
5-5.9	.3	1.1	.8	.3	.3				.3												
6-6.9			.3	.3	.3	.3															
7-8.9		.5	.5							.3	.3	.3									
9-10.9			.3	.3	.3																
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	3.2	11.3	3.5	2.8	2.0	1.1		0.9	0.3	0.3	0.3	0.3									

DIR.	SSW							S							SSE							Σ
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																						9.9
2-2.9																						39.8
3-3.9																						19.7
4-4.9																.3						14.2
5-5.9																						10.4
6-6.9																						3.6
7-8.9																						3.8
9-10.9																						1.5
11-12.9																						0.3
13-14.9																						0.6
15-16.9																						0.3
17-18.9																						
19 +																						
Σ																0.3						104.1

SEA

DIR.	N					NNW					NW					WNW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9											3.3									
2-2.9	.5										5.0	.6				.5				
3-3.9		.5				.3	.3				5.4	3.7								
4-4.9		.3					.4				.3	6.9	.3				.5			
5-5.9							.5					4.4								
6-6.9		.3					.7					1.9	.5							
7-8.9													13.5					.3		
9-10.9													1.8	2.2				.3		
11-12.9													.3	2.7						
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	0.5	1.1				0.3	1.9				14.0	17.5	16.4	4.9		0.5	0.5	0.6		

DIR.	W					WSW					SW					SSW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9	.5					.5					1.2									
2-2.9	.8					.6					1.7					.5				
3-3.9											.3	.4								
4-4.9		.8					.3					.7								
5-5.9		.3																		
6-6.9																				
7-8.9																				
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	1.3	1.1				1.1	0.3				3.2	1.1				0.5				

DIR.	S					SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9	.5										.8											6.8
2-2.9	.6										1.1						1.0					12.9
3-3.9		.4					.3				.3	.3				.5	1.1					13.8
4-4.9		.7					.5					.4					.5					12.6
5-5.9												.3					.3					5.8
6-6.9												.3										3.7
7-8.9													.3									14.1
9-10.9																						4.3
11-12.9																						3.0
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
																					23.0	23.0
Σ	1.1	1.1					0.8				2.2	1.3	0.3			0.5	2.9				23.0	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.4 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 April (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 642

DIR.	NNW							NW							WNW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9																10.6	8.1	1.4	1.1		
2-2.9															1.4	13.4	4.7	1.7	1.9	1.1	
3-3.9															.3	6.1	2.8	1.1	1.1	1.4	
4-4.9															.6	.6	1.1	1.4	1.1		
5-5.9															.3	2.2		.8	.3		
6-6.9																.8	.3		.3		
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															2.6	33.7	17.2	6.4	5.8	2.5	

DIR.	W							WSW							SW						
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+
1-1.9		.8																			
2-2.9	2.8	3.3	1.4	.8												.6					
3-3.9	2.2	3.1	.6	.6																	
4-4.9	.5	.3	.3													.3					
5-5.9	.6	.6																			
6-6.9		.3	.3	.3		.3															
7-8.9		.3	.3																		
9-10.9			.3																		
11-12.9			.3																		
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ	6.1	8.7	3.5	1.7		0.3										0.9					

DIR.	SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																						22.0
2-2.9																						33.1
3-3.9																						19.3
4-4.9																						6.2
5-5.9																						4.8
6-6.9																						2.6
7-8.9																						0.6
9-10.9																						0.3
11-12.9																						0.3
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																						89.2

SEA

DIR.	N					NNW					NW					WNW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9						.8					5.0					.7				
2-2.9	.3					1.1	.3				7.6	.9				1.0				
3-3.9						.8					3.1	2.7				.5				
4-4.9		.3					.5					4.6					.5			
5-5.9		.3					.3					3.2					.3			
6-6.9		.3					.5					1.7								
7-8.9													5.8					.8		
9-10.9													1.4	.8				.8		
11-12.9													.5	.5						
13-14.9													.5	.3						
15-16.9																				
17-18.9																				
19 +																				
Σ	0.3	0.9				2.7	1.6				15.7	13.1	8.2	1.6		2.2	0.8	1.6		

DIR.	W					WSW					SW					SSW				
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+
1-1.9											.3									
2-2.9	.5	.3				.5					.5									
3-3.9	.5	.3				.3	.3				.3	.4				.3				
4-4.9		1.1					.5					.7								
5-5.9																				
6-6.9		.8																		
7-8.9			.3										.3							
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ	1.0	2.5	0.3			0.8	0.8				1.1	1.1	0.3			0.3				

DIR.	S					SSE					SE					NE						
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9						.3																7.1
2-2.9	.3					.5																13.8
3-3.9	.8	.3				.3																10.9
4-4.9		.5					.3															9.0
5-5.9																						4.1
6-6.9		.5																				3.8
7-8.9			.3																			7.5
9-10.9																						3.0
11-12.9																						1.0
13-14.9																						0.8
15-16.9																						
17-18.9																						
19 +																						
																					39.0	39.0
Σ	1.1	1.3	0.3			1.1	0.3														39.0	100.0

[1] Based on 30 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 7.5 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 May (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 666

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	6-8	8-10	10-12	12-14	14-16	16-18	18+	
1-1.9																10.9	12.2	2.4	.8	.8				1.8						1.6																																		30.5
2-2.9															2.9	7.9	8.6	1.8	1.3	.5	.5	.3	2.7	.5		.3			1.8	1.1	.5																																	30.7
3-3.9															.8	3.4	1.8	.8		.3			.8	.3	.3				.3		.3																																	11.1
4-4.9																1.6	1.6	.3	.3	.3				.3	.3	.3			.3	.3																																		5.6
5-5.9																1.2	1.6	.5	.3	.3										.3	.5																																	6.7
6-6.9																.8	1.1	.5	.3				.3	.8	.3					.3																																		4.4
7-8.9																															.5																																	0.5
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															3.7	25.8	26.9	6.3	3.0	2.2	0.5	0.3	3.8	3.7	0.9	0.6			2.4	3.5	1.8																																	89.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s / H_s	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+	4-6	6-8	8-10	10-12	12+		
1-1.9	.5					.5					6.0					.3					1.7										.5										.3																					9.8
2-2.9	.6					.6					9.1	.7				.5					2.6					.3					.8										.5															.5						10.2
3-3.9											1.8	3.6	.3			.8	.3		.5		.5										.5										.3										.3											8.9
4-4.9												6.7	1.6				.5	.3	.3			.3																														.3					.3					10.3
5-5.9												4.2																																													.3					4.5
6-6.9			.3				.3					1.7	5.9																																																	8.2
7-8.9													8.6																																																	8.6
9-10.9													3.5	.5																																																4.0
11-12.9													.3	.3																																																0.6
13-14.9																																																															
15-16.9																																																															
17-18.9																																																															
19 +																																																															
																																																															28.9	28.9
Σ	1.1		0.3			1.1	0.3				16.9	16.9	20.2	0.8		1.6	0.8	0.3	0.8		4.8	0.3				0.3					1.8										1.1										0.3	0.3				0.5	0.6				28.9	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 7.6 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 June (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 639

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	Σ
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																10.3	7.2	.6	.3																																													18.4
2-2.9																13.9	8.1	2.5	1.4	.6		.8	1.7	1.4	.3																																							30.7
3-3.9																9.2	2.2																																															11.4
4-4.9																2.2																																																2.2
5-5.9																4.7	.3																																															5.0
6-6.9																.8	1.9																																															2.7
7-8.9																	.8																																															0.8
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ																41.1	20.5	3.1	1.7	0.6		0.8	1.7	1.4	0.3																																							71.2

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE						
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	CALM[2]	Σ
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.4					.4					4.6										.4																				.3																					6.1
2-2.9	.4					.4					6.8	.3				.3					.7										.3										.3															.3						9.8
3-3.9						.6					5.6	5.0					.3																																													11.5
4-4.9							.6					9.3	-				.3					.3																																								10.5
5-5.9							.3					5.3																																																		5.6
6-6.9												1.6	2.8					.3																																												4.7
7-8.9													14.2					.6																																												14.8
9-10.9													4.7	2.8					.3																																											7.8
11-12.9													.6	2.2																																																2.8
13-14.9														1.1																																																1.1
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																													25.3	25.3
Σ	0.8					1.4	0.9				17.0	21.5	22.3	6.1		0.3	0.6	0.9	0.3		1.1	0.3									0.3										0.6															0.3					25.3	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.7 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 July (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 344

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9																30.3	15.2	.8																																															46.3
2-2.9															1.1	10.6	5.8																																															17.5
3-3.9																4.8	.3	.3																																														5.4
4-4.9																2.7																																																2.7
5-5.9																1.8	.5																																															2.3
6-6.9																.5	.5																																															1.0
7-8.9																	.3																																															.3
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															1.1	50.7	22.6	1.1																																														75.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9	.4					.6					10.6					.6					.3										.4																															12.9
2-2.9	.7					1.0					15.8	.5				.7					.5					.3					.7										.3																					20.5
3-3.9											1.1	5.0				.3	.3				.3															.3					.3																					7.6
4-4.9		.3										9.7					.8																																													10.8
5-5.9												5.7	.8																																																	6.5
6-6.9												2.2	2.4																																																	4.6
7-8.9													6.5					.3																																												6.8
9-10.9													.3	.3				.5																																												1.1
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														29.2	29.2
Σ	1.1	0.3				1.6					27.5	23.1	10.0	0.3		1.6	1.1	0.8			1.1					0.3					1.1					0.3					0.6																				29.2	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.8 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 August (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 539

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9																18.1	13.6	2.9	.3																																.3													35.2
2-2.9															.5	15.3	7.1	.8																																.3														24.0
3-3.9																4.6	1.1																																		.3	.3												6.3
4-4.9																1.8	2.7																																			.3		.3										5.1
5-5.9																.5	.3																																															0.8
6-6.9																	.8																																															0.8
7-8.9																	.3																																															0.3
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															0.5	40.3	25.9	3.7	0.3																															0.3	0.6	0.6		0.3										72.5

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.7										9.0										.3										.3																															10.3
2-2.9	1.1					.5					13.4	.3					.3				.5										.5																				.3					.3						17.2
3-3.9											1.8	5.4				.5	.3				.5										.3																															8.8
4-4.9		.3					.3					10.8										.3																																								11.7
5-5.9												6.4																																																		6.4
6-6.9												2.2	2.2																																																	4.4
7-8.9													6.7																																																	6.7
9-10.9													1.6																																																	1.6
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														32.9	32.9
Σ	1.8	0.3				0.5	0.3				24.2	25.1	10.5			0.5	0.6				1.3	0.3									1.1																				0.3					0.3					32.9	100.0

[1] Based on 31 Days

[2] Includes waves of 0 to 0.9 feet

TABLE 7.9 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 September (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 626

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s / H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	
1-1.9															.8	17.5	17.0	3.3	.8			.3	1.9	.3						.8																												.3	.3					43.3
2-2.9															1.7	7.5	8.9	1.7	.8	.8																																						.3		.6	.6		.6	23.5
3-3.9																7.2	2.8	1.1	.6	.8																																							.3					12.8
4-4.9																1.9	.3	2.5	.6	.3																																								.3	.3	.3		6.5
5-5.9																.6	.3																																															0.9
6-6.9																																																																
7-8.9																																																																
9-10.9																																																																
11-12.9																																																																
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															2.5	34.7	29.3	8.6	2.8	1.9		0.3	1.9	0.3						0.8																												0.6	0.6	0.9	0.9	0.3	0.6	87.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s / H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +		
1-1.9						1.4					4.6					.3					.3										.3																															6.9
2-2.9						2.2					6.8	.5				.3					.5					.3					.3										.3																					11.2
3-3.9						.3	.3				5.0	5.7					.4					.3																																								12.0
4-4.9							.6					10.9	.3				.7					.3																																								12.8
5-5.9							.3					6.9	.3																																																	7.5
6-6.9												3.5	.3																																																	3.8
7-8.9												.8	4.4																																																	5.2
9-10.9													2.2																																																	2.2
11-12.9														1.1																																																1.1
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																														37.3	37.3
Σ						3.9	1.2				16.4	28.3	7.5	1.1		0.6	1.1				0.8	0.6				0.3					0.6										0.3																				37.3	100.0

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1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.10 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 October (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 692

DIR.	NNW							NW							WNW							W						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9															1.1	11.7	11.2	4.8	.8				.3					
2-2.9															2.9	14.9	13.0	1.1	1.1	.5	.3	1.3	2.4	.8	1.1			
3-3.9															.8	4.3	.8	2.4	1.1	.8	.3	.3	.3	.3				
4-4.9																1.6	1.6	1.1	.3	.3			.8	.5				
5-5.9																1.1	1.6	.3						.3				
6-6.9																.3				.3			.5	.3				
7-8.9																			.3									
9-10.9																												
11-12.9																												
13-14.9																												
15-16.9																												
17-18.9																												
19 -+																												
Σ															4.8	33.9	28.2	9.7	3.6	1.9	0.6	1.6	4.3	2.2	1.1			

DIR.	WSW							SW							SSW							S							SSE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9		1.1																																		31.0
2-2.9																																				39.4
3-3.9																																				11.4
4-4.9																																				6.2
5-5.9																																				3.3
6-6.9																																				1.4
7-8.9																																				0.3
9-10.9																																				
11-12.9																																				
13-14.9																																				
15-16.9																																				
17-18.9																																				
19 -+																																				
Σ		1.1																																		93.0

SEA

DIR.	N					NNW					NW					WNW					W					WSW				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9						.7					5.7										.5									
2-2.9	.3					1.1					8.5	.6				.5					.8					.5				
3-3.9							.5				1.8	4.3				.3	.3													
4-4.9												8.2					.8	.3												
5-5.9												4.9						.3												
6-6.9												1.6	.8																	
7-8.9												.8	7.8					.3												
9-10.9													3.2	.3					.5											
11-12.9																														
13-14.9																														
15-16.9																														
17-18.9																														
19 +																														
Σ	0.3					1.8	0.5				16.0	20.4	11.8	0.3		0.8	1.1	0.9	0.5		1.3					0.5				

DIR.	SW					SSW					S					SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9	.5										.9																					8.3
2-2.9	.8					.3					1.3					.5																15.2
3-3.9							.3									.5											.5					8.5
4-4.9																											.3					9.6
5-5.9																																5.2
6-6.9																																2.4
7-8.9																																8.9
9-10.9																																4.0
11-12.9																																
13-14.9																																
15-16.9																																
17-18.9																																
19 +																																
																															37.9	37.9
Σ	1.3					0.3	0.3				2.2					1.0											0.8				37.9	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.11 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 November (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 656

DIR.	NNW							NW							WNW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9															.6	13.6	8.7	1.1	.8		.3
2-2.9															1.1	12.0	5.6	3.9	1.9	.5	
3-3.9															.3	8.3	7.8	2.2	.6		.3
4-4.9															.3	1.7	2.5	1.9	.6	.3	.3
5-5.9																.3	.3	.6			
6-6.9																.6	.3	.8			
7-8.9																.3	.3	1.1			
9-10.9																	.8		.3		
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ															2.3	36.8	27.3	11.6	4.2	0.8	0.9

DIR.	W							WSW							SW						
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +
1-1.9		1.1	2.5																		
2-2.9		1.1	1.9	.6																	
3-3.9																					
4-4.9																					
5-5.9																					
6-6.9																					
7-8.9																					
9-10.9																					
11-12.9																					
13-14.9																					
15-16.9																					
17-18.9																					
19 +																					
Σ		2.2	4.4	0.6																	

DIR.	SSW							S							SSE							
T_s H_s	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	6 8	8 10	10 12	12 14	14 16	16 18	18 +	Σ
1-1.9																						29.7
2-2.9																						28.6
3-3.9																						19.5
4-4.9																						7.6
5-5.9																						1.2
6-6.9																						1.7
7-8.9																						1.7
9-10.9																						1.1
11-12.9																						
13-14.9																						
15-16.9																						
17-18.9																						
19 +																						
Σ																						91.1

SEA

DIR.	N					NNW					NW					WNW					W				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9	.3					.3					3.3										.3				
2-2.9	.3					.5	.3				5.0					.3					.5				
3-3.9						.6	.3				1.9	4.1					.3					.3			
4-4.9							.3					8.0					.6								
5-5.9							.3					4.4													
6-6.9												.8													
7-8.9												2.2	3.6												
9-10.9													1.7												
11-12.9														.3											
13-14.9														.3											
15-16.9														.3											
17-18.9																									
19 +																									
Σ	0.6					1.4	1.2				10.2	19.5	5.3	0.9		0.3	0.9				0.8	0.3			

DIR.	WSW					SW					SSW					S				
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +
1-1.9																.3				
2-2.9						.3										.3				
3-3.9																				
4-4.9																				
5-5.9																				
6-6.9																				
7-8.9																				
9-10.9																				
11-12.9																				
13-14.9																				
15-16.9																				
17-18.9																				
19 +																				
Σ						0.3										0.6				

DIR.	SSE					SE					NE						
T_s H_s	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	4 6	6 8	8 10	10 12	12 +	CALM[2]	Σ
1-1.9																	4.5
2-2.9											.6	1.7					9.8
3-3.9												2.5					10.0
4-4.9												2.5					11.4
5-5.9												.8					5.5
6-6.9												.8					1.6
7-8.9												.3					6.1
9-10.9																	1.7
11-12.9																	0.3
13-14.9																	0.3
15-16.9																	0.3
17-18.9																	
19 +																	
																48.5	48.5
Σ											0.6	8.6				48.5	100.0

1 Based on 30 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.12 AVERAGE Monthly HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 December (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS 824

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9															.3	8.6	1.3	.3	1.1	.3	.3				.3																																							12.5
2-2.9															4.0	6.7	2.9	1.3	2.9	1.6	.8	.3	3.8	2.4	1.6	.8																																						29.1
3-3.9															2.7	7.5	4.0	4.8	3.5	1.6	.5	.3	.3	.5	.3				.5																																			26.5
4-4.9															.3	5.9	2.4	1.6	1.3	.5	.3		.3									.3																																12.9
5-5.9																3.2	4.3	2.9	1.1	.3			.3		.3				.3																																			12.7
6-6.9																1.3	2.7	1.6	.8	.5			.3	.3						.3																																		7.8
7-8.9																1.1	2.2	2.4	.3	.3				.3							.5																																	7.1
9-10.9																	.8	.8	.3																																													1.9
11-12.9																		.3																																														0.3
13-14.9																																																																
15-16.9																																																																
17-18.9																																																																
19 +																																																																
Σ															7.3	34.3	20.6	16.0	11.3	5.1	1.9	0.6	5.0	3.5	2.5	0.8			0.8	0.3	0.5	0.3																																110.8

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.4					.4					6.9					.3																									.6										.3					.6						9.5
2-2.9	.7					.7					10.4					.5					.5										.3										.8					.3					.5					.8	5.7					21.2
3-3.9	.3						.3				2.8	2.4				.3					.3					.3						.3										.3															6.2					13.5
4-4.9							.8					4.7					.3										.3															.5					.3										1.8					8.7
5-5.9							.3					2.8																																													.3					3.4
6-6.9							.3					1.0					.3					.3																																								1.9
7-8.9													3.2					.3					.5																				.3																			4.3
9-10.9													.3																																																	0.3
11-12.9																																																														
13-14.9																																																														
15-16.9																																																														
17-18.9																																																														
19 +																																																														
																																																													37.2	37.2
Σ	1.4					1.1	1.7				20.1	10.9	3.5			1.1	0.6	0.3			0.8	0.3	0.5			0.3	0.3				0.3	0.3									1.4	0.8	0.3			0.3	0.3				0.8					1.4	14.0				37.2	100.0

1 Based on 31 Days

2 Includes waves of 0 to 0.9 feet

TABLE 7.13 AVERAGE Annual HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)[1] STATION 7 (1956,1957,1958)

SWELL AVERAGE TOTAL HOURS

DIR.	NNW							NW							WNW							W							WSW							SW							SSW							S							SSE							Σ
T_s	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	
H_s	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	8	10	12	14	16	18	+	
1-1.9															23	1294	909	160	57	12	.07	.02	48	23	02	05				22																					.02							02	02					2504
2-2.9															238	1026	681	155	147	74	16	.88	207	106	62	35	.11	.02	70	.12	11	02					.05													.02								02		05	05		05	2912
3-3.9															101	686	277	145	72	58	14	42	87	50	35	02	09	02	16	09	02																				.02	.02							.02					1613
4-4.9															12	282	195	139	79	50	04	16	48	23	09	12	02		07	09		02					.02															02		02				02		02	02	02		8.82
5-5.9															02	217	147	77	19	09		12	28	32	14	10			02	09	09																																	587
6-6.9																.67	127	42	.26	07			.31	32	12	07	05			07																																		363
7-8.9																21	87	.56	17	02			22	32	20	02				02	13	05	.02																															281
9-10.9																02	21	.17	.07				02	23	16	10					04																																	1.02
11-12.9																02		02						17	02	07	02																																					32
13-14.9																	02	02						05	09																																							18
15-16.9																			02																																													02
17-18.9																																																																
19 +																																																																
Σ															576	3537	2458	785	471	192	42	160	473	343	181	.90	.29	04	45	.70	39	09	02				.07													02	04	04		02				06	.04	07	07	.02	05	9296

SEA

DIR.	N					NNW					NW					WNW					W					WSW					SW					SSW					S					SSE					SE					NE					CALM[2]	Σ
T_s	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12		
H_s	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+		
1-1.9	.54					.54					548					.25					42					.10					.52										57					.08					16					.07	02					815
2-2.9	.59					.88	05				821	46				47	.02				74	07				29	.05				58	.07				.09	.02				60					.19					26					21	83					1468
3-3.9	05	04				27	19				767	405	10			.25	25		04		.17	07				.07	.07				14	.16				.05	.02				.14	11				07	02				07	07				.11	104					1032
4-4.9		24					40				02	784	21				.58	.05	.02			.31					15					.17					07					.23					12					12				02	59					1112
5-5.9		02					23					448	09				.12	.02	.02			02					.02					.02										.02					.02					07					70					535
6-6.9		05	02				.21					171	453				.07	.05				.09					02					.02					.02					.07					.02					05					07					400
7-8.9												.37	696					.55					.07										.05					.12					.12					02					05					02					811
9-10.9													182	60				.16	.07																			.02					07										05									279
11-12.9													21	64																																							02									.87
13-14.9													04	22																																																26
15-16.9														02																																																.02
17-18.9																																																													
19 +																																																													
																																																														34.33	3433
Σ	98	40	.02			169	108				[illegible]	1889	[illegible]	149		97	104	.61	.15		133	56	.07			46	29				104	44	05			.14	.13	.14			111	43	19			34	18	02			49	51	12			41	277				3433	100.00

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

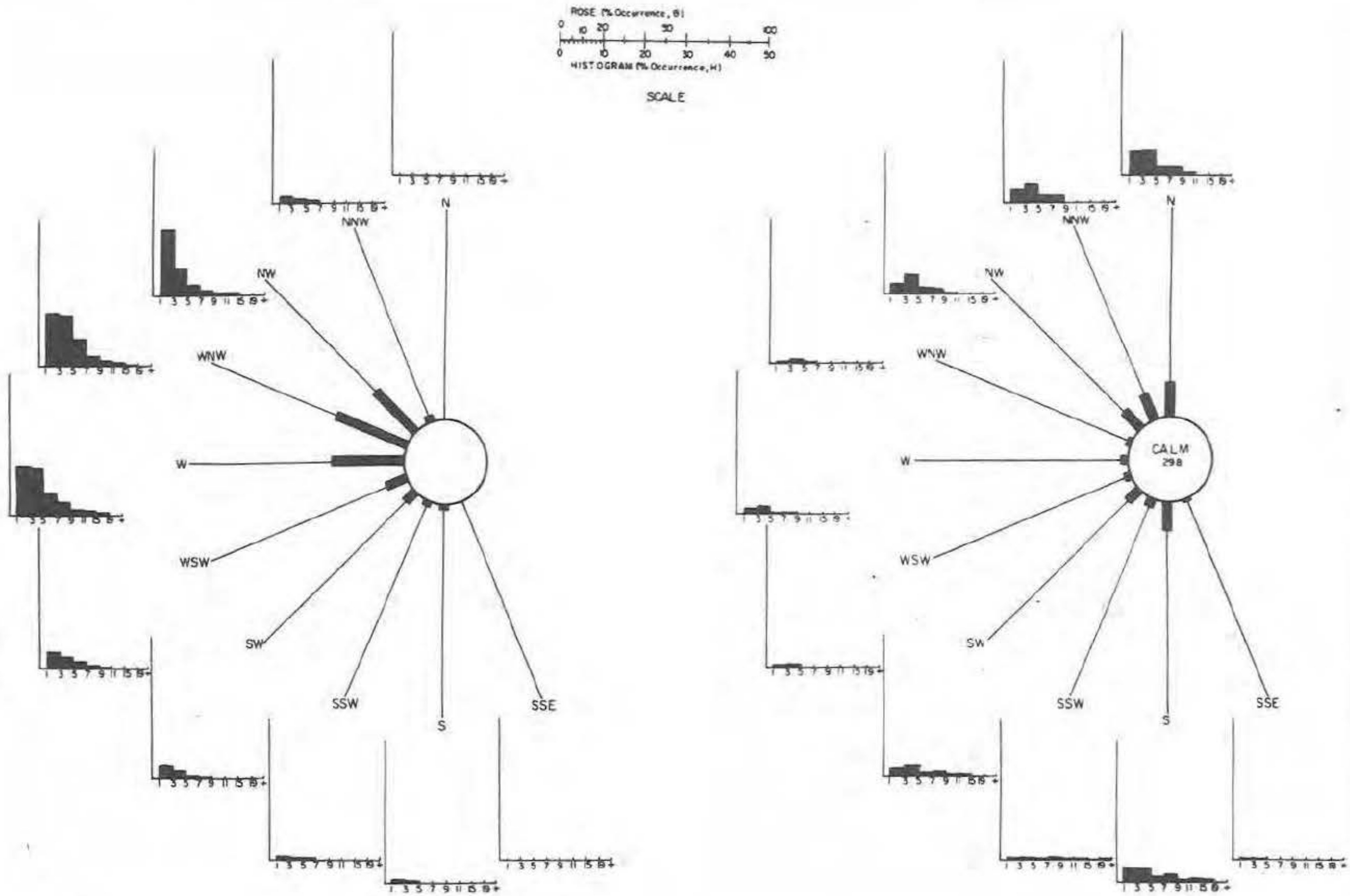

FIGURE: 4

AVERAGE ANNUAL SWELL ROSE FOR STATION 1

AVERAGE ANNUAL SEA ROSE FOR STATION 1

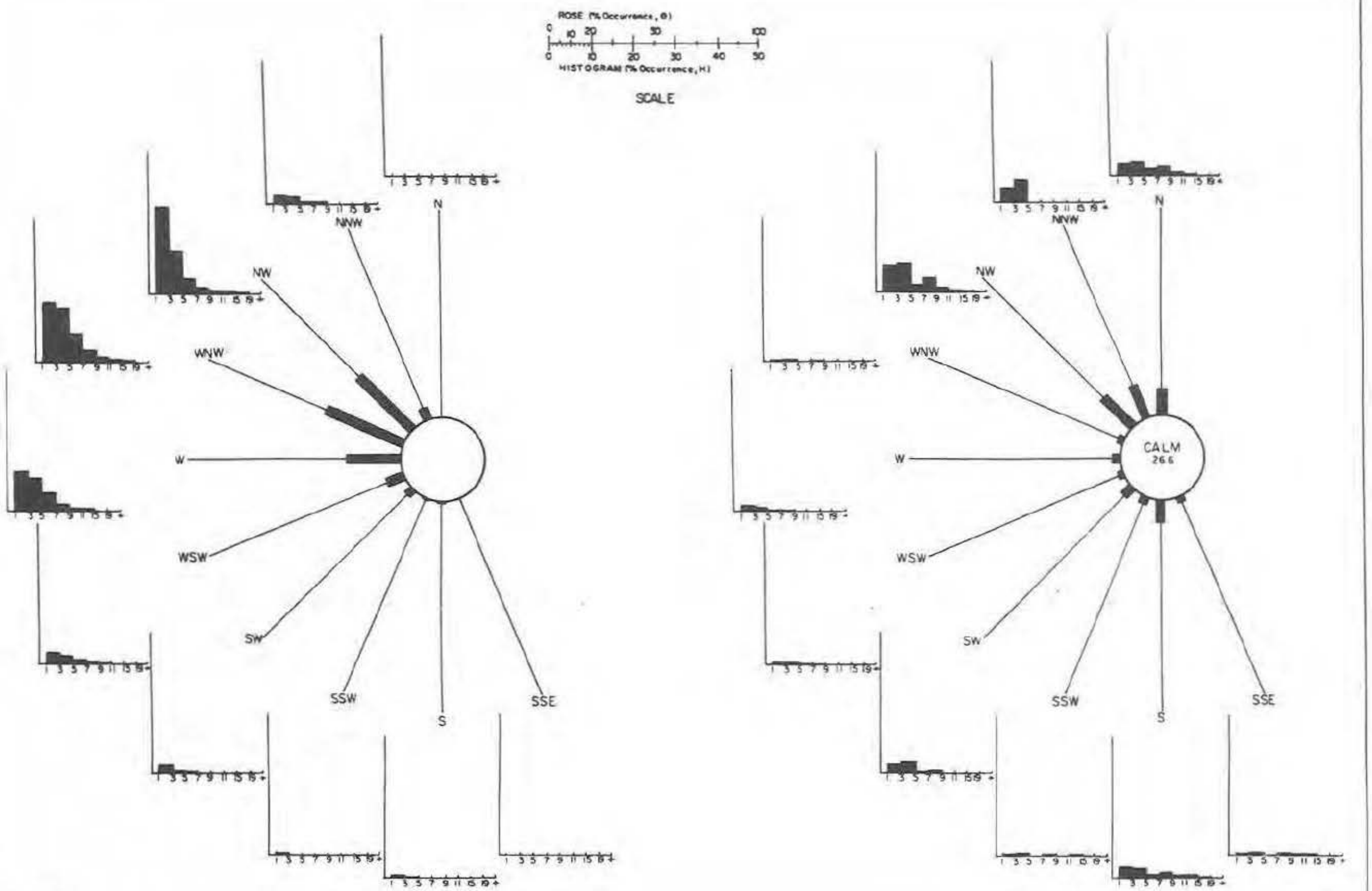

FIGURE: 5

AVERAGE ANNUAL SWELL ROSE FOR STATION 2

AVERAGE ANNUAL SEA ROSE FOR STATION 2

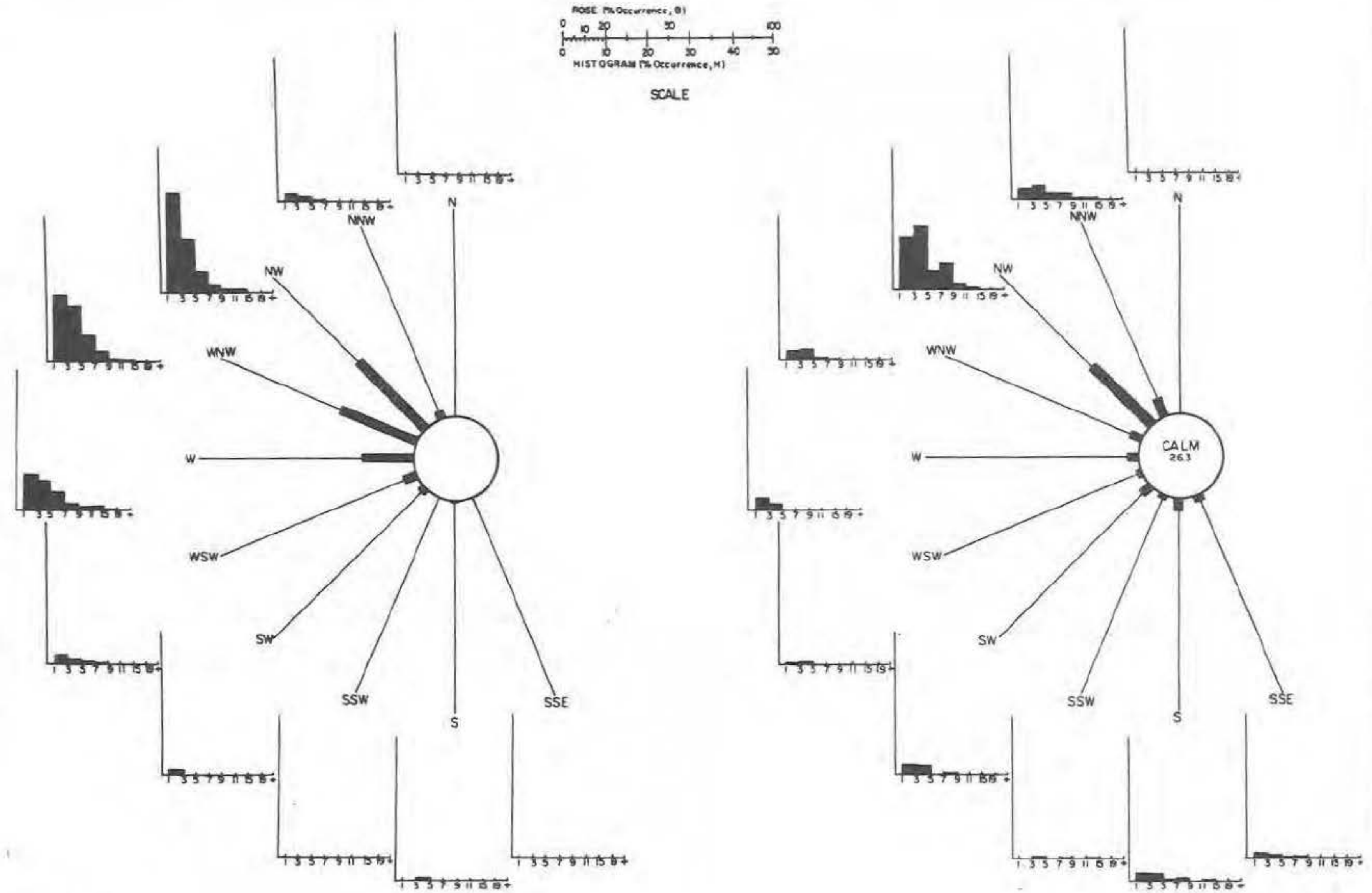

FIGURE: 6

AVERAGE ANNUAL SWELL ROSE FOR STATION 3

AVERAGE ANNUAL SEA ROSE FOR STATION 3

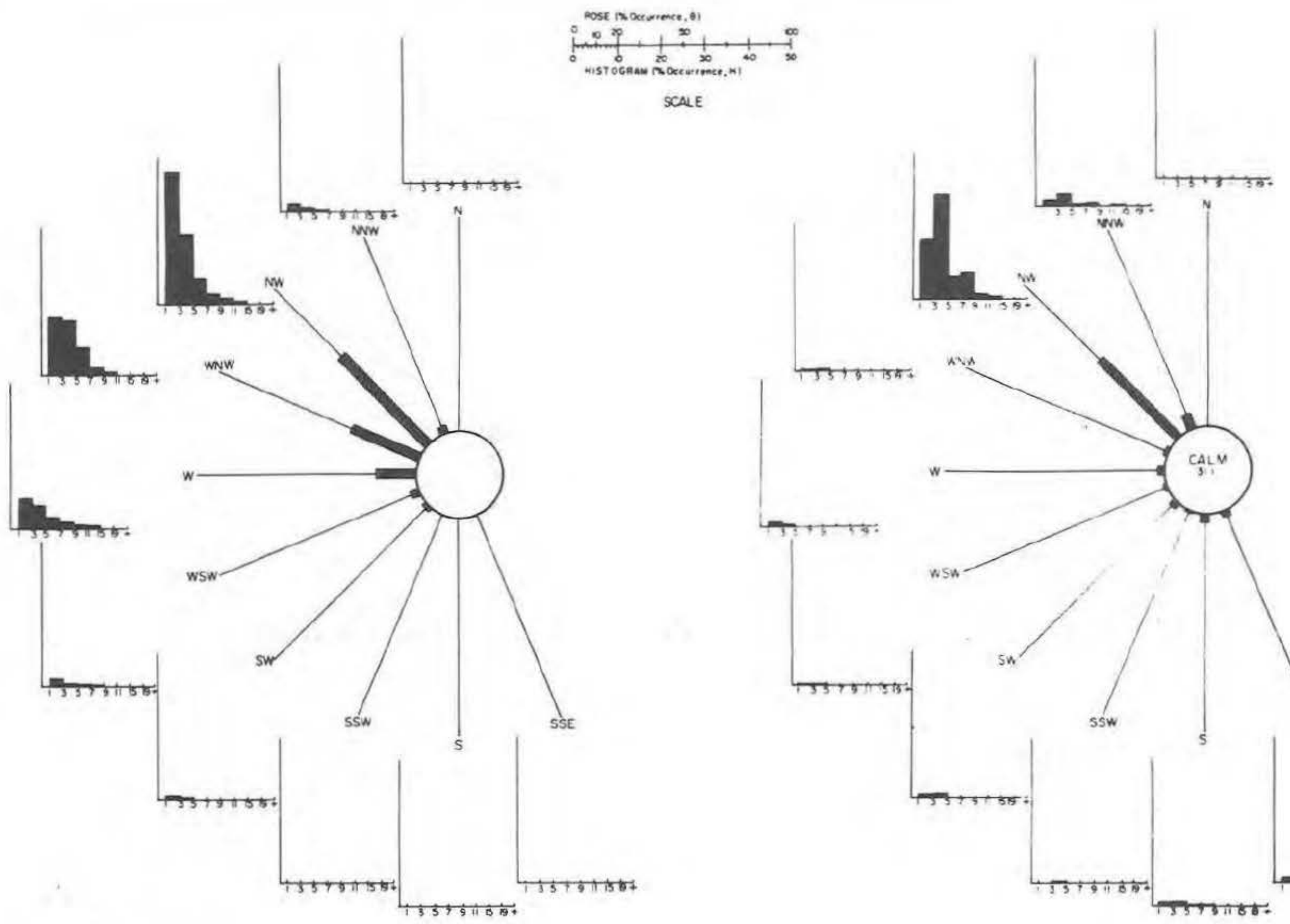

FIGURE: 7

AVERAGE ANNUAL SWELL ROSE FOR STATION 4

AVERAGE ANNUAL SEA ROSE FOR STATION 4

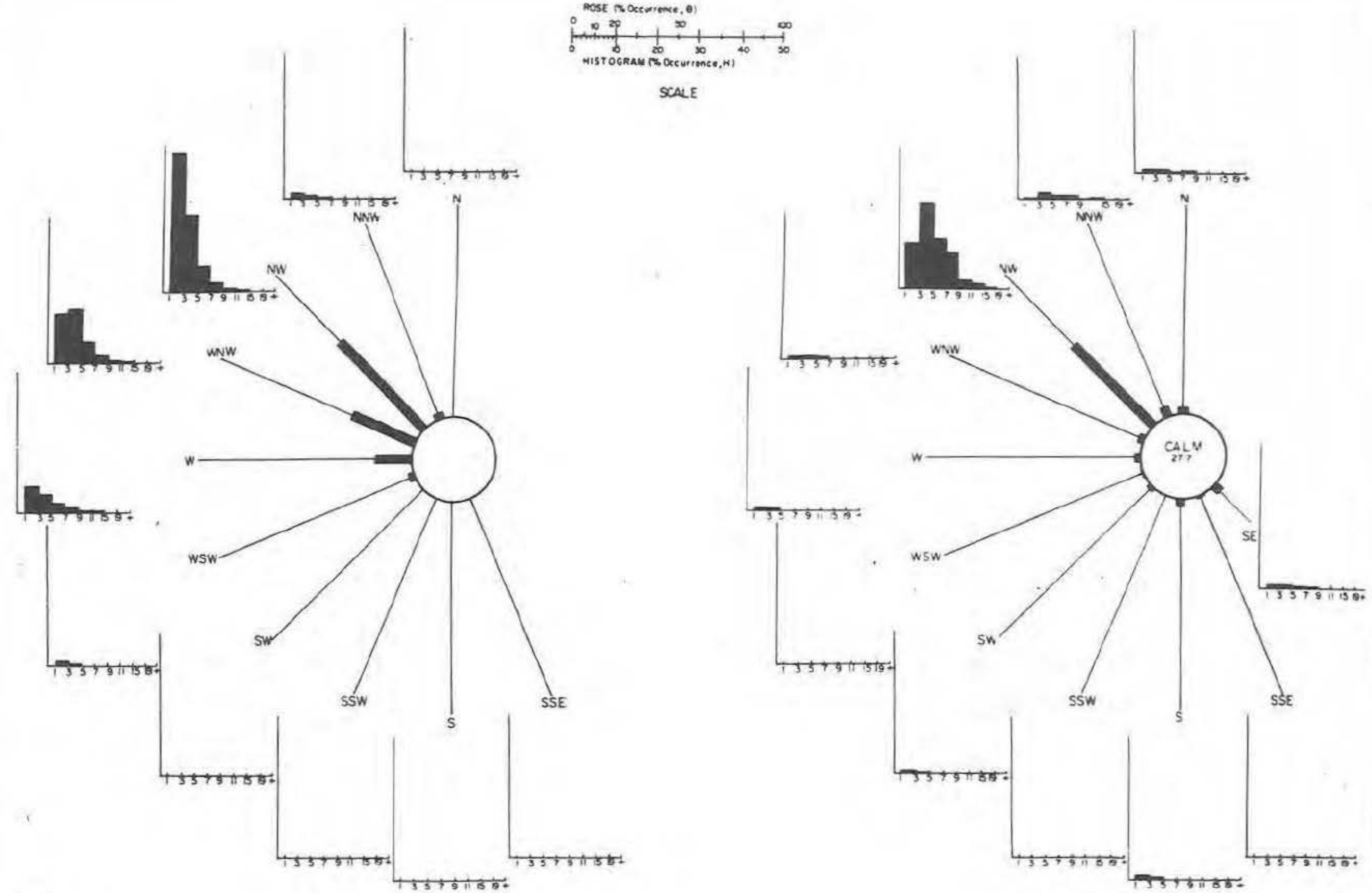

FIGURE: 8

AVERAGE ANNUAL SWELL ROSE FOR STATION 5

AVERAGE ANNUAL SEA ROSE FOR STATION 5

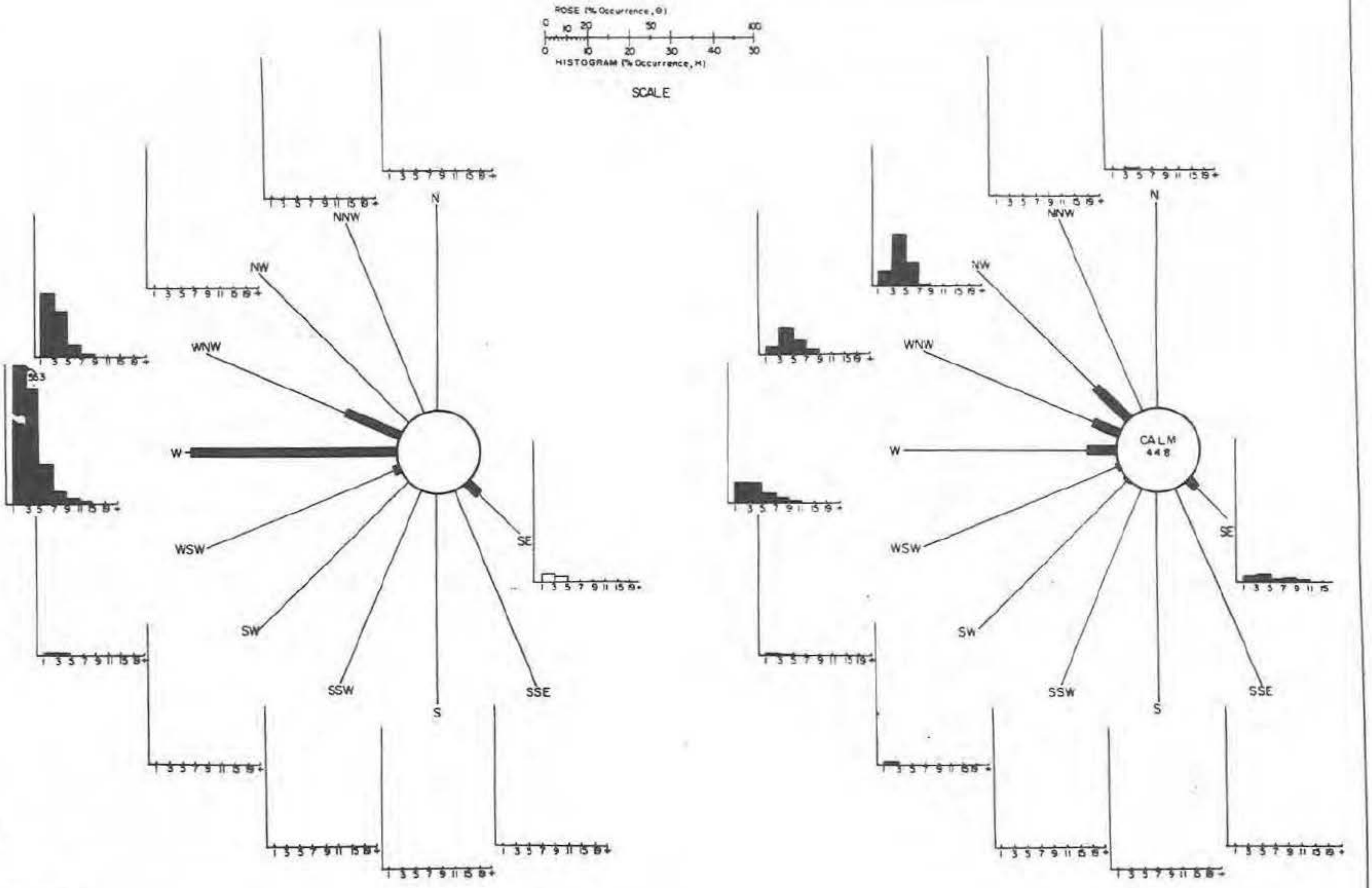

FIGURE: 9

AVERAGE ANNUAL SWELL ROSE FOR STATION 6

AVERAGE ANNUAL SEA ROSE FOR STATION 6

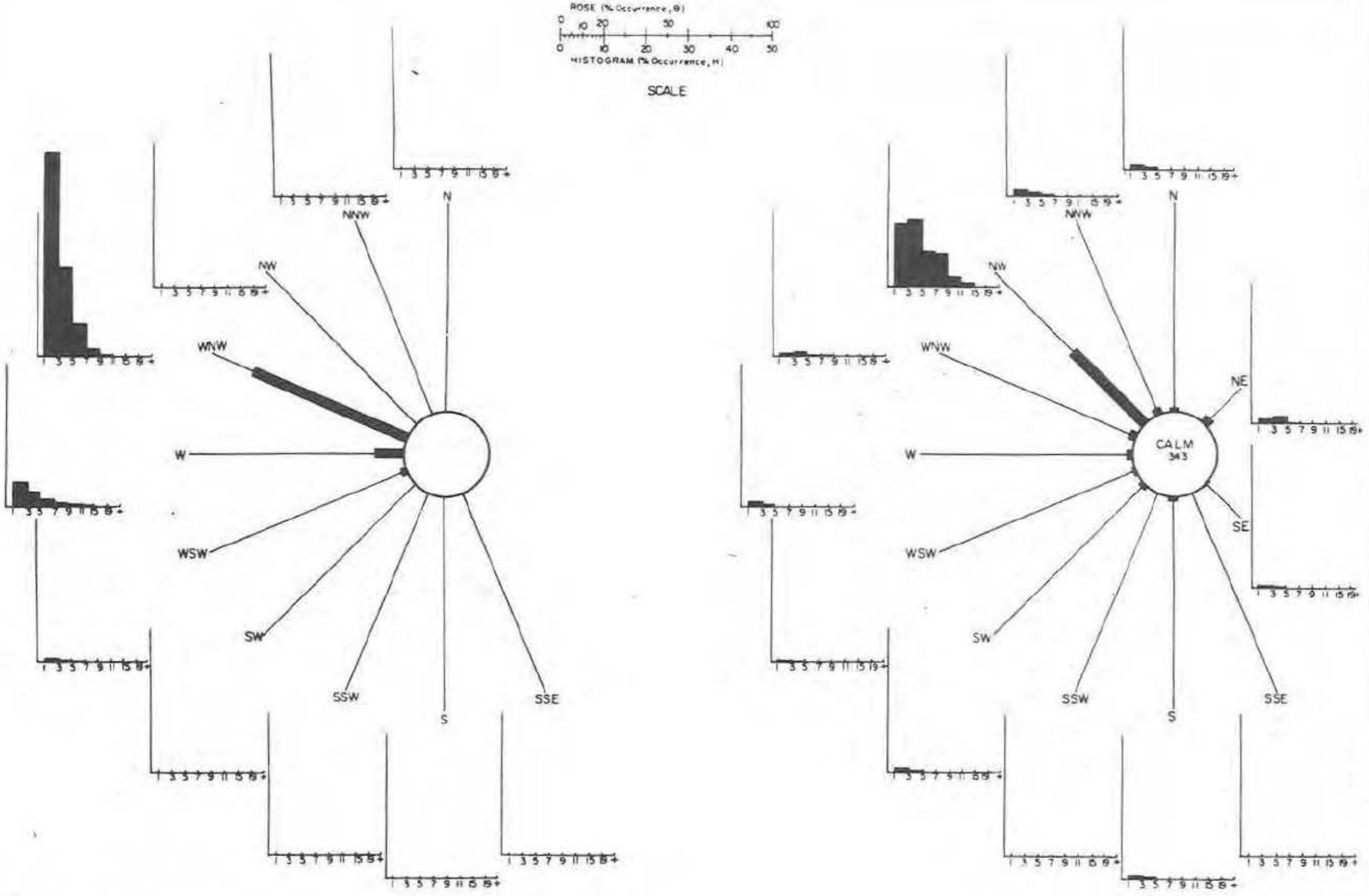

FIGURE: 10

AVERAGE ANNUAL SWELL ROSE FOR STATION 7

AVERAGE ANNUAL SEA ROSE FOR STATION 7

APPENDIX 6.2

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.2

Storm Wave Study, Santa Barbara Channel

Oceanographic Services, Inc.

Report #166-2

March, 1969

OCEANOGRAPHIC SERVICES, INC.

OSI#166-2
March 1969
Santa Barbara, California

Prepared For

ESSO PRODUCTION RESEARCH

Submitted By

OCEANOGRAPHIC SERVICES, INC.

STORM WAVE STUDY

SANTA BARBARA CHANNEL

Richard Kent

Approved: Richard Kent, President

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STORM WAVE STUDY

SANTA BARBARA CHANNEL

Part 1

PROCEDURES USED TO PREPARE STORM WAVE DATA

It is obvious that the best wave data input for the design of a structure at a given location would be derived from a very long series of wave measurements made at that location. Unfortunately, however, this circumstance essentially never occurs; it is, in fact, a truly rare event that any directly-measured data have been taken at or even near the design site.

The next best procedure involves the use of wave forecasting technology and a long series of meteorological maps to procure the needed information. This approach, when applied by skilled forecasters who have had a great deal of practicing experience in the exact area of interest, yields excellent results. Fortunately, this is the case for the Santa Barbara Channel area, where OSI forecasters have been working continuously since 1956.

Sources of Data

For this task, the following sources of data were used:

1. Meteorological maps and wave records. Oceanographic Services, Inc., 1956 - 1968.

2. Meteorological maps. U. S. Weather Bureau, Los Angeles, California, 1940 - 1956.

3. Meteorological maps. California Institute of Technology, 1940 - 1950.

4. Historical weather maps, daily synoptic series. U. S. Weather Bureau, 1899 - 1956.

5. Newspaper accounts. Los Angeles and Santa Barbara papers, 1890 - 1956.

Data Filtering Process

The task of selecting the final ten sets of extreme storm wave data at the five study locations involved three consecutive filtering operations.

In the first operation, the long-term, continuous series of meteorological maps(see item 4 above)plus OSI records were carefully reviewed and all storms capable of producing high waves at the study locations dated and subjectively categorized in terms of relative severity. These specific storms then were checked in newspaper records, etc., to determine if they were sufficiently unusual to merit mention. Conversely, newspaper records covering the period 1899 - 1956* were reviewed, and where mention of unusually severe storm conditions existed, a cross-check into the corresponding set of meteorological maps was made. Through this feedback procedure, all important storms affecting the study area during the period 1899 - 1968 were dated and categorized for the next, finer, filtering operation.

As one would expect, the first filtering step produced a very large number of storms for further examination – about 400 in this case.

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* Not necessary beyond 1956 since OSI wave records for the area began in that year.

In the second, more refining, filtering process, those factors intimately affecting storm wave characteristics at each site were evaluated. The overall procedure was as follows:

1. The exposure of each site, to the various selected storms was resolved. As expected, each site was different. For example, Station 1 is exposed to storm waves from the southwest whereas Station 4 is not, etc. This evaluation also included considerations of refraction due to bottom effects. Here, each station is located in a depth that eliminates direct refractive effects; however, in the case of Stations 1 and 5, it is possible for open ocean waves arriving from the west northwest and southwest directions respectively, to refract around the shallow portions of the adjacent points of land, just enough to be redirected into the deep water leases.

2. Following definition of the wave exposure and refraction indices for all five stations, each of the initially filtered storms then was rated in terms of its wind velocity field, its duration, and its distance from the target area.

This classifying process, coupled with considerations of the exposure and refraction indices, provided the twenty most severe storms at each site from which a further refining, filtering analysis would yield the desired ten, most severe, storm set.

Because several of the stations exhibit similar exposures, several of the severe storms resulting from the second filtering operation were common to those stations.

In the third and final filtering process, each of the twenty storms derived from filter process #2 was analyzed in detail using wave forecast technology. In the analysis, use was made of the Pierson-Neumann-James (PNJ) theory, aspects of which may be found in Reference 8.

Without going into detail on the PNJ theory, it is worthwhile to note that the theory involves the concept that winds generate an infinite number of wave components of various amplitudes and frequencies, superposition of which gives a certain energy, and hence wave height, in space. This method pretty much referred to as the wave "spectral" theory, has been used by OSI forecasters in the Santa Barbara Channel since 1956 and has yielded good results.

Application of the PNJ forecasting theory to the twenty-storm series resulted in a tabulation of significant wave characteristics in terms of height,* period, and direction as a function of time at each station. From these detailed wave data (twenty sets), the ten most severe were selected at each station, and are presented in this report.

As can be seen from the tables of wave data, several trains of waves frequently existed simultaneously in time at each station. This simultaneity feature is the normal circumstance existing during severe storms in the Santa Barbara Channel.

One complexing aspect of these simultaneous wave trains, is that involving methods of combining the several individual trains of energy into a single wave. The physics of the subject is not well-known when the directions and periods differ very much. A common practice, so long as the waves are not oppositely directed, is to apply the root-mean-square technique for combining these simultaneously-existing energies without consideration of period. To a great extent, any such procedure is, we feel, related to the specific application and associated risk factor. Accordingly, it is normal practice for OSI to provide the componentized wave

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* Significant wave height is defined as the average of the upper one-third of wave heights.

train data to the user, without combining them into a single "wave."

Part 2

METEOROLOGICAL SITUATIONS PRODUCING SEVERE STORM WAVES

There are basically three different meteorological situations which give rise to extreme storm waves in the Santa Barbara Channel. However, due to the east-west orientation of the Santa Barbara coast line (Figure 1) and the Channel Islands to the south, there are varying degrees of protection afforded to specific areas within the channel for each of the above situations. This aspect will be treated quantitatively in the next section. In the following paragraphs, the three basic meteorological patterns will be described briefly.

1. Cyclogenesis Near the Coast (Southeast Sea and Southwest Swell)

Very often the most intense winter storms intensify rapidly only a few hundred miles southwest of Point Conception. In combination with high-pressure over the plateau, strong pressure gradients result in gale or hurricane force, east southeast winds blowing through the entire length of the Santa Barbara Channel. Such a storm, March 1905, is illustrated in Figure 2. Two other fetch areas are important wave producers in the storm: 1) The southerly winds in the warm sector

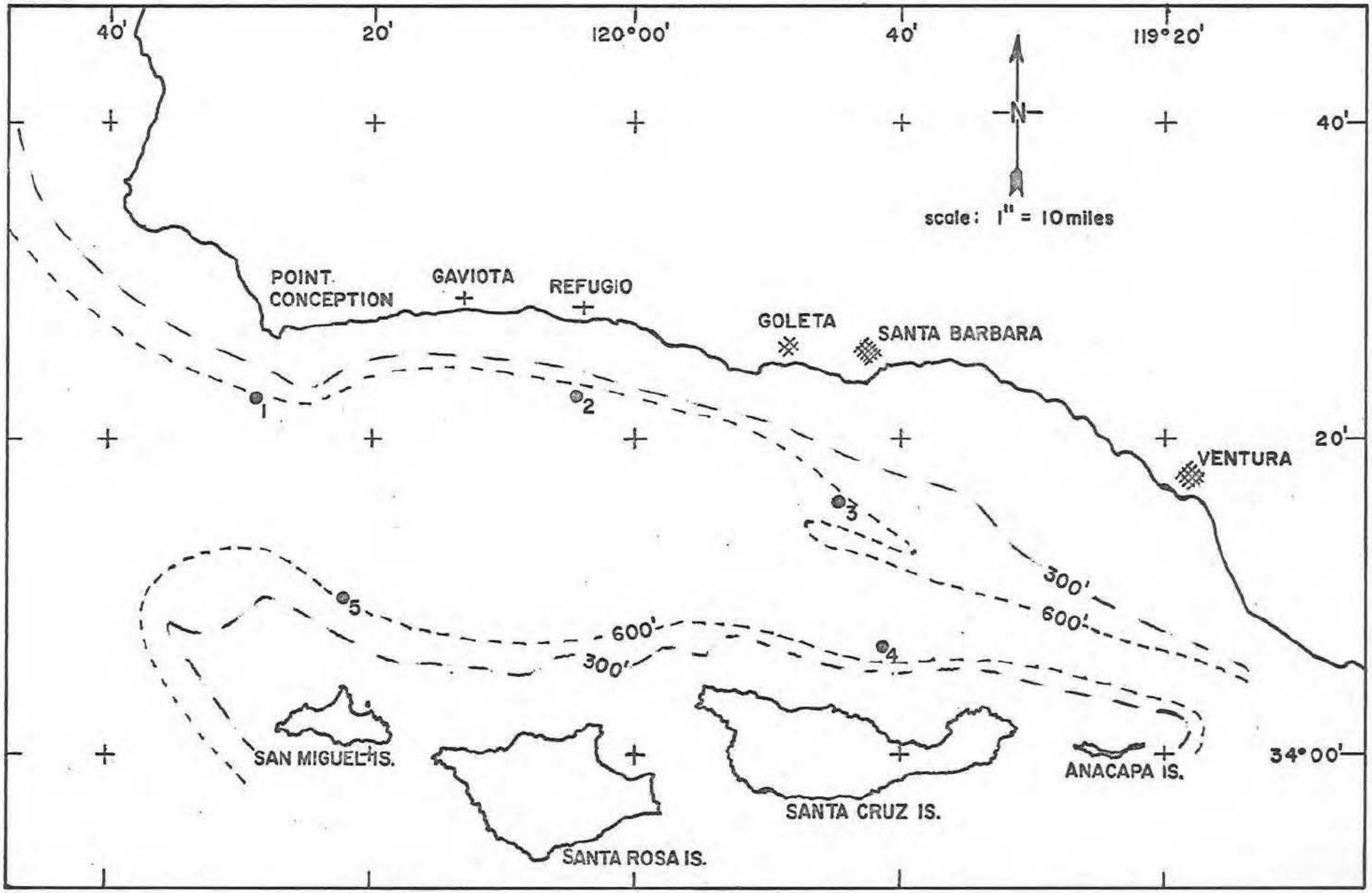

FIGURE 1

LOCATION OF HINDCAST SITES

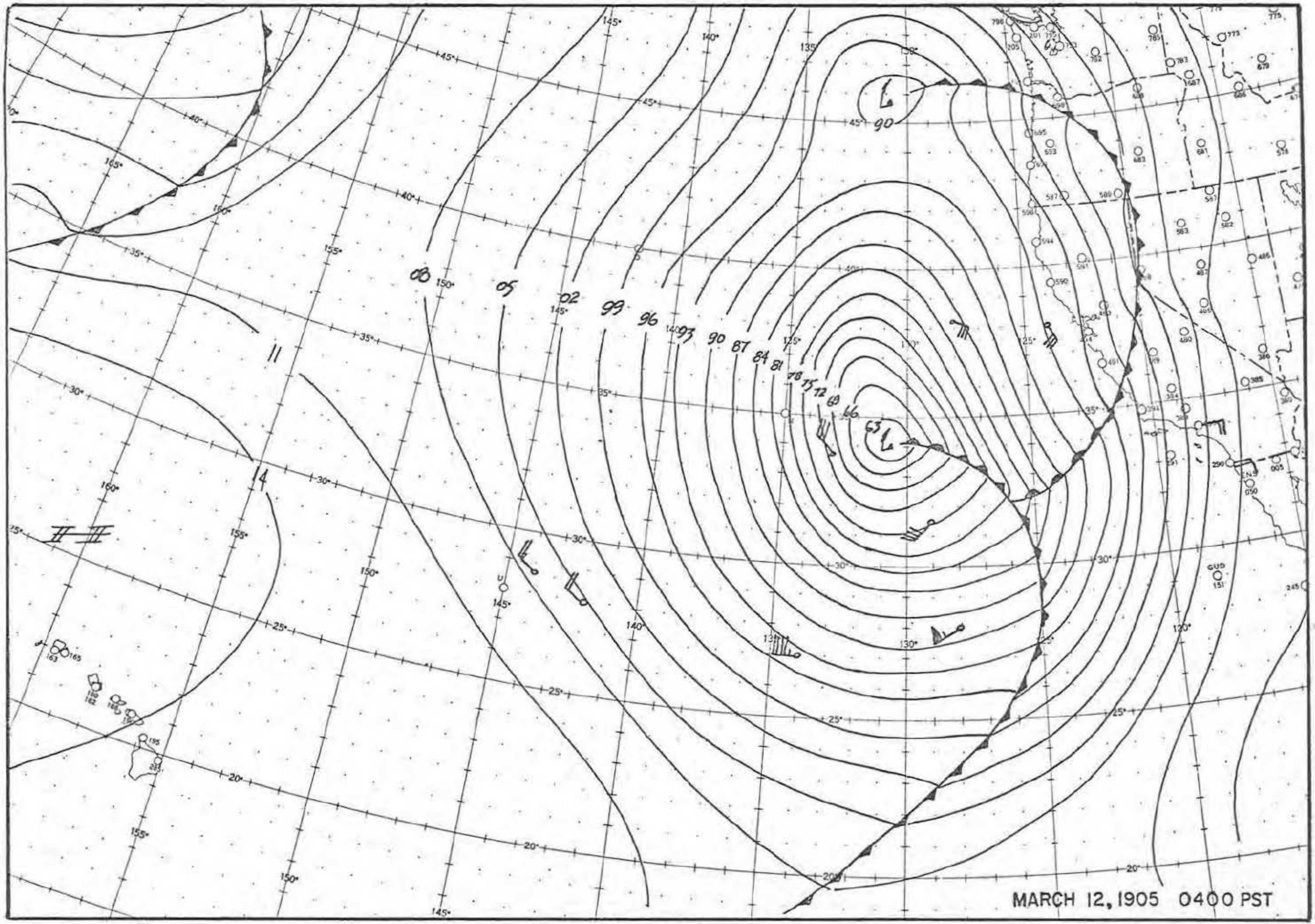

Figure 2

CYCLOGENESIS NEAR THE COAST

preceding the cold front; 2) The southwesterly winds in the cold air behind the cold front. The latter has the greatest potential for producing the highest waves owing to the fact that the storm center moved northeastward allowing for a much greater effective fetch length.

Though this particular storm type is a common one and can be expected to occur frequently, it is rare that the storm track is so far south and the low so intense as in the March 1905 storm. Station 1 is most vulnerable to this type of storm due to its unobstructed exposure to the southwest. In the 1905 storm, the southwest wind fetch moved directly to Station 1, and resulted in a significant wave height of 27.5 ft.

2. Cyclogenesis in Mid-Pacific (Westerly Swell)

Usually, the intense extratropical cyclones forming in the mid and western Pacific stall, or move northeastward before strong westerly winds blowing in the southwest quadrant of these storms generate exceptionally high waves, especially when the fetch is long and/or the storm has been moving directly toward the coast. However, because of the large decay distances involved, very rarely are waves high enough by the time they reach the Santa Barbara Channel to qualify among the maximum ten storms. An exception to this was the storm of April 1958, which is shown in Figure 3. This storm is exceptional in its wind speed, duration, and fetch length, and produced waves ranging from 17 to 24.5 ft. at the study sites.

If, however, the arrival of this westerly swell should coincide with strong west to northwest winds along the California coast, then exceptionally high waves are generated. This combination of events is especially important at Stations 3 and 4.

3. Nevada Low (Northwest to West Sea and Swell)

Frequently, particularly during spring, large cold air masses aloft, move from Western Canada and Alaska southward into Utah, Nevada, and Arizona. Cyclogenesis occurs on the surface with deep low-pressure centers usually forming in the area of Southern Nevada. In coordination with the Pacific high, which is located but a few hundred miles offshore, this low produces a very high-pressure gradient along the California coast. Winds are further intensified as the core of maximum winds in the jet stream moves southeastward around the low.

Because of the exposure to the northwest, many of the ten

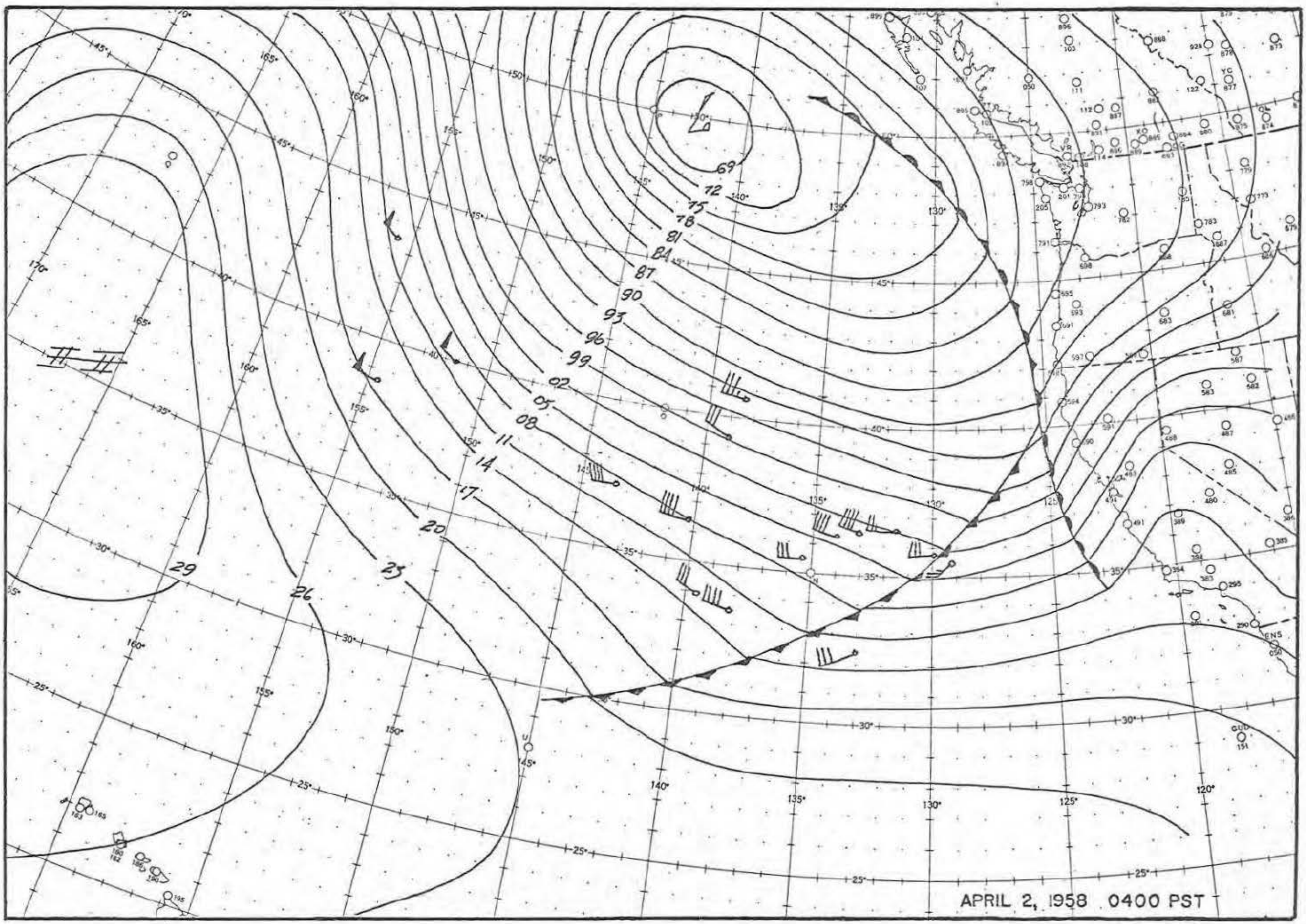

Figure 3

CYCLOGENESIS IN MID-PACIFIC

maximum storms for Station 5 are of this type. An example is shown in Figure 4, January 1913. This storm produced sustained 35 to 40 knot winds along the entire California coast with locally stronger winds blowing in the Point Conception to San Miguel Island area.

As a matter of interest, one of the most famous storms in Southern California history was the hurricane of September 1939. This storm, spawned off the coast of Central America, moved on a north-northwest track paralleling the coast and finally moved inland directly over Los Angeles. It is the only hurricane on record to have reached California. The significant height of the south-southeast waves off Long Beach was 25 to 30 ft. However, because of the protection from the Channel Islands, the waves are of little consequence for the purposes of this study, reaching a height of only 17 ft. at the eastern corner of the channel, and decreasing progressively westward.

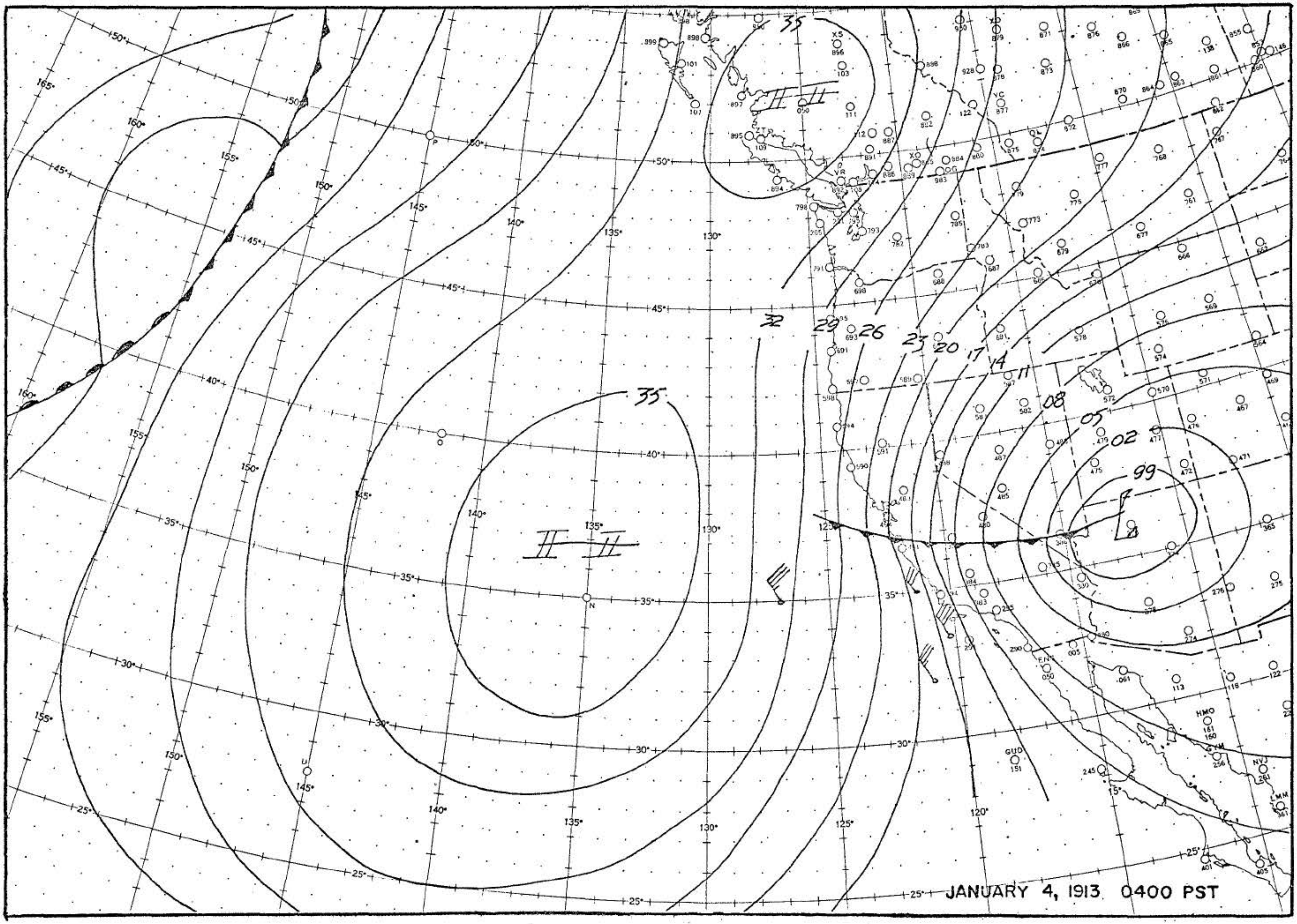

Figure 4

NEVADA LOW

Part 3

EXTRAPOLATION OF STORM WAVE DATA

In areas with a variable sheltering factor, a slight difference in the local wind direction or in the approach direction of a swell train might significantly alter the wave height at one location while having little effect on the height at another. Each storm should, therefore, be treated differently with respect to extrapolating the wave height from one location to another. It is possible, however, to treat the problem in a rather gross manner using specific weather types and average approach directions. Figures 5 through 8 show the ratio of the wave height at any given location to the maximum wave height in the channel for the following wave conditions: 1)southeast seas; 2)southwest swell; 3)westerly swell; 4)northwest to west sea and swell.

Southeast Sea

The most extreme winds in the Santa Barbara Channel occur in conjunction with a deep low-pressure center offshore as in Figure 2. Winds may reach 65 to 70 mph with gusts to 100 mph from the east-southeast. Within a very few hours after the maximum wind speeds are attained, the wave height becomes limited by the fetch distance between the forecast (or hindcast) site and the eastern end of the channel. (A minor contribution to the wave height is made by waves entering from south of the channel between the islands and the mainland.) The wave height, therefore, increases as the fetch increases and the highest waves are observed in the area of Point Conception (Figure 5).

Southwest Swell

The weather pattern producing high southwesterly swell was illustrated in Figure 2. The islands and, to a lesser extent, the shoal area northwest of San Miguel shelter a large portion of the channel. The wind direction and the location of the fetch area is critical. The wave period is also important owing to refraction considerations around the previously mentioned shoal. Figure 6 indicates a rather sharp decrease in wave height in the Gaviota-Refugio area. This diagram was constructed for a wave direction of 220^0. A more southerly direction would shift the cut-off point westward. Also, considerable divergence of wave energy occurs in the area around Station 5.

Westerly Swell

In addition to wave period and approach direction, the extrapolation indices for westerly swell from distant storms are dependent upon decay distance and fetch width. The indices shown in Figure 1 are for two specific storms: 4 April 1958 (approach direction 265^0), and

10 February 1963 (approach direction 285^0). These two storms along with that of 9 February 1960 are the only storms considered in this study where local winds had only a slight effect on increasing the wave height at the selected stations.

Northwest to West Sea and Swell

The ten maximum storms at Stations 3, 4, and 5 are composed predominently of "Nevada low" type situations. Under such conditions, the northwest winds along the coast north of the Santa Barbara Channel swing around to a due west direction within the Channel itself. The waves at Stations 3 and 4, therefore, are a combination of swell from the northwest winds outside of Point Conception and sea from the local westerly winds. Station 2 is largely protected from the northwest swell, and the westerly fetch is short. Extrapolation values for the Nevada low situation are shown in Figure 8.

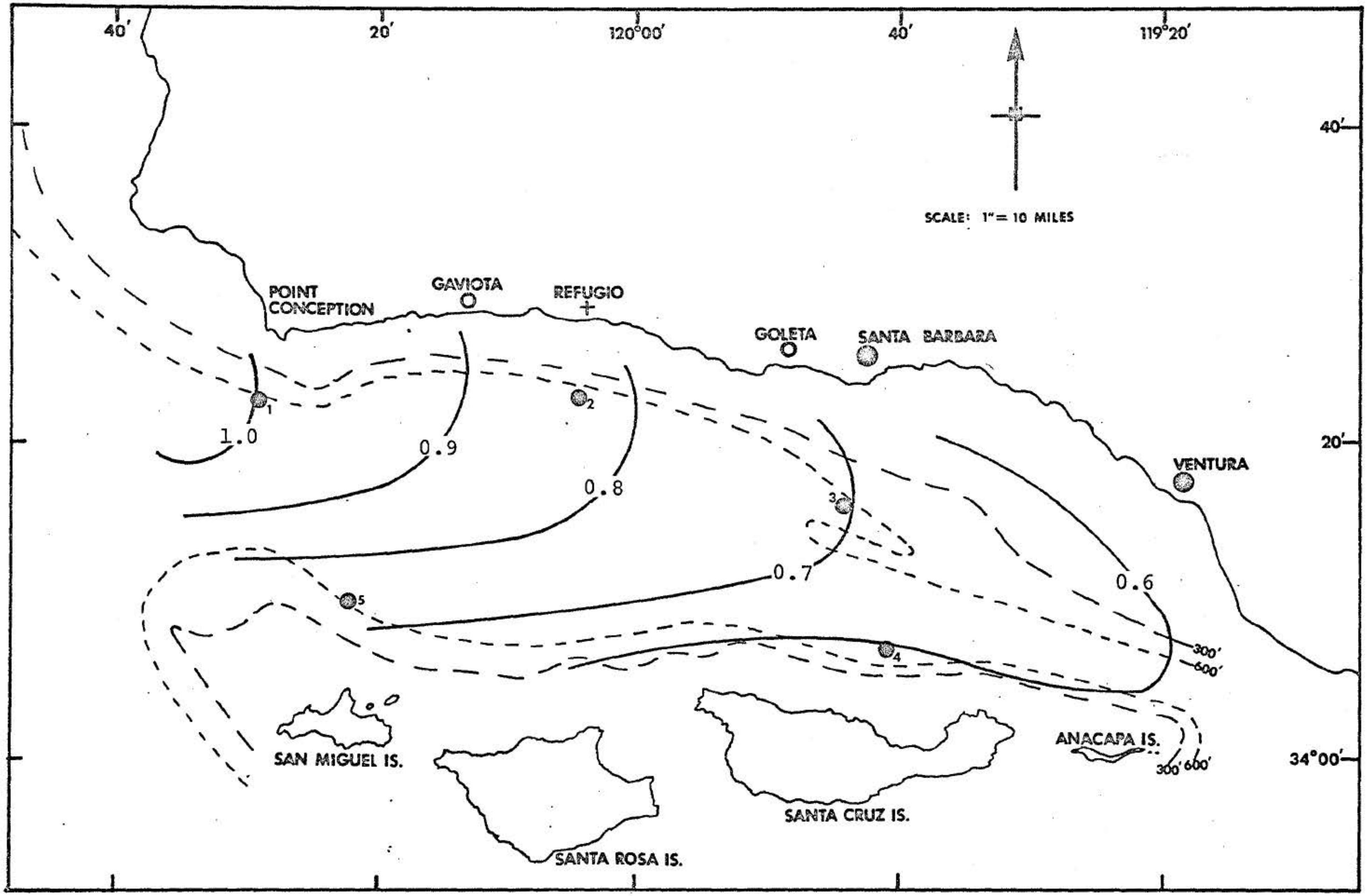

Figure 5 RELATIVE WAVE HEIGHTS FOR AN EAST-SOUTHEAST SEA

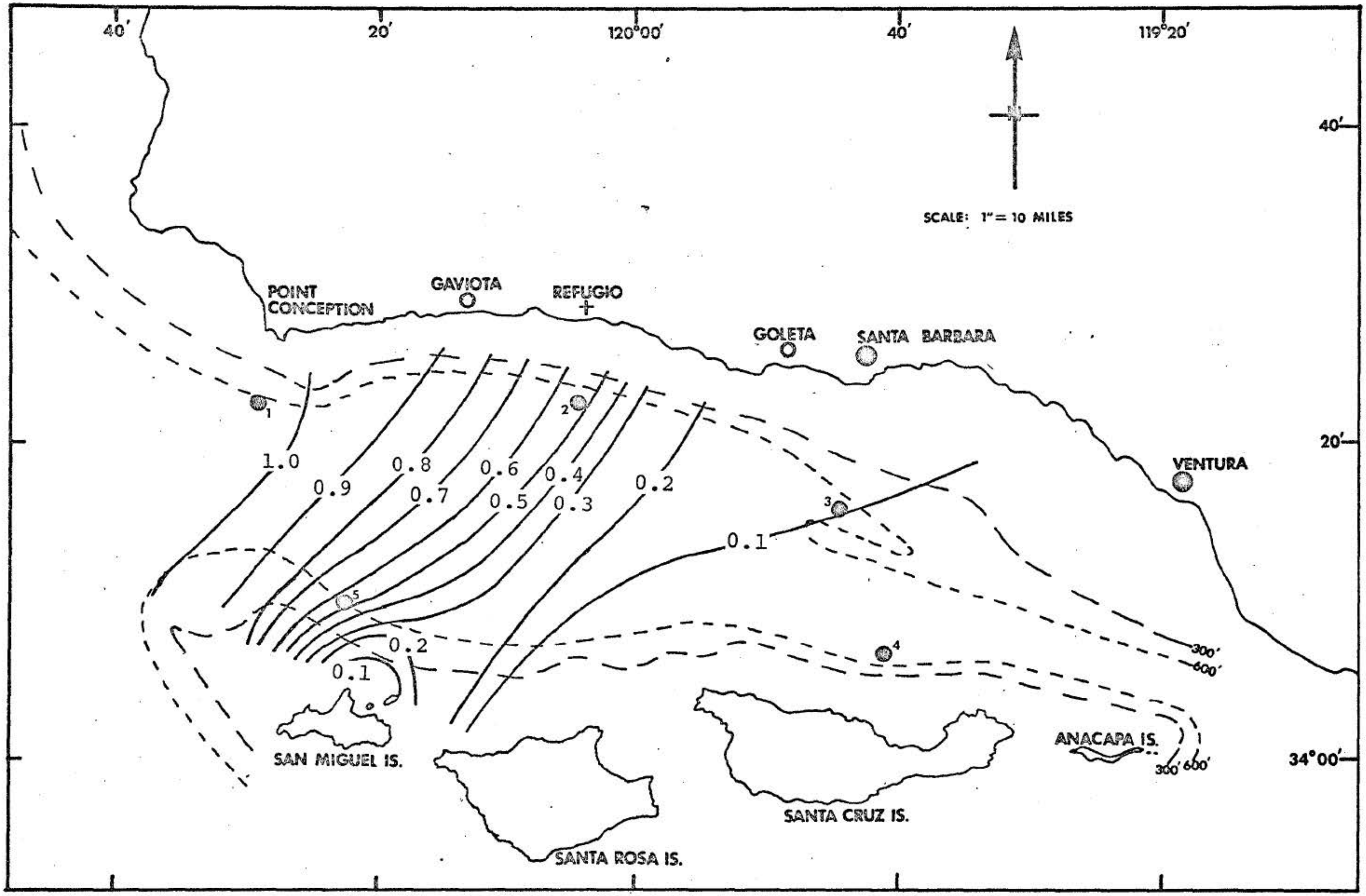

Figure 6 RELATIVE WAVE HEIGHTS FOR A SOUTHWEST SWELL

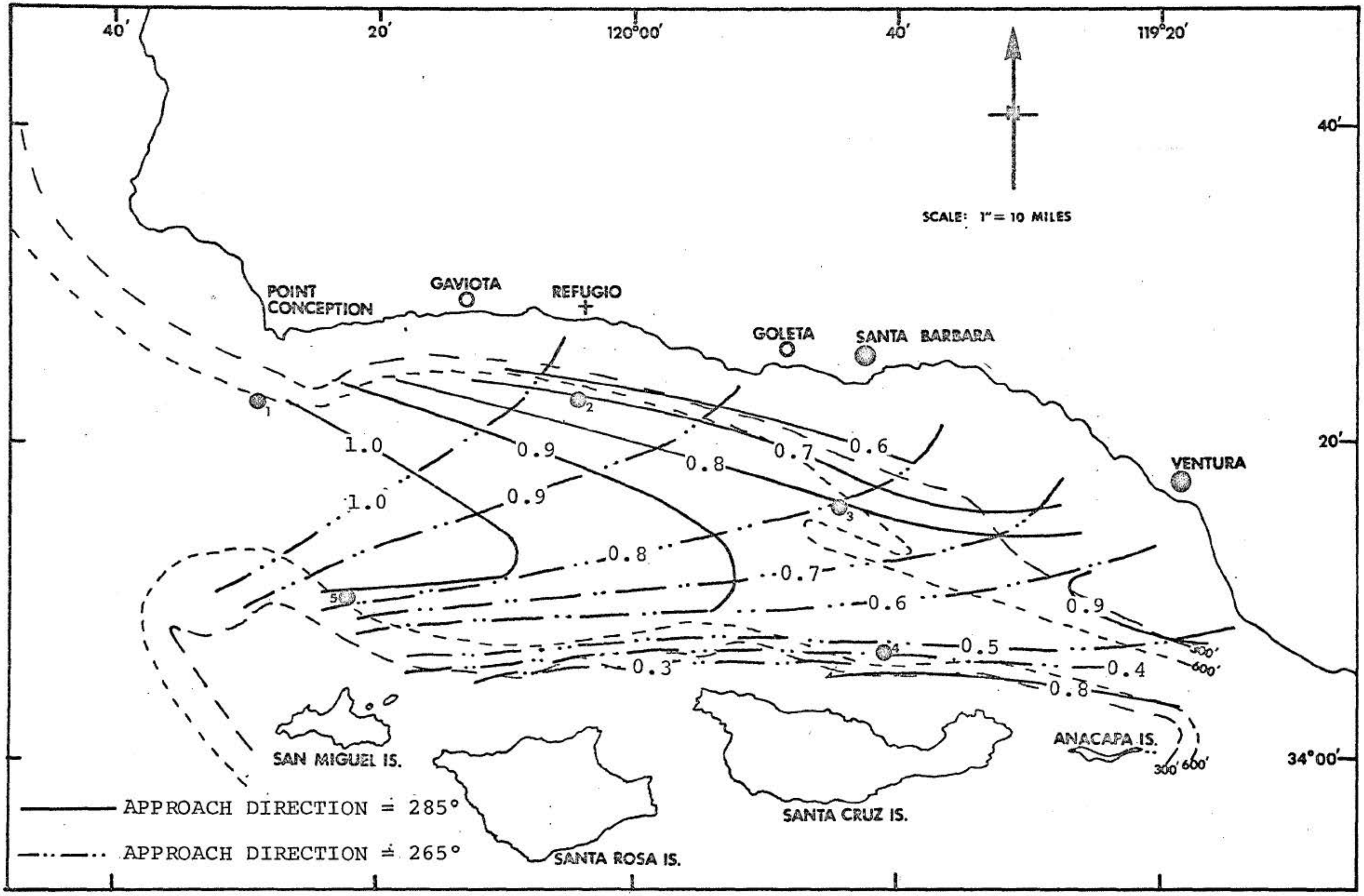

Figure 7 RELATIVE WAVE HEIGHTS FOR A WESTERLY SWELL

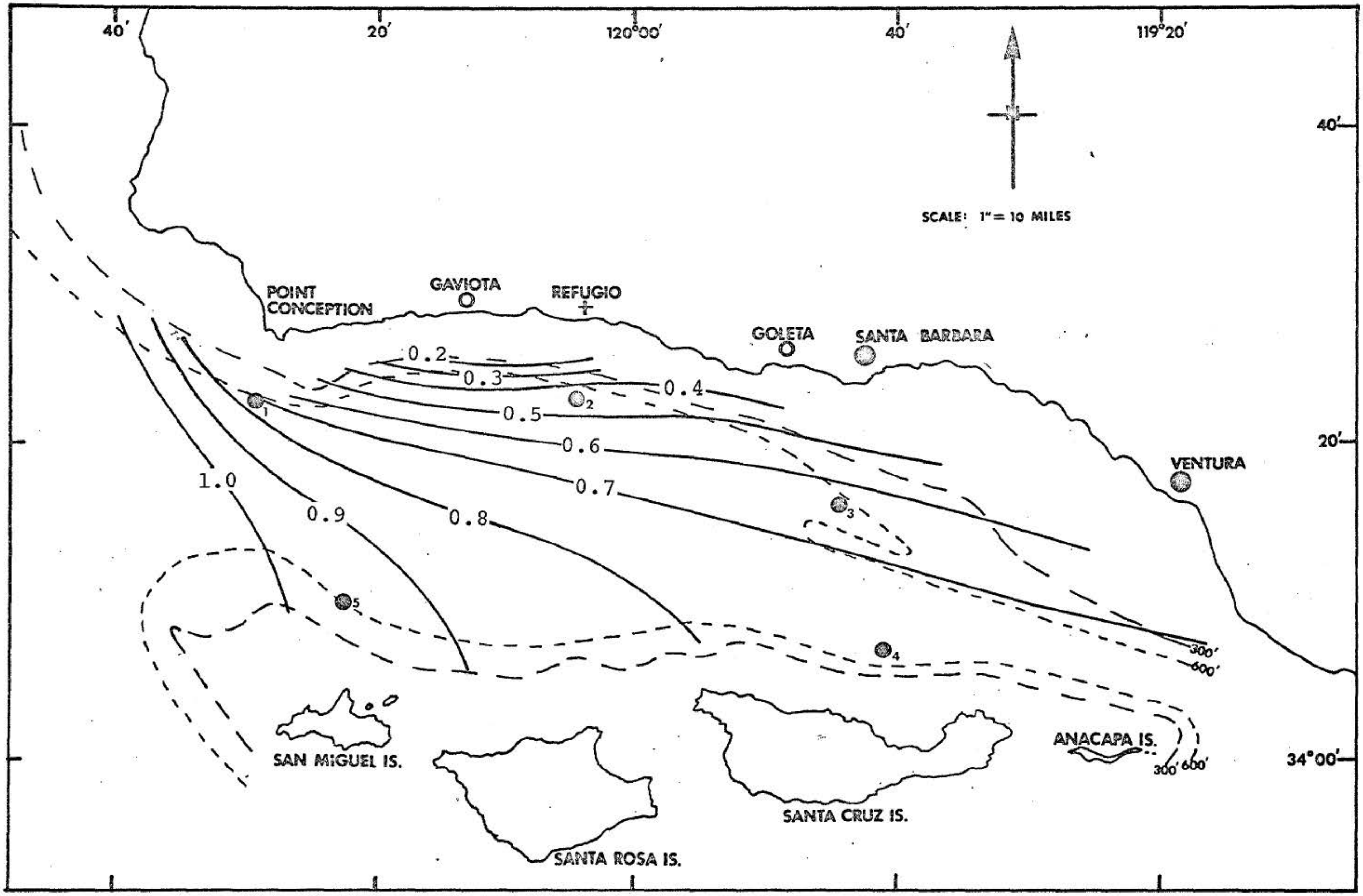

Figure 8 RELATIVE WAVE HEIGHTS FOR WEST AND NORTHWEST SEA AND SWELL

Part 4

REFERENCES

1. Arthur, R. S., "Variability in Direction of Wave Travel," Annals, New York Academy of Sc., Vol. 51, 1949.
2. Bretschneider, C. L., "Revised Wave Forecasting Curves and Procedures," Tech. Report No. 155-47, Inst. of Eng. Research, Univ. of Calif. at Berkeley, Sept., 1951.
3. Forrest, D. R., "A Method of Estimating Wave Direction," Bulletin of the Beach Erosion Board, Vol. 4, No. 2.
4. Longuet-Higgins, M. S., "On the Statistical Distribution of the Heights of Sea Waves," Jour. of Marine Research, Vol. X, Dec., 1952.
5. Mason, M. A., "Surface Water Wave Theories," Trans. Am. Soc. Civil Eng., Vol. 118, 1953.
6. National Marine Consultants, "Wave Statistics for Seven Deep Water Stations Along the Calif. Coast," Dec., 1960.
7. Neumann, G., "Notes on the Generation and Growth of Ocean Waves Under Wind Action," Proc. Third Conf. on Coastal Eng., Council on Wave Research, The Eng. Found., Berkeley, Calif., 1952.
8. Pierson, W. J., Jr., "A Unified Mathematical Theory for the Analysis, Propagation, and Refraction of Storm Generated Ocean Surface Waves, Part I and II," Research Div., College of Eng., New York University, 1952.
9. Pierson, W. R., Newmann, G., and James, R., "Practical Methods for Observing and Forecasting Ocean Waves by Means of Wave Spectra and Statistics," Research Div., College of Eng., New York University, 1953.

TABLE 1-A
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1, Block 342 Date Mar 1905

Day	Time	Wave Train							
		1 (110^0)*		2 (210^0)		3 (240^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16								
	22	10.0	7						
12	04	20.0	9						
	10	16.5	9	11.0	9				
	16	14.0	8	16.0	11				
	22	6.0	6	16.5	11	27.5	15		
13	04			10.5	10	27.0	14		
	10			6.0	7	19.0	10		
	16					11.0	8		
	22					6.5	7		
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-A

WAVE HEIGHT PLOT: STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

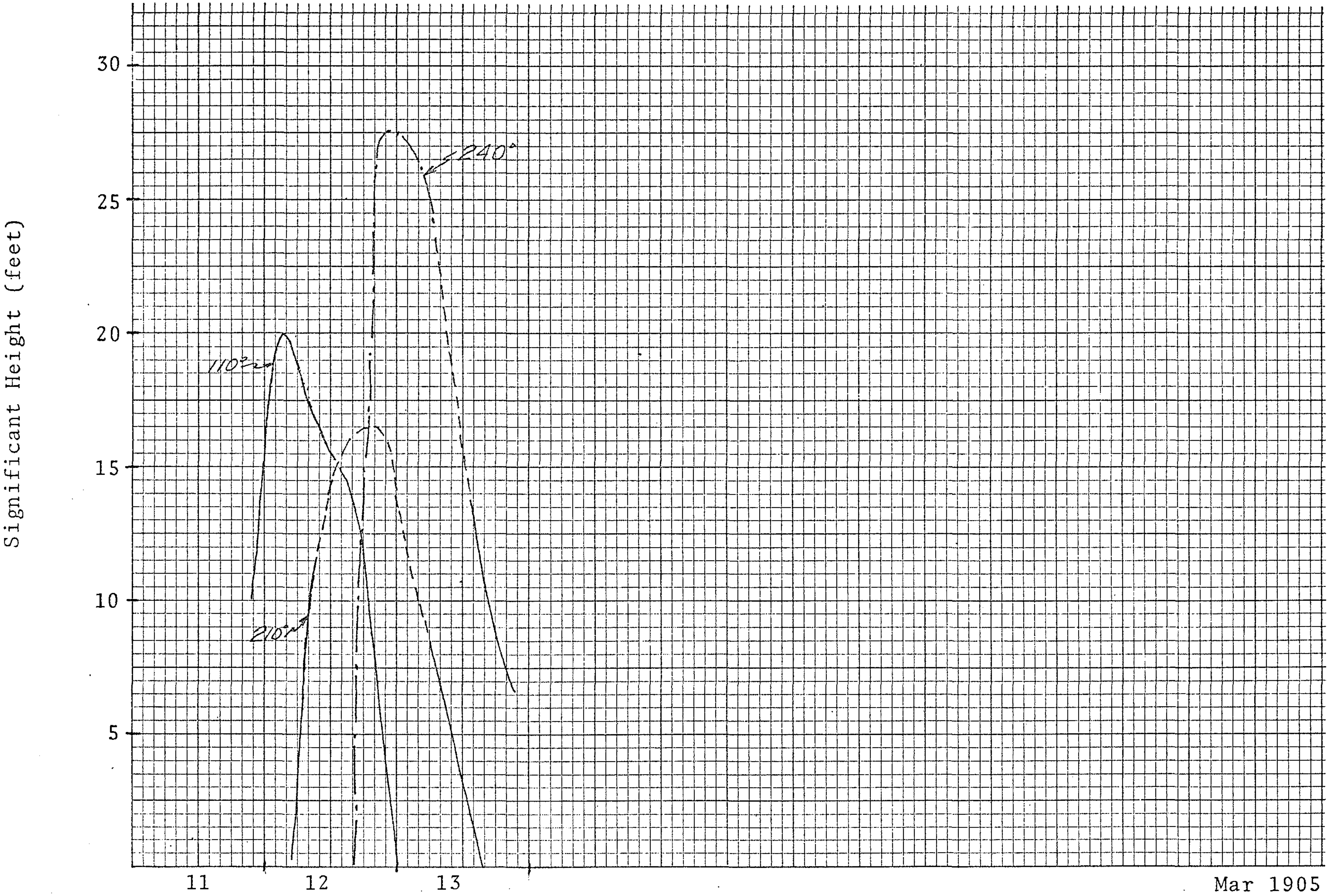

TABLE 1-B
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Jan 1914

Day	Time	Wave Train							
		1 (110^{0})*		2 (135^{0})		3 (225^{0})		4 (280^{0})	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16								
	22	4.5	4						
24	04	10.0	7						
	10	9.0	7						
	16	6.0	6						
	22	10.0	7						
25	04	14.0	8						
	10			10.0	7	17.5	11		
	16			9.0	7	23.5	13		
	22			6.0	6	22.5	13	2.0	17
26	04			5.0	5	13.5	10	13.5	15
	10					7.5	8	16.5	13
	16							15.5	11
	22							15.5	10
27	04							17.0	10
	10							16.0	10
	16							15.5	10
	22							15.0	10
28	04							12.5	10
	10							7.0	8
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-B

WAVE HEIGHT PLOT:STATION 1 BLOCK 342

TABLE 1-C
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Feb 1915

Day	Time	Wave Train							
		1 (240^0)*		2 (135^0)		3 (280^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04	6.0	6						
	10	9.5	7			5.5	18		
	16	15.0	9			9.5	17		
	22	14.0	11	13.0	8	12.0	16		
2	04	14.0	11	16.0	8	11.5	13		
	10	21.5	11	17.0	8	11.0	12		
	16	23.0	11	4.5	6	18.0	10		
	22	22.0	11			10.0	11		
3	04	13.5	9			17.5	14		
	10	7.5	7			19.0	13		
	16					16.0	10		
	22					12.5	8		
	04					10.0	8		
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-C

WAVE HEIGHT PLOT:STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

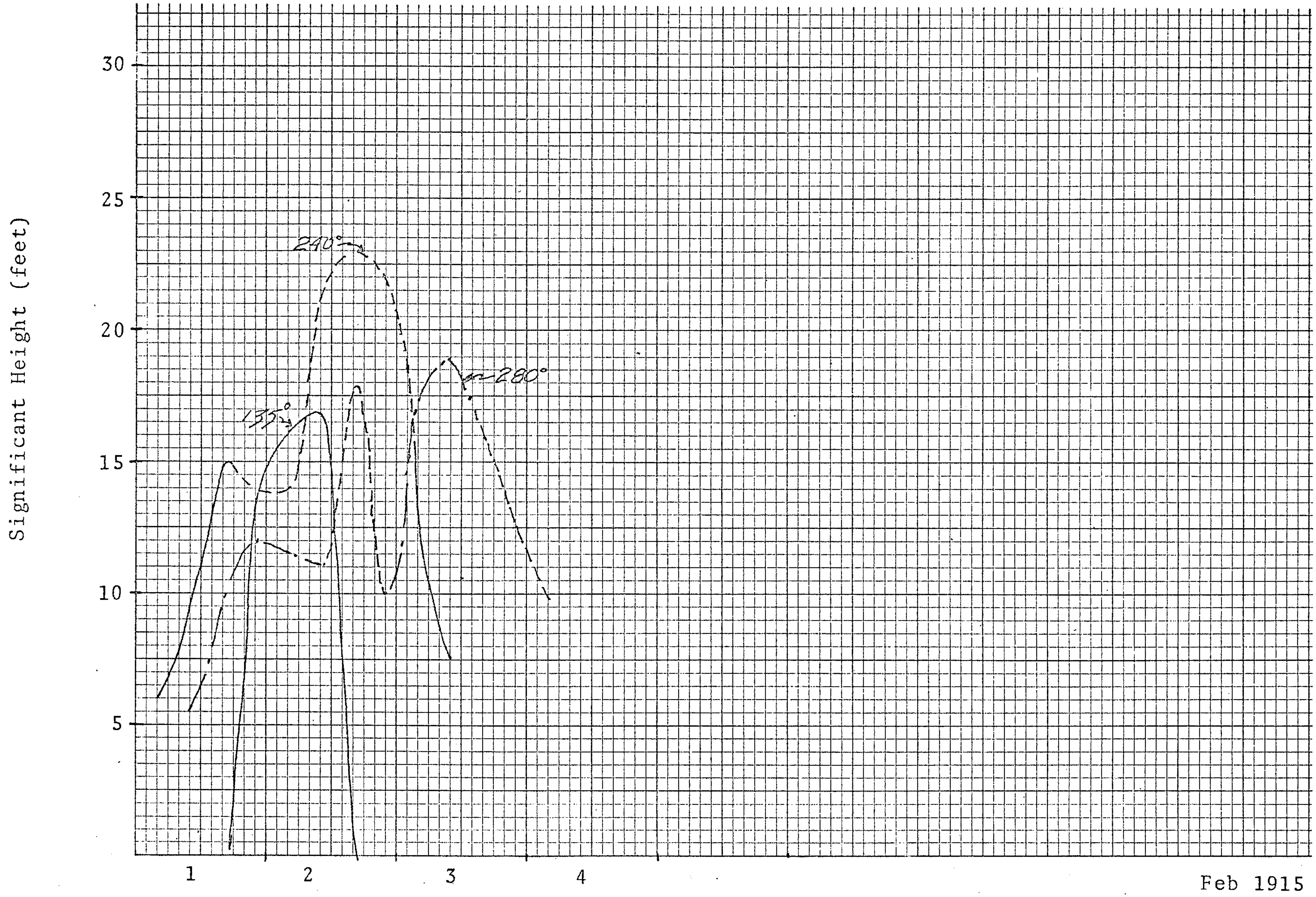

TABLE 1-D
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Dec 1916

Day	Time	Wave Train							
		1 (290^0)*		2 (225^0)		3 (135^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16	7.5	9						
	22	10.5	10			9.5	7		
24	04	16.0	12			11.0	7		
	10	14.0	11			11.0	7		
	16	16.5	10	12.0	8	4.5	7		
	22	22.0	12	8.0	7				
25	04	21.5	12						
	10	18.0	12						
	16	18.0	12						
	22	17.0	12						
26	04	8.0	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-D

WAVE HEIGHT PLOT:STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

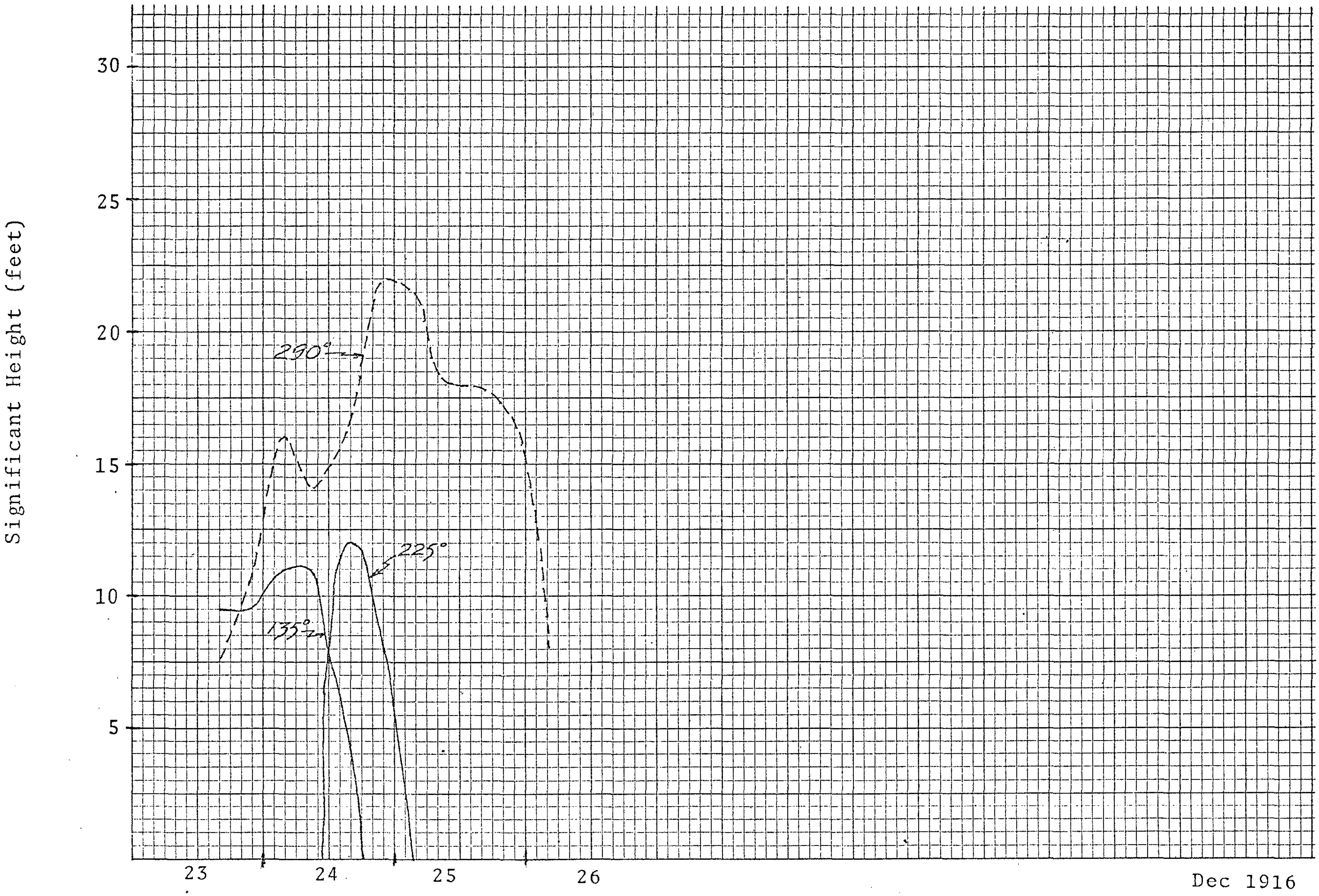

TABLE 1-E

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Dec 1921

Day	Time	Wave Train							
		1 (110^0)*		2 (215^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
24	04								
	10								
	16	7.0	6						
	22	13.0	8	16.5	10				
25	04	17.5	9	19.0	11				
	10	16.0	8	21.5	12				
	16	6.0	6	22.0	12				
	22	8.5	6	22.0	12				
26	04	16.0	9	9.0	9				
	10	14.0	8	6.5	8				
	16	4.5	7	14.0	13				
	22			14.0	12				
27	04			13.5	12				
	10			9.0	8				
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-E

WAVE HEIGHT PLOT: STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

TABLE 1-F
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Jan 1932

Day	Time	Wave Train							
		1 (300°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	8.0	6						
	22	11.0	7						
12	04	18.0	10						
	10	20.5	11						
	16	21.0	12						
	22	21.0	12						
13	04	17.5	10						
	10	11.0	10						
	16	8.5	7						
	22	4.0	5						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-F

WAVE HEIGHT PLOT: STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

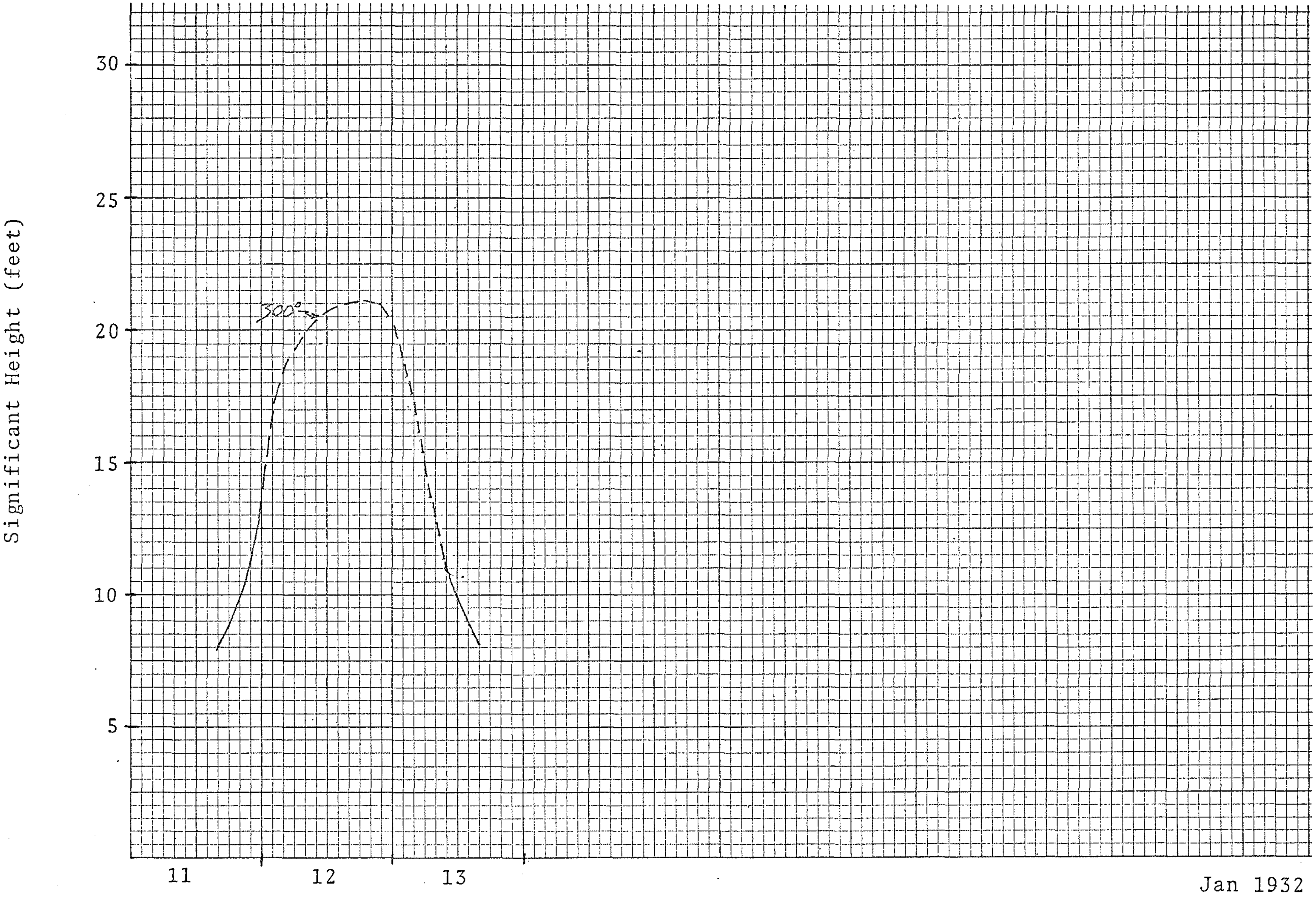

TABLE 1-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Jan 1939

Day	Time	Wave Train							
		1 (300^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
5	04								
	10	3.0	8						
	16	13.5	15						
	22	18.5	14						
6	04	22.0	12						
	10	19.0	10						
	16	16.5	10						
	22	13.5	9						
7	04	10.0	8						
	10	6.0	7						
	16	5.0	7						
	22	3.5	7						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-G

WAVE HEIGHT PLOT:STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

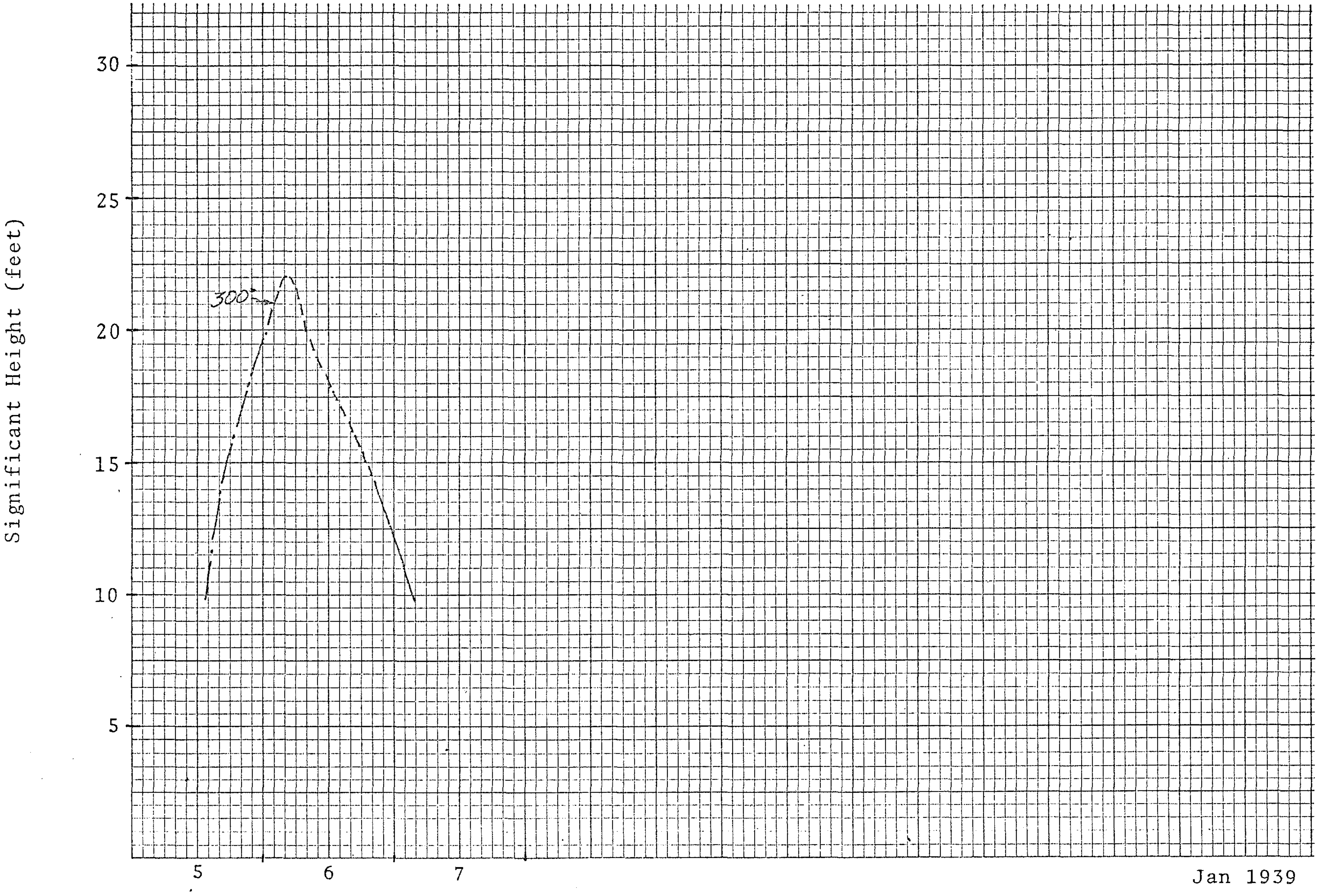

TABLE 1-H

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Feb-Mar 1941

Day	Time	Wave Train							
		1 (110^0)*		2 (220^0)		3 (270^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
27	04								
	10	9.0	7						
	16	12.5	7						
	22	17.5	8	11.5	8				
28	04	19.5	8	16.0	9				
	10	5.0	6	19.5	10				
	16			19.5	10				
	22			6.0	7	6.5	6		
1	04					14.0	10		
	10					14.0	10		
	16					14.0	10		
	22					14.0	10		
2	04					13.0	10		
	10					10.5	9		
	16					6.5	7		
	22					4.0	7		
3	04	5.5	5						
	10	12.0	7						
	16	16.0	8						
	22	11.5	7						
4	04			21.5	9				
	10			14.0	8	9.5	7		
	16					12.5	8		
	22					11.5	8		
	04					6.0	7		
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 1-H

WAVE HEIGHT PLOT:STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

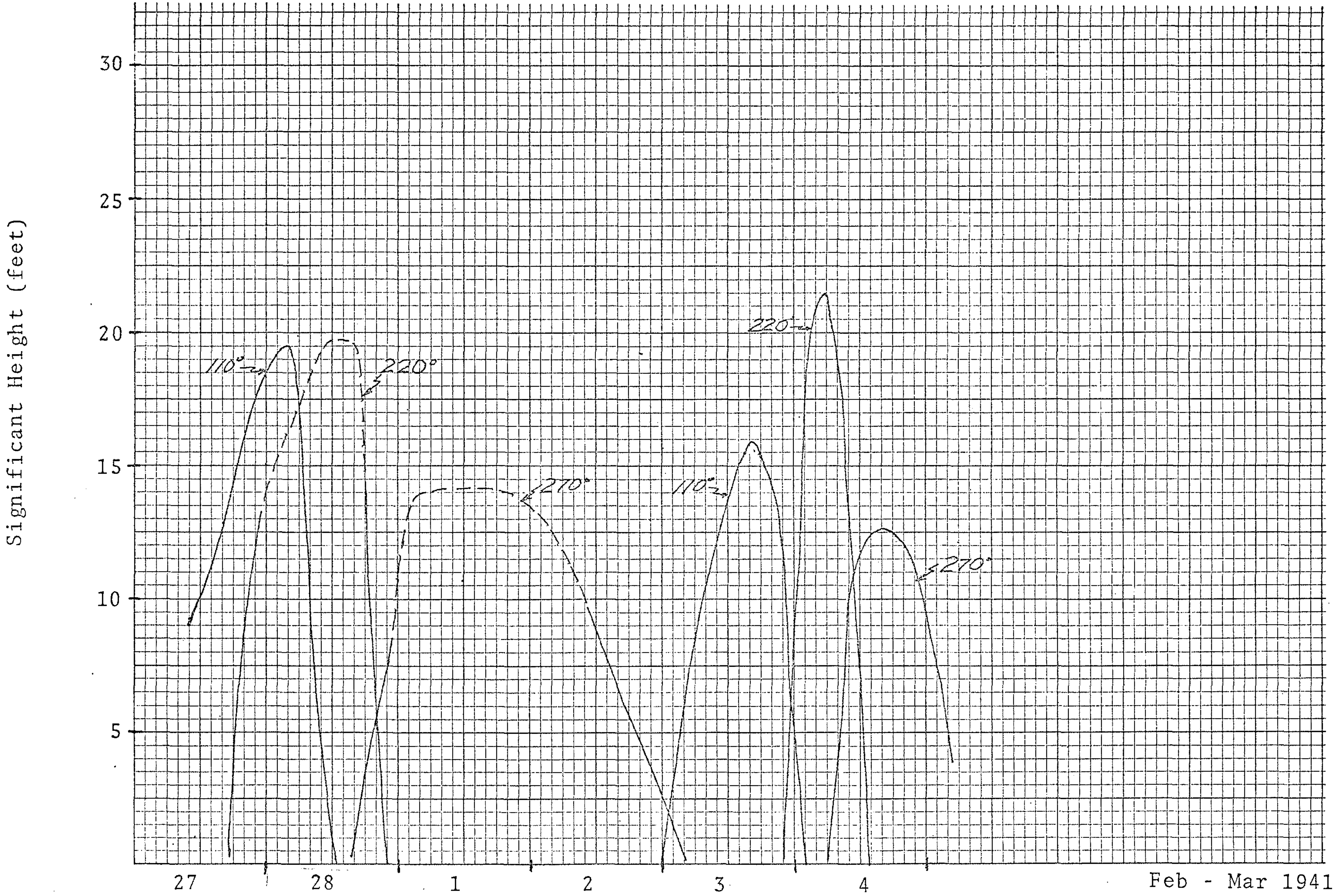

TABLE 1-I
SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342   Date Apr 1958

Day	Time	Wave Train							
		1 (285^0)*		2 (135^0)		3 (110^0)		4 (225^0)	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	12.5	13						
	22	17.0	12						
2	04	17.5	14						
	10	18.0	13	4.0	4				
	16	14.0	12	10.0	7				
	22	12.0	11	11.0	7				
3	04	9.0	9					12.0	8
	10	10.0	17					8.0	6
	16	16.5	15					3.5	6
	22	21.0	14						
4	04	22.5	14						
	10	23.5	16						
	16	24.5	15						
	22	21.5	14						
5	04	19.0	12						
	10	16.0	10						
	16	13.5	10	4.0	5				
	22	11.0	10	7.0	6				
6	04	9.5	9						
	10	7.5	8			4.0	4		
	16	15.5	13			11.0	7		
	22	18.0	15			9.0	7		
7	04	15.0	12						
	10	10.0	10						
	16	6.5	8						
	22	4.5	7						
	04								
	10								
	16								
	22								

*approach direction

Figure 1-I

WAVE HEIGHT PLOT: STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

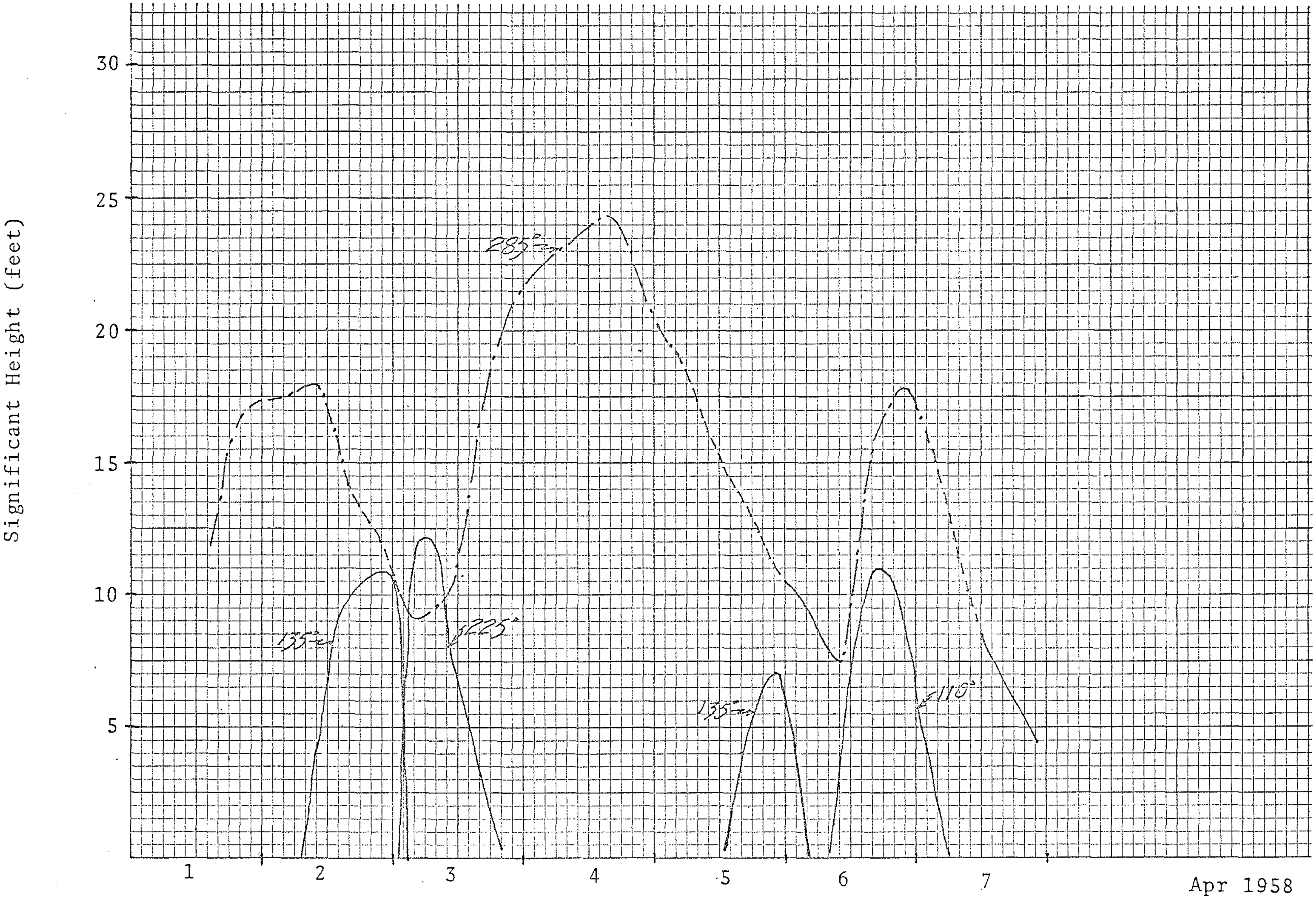

TABLE 1-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 1 Block 342 Date Feb 1959

Day	Time	Wave Train							
		1 (110^{0})*		2 (225^{0})		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
15	04	10.0	6						
	10	16.0	7						
	16	18.5	8						
	22	18.5	8	10.5	14				
16	04	18.5	8	21.5	11				
	10	8.5	5	19.5	10				
	16			13.0	8				
	22			7.5	8				
	04								
	10								
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	04								
	10								
	16								
	22								

*approach direction

Figure 1-J

WAVE HEIGHT PLOT: STATION 1 BLOCK 342

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

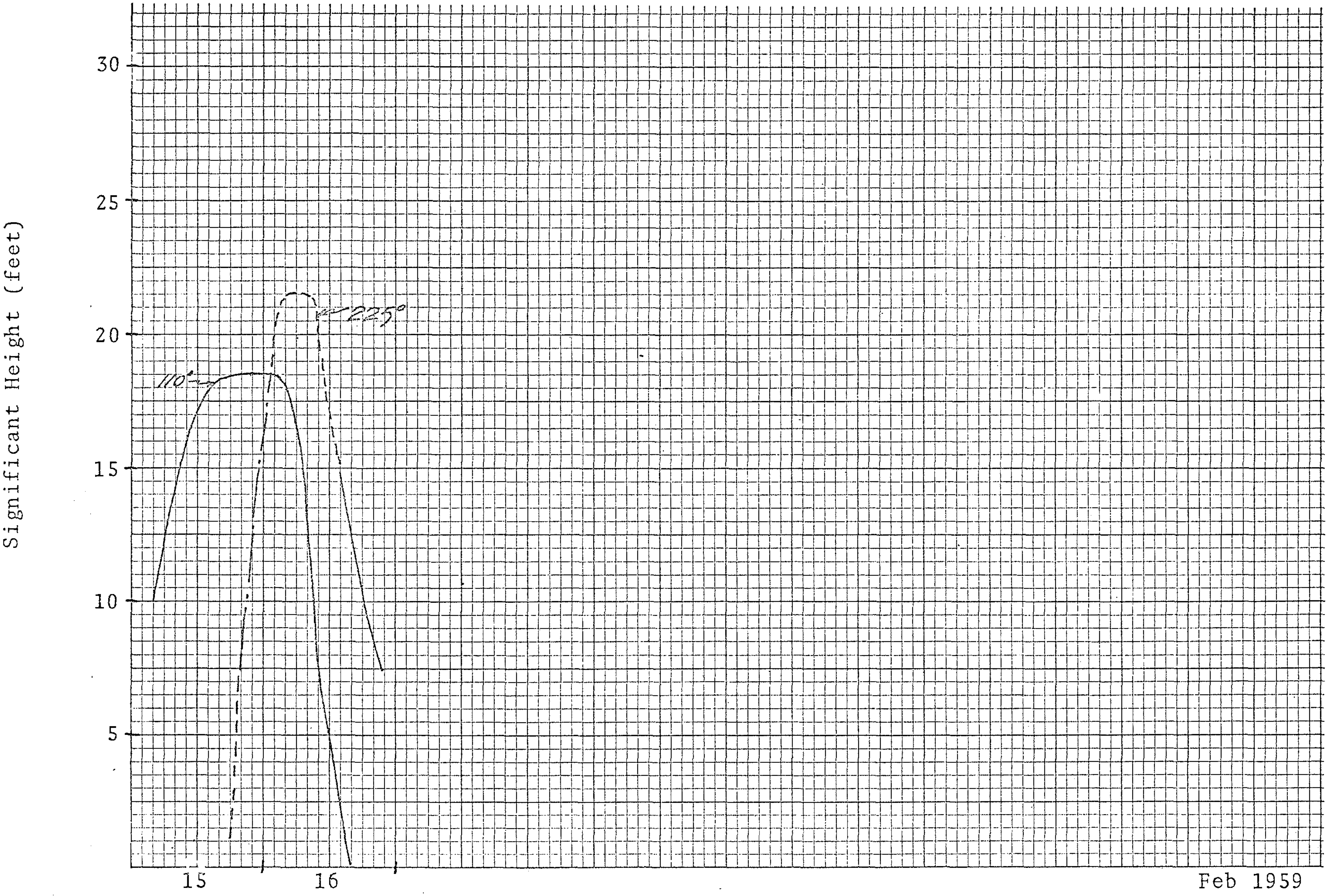

TABLE 2-A
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Mar 1905

Day	Time	Wave Train							
		1 (110^0)*		2 (240^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	1.0	2						
	22	9.0	7						
12	04	18.0	9						
	10	14.5	8						
	16	12.0	7	8.5	9				
	22	5.0	5	20.0	15				
13	04			20.5	14				
	10			19.5	13				
	16			14.0	11				
	22			8.5	8				
	04								
	10								
	16								
	22								
	04								
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	22								
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	10								
	16								
	22								

*approach direction

Figure 2-A

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

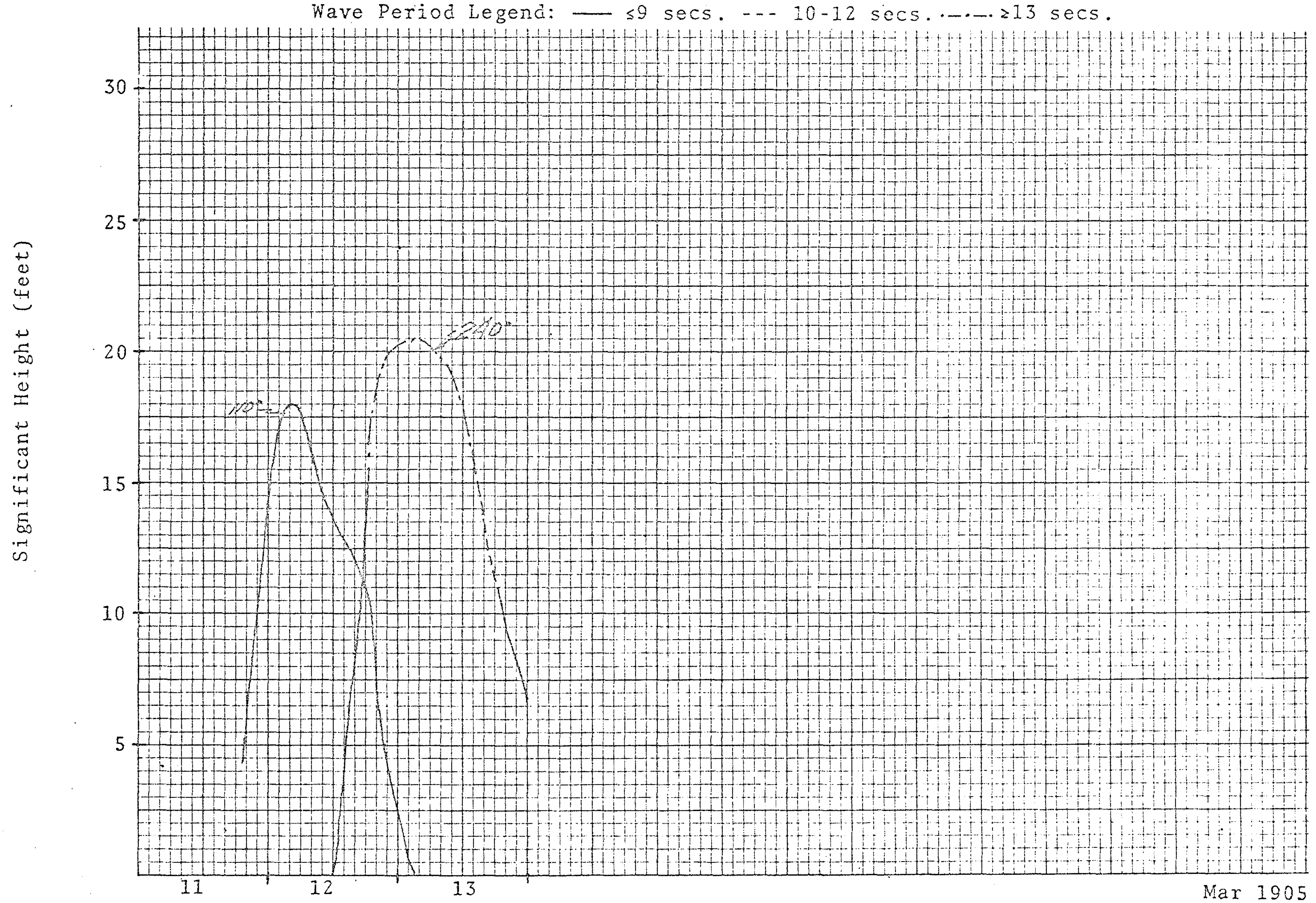

TABLE 2-B
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Mar 1912

Day	Time	Wave Train							
		1 (110^0)*		2 (220^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	6.0	6						
	22	9.5	8						
12	04	13.5	8						
	10	17.0	9	5.0	7				
	16	9.0	8	11.0	9				
	22			7.0	7				
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-B

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

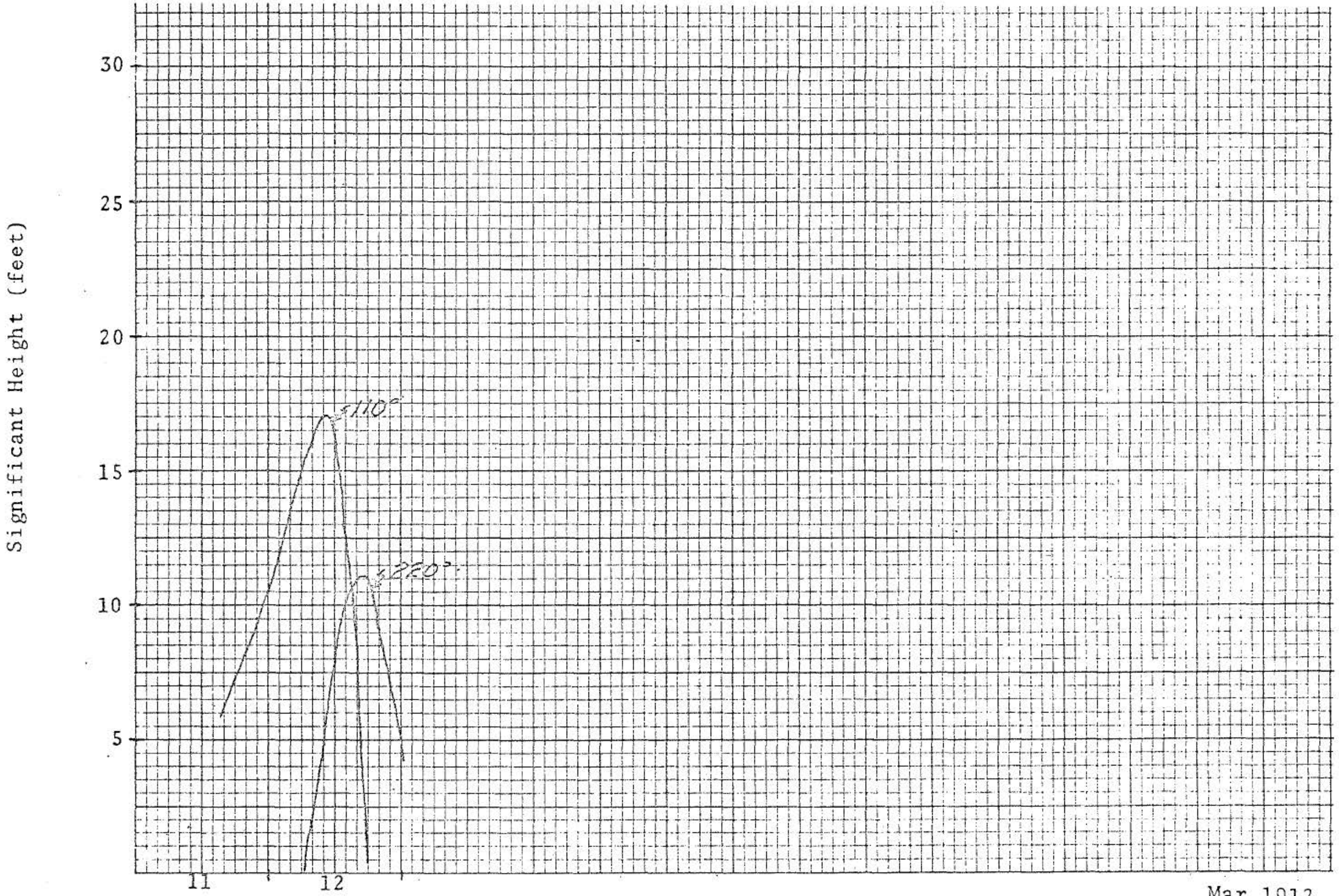

TABLE 2-C

SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Jan 1914

Day	Time	Wave Train							
		1 (135⁰)*		2 (245⁰)		3 (270⁰)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
25	04	10.0	8						
	10	8.0	7	9	10				
	16	7.0	6	15.5	12				
	22	5.0	6	15.5	13				
26	04	4.0	5	14.5	13				
	10			14.0	12				
	16			~~8.0~~	~~10~~	12.0	11		
	22					12.0	10		
27	04					12.0	10		
	10					11.5	10		
	16					10.5	10		
	22					10.0	10		
28	04					8.5	8		
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-C

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

TABLE 2-B

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1915

Day	Time	Wave Train							
		1 (270^0)*		2 (240^0)		3 (135^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04			4.5	6				
	10	5.0	18	6.0	7				
	16	7.5	17	10.5	9				
	22	10.5	16	10.0	9	10.5	7		
2	04	10.0	13	10.0	9	13.0	8		
	10	9.5	12	10.5	10	13.5	9		
	16	8.5	11	18.5	10	5.0	8		
	22	7.5	15	16.0	8				
3	04	13.5	12	7.0	7				
	10	14.0	11						
	16	11.5	9						
	22	9.0	8						
	04	7.0	7						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-D

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

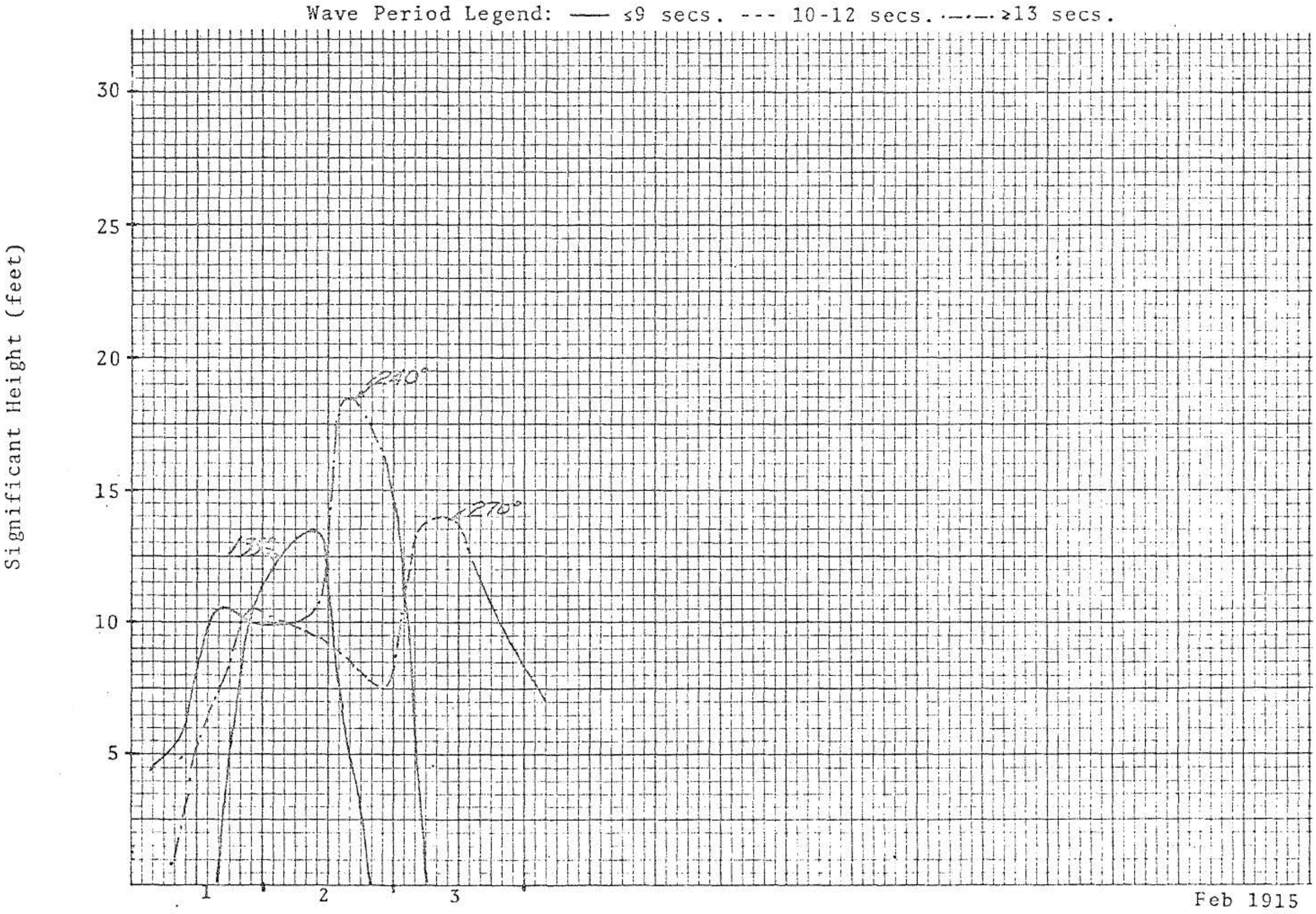

TABLE 2-E

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Dec 1916

Day	Time	Wave Train							
		1 (270°)*		2 (240°)		3 (135°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16	6.0	9						
	22	8.5	10			9.5	7		
24	04	12.5	12			11.0	7		
	10	11.0	11			11.0	7		
	16	7.5	9	8.0	8				
	22	15.0	12	5.0	7				
25	04	12.5	12						
	10	10.0	12						
	16	10.0	12						
	22	10.0	11						
26	04	5.0	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-E

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

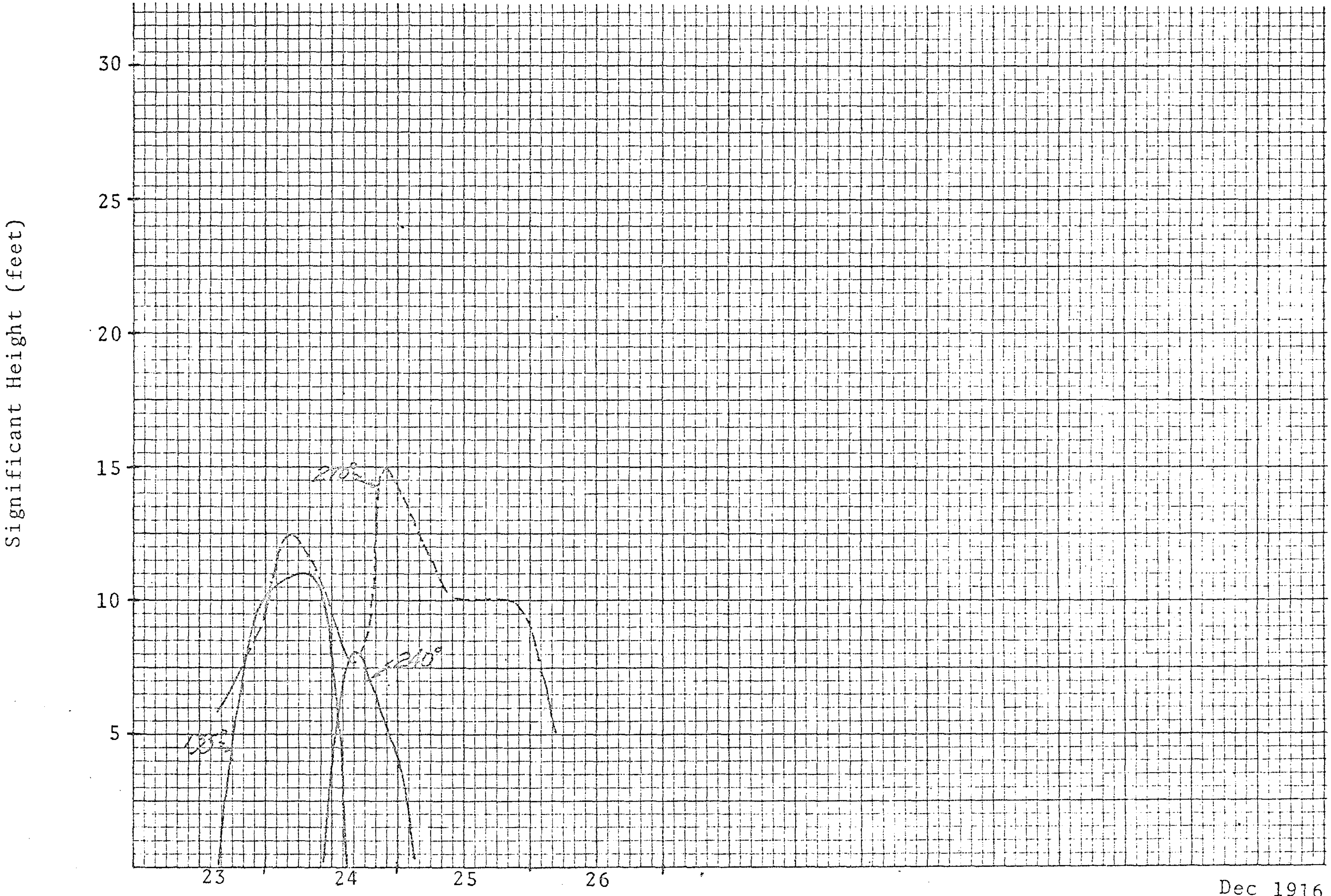

TABLE 2-F

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Dec 1927

Day	Time	Wave Train							
		1 (120°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
24	04	8.0	6						
	10	13.0	8						
	16	14.0	8						
	22	15.5	8						
25	04	16.5	8						
	10	17.0	9						
	16	17.0	9						
	22	14.0	8						
26	04	13.0	8						
	10	13.0	8						
	16	8.0	7						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-F

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.

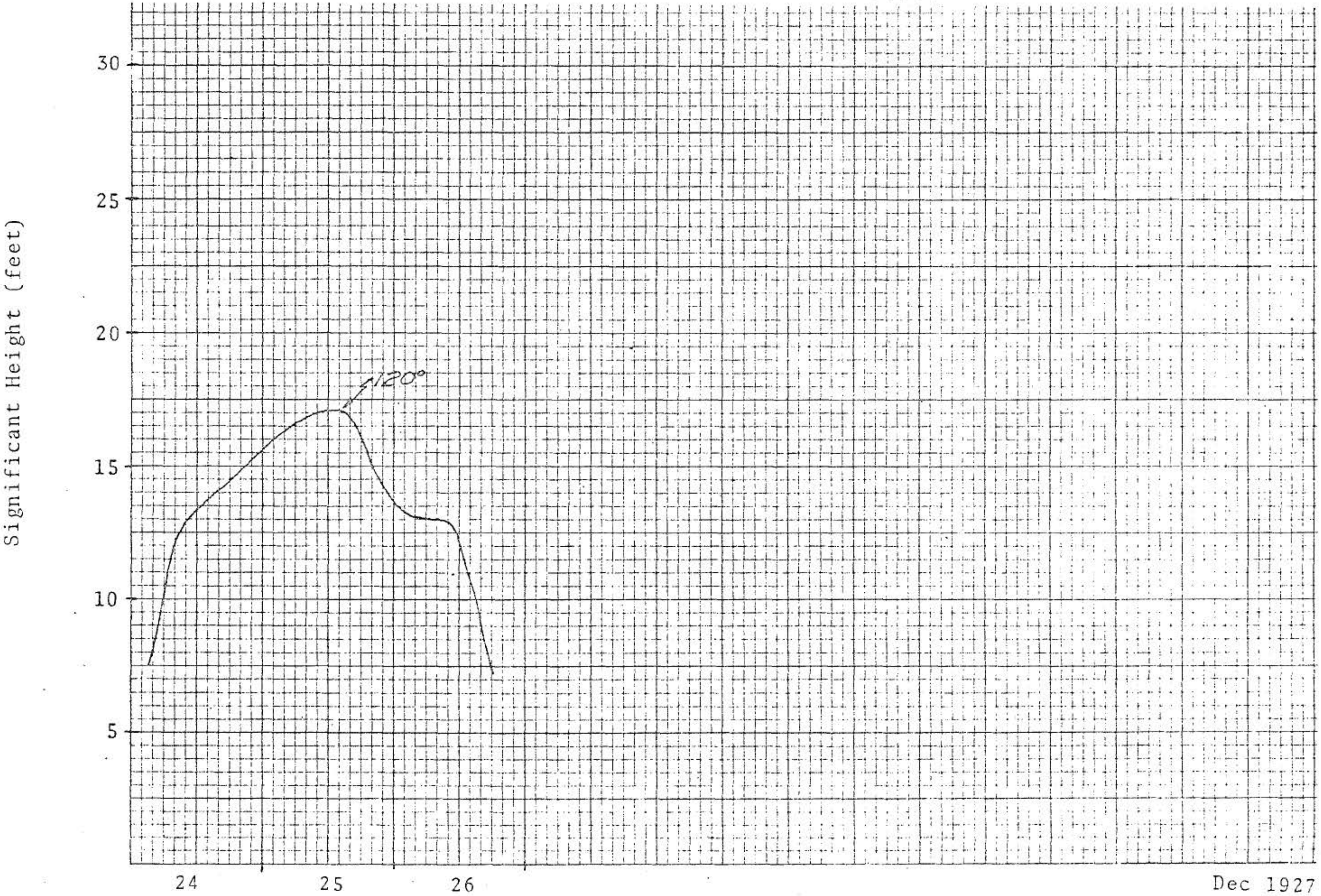

TABLE 2-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb - Mar 1941

Day	Time	Wave Train							
		1 (110°)*		2 (240°)		3 (270°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
27	04	4.0	5						
	10	8.0	7						
	16	10.5	7						
	22	15.0	8						
28	04	17.0	8	6.0	8				
	10	5.0	6	9.5	9				
	16			11.0	10				
	22			11.0	10	6.5	6		
1	04			4.0	7	12.0	10		
	10					12.0	10		
	16					12.0	10		
	22					12.0	10		
2	04					11.0	10		
	10					7.5	9		
	16					4.5	8		
	22					3.0	8		
3	04	5.0	5						
	10	9.5	7						
	16	13.0	8						
	22	9.5	7						
4	04			17.0	9				
	10			12.0	8	7.5	7		
	16			5.0	7	10.5	9		
	22					9.5	8		
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-G

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·— ≥13 secs.

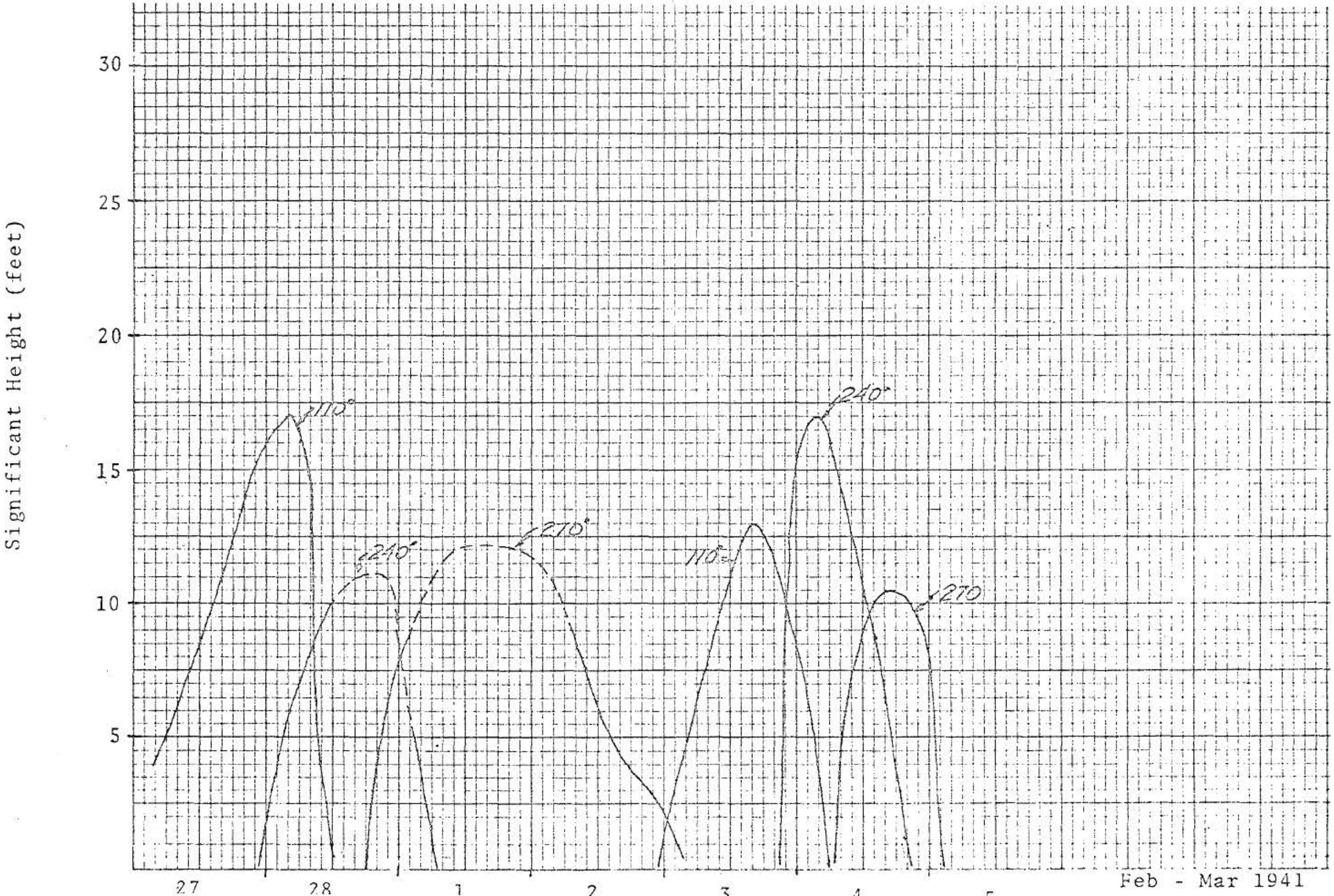

TABLE 2-H
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Apr 1958

Day	Time	Wave Train							
		1 (270⁰)*		2 (155⁰)		3 (110⁰)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	11.0	13						
	22	14.5	11						
2	04	14.0	13						
	10	14.0	12	4.5	5				
	16	12.0	11	7.5	7				
	22	9.0	10	9.0	7				
3	04	6.5	9	9.0	7				
	10	9.5	13						
	16	14.0	13						
	22	15.0	12						
4	04	16.5	11						
	10	17.0	15						
	16	16.5	14						
	22	15.0	13						
5	04	13.0	12						
	10	11.0	11						
	16	9.0	10	4.0	4				
	22	7.0	9	6.0	6				
6	04	6.0	9						
	10	5.0	8			4.0	5		
	16	14.0	17			9.5	7		
	22	18.0	15			6.5	6		
7	04	15.0	12			4.0	3		
	10	10.0	10						
	16	6.5	9						
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-H

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

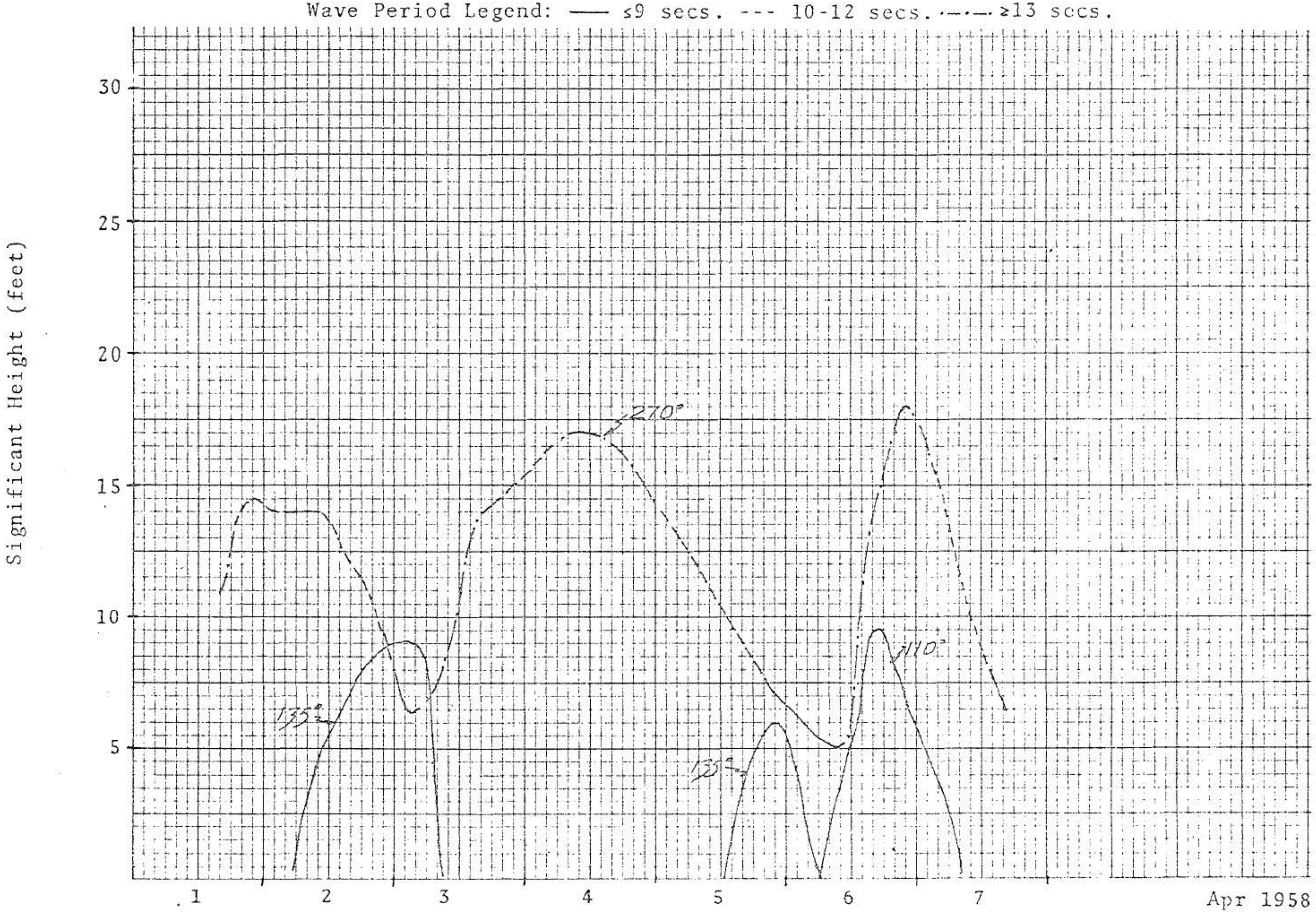

TABLE 2-1

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1959

Day	Time	Wave Train							
		1 (110^0)*		2 (240^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
15	04	6.5	6						
	10	10.0	7						
	16	13.0	8						
	22	16.0	8	6.5	14				
16	04	16.0	8	13.5	12				
	10	5.0	6	12.0	10				
	16			8.0	8				
	22			5.0	8				
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-I

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·— ≥13 secs.

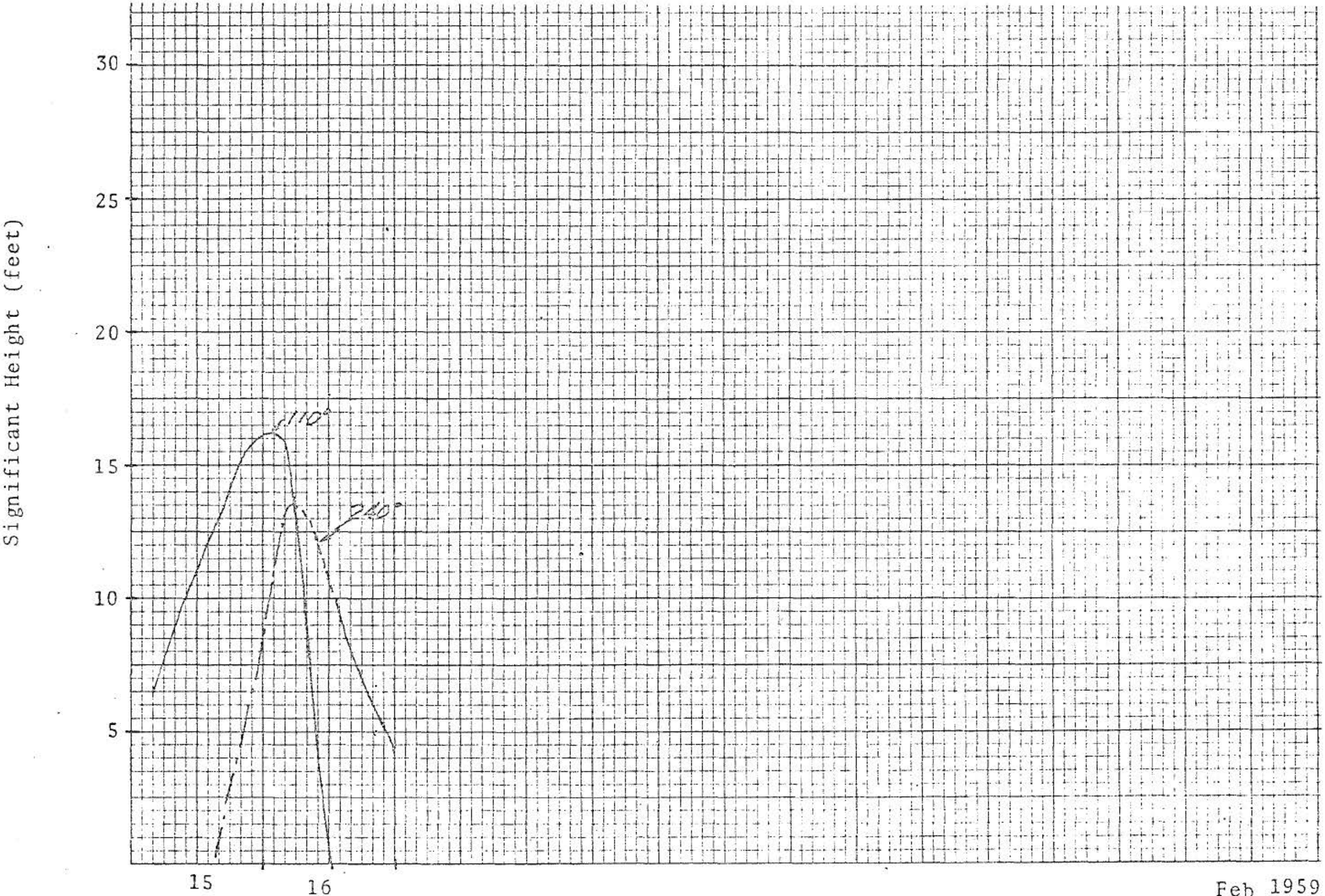

TABLE 2-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1963

Day	Time	Wave Train							
		1 (215°)*		2 (240°)		3 (110°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	9.0	14			6.0	7		
	10	9.0	14	5.0	8	10.0	8		
	16	9.5	14	6.5	9	10.0	8		
	22	12.5	14	2.5	8				
10	04	19.0	14						
	10	20.0	13						
	16	20.0	13						
	22	18.0	12						
11	04	11.0	10						
	10	6.5	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-J

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—· ≥13 secs.

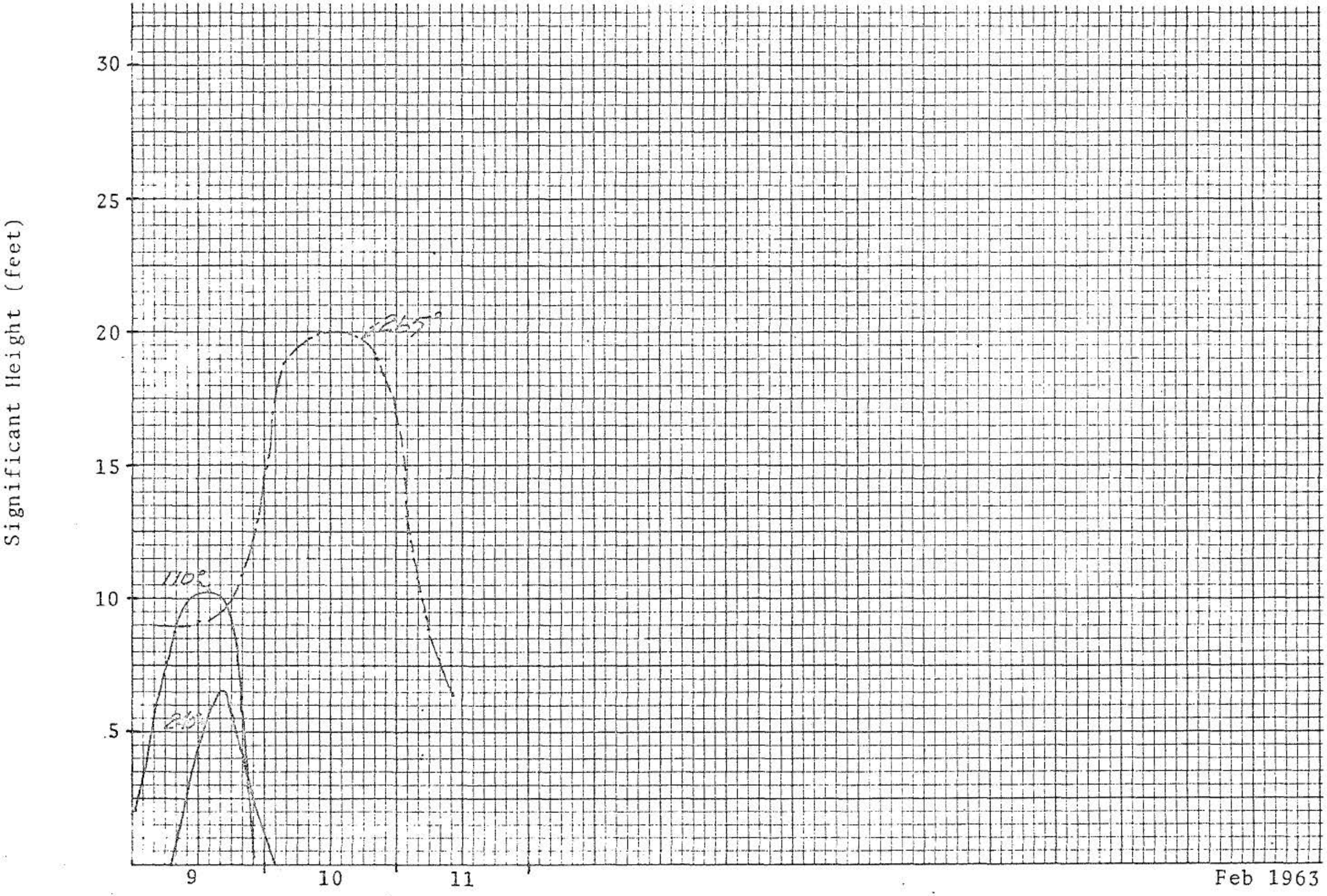

TABLE 3-A
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Jan 1913

Day	Time	Wave Train							
		1 (275°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
3	04								
	10	5.0	7						
	16	8.5	9						
	22	14.0	10						
4	04	17.5	11						
	10	19.5	11						
	16	17.0	11						
	22	17.0	11						
5	04	15.0	10						
	10	15.0	10						
	16	14.0	9						
	22	11.0	8						
6	04	8.5	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-A

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

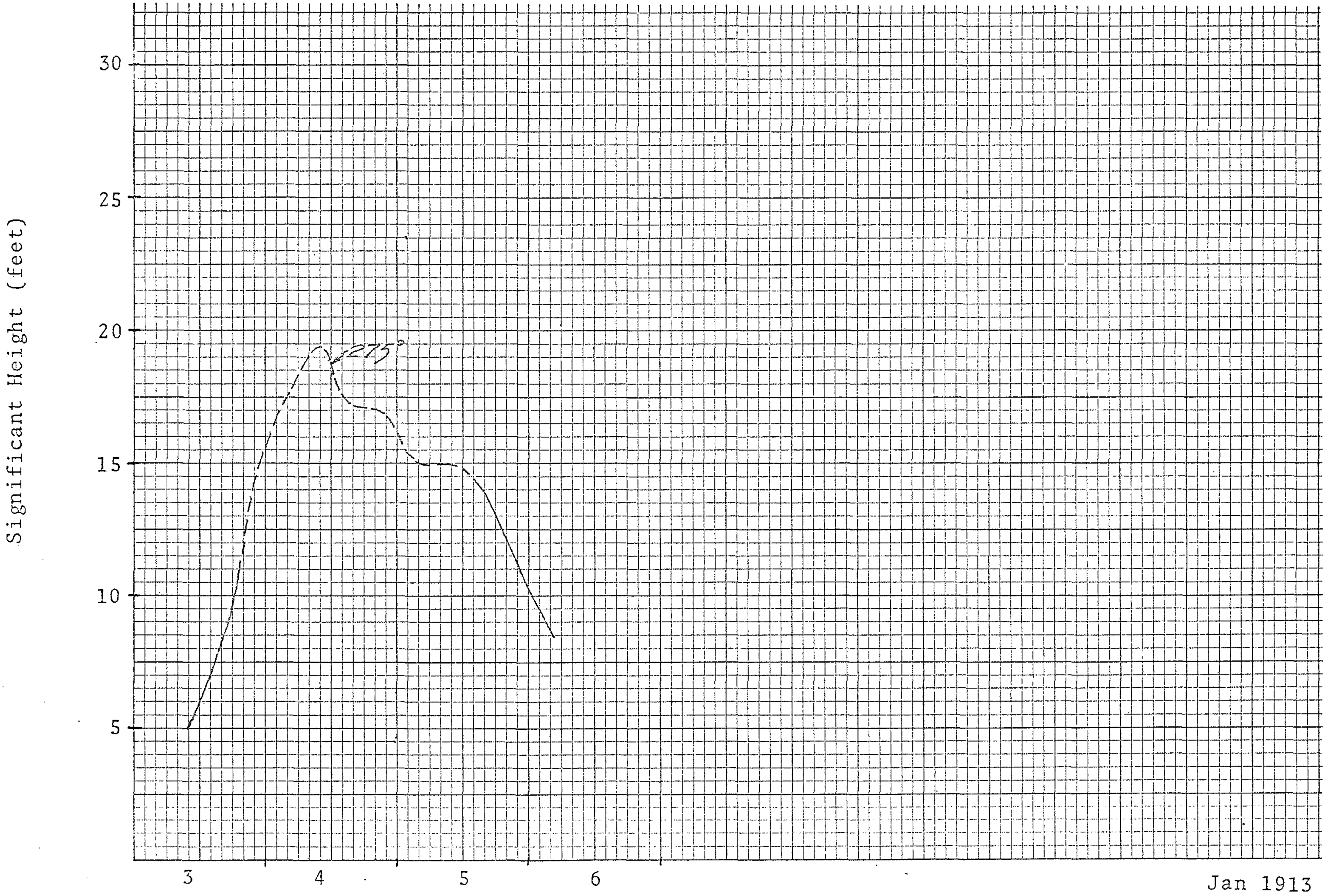

TABLE 3-B
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Feb 1915

Day	Time	Wave Train							
		1 (270^{0})*		2 (135^{0})		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10	3.5	19						
	16	8.0	18						
	22	9.0	15	6.0	6				
2	04	9.0	13	8.5	7				
	10	8.5	12	9.0	7				
	16	17.5	10	5.0	7				
	22	13.5	10						
3	04	12.5	12						
	10	12.0	11						
	16	11.0	10						
	22	9.0	9						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-B

WAVE HEIGHT PLOT: STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

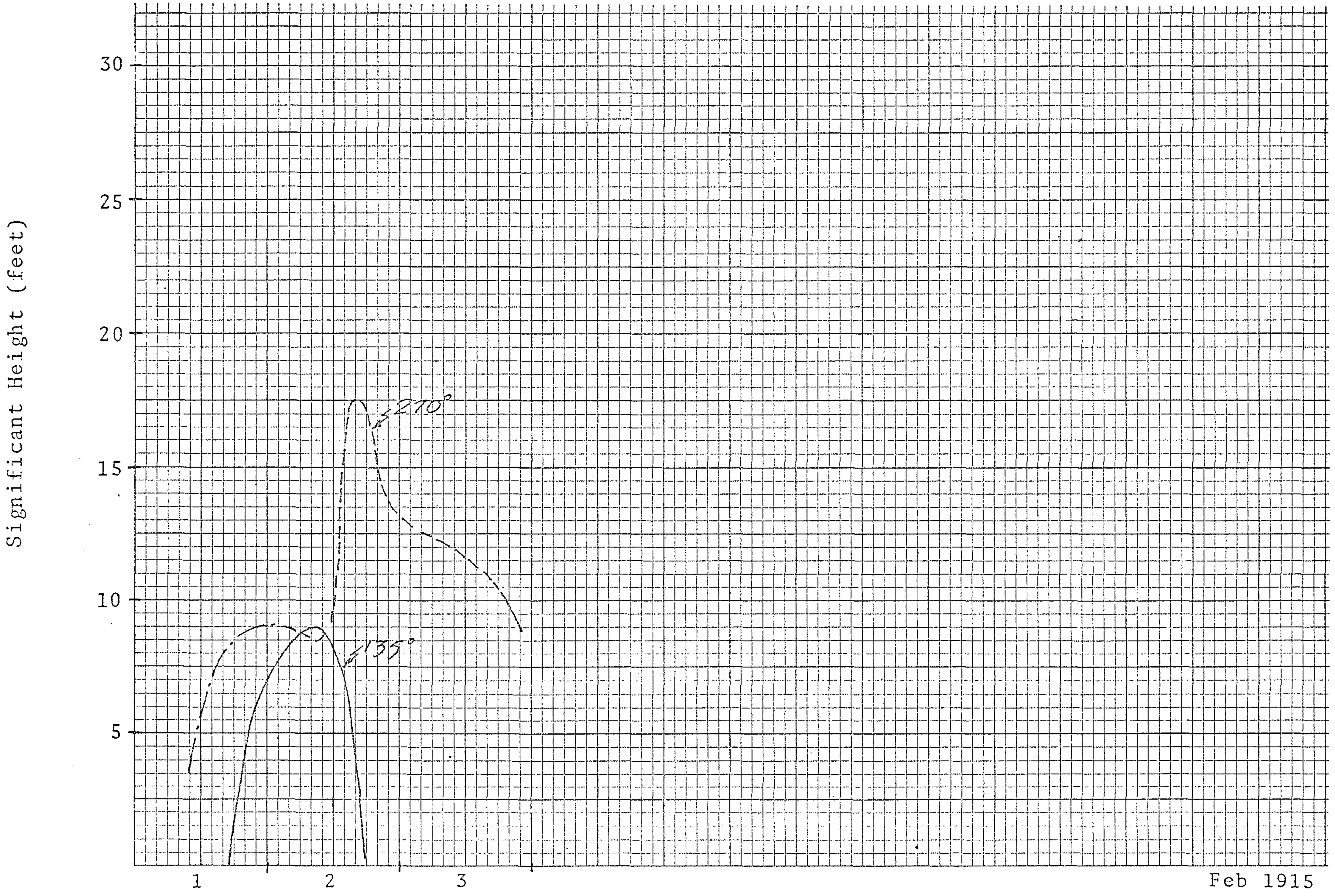

TABLE 3-C
SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Apr-May 1915

Day	Time	Wave Train							
		1 (275°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
29	04	5.0	4						
	10	11.0	7						
	16	17.5	11						
	22	16.5	12						
30	04	16.5	12						
	10	16.5	12						
	16	16.0	12						
	22	15.5	12						
1	04	15.5	12						
	10	15.0	12						
	16	15.0	12						
	22	11.5	12						
2	04	11.5	12						
	10	10.0	12						
	16	6.0	8						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-C

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

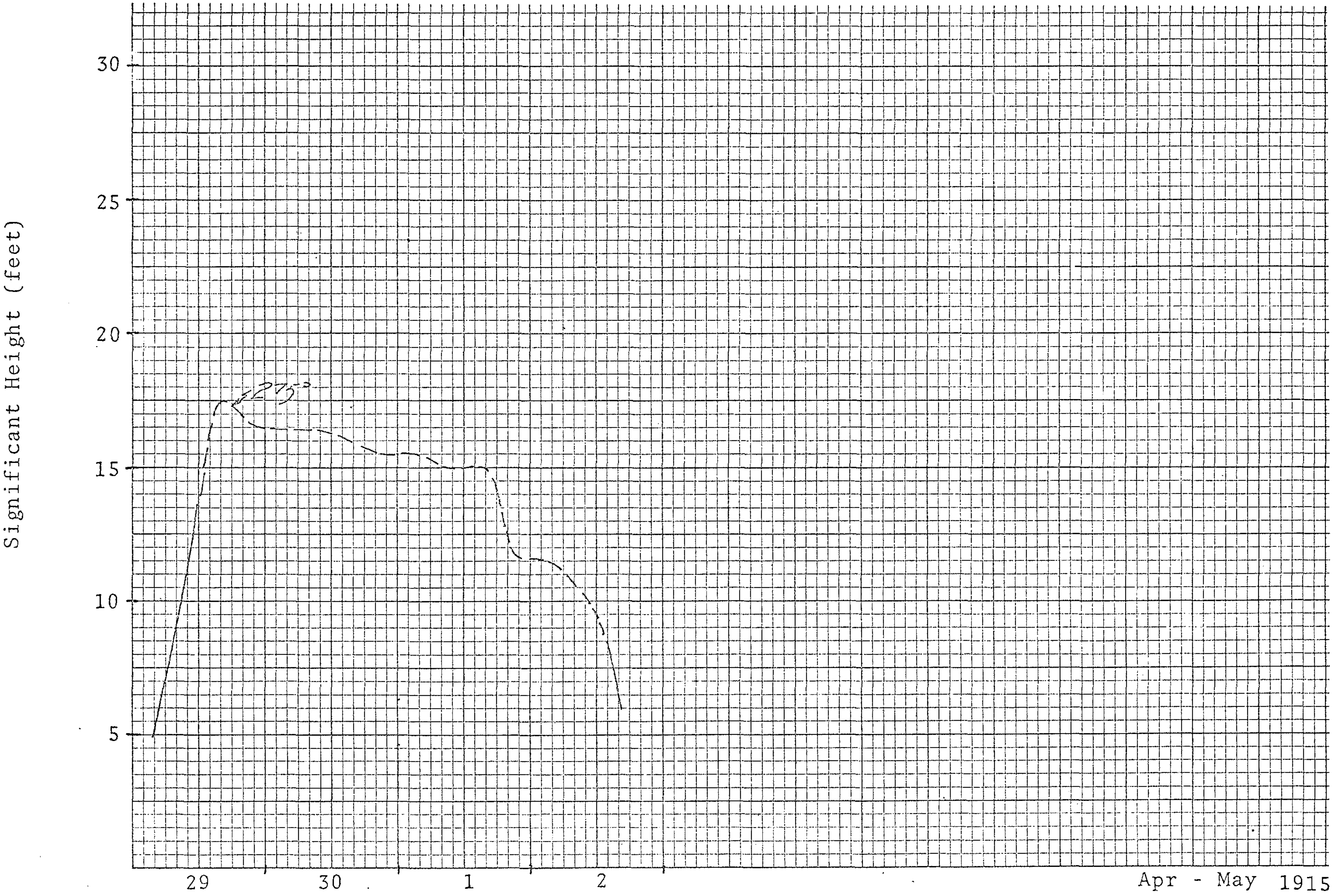

TABLE 3-D

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Mar 1916

Day	Time	Wave Train							
		1 (275°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
22	04								
	10								
	16	6.0	4						
	22	12.0	7						
23	04	15.5	8						
	10	17.5	10						
	16	17.0	9						
	22	13.5	9						
24	04	7.0	9						
	10	5.0	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-D

WAVE HEIGHT PLOT: STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—· ≥13 secs.

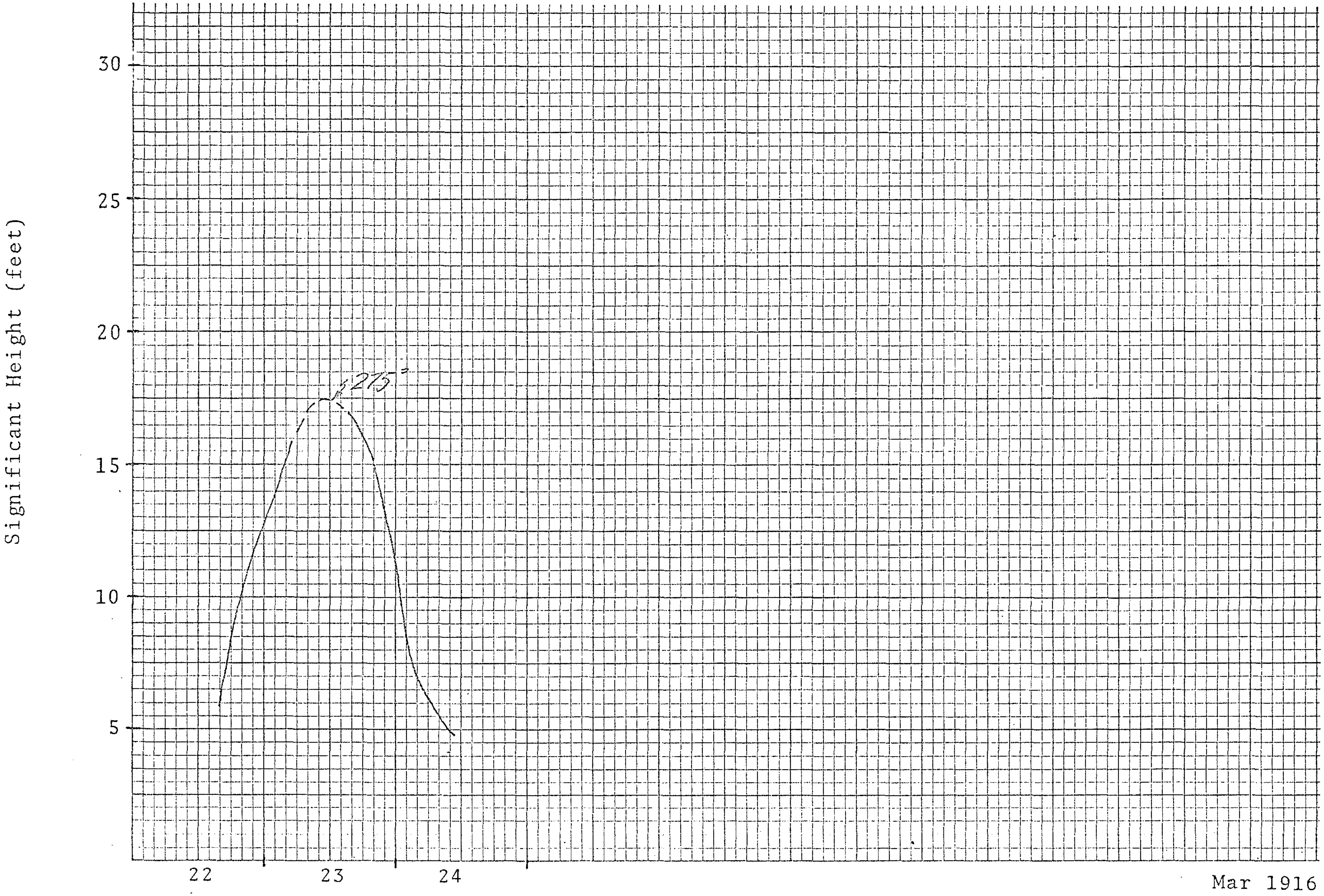

TABLE 3-E
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Dec 1916

Day	Time	Wave Train							
		1 (275°)*		2 (135°)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16	6.5	9						
	22	9.5	10	8.5	6				
24	04	14.0	12	8.5	6				
	10	12.5	11	8.5	6				
	16	13.5	8						
	22	18.0	12						
25	04	18.5	12						
	10	16.5	12						
	16	12.5	12						
	22	12.5	11						
26	04	6.0	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-E

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

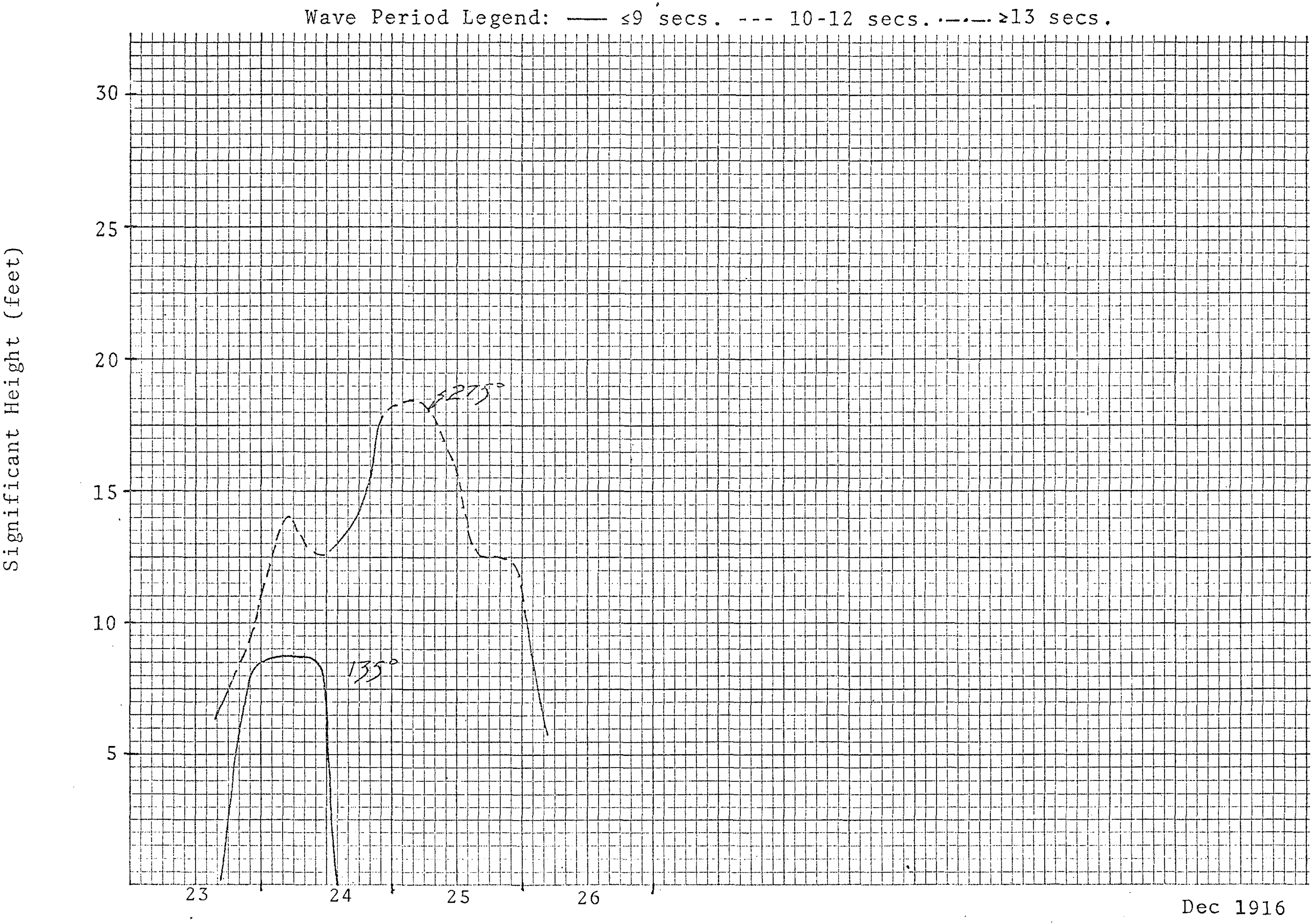

TABLE 3-F

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Jan 1932

Day	Time	Wave Train							
		1 (275°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10	2.0	3						
	16	10.0	6						
	22	11.5	8						
12	04	15.0	10						
	10	17.0	10						
	16	20.0	10						
	22	20.0	10						
13	04	14.0	10						
	10	10.0	10						
	16	9.0	8						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-F

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

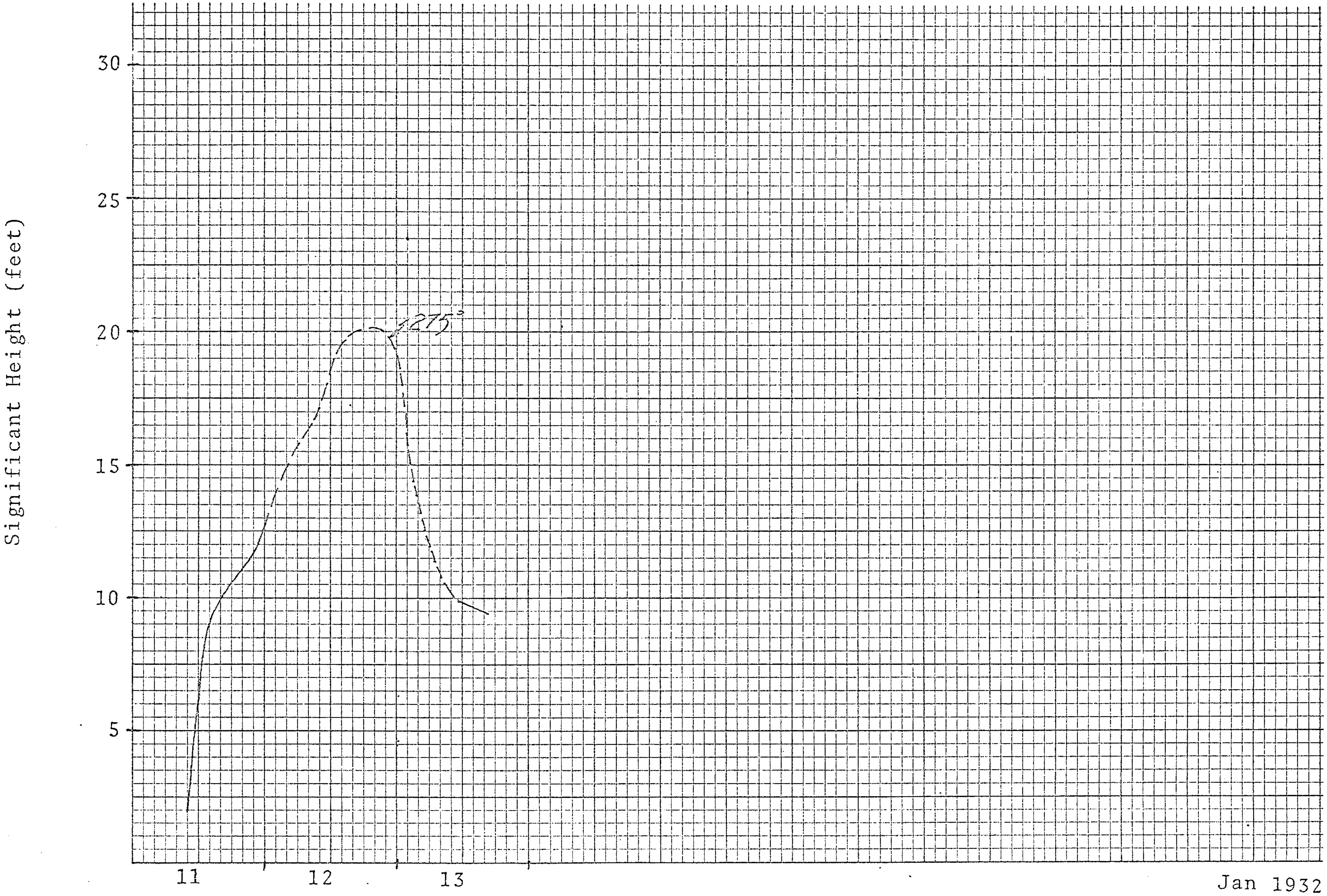

TABLE 3-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Jan 1939

Day	Time	Wave Train							
		1 (275^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
5	04								
	10	5.0	6						
	16	14.5	14						
	22	19.0	13						
6	04	20.0	12						
	10	17.5	10						
	16	16.0	10						
	22	10.5	9						
7	04	8.0	8						
	10	5.0	7						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-G

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

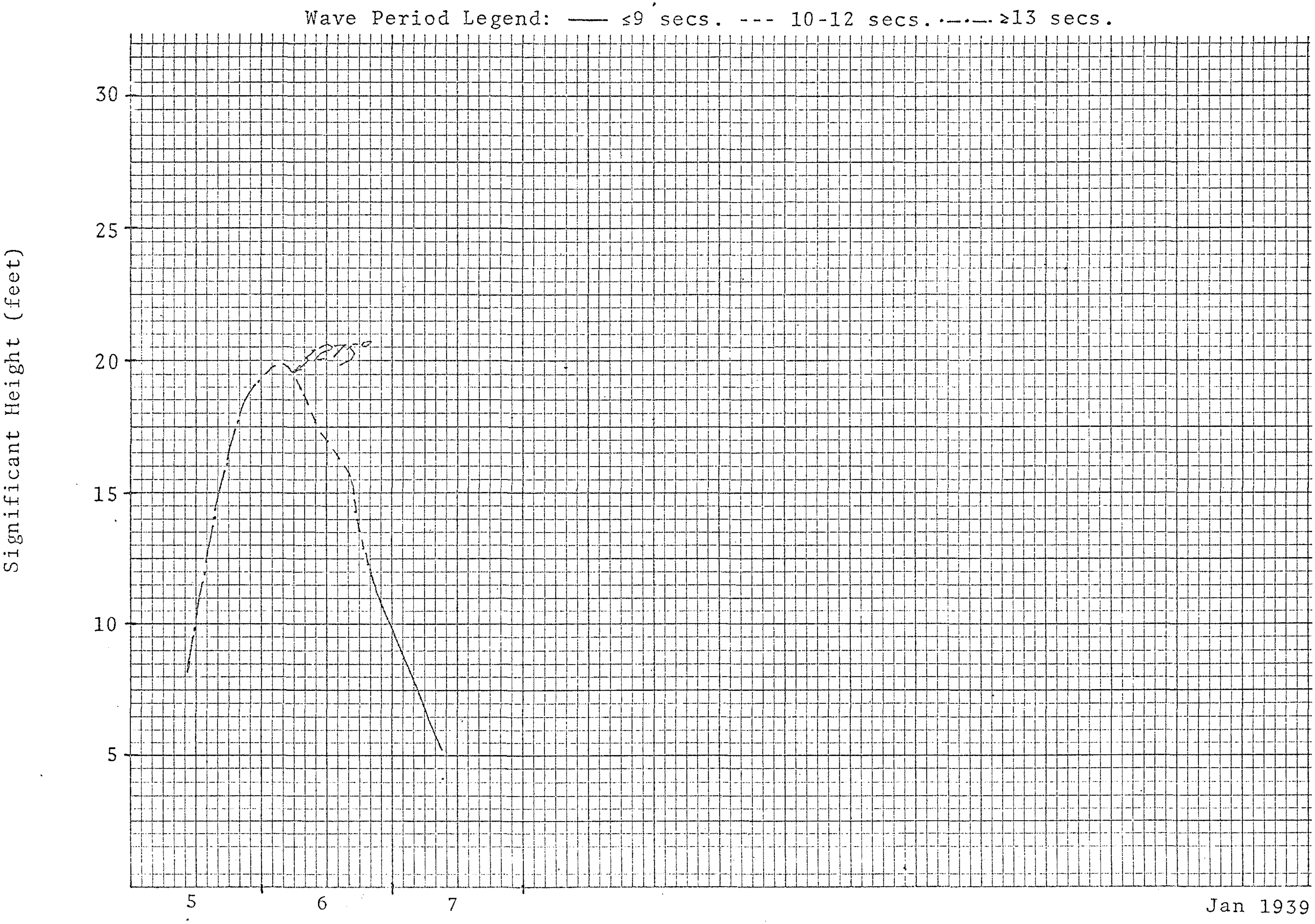

TABLE 3-H
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date April 1958

Day	Time	Wave Train							
		1 (275°)*		2 (135°)		3 (110°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	8.5	14						
	22	13.5	13						
2	04	13.5	12						
	10	14.0	13						
	16	12.5	12	5.5	6				
	22	10.0	10	7.0	6				
3	04	8.0	9	7.0	6				
	10	8.5	14						
	16	13.0	14						
	22	15.0	14						
4	04	17.0	17						
	10	18.0	16						
	16	19.0	15						
	22	17.0	13						
5	04	15.0	13						
	10	13.0	12						
	16	10.5	10						
	22	9.0	10						
6	04	7.5	9						
	10	6.5	8			3.0	4		
	16	11.0	14			7.5	7		
	22	16.0	13			6.5	6		
7	04	14.0	12						
	10	10.0	11						
	16	6.5	9						
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-H

WAVE HEIGHT PLOT: STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

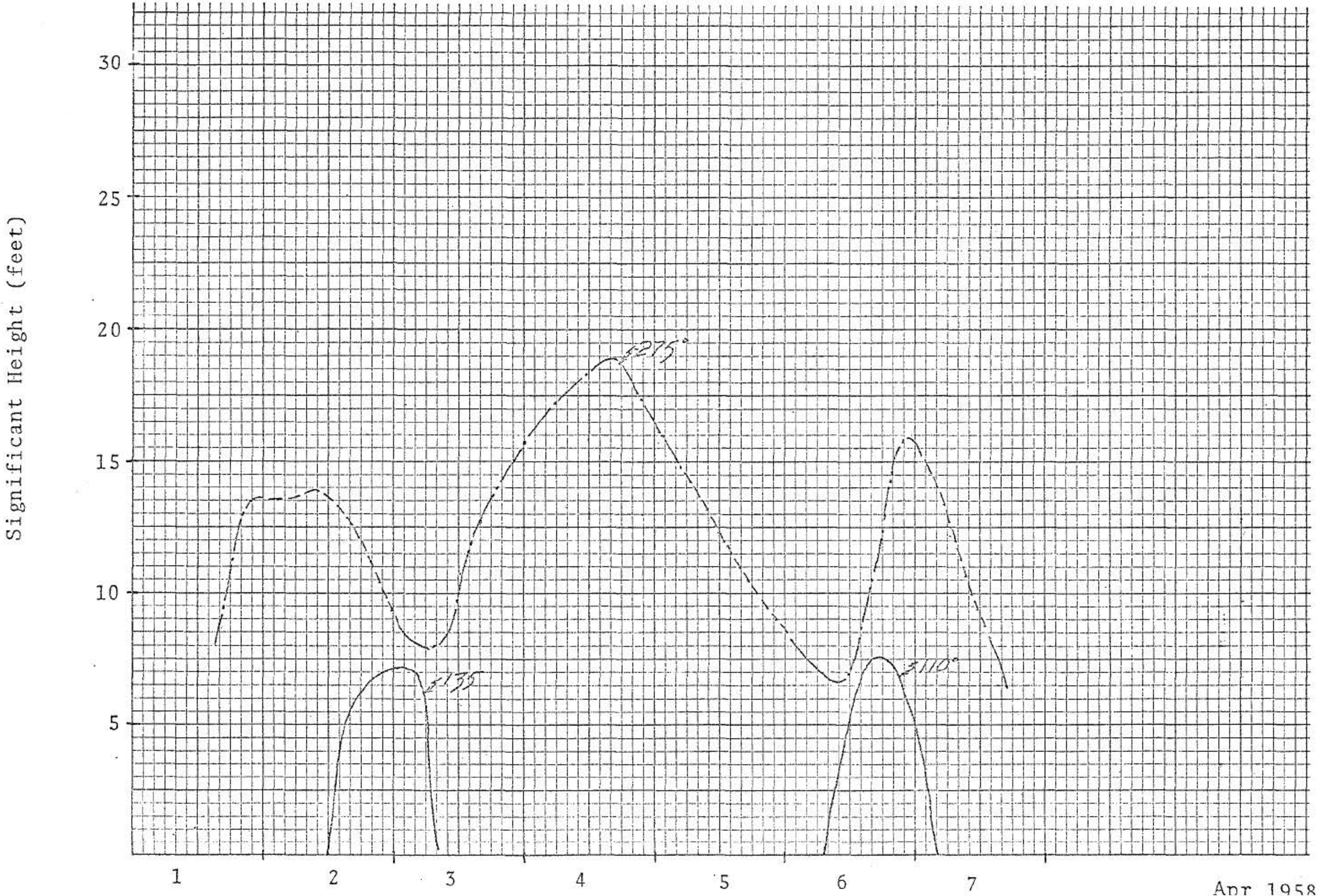

TABLE 3-I
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Feb 1960

Day	Time	Wave Train							
		1 (270^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	11.0	16						
	10	17.5	14						
	16	17.5	13						
	22	17.0	13						
10	04	11.0	12						
	10	11.0	12						
	16	11.0	12						
	22	11.0	12						
11	04	9.0	11						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-I

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

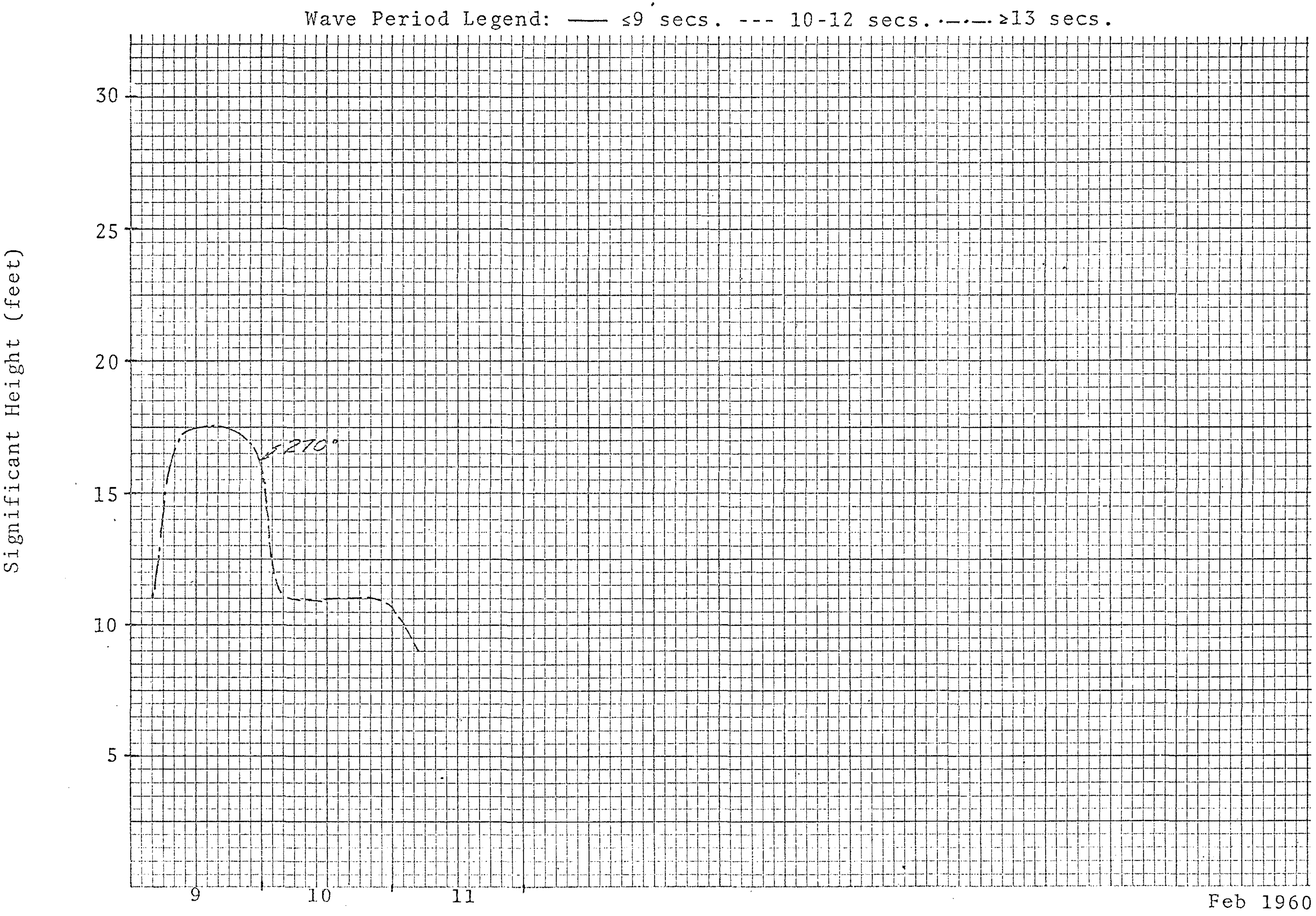

TABLE 3-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 3 Block 397 Date Feb 1963

Day	Time	Wave Train							
		1 (265^0)*		2 (110^0)		3 (290^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	9.0	14	5.0	6				
	10	9.0	14	9.0	8				
	16	9.5	14	9.0	8				
	22	12.5	14						
10	04	15.5	13						
	10	16.0	13			4.5	4		
	16	18.5	12			9.0	7		
	22	14.5	12			2.0	7		
11	04	9.0	10						
	10	5.5	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 3-J

WAVE HEIGHT PLOT:STATION 3 BLOCK 397

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

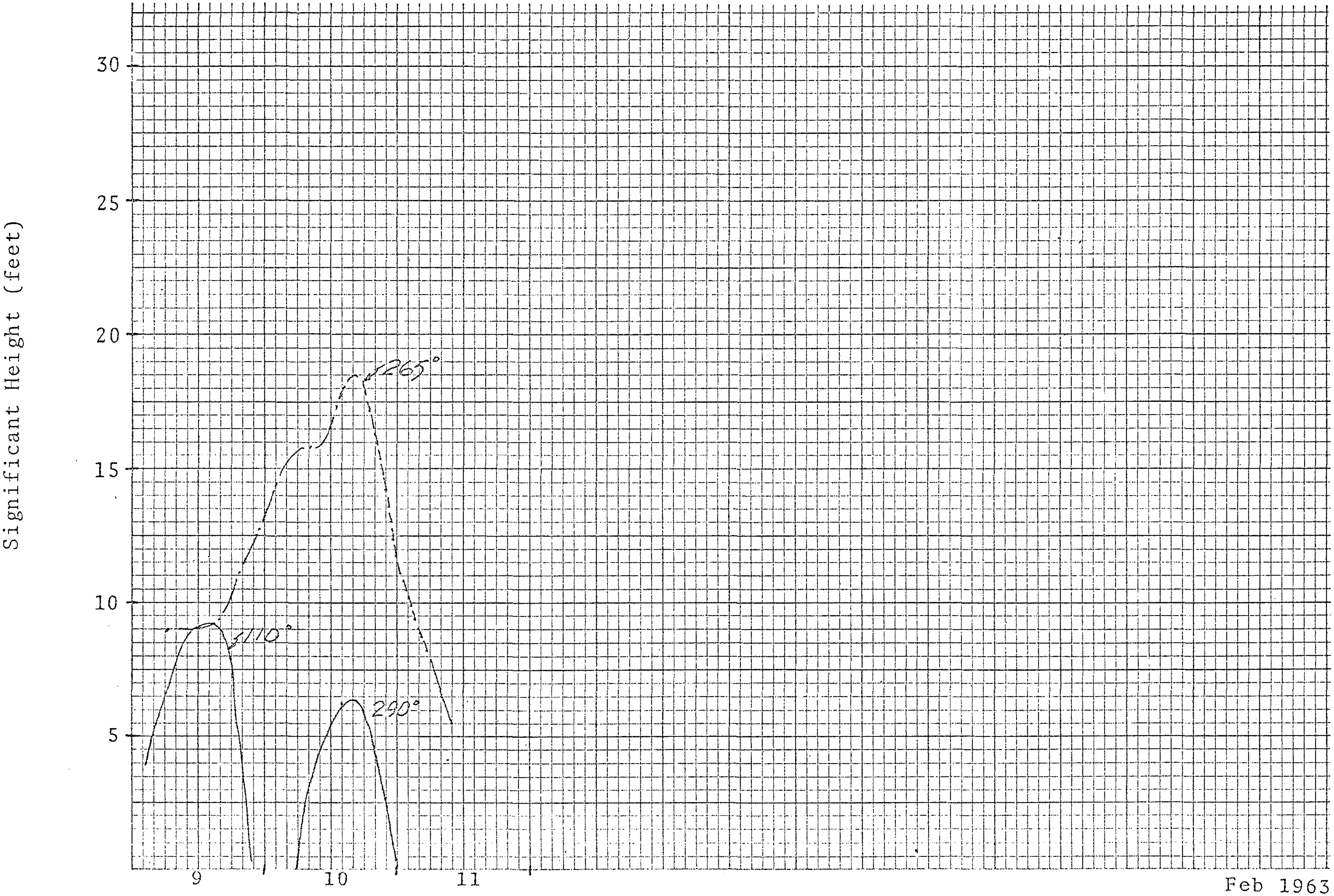

TABLE 4-A
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Jan 1913

Day	Time	Wave Train							
		1 (285^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
3	04								
	10	5.5	5						
	16	9.5	7						
	22	15.5	9						
4	04	19.0	10						
	10	21.5	11						
	16	21.5	11						
	22	21.0	11						
5	04	18.5	11						
	10	18.5	11						
	16	17.0	11						
	22	11.5	10						
6	04	9.5	9						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-A

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·— ≥13 secs.

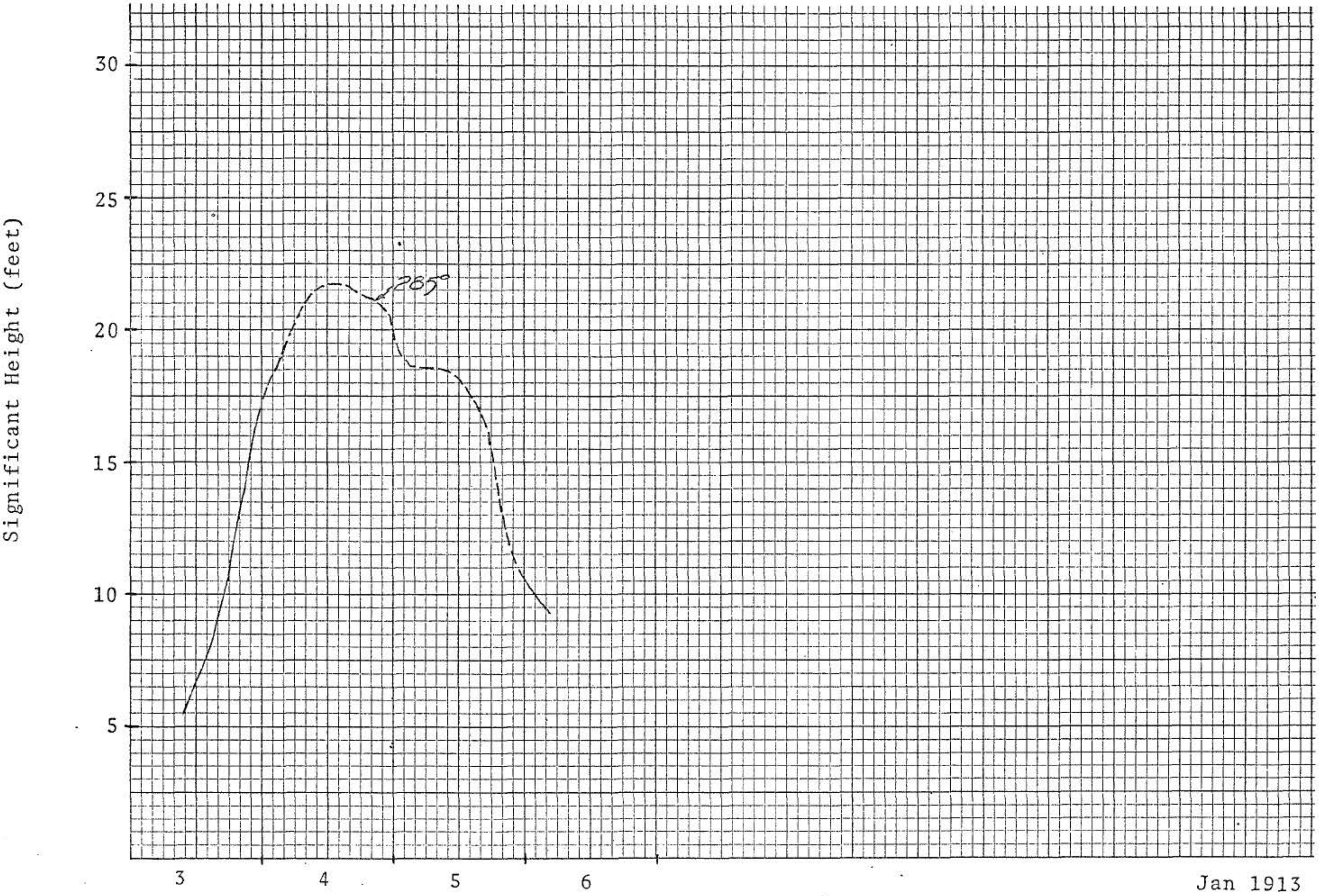

TABLE 4-B
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Apr - May 1915

Day	Time	Wave Train							
		1 (285°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
29	04	4.5	5						
	10	11.0	7						
	16	18.0	11						
	22	21.5	11						
30	04	20.0	11						
	10	20.0	11						
	16	19.5	11						
	22	19.0	11						
1	04	19.0	11						
	10	18.0	10						
	16	18.0	10						
	22	13.5	9						
2	04	13.0	9						
	10	11.0	9						
	16	6.5	8						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-B

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

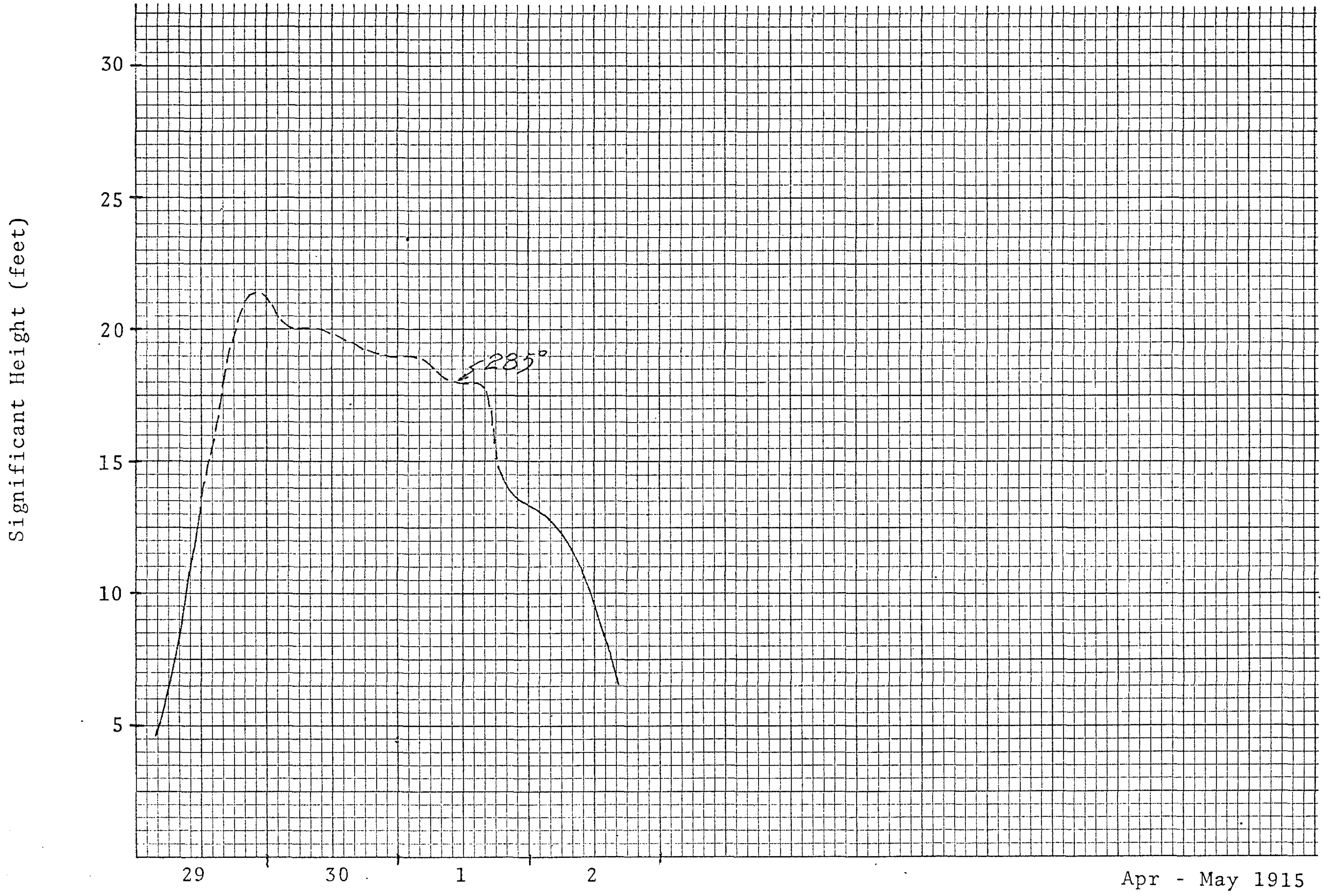

TABLE 4-C
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Mar 1916

Day	Time	Wave Train							
		1 (285^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
22	04								
	10								
	16	8.5	7						
	22	12.5	7						
23	04	15.0	8						
	10	17.5	9						
	16	18.5	10						
	22	14.5	9						
24	04	7.0	9						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-C

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

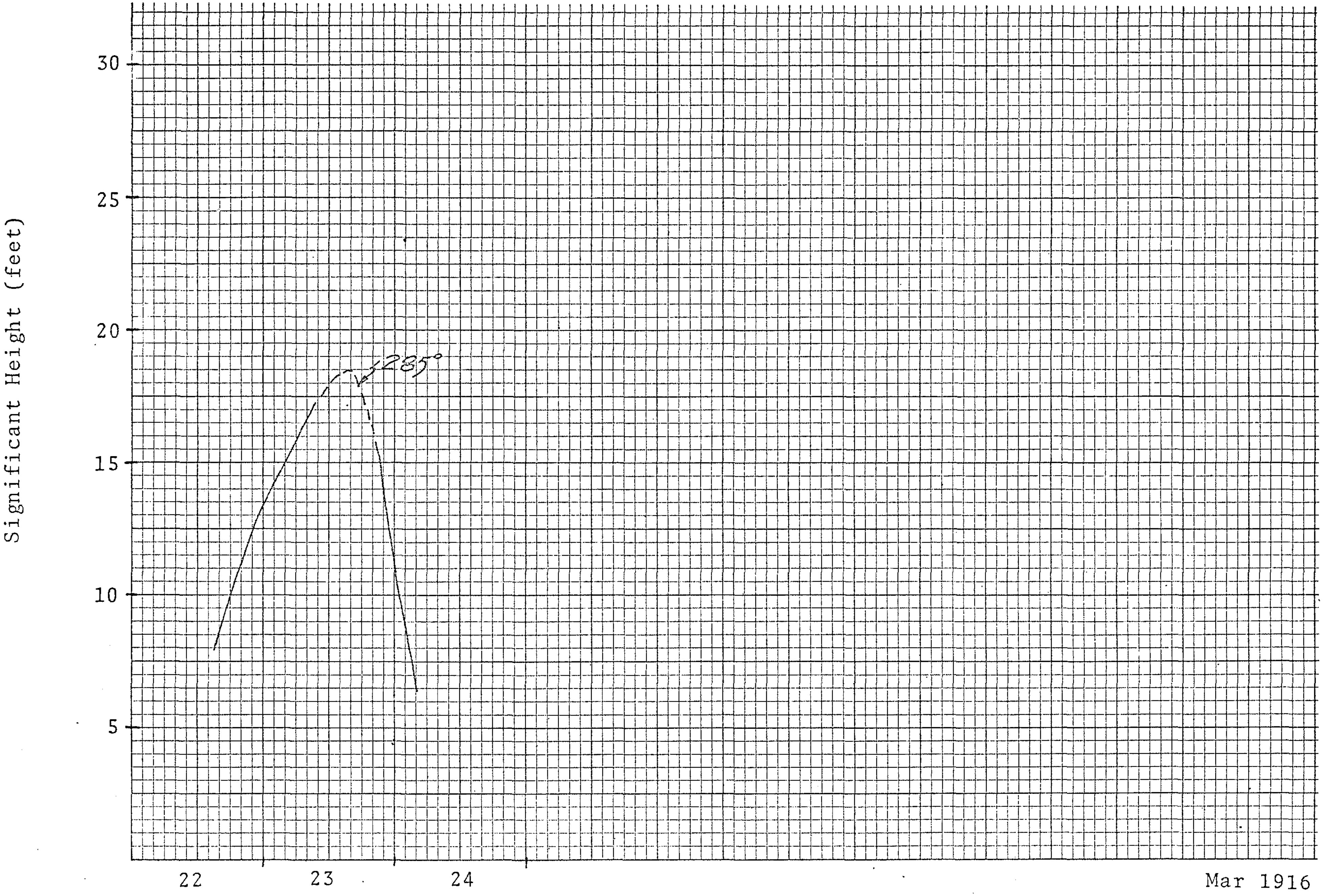

TABLE 4-D

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Dec 1916

Day	Time	Wave Train							
		1 (285^0)*		2 (135^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16								
	22	8.5	10	5.5	5				
24	04	12.5	12	6.0	5				
	10	11.0	11	6.0	5				
	16	12.0	8						
	22	19.5	12						
25	04	19.0	12						
	10	18.0	12						
	16	15.0	12						
	22	7.0	8						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-D

WAVE HEIGHT PLOT:STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

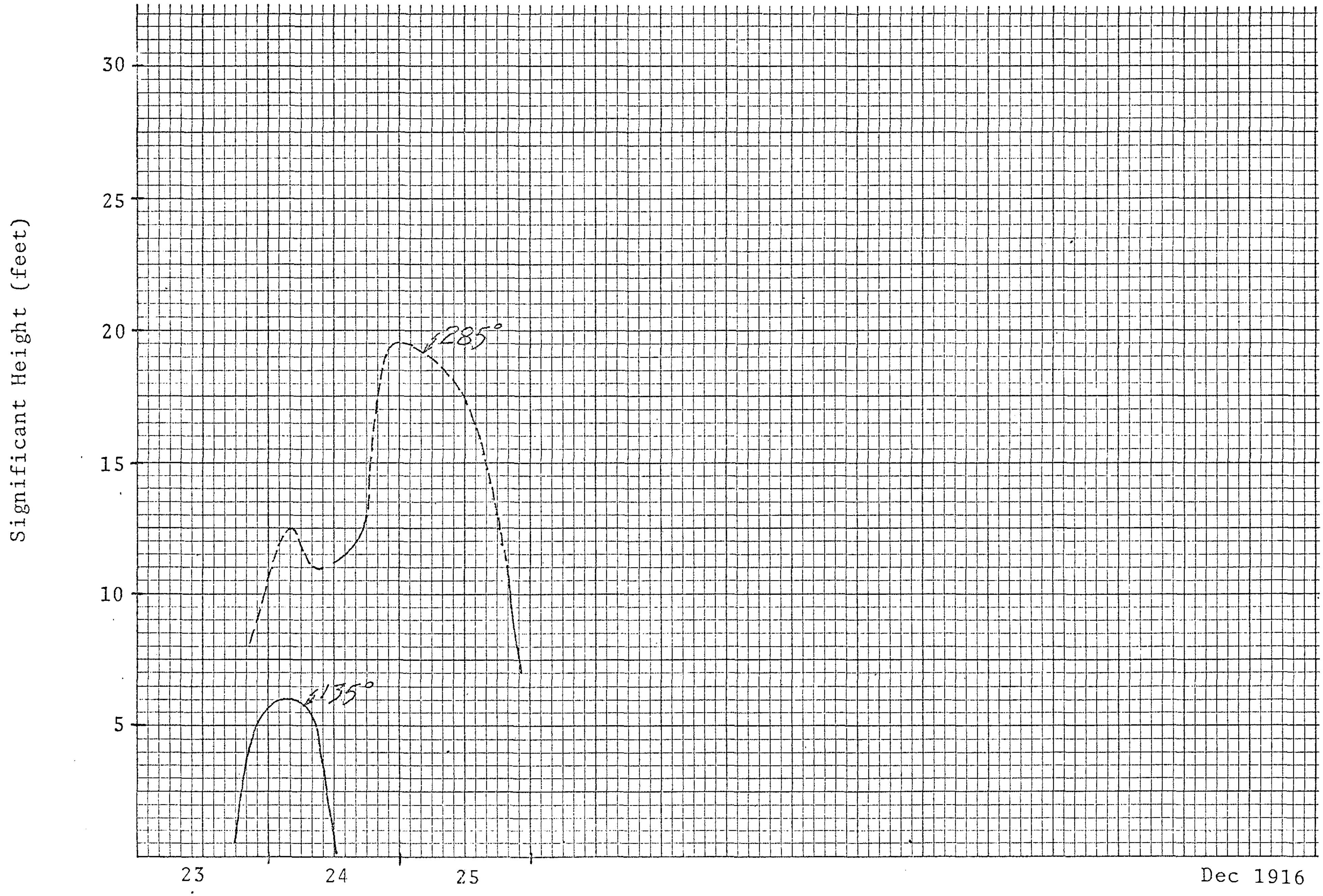

TABLE 4-E
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Feb 1919

Day	Time	Wave Train							
		1 (285^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04	8.5	12						
	10	13.0	10						
	16	15.0	10						
	22	16.5	10						
12	04	11.0	9						
	10	6.0	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-E

WAVE HEIGHT PLOT:STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

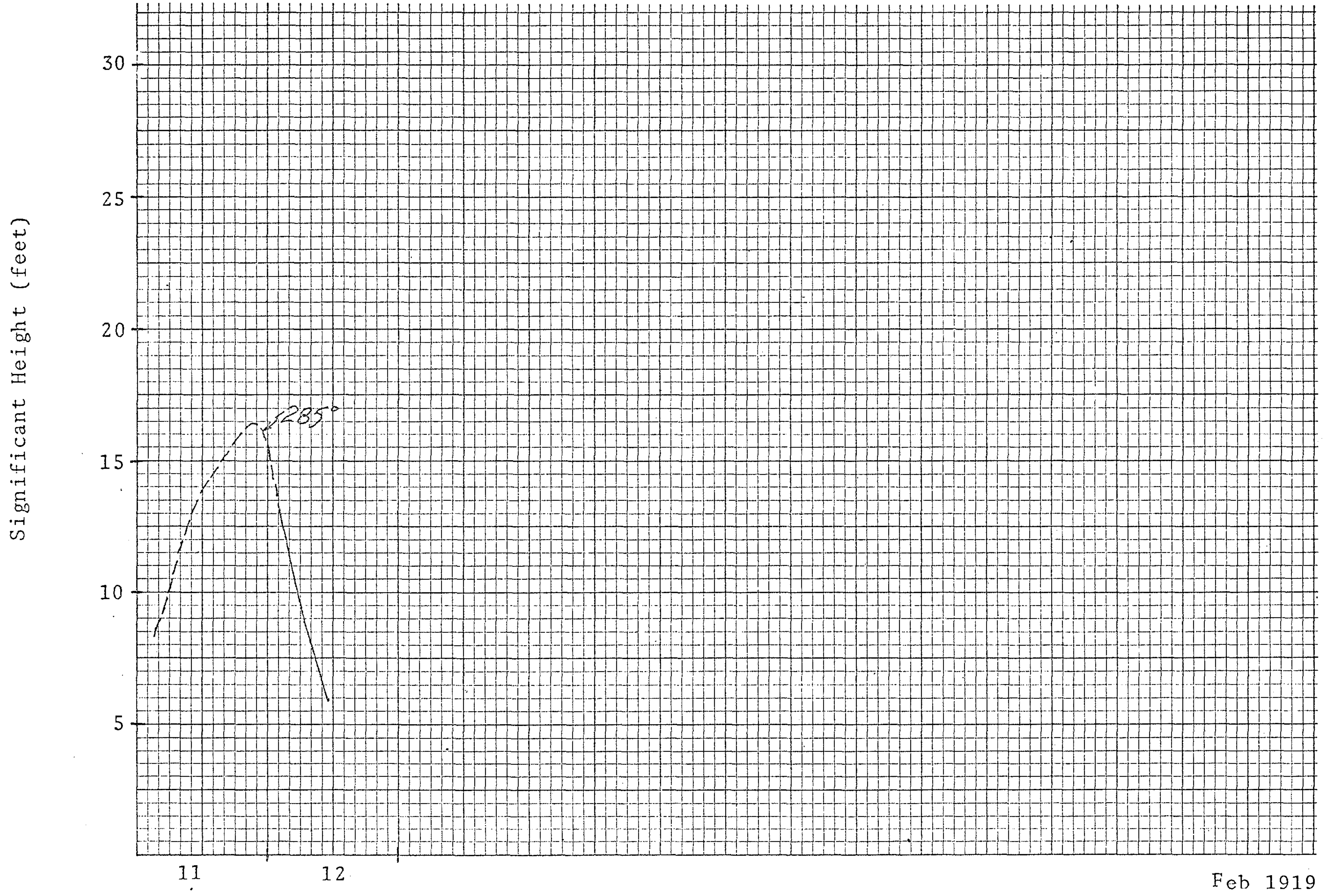

TABLE 4-F
SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349

Date Jan 1932

Day	Time	Wave Train							
		1 (285°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	9.5	6						
	22	11.5	8						
12	04	15.5	10						
	10	18.0	11						
	16	20.5	11						
	22	20.5	11						
13	04	15.0	10						
	10	11.0	10						
	16	9.5	8						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-F

WAVE HEIGHT PLOT:STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

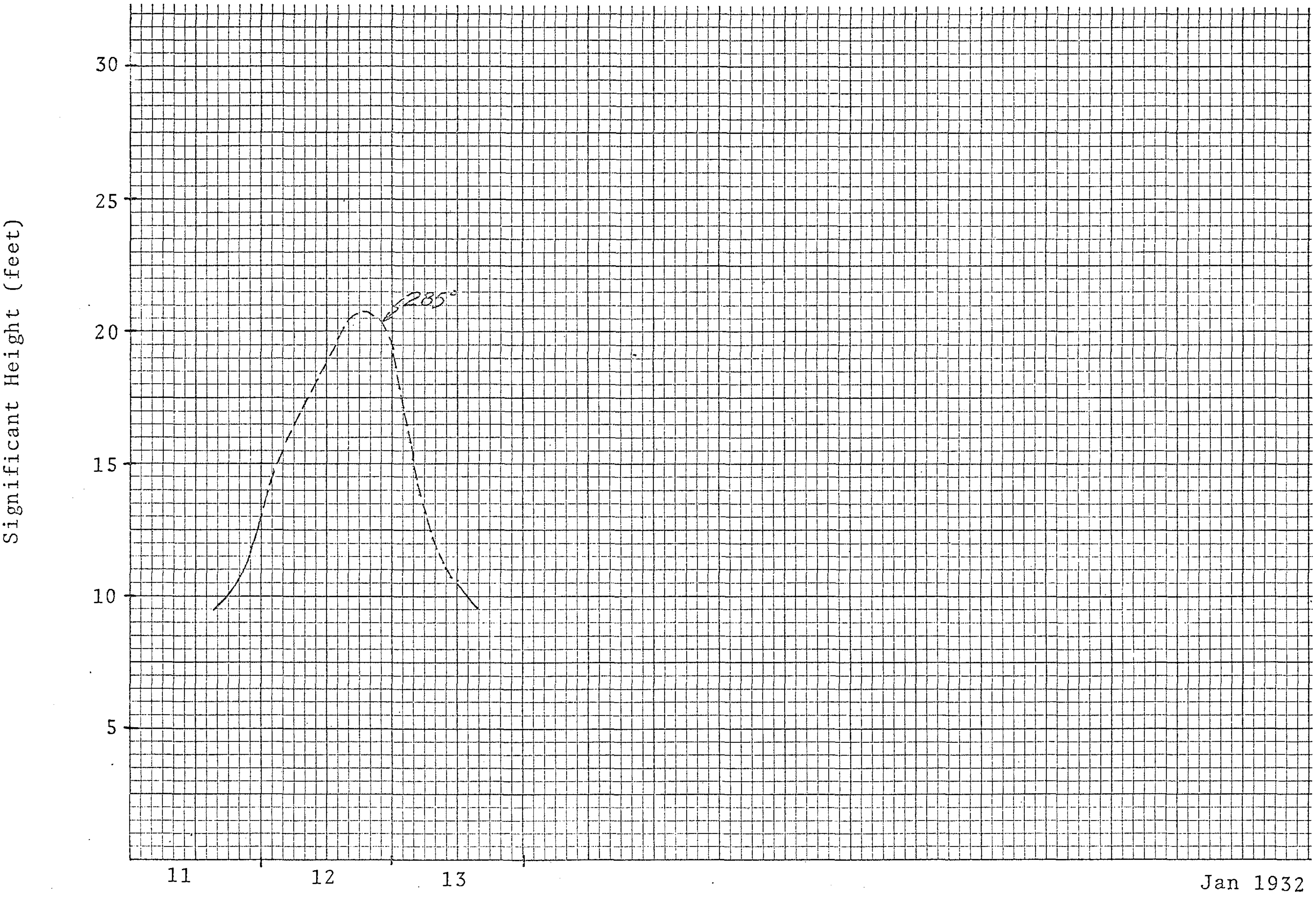

TABLE 4-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Jan 1939

Day	Time	Wave Train							
		1 (285^0)*		2 (135^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
5	04								
	10	9.5	8	4.5	4				
	16	13.5	8						
	22	17.5	13						
6	04	19.0	12						
	10	16.0	10						
	16	15.0	10						
	22	8.5	9						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-G

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

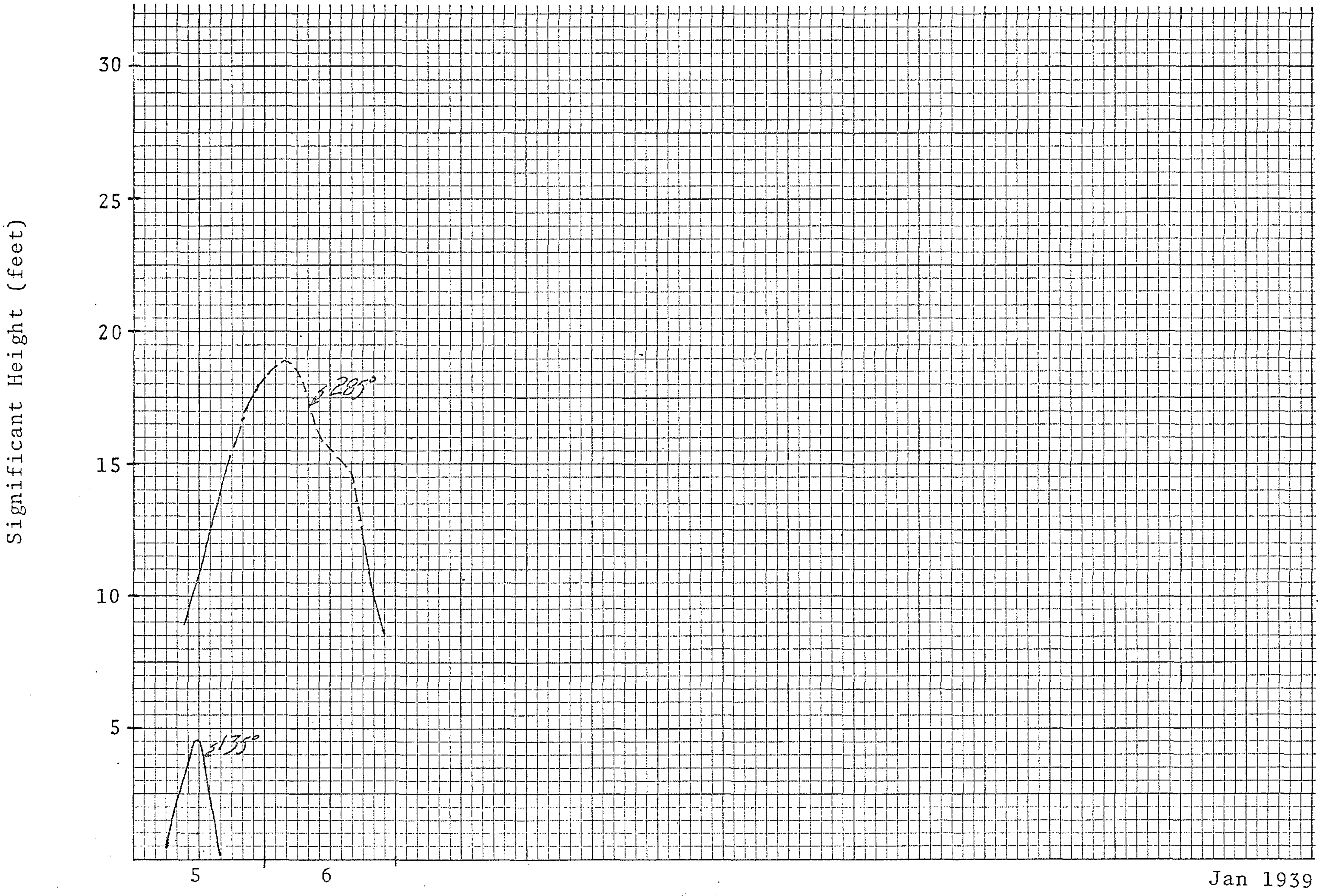

TABLE 4-H
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Feb 1958

Day	Time	Wave Train							
		1 (285°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
25	04								
	10	6.0	8						
	16	13.0	9						
	22	16.0	10						
26	04	16.5	10						
	10	17.0	10						
	16	15.0	10						
	22	13.0	9						
27	04	12.5	9						
	10	11.5	8						
	16	7.5	8						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-H

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

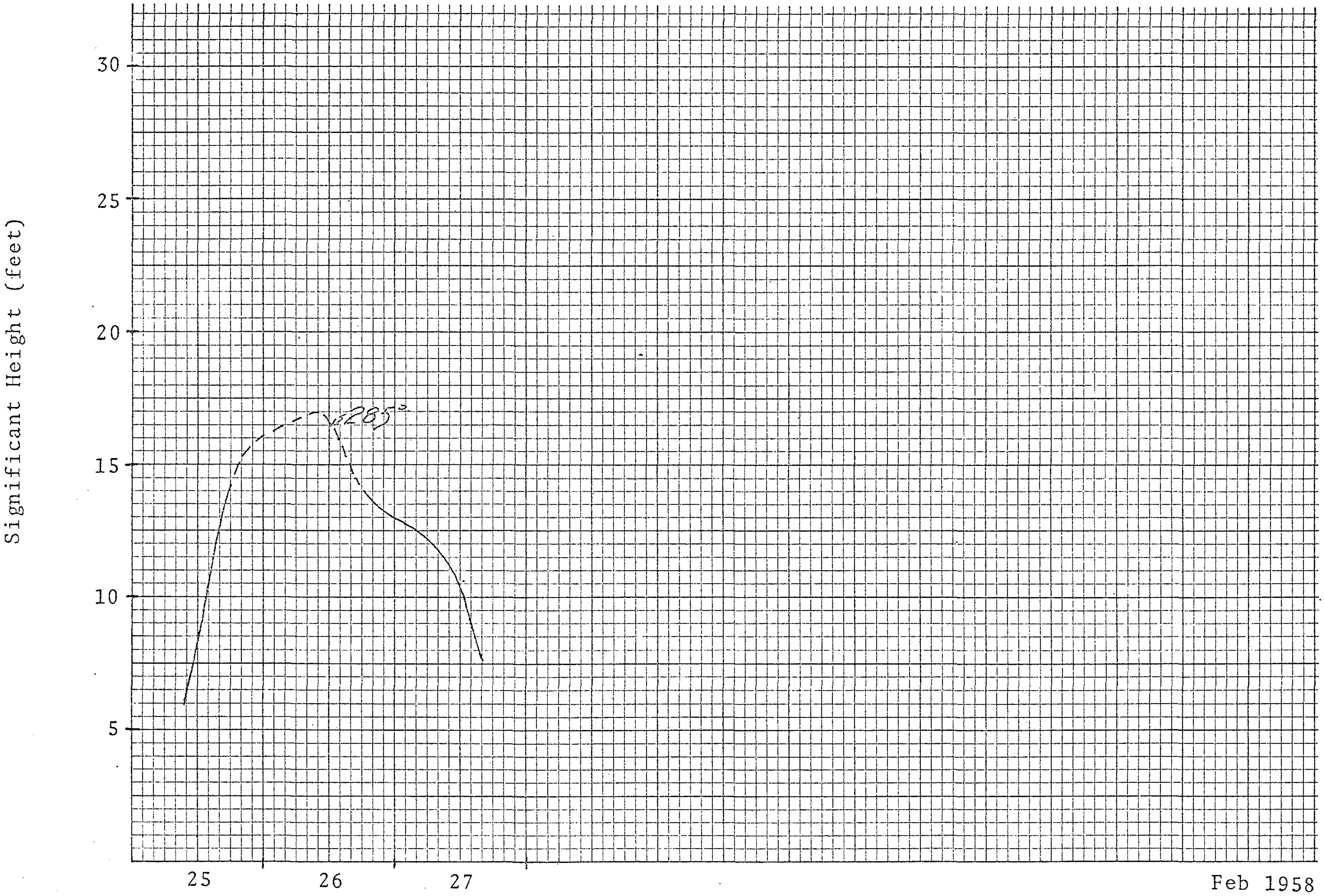

TABLE 4-I
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Apr 1958

Day	Time	Wave Train							
		1 (285^0)*		2 (135^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	8.5	13						
	22	13.5	12						
2	04	14.0	11						
	10	14.0	13	4.0	4				
	16	12.5	13	7.0	6				
	22	10.0	10	8.5	6				
3	04	8.0	8	8.5	6				
	10	7.5	14						
	16	14.0	14						
	22	17.0	14						
4	04	19.5	12						
	10	20.0	16						
	16	20.5	15						
	22	19.5	13						
5	04	16.5	14						
	10	14.5	12						
	16	12.0	10						
	22	10.0	16						
6	04	8.5	9						
	10	7.0	8						
	16	6.0	7						
	22	5.5	7						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-I

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

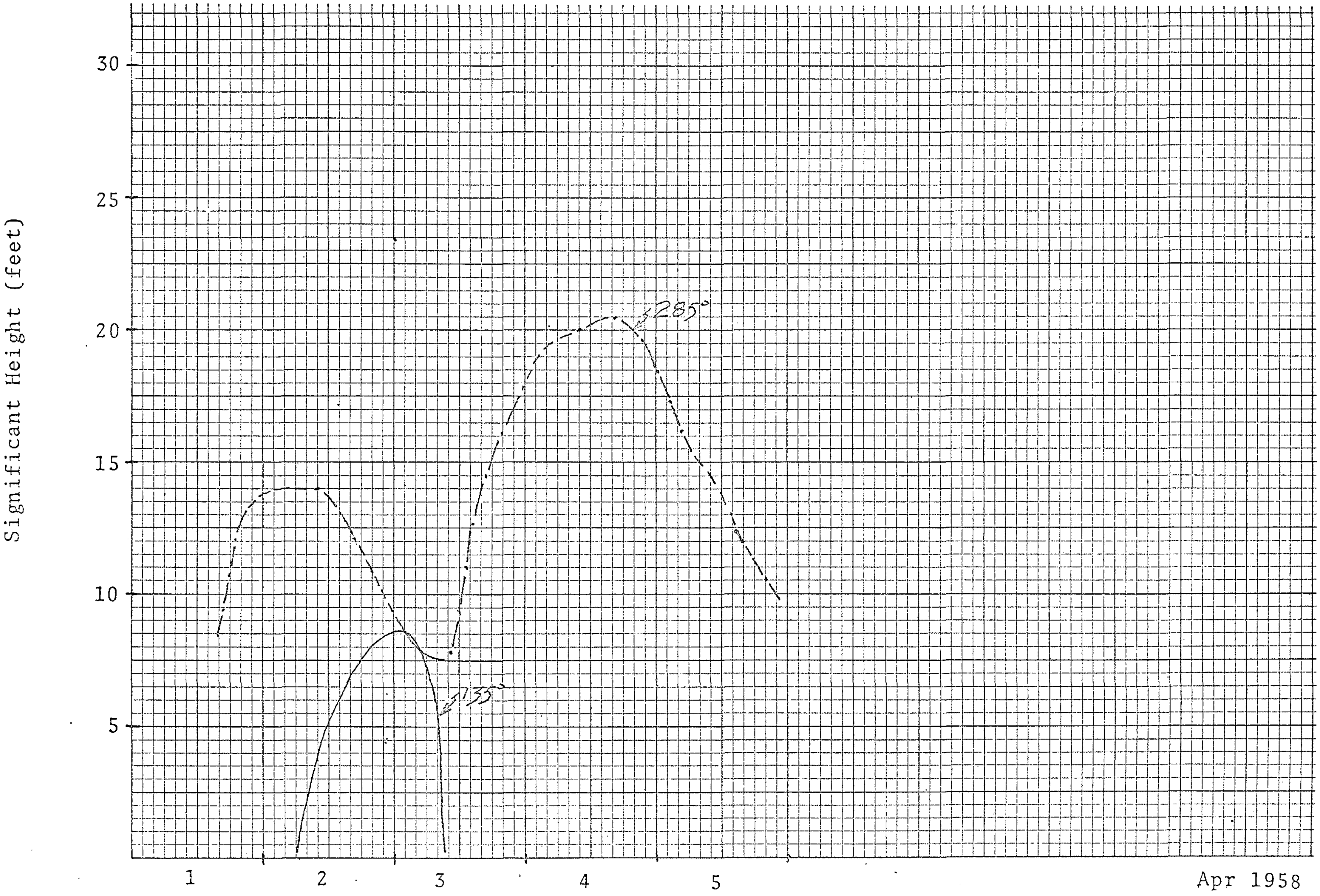

TABLE 4-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 4 Block 349 Date Feb 1960

Day	Time	Wave Train							
		1 (285^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	11.0	16						
	10	17.5	14						
	16	17.5	13						
	22	17.0	13						
10	04	11.0	12						
	10	11.0	12						
	16	11.0	12						
	22	11.0	12						
11	04	9.0	11						
	10								
	16								
	22								
	04								
	10								
	16								
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	16								
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	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 4-J

WAVE HEIGHT PLOT: STATION 4 BLOCK 349

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

TABLE 5-A
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Jan 1913

Day	Time	Wave Train							
		1 (315^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
3	04								
	10	4.0	5						
	16	5.0	7						
	22	12.5	9						
4	04	19.0	10						
	10	24.5	12						
	16	25.0	13						
	22	23.5	13						
5	04	20.5	12						
	10	16.5	11						
	16	15.5	11						
	22	14.0	10						
6	04	9.0	9						
	10	6.0	7						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-A

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

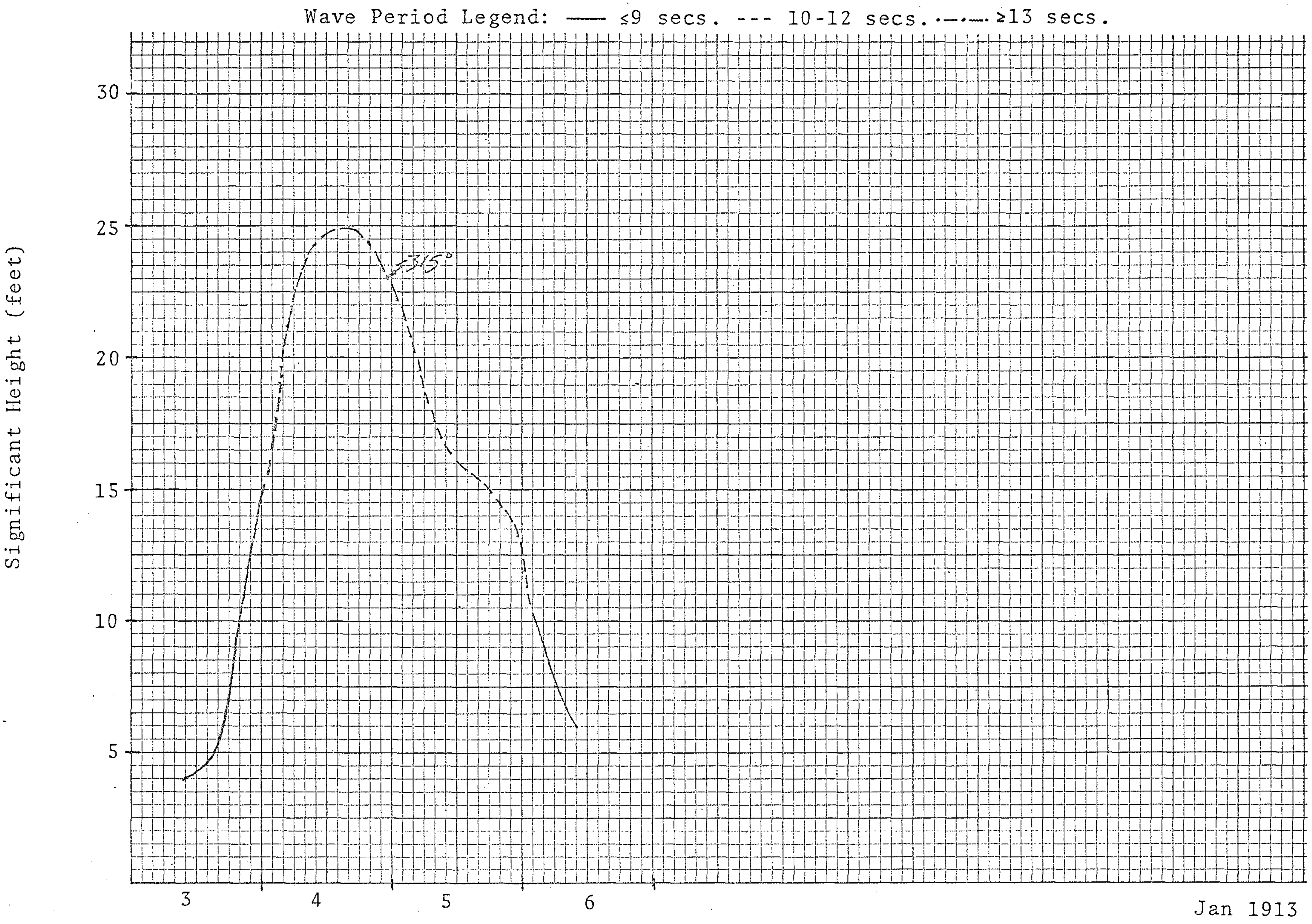

TABLE 5-B

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Apr - May 1915

Day	Time	Wave Train							
		1 (315^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
29	04	6.0	5						
	10	11.0	7						
	16	24.0	12						
	22	25.0	12						
30	04	25.0	12						
	10	25.0	12						
	16	23.5	12						
	22	23.5	12						
1	04	23.5	12						
	10	23.0	10						
	16	23.0	10						
	22	21.0	9						
2	04	21.0	9						
	10	18.5	9						
	16	10.5	8						
	22	6.5	7						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-B

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

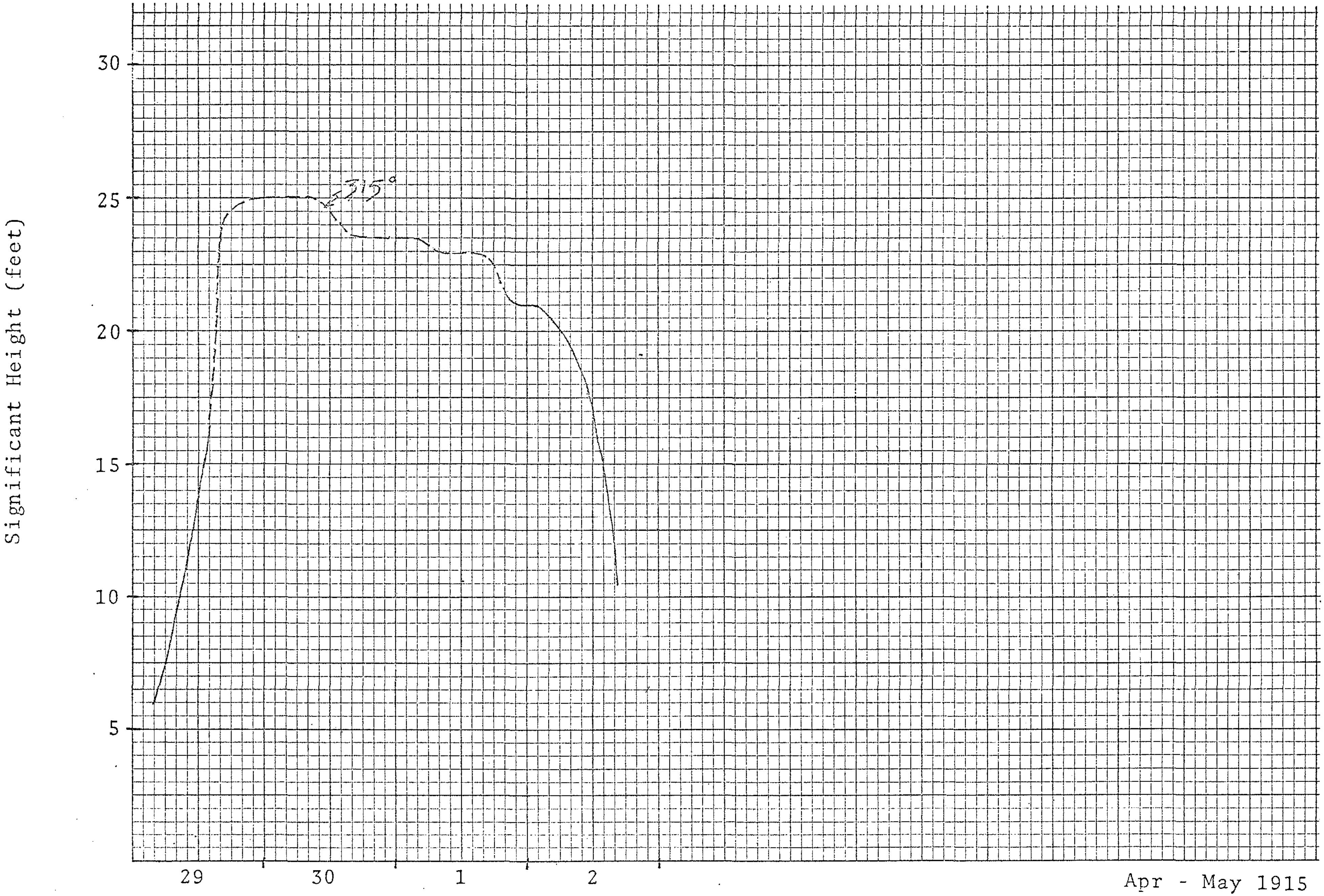

TABLE 5-C

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Mar 1916

Day	Time	Wave Train							
		1 (315^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
22	04								
	10								
	16	7.5	5						
	22	12.0	7						
23	04	17.0	8						
	10	21.5	10						
	16	20.5	9						
	22	17.0	9						
24	04	12.0	8						
	10	8.0	7						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-C

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

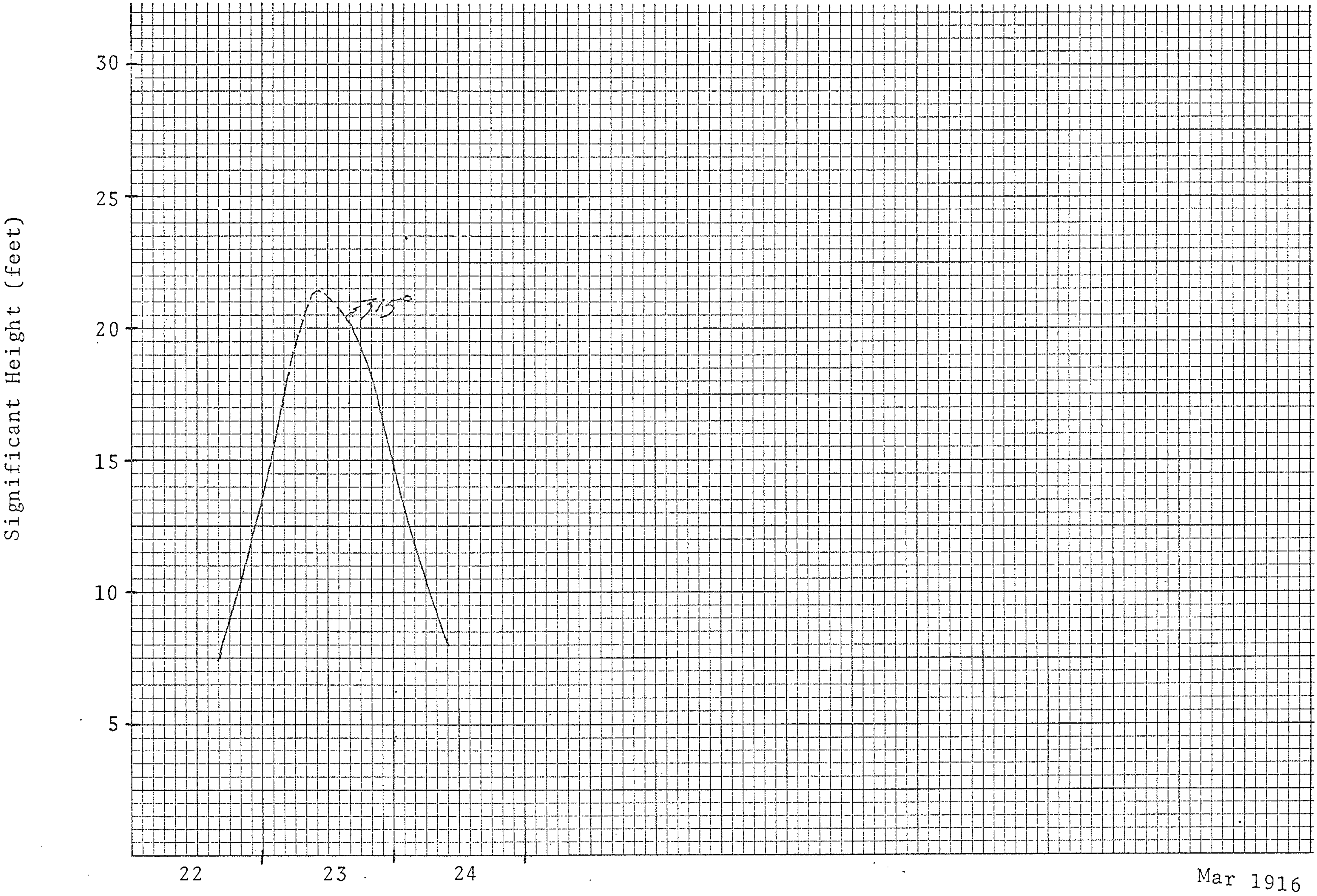

TABLE 5-D

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Dec 1916

Day	Time	Wave Train							
		1 (290^0)*		2 (135^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16	7.0	9						
	22	9.0	10	5.5	5				
24	04	14.0	12	6.0	5				
	10	12.5	11	6.0	5				
	16	18.5	12						
	22	24.0	12						
25	04	23.5	12						
	10	22.5	12						
	16	22.5	12						
	22	21.0	12						
26	04	9.5	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-D

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

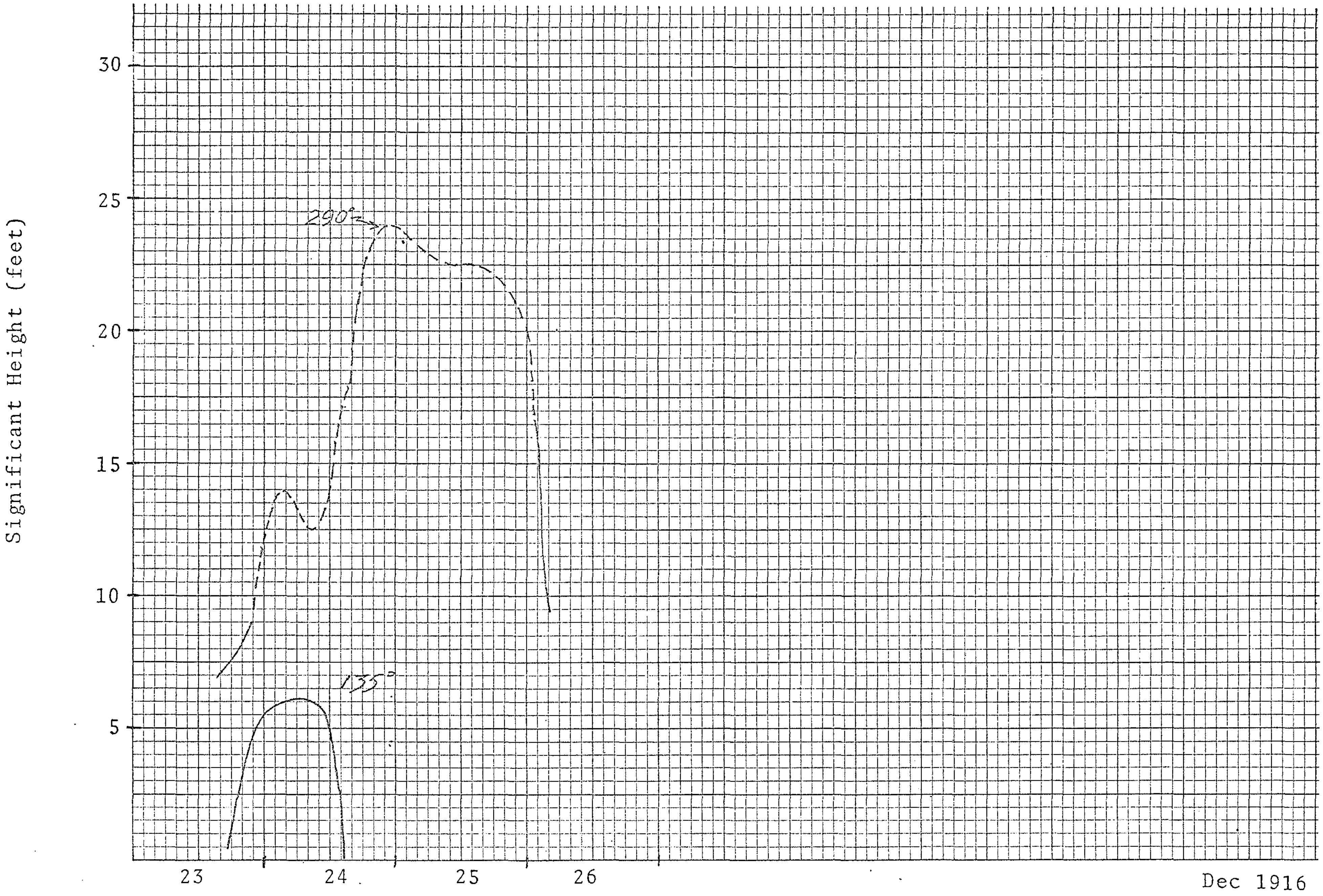

TABLE 5-E
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Feb 1919

Day	Time	Wave Train							
		1 (315^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04	8.5	12						
	10	13.0	10						
	16	17.0	11						
	22	20.0	11						
12	04	15.0	9						
	10	10.5	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-E

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

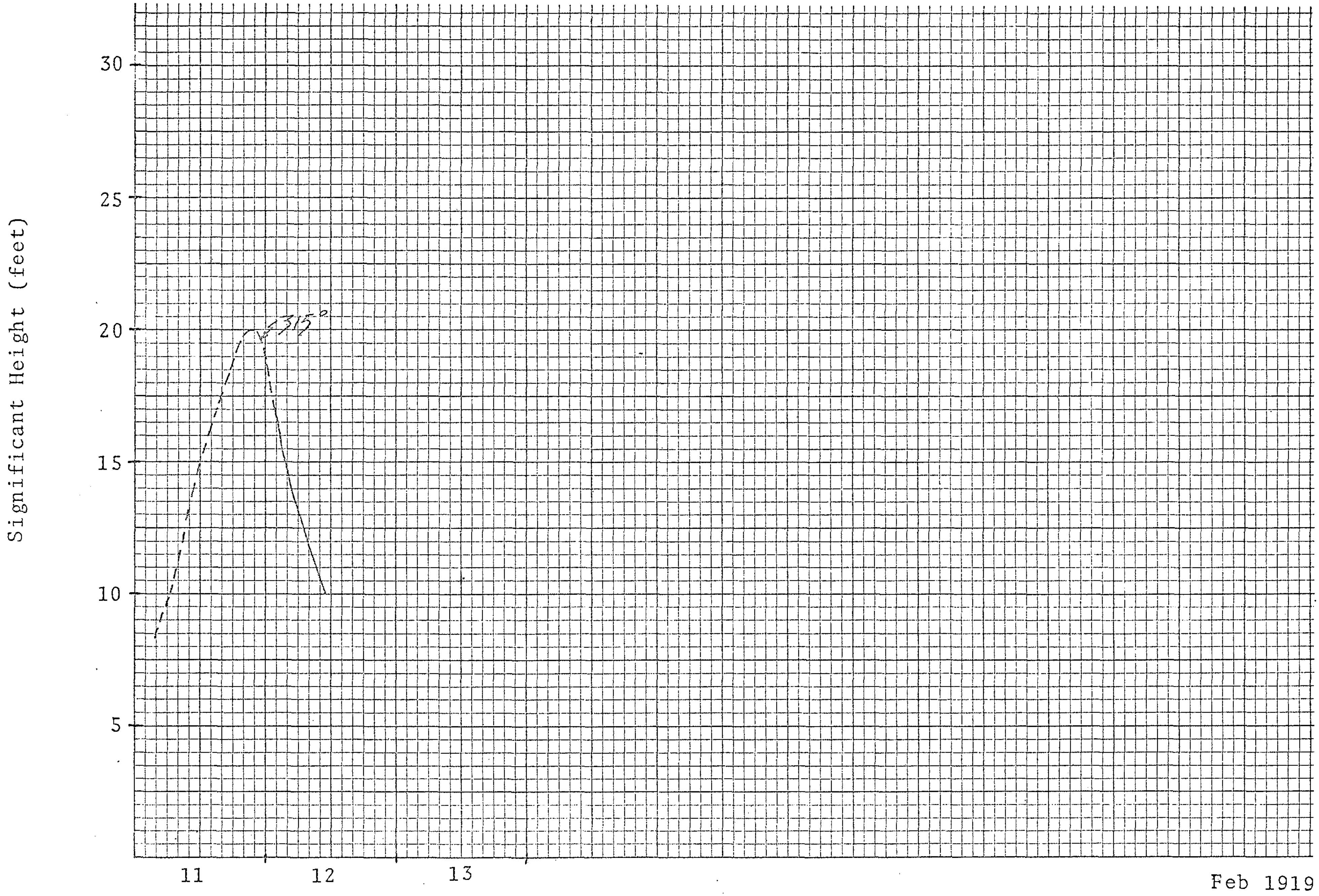

TABLE 5-F
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Jan 1932

Day	Time	Wave Train							
		1 (315^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	8.5	6						
	22	12.0	8						
12	04	23.5	10						
	10	25.5	11						
	16	27.0	12						
	22	27.0	12						
13	04	23.5	10						
	10	14.5	9						
	16	10.5	8						
	22	6.0	7						
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-F

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

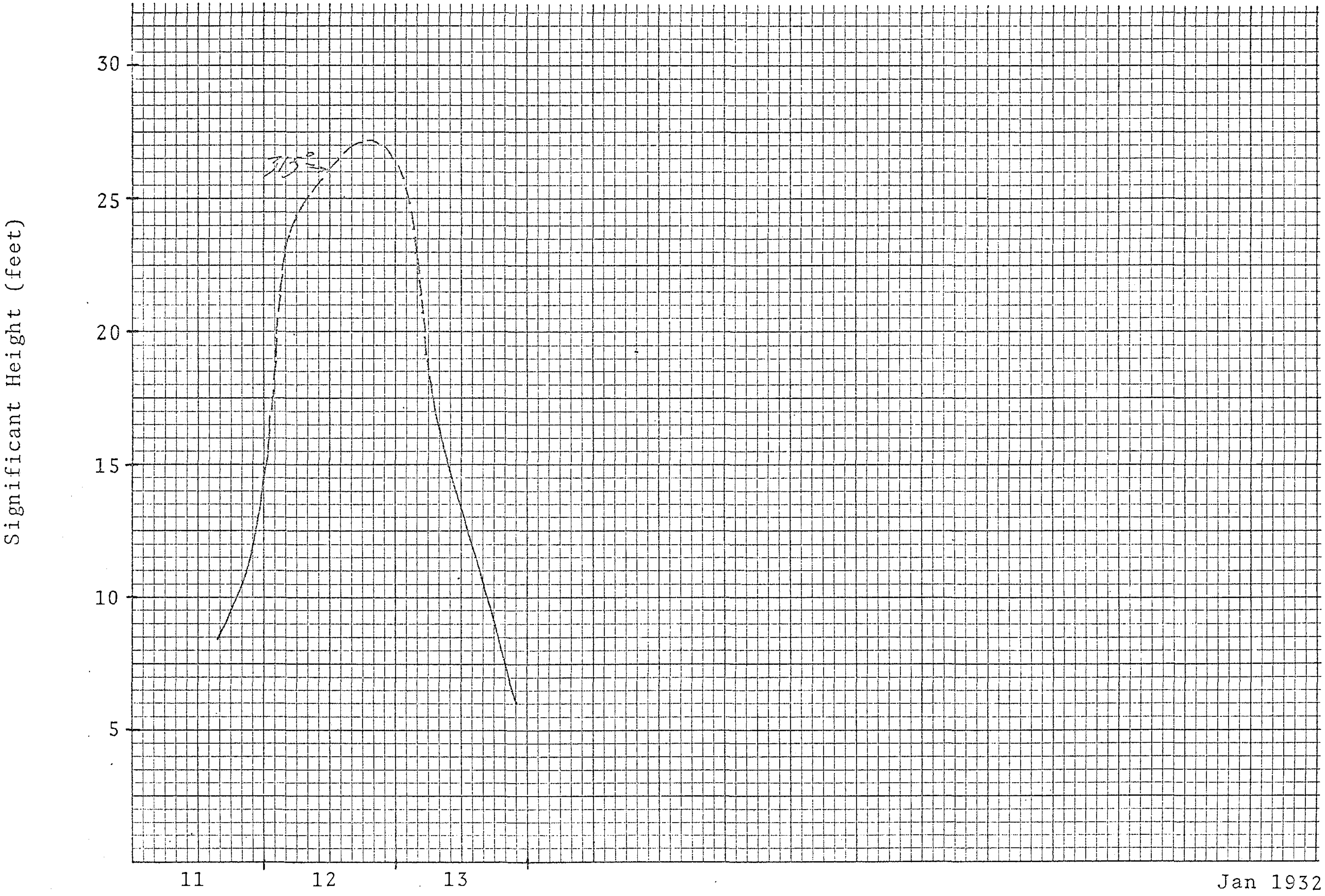

TABLE 5-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Jan 1939

Day	Time	Wave Train							
		1 (305^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
5	04								
	10	5.0	5						
	16	14.5	9						
	22	21.0	13						
6	04	26.5	12						
	10	21.5	10						
	16	17.5	10						
	22	16.0	9						
7	04	13.0	8						
	10	7.0	7						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-G

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

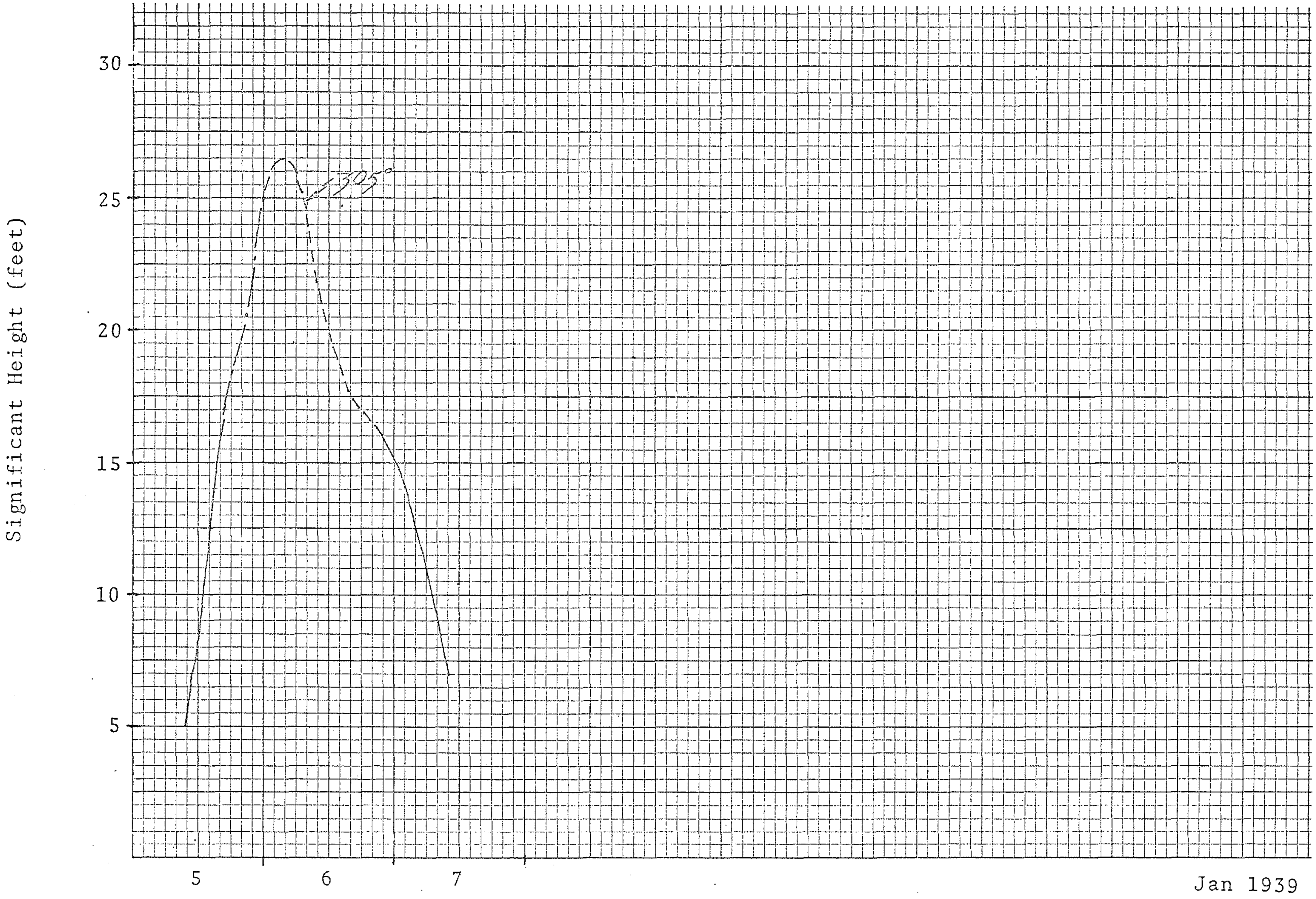

TABLE 5-H
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Feb 1958

Day	Time	Wave Train							
		1 (290^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
25	04								
	10	6.0	9						
	16	15.5	10						
	22	19.0	11						
26	04	19.5	11						
	10	19.0	11						
	16	17.0	10						
	22	17.0	10						
27	04	16.5	10						
	10	14.5	9						
	16	14.5	9						
	22	19.0	8						
28	04	12.0	8						
	10	10.5	7						
	16	7.0	7						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-H

WAVE HEIGHT PLOT:STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

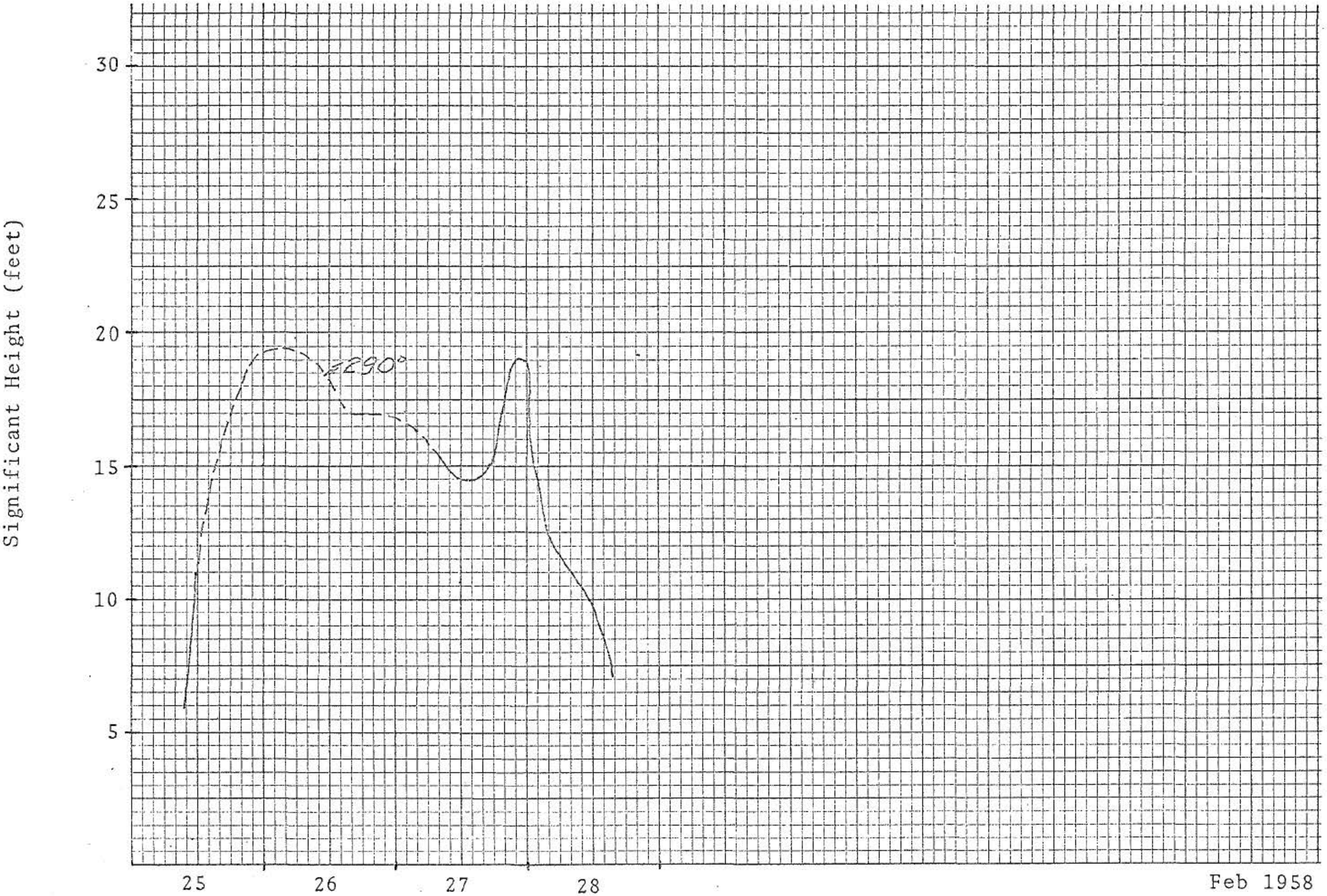

TABLE 5-I
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Apr 1958

Day	Time	Wave Train							
		1 (285^0)*		2 (135^0)		3 (110^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	12.5	13						
	22	17.0	12						
2	04	17.5	14						
	10	18.0	13	5.0	5				
	16	14.0	12	7.0	6				
	22	12.0	10	8.5	6				
3	04	9.0	9						
	10	10.0	14						
	16	18.5	14						
	22	21.5	14						
4	04	23.0	13						
	10	23.5	16						
	16	24.5	15						
	22	21.5	14						
5	04	19.0	12						
	10	16.0	10						
	16	13.5	9	4.0	4				
	22	11.0	8	6.0	5				
6	04	9.5	7						
	10	7.5	7						
	16	13.0	13			8.5	7		
	22	14.5	16			7.0	7		
7	04	12.0	13						
	10	8.0	9						
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-I

WAVE HEIGHT PLOT: STATION 5 BLOCK 316

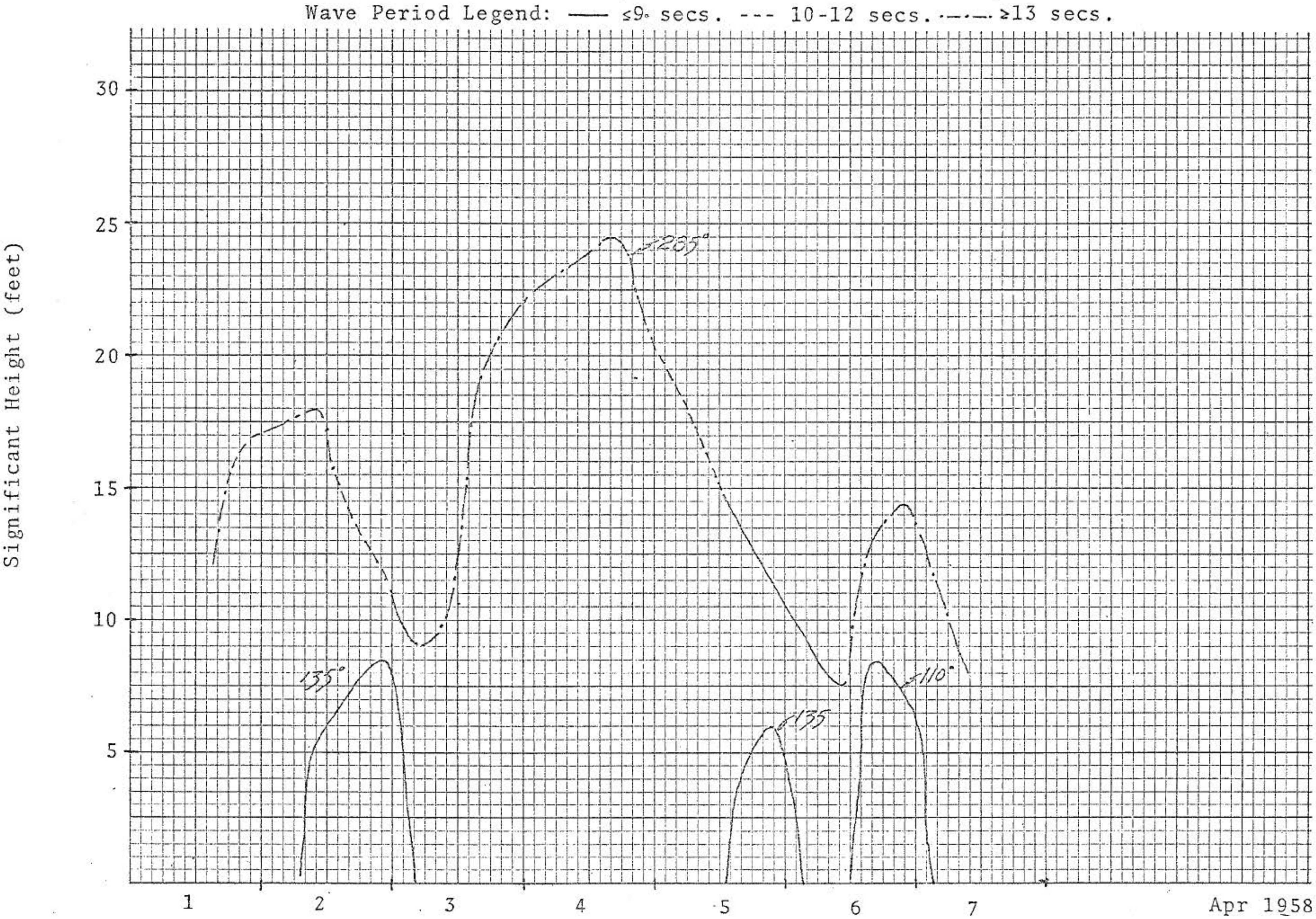

TABLE 5-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 5 Block 316 Date Feb 1960

Day	Time	Wave Train							
		1 (290^0)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	12.5	16						
	10	19.5	14						
	16	19.5	13						
	22	18.5	13						
10	04	18.5	12						
	10	17.5	12						
	16	17.5	12						
	22	17.5	12						
11	04	16.0	11						
	10	10.5	10						
	16								
	22								
	04								
	10								
	16								
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	22								
	04								
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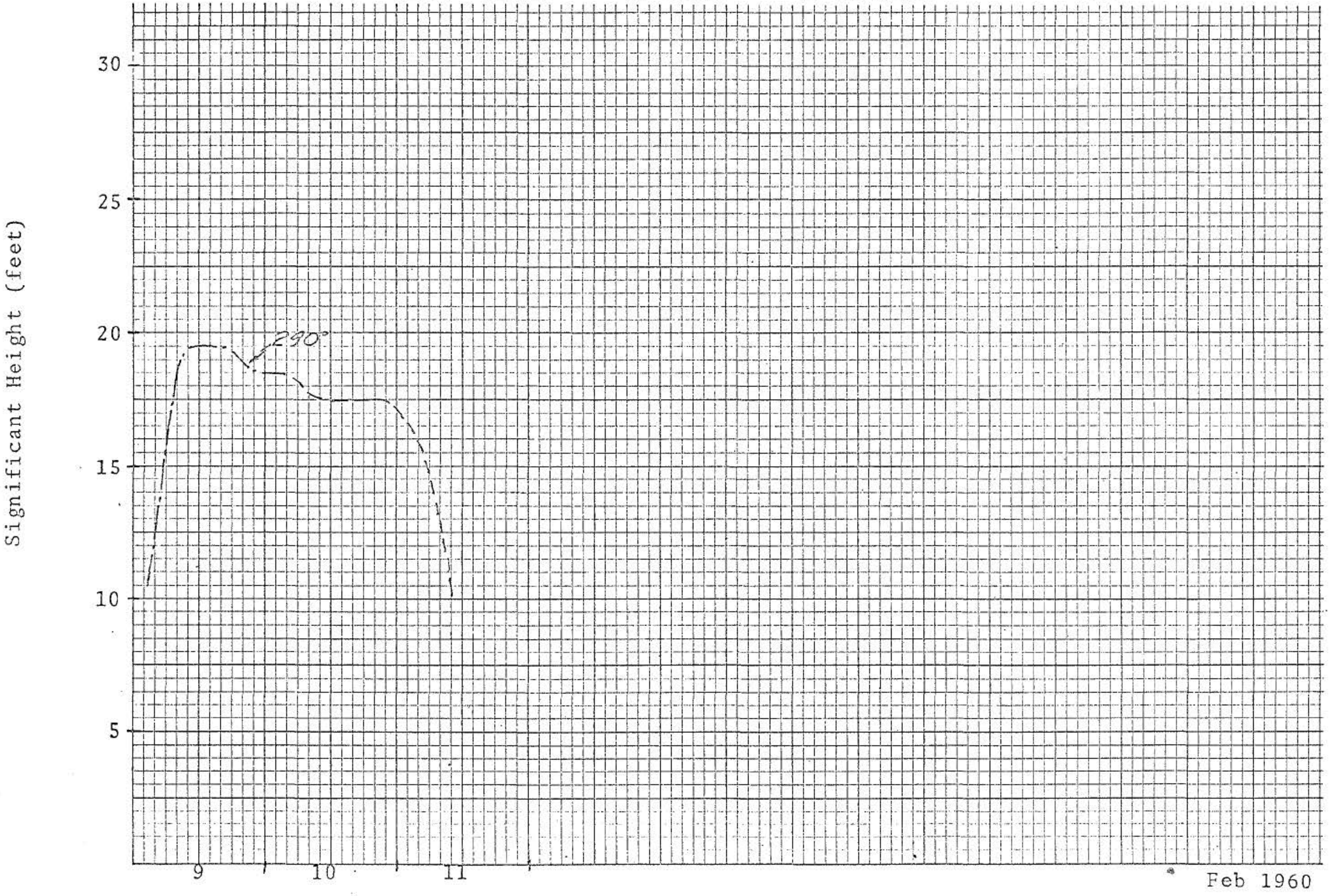
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 5-J

WAVE HEIGHT PLOT: STATION 5 BLOCK 316

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.



OCEANOGRAPHIC SERVICES, INC.

August 1969

Prepared For

Esso Production Research Company

Submitted By

Oceanographic Services, Inc.

Addendum To

OSI#166-2

Storm Wave Study
Santa Barbara Channel

OCEANOGRAPHIC SERVICES, INC.

To: Esso Production Research Company
Houston, Texas
Attention: Mr. Hans O. Jahns

From: Oceanographic Services, Inc.
Santa Barbara, California
Richard Kent, President

Subject: Addendum to Report No. OSI#166-2, March 1969, "Storm Wave Study, Santa Barbara Channel"

On 16 December 1968 EPR engaged OSI to conduct a study of storm wave conditions in the Santa Barbara Channel. The resulting report was transmitted to EPR on 31 March 1969. Subsequently, EPR requested that certain aspects of the report be amplified. Accordingly, the following addendum to OSI#166-2 has been prepared to fulfill this request.

Those aspects for which amplification was requested are as follows:

1. The basic methods employed in making the wave calculations.
    a. Delineation of wind field, fetch, duration, and station exposure, with an example of how a forecast is prepared.
    b. Refraction.
2. Development and significance of Figures 5, 6, 7, and 8 of the report.

1. The basic methods employed in making the wave calculations.

At this time, there are two basic wave hindcasting theories which are in common use. These are the Sverdrup/Munk (SM) theory and the Pierson/Neumann/James (PNJ) theory.

The SM approach essentially provides a single wave characteristic (H,T,) for a given set of generating conditions whereas the PNJ approach provides a wave spectrum. Many characteristics of each system are transferrable into the other to some extent, through use of empirical data and statistical analysis. As a consequence, results from the two approaches often are virtually identical. Details on each can be found in the literature.

OSI has tested both approaches in the last several years and has settled upon using the SM method for local generation (sea) and the PNJ method for distant generation (swell). One major modification we employ in use of the PNJ method concerns wave group velocity. The PNJ method employs the classical deep water relationship

$$V = 1.5T$$

where V is group velocity and T is wave period. Our experience has shown that this particular formula results in wave travel times that are too large. That is, the energy travels too slowly. After considerable checking and statistical analysis, an empirical relationship

$$V = 2.02T$$

was concluded as being operationally realistic and has been used by OSI in the Santa Barbara Channel for several years. An example of a prepared wave hindcast for EPR Station 342 is presented below. The storm under consideration is that of March 1905. Twelve hourly meteorological maps of this storm covering the period from 0400 11 March to 0400 13 March are shown in the five attachments.

Interpretation of the maps is difficult for a non-meteorologist; however, the map of 0400 11 March 1905 indicates that a wind of 12 knots from 110^0 is blowing in the Santa Barbara Channel. By 2200 hours of the 11th, this wind has increased to 44 knots along a 40 nautical mile length of the channel. The resulting wave (SM) at 2200 hours has a height of 10 feet and a period of 7 seconds. The consequent parameters in time are:

Time	Wind Speed	Direction	Fetch Length	H_s	T_s
0400/12th	70	110^0	40	20.0	9
1000	56	110^0	40	16.5	9
1600	40	110^0	40	14.0	8
2200	28	110^0	100	6.0	6
0400/13th	18	110^0	100	6.0	6

Examination of the enclosed weather maps also shows that the storm in question had non-local fetches to the southwest and west-southwest of the channel which generated high waves. For example, the 1600 weather map on 12 March 1905 shows a fully developed fetch 350 miles in length with an effective wind speed of 34 knots. The decay distance from the front of the fetch is 50 nautical miles and the energy indice of Station 342, using the PNJ method,is 96. The swell parameters at EPR 342 are:

Time	Direction	H_s	T_s
2200/12th	240^0	27.5	15
0400/13th	240^0	27.0	14
1000/13th	240^0	19.0	10
1600/13th	240^0	11.0	8
2200/13th	240^0	6.5	7

Clearly, a considerable amount of technique and experience is involved in selecting the appropriate fetch, wind speed, duration, and exposure from a weather chart. Details on forecasting technology cannot be provided in a report of this nature.

With respect to bottom modification of the deep water waves, a detailed series of refraction diagrams were drawn for each of the EPR stations, covering every important wave condition (period and direction). The discrete deep water significant waves were modified according to these refraction coefficients. As indicated in the report, all stations were in sufficiently deep water that bottom effects directly at the sites were negligible. The only cases of importance were those wherein the shoals off Pt. Arguello/Pt. Conception and San Miguel Island re-directed open ocean (refracted) waves to the stations within the channel.

2. The development and significance of Figures 5, 6, 7, and 8 of the report.

Figures 5, 6, 7, and 8 were developed to serve as simplified tools for extrapolating the storm wave data widely throughout the Humble lease areas in the Santa Barbara Channel. This subject is discussed in pages 3-1 to 3-3 of the report.

As indicated in the report, design magnitude waves are generated by four distinct storm conditions only. Because of this, and the orientation, exposure, and narrow width of the Santa Barbara Channel, a very effective filter exists, such that waves of design category fall in a few rather narrow period/direction band widths. For example, the maximum southeasterly waves at EPR 342 peak very sharply at 115^0 $\pm 5^0$. Similarly, maximum west-southwesterly waves peak directionally at 235^0 $\pm 10^0$, etc. Also, those periods associated with the design waves fall in narrow ranges. For example, at EPR Station 342, design waves from the southeast with periods differing much from 9 to 10 seconds just cannot develop. Similarly, design waves from the west to west-southwest cluster around a period of 13-16 seconds, and so on.

Because of this filtering aspect – which, in effect, restricts design magnitude waves to narrow period and direction bands, it is feasible to prepare Figures 5, 6, 7, and 8 in somewhat generalized format. As can be derived from the several sets of tabulated data, period ranges which are implicitly included in Figures 5, 6, 7, and 8 are 7-9, 10-13, 13-16, and 9-12 seconds, respectively.

APPENDIX 6.3

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.3

A Study of Wave Conditions Along a Tow Route From Long Beach to a Proposed Platform Location Off Gaviota

Oceanographic Services

Report #240-2

July, 1971

OCEANOGRAPHIC SERVICES, INC.

OSI#240-2
July 1971
Santa Barbara
California

Prepared For:

ESSO PRODUCTION RESEARCH COMPANY

Submitted By:

OCEANOGRAPHIC SERVICES, INC.

A STUDY OF WAVE CONDITIONS ALONG A TOW ROUTE FROM LONG BEACH TO A PROPOSED PLATFORM LOCATION OFF GAVIOTA

James W Winchester

Approved: Richard Kent, President
By James W. Winchester, Vice President/General Manager

FOREWORD

This report, "A Study of Wave Conditions Along a Tow Route from Long Beach to a Proposed Platform Location off Gaviota," was prepared for Esso Production Research Company by the marine meteorologists of Oceanographic Services, Inc. The wave calculations and data compilations were made by James D. Dykas under the direction of Arthur E. Stockel, Manager of the Forecast Division.

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List of Tables

A STUDY OF WAVE CONDITIONS ALONG A TOW ROUTE FROM LONG BEACH TO A PROPOSED PLATFORM LOCATION OFF GAVIOTA

Part 1

INTRODUCTION

The purpose of this study is to describe the normal sea conditions prevailing during a period of one year along a sea route from Long Beach to a proposed platform location off Gaviota (Figure 1) and to describe the extreme monthly wave conditions* to be expected along this route during a five-year period. This was accomplished by providing the wave statistics at the following representative locations along the route:

1. The entrance to Santa Monica Bay.

2. A point off Ventura.

3. The proposed platform location off Gaviota.

The year 1970 was selected as the period during which a continuous plot of wave heights along the tow route would be provided because of the availability of actual wave observations from drilling vessels operating in the area of the proposed platform location. The search for maximum monthly wave conditions for the period 1965-1969 was chosen because this would provide a consecutive six-year data base.

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*All wave heights referred to in the study are significant wave heights (H_s) = the average height of the one-third highest waves.

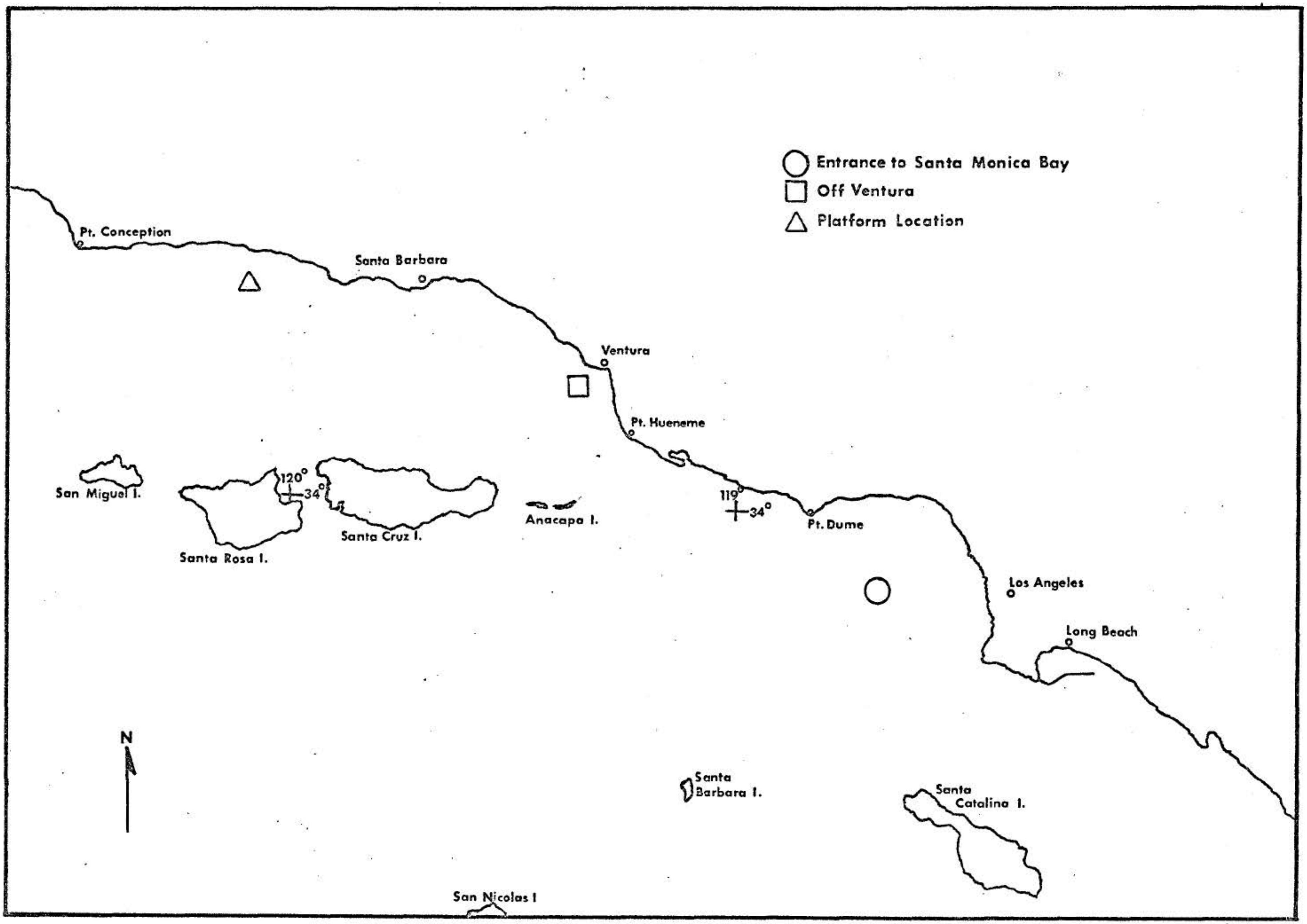


FIGURE 1 Locator Chart

Part 2

DATA PROCESSING

The wave data used in the compilation of this report were obtained in several different ways. The recorded wave observations of the drilling vessels operating off Gaviota were used as the data base for the proposed platform location. For the point off Ventura, the recorded wave heights of the Harbor Master's office, Ventura Marina, were converted to deep-water equivalents and used as the data base for this location. Wave statistics derived from the Ventura data were used as the basis for the compilation of wave statistics for the site at the entrance to Santa Monica Bay. The methods used in acquiring and processing the wave data are described in the following paragraphs.

The Entrance to Santa Monica Bay

Since the swell waves arrived predominantely from the west during the entire year, the standard height/distance relationships were applied to the Ventura data to derive continuous wave data for the location at the entrance to Santa Monica Bay. This was accomplished by using a distance equal to the west-east interval between these two points as an additional decay distance and calculating the wave heights off the entrance to Santa Monica Bay from the wave heights occurring off Ventura. The statistical relationships between these two points, based on the data derived in this study, agreed very closely in respect to wave heights and frequencies with those of the "Climatological Study, Southern California Operating Area" prepared by the Naval Weather Service Environmental Detachment for the Fleet Weather Facility, San Diego, California.

A Point Off Ventura

The statistics describing conditions at this location were calculated by applying a factor to the wave observations recorded at the Harbor Master's office, Ventura Marina. Through use of the known shoaling and refraction coefficients and wave periods, the shallow-water wave heights were converted to deep-water wave heights. The results were tabulated and accurately represent wave conditions at the deep-water site.

Proposed Platform Location Off Gaviota

The statistics describing wave conditions at this location were compiled directly from the wave observations recorded by personnel of the BLUEWATER II or the WODECO IV, depending upon which one was closer to the site at a particular time. These drilling vessels, operating for Humble Oil and Refining Company, were at or near the site during the entire calendar year of 1970.

Part 3

WAVE CALCULATIONS

The widely accepted hindcast methods of Sverdrup, Munk, and Bretschneider (SMB) and Pierson, Neumann, and James (PNJ) were used in calculating the wave heights (H_s) and characteristics of that part of the study describing the maximum monthly wave conditions at each site during the five-year period. The six-hourly historical surface weather charts of the National Climatic Center, Asheville, North Carolina, were used as the initial reference in all wave calculations. The SMB method was used in calculating all locally-generated waves (sea) and the PNJ method was used in calculating the heights and arrival times of all waves arriving from distant wave generation areas (swell). Both these methods are used daily by meteorologists of Oceanographic Services, Inc. (OSI) in forecasting wave conditions at offshore or nearshore sites.

Part 4

DATA PREPARATION AND PRESENTATION

The wave statistics are presented in both tabular and graphical form. A brief description of the methods of preparation and presentation of the two parts of this study follow.

A Summary of Wave Conditions Along the Tow Route During a Consecutive One-Year Period (1970)

The statistics in this part of the study are presented in both tabular and graphical form. In both cases, the source of input data was the actual recorded wave observations or valid derivations from recorded wave data. The monthly graphs are a continuous plot of the significant wave heights (H_s) and associated wave periods and arrival directions at each of the three sites (Figures 1-A through 1-L, 2-A through 2-L, and 3-A through 3-L). Monthly tables for each site were compiled which show the frequency of occurrence by height interval, period, and arrival direction of all significant waves (Tables 1-A through 1-L, 2-A through 2-L, and 3-A through 3-L).

A Summary of Maximum Wave Conditions During a Five-Year Period Along the Tow Route

A search of weather maps for a five-year period (1965-1969) was conducted to select those storms capable of producing particularly high waves at each of the three sites along the tow route. All the different exposure angles were considered in selecting the storms, and several storms were selected each month to ensure that no potential wave-producing storms were overlooked. The significant wave heights (H_s) generated by each of these storms were then calculated using the PNJ and/or SMB methods, and the monthly sequence of wave events presented for those sites where significant waves ≥5 feet had occurred. The sequence of wave events and wave characteristics for each storm at each site with waves ≥5 feet are presented in tabular form (Tables 4-A through 4-D, 5-A through 5-L, and 6-A through 6-J) and in graphical form as a consecutive plot of wave heights with associated characteristics (Figures 4-A through 4-D, 5-A through 5-L, and 6-A through 6-J). The table and figure numbers of each wave sequence are identical, and the figure for each storm sequence is placed immediately following the applicable table for easy reference.

Part 5

DISCUSSION OF THE DATA

Wave conditions at each of the three selected sites along the tow route are discussed both from the standpoint of consecutive occurrences during a one-year period (1970) and in terms of maximum conditions occurring during a five-year period (1965-1969). During the one-year period of consecutive data, the wave climate along the proposed tow route was quite bland. This condition was considered to be normal, however, since the tow route crosses the most sheltered area of the Santa Barbara Channel. This sheltered condition is due to the local wind regime and the limited exposure angle restricting the arrival of swell waves from outside the channel. Except in winter during the passage of an occasional Pacific storm, the stronger prevailing winds blow offshore in this area of the channel. Therefore, the buildup of waves in the nearshore areas is limited because of the extremely short fetch distances.

During the consecutive one-year period (1970), the highest wave occurring along the tow route was a southeasterly wave of 14 feet with a period of 10-12 seconds. This condition was reported at the proposed platform location during the month of November. This was the only observation of a wave greater than 10 feet in height along the route during the one-year period, and, most of the time, wave heights were less than five feet.

The five-year (1965-1969) maximum wave conditions calculated for the tow route were also quite bland, and the greatest wave heights were the two cases of 13 feet, calculated at the platform location for January 1965 and February 1966. Waves exceeding 10 feet in height were calculated only for the months of January and

February, and no waves greater than five feet in height were calculated at any of the sites for the consecutive period June through August. The statistics for this five-year period emphasize the fact that the year of 1970 was quite normal.

The description of wave conditions at each of the sites is presented in the following paragraphs.

Entrance to Santa Monica Bay

During the consecutive one-year period (1970), all waves arrived at this location from the west and were less than five feet in height except during the months of March, April, November, and December. Waves between five and ten feet in height, during these months, occurred (on the average) less than 2% of the time. During the period of the five-year search (1965-1969) for maximum waves, the highest calculated wave of nearly 12 feet was for the month of January 1969. This was the only time that a wave exceeding 10 feet was calculated for this location.

Location Off Ventura

Waves less than five feet in height were reported during all months except March, April, November, and December for the consecutive one-year period (1970). During these months, the frequency of occurrence of wave heights between five and ten feet ranged from a low of less than 2% in November to a high of 9% in April. During the period of the five-year search (1965-1969), the highest calculated wave at this location was 10 feet for the month of January 1969.

Proposed Platform Location Off Gaviota

Of the three sites along the tow route, the proposed platform location had the worst reported wave conditions during the one-year consecutive period (1970) in respect to height, frequency, and variability of arrival direction. The highest reported wave was 14 feet with a period of 10-12 seconds, which arrived from the southeast. This was the highest wave at any of the sites during this one-year period. Even so, conditions were not considered to be particularly bad from an operational standpoint. During the months of March, May, June, and July, all reported waves were less than five feet, and even during the worst months, wave conditions of less than five feet in height prevailed more than 94% of the time.

During the five-year period (1965-1969), maximum wave conditions of 10 feet or higher were calculated for this site for January 1965 (11 feet), January 1966 (13 feet), and November 1969 (10.5 feet). These conditions were, by far, the most severe for any of the locations along the tow route during the five-year period, but they could not be considered extremely critical.

Highest Calculated Wave for a 70-Year Period Along the Tow Route

The highest wave calculated along the tow route was 20.5 feet at the proposed platform location off Gaviota. This wave height was calculated for the storm of March 11-13, 1905, and a complete account of this storm can be found in the report, "Storm Wave Study, Santa Barbara Channel," prepared for EPRCO by OSI in 1969.

Part 6

CONCLUSIONS

1. The wave statistics presented in this study are considered to be representative of normal wave conditions along the tow route, not only during the consecutive one-year period (1970), but during the five-year period (1965-1969).

2. Even the worst wave conditions depicted by this study (January or November at the proposed platform location off Gaviota) should not be drastically restrictive to a towing operation.

3. It appears that a barging operation would be possible during any period of the year, however, the period from June-August would be the best and the period from November-April the worst.

4. January appears to be the worst single month in respect to wave conditions.

Table 1-A

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY

Month JANUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s Θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

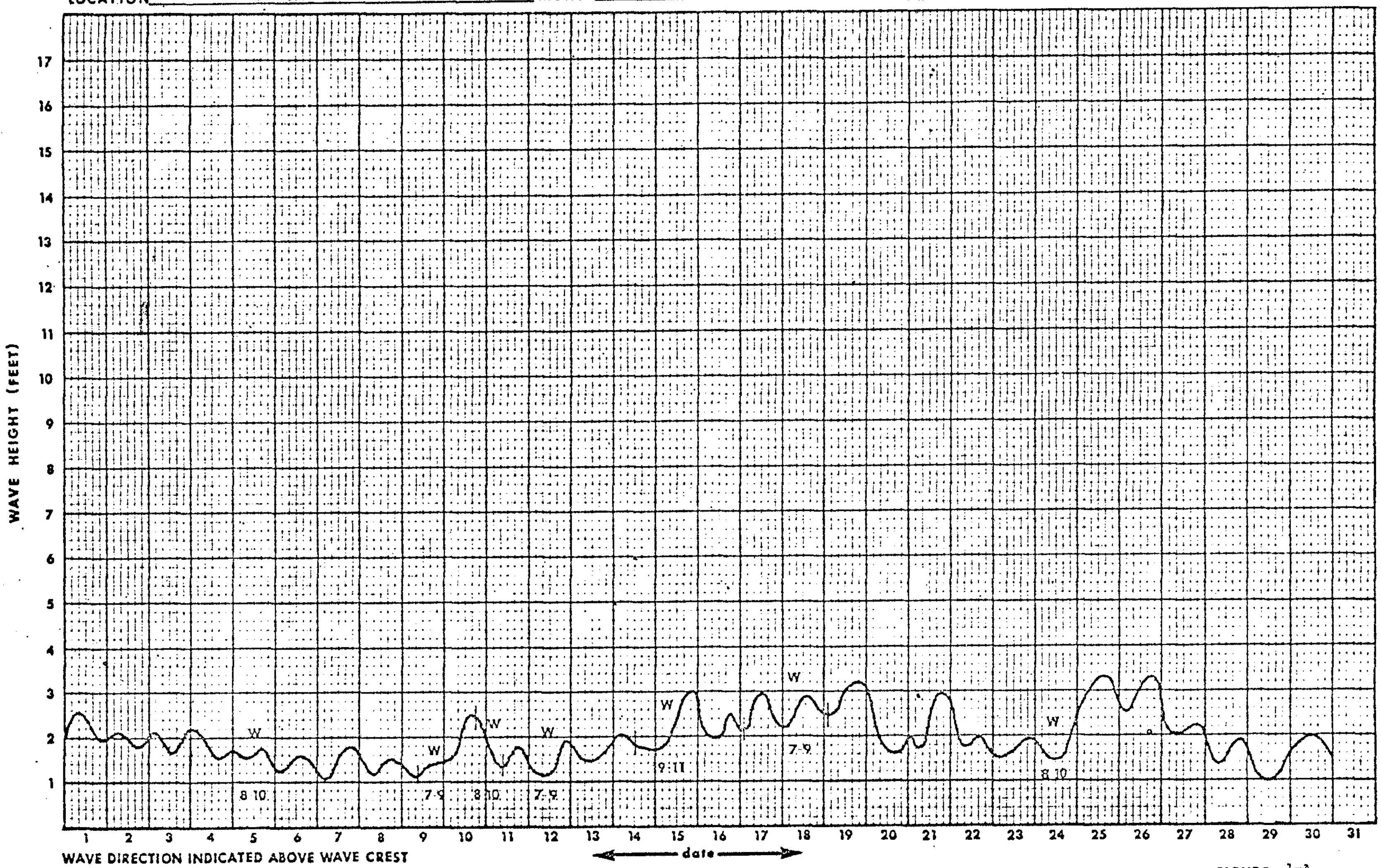
H_s Θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	W						NW						Sum
0-5			91.4	8.6									100
5-10													
10-15													
15-20													
20+													
Sum			91.4	8.6									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Jan YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-A

Table 1-B

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY

Month FEBRUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

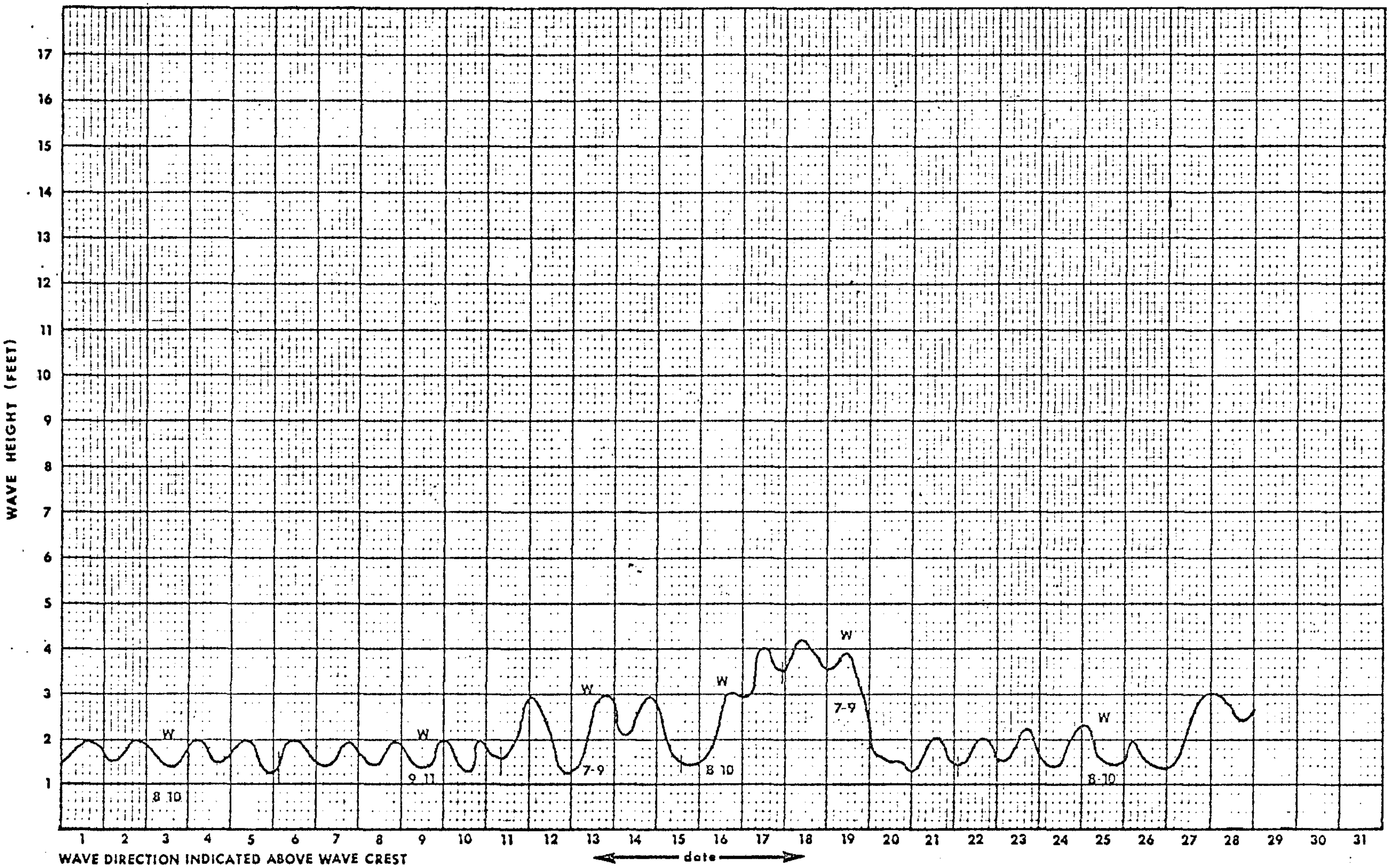
H_s θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s θ	W						NW						Sum
0-5			81.5	18.5									100
5-10													
10-15													
15-20													
20+													
Sum			81.5	18.5									100

*Based on 672 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Feb YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-B

Table 1-C

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

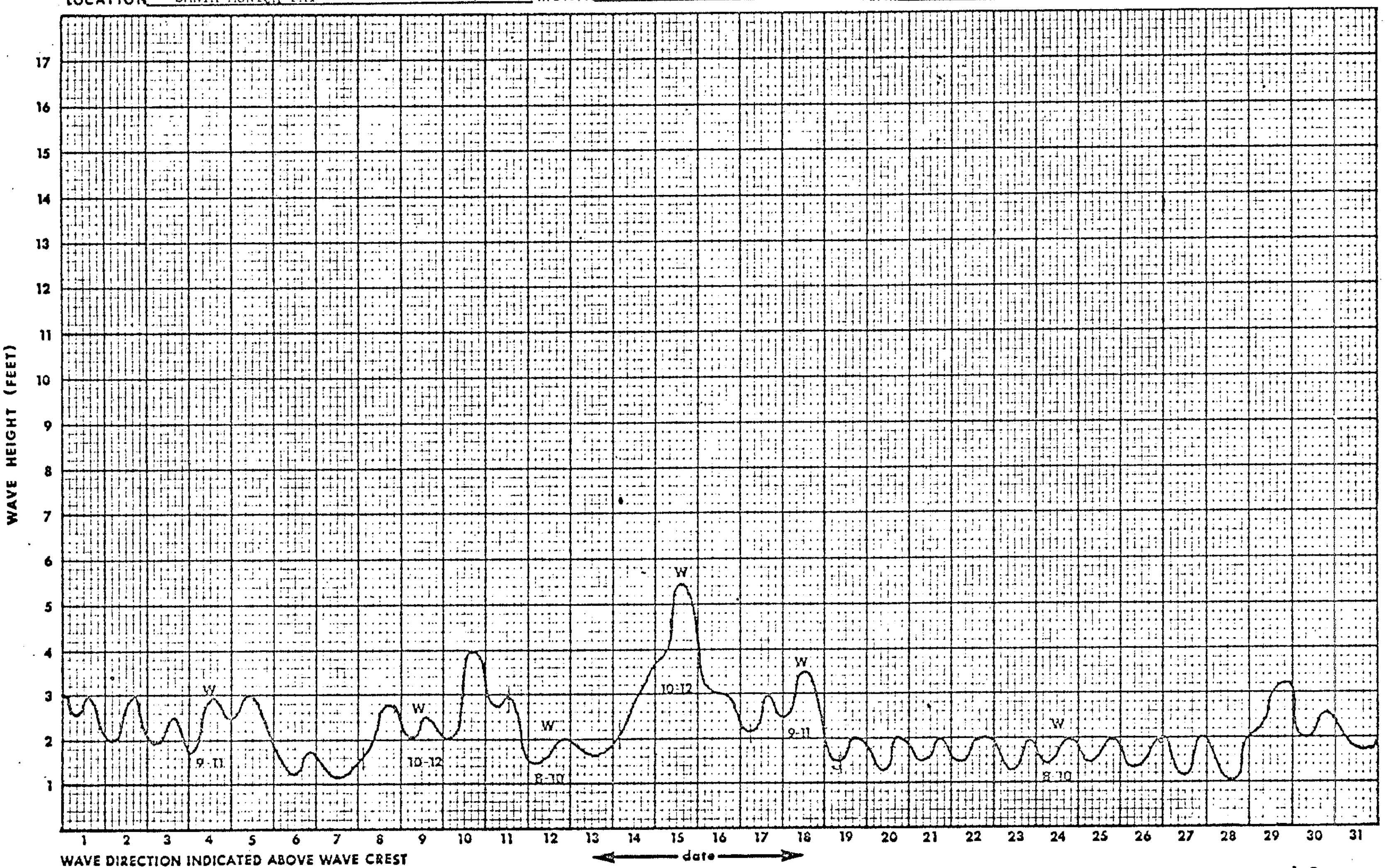
Station SANTA MONICA BAY Month MARCH 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	W						NW						Sum
0-5			33.6	65.3									98.9
5-10				1.1									1.1
10-15													
15-20													
20+													
Sum			33.6	66.4									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY **MONTH** Mar **YEAR** 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-C

Table 1-D

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

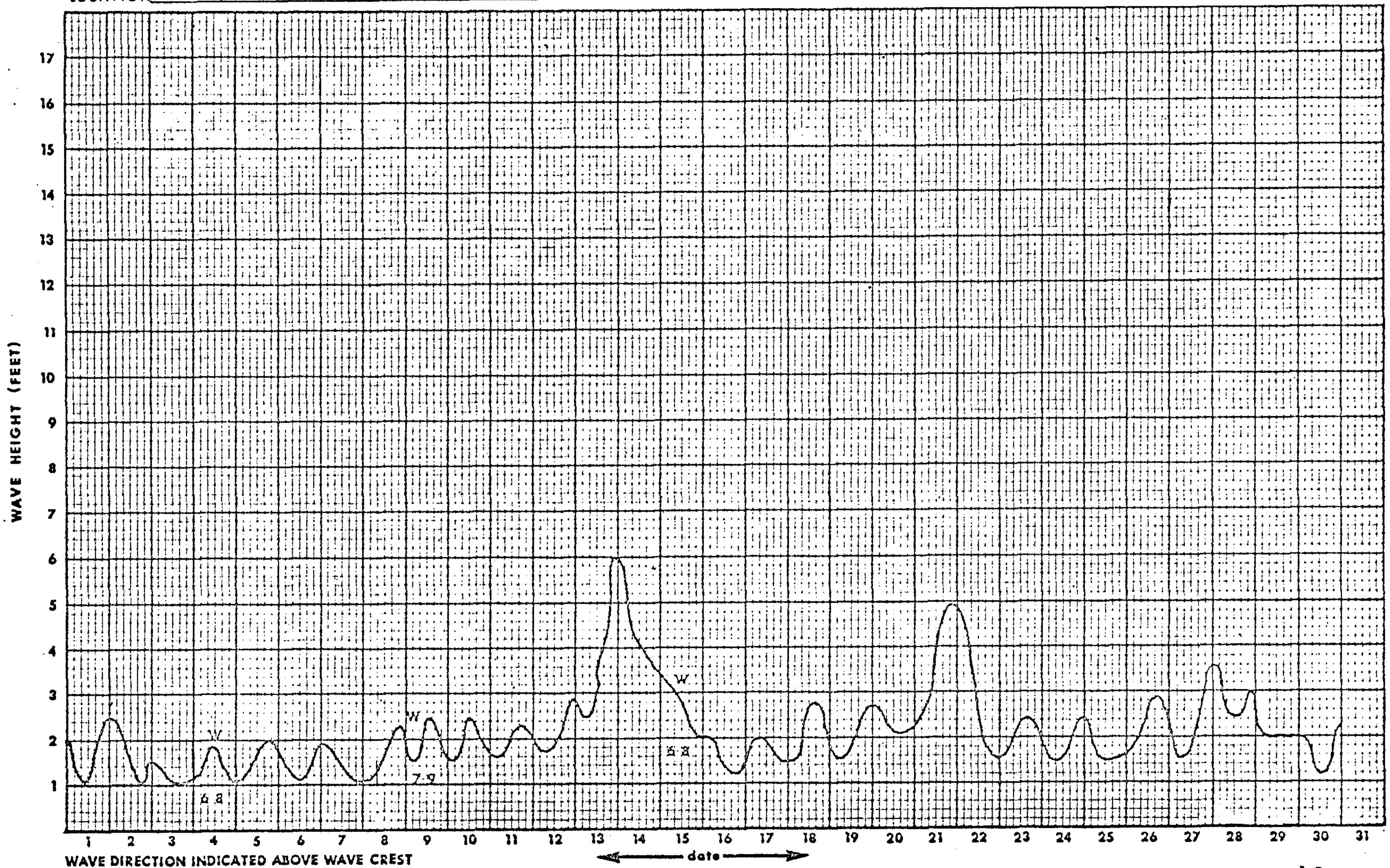
Station SANTA MONICA BAY Month APRIL 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	W						NW						Sum
0-5		93.6	5.0										98.6
5-10		1.4											1.4
10-15													
15-20													
20+													
Sum		95.0	5.0										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Apr YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-D

Table 1-E

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY

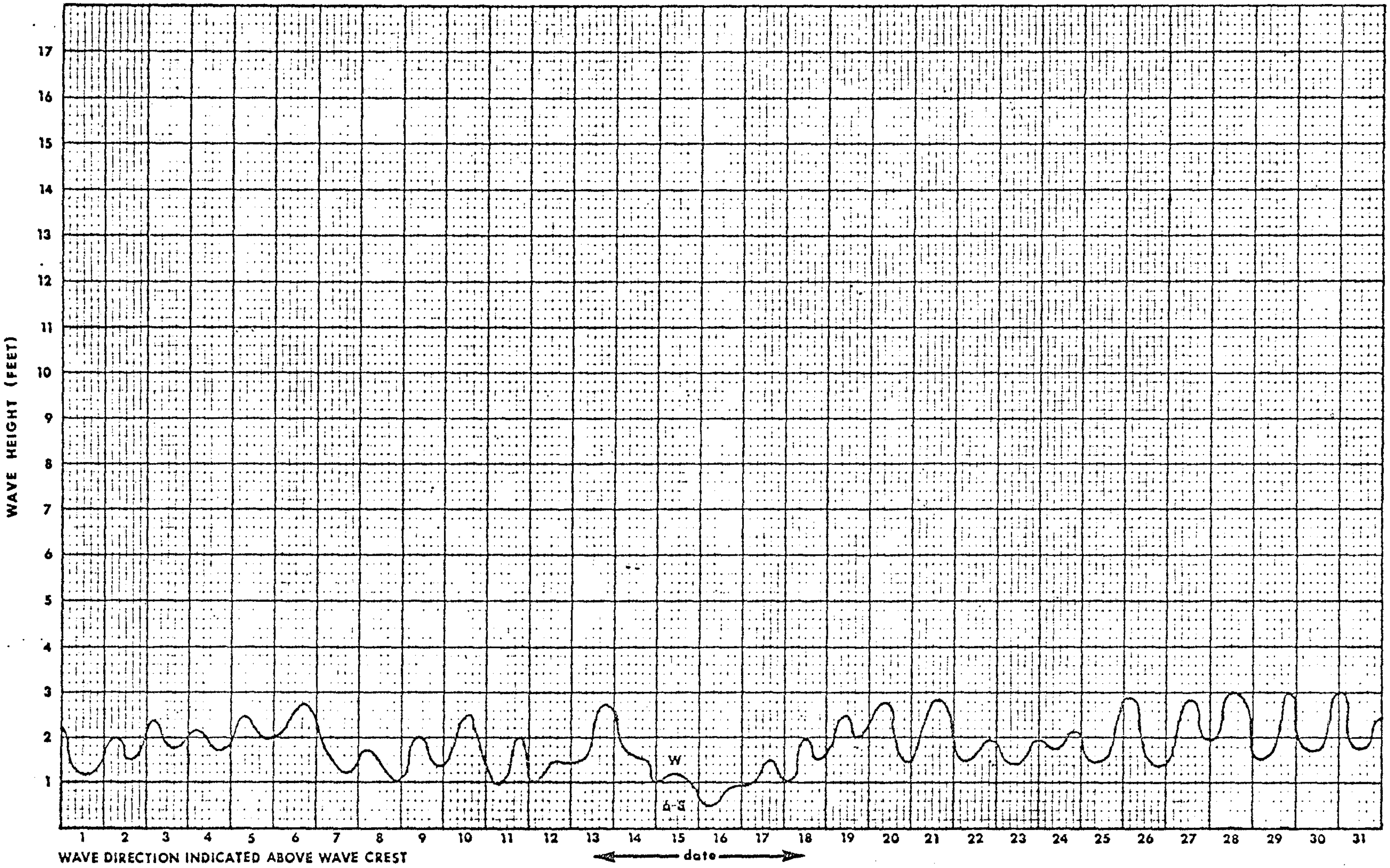
Month MAY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5		100											100
5-10													
10-15													
15-20													
20+													
Sum		100											100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH May YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-E

Table 1-F

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

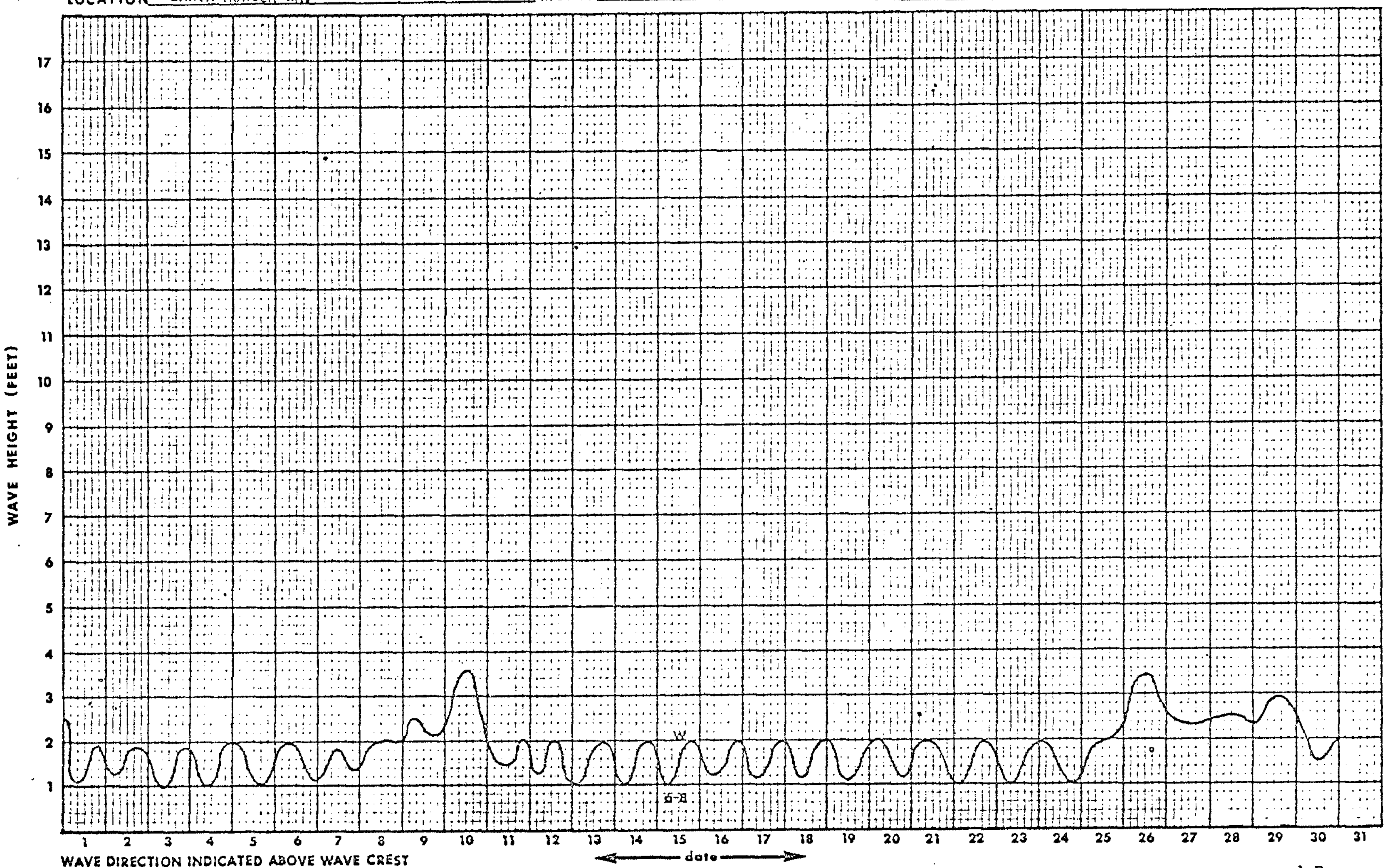
Station SANTA MONICA BAY Month JUNE 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5		100											100
5-10													
10-15													
15-20													
20+													
Sum		100											100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Jun YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-F

Table 1-G

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

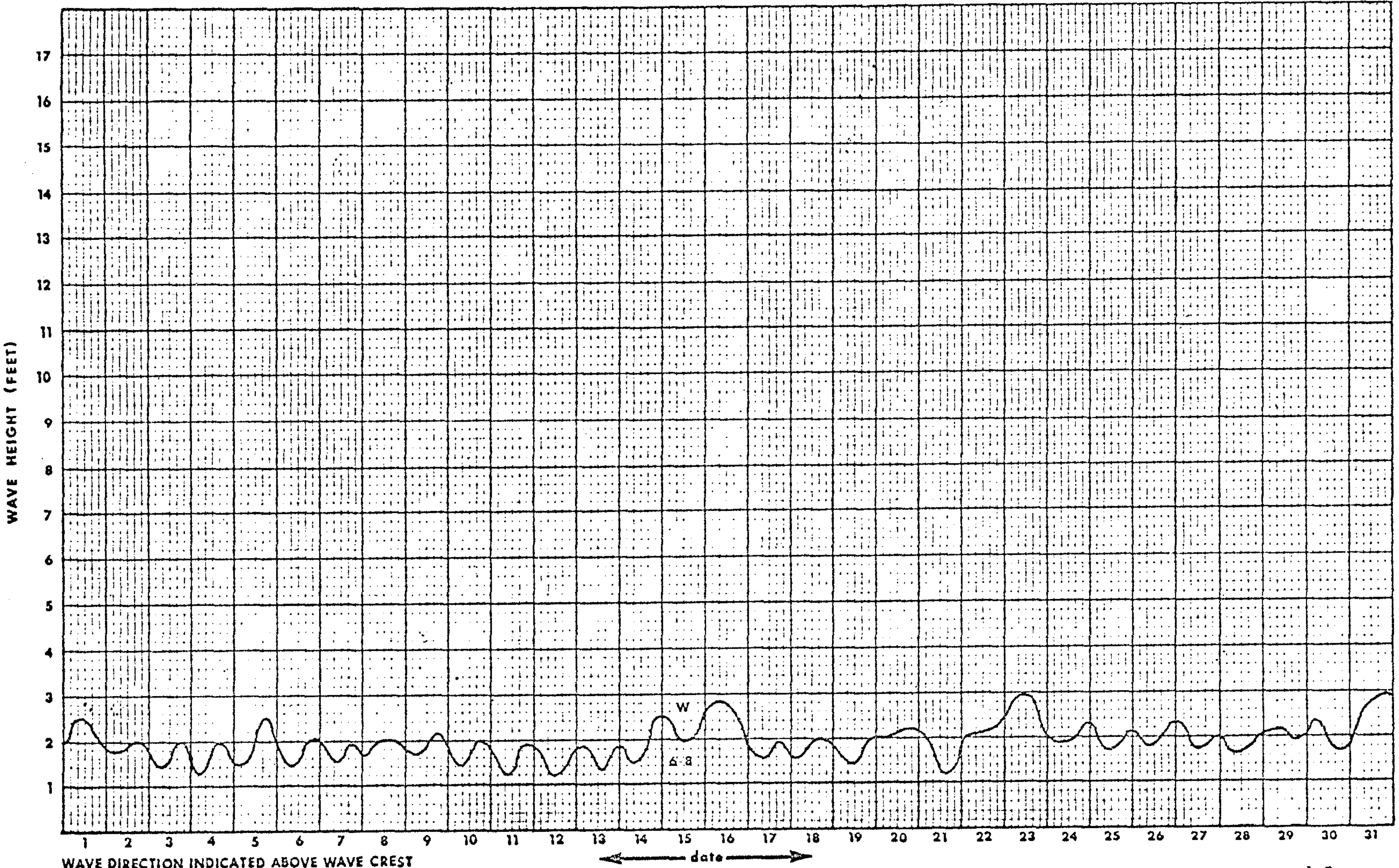
Station SANTA MONICA BAY Month JULY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5		100											100
5-10													
10-15													
15-20													
20+													
Sum		100											100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Jul YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-G

Table 1-H

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY Month AUGUST 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s Θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

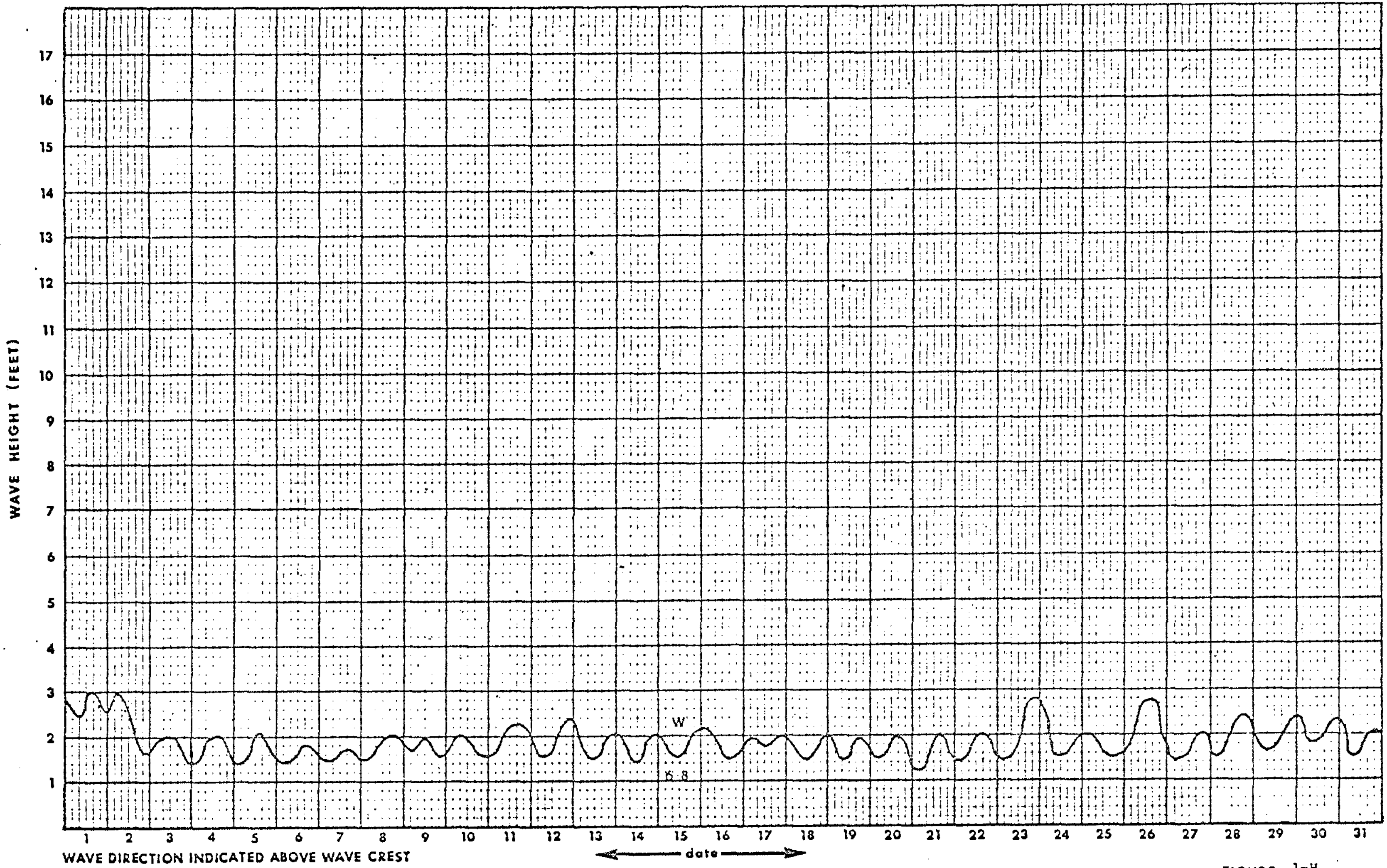
H_s Θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	W						NW						Sum
0-5		100											100
5-10													
10-15													
15-20													
20+													
Sum		100											100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Aug YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-H

Table 1-I

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY

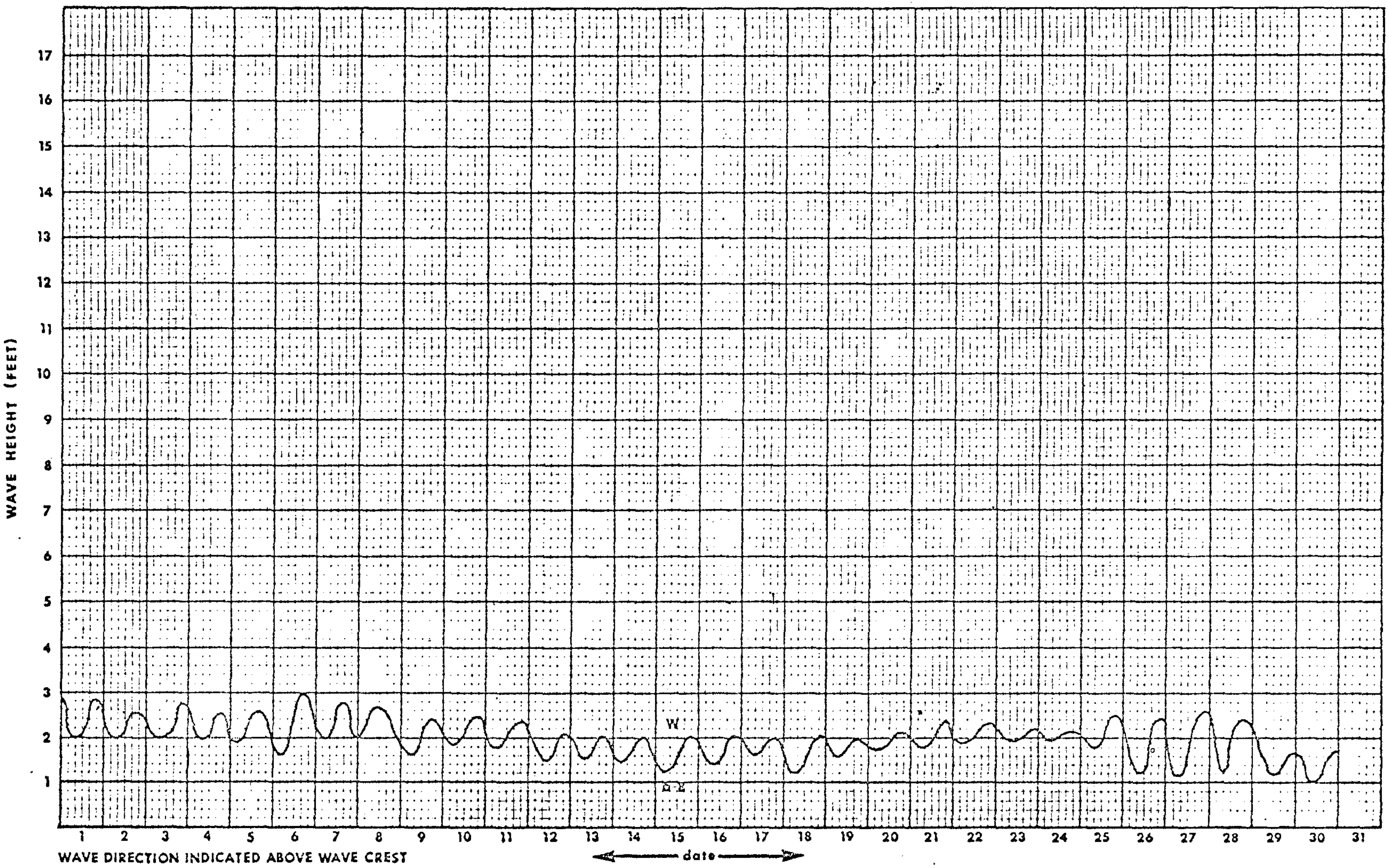
Month SEPTEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	W						NW						Sum
0-5		100											100
5-10													
10-15													
15-20													
20+													
Sum		100											100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Sep YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-I

Table 1-J

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY

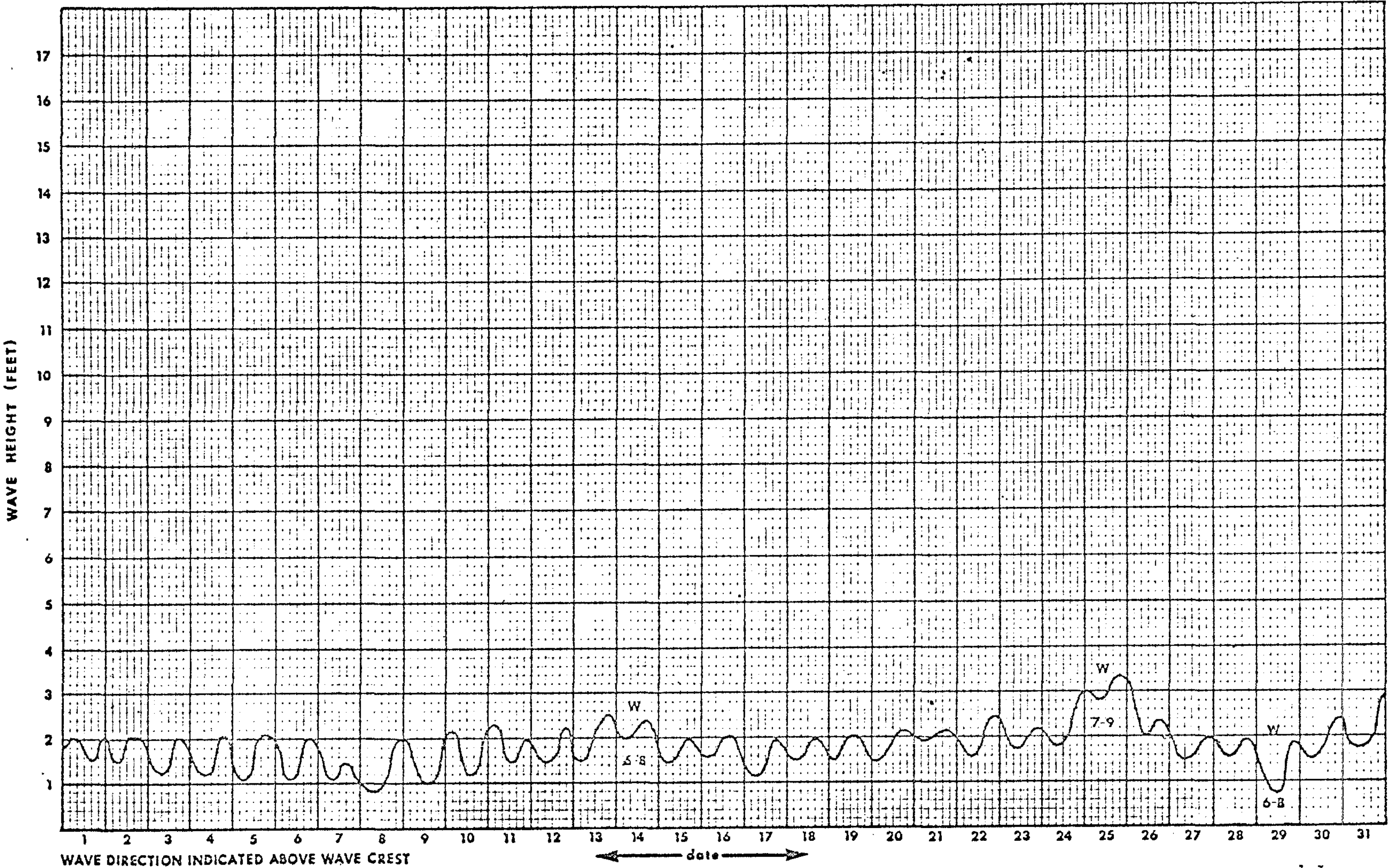
Month OCTOBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5		90.9	9.1										100
5-10													
10-15													
15-20													
20+													
Sum		90.9	9.1										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Oct YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-J

Table 1-K

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station SANTA MONICA BAY Month NOVEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s \ Θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s \ Θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

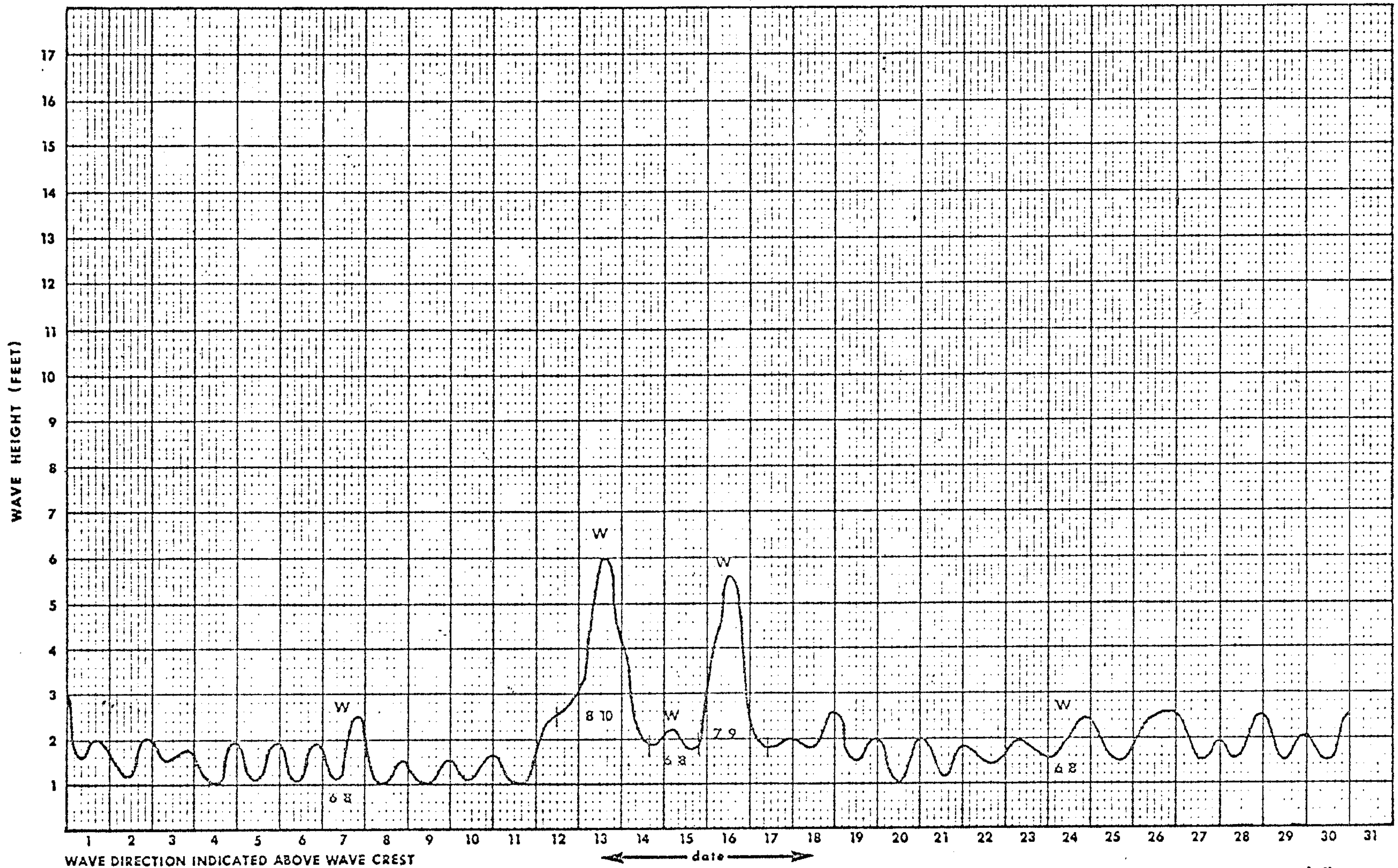
H_s \ Θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s \ Θ	W						NW						Sum
0-5		88.1	9.4										97.
5-10			2.5										2.
10-15													
15-20													
20+													
Sum		88.1	11.9										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Nov YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-K

Table 1-L

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

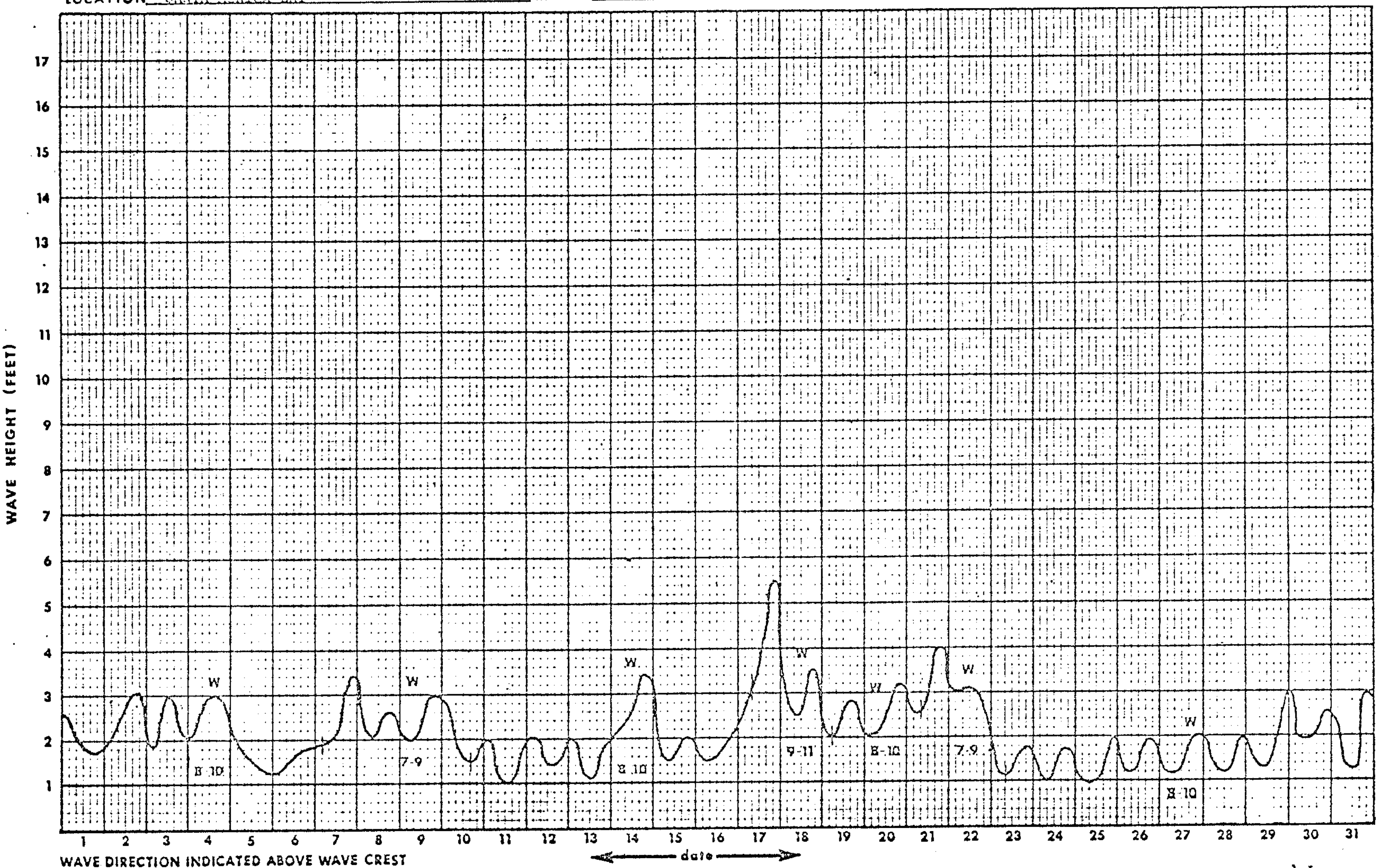
Station SANTA MONICA BAY Month DECEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			93.7	5.6									99.3
5-10				0.7									0.7
10-15													
15-20													
20+													
Sum			93.7	6.3									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION SANTA MONICA BAY MONTH Dec YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 1-L

Table 2-A

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

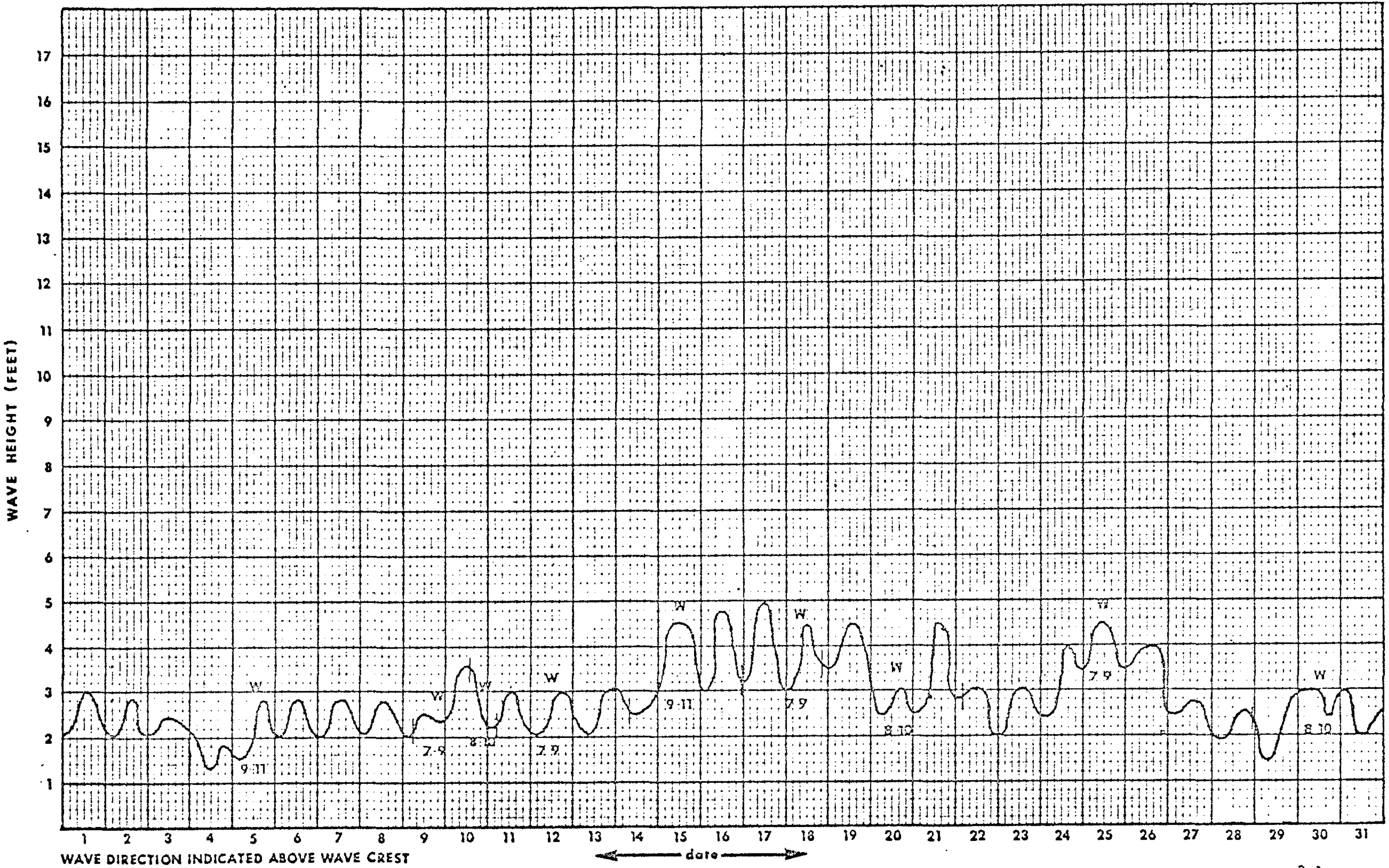
Station VENTURA Month JANUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ	W						NW						Sum
0-5			64.8	35.2									100
5-10													
10-15													
15-20													
20+													
Sum			64.8	35.2									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Jan YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-A

Table 2-B

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

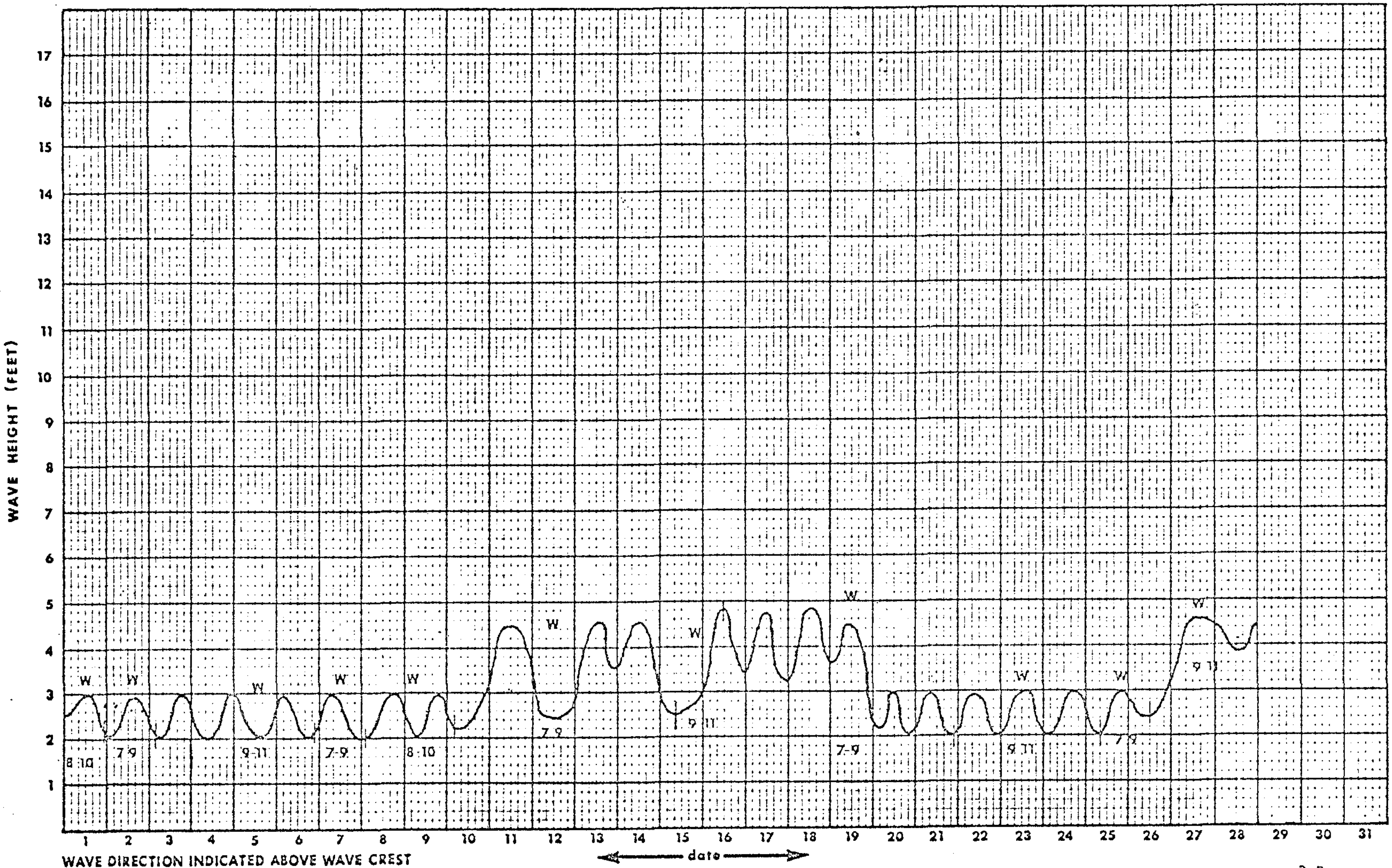
Month FEBRUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			61.9	38.1									100
5-10													
10-15													
15-20													
20+													
Sum			61.9	38.1									100

*Based on 672 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Feb YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-B

Table 2-C

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

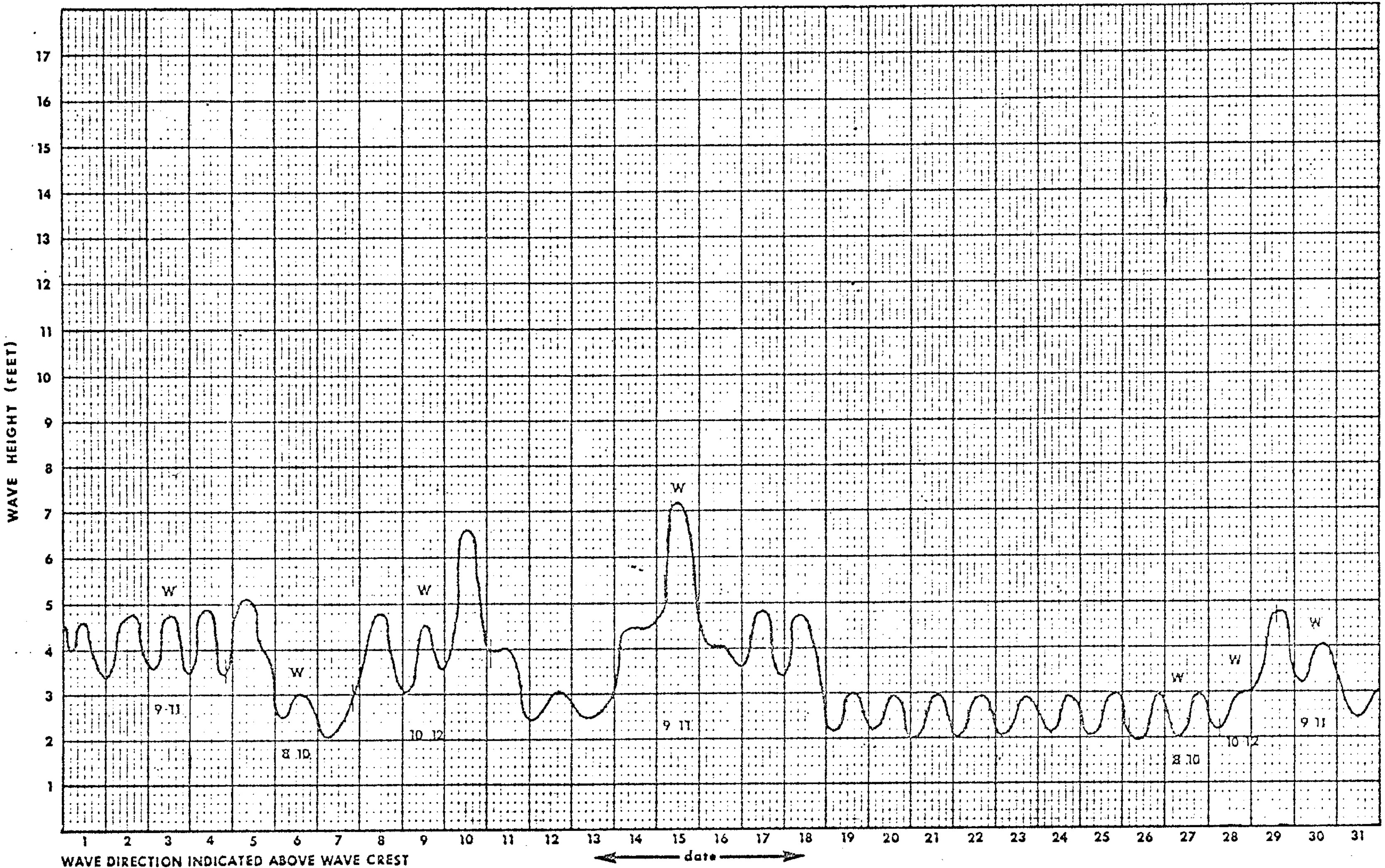
Month MARCH 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			15.6	79.4									95.0
5-10			1.7	3.9									5.0
10-15													
15-20													
20+													
Sum			16.7	83.3									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Mar YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-C

Table 2-D

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

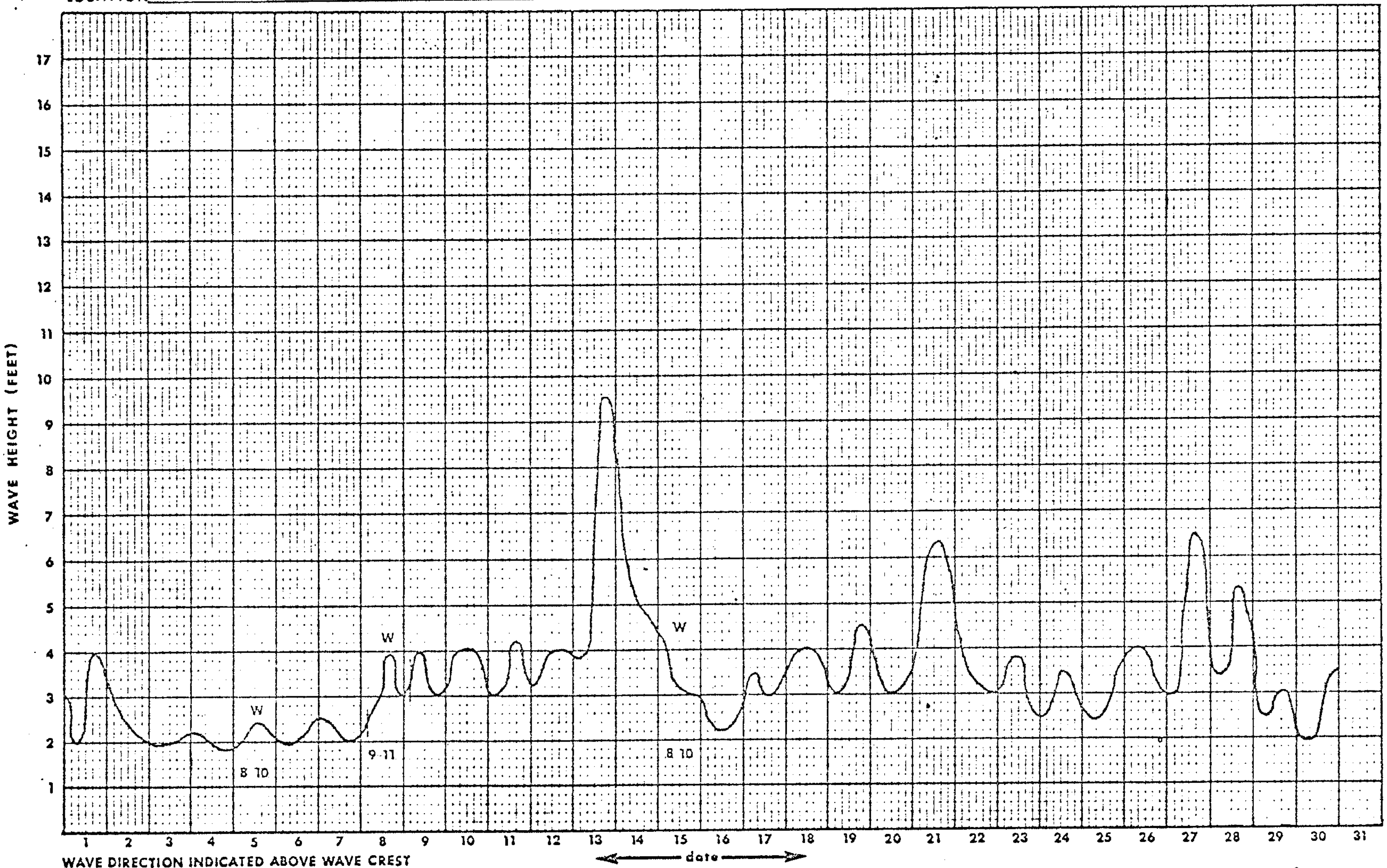
Station VENTURA Month APRIL 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			87.7	3.3									91.0
5-10			9.0										9.0
10-15													
15-20													
20+													
Sum			96.7	3.3									100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Apr YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-D

Table 2-E

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

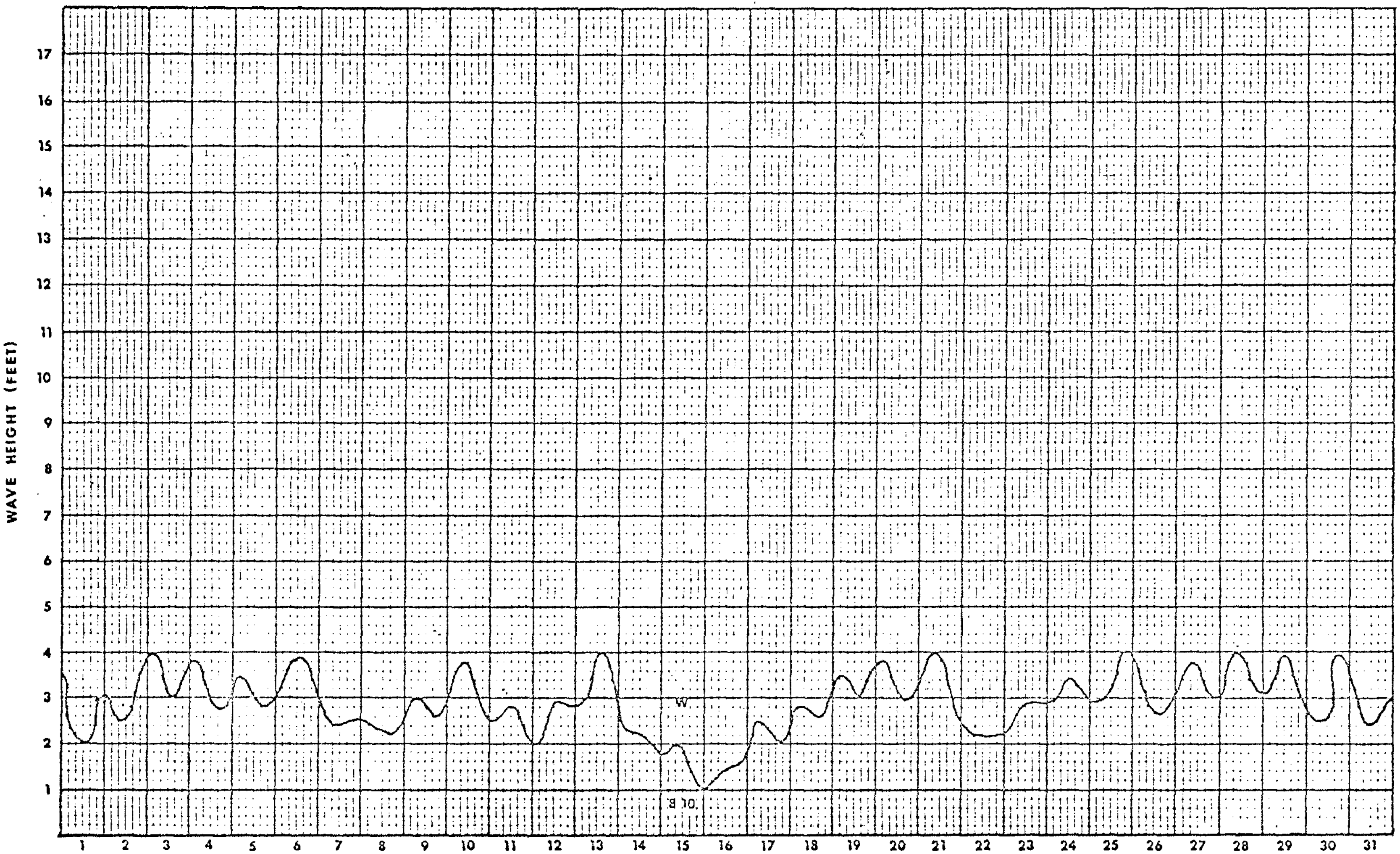
Station VENTURA Month MAY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s Θ			N						NE				
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ			E						SE				
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ			S						SW				
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s Θ			W						NW				Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH May YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-E

Table 2-F

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA Month JUNE 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

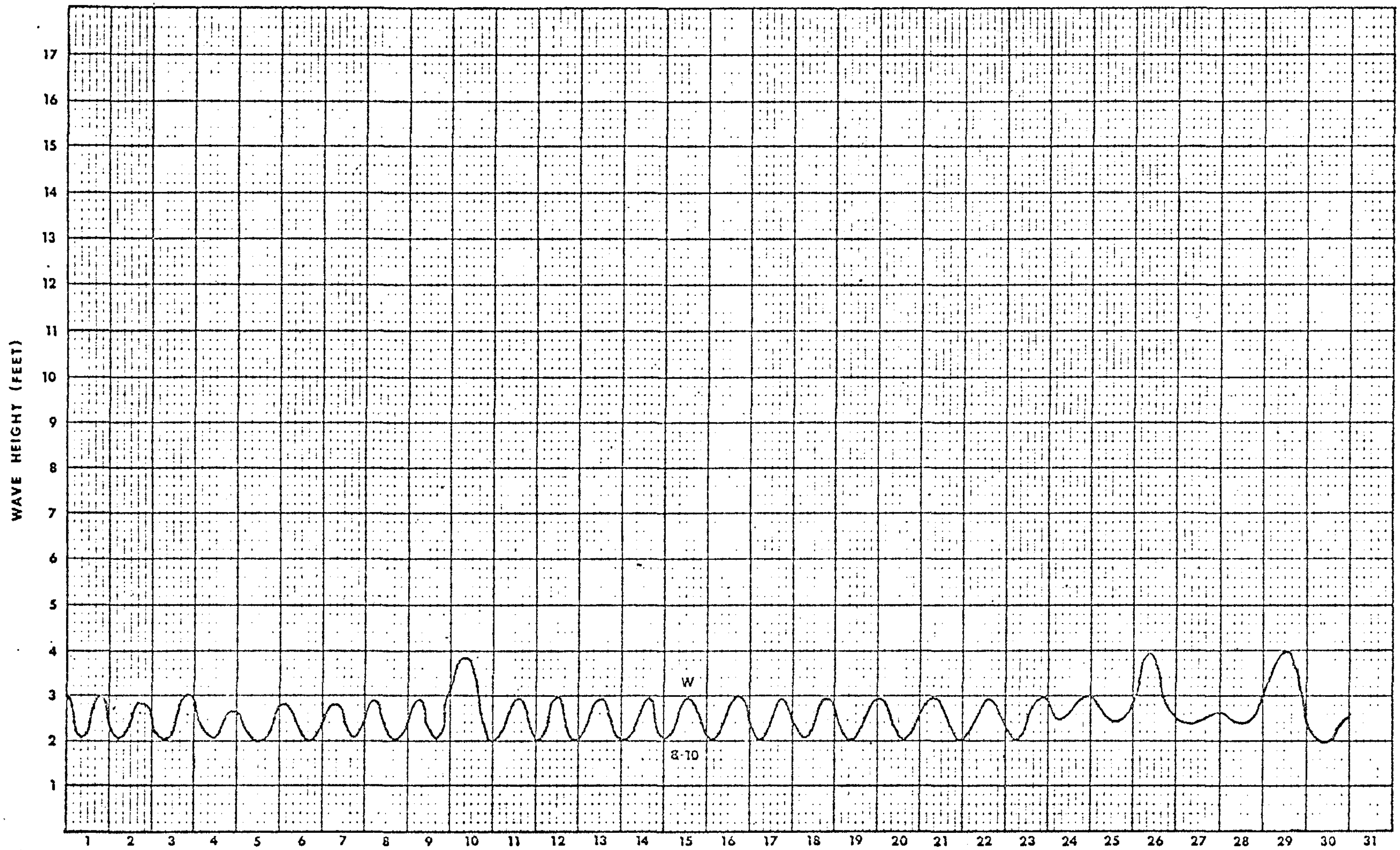
H_s θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s θ	W						NW						Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Jun YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-F

Table 2-G

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

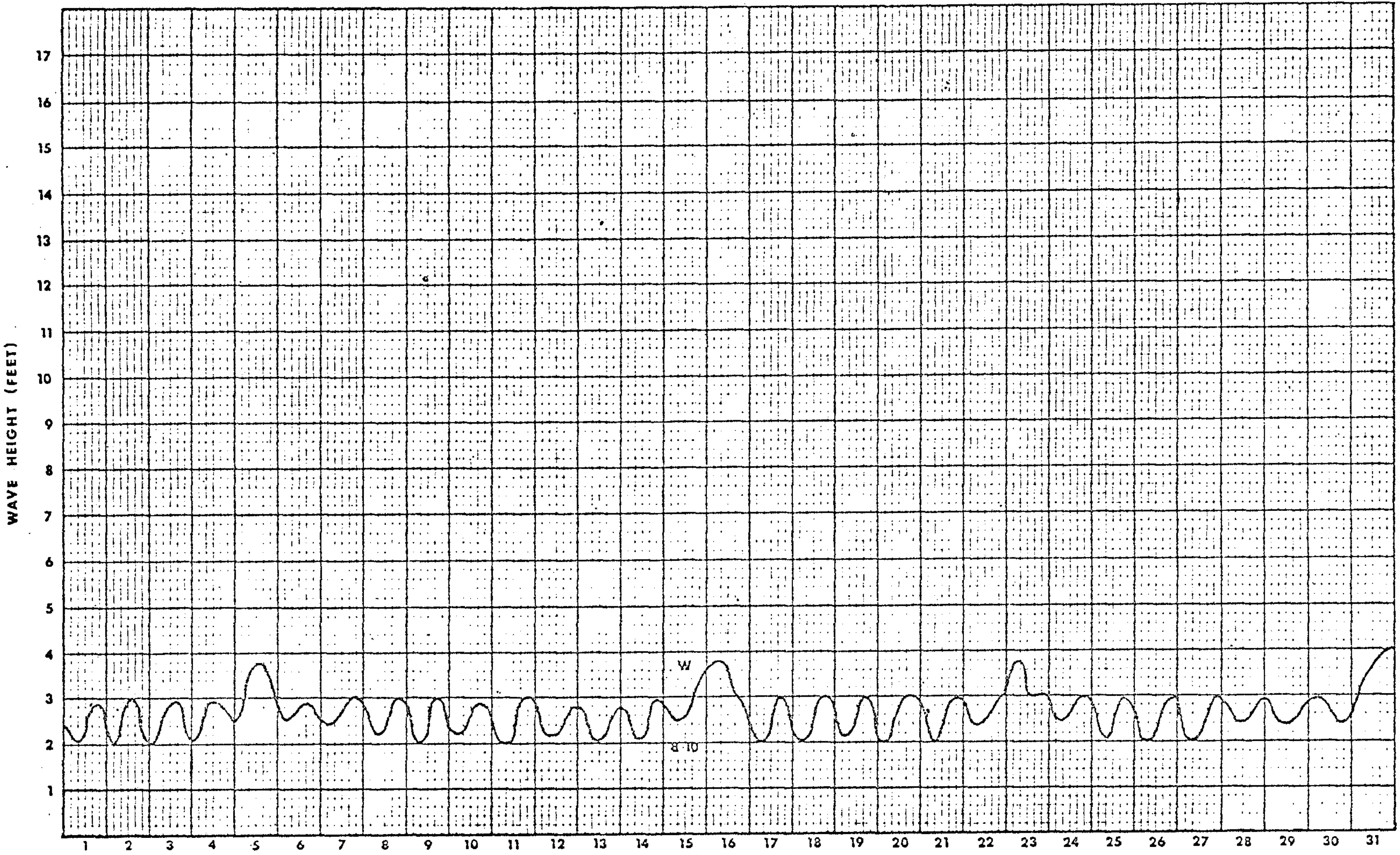
Month JULY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Jul YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-G

Table 2-H

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

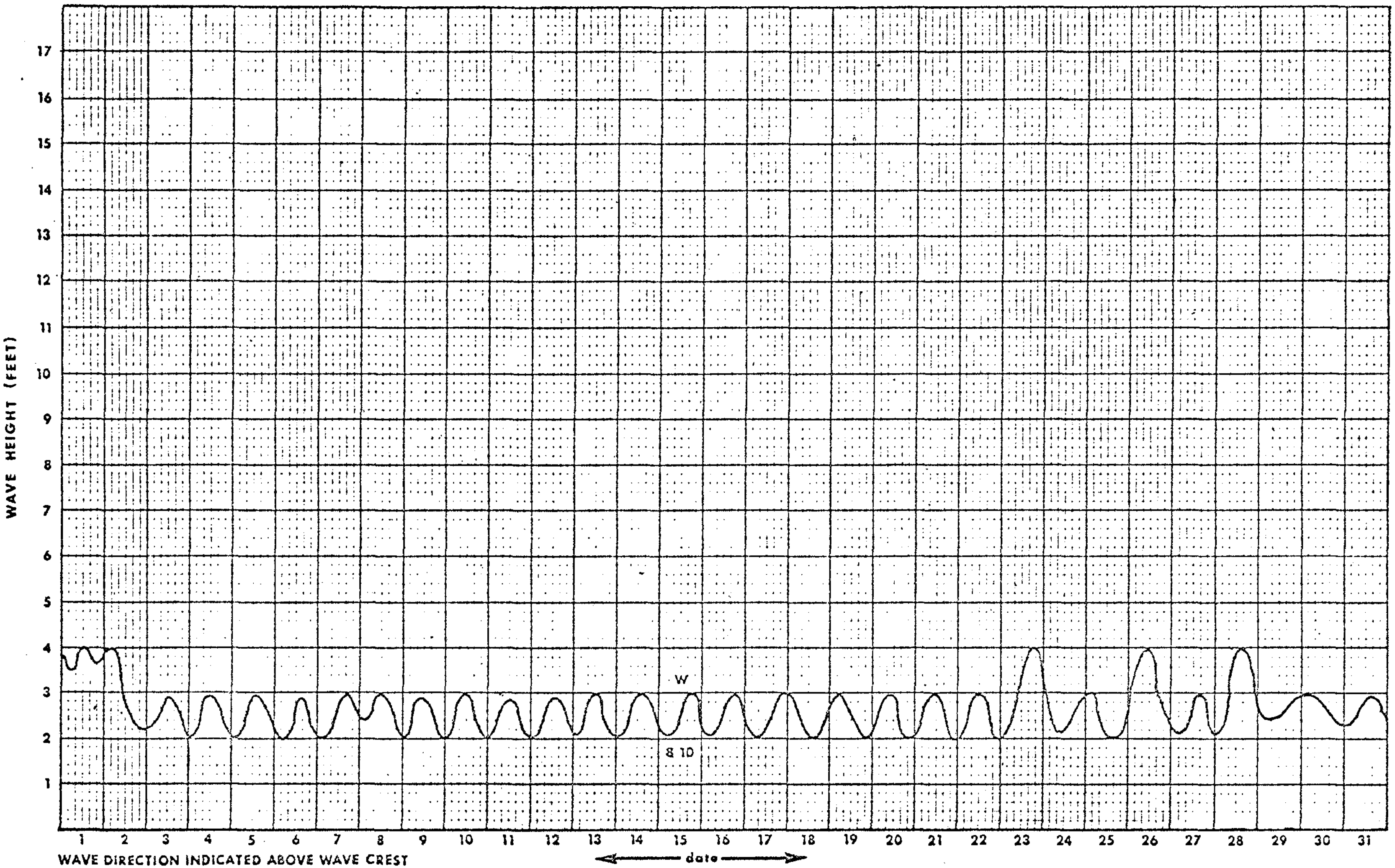
Month AUGUST 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Aug YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-H

Table 2-I

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA Month SEPTEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s Θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

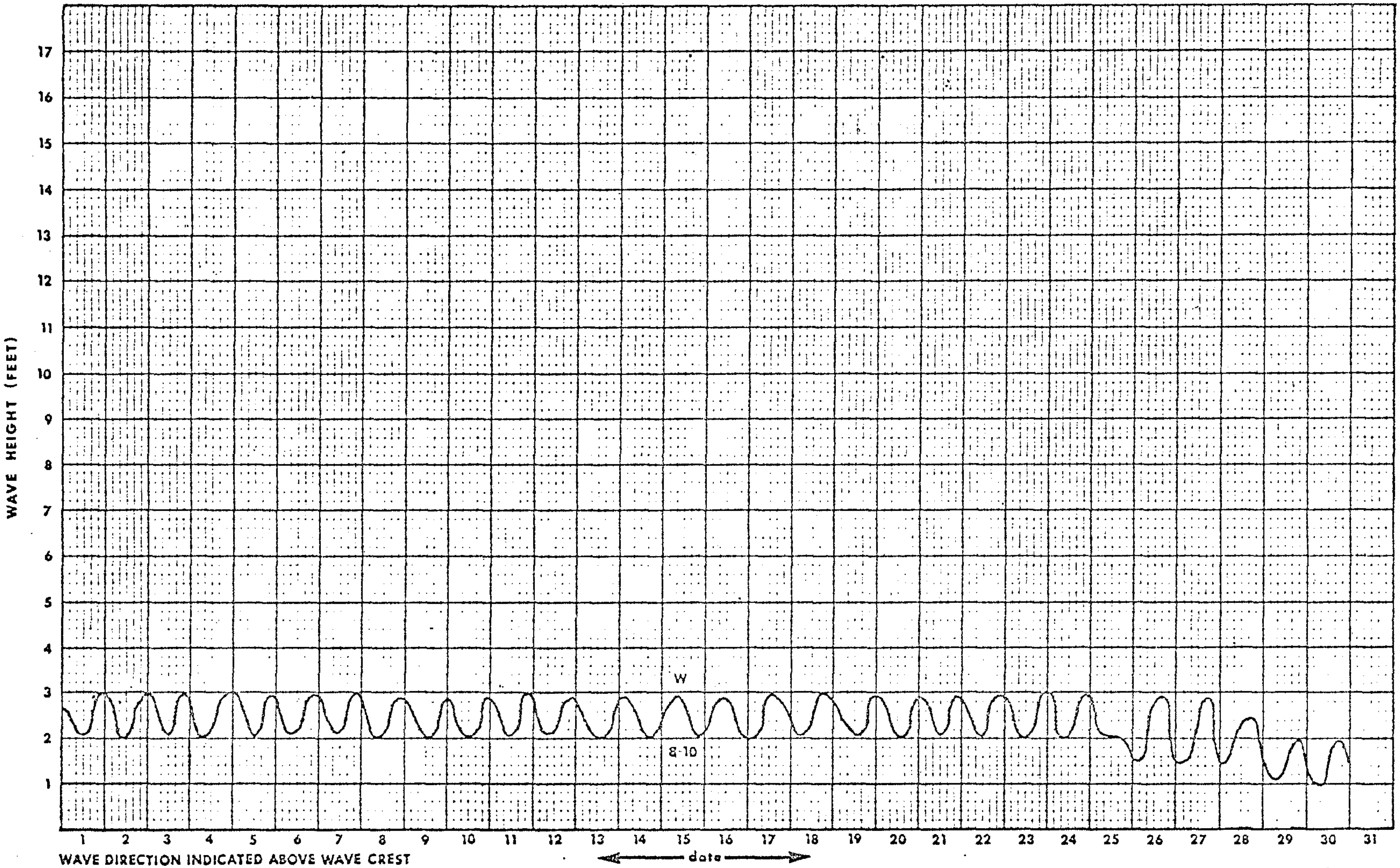
H_s Θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s Θ	W						NW						Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Sep YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-I

Table 2-J

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

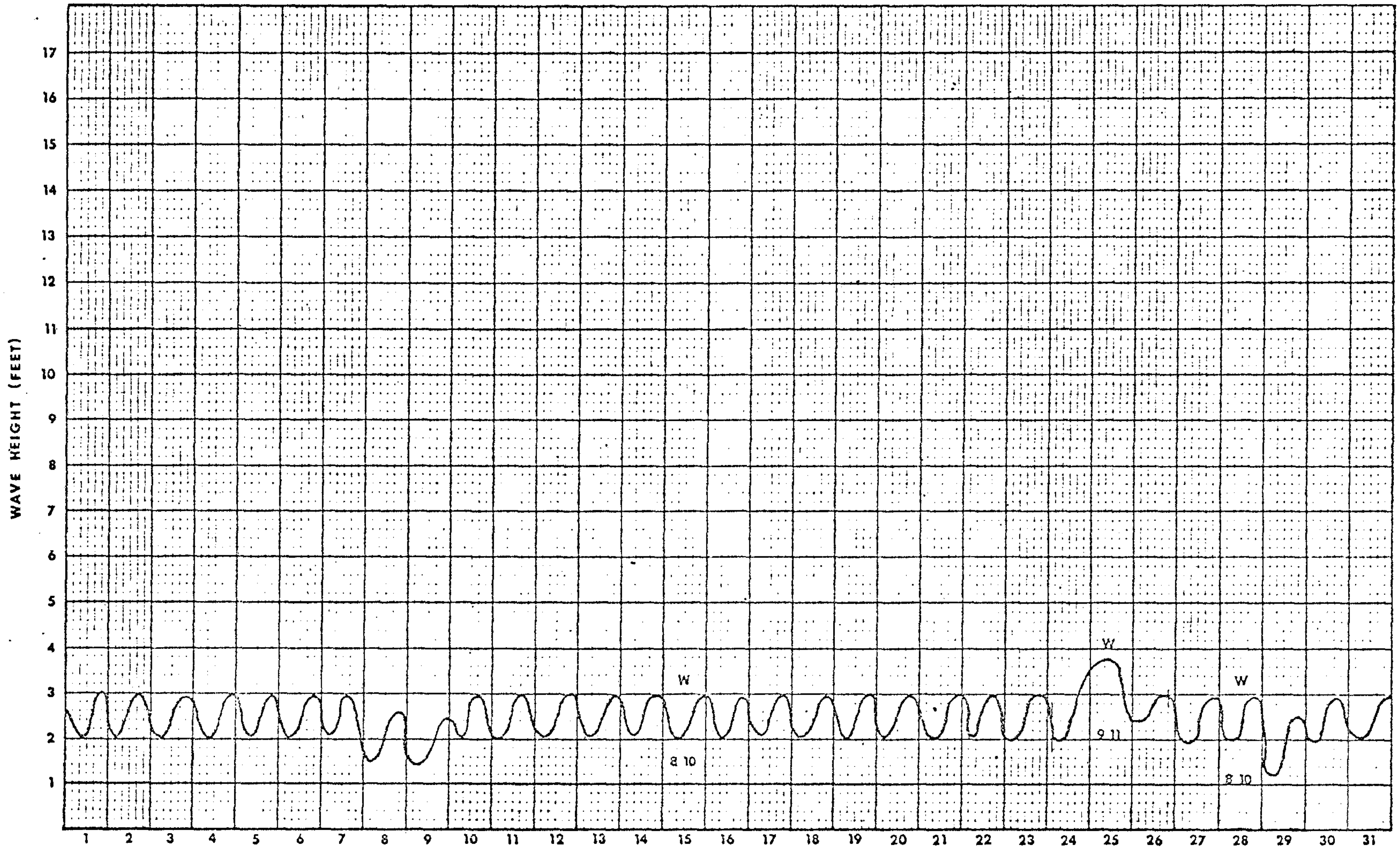
Month OCTOBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	W						NW						Sum
0-5			91.3	8.7									100
5-10													
10-15													
15-20													
20+													
Sum			91.3	8.7									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Oct YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-J

Table 2-K

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

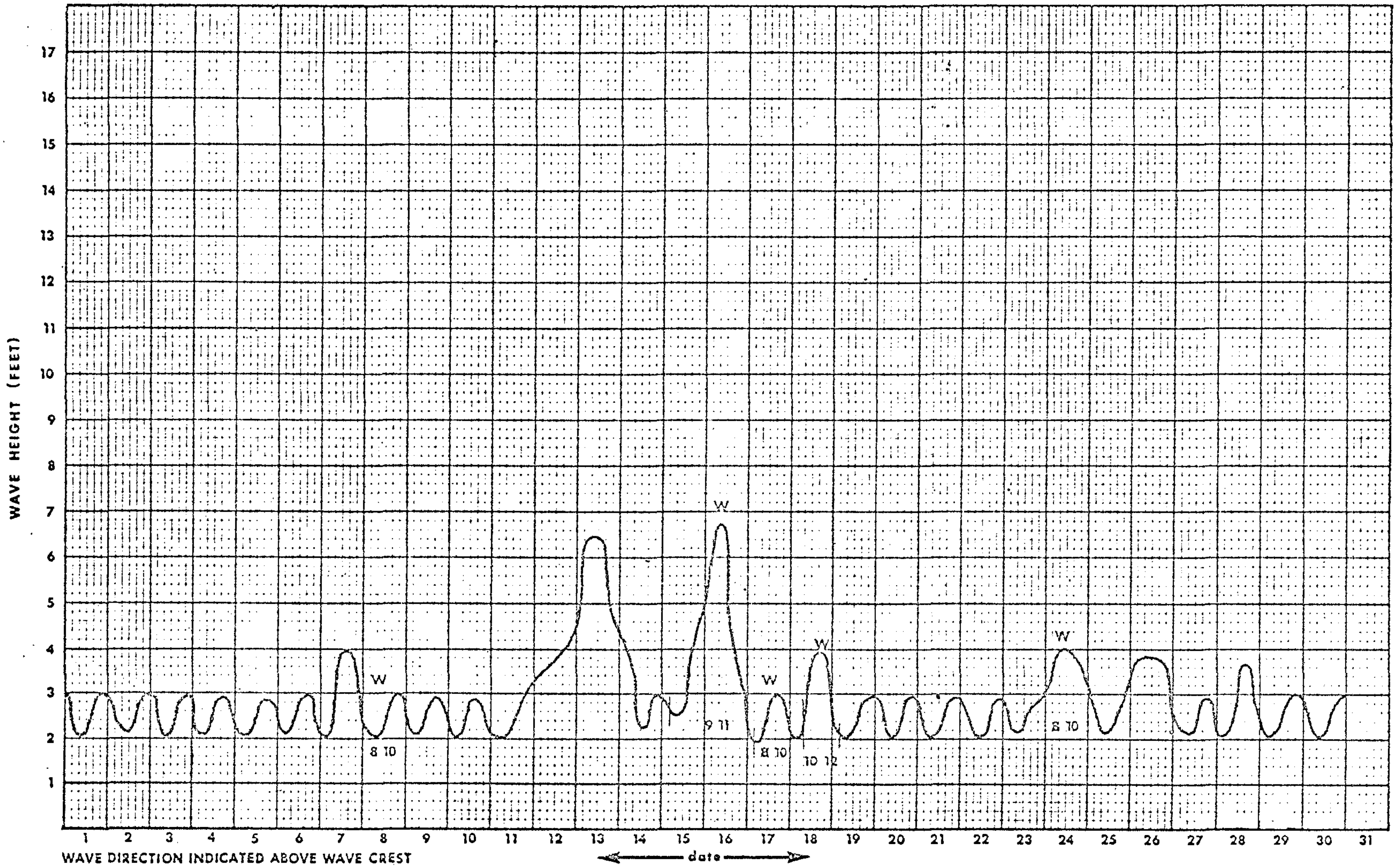
Month NOVEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			90.3	7.9									98.2
5-10				1.8									1.8
10-15													
15-20													
20+													
Sum			90.3	9.7									100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Nov YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-K

Table 2-L

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station VENTURA

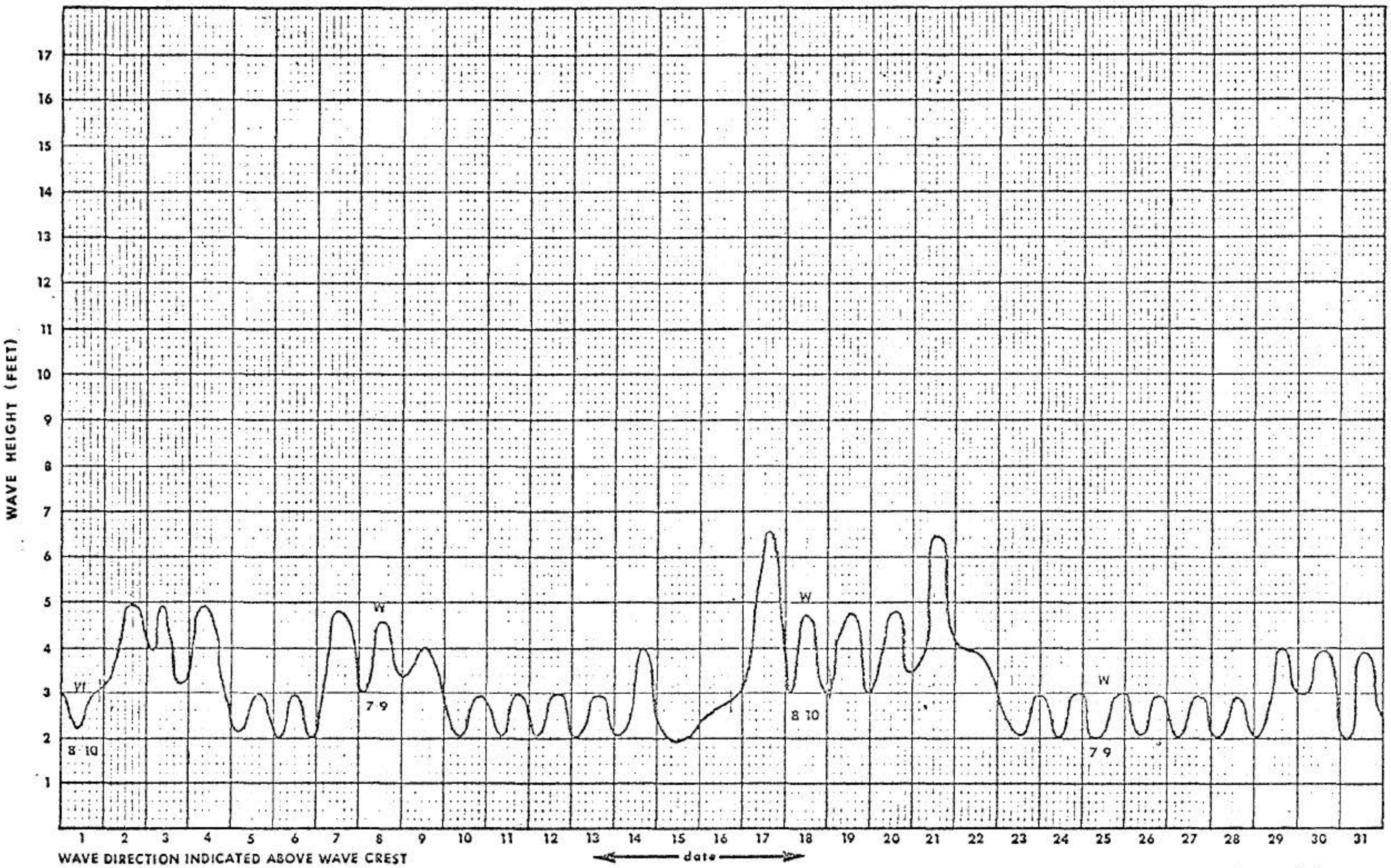
Month DECEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			97.3										97.3
5-10			2.7										2.7
10-15													
15-20													
20+													
Sum			100										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION VENTURA MONTH Dec YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 2-L

Table 3-A

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station PLATFORM LOCATION Month JANUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s \ θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s \ θ	E						SE					
0-5							0.8	1.1				
5-10									2.2			
10-15												
15-20												
20+												
Sum							0.8	1.1	2.2			

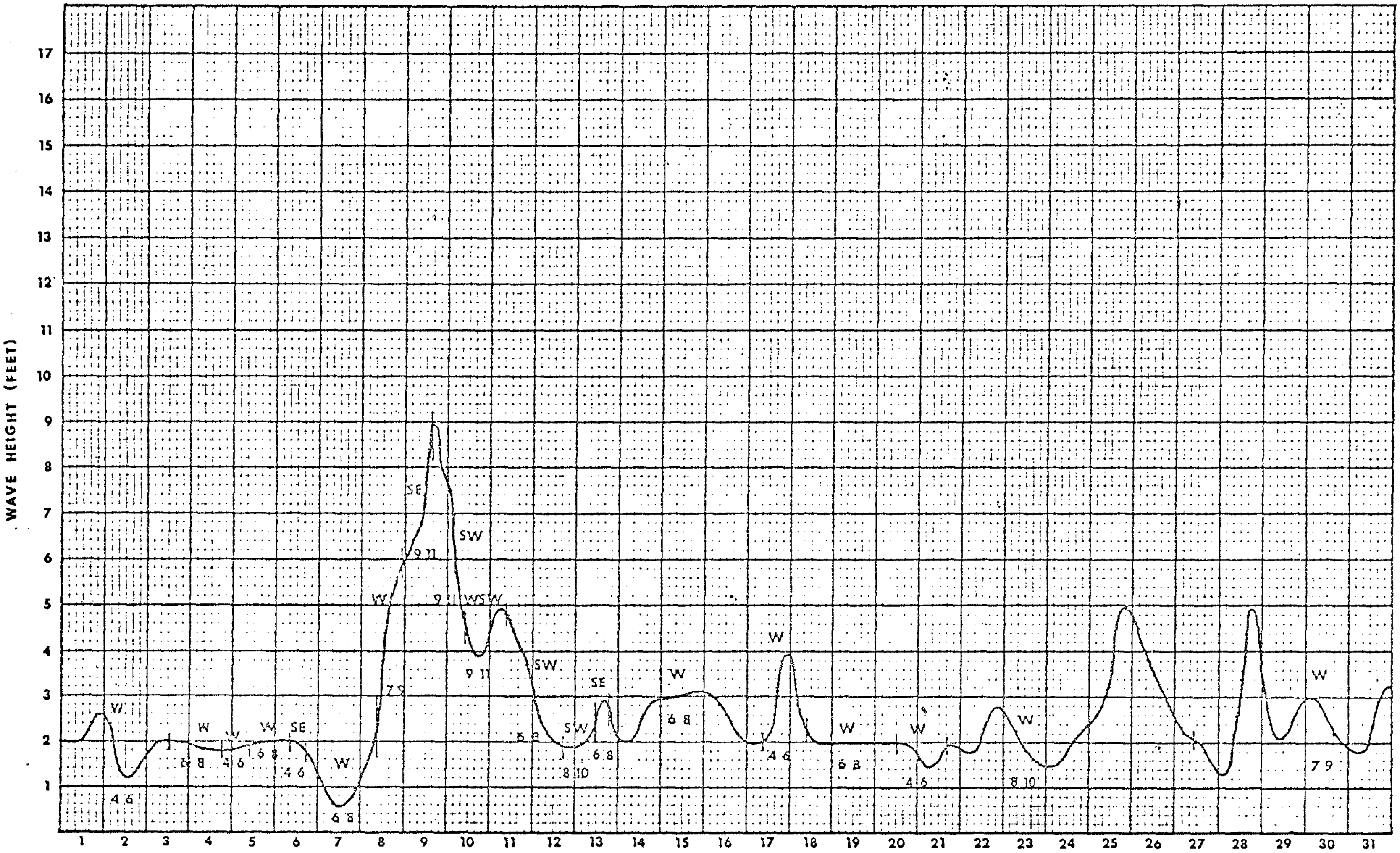
H_s \ θ	S						SW					
0-5								4.3	2.4	3.2		
5-10									2.4			
10-15												
15-20												
20+												
Sum								4.3	4.8	3.2		

H_s \ θ	W						NW						Sum
0-5	18.0	46.3	18.0										94.1
5-10		0.8	0.5										5.9
10-15													
15-20													
20+													
Sum	18.0	47.1	18.5										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Jan YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-A

Table 3-B

Average Monthly Height-Period-Direction
Frequency Distribution (Percent)*

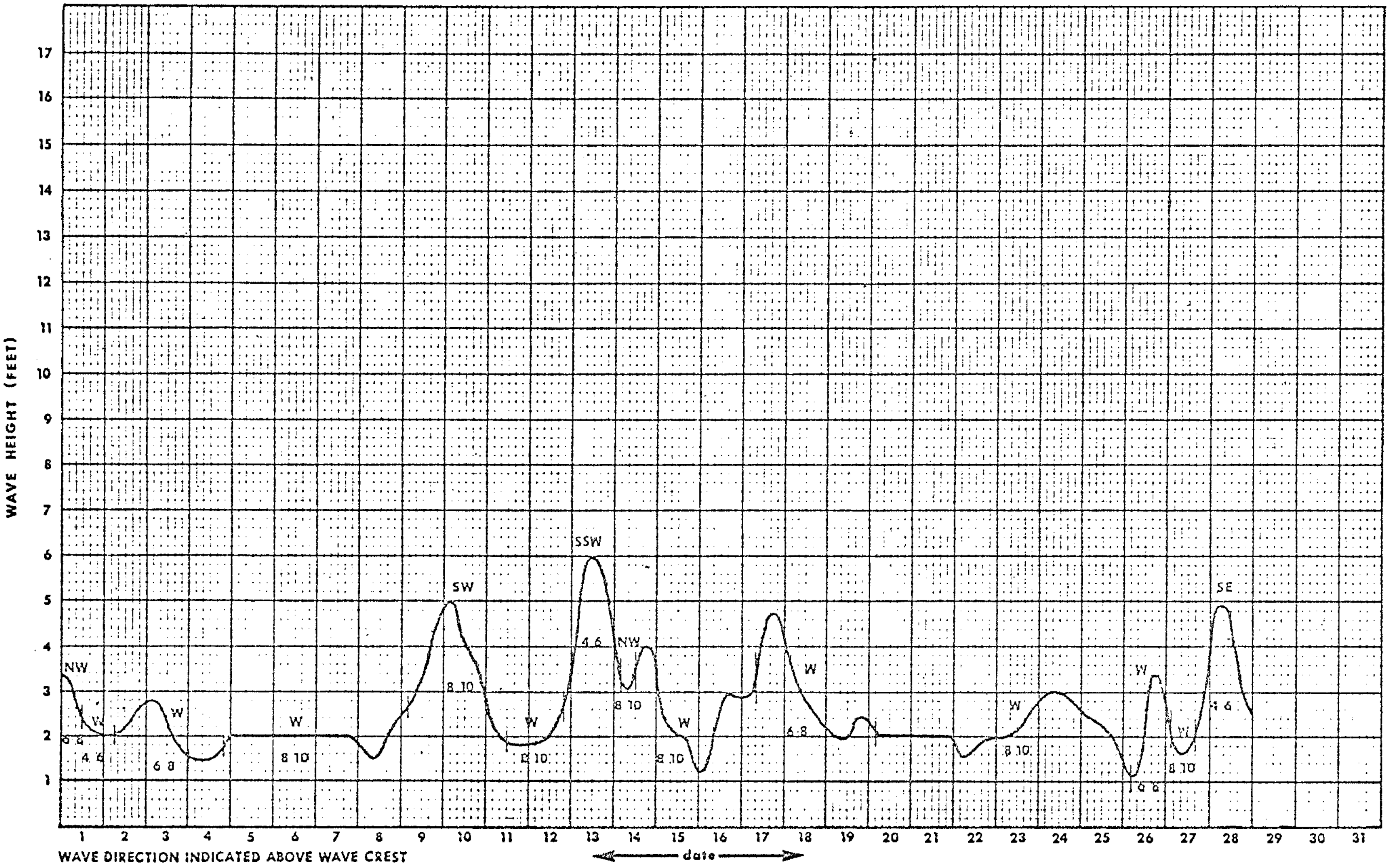
Station PLATFORM LOCATION Month FEBRUARY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5							5.1						
5-10													
10-15													
15-20													
20+													
Sum							5.1						
H_s \ Θ	S						SW						
0-5							2.1		8.3				
5-10								2.4					
10-15													
15-20													
20+													
Sum							2.1	2.4	8.3				
H_s \ Θ	W						NW						Sum
0-5	2.5	22.3	53.9					1.9	1.5				97.6
5-10													2.4
10-15													
15-20													
20+													
Sum	2.5	22.3	53.9					1.9	1.5				100

*Based on 672 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Feb YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-B

Table 3-C

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

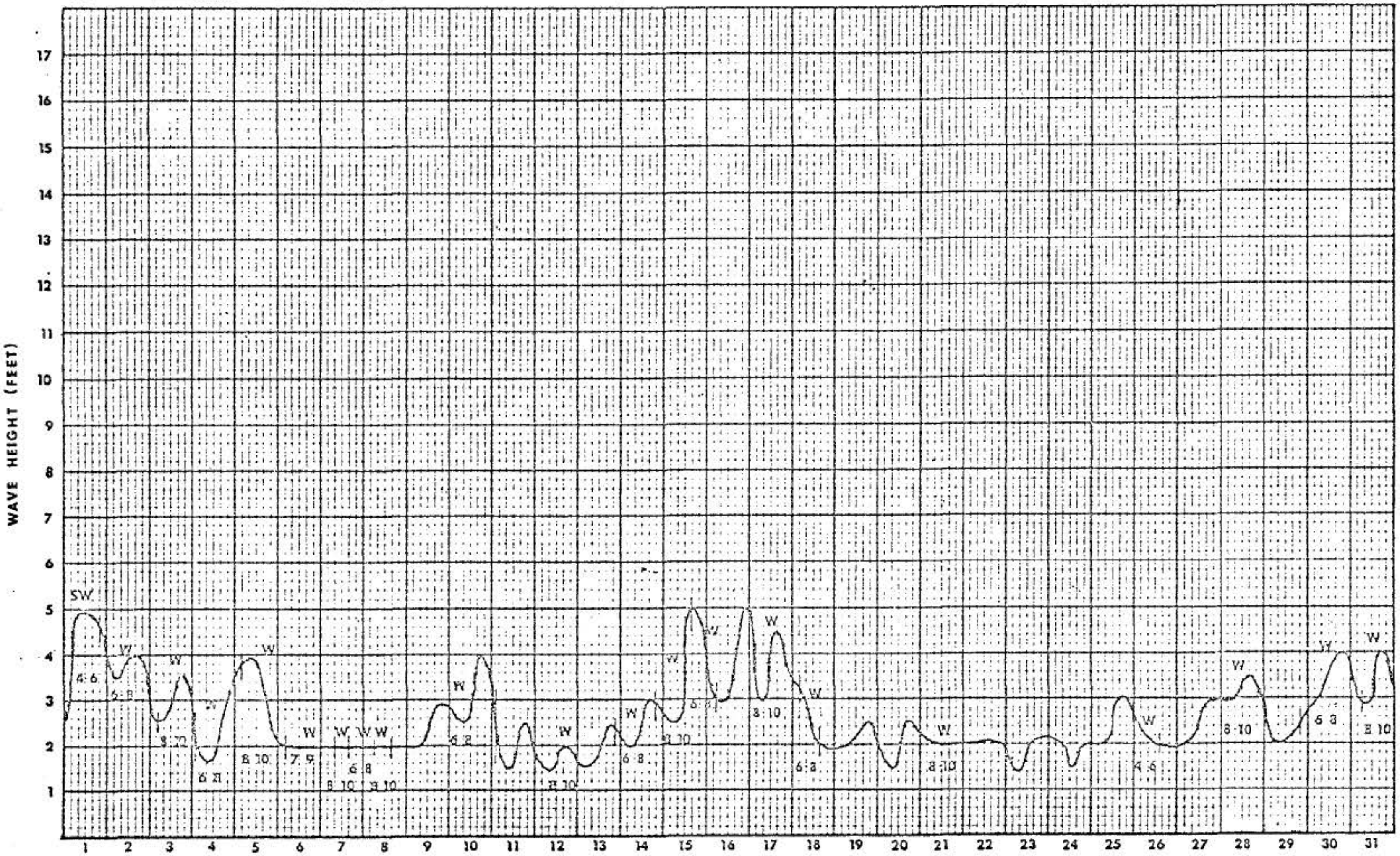
Station PLATFORM LOCATION Month MARCH 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5							2.7						
5-10													
10-15													
15-20													
20+													
Sum							2.7						
H_s \ Θ	W						NW						Sum
0-5	2.2	32.4	62.7										100
5-10													
10-15													
15-20													
20+													
Sum	2.2	32.4	62.7										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Mar YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-C

Table 3-D

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station PLATFORM LOCATION Month APRIL 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+
H_s \ Θ	N						NE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s \ Θ	E						SE					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

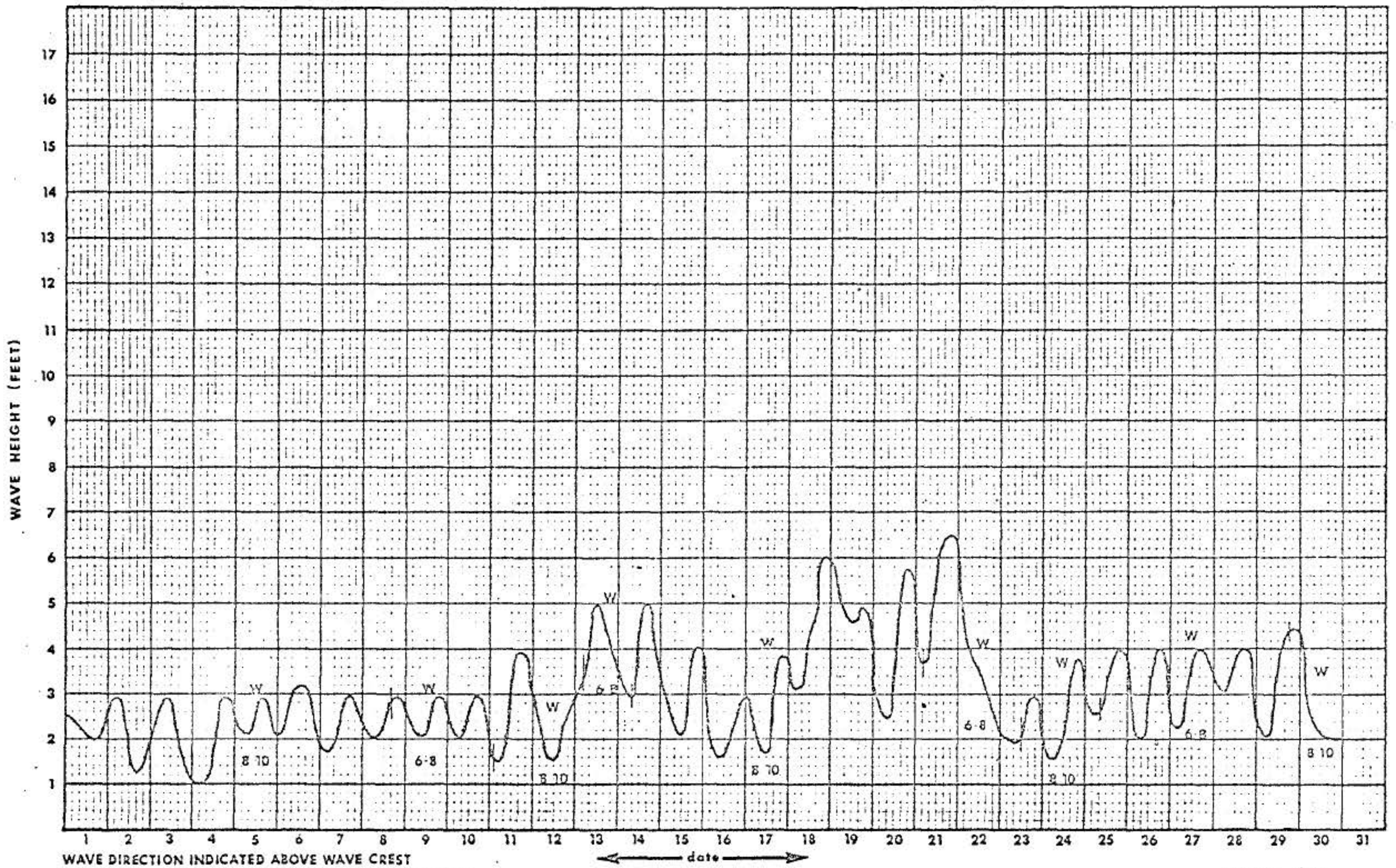
H_s \ Θ	S						SW					
0-5												
5-10												
10-15												
15-20												
20+												
Sum												

H_s \ Θ	W						NW						Sum
0-5		31.7	62.8										94.5
5-10		2.2	3.3										5.5
10-15													
15-20													
20+													
Sum		33.9	66.1										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Apr YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-D

Table 3-E

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station PLATFORM LOCATION

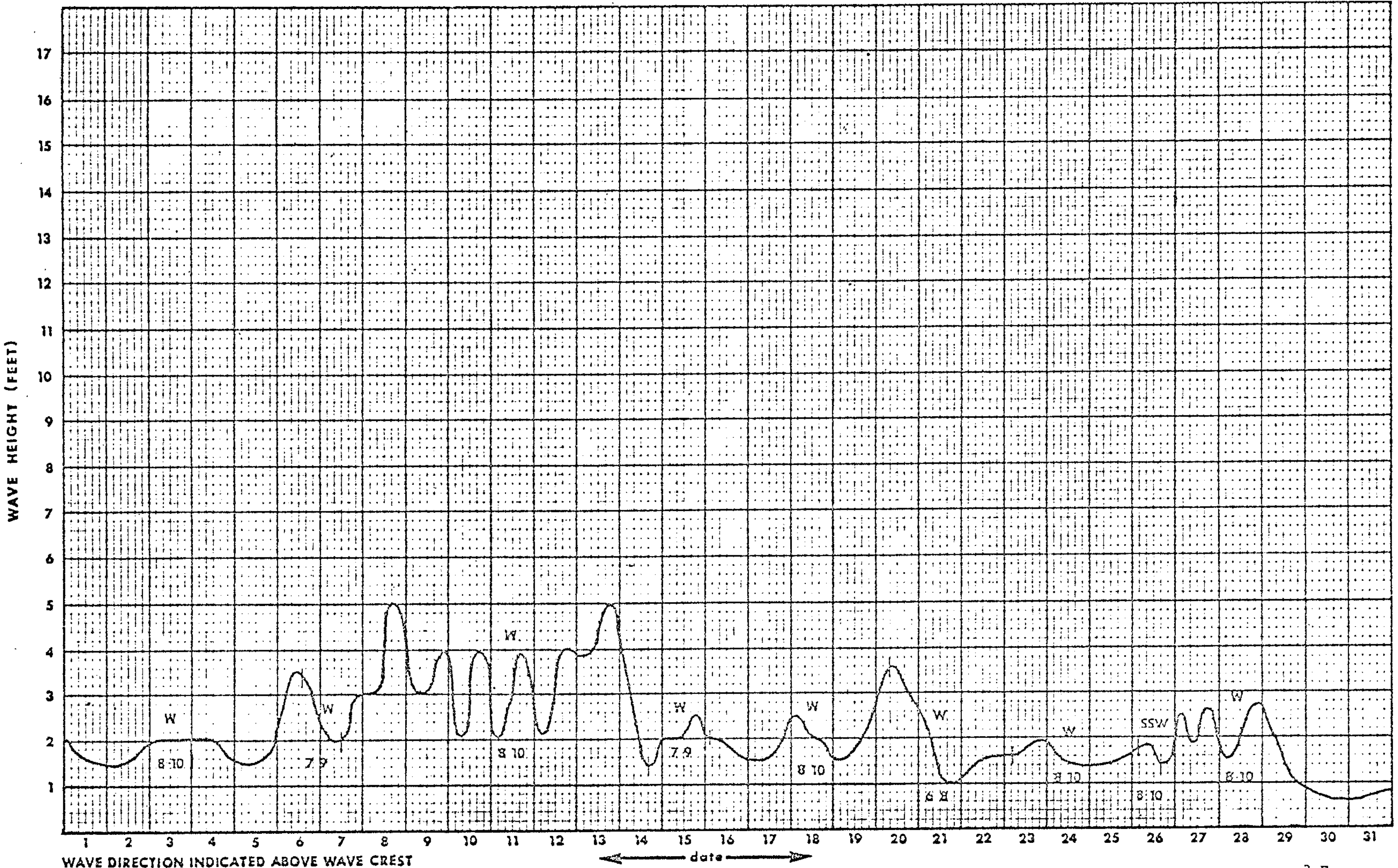
Month MAY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ θ	S						SW						
0-5								1.9					
5-10													
10-15													
15-20													
20+													
Sum								1.9					
H_s \ θ	W						NW						Sum
0-5		16.7	81.4										100
5-10													
10-15													
15-20													
20+													
Sum		16.7	81.4										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH May YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-E

Table 3-F

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

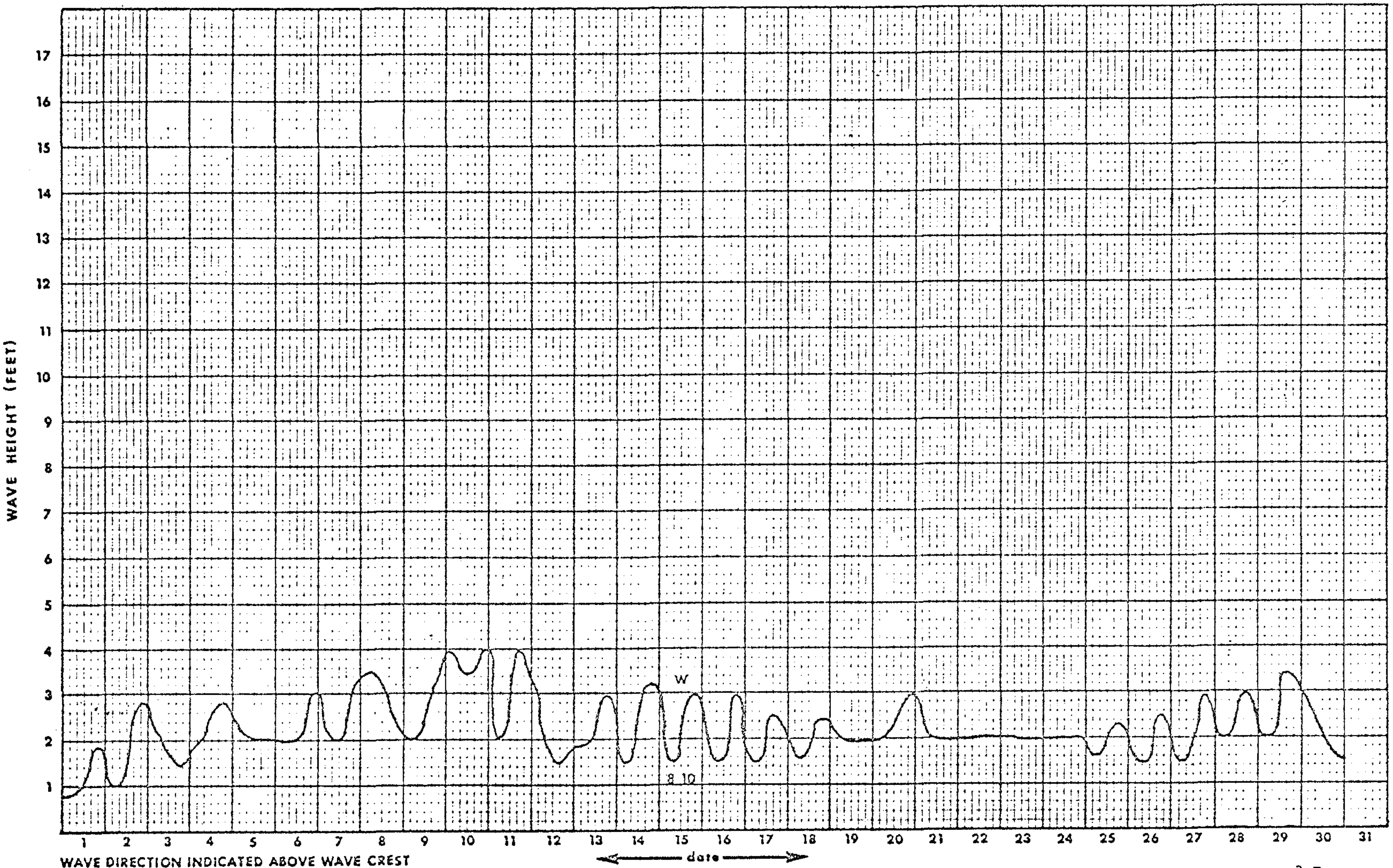
Station PLATFORM LOCATION Month JUNE 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			100										100
5-10													
10-15													
15-20													
20+													
Sum			100										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Jun YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-F

Table 3-G

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

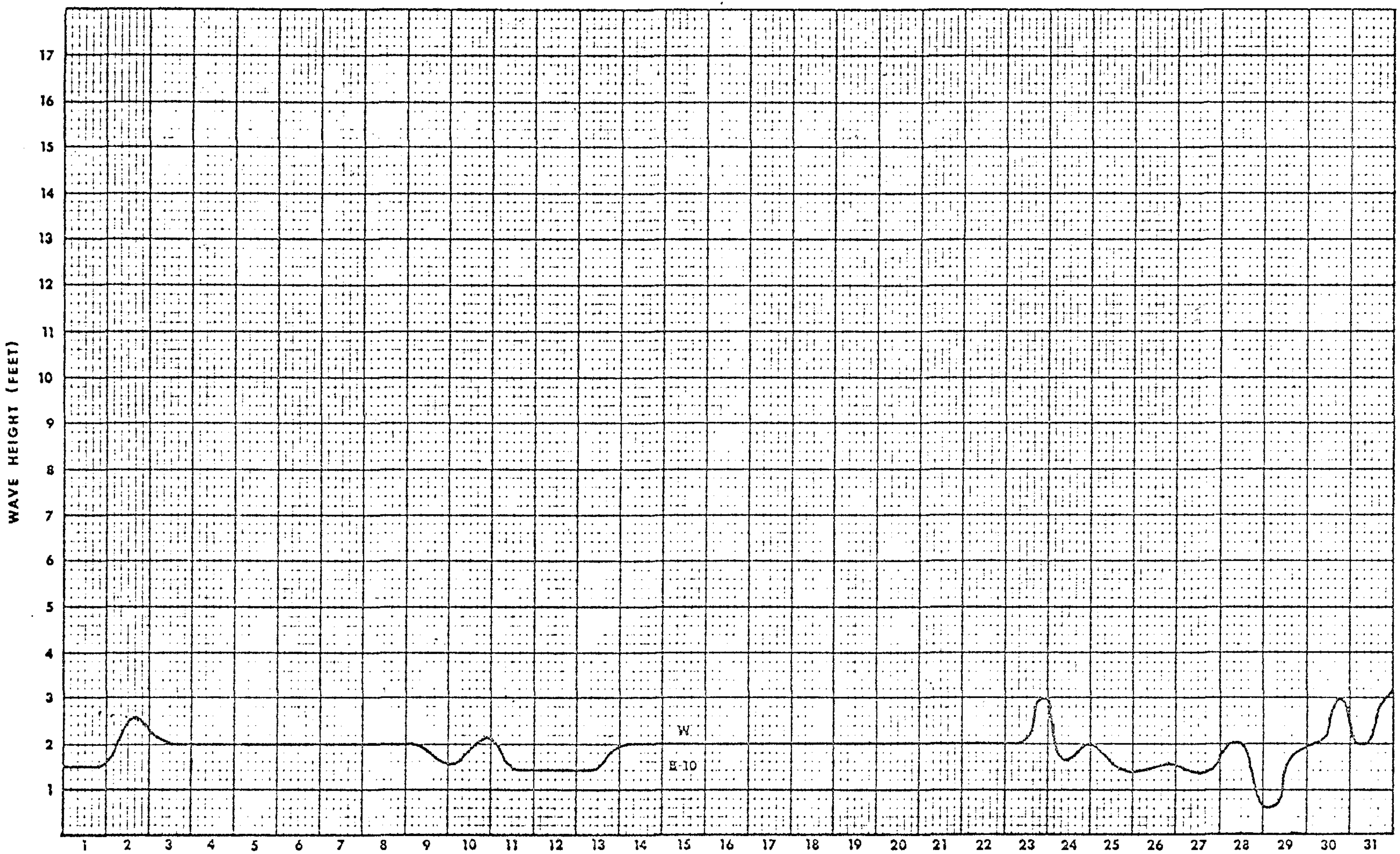
Station PLATFORM LOCATION Month JULY 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5				100									100
5-10													
10-15													
15-20													
20+													
Sum				100									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Jul YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-G

Table 3-H

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

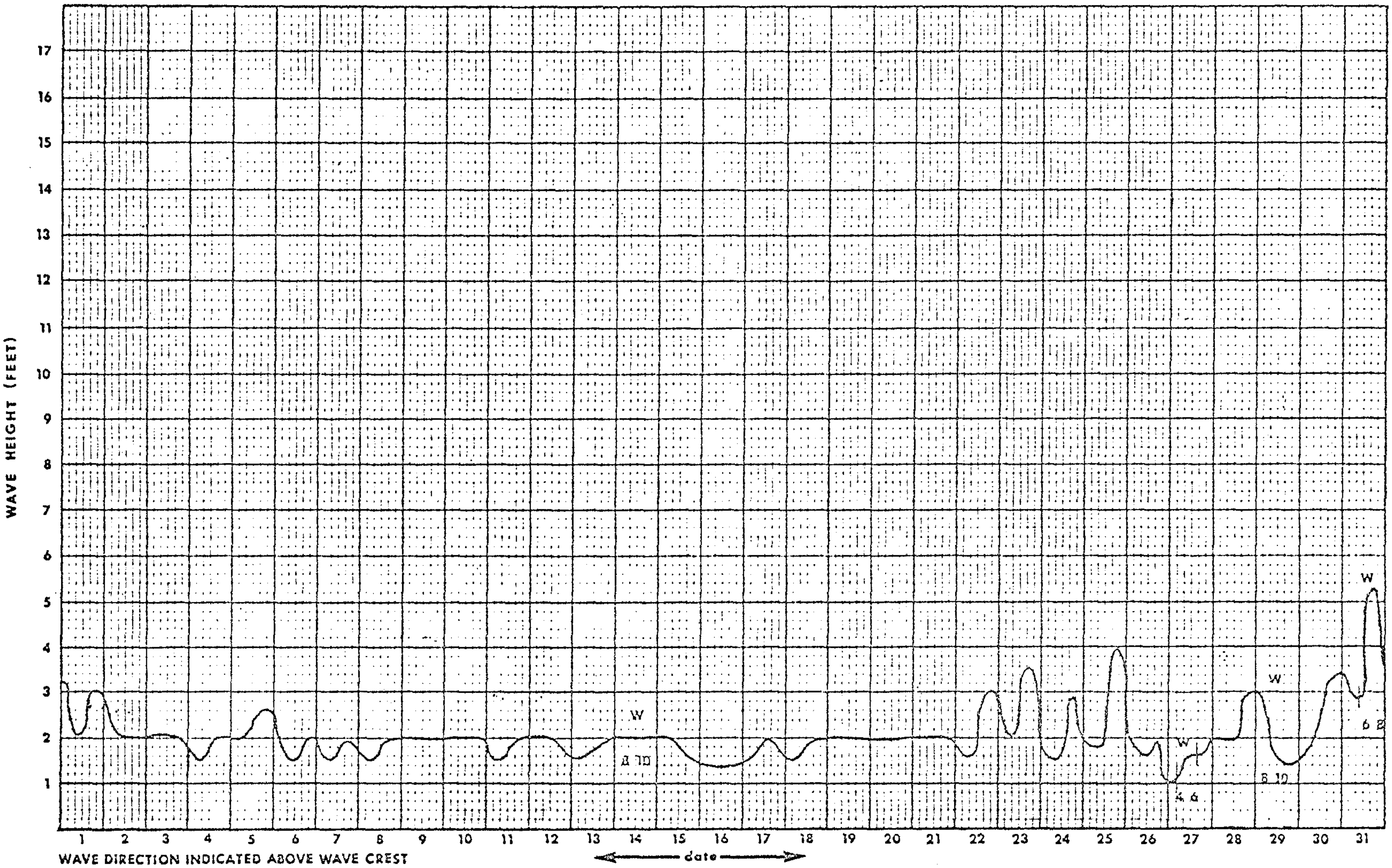
Station PLATFORM LOCATION Month AUGUST 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5	1.3	0.5	97.4										99.2
5-10		0.8											0.8
10-15													
15-20													
20+													
Sum	1.3	1.3	97.4										100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Aug YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-H

Table 3-I

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

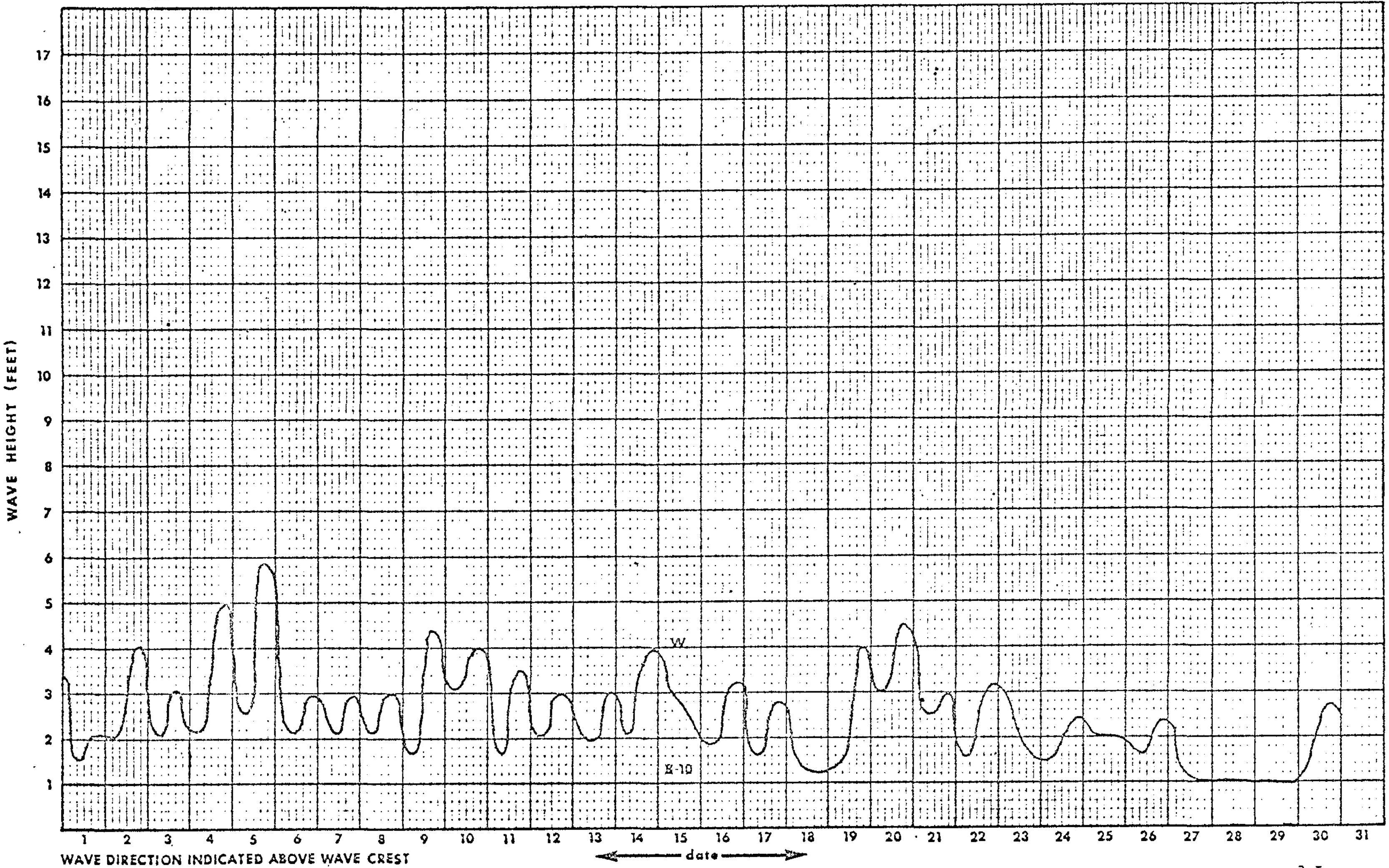
Station PLATFORM LOCATION Month SEPTEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			97.9										97.9
5-10			2.1										2.1
10-15													
15-20													
20+													
Sum			100										100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Sep YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST

WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-I

Table 3-J

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

Station PLATFORM LOCATION

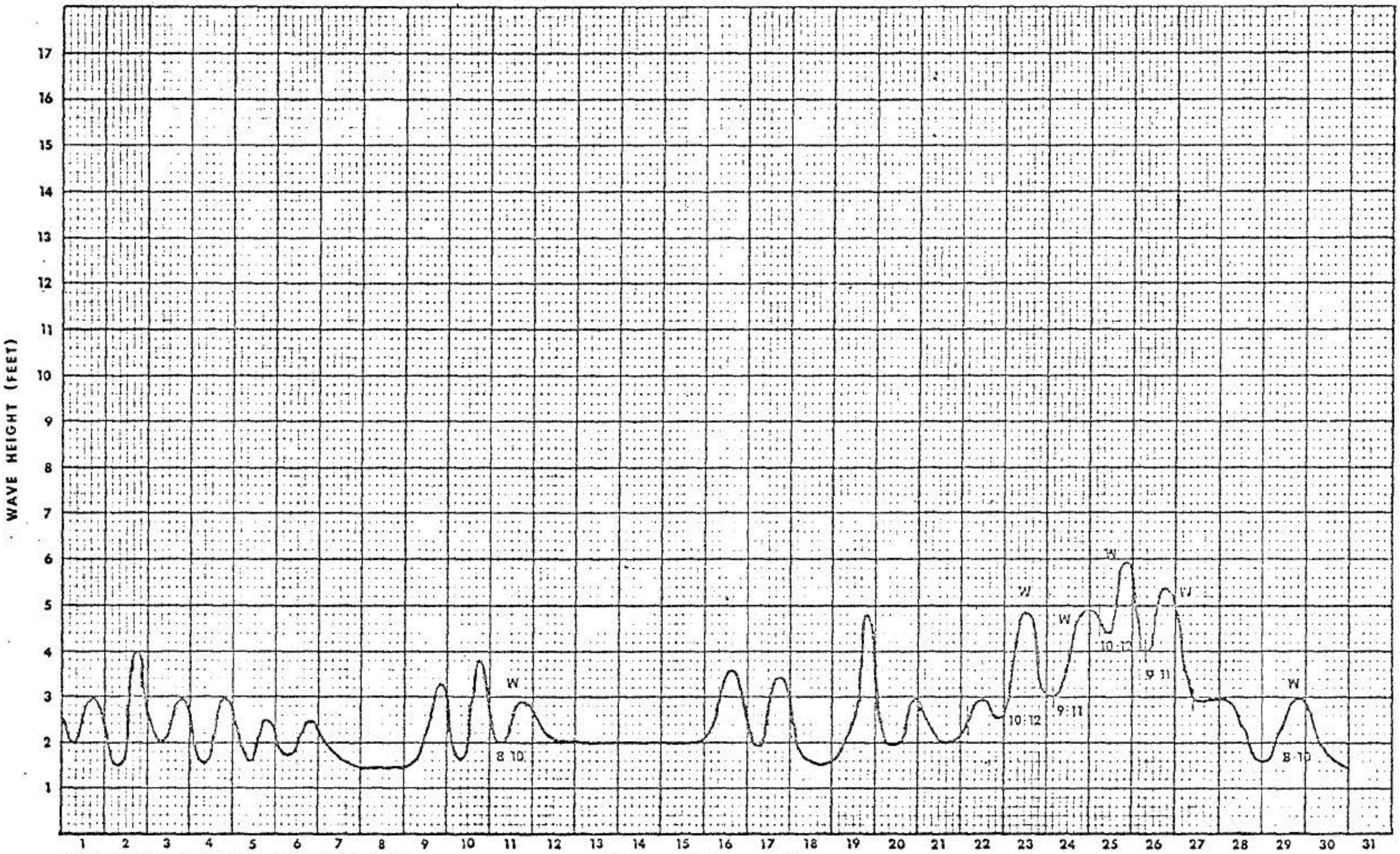
Month OCTOBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s θ	W						NW						Sum
0-5			83.3	12.9									96.2
5-10				3.8									3.8
10-15													
15-20													
20+													
Sum			83.3	16.7									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Oct YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-J

Table 3-K

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

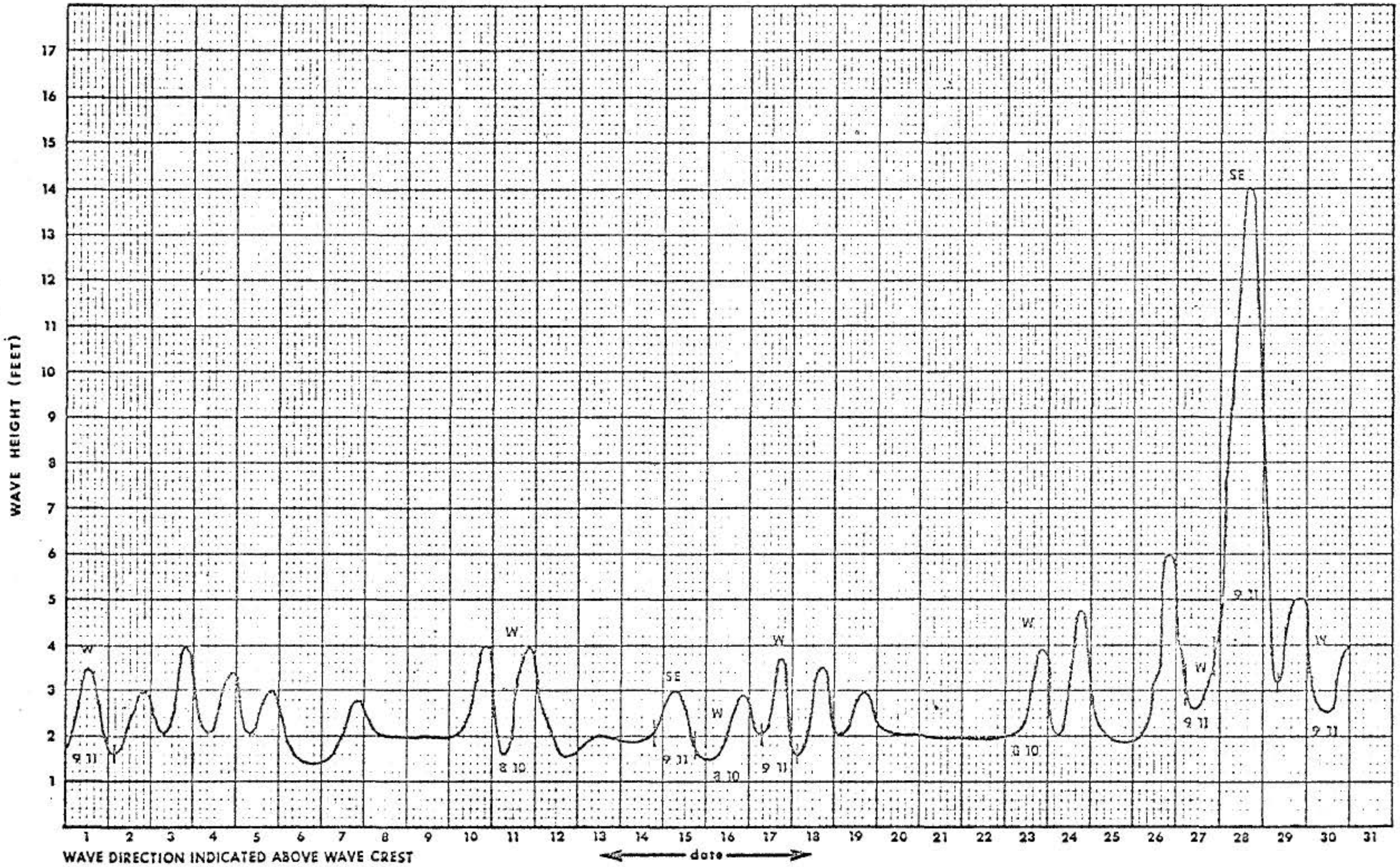
Station PLATFORM LOCATION Month NOVEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5										4.0			
5-10										1.8			
10-15										2.2			
15-20													
20+													
Sum										8.0			
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			78.4	12.8									95.2
5-10				0.8									2.6
10-15													2.2
15-20													
20+													
Sum			78.4	13.6									100

*Based on 720 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Nov YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-K

Table 3-L

Average Monthly Height-Period-Direction Frequency Distribution (Percent)*

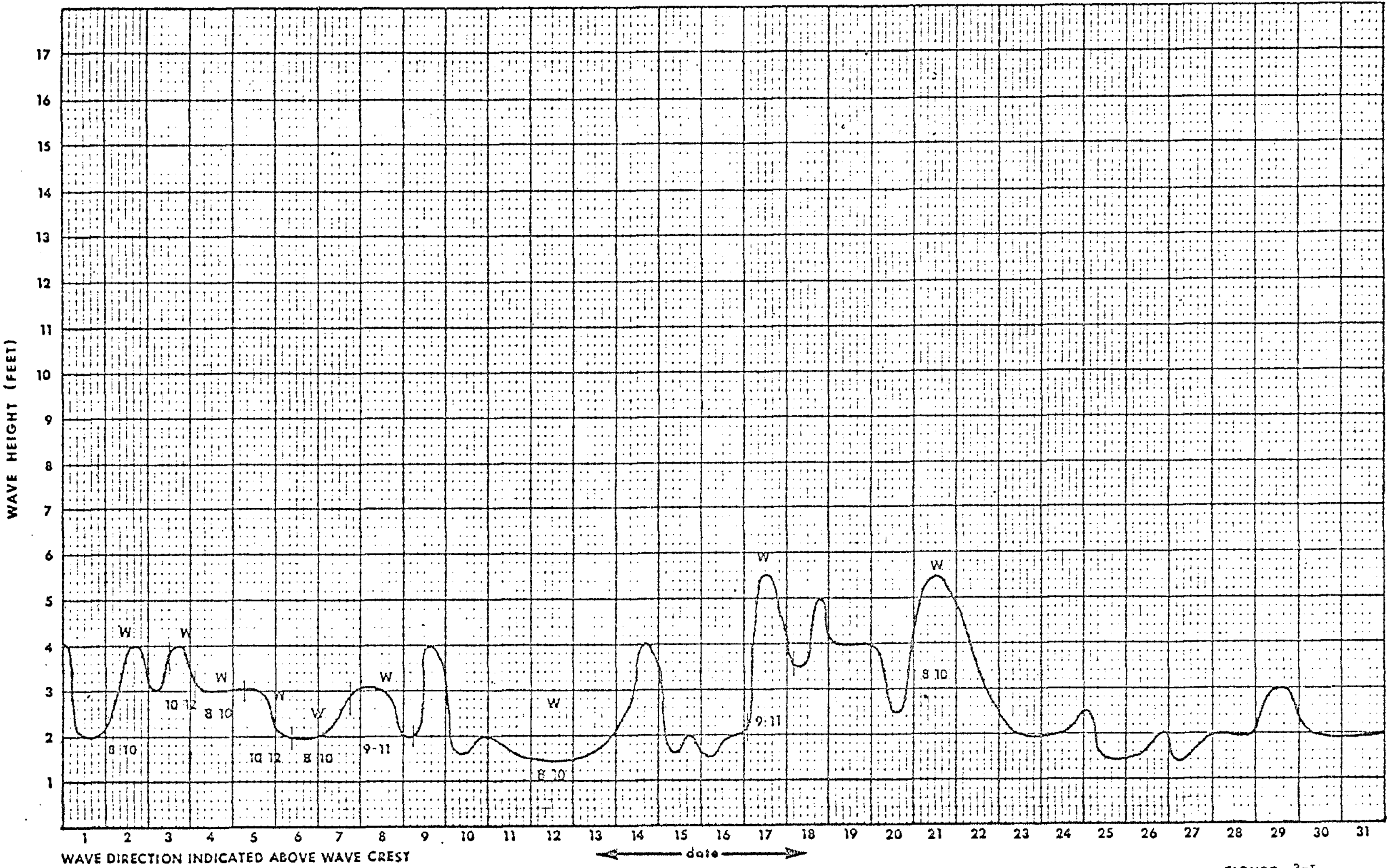
Station PLATFORM LOCATION Month DECEMBER 1970

T_s	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14+	
H_s \ Θ	N						NE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	E						SE						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	S						SW						
0-5													
5-10													
10-15													
15-20													
20+													
Sum													
H_s \ Θ	W						NW						Sum
0-5			82.1	13.8									95.9
5-10			2.6	1.5									4.1
10-15													
15-20													
20+													
Sum			84.7	15.3									100

*Based on 744 hours

COMBINED SEA AND SWELL CONDITIONS

LOCATION PLATFORM LOCATION MONTH Dec YEAR 1970



WAVE DIRECTION INDICATED ABOVE WAVE CREST
WAVE PERIOD (SECONDS) INDICATED BELOW WAVE CREST

FIGURE 3-L

Maximum Storm Characteristics

Station SANTA MONICA BAY Date JANUARY 1969

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
25	00													
	06													
	12													
	18	22	SW	5.0	7	WSW	5.0	12				WSW	7.0	12
26	00	26	SW	8.0	7	WSW	7.5	10				WSW	11.5	10
	06	18	SW	5.0	8	WSW	5.5	8				WSW	7.5	8
	12	12	SW	3.0	8	WSW	3.5	7				WSW	5.0	7
	18					WSW	2.5	7	WSW	2.5	16	WSW	3.5	16
27	00								WSW	5.5	15			
	06								WSW	6.5	14			
	12								WSW	6.5	12			
	18								WSW	5.5	10			
28	00								WSW	5.0	8			
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE -A

WAVE HEIGHT PLOT - SANTA MONICA BAY

Date JANUARY 1969

Composite Wave Height ∘∘∘∘∘

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

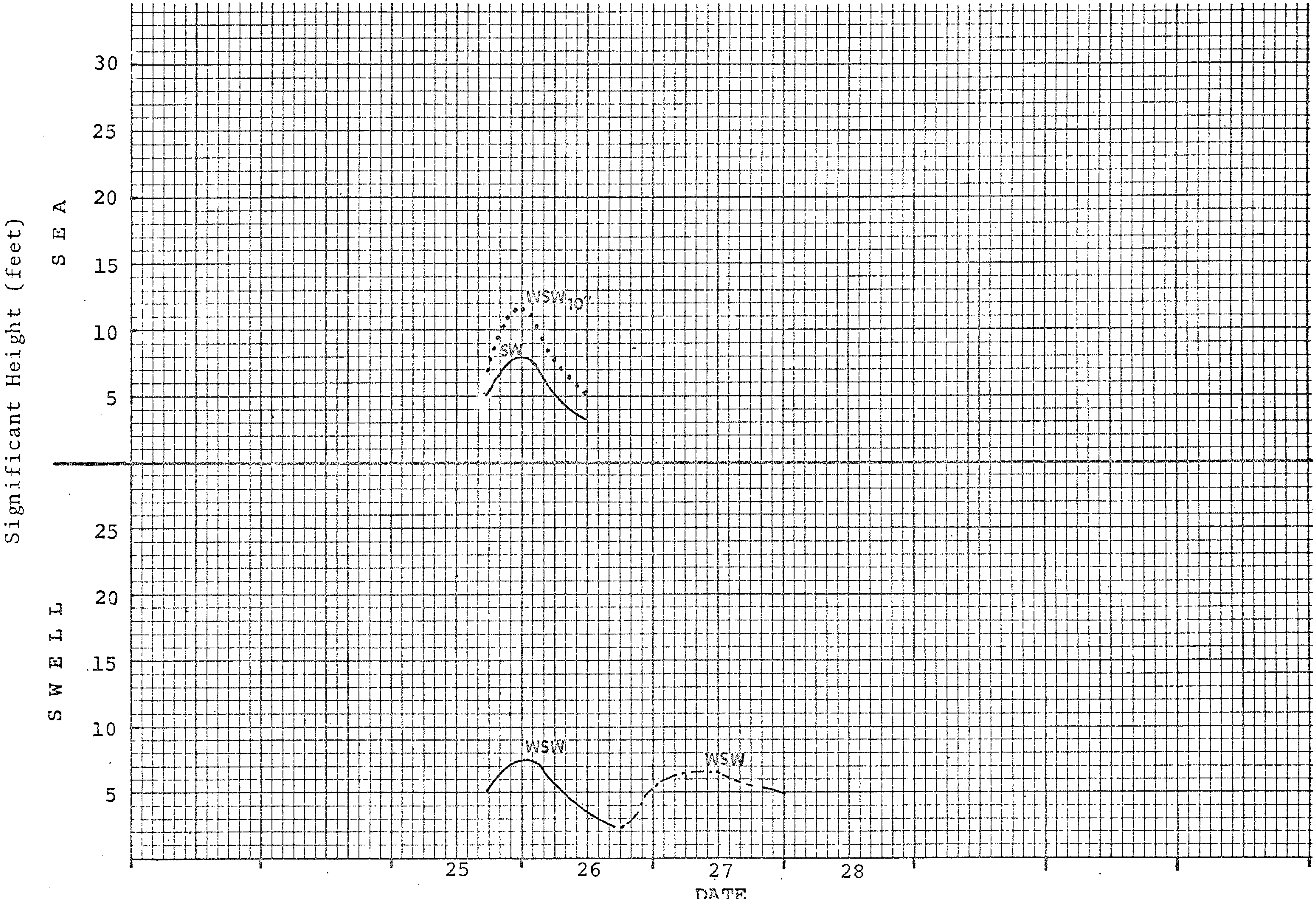


TABLE 4-B

Maximum Storm Characteristics

Station SANTA MONICA BAY Date FEBRUARY 1969

Day	Time (GMT)		Wave Trains												
		Wind	Sea			1			2			Composite		
		Kts	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s
6	00													
	06													
	12	24	SW	6.0	7									
	18	18	WSW	5.5	7									
7	00	16	WSW	4.5	6									
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

Θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE ±-B

WAVE HEIGHT PLOT - SANTA MONICA BAY

Date FEBRUARY 1969

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·— ≥13 secs.

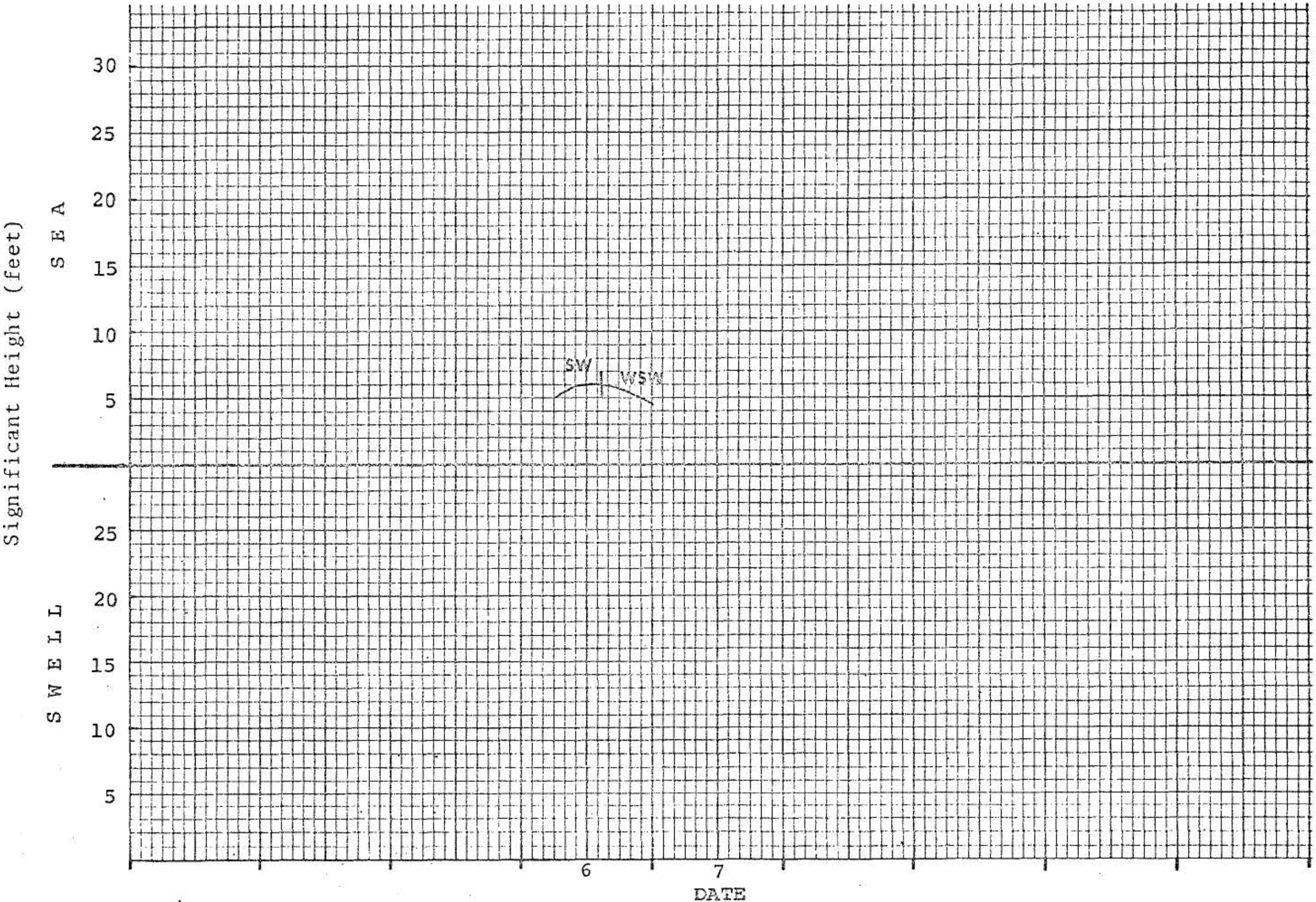


TABLE 4-C

Maximum Storm Characteristics

Station SANTA MONICA BAY Date NOVEMBER 1969

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
26	00													
	06													
	12	12	WNW	2.0	5									
	18	24	WNW	6.0	7									
27	00	14	WNW	3.5	6									
	06	12	WNW	2.5	5									
	12	10	WNW	2.0	5									
	18	22	WNW	5.0	7									
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

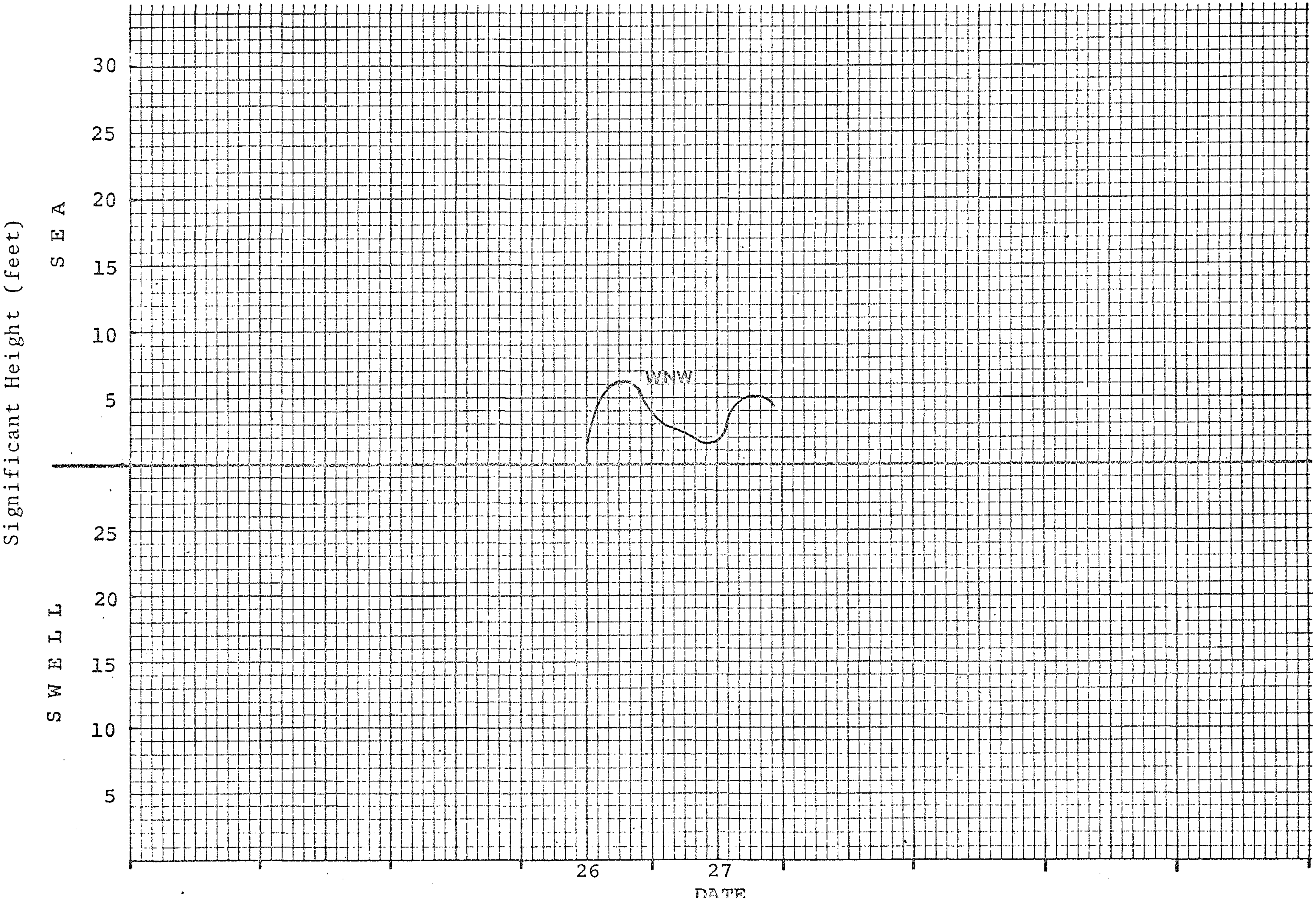
FIGURE 4-C

WAVE HEIGHT PLOT - SANTA MONICA BAY

Date NOVEMBER 1969

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.



Maximum Storm Characteristics

Station SANTA MONICA BAY Date DECEMBER 1968

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
19	00													
	06													
	12													
	18	18	WNW	3.0	4									
20	00	22	WNW	5.5	7									
	06	12	W	2.5	6									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE -D

WAVE HEIGHT PLOT - SANTA MONICA BAY

Date DECEMBER 1968

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

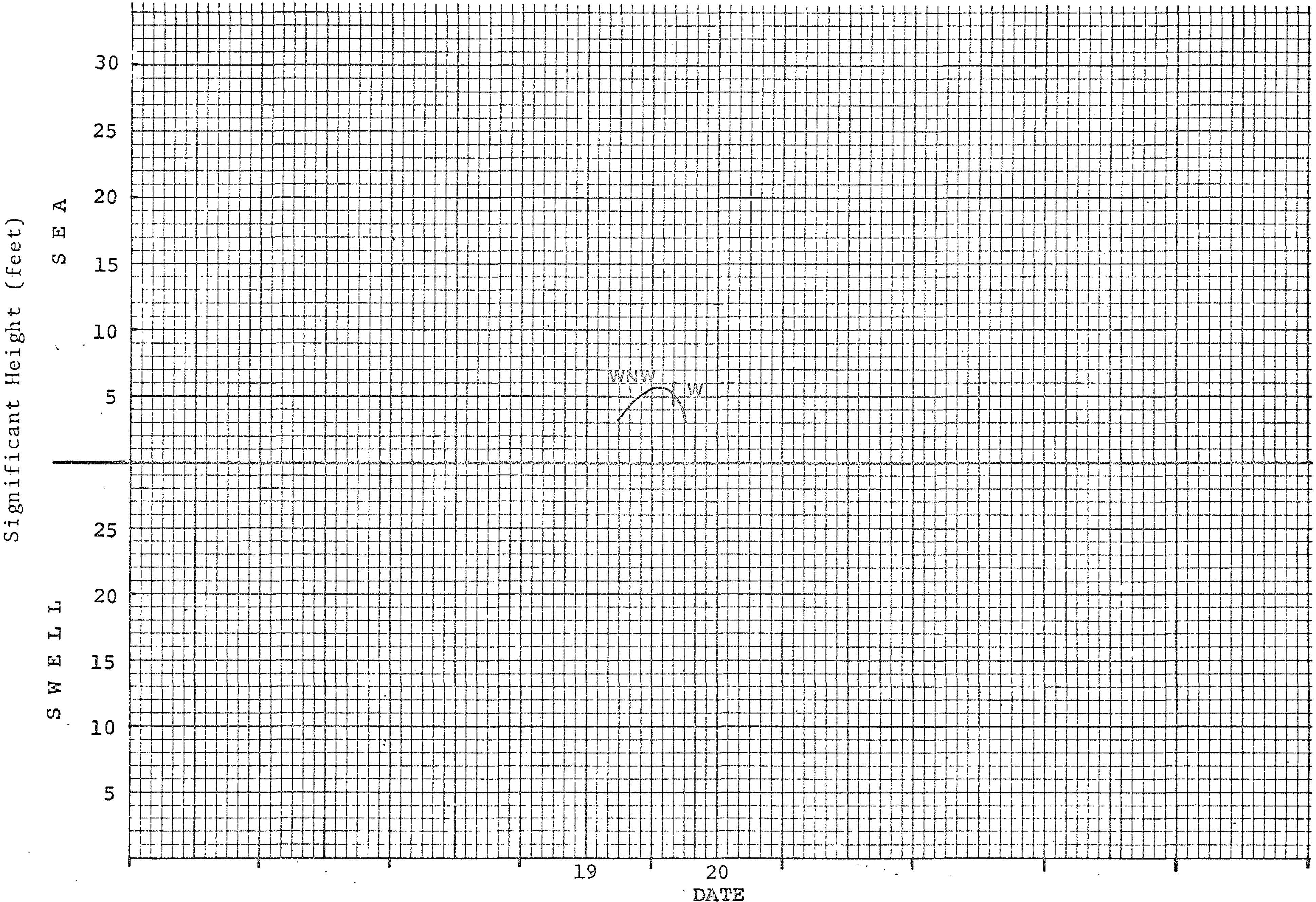


TABLE 5-A

Maximum Storm Characteristics

Station VENTURA Date JANUARY 1969

Day	Time (GMT)		Wave Trains												
		Wind	Sea			1			2			Composite			
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	
19	00					W	4.5	13							
	06					W	6.0	12							
	12					W	7.0	12	W	1.5	15	W	7.0	15	
	18					W	7.0	10	W	5.5	14	W	9.5	14	
20	00					W	6.5	10	W	7.5	13	W	10.0	13	
	06					W	6.0	9	W	7.5	12	W	10.0	12	
	12					W	5.5	8	W	7.5	11	W	9.5	11	
	18					W	4.5	8	W	6.5	10	W	8.0	10	
21	00					W	3.5	7	W	6.0	9	W	7.5	9	
	06					W	3.0	7	W	5.5	8	W	6.5	8	
	12					W	2.5	7	W	4.5	8	W	5.0	8	
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

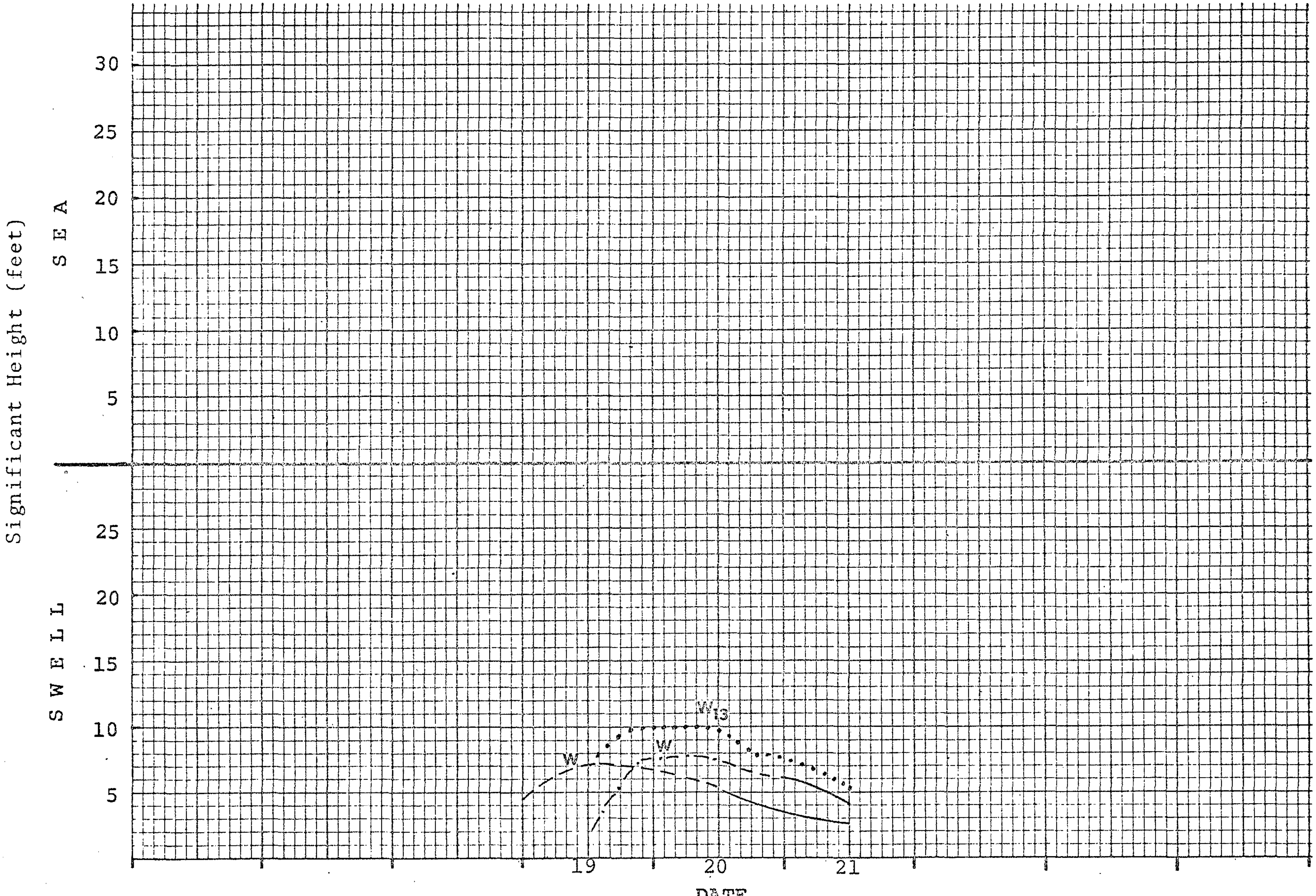
FIGURE 5-A

WAVE HEIGHT PLOT - VENTURA

Date JANUARY 1969

Composite Wave Height ●●●●●.

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date FEBRUARY 1966

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
4	00					W	5.0	15						
	06					W	7.0	13						
	12					W	8.0	13						
	18					W	8.5	12						
5	00					W	7.5	11						
	06					W	7.0	9						
	12					W	6.0	9						
	18					W	5.5	8						
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

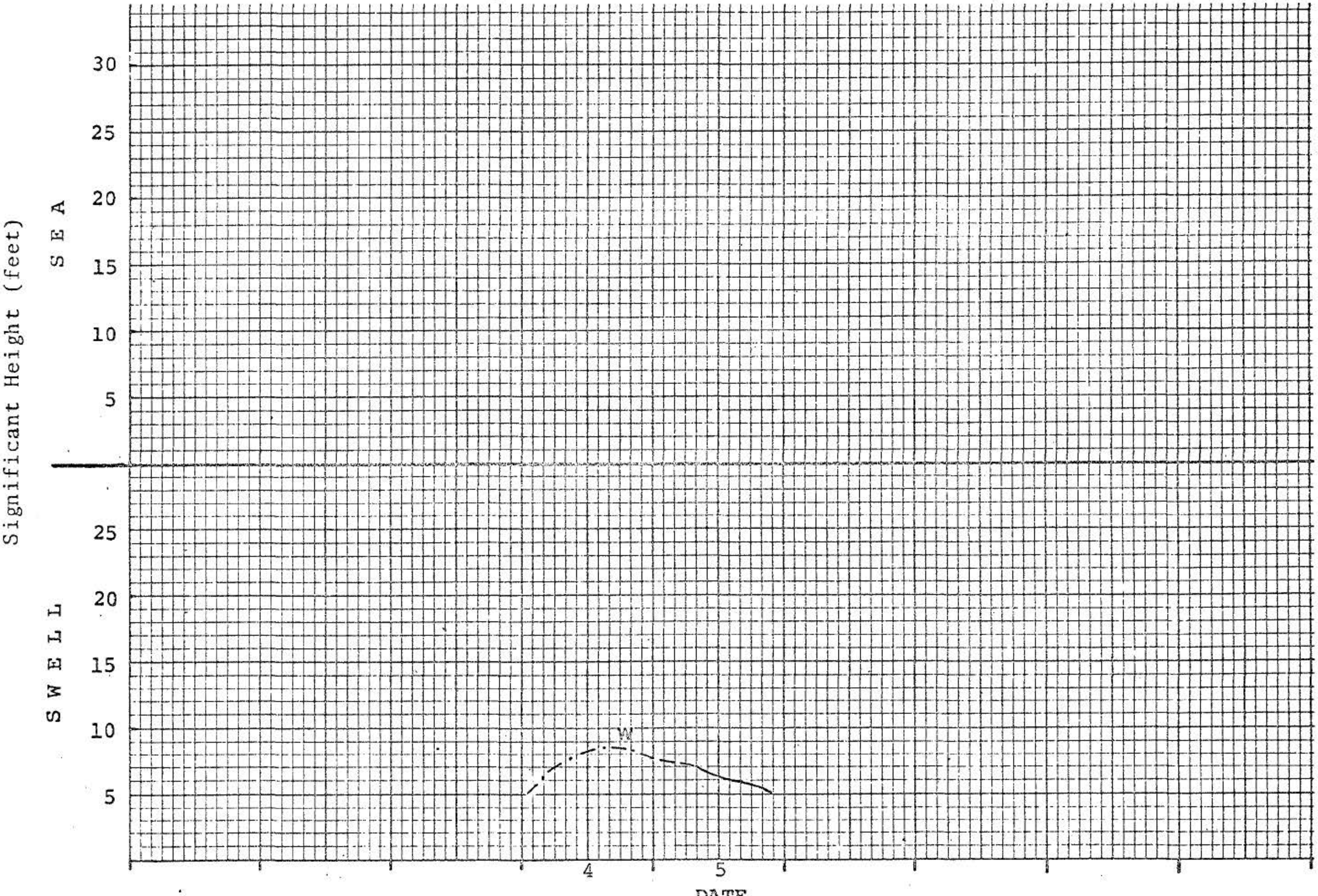
FIGURE 5-B

WAVE HEIGHT PLOT - VENTURA

Date FEBRUARY 1966

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date FEBRUARY 1969

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
16	00													
	06					W	4.5	12						
	12					W	6.0	12						
	18					W	6.5	11						
17	00					W	6.5	10						
	06					W	6.0	9						
	12					W	5.5	9						
	18					W	5.0	8						
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 5-C

WAVE HEIGHT PLOT - VENTURA   Date FEBRUARY 1969

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

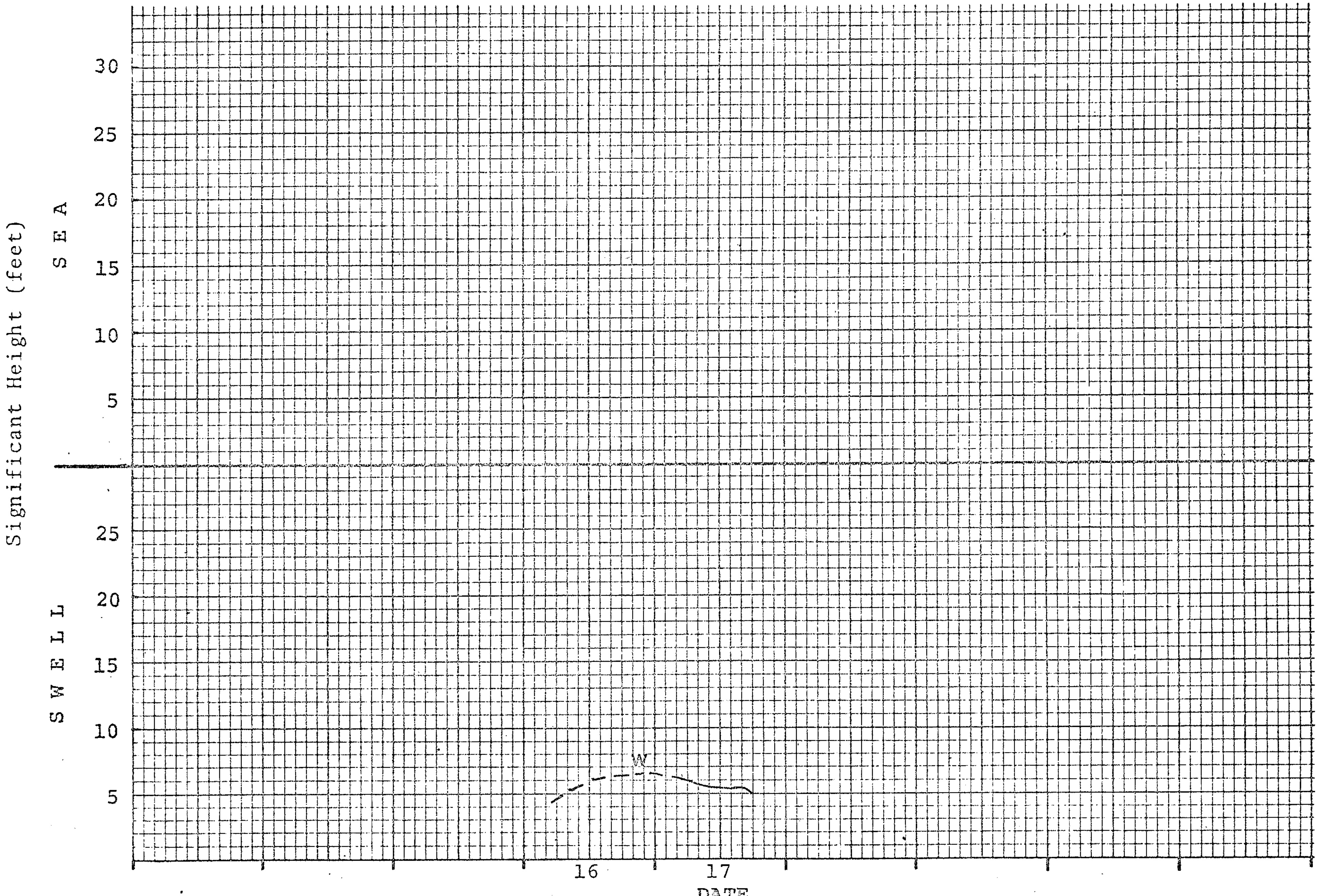


TABLE 5-D

Maximum Storm Characteristics

Station VENTURA Date MARCH 1966

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s
2	00	26	W	6.5	8									
	06	10	W	2.5	6									
	12	16	W	3.0	6									
	18	16	W	4.0	6									
3	00	24	W	6.0	7									
	06	28	W	8.5	8									
	12	16	W	4.5	7									
	18	16	WNW	4.5	7									
4	00	24	WNW	6.0	8									
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

Θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 5-D

WAVE HEIGHT PLOT - VENTURA

Date MARCH 1966

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·— ≥13 secs.

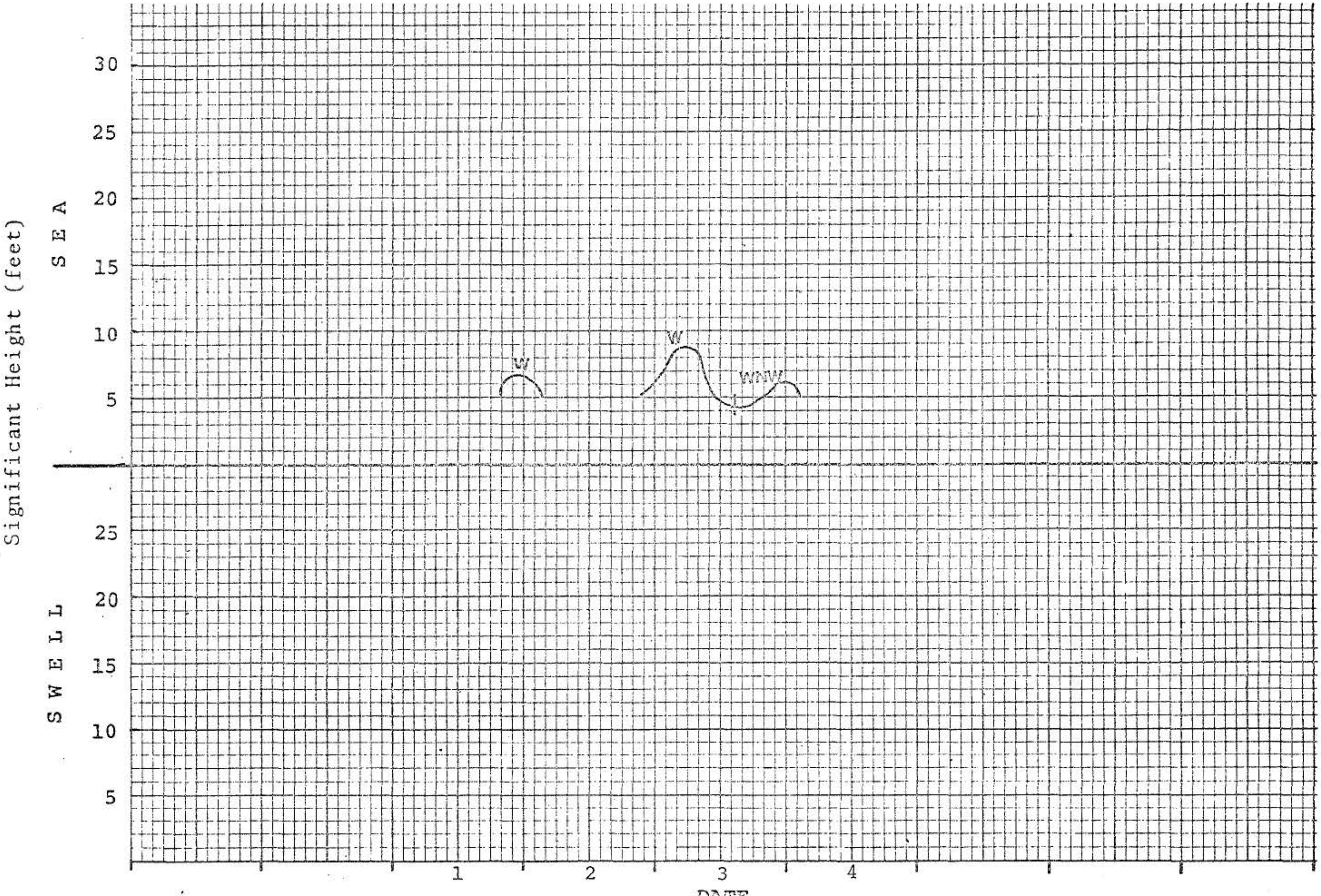


TABLE 5-E

Maximum Storm Characteristics

Station VENTURA Date MARCH 1968

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
2	00													
	06													
	12					W	3.5	12						
	18					W	5.5	11						
3	00					W	6.5	11						
	06					W	6.5	11						
	12					W	6.5	10						
	18					W	5.5	9						
4	00					W	4.5	8						
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

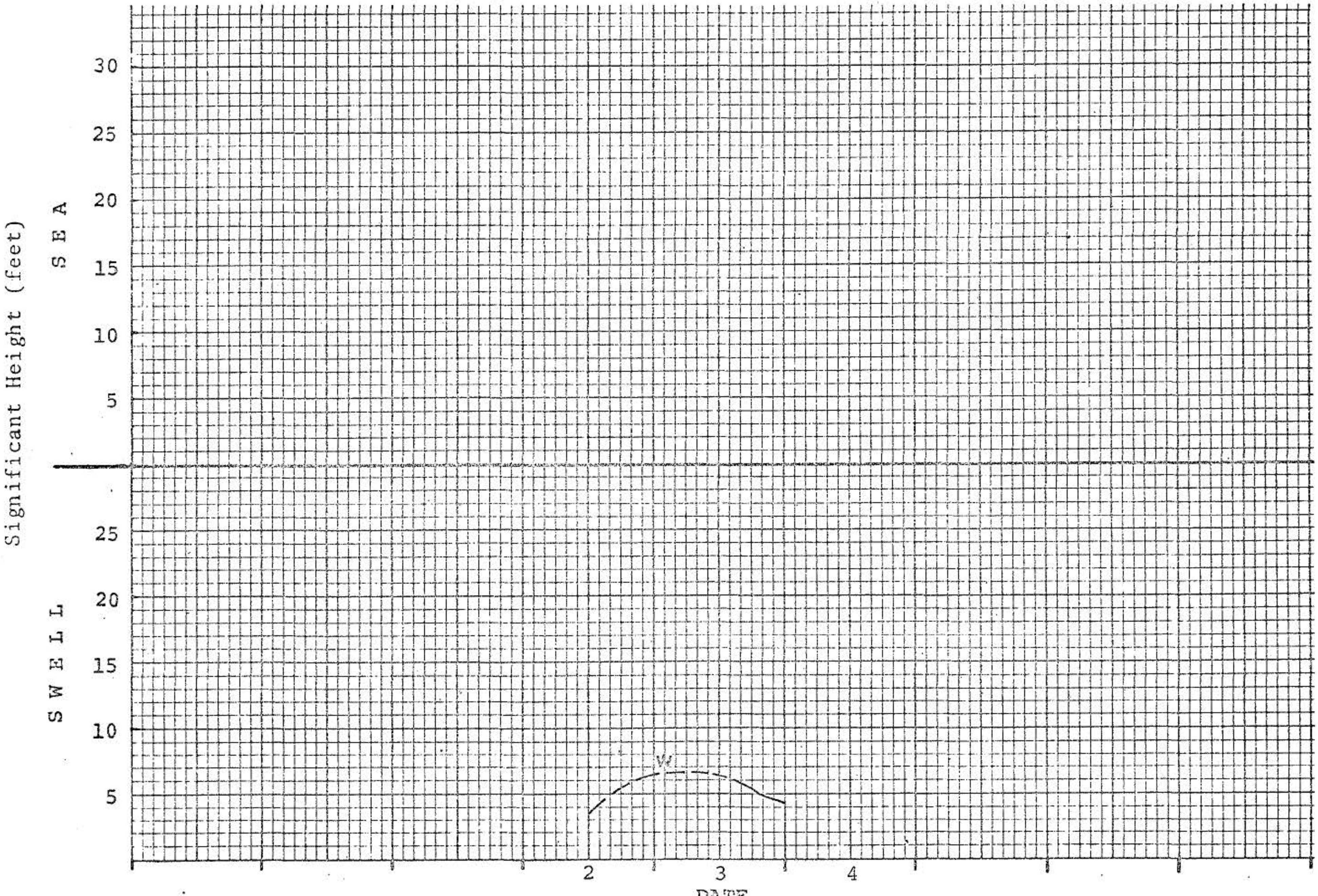
FIGURE 5-E

WAVE HEIGHT PLOT - VENTURA

Date MARCH 1968

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—· ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date APRIL 1966

Day	Time (GMT)	Wind		Wave Trains												
				Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
18	00													
	06													
	12	16	W	4.0	7									
	18	24	W	6.0	7									
19	00	24	W	7.5	7									
	06	20	WSW	6.5	7									
	12	20	W	6.0	7									
	18	16	W	4.0	7									
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 2-F

WAVE HEIGHT PLOT - VENTURA

Date APRIL 1966

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

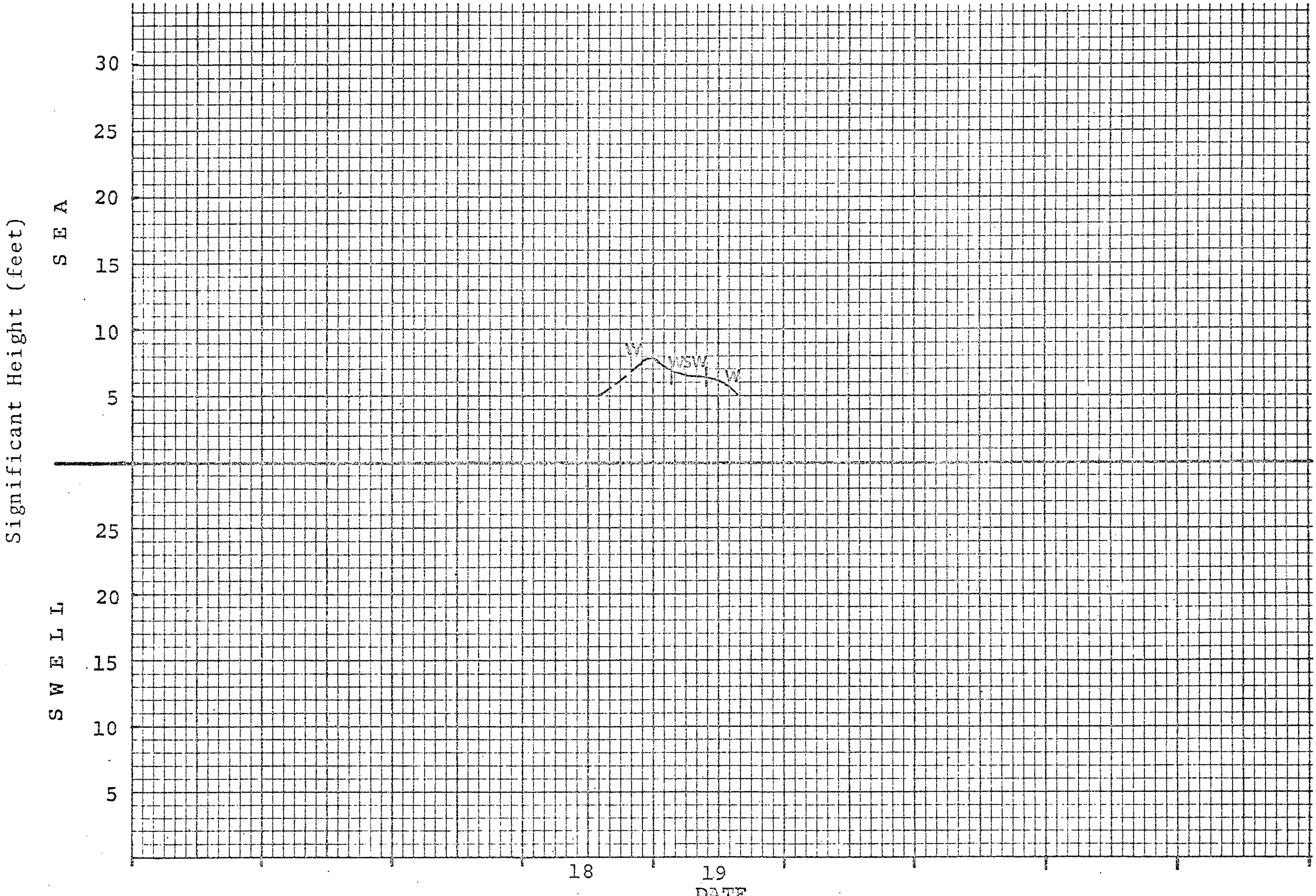


TABLE 5-G

Maximum Storm Characteristics

Station VENTURA Date MAY 1968

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s
12	00													
	06													
	12	18	W	4.5	6									
	18	18	W	5.0	7									
13	00	26	W	7.5	8									
	06	16	W	4.0	7									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

Θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

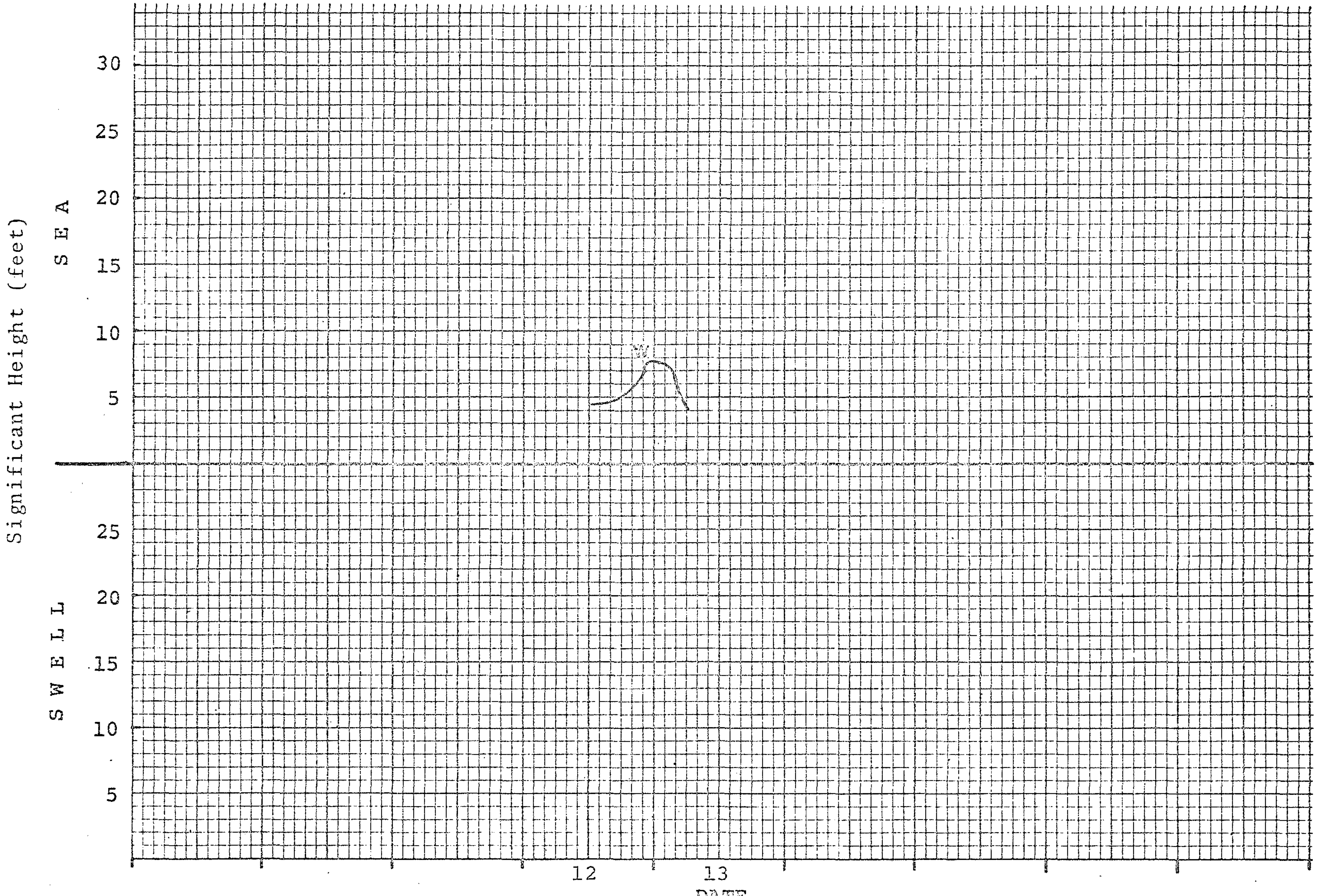
FIGURE 2-G

WAVE HEIGHT PLOT - VENTURA

Date MAY 1968

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date SEPTEMBER 1966

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
19	00	26	W	6.0	7									
	06	14	W	3.0	7									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
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	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

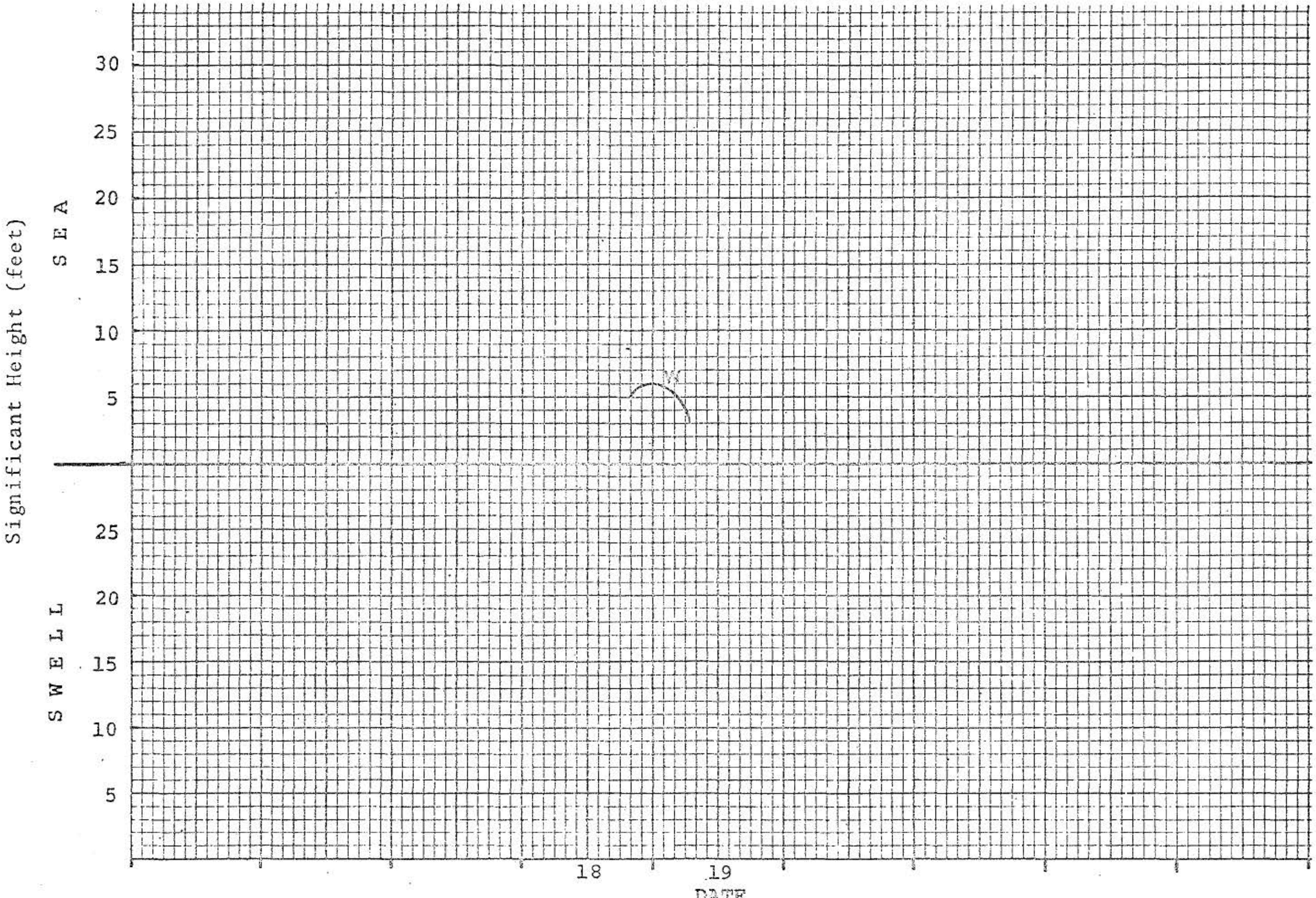
Kts = Wind Speed (knots)
H_s = Significant Wave Height (feet)
T_s = Significant Wave Period (seconds)

FIGURE [illegible]-H

WAVE HEIGHT PLOT - VENTURA Date SEPTEMBER 1966

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date NOVEMBER 1965

						Wave Trains								
Day	Time (GMT)	Wind	Sea			1			2			Composite		
		Kts	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s
15	00					W	7.0	13						
	06					W	9.5	12						
	12					W	9.5	11						
	18					W	8.0	10	W	3.0	13	W	8.5	13
16	00					W	6.5	9	W	6.5	12	W	9.5	12
	06					W	5.5	8	W	7.5	11	W	9.5	11
	12					W	4.5	8	W	7.5	17	W	8.5	17
	18					W	3.5	7	W	6.5	15	W	7.5	15
17	00					W	3.5	7	W	4.5	12	W	6.5	12
	06					W	3.5	7	W	4.5	10	W	6.0	10
	12					W	3.0	7	W	4.0	8	W	5.0	8
	18					W	2.5	7	W	3.5	7	W	4.5	7
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

Θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 2-1

WAVE HEIGHT PLOT - VENTURA

Date NOVEMBER 1965

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

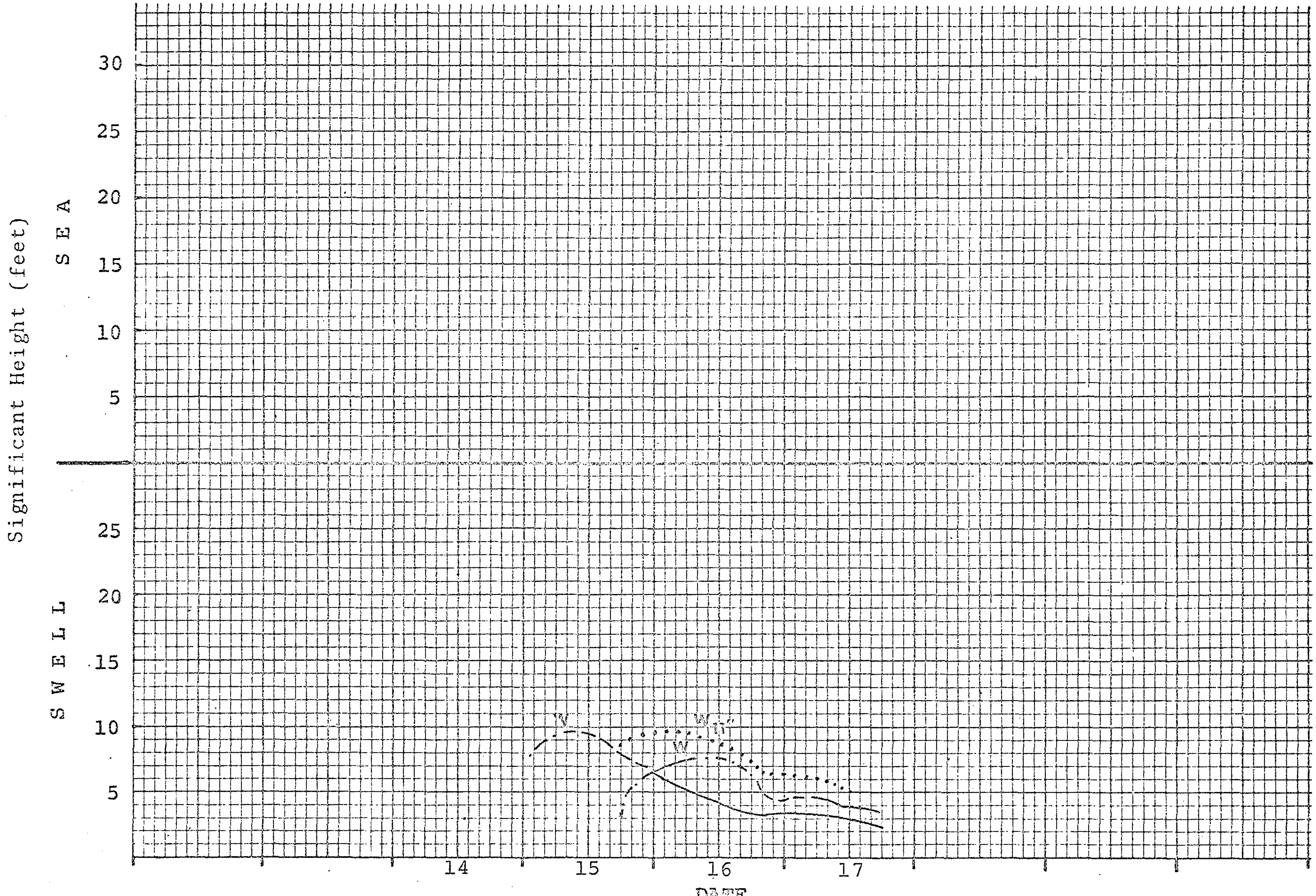


TABLE 5-J

Maximum Storm Characteristics

Station VENTURA Date NOVEMBER 1968

Day	Time (GMT)	Wind	Wave Trains											
			Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
21	00					W	4.5	14						
	06					W	5.5	13						
	12					W	6.5	13						
	18					W	7.0	12						
22	00					W	6.5	11						
	06					W	6.5	10						
	12					W	6.0	9						
	18					W	5.5	9						
23	00					W	5.0	8						
	06					W	4.5	8						
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 5-J

WAVE HEIGHT PLOT - VENTURA Date NOVEMBER 1968

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.

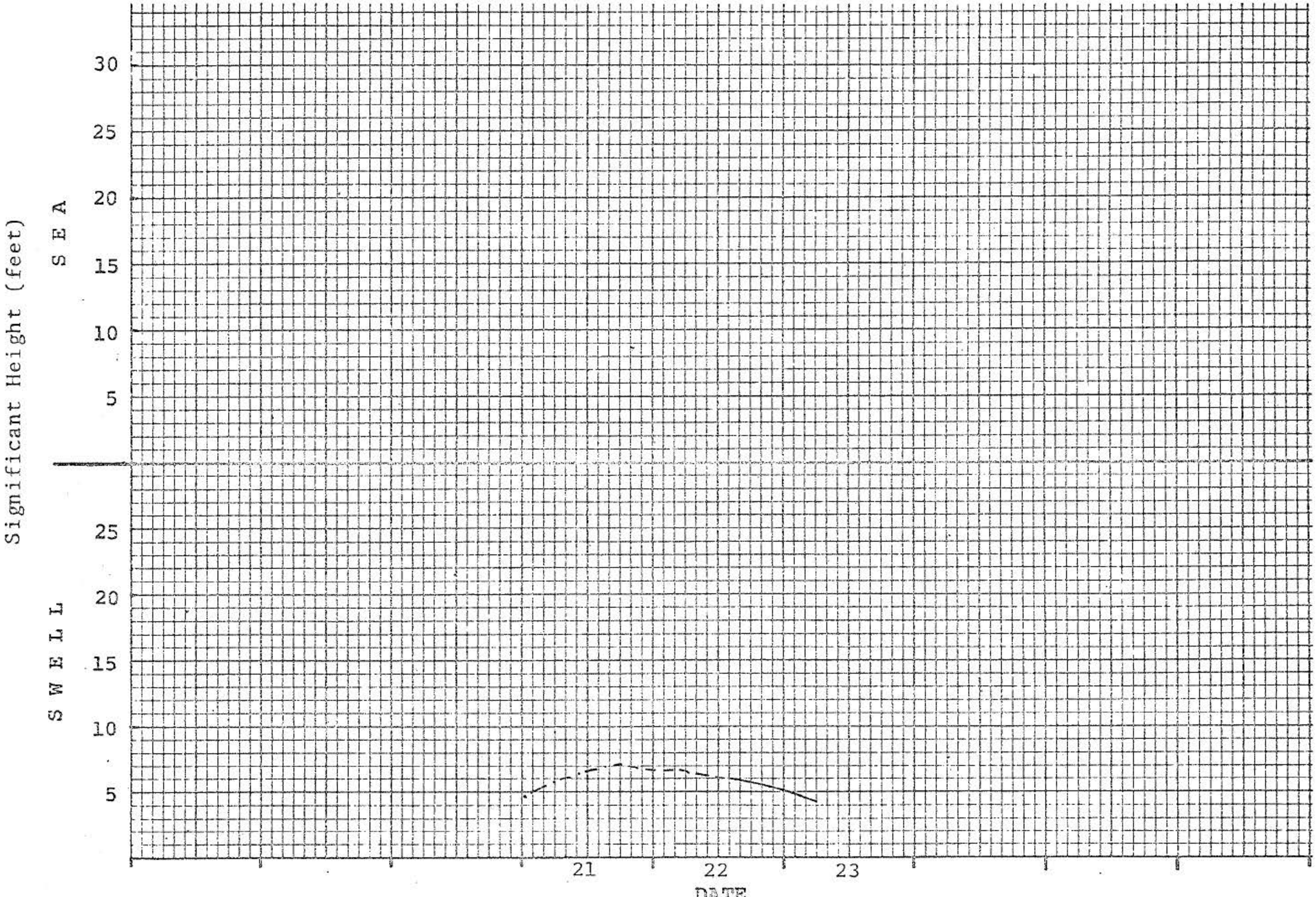


TABLE 5-K

Maximum Storm Characteristics

Station VENTURA Date DECEMBER 1965

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
22	00													
	06													
	12													
	18	14	NW	2.5	4									
23	00	26	NW	7.0	6									
	06	22	NW	7.0	6									
	12	8	N	3.5	4									
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

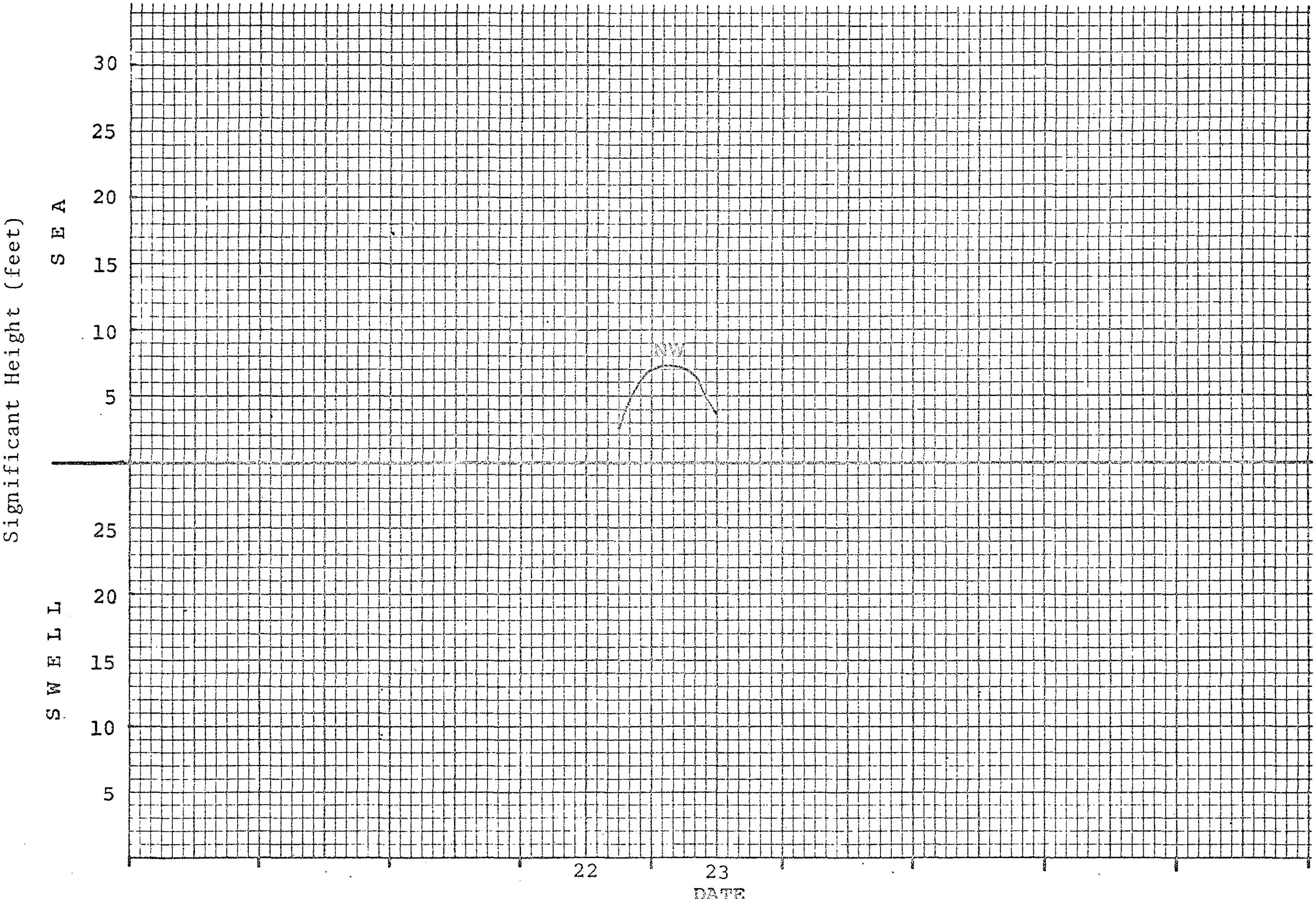
T_s = Significant Wave Period (seconds)

FIGURE 5-K

WAVE HEIGHT PLOT - VENTURA Date DECEMBER 1965

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.



Maximum Storm Characteristics

Station VENTURA Date DECEMBER 1968

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
19	00													
	06													
	12	6	W	2.0	4									
	18	24	W	5.5	5									
20	00	28	W	9.0	7									
	06	10	NW	5.0	5									
	12	6	NE	2.5	4									
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 2-L

WAVE HEIGHT PLOT - VENTURA Date DECEMBER 1968

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

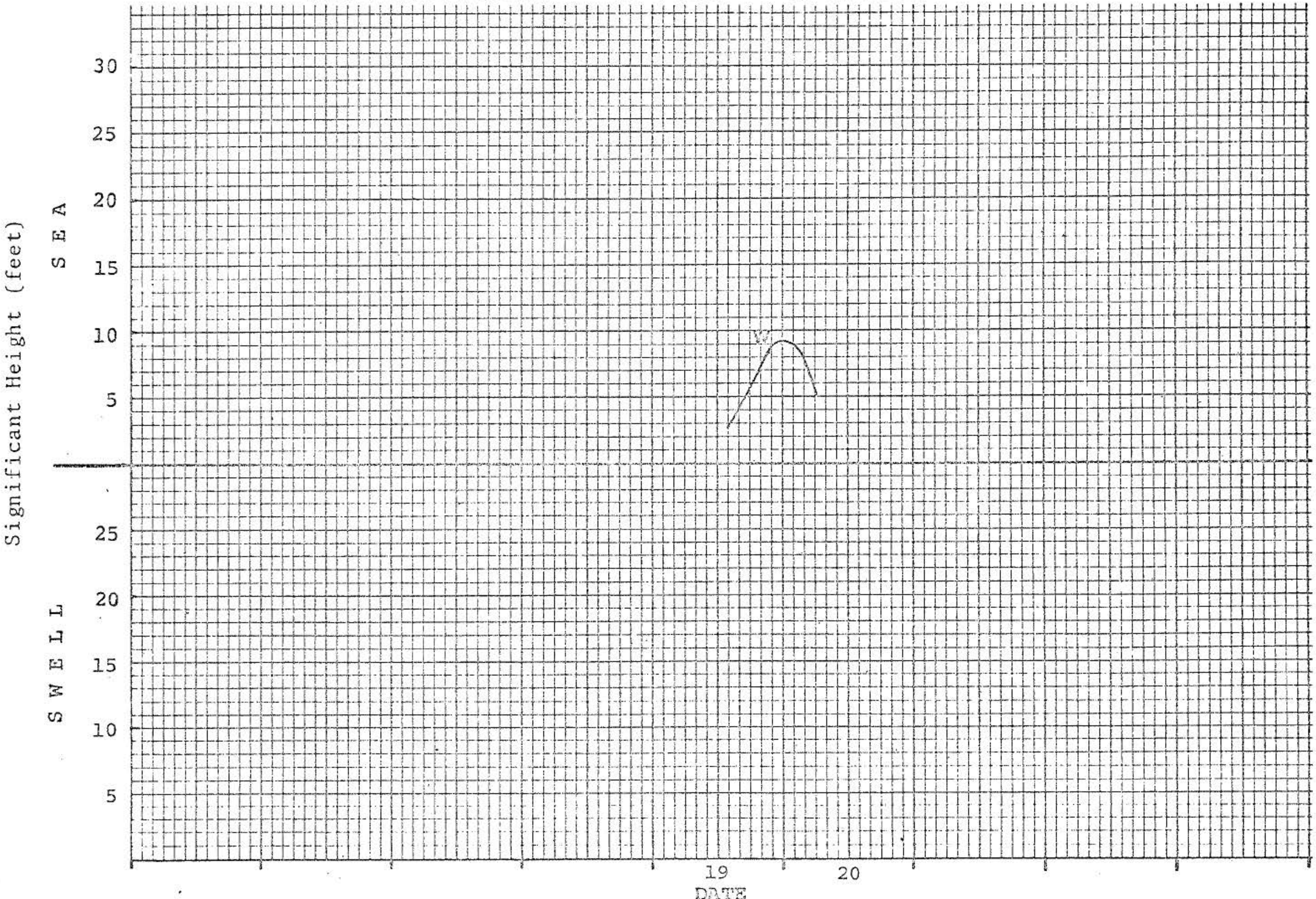


TABLE 6-A

Maximum Storm Characteristics

Station PLATFORM LOCATION Date JANUARY 1965

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
24	00	18	W	3.0	5									
	06	24	W	6.5	5									
	12	30	W	10.0	7									
	18	30	W	11.0	7									
25	00	34	W	13.0	8									
	06	20	WNW	6.0	6									
	12	20	NW	4.0	6									
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

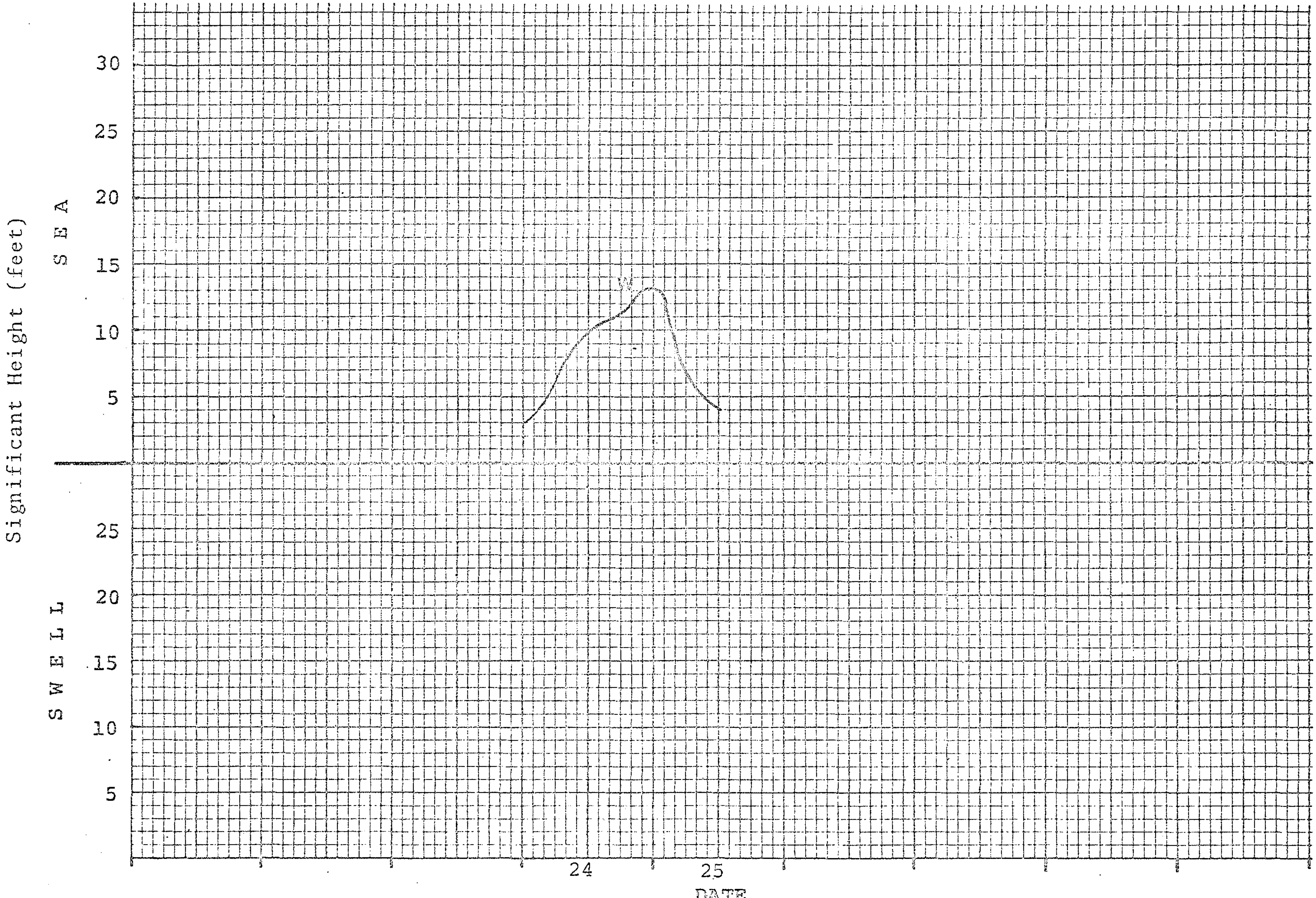
FIGURE 6-A

WAVE HEIGHT PLOT - PLATFORM LOCATION

Date JANUARY 1965

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.



Maximum Storm Characteristics

Station PLATFORM LOCATION Date JANUARY 1966

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
26	00													
	06													
	12	18	SSW	4.0	4									
	18	20	S	5.0	5									
27	00	26	SE	7.0	6									
	06	30	SE	8.0	6									
	12	34	SE	10.0	7									
	18	20	ESE	5.0	5									
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)
H_s = Significant Wave Height (feet)
T_s = Significant Wave Period (seconds)

FIGURE 6-B

WAVE HEIGHT PLOT - PLATFORM LOCATION Date JANUARY 1966

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.

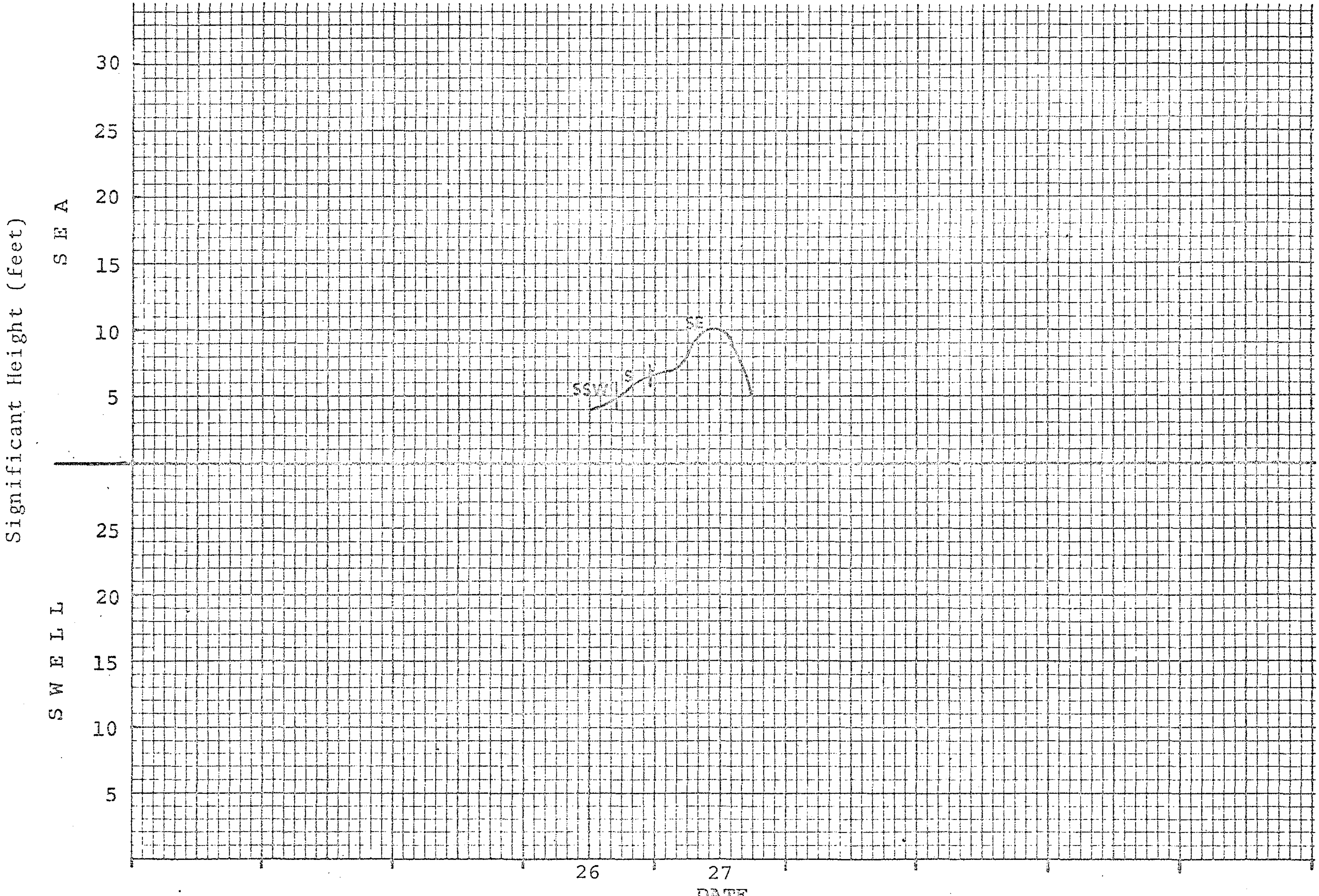


TABLE 6-C

Maximum Storm Characteristics

Station PLATFORM LOCATION Date FEBRUARY 1966

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s	Θ	H_s	T_s
2	00					W	4.0	14						
	06					W	9.5	13						
	12					W	11.5	12						
	18					W	12.5	12						
3	00					W	13.0	10						
	06					W	11.0	10						
	12					W	9.5	10						
	18					W	7.5	9						
4	00					W	6.5	8						
	06					W	5.5	8						
	12					W	4.5	7						
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

Θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 6-C

WAVE HEIGHT PLOT - PLATFORM LOCATION

Date FEBRUARY 1966

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—· ≥13 secs.

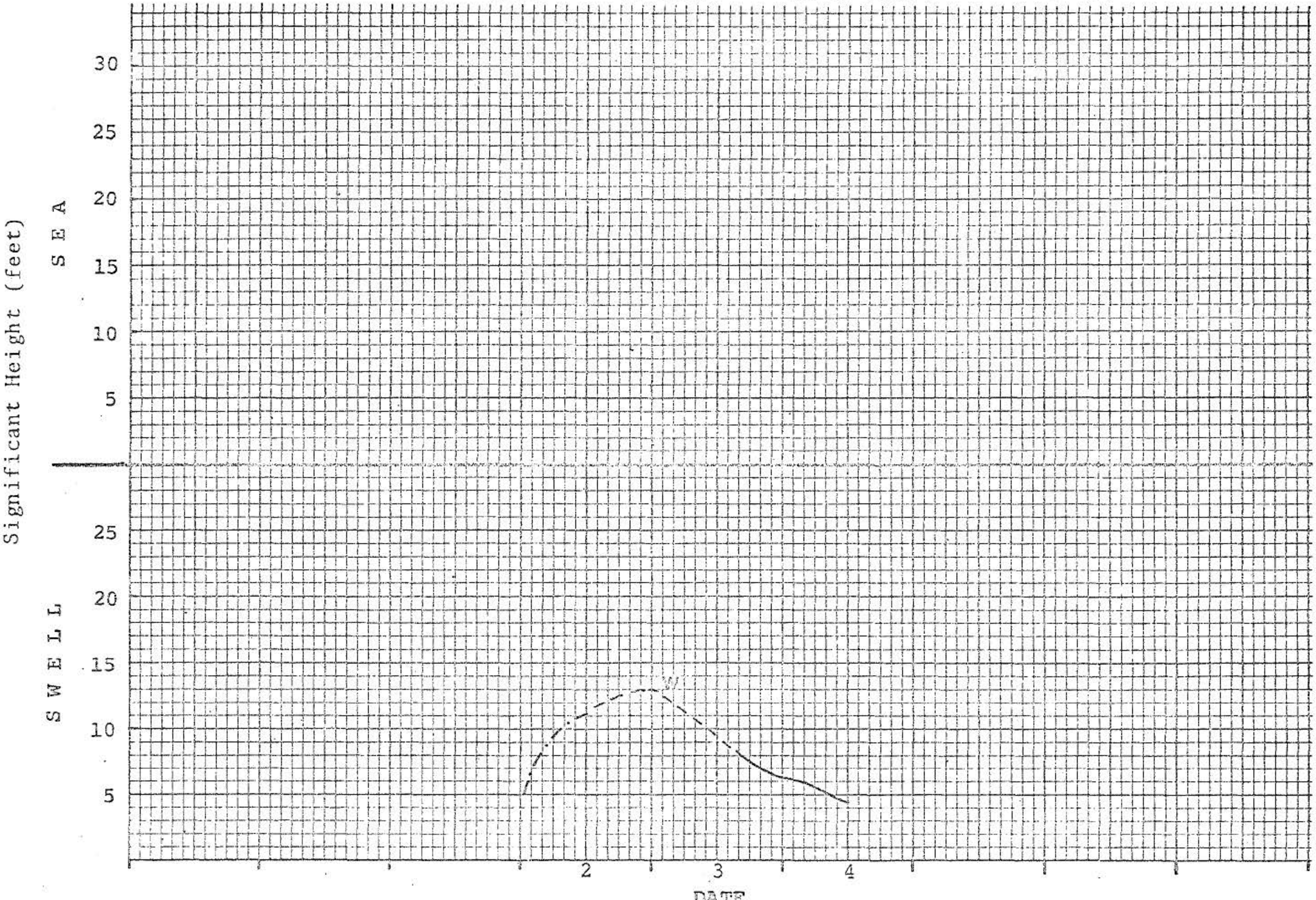


TABLE 6-D

Maximum Storm Characteristics

Station PLATFORM LOCATION Date FEBRUARY 1969

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
5	00													
	06													
	12	26	SSE	6.0	8									
	18	14	WSW	3.0	5									
6	00	24	SW	5.5	7									
	06	28	SW	8.0	8									
	12	26	W	7.5	8									
	18	22	W	6.0	7									
7	00	26	W	7.5	8									
	06	20	WNW	5.0	7									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 6-D

WAVE HEIGHT PLOT - PLATFORM LOCATION Date FEBRUARY 1969

Composite Wave Height ○○○○○

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.

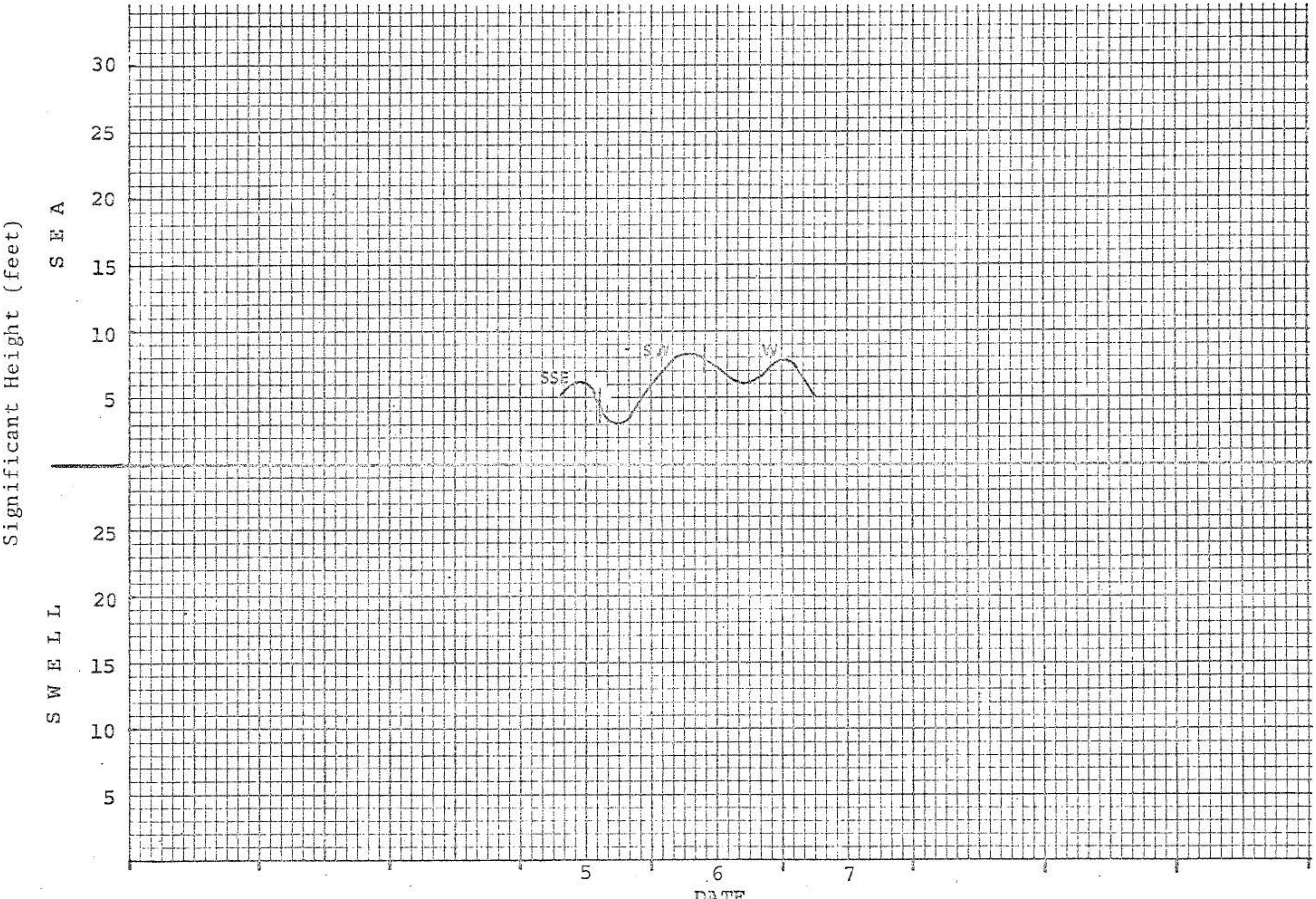


TABLE 6-E

Maximum Storm Characteristics

Station PLATFORM LOCATION Date MARCH 1966

Day	Time (GMT)		Wave Trains												
		Wind	Sea			1			2			Composite			
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	
1	00														
	06														
	12														
	18	20	W	2.0	5										
2	00	30	W	9.0	9										
	06	22	W	5.0	8										
	12	24	W	6.0	8										
	18	30	W	9.0	9										
3	00	30	W	9.0	9										
	06	20	W	5.0	8										
	12														
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														
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	06														
	12														
	18														
	00														
	06														
	12														
	18														
	00														
	06														
	12														
	18														

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 6-E

WAVE HEIGHT PLOT - PLATFORM LOCATION Date MARCH 1966

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·—· ≥13 secs.

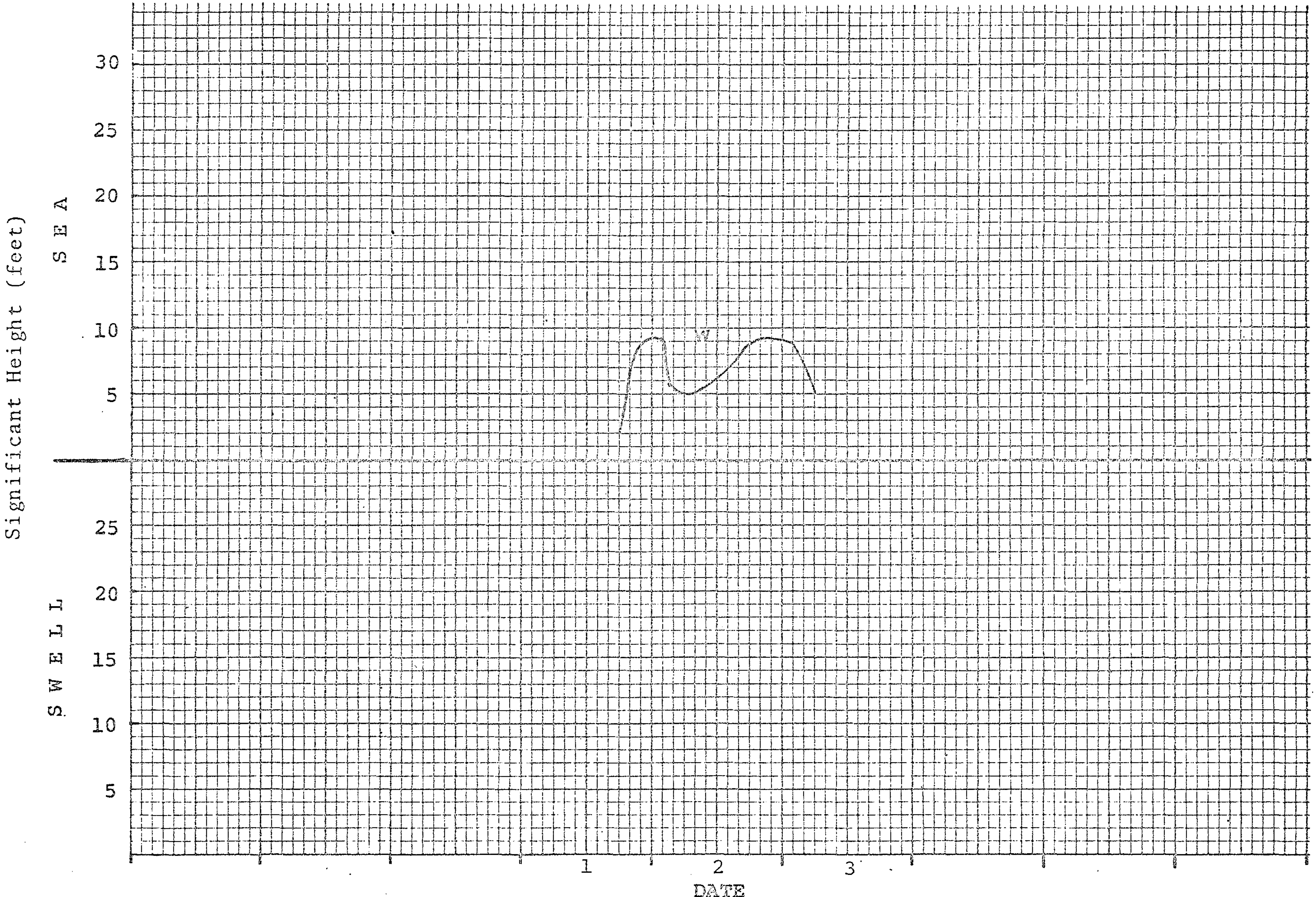


TABLE 6-F

Maximum Storm Characteristics

Station PLATFORM LOCATION Date APRIL 1967

Day	Time (GMT)			Wave Trains										
		Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
10	00													
	06													
	12													
	18	14	W	3.0	6									
11	00	22	W	6.0	7									
	06	16	W	5.0	7									
	12	14	W	4.0	7									
	18	14	W	4.0	7									
12	00	26	W	8.0	8									
	06	18	W	5.5	7									
	12	10	NW	2.5	6									
	18	24	W	6.5	7									
13	00	26	W	9.0	9									
	06	14	WNW	3.0	6									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

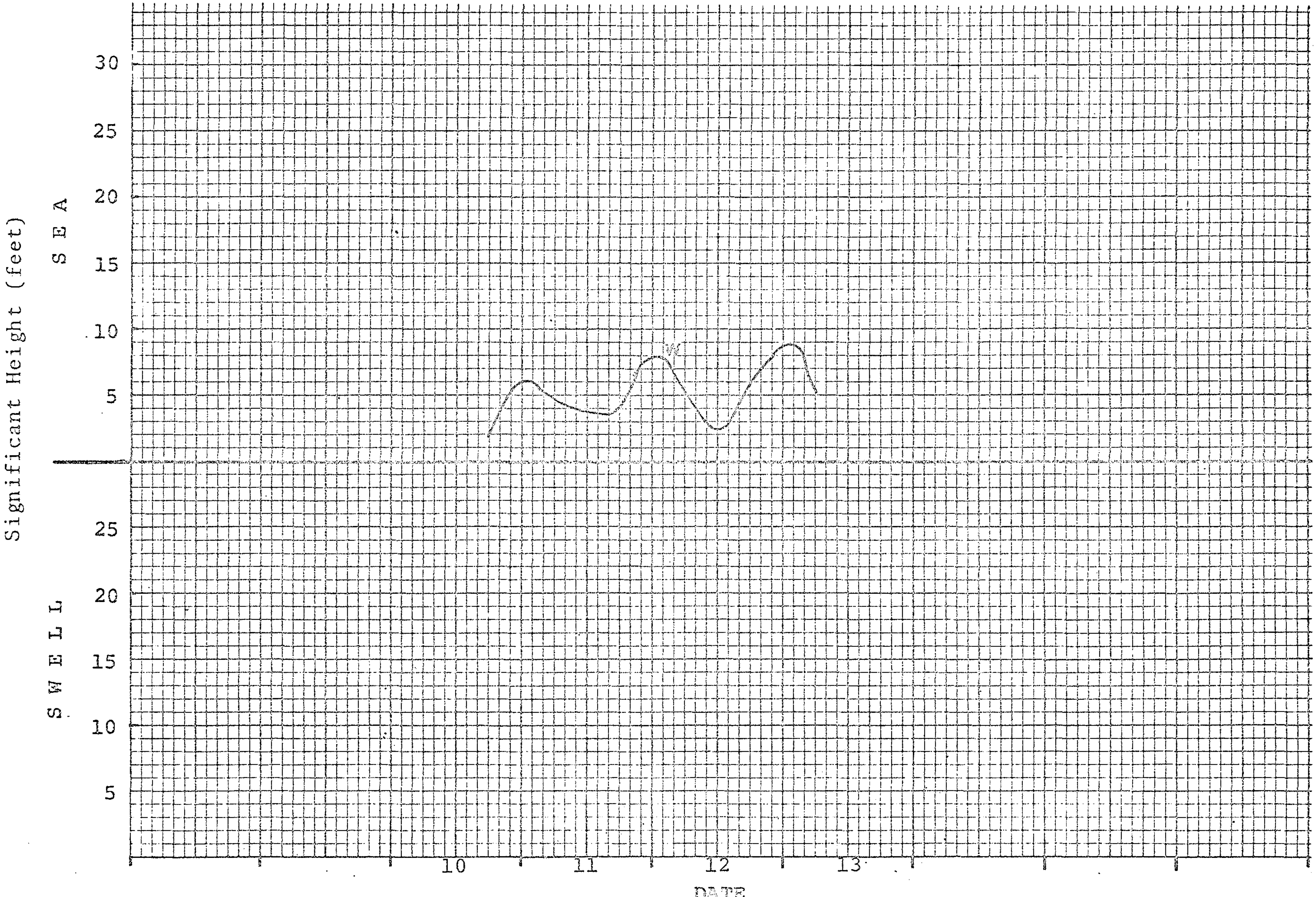
T_s = Significant Wave Period (seconds)

FIGURE 6-F

WAVE HEIGHT PLOT - PLATFORM LOCATION   Date APRIL 1967

Composite Wave Height ●●●●●.

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.



Maximum Storm Characteristics

Station PLATFORM LOCATION Date MAY 1965

Day	Time (GMT)		Wave Trains											
		Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
1	00													
	06													
	12													
	18	16	W	3.5	7									
2	00	24	W	7.5	8									
	06	20	W	6.0	8									
	12	8	NE	2.0	6									
	18	24	W	6.0	7									
3	00	22	W	5.5	7									
	06	16	W	4.5	7									
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 6-G

WAVE HEIGHT PLOT - PLATFORM LOCATION Date MAY 1965

Composite Wave Height ●●●●●.

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

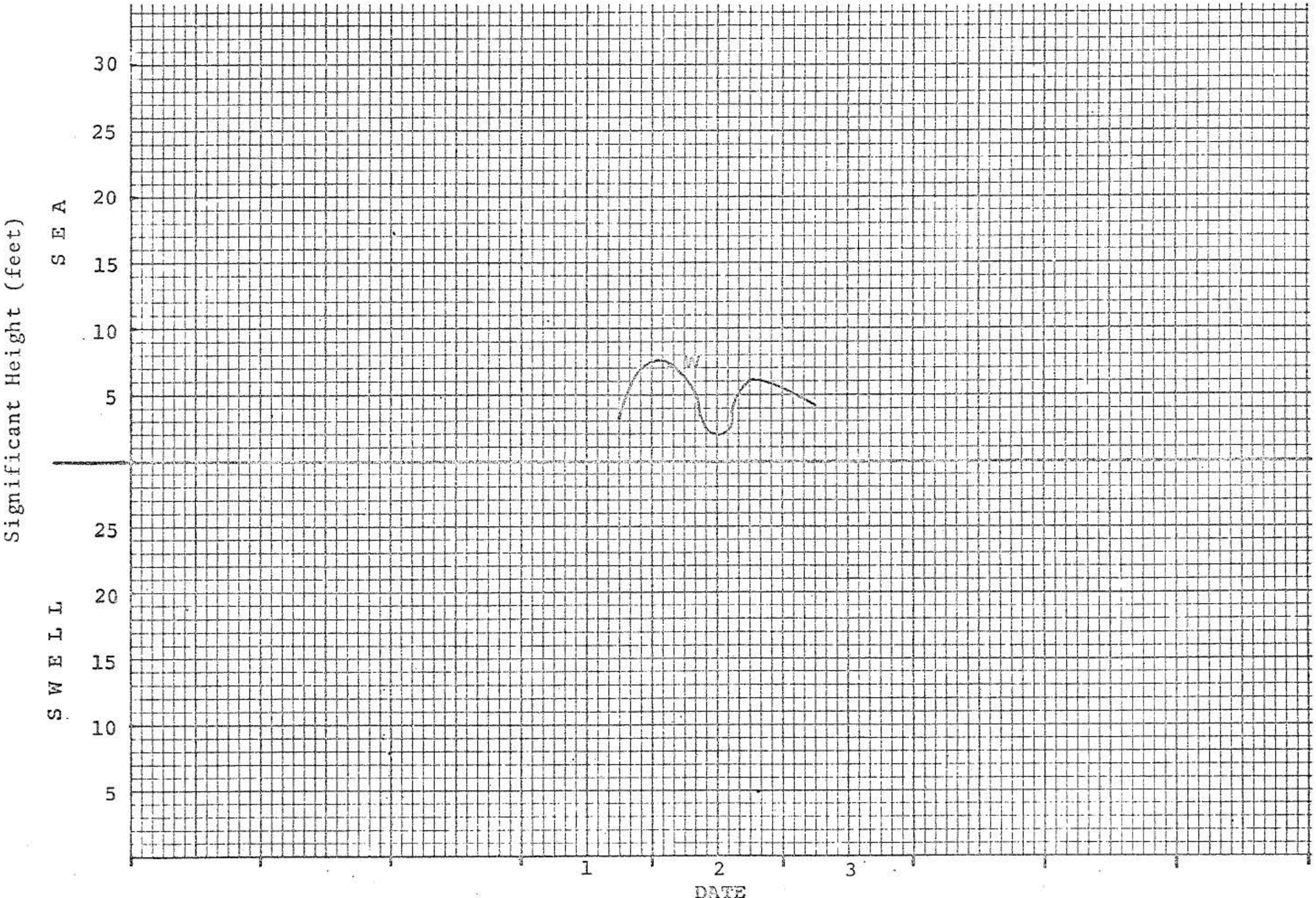


TABLE 6-H

Maximum Storm Characteristics

Station PLATFORM LOCATION Date NOVEMBER 1969

			Wave Trains											
Day	Time (GMT)	Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
8	00													
	06													
	12													
	18	22	SE	5.0	7									
9	00	34	SE	10.5	9									
	06	30	SE	10.0	9									
	12	26	SE	8.0	8									
	18	32	SE	10.5	9									
10	00	24	ESE	7.5	8									
	06	20	ESE	6.0	8									
	12	16	ESE	4.5	8									
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

T_s = Significant Wave Period (seconds)

FIGURE 6

WAVE HEIGHT PLOT - PLATFORM LOCATION Date NOVEMBER 1969

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

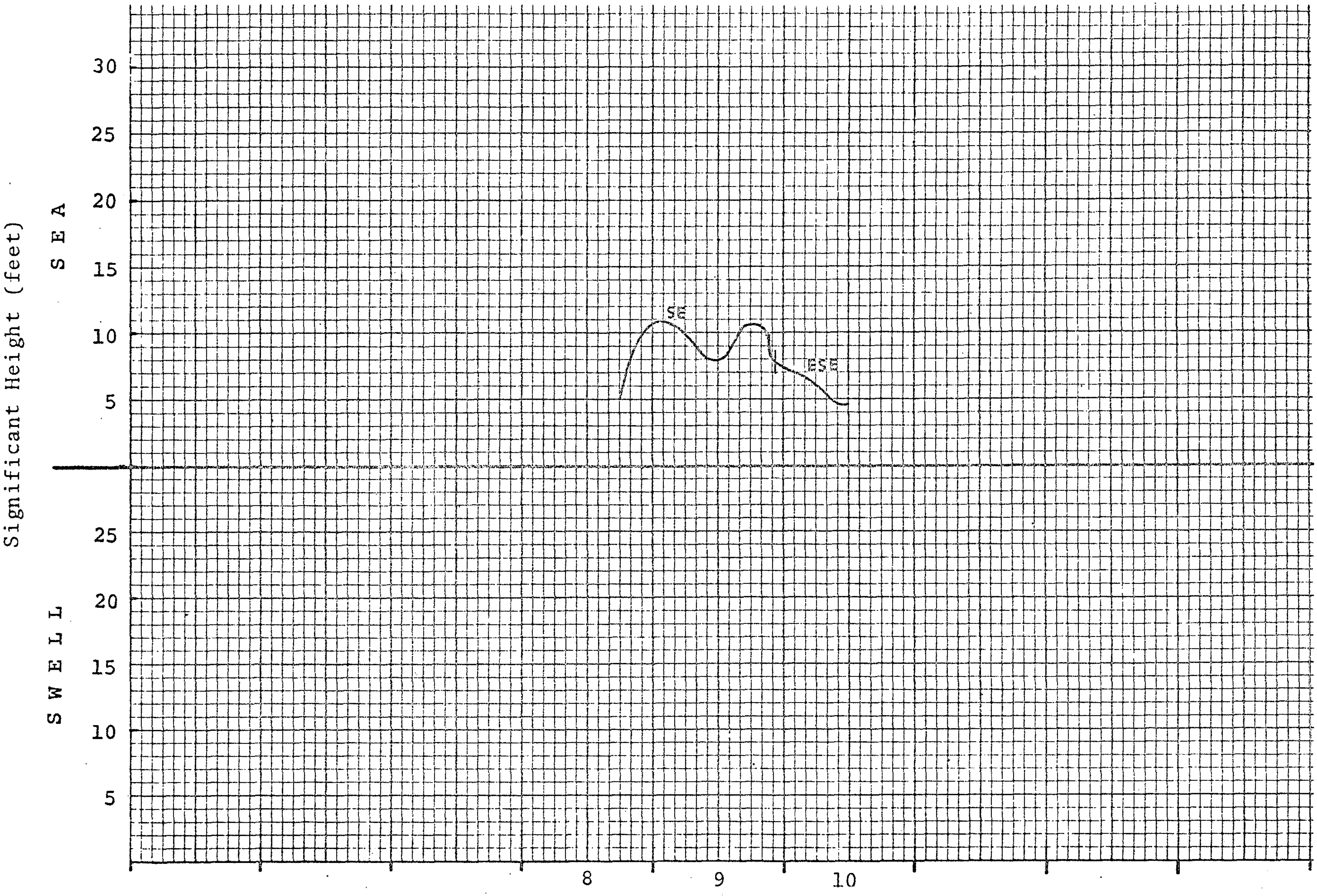


TABLE 6-I

Maximum Storm Characteristics

Station PLATFORM LOCATION Date DECEMBER 1965

			Wave Trains											
Day	Time (GMT)	Wind	Sea			1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
28	00													
	06													
	12													
	18	14	SW	3.0	5									
29	00	22	SSW	6.0	7									
	06	26	SSW	8.5	8	WSW	1.5	12				WSW	8.5	12
	12	20	WNW	6.5	8	WSW	3.5	12				WSW	7.5	12
	18	16	WNW	4.5	7	WSW	4.5	11				WSW	6.5	11
30	00	26	W	8.0	8	WSW	5.0	11				WSW	9.5	11
	06	14	W	3.5	7	WSW	5.5	11				WSW	6.5	11
	12					WSW	5.0	9						
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

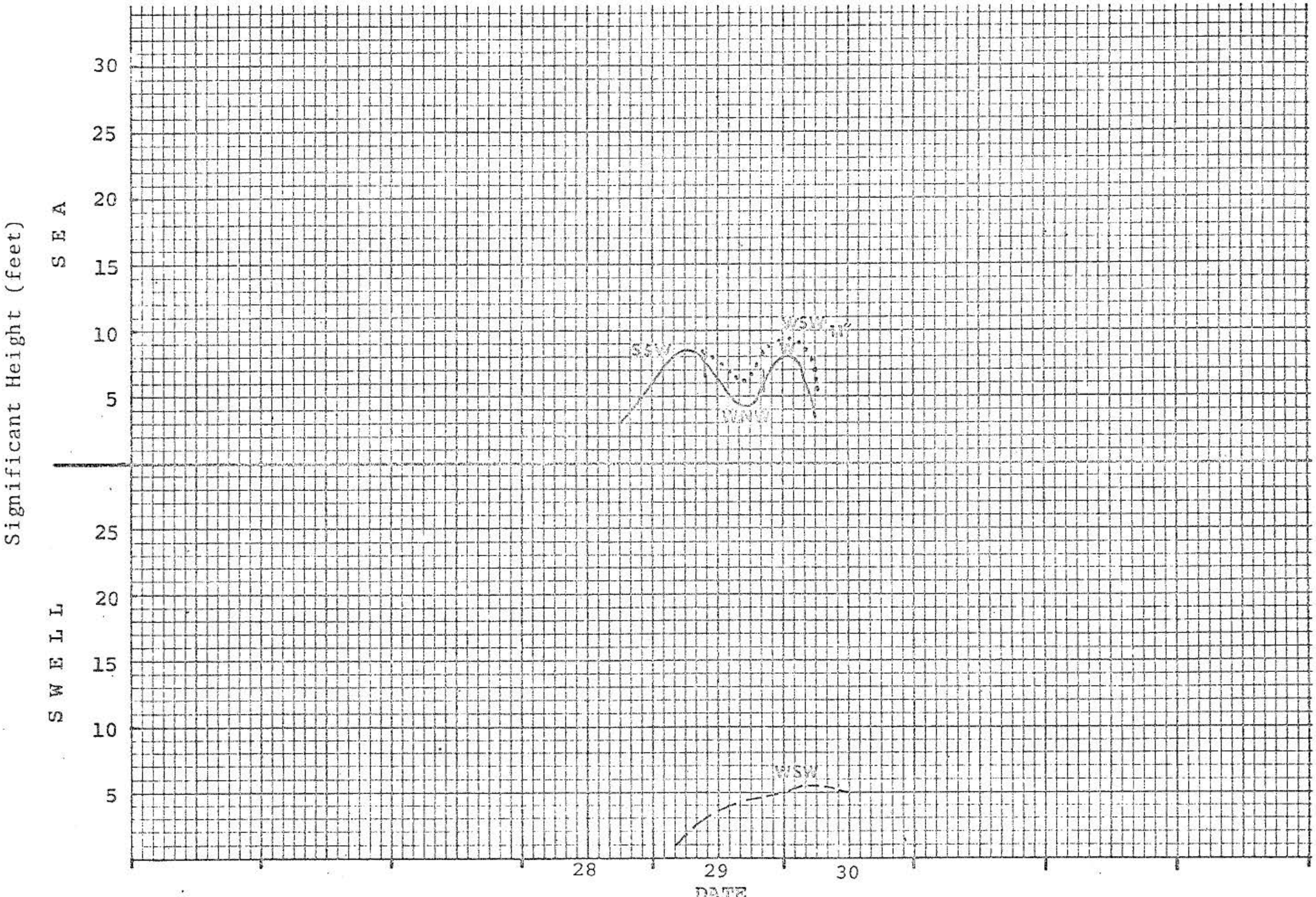
T_s = Significant Wave Period (seconds)

FIGURE 6-I

WAVE HEIGHT PLOT - PLATFORM LOCATION Date DECEMBER 1965

Composite Wave Height ●●●●●

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.



Maximum Storm Characteristics

Station PLATFORM LOCATION Date DECEMBER 1966

				Wave Trains										
Day	Time (GMT)	Wind		Sea		1			2			Composite		
		Kts	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s	θ	H_s	T_s
5	00													
	06													
	12													
	18	16	WSW	3.0	6									
6	00	22	WSW	6.0	7									
	06	24	WSW	8.0	8									
	12	20	WSW	6.5	8									
	18	24	SW	8.0	8									
7	00	20	SW	9.0	8									
	06	20	W	6.0	7									
	12	22	WNW	4.0	6									
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
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	06													
	12													
	18													
	00													
	06													
	12													
	18													
	00													
	06													
	12													
	18													

θ = Direction from which wind blows and waves approach

Kts = Wind Speed (knots)

H_s = Significant Wave Height (feet)

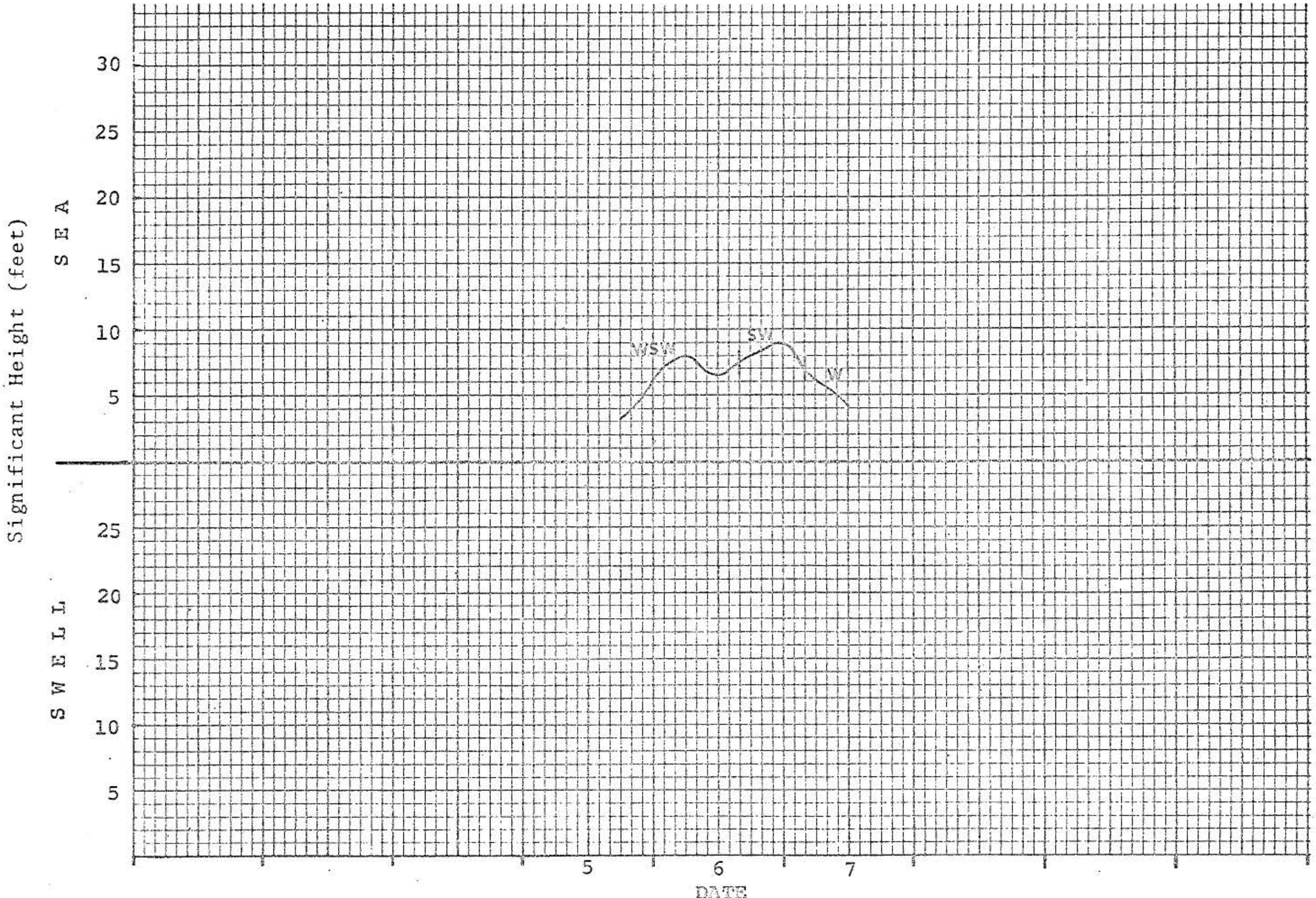
T_s = Significant Wave Period (seconds)

FIGURE 6-J

WAVE HEIGHT PLOT - PLATFORM LOCATION Date DECEMBER 1966

Composite Wave Height ●●●●●.

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.



APPENDIX 6.4

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.4

Study of Ocean Currents Affecting Proposed Pipeline in Santa Barbara Channel, Easterly Route

Oceanographic Services, Inc.

Report #222-2A

June, 1971

OCEANOGRAPHIC SERVICES, INC.

OSI#222-2A
June 1971
Santa Barbara
California

Prepared For:

ESSO PRODUCTION RESEARCH COMPANY

Submitted By:

OCEANOGRAPHIC SERVICES, INC.

STUDY OF OCEAN CURRENTS
AFFECTING PROPOSED PIPELINE
IN SANTA BARBARA CHANNEL

Easterly Route

Richard Kent

Approved: Richard Kent, President

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PREFACE

This report was prepared by Mr. Kenneth M. Schwab under the direction of Dr. Richard C. Miller.

STUDY OF OCEAN CURRENTS AFFECTING PROPOSED PIPELINE IN SANTA BARBARA CHANNEL

Westerly Route

Part 1

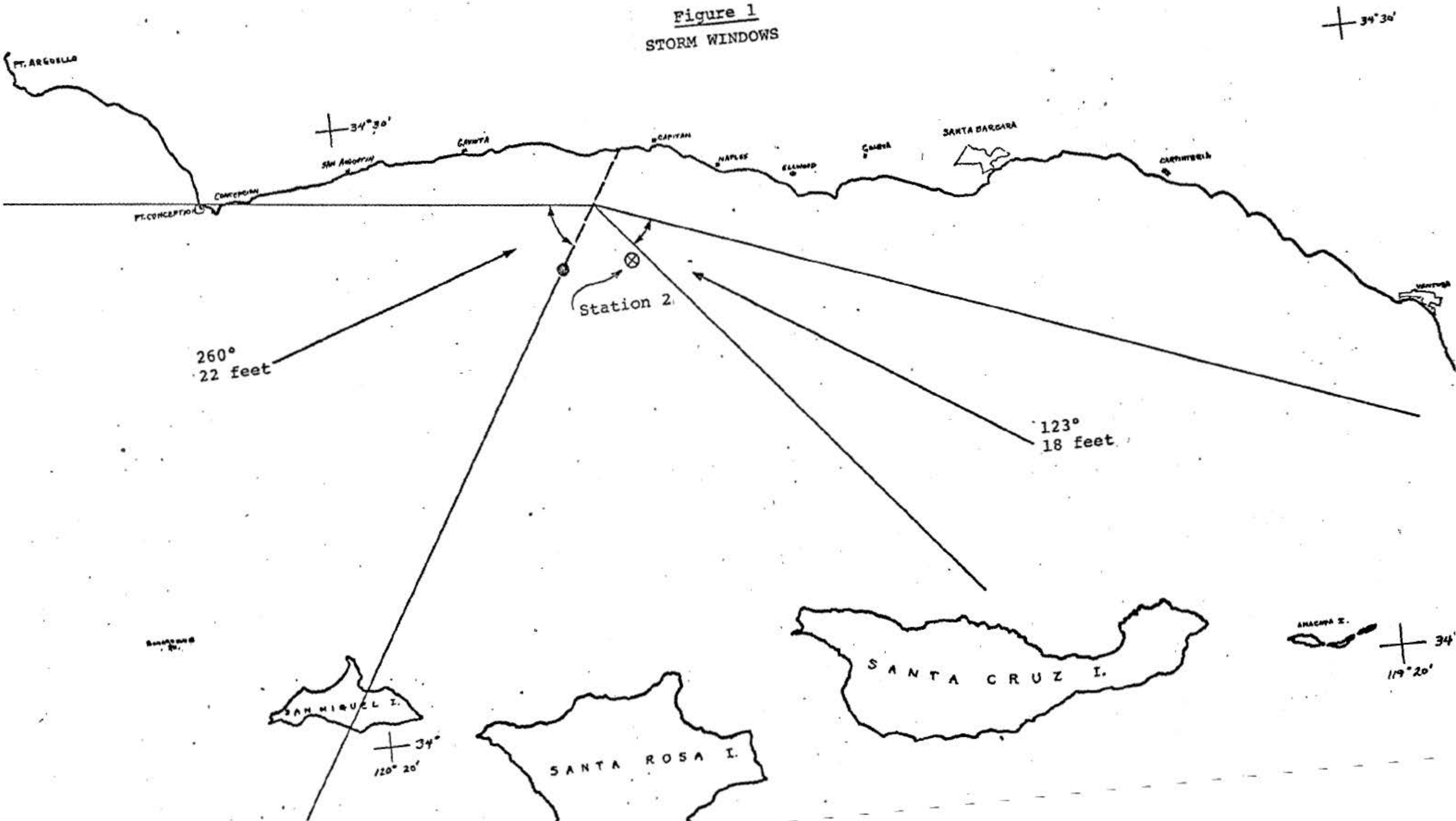
INTRODUCTION

This report is one of two reports in which preliminary design wave statistics and bottom currents are developed for two proposed underwater pipelines offshore of Gaviota in the Santa Barbara Channel. Even though the description of methods and procedures as well as basic wave statistics are common to both pipeline routes, they are reproduced in each report in order that the reports may be used independently.

This report addresses the proposed pipeline route shown in Figure 1. The offshore origin is located at 34°23.4'N latitude, 120°7.1'W longitude in 850 feet of water. The scope of work for developing the design statistics for this pipeline route has been limited to data that were available from local sources and within OSI's library.

Figure 1

STORM WINDOWS



Part 2

SEVERE STORM DATA

The optimum data set for calculating the design wave for a proposed submerged pipeline would consist of long-term, continuous records of wave heights, periods, and durations at the site in question. As usual, these are not available for the area being considered in this report.

When the actual data are not available, it is necessary to use historical records of severe storms for as long a period in time as possible in order to calculate wave statistics. From these sources, a historical record of wave conditions from extreme storms for a particular area can be developed. This technique can yield valuable results when the meteorologists performing the hindcasts have had extensive experience in the specific area. OSI's meteorologists know Santa Barbara Channel well.

The sources of severe storm data used for this study have been taken from a report done by OSI for Esso Production Research Company in March of 1969, "Storm Wave Study, Santa Barbara Channel."

The techniques of hindcasting sea and swell are fully documented in that report and, hence, will not be included here. The sources of storm data were taken from:

1. Meteorological Maps and Wave Records, Oceanographic Services, Inc., 1956-1968.

2. Meteorological Maps, U. S. Weather Bureau, Los Angeles, California, 1940-1956.

3. Meteorological Maps, California Institute of Technology, 1940-1950.

4. Historical Weather Maps, Daily Synoptic Series, U. S. Weather Bureau, 1899-1956.

5. Newspaper Accounts. Los Angeles and Santa Barbara Newspapers, 1890-1956.

Part 3

DEEP WATER WAVE STATISTICS AT THE PIPELINE

Severe storms for a 65-year period (1905-1970) have been reviewed for a location very near the proposed submerged pipeline (see Station 2, Figure 1). In Appendix A, calculated wave data are shown both in graphical and tabular form. Two windows limit the direction of waves that can reach the area of the proposed pipeline (see Figure 1). In general, the pipeline will be vulnerable to southeasterly and westerly waves that attack the pipeline through these windows. Tabulation of wave data from the severe storms (during this 65-year period) for these directions is shown in Table 1. The southeasterly winds generate short period (9-second) waves and, in general, these waves are generated within the channel fetch. The westerly storm waves are longer period (15-second) and are generated over a longer fetch area and, consequently, they are usually larger in amplitude.

Using the theory of statistics of extremes (Gumbel, 1966), recurrence intervals for the significant waves were tabulated. This tabulation is based upon the assumption that all waves smaller than the significant wave occur when the significant wave occurs. Figure 2 shows these results for the westerly waves, and Figure 3 shows the results for the southeasterly waves. Curves fitted to these data show a 100-year significant wave height of 22 feet for the westerly waves and 18 feet for the southeasterly waves.

Due to limitations in sample size, determination of confidence limits for these curves requires more than mathematical treatment. From OSI's experience, it is felt that 90% of the significant waves generated by 100-year storms will fall within $20' < H_s < 22'$

Table 1

SEVERE STORM WAVE DATA

	Date	Θ (degrees True)	H_s (significant height, feet)	T_s (period, sec)
Westerly	Feb 1963	215	20.0	13
	Feb 1959	240	13.5	12
	Apr 1958	270	14.5	11
	" "	270	17.0	15
	" "	270	18.0	15
	Feb 1941	270	12.0	10
	" "	240	17.0	9
	Dec 1916	270	15.0	12
	Feb 1915	240	18.5	10
	" "	270	14.0	11
	Jan 1914	245	15.5	13
	" "	270	12.0	11
	Mar 1912	220	11.0	9
	Mar 1905	240	20.5	14
Southeasterly	Feb 1963	110	10.0	8
	Feb 1959	110	16.0	8
	Feb 1941	110	17.0	8
	Dec 1927	120	17.0	9
	Feb 1915	135	13.5	9
	Jan 1914	135	10.0	8
	Mar 1905	110	18.0	9

Figure 2

OCCURRENCE OF EXTREME WESTERLY WAVES

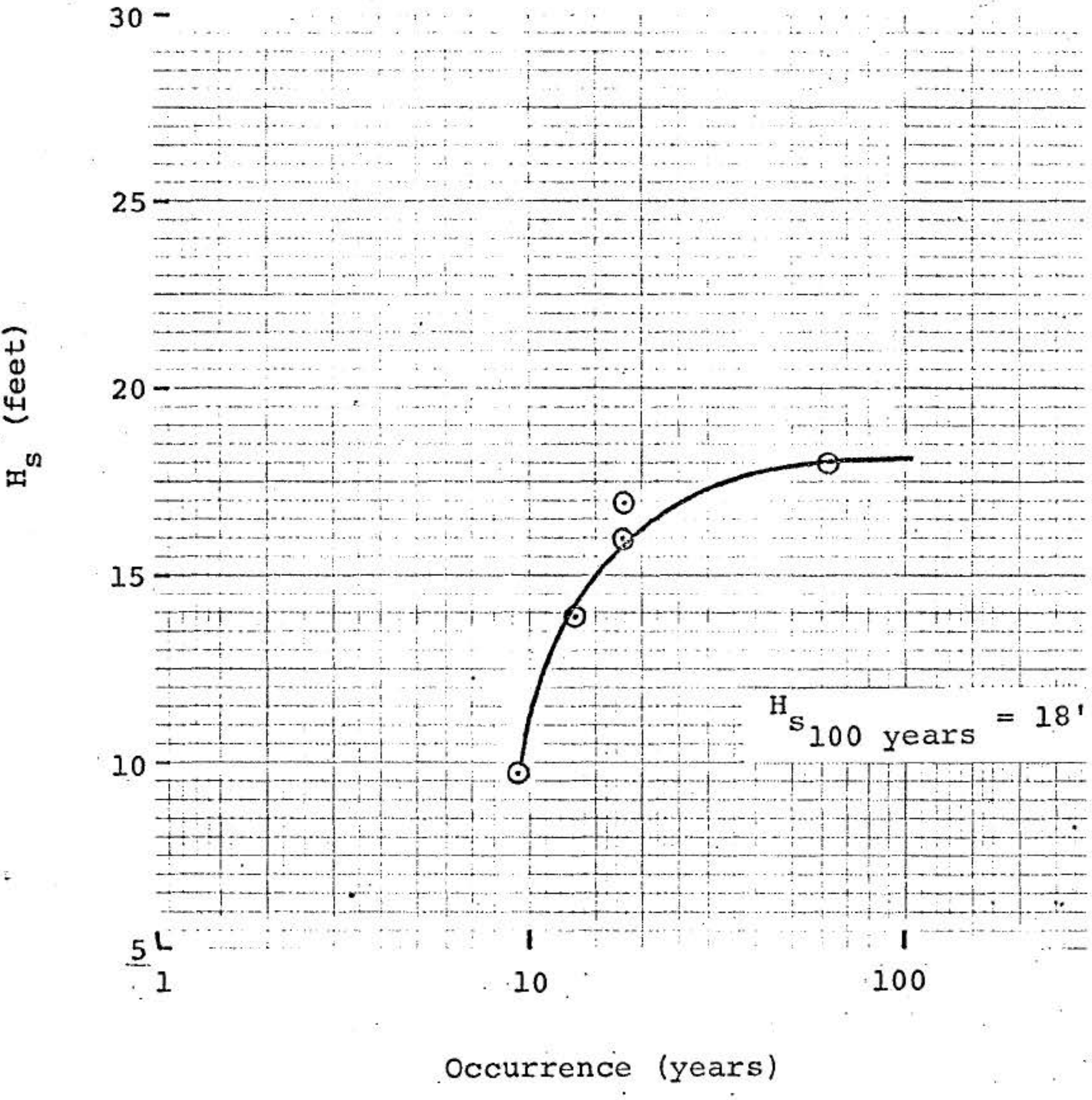
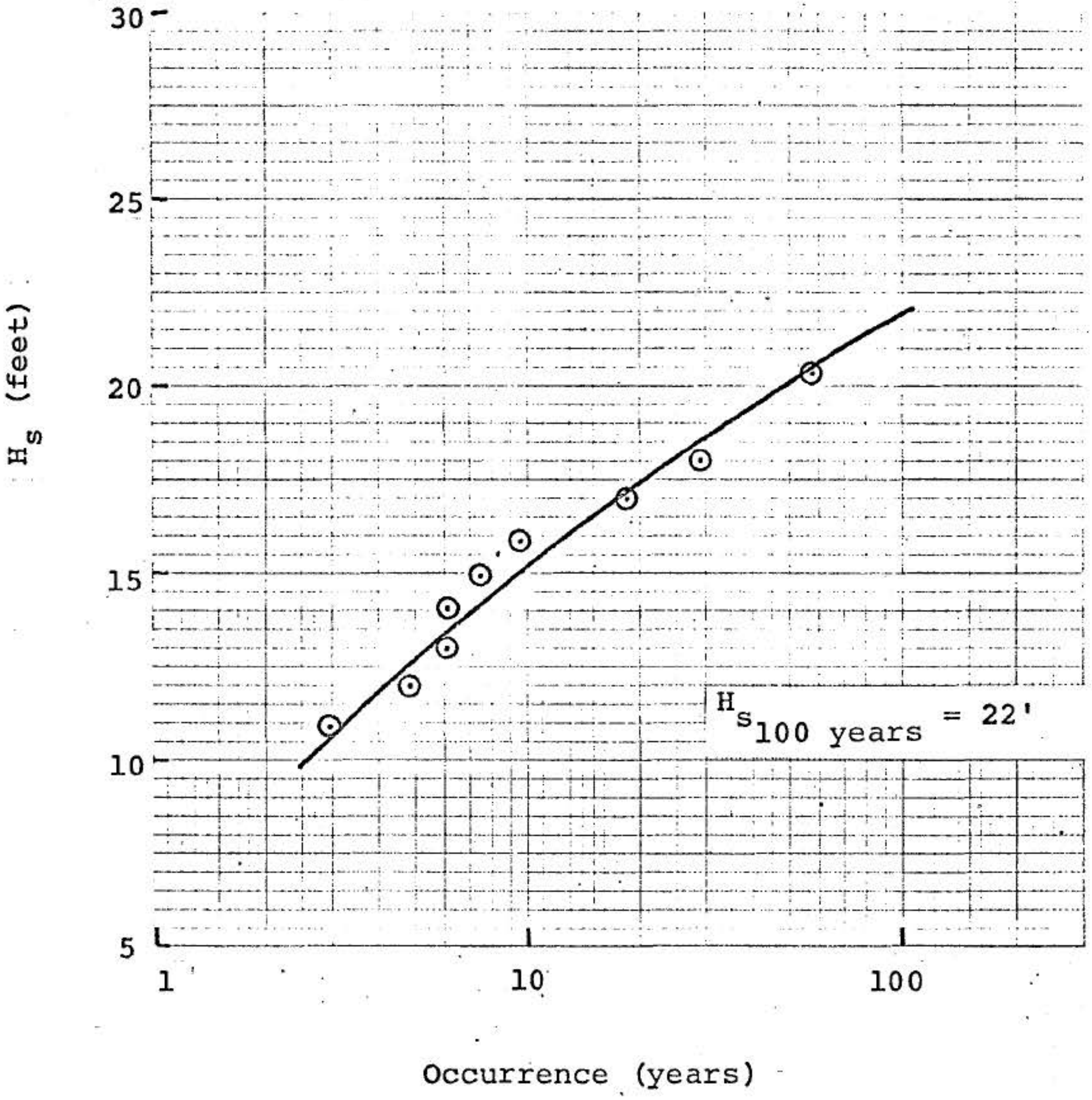


Figure 3

OCCURRENCE OF EXTREME SOUTHEASTERLY WAVES



for the westerly storm and 80% within $17' < H_s < 18'$ for the easterly storm. The low upper bound on these estimates is obtained by noticing the fact that lower waves, like 10 to 14 feet, are likely to go unreported. It is reasonable to allow an occurrence of at least one per year for the 10-foot wave. This would lower the 100-year projections slightly in both the easterly and westerly cases, and this fact is reflected in the confidence limits.

Storm durations for the significant wave heights are plotted in Appendix A. These plots have been reduced to duration intervals for 10-, 15-, and 20-foot (H_s) occurrences shown in Figures 4 and 5. Unfortunately, the data set for the occurrences of storm durations for 15- and 20-foot waves is inadequate to extrapolate with high confidence. From OSI's meteorological experience, and the data presented in Figures 4 and 5, a westerly design duration of 14 hours and an easterly design duration of 7 hours were chosen.

From wave refraction analysis based on the bathymetry shown in Figure 6 (see also Appendix B), it appears that the westerly design direction is 260°, and the southeasterly design direction is 123°.

Complete specifications of the deep water design waves are given in Table 2.

Figure 4

STORM WAVE DURATION FOR WESTERLY STORMS

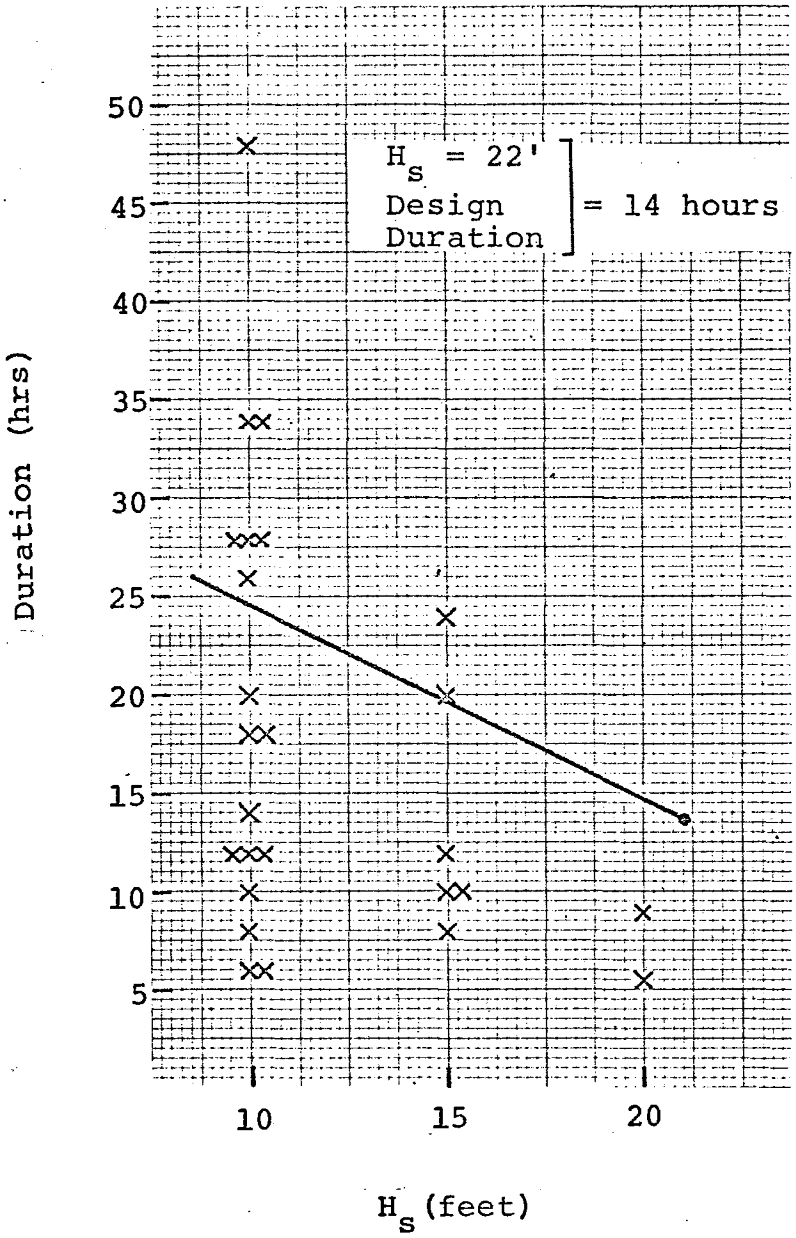
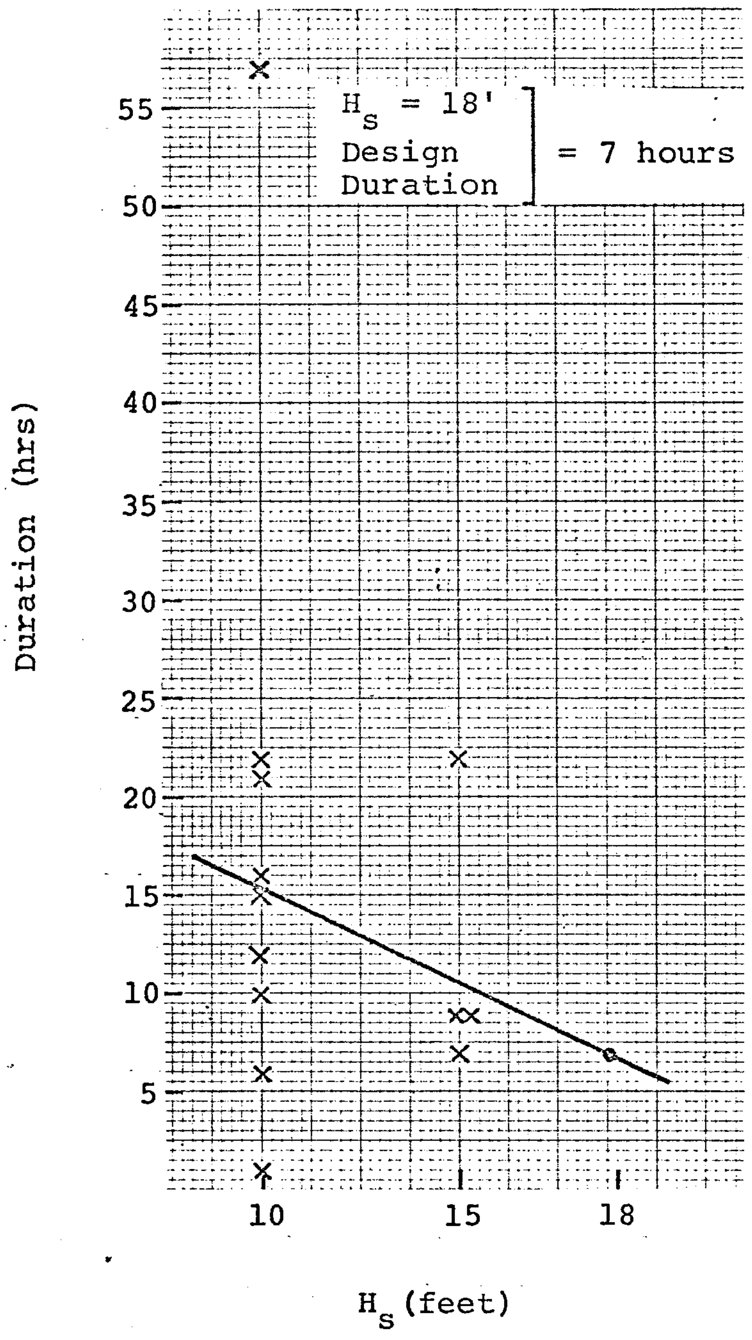


Figure 5

STORM WAVE DURATION FOR SOUTHEASTERLY STORMS



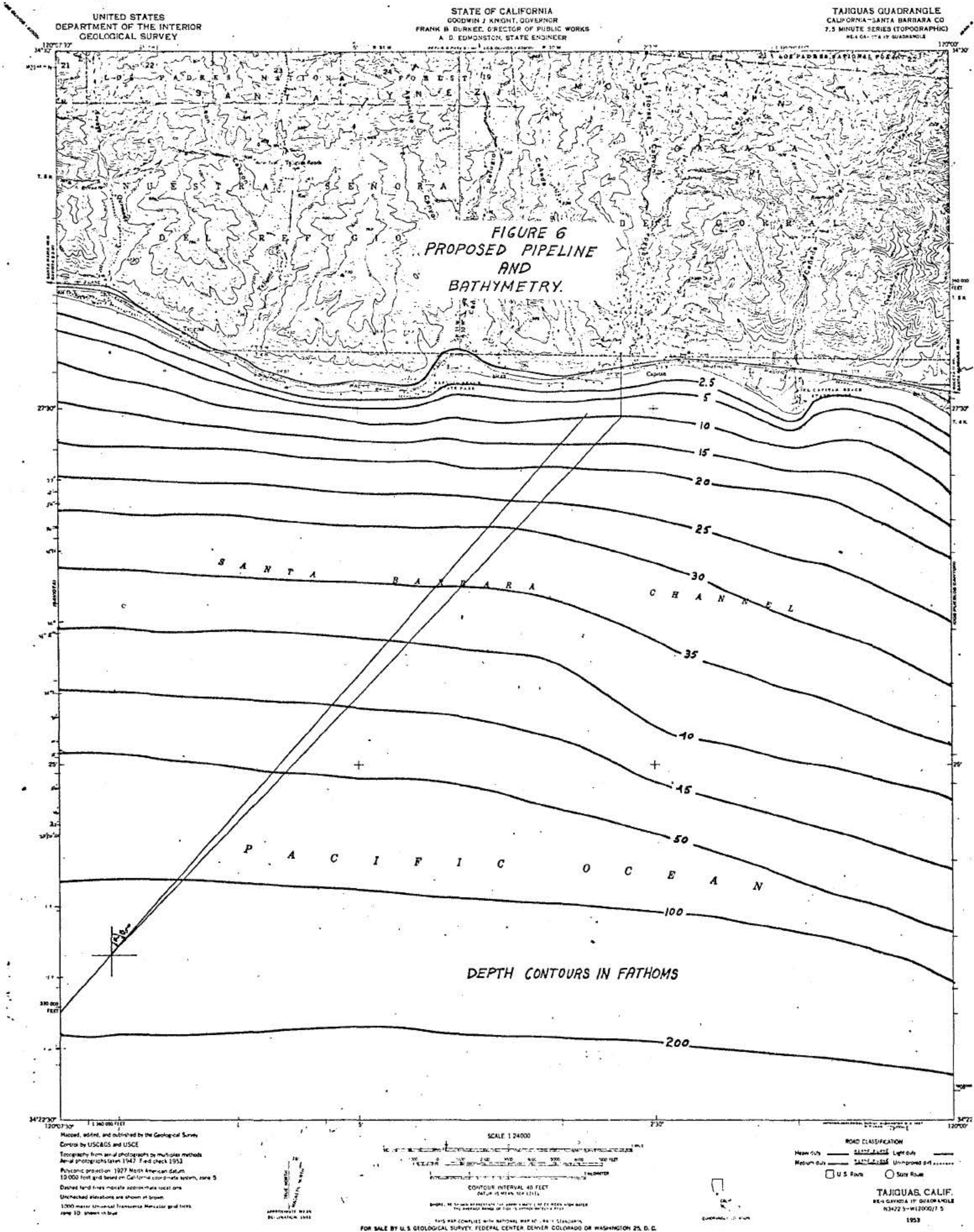


FIGURE 6
PROPOSED PIPELINE AND BATHYMETRY.

Table 2

DEEP WATER DESIGN WAVE

Westerly

θ (degrees True) = 260

H_s (feet) = 22

T_s (seconds) = 16

D_s (duration, hours) = 14

Southeasterly

θ (degrees True) = 123

H_s (feet) = 18

T_s (seconds) = 10

D_s (duration, hours) = 7

Part 4

BOTTOM PARTICLE VELOCITIES ALONG THE PIPELINE

The total current is composed of relative contributions of current caused by wind stress, waves, density variations, bathymetric influences, tides, etc. For the pipeline route under consideration, the following components of current are of significance to the predicted total current: wave induced particle speed (U_A), tidal* current (U_T), and longshore current (U_L).

A discussion of each of these components follows:

A. Wave Induced Particle Speeds (U_A).

A high wave within the wave train can cause failure of a rigid underwater pipeline. The design wave height in this case should be based upon H_1, the average of the highest 1% of all waves occurring in the 100-year storm ($H_1 = 1.67\ H_s$). If the underwater pipeline has been designed to tolerate some flexure (i.e., it can be considered as a semi-rigid structure), the design wave height then can be selected within a range of H_{10} ($1.27\ H_s$) to H_1. For this study, the calculation of particle velocities will be based on H_1.

Airy theory was used to calculate the maximum horizontal bottom speeds along the pipeline. These calculations are given in Tables 5 and 6. The angles of these motions with respect to the pipeline are based upon refraction analysis (See Appendix B).

---

*The "Tidal" component is taken to include dynamic topography and conservation of potential vorticity, as well as the component induced by planetary tides.

B. Tidal Currents (U_T).

The qualification placed upon "Tidal" current was briefly outlined in the footnote. This component of current is composed of drift current caused by average wind stress, density currents, and the astronomical tidal effect. The values of U_T, shown in Tables 4 and 6, are based primarily on empirical experience.

C. Longshore Currents (U_L).

This current is confined primarily to the surf zone, moves essentially parallel to shore, and is usually generated by waves breaking essentially nonparallel to shore. Seaward return flow, including rip currents, can cause an extension of the "longshore" current seaward into depths deeper than 100 feet.

The estimates of longshore current given in Table 4 are based strictly on OSI's experiences in the Santa Barbara Channel area. It is OSI's professional opinion that a 100-year storm will not cause longshore currents higher than these estimates.

The vectorial summation of these components (see Tables 4 and 6) yield the predicted bottom currents given in Figure 7. The calculations relating to these vector summations are given in Table 5. The bottom current estimates (both speed and direction) given at 720 feet on this profile are valid for 850 feet as well. The profile shown in Figure 7 has its origin at a point coincident with, but slightly inshore of, the 850-foot location presently being considered.

Table 3 gives bottom-current extremes observed by Esso during 1969 and 1970. These values are representative of normal year conditions and do not reflect any 100-year storm situations.

Part 5

CONFIDENCE LIMITS

As stated previously, the bottom speeds shown in Figure 7 are based upon the average wave height of the highest 1% of all waves occurring in the 100-year storm, the maximum tidal current to be expected, and the maximum wave-induced longshore current. The data base upon which each of these predictions is based naturally affects the confidence criterion placed on the design bottom currents given in Figure 7.

The limitations in confidence on the particle velocities induced by waves alone are discussed on page 3-1. These results imply that approximately 90% of all 100-year storms will generate significant waves equal to or less than the predicted H_s, or 9 out of 10 one hundred-year storms will produce particle velocities (wave-induced only) equal to or less than predicted in Table 4.

It is more difficult to establish quantitative confidence limits on the maximum bottom tidal currents since the data base is severely limited. However, from an analysis of the dynamic topographies, and conservation of potential vorticity for this area, it is reasonable to assume that 90% of all 100-year storms will generate bottom currents less than those predicted.

The nearshore currents will affect only the two nearshore stations shown in Figure 7. These predictions are based on empirical experience only.

Table 3

CURRENT DATA EXTREMES

Date	Block	Depth/Bottom (feet)	Speed (knots)	Direction (degrees True)
Sep 5 1969	190-3	1200/1245	.24	270
Dec 4 1969	186-3	585/629	.38	270
Dec 24 1969	186-3	585/629	.44	270
Dec 28 1969	186-3	585/629	.44	260
Sep 2 1969	?	700/730	.26	145
Sep 8 1969	?	700/730	.28	170
Sep 12 1969	?	700/730	.34	160
Oct 9 1969	?	700/730	.28	70
Nov 27 1969	197-3	700/730	.19	40
Dec 27 1969	185	900/913	.36	160

Figure 7

HORIZONTAL BOTTOM PARTICLE VELOCITIES

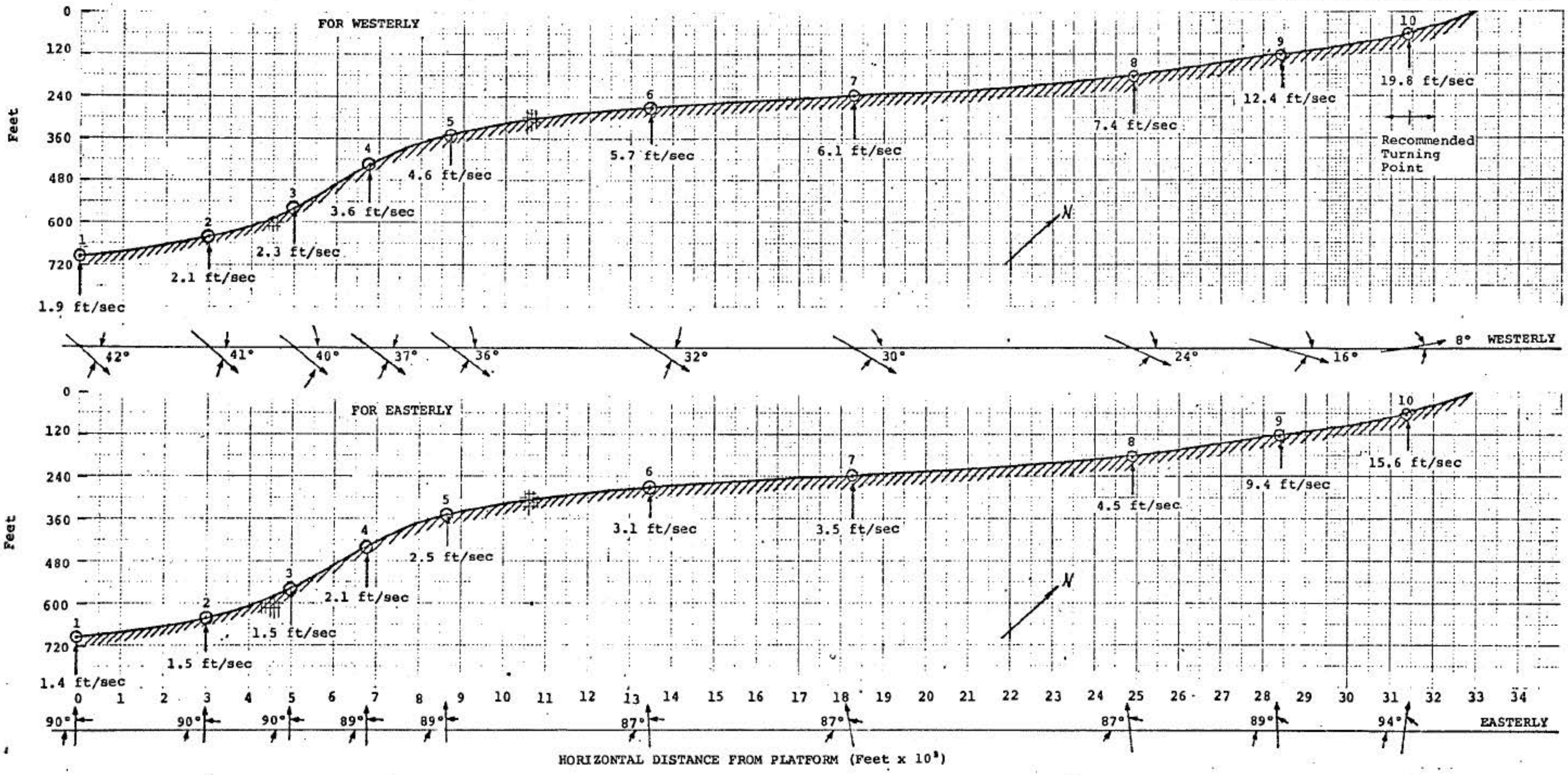


Table 4

BOTTOM PARTICLE SPEEDS AND DIRECTIONS

	Station	Depth	U_T	θ_T	U_A	θ_A	U_L	θ_L	U_R	θ_R
Westerly	1	700	1.40	45	.49	32	--	--	1.87	42
	2	650	1.45	45	.63	31	--	--	2.07	41
	3	600	1.50	45	.79	30	--	--	2.26	40
	4	430	2.00	45	.95	28	--	--	3.63	37
	5	350	2.25	45	2.36	27	--	--	4.55	36
	6	270	2.45	45	3.32	22	--	--	5.65	32
	7	240	2.50	45	3.79	20	--	--	6.13	30
	8	180	2.60	45	5.04	13	--	--	7.37	24
	9	120	2.70	45	7.17	5	3	16	12.37	16
	10	60	3.00	45	12.56	0	5	8	19.83	8
Easterly	1	700	1.40	90	--	--	--	--	1.40	90
	2	650	1.45	90	--	--	--	--	1.45	90
	3	600	1.50	90	--	--	--	--	1.50	90
	4	430	2.00	90	.10	75	--	--	2.10	89
	5	350	2.25	90	.26	75	--	--	2.50	89
	6	270	2.45	90	.69	76	--	--	3.12	87
	7	240	2.50	90	.97	78	--	--	3.50	87
	8	180	2.60	90	1.92	83	--	--	4.50	87
	9	120	2.70	90	3.69	88	3	89	9.39	89
	10	60	3.00	90	7.63	96	5	94	15.62	94

U_T , θ_T = Maximum tidal speed (ft/sec) and direction (degrees) at bottom with respect to the pipeline.*

U_A , θ_A = Particle speed (ft/sec) and direction (degrees) at bottom based upon Airy theory.

U_L , θ_L = Longshore component of speed (ft/sec) and direction (degrees) at bottom, based upon empirical data.

U_R , θ_R = Vector summation of Tidal, Airy, and Longshore components of speed and direction at the bottom.

---

*The tidal component is taken to include dynamic topography, conservation of potential vorticity, and the component induced by planetary tides.

Table 5

AIRY ANALYSIS

Westerly Waves

L_o = 1310.72

H_o = 36.74

T = 16

Station	d	$\frac{d}{L_o}$	$\frac{d}{L}$	L	$\frac{H}{H_o}$	H	Hπ/T	sinh kd	U Bottom
1	700	.534	.535	1307.68	.993	36.48	7.16	14.43	.49
2	650	.496	.498	1305.22	.990	36.37	7.14	11.39	.63
3	600	.458	.461	1302.08	.986	36.22	7.11	9.02	.79
4	430	.328	.338	1272.19	.958	35.20	6.91	4.12	1.68
5	350	.267	.283	1238.06	.938	34.46	6.76	2.87	2.36
6	270	.206	.230	1173.91	.920	33.80	6.63	2.00	3.32
7	240	.183	.211	1138.52	.915	33.61	6.60	1.74	3.79
8	180	.137	.170	1044.08	.916	33.65	6.60	1.31	5.04
9	120	.092	.130	895.52	.940	34.54	6.78	.95	7.17
10	60	.046	.090	667.41	1.038	38.14	7.49	.60	12.56
Easterly Waves		L_o = 512							
		H_o = 30.06							
		T = 10							
1	700	1.367	--	--	--	--	--	--	--
2	650	1.270	--	--	--	--	--	--	--
3	600	1.172	--	--	--	--	--	--	--
4	430	.840	.840	511.90	1.000	30.06	9.44	97.43	.10
5	350	.684	.684	511.70	.999	30.03	9.43	35.90	.26
6	270	.527	.528	511.36	.993	29.85	9.37	13.67	.69
7	240	.469	.472	508.47	.987	29.67	9.32	9.65	.97
8	180	.352	.360	500.00	.965	29.01	9.11	4.74	1.92
9	120	.234	.254	472.44	.927	27.87	8.75	2.37	3.69

U = horizontal particle speed at bottom (ft/sec)

$$U_{(z)} = \frac{\pi H}{T} \frac{\cosh k(d + z)}{\sinh kd}$$

d/L_o = ratio of the depth of water at a location to the wave length in deep water.

d/L = ratio of the depth of water at a location to the wave length at the same location.

H/H_o = ratio of the wave height in shallow water to wave height in deep water.

$k = 2\pi/_L$

<u>Table 6</u>

TIDAL AND AIRY VECTOR SUMMATIONS

		Tidal						Airy						Resultant					
	Station	U_T	θ_T	$\cos\theta$	$\sin\theta$	U_x^T	U_y^T	U_A	θ_A	$\cos\theta$	$\sin\theta$	U_x^A	U_y^A	U_{Rx}	U_{Ry}	U_{Rx}/U_{Ry}	θ	$\sin\theta$	U_R^{AT}
Westerly	1	1.40	45	.707	.707	.99	.99	.49	32	.848	.529	.41	.26	1.40	1.24	1.125	41°38'	.664	1.87
	2	1.45	45	.707	.707	1.03	1.03	.63	31	.857	.515	.54	.32	1.57	1.35	1.163	40°41'	.652	2.07
	3	1.50	45	.707	.707	1.06	1.06	.79	30	.866	.500	.68	.40	1.74	1.45	1.198	39°51'	.641	2.26
	4	2.00	45	.707	.707	1.41	1.41	1.68	28	.883	.469	1.48	.79	2.89	2.20	1.313	37°18'	.606	3.63
	5	2.25	45	.707	.707	1.59	1.59	2.36	27	.891	.454	2.10	1.07	3.69	2.66	1.387	35°47'	.585	4.55
	6	2.45	45	.707	.707	1.73	1.73	3.32	22	.927	.375	3.08	1.25	4.81	2.98	1.614	31°47'	.527	5.65
	7	2.50	45	.707	.707	1.77	1.77	3.79	20	.939	.342	3.56	1.29	5.32	3.06	1.738	29°55'	.499	6.13
	8	2.60	45	.707	.707	1.84	1.84	5.04	13	.974	.225	4.91	1.13	6.74	2.97	2.269	23°47'	.403	7.37
	9	2.70	45	.707	.707	1.91	1.91	7.17	5	.996	.087	7.14	.62	9.04	2.53	3.575	15°38'	.270	9.37
	10	3.00	45	.707	.707	2.12	2.12	12.56	0	1.000	0.000	12.56	0.00	14.68	2.12	6.921	8°14'	.143	14.83
Easterly	1	1.40	90	0.000	1.000	0	1.40	--	--	--	--	--	--	--	--	--	-- --	--	--
	2	1.45	90	0.000	1.000	0	1.45	--	--	--	--	--	--	--	--	--	-- --	--	--
	3	1.50	90	0.000	1.000	0	1.50	--	--	--	--	--	--	--	--	--	-- --	--	--
	4	2.00	90	0.000	1.000	0	2.00	.10	75	.259	.966	.02	.10	.02	2.10	.009	89°29'	1.000	2.10
	5	2.25	90	0.000	1.000	0	2.25	.26	75	.259	.966	.06	.25	.06	2.50	.026	88°32'	.999	2.50
	6	2.45	90	0.000	1.000	0	2.45	.69	76	.241	.970	.17	.67	.17	3.12	.054	86°55'	.999	3.12
	7	2.50	90	0.000	1.000	0	2.50	.97	78	.208	.978	.20	.94	.20	3.44	.058	86°41'	.998	3.45
	8	2.60	90	0.000	1.000	0	2.60	1.92	83	.122	.993	.23	1.90	.23	4.50	.051	87°05'	.999	4.50
	9	2.70	90	0.000	1.000	0	2.70	3.69	88	.035	.999	.13	3.68	.13	6.38	.020	88°51'	.999	6.39
	10	3.00	90	0.000	1.000	0	3.00	7.63	96	.995	.105	-.80	7.59	-.80	10.59	.075	94°18'	.997	10.62

Part 6

REFERENCES

Gumbel, E. J., Statistics of Extremes, Columbia University Press, (1958).

McCowan, J., "On the Solitary Wave," Phil., Mag. J. Sci., Vol. 38, p. 1351 (London, Edinburgh, and Dublin, 1891).

Kinsman, B., Wind Waves, Prentice-Hall Inc. (1965).

Laitone, E. V., "Limiting Conditions for Cnoidal and Stokes Waves," J. Geophys. Res., Vol. 67 (4):1555 (1962).

Munk, W. H., "The Solitary Wave and Its Application to Surf Problems," Ann. N. Y. Acad. Sci., Vol 51, p. 376 (1948).

APPENDIX A

Severe storm wave characteristics for Station 2 in Block 331, directly offshore of El Capitan, (see Figure 1) are tabulated and plotted on the following pages.

TABLE 2-A

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Mar 1905

Day	Time	Wave Train							
		1 (110^0)*		2 (240^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	1.0	2						
	22	9.0	7						
12	04	18.0	9						
	10	14.5	8						
	16	12.0	7	8.5	9				
	22	5.0	5	20.0	15				
13	04			20.5	14				
	10			19.5	13				
	16			14.0	11				
	22			8.5	8				
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-A

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.

TABLE 2-B

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Mar 1912

Day	Time	Wave Train							
		1 (110^0)*		2 (220^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
11	04								
	10								
	16	6.0	6						
	22	9.5	8						
12	04	13.5	8						
	10	17.0	9	5.0	7				
	16	9.0	8	11.0	9				
	22			7.0	7				
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-B

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

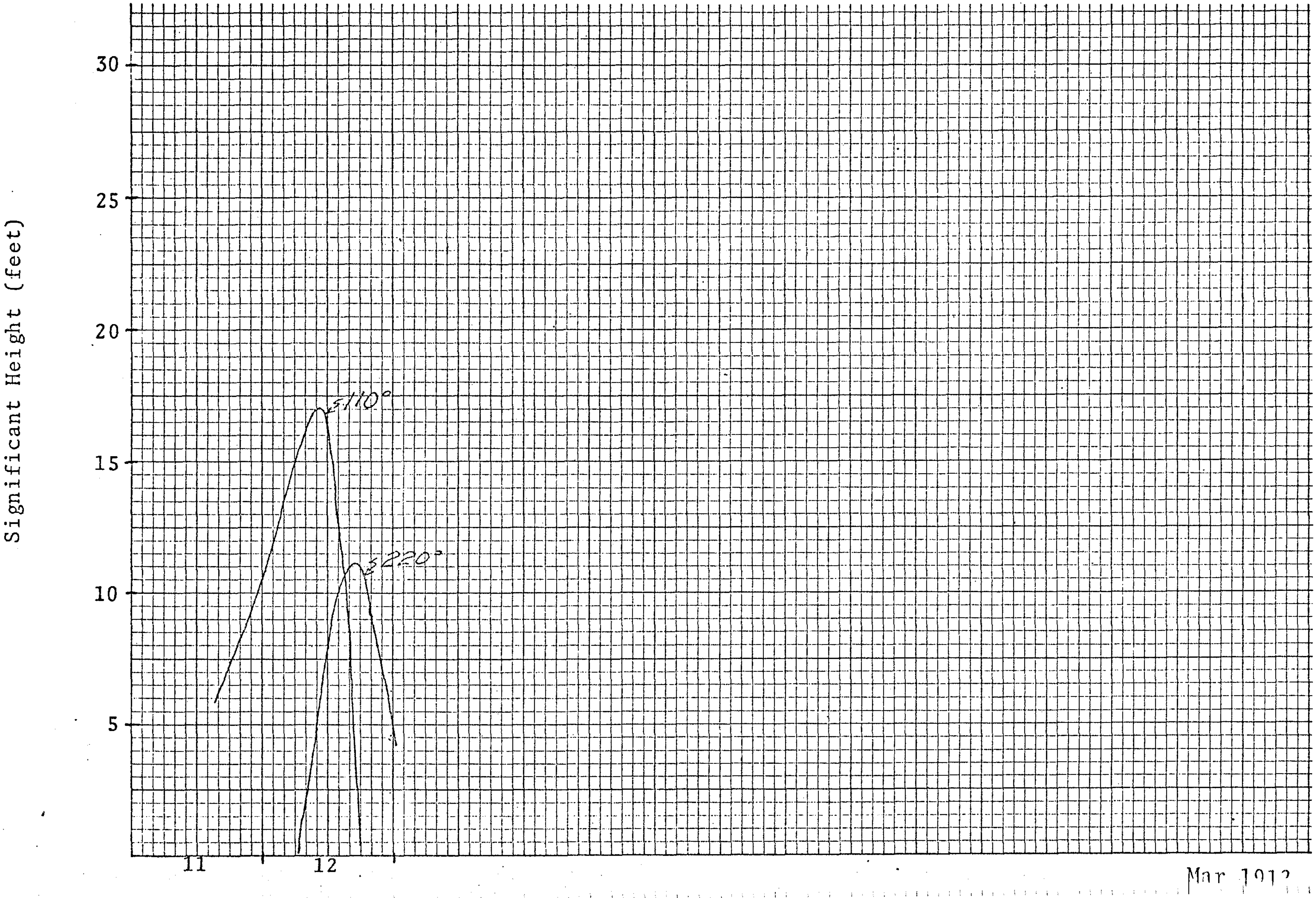


TABLE 2-C

SANTA BARBARA CHANNEL

SEVERE STORM WAVE CHARACTERISTICS

SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Jan 1914

Day	Time	Wave Train							
		1 (135°)*		2 (245°)		3 (270°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
25	04	10.0	8						
	10	8.0	7	9	10				
	16	7.0	6	15.5	12				
	22	5.0	6	15.5	13				
26	04	4.0	5	14.5	13				
	10			14.0	12				
	16			~~8.0~~	~~10~~	12.0	11		
	22					12.0	10		
27	04					12.0	10		
	10					11.5	10		
	16					10.5	10		
	22					10.0	10		
28	04					8.5	8		
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-C

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

TABLE 2-D
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1915

Day	Time	Wave Train							
		1 (270°)*		2 (240°)		3 (135°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04			4.5	6				
	10	5.0	18	6.0	7				
	16	7.5	17	10.5	9				
	22	10.5	16	10.0	9	10.5	7		
2	04	10.0	13	10.0	9	13.0	8		
	10	9.5	12	10.5	10	13.5	9		
	16	8.5	11	18.5	10	5.0	8		
	22	7.5	15	16.0	8				
3	04	13.5	12	7.0	7				
	10	14.0	11						
	16	11.5	9						
	22	9.0	8						
	04	7.0	7						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-D

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

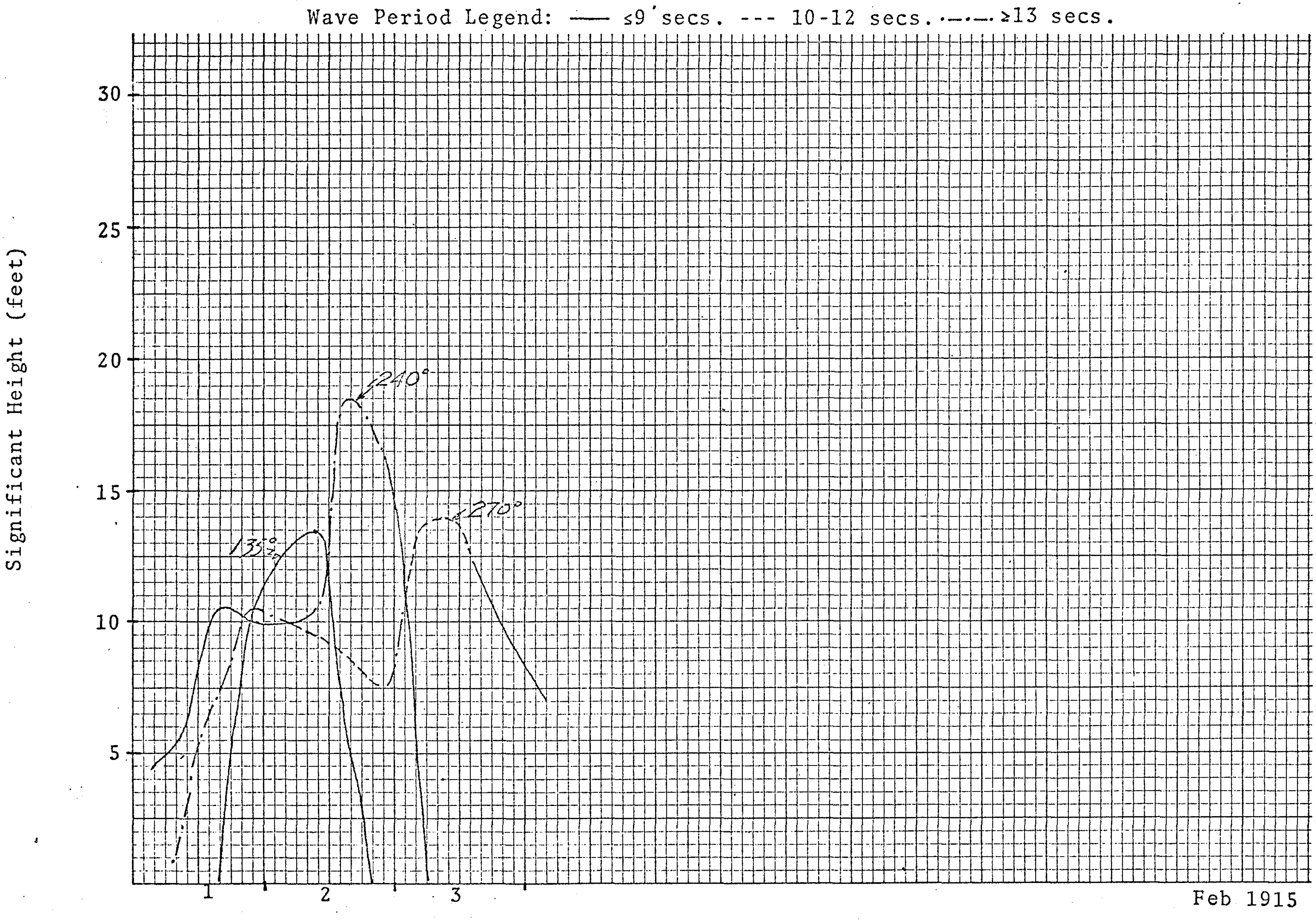


TABLE 2-E
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Dec 1916

Day	Time	Wave Train							
		1 (270°)*		2 (240°)		3 (135°)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
23	04								
	10								
	16	6.0	9						
	22	8.5	10			9.5	7		
24	04	12.5	12			11.0	7		
	10	11.0	11			11.0	7		
	16	7.5	9	8.0	8				
	22	15.0	12	5.0	7				
25	04	12.5	12						
	10	10.0	12						
	16	10.0	12						
	22	10.0	11						
26	04	5.0	8						
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-E

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

TABLE 2-F
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Dec 1927

Day	Time	Wave Train							
		1 (120°)*		2 ( )		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
24	04	8.0	6						
	10	13.0	8						
	16	14.0	8						
	22	15.5	8						
25	04	16.5	8						
	10	17.0	9						
	16	17.0	9						
	22	14.0	8						
26	04	13.0	8						
	10	13.0	8						
	16	8.0	7						
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-F

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. ·—·— ≥13 secs.

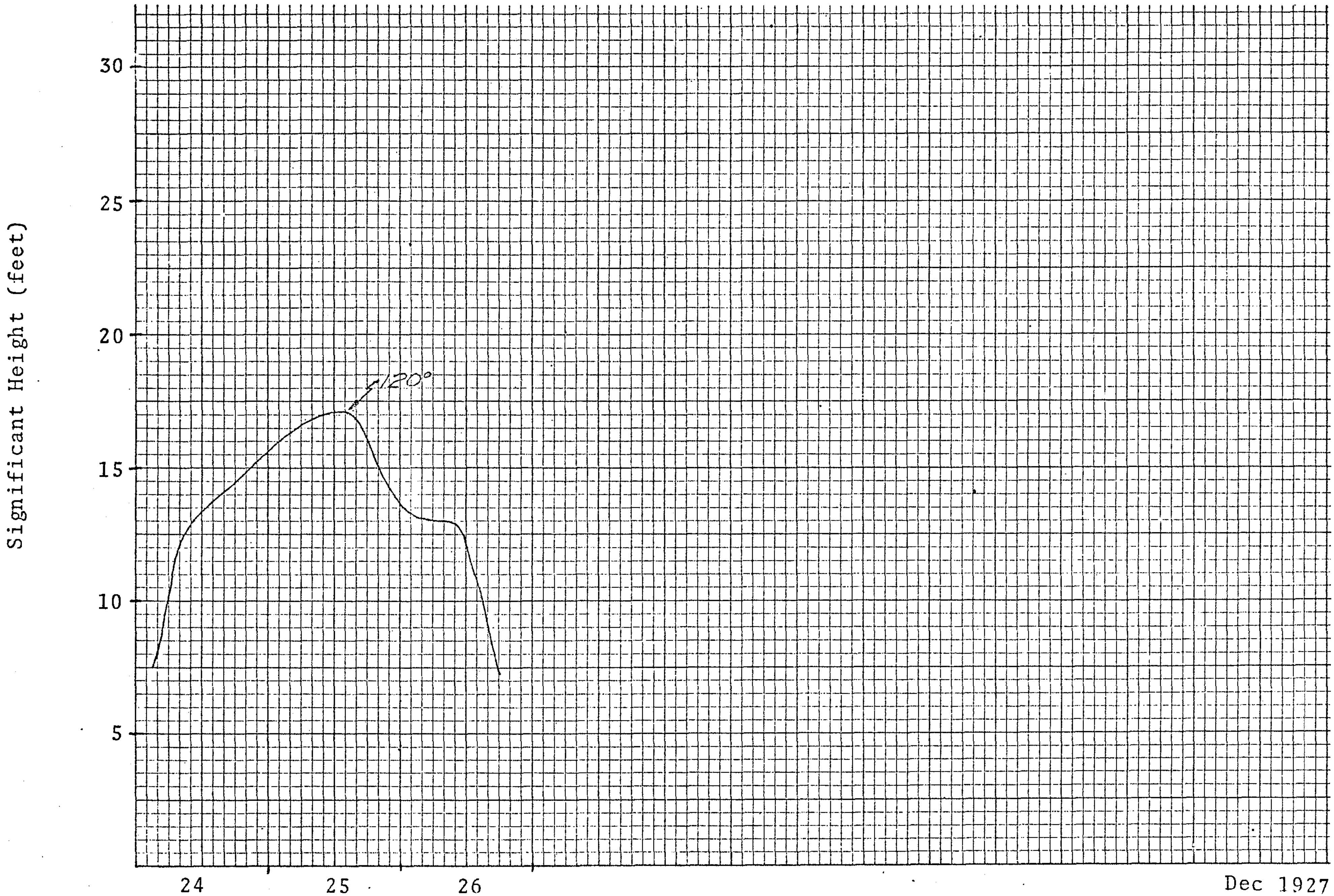


TABLE 2-G
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb - Mar 1941

Day	Time	Wave Train							
		1 (110^0)*		2 (240^0)		3 (270^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
27	04	4.0	5						
	10	8.0	7						
	16	10.5	7						
	22	15.0	8						
28	04	17.0	8	6.0	8				
	10	5.0	6	9.5	9				
	16			11.0	10				
	22			11.0	10	6.5	6		
1	04			4.0	7	12.0	10		
	10					12.0	10		
	16					12.0	10		
	22					12.0	10		
2	04					11.0	10		
	10					7.5	9		
	16					4.5	8		
	22					3.0	8		
3	04	5.0	5						
	10	9.5	7						
	16	13.0	8						
	22	9.5	7						
4	04			17.0	9				
	10			12.0	8	7.5	7		
	16			5.0	7	10.5	9		
	22					9.5	8		
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-G

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

Wave Period Legend: —— ≤9 secs. --- 10-12 secs. —·—·— ≥13 secs.

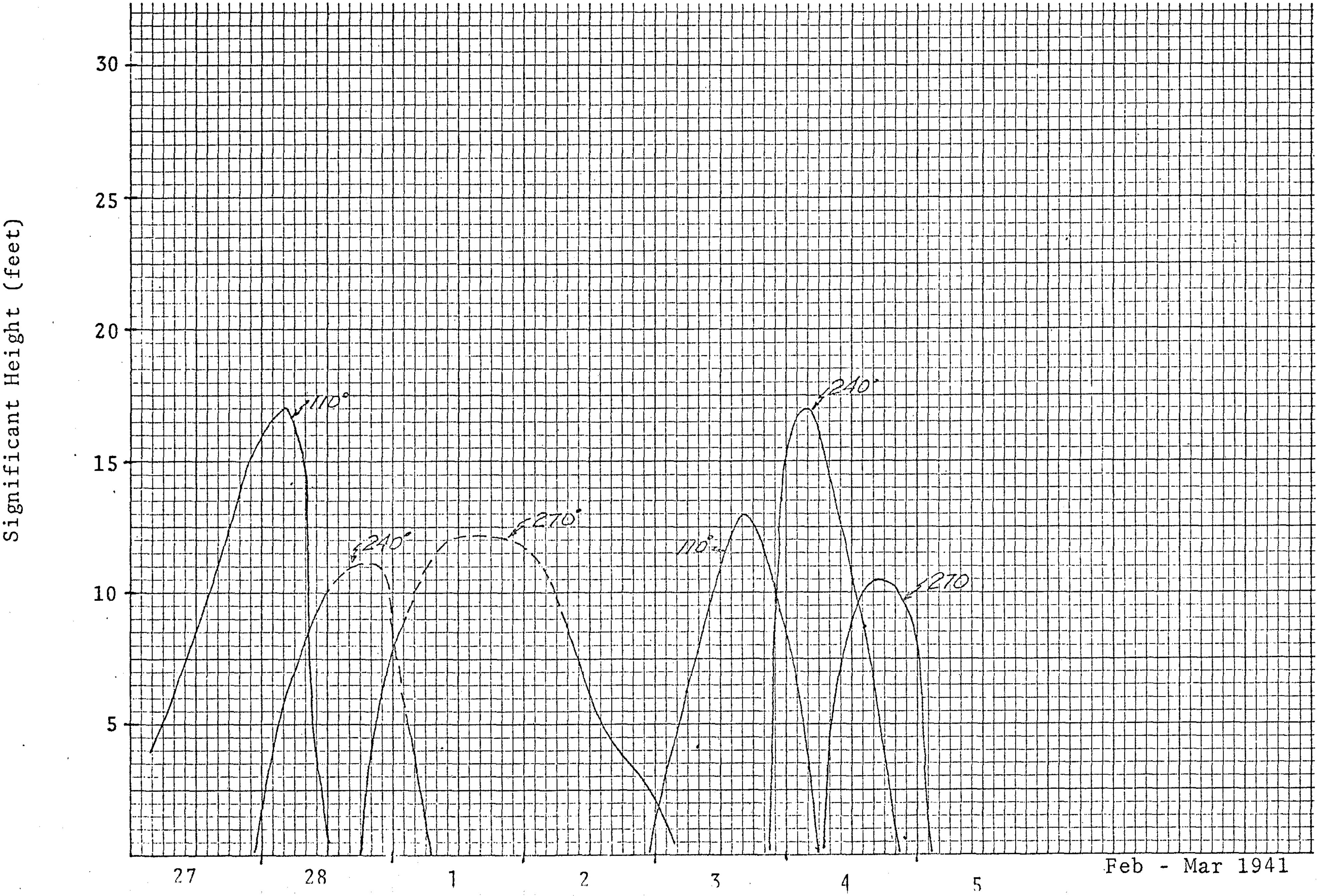


TABLE 2-H
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Apr 1958

Day	Time	Wave Train							
		1 (270^0)*		2 (135^0)		3 (110^0)		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
1	04								
	10								
	16	11.0	13						
	22	14.5	11						
2	04	14.0	13						
	10	14.0	12	4.5	5				
	16	12.0	11	7.5	7				
	22	9.0	10	9.0	7				
3	04	6.5	9	9.0	7				
	10	9.5	13						
	16	14.0	13						
	22	15.0	12						
4	04	16.5	11						
	10	17.0	15						
	16	16.5	14						
	22	15.0	13						
5	04	13.0	12						
	10	11.0	11						
	16	9.0	10	4.0	4				
	22	7.0	9	6.0	6				
6	04	6.0	9						
	10	5.0	8			4.0	5		
	16	14.0	17			9.5	7		
	22	18.0	15			6.5	6		
7	04	15.0	12			4.0	3		
	10	10.0	10						
	16	6.5	9						
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-H

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

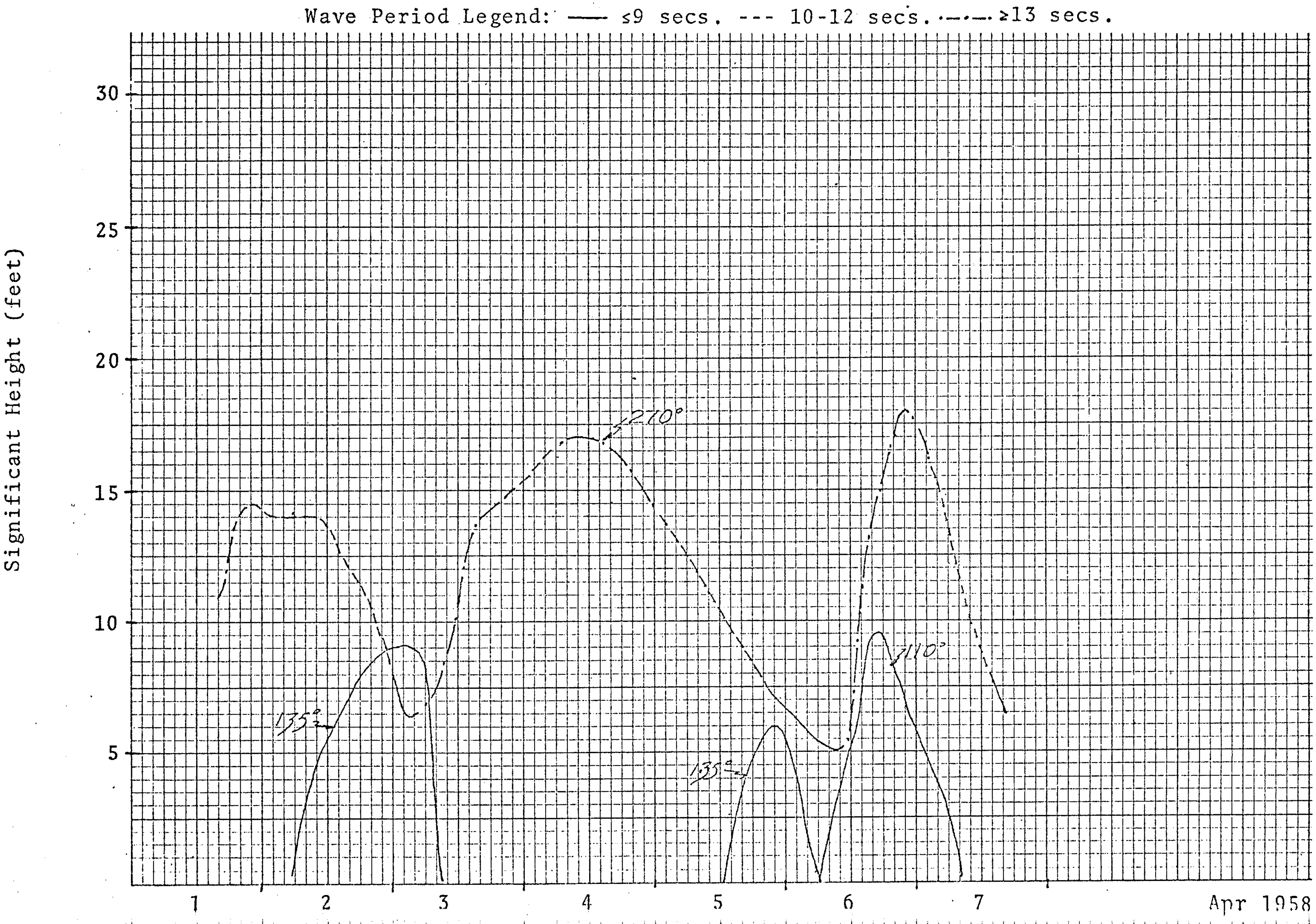


TABLE 2-I
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1959

Day	Time	Wave Train							
		1 (110^0)*		2 (240^0)		3 ( )		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
15	04	6.5	6						
	10	10.0	7						
	16	13.0	8						
	22	16.0	8	6.5	14				
16	04	16.0	8	13.5	12				
	10	5.0	6	12.0	10				
	16			8.0	8				
	22			5.0	8				
	04								
	10								
	16								
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	04								
	10								
	16								
	22								

*approach direction

Figure 2-I

WAVE HEIGHT PLOT: STATION 2 BLOCK 331

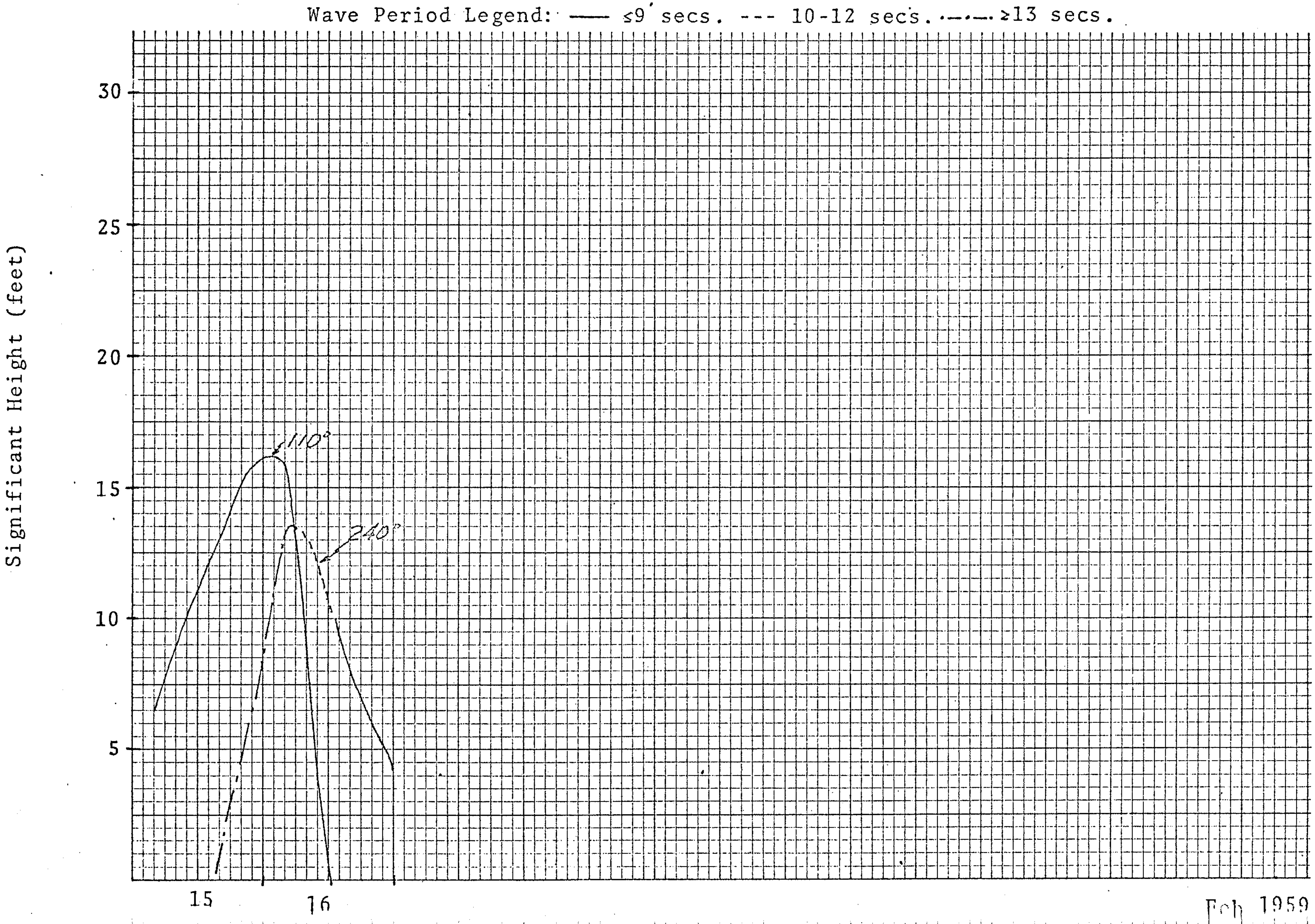


TABLE 2-J
SANTA BARBARA CHANNEL
SEVERE STORM WAVE CHARACTERISTICS
SIGNIFICANT WAVE HEIGHT, H_s, (ft.) AND PERIOD, T_s, (sec.)

Station 2 Block 331 Date Feb 1963

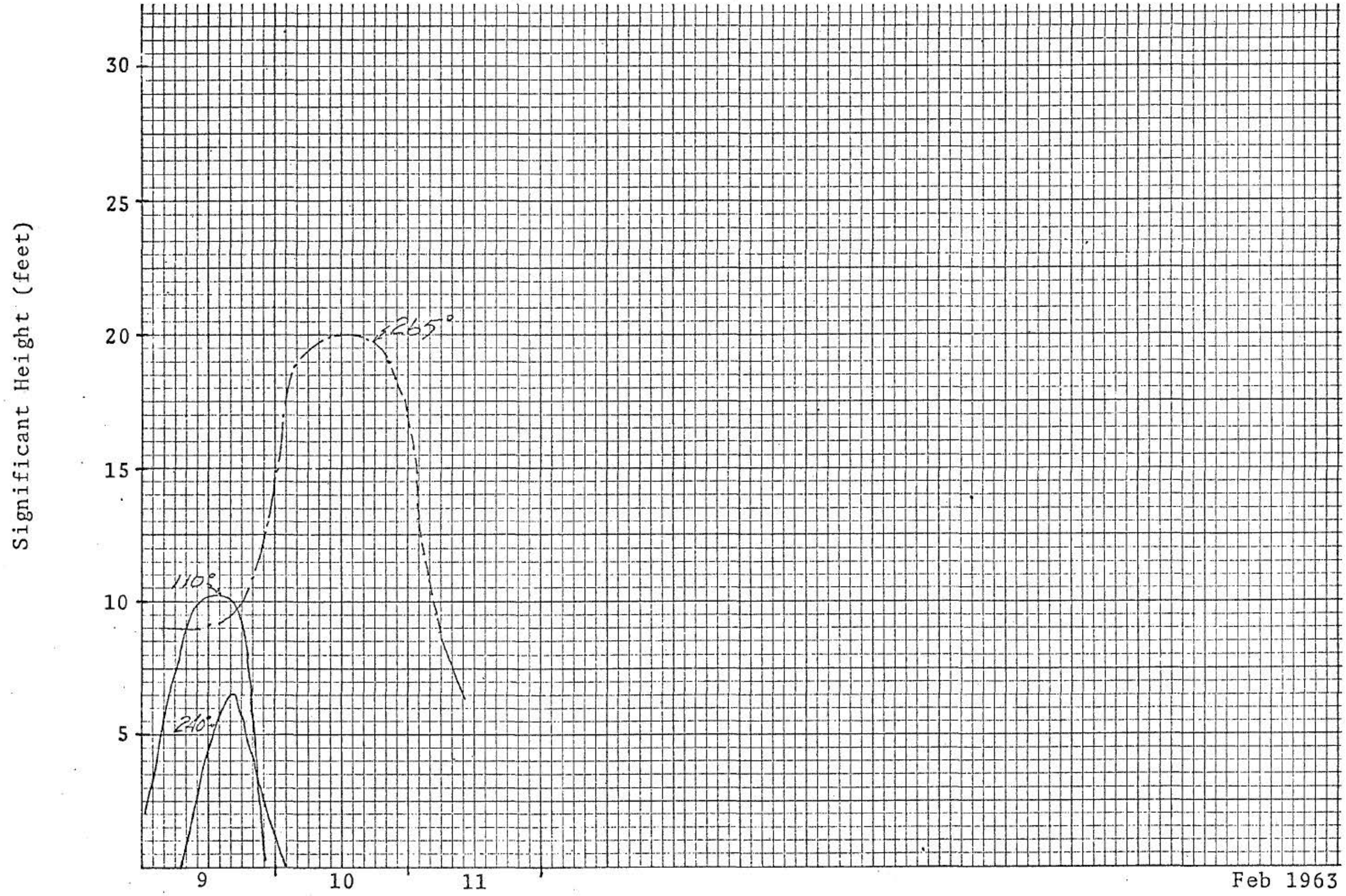
Day	Time	Wave Train							
		1 (215^{0})*		2 (240^{0})		3 (110^{0})		4 ( )	
		H_s	T_s	H_s	T_s	H_s	T_s	H_s	T_s
9	04	9.0	14			6.0	7		
	10	9.0	14	3.0	8	10.0	8		
	16	9.5	14	6.5	9	10.0	8		
	22	12.5	14	2.5	8				
10	04	19.0	14						
	10	20.0	13						
	16	20.0	13						
	22	18.0	12						
11	04	11.0	10						
	10	6.5	8						
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								
	04								
	10								
	16								
	22								

*approach direction

Figure 2-J

WAVE HEIGHT PLOT:STATION 2 BLOCK 331

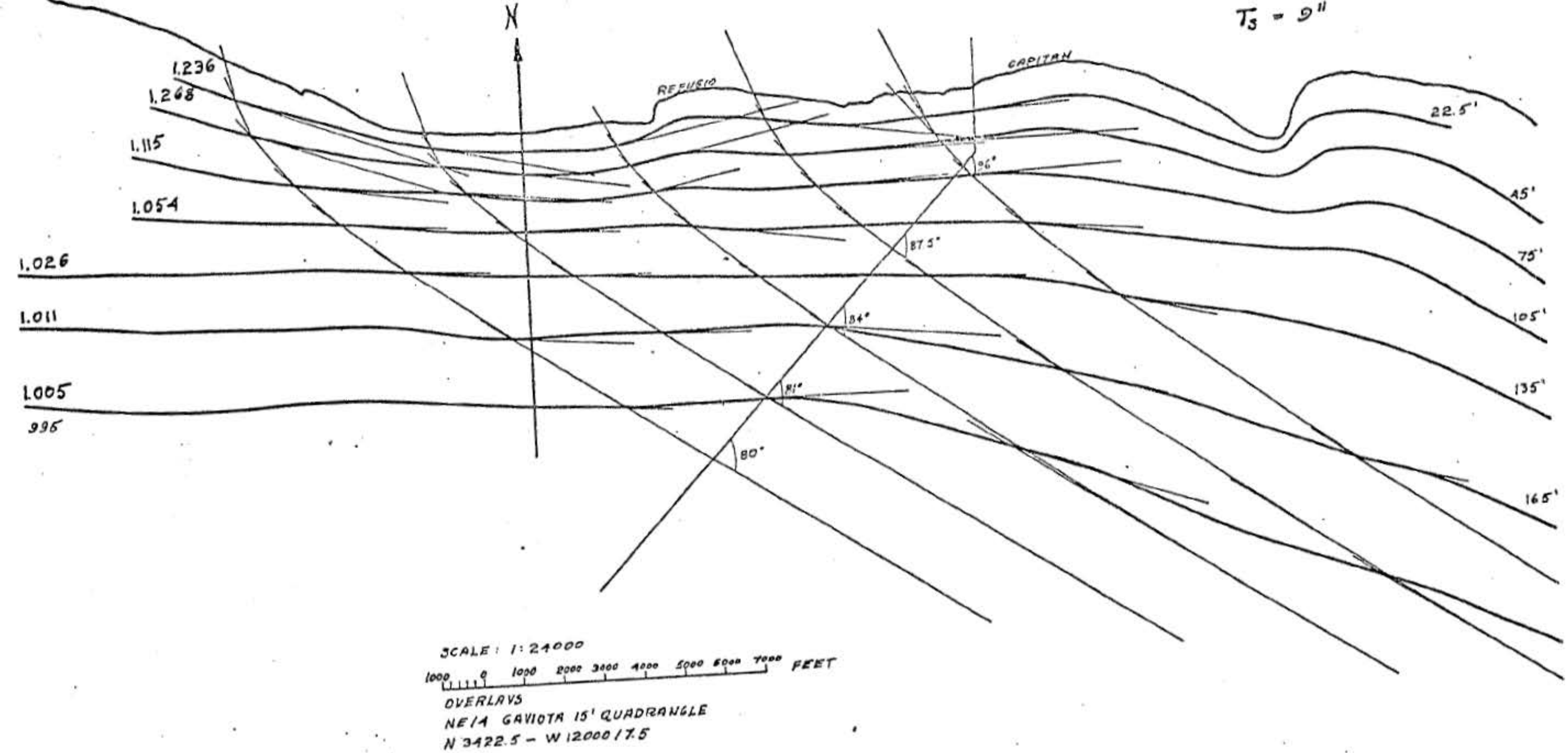
Wave Period Legend: —— ≤9 secs. --- 10-12 secs. -·-·- ≥13 secs.



APPENDIX B

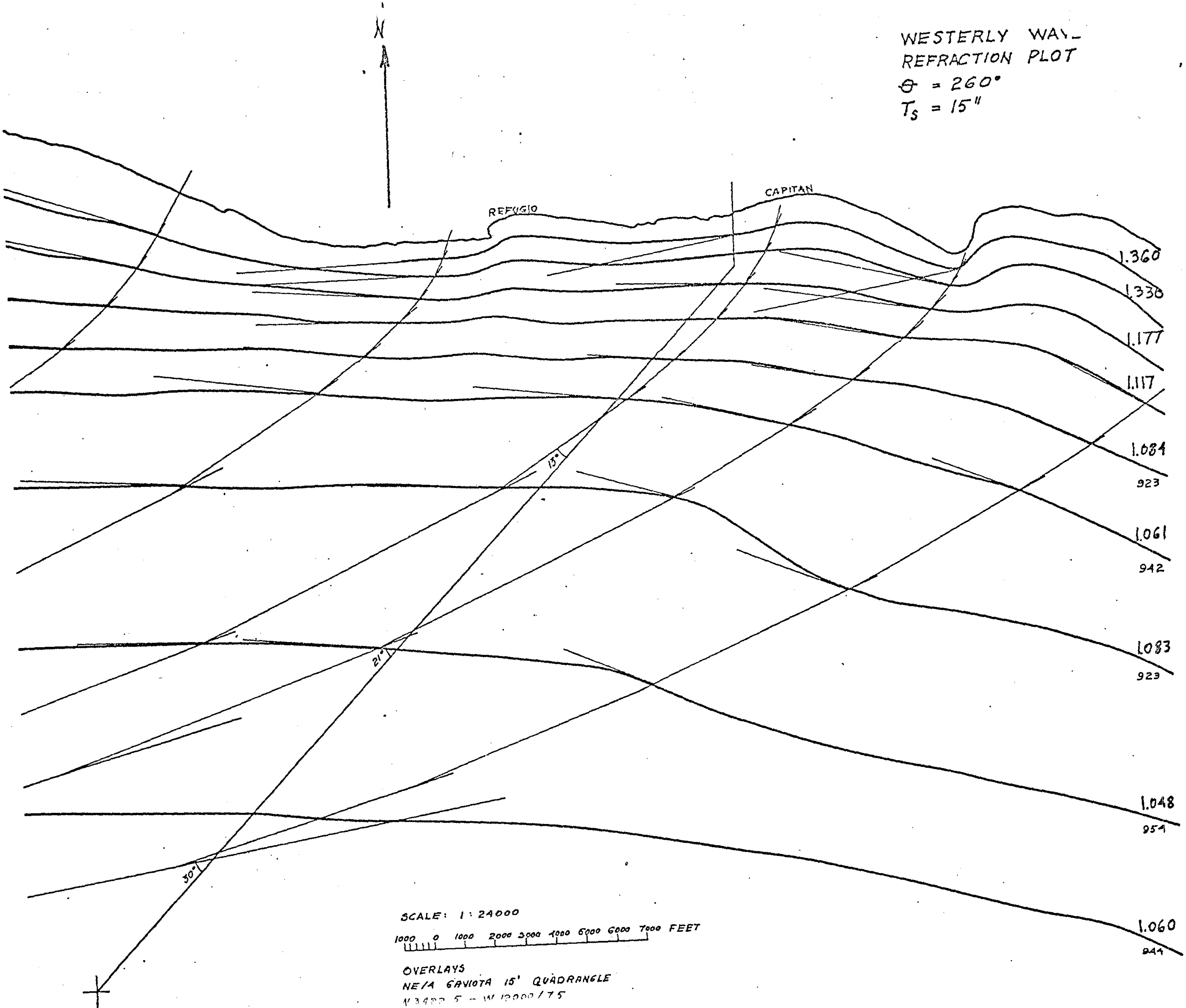
Bathymetry and refraction plots for westerly and easterly storms are given on the following pages.

EASTERLY WAVE
REFRACTION PLOT
$\theta = 123°$
$T_3 = 9''$



SCALE : 1:24000
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
OVERLAYS
NE/4 GAVIOTA 15' QUADRANGLE
N 3422.5 – W 12000/7.5

WESTERLY WAVE REFRACTION PLOT
$\theta = 260°$
$T_s = 15''$



APPENDIX 6.5

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.5

Well Control Training

Humble Oil & Refining Company

October, 1971

WELL CONTROL TRAINING

A Well Control Training Facility has been established in the Saticoy Field, Ventura County, California. The facility is a joint interest venture between Humble, Shell, SOCAL, Sun, Union, and Texaco with Humble designated as the operator. This facility provides training for both operator and contractor personnel in proper well control techniques. An actual wellbore is utilized with full size rig equipment to circulate out, under control, a simulated influx of reservoir fluid. To date, 107 people have undergone training at this facility.

A total of 28 contract and Humble employees associated with drilling in the Santa Barbara Channel have undergone intensive training at this facility. Humble rig supervisors and all of the drilling contractor's drillers and toolpushers are schooled at the facility twice each year. Other key Humble supervisory personnel practice at the facility about once each year.

EQUIPMENT

The facility consists of an abandoned well with a cement plug at 6200 feet, 6000 feet of dual tubing (1-1/4" and 2-7/8"), a choke manifold incorporating a SWACO hydraulically adjustable choke and a manually adjustable choke, a control house, two nitrogen surge tanks, a mud tank with a mud-gas separator, and a mud pump. A nitrogen service truck provides the kick medium. (Figures 1 & 2)

TRAINING

A typical training session consists of a four-hour classroom session followed by actual kick control practice. The classroom session begins with a film lecture on the causes, indications and control of formation fluid kicks. Subsequent discussion includes particular problems associated with the areas in which the men drill, and the causes and indications of kicks generally encountered in practice in different areas. A theoretical problem is given to each man. The problem and its answers are discussed until everyone clearly understands the proper control procedure.

Each student is required to control one kick with the hydraulically operated choke and one kick with the manually adjustable choke because the two systems have different pressure response characteristics. The supply truck injects nitrogen down the 1-1/4" tubing, displacing mud out of the well into the mud tank. This simulates formation fluid influx. An alarm whistle sounds when 10 to 15 bbls. have been gained in the tank, signaling the student to begin his well kill procedure. He shuts the well in at the choke manifold to establish the shut-in drill pipe and wellhead pressures. This operation is similar to closing the rig BOP and choke manifold. He determines from these pressures whether the kick was caused by swabbing or by abnormal formation pressure, and how much the mud weight must be increased. He then tells the pump man to begin pumping at some constant drill pipe pressure while the gas bubble is displaced up the annulus, through the choke and into the mud-gas separator.

While the bubble is in the annulus, one of several problems will be simulated to test the student's grasp of well control principles. These problems include loss of rig power, loss of control air pressure, lost circulation and partial or complete loss of the pump. After the problem has occurred, performance is discussed and, if required, the correct procedure to handle the problem is explained before continuing with the gas displacement. If the bottom hole pressure becomes less than the "formation pressure" a secondary kick is produced. The student must then regain control and circulate out both kicks.

Each student practices this procedure twice and observes several other students handling kicks. Ample opportunity is given for the discussion of each problem that arises during the day and the correct procedure to correct them.

SCHEMATIC OF THE SURFACE EQUIPMENT TO INJECT & DISPLACE A NITROGEN KICK UNDER CONTROL

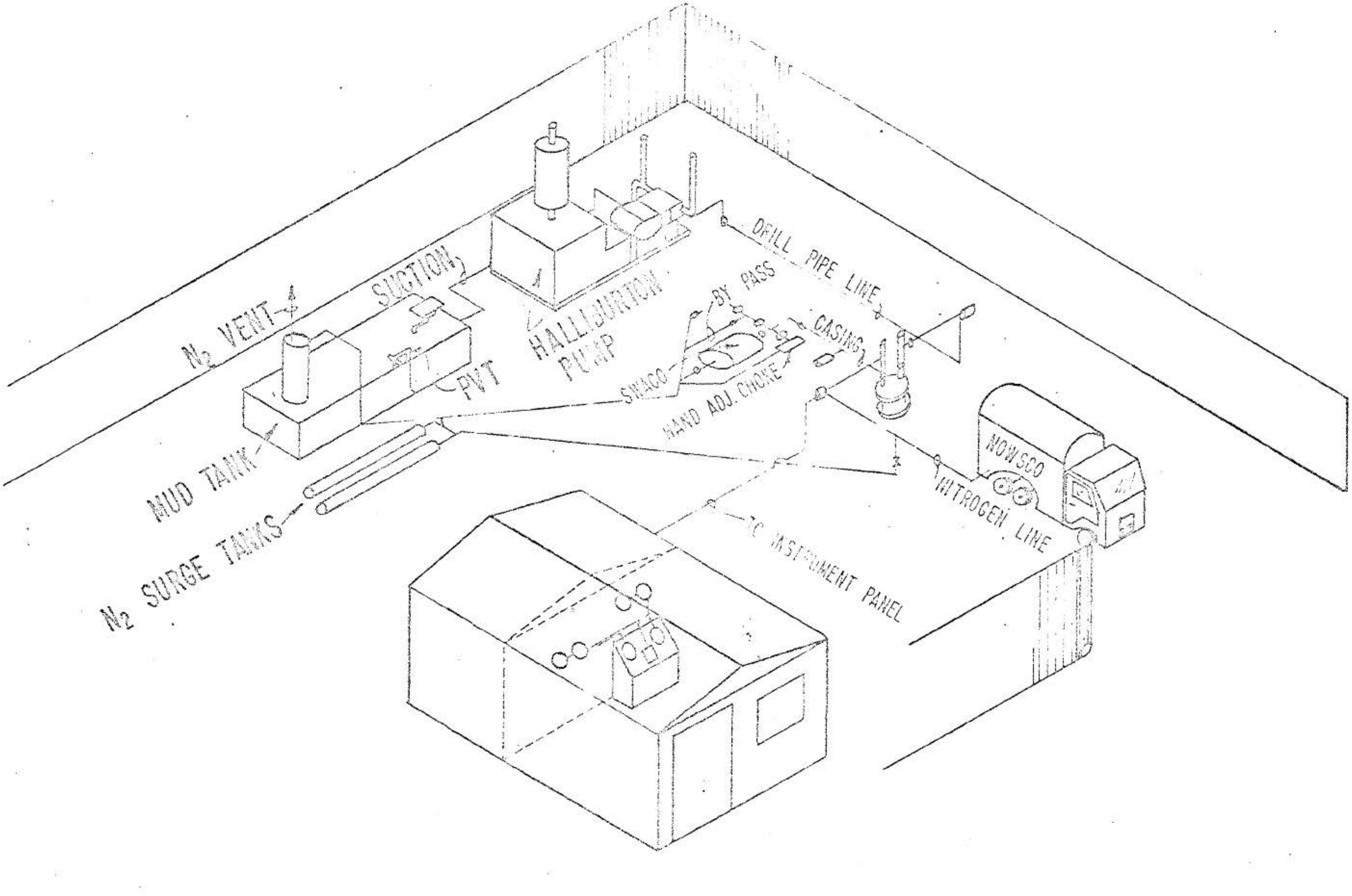


Figure 1

SCHEMATIC OF EQUIPMENT SHOWING THE INJECTION OF THE NITROGEN BUBBLE & ITS DISPLACEMENT FROM THE WELL INTO THE MUD TANK

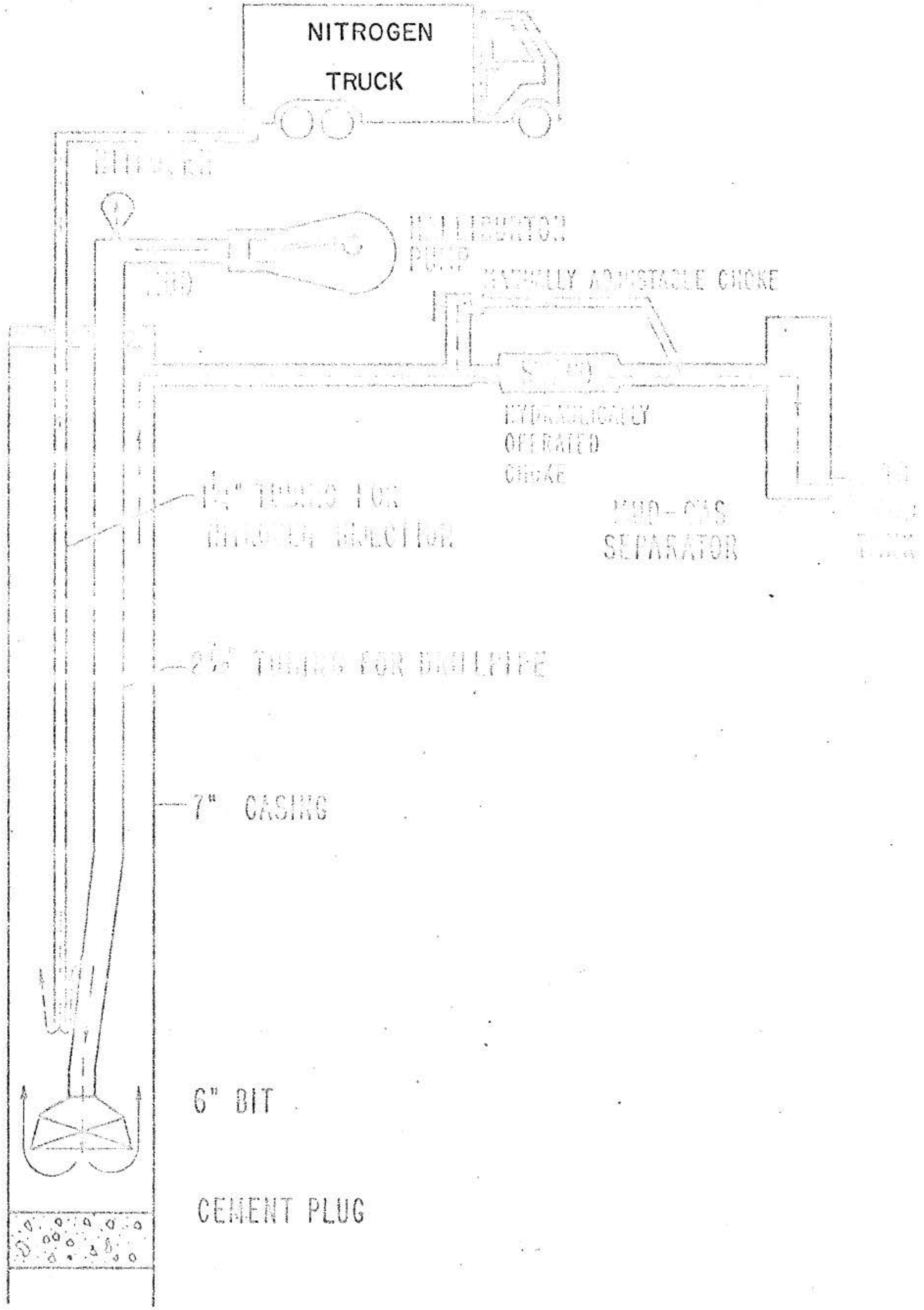
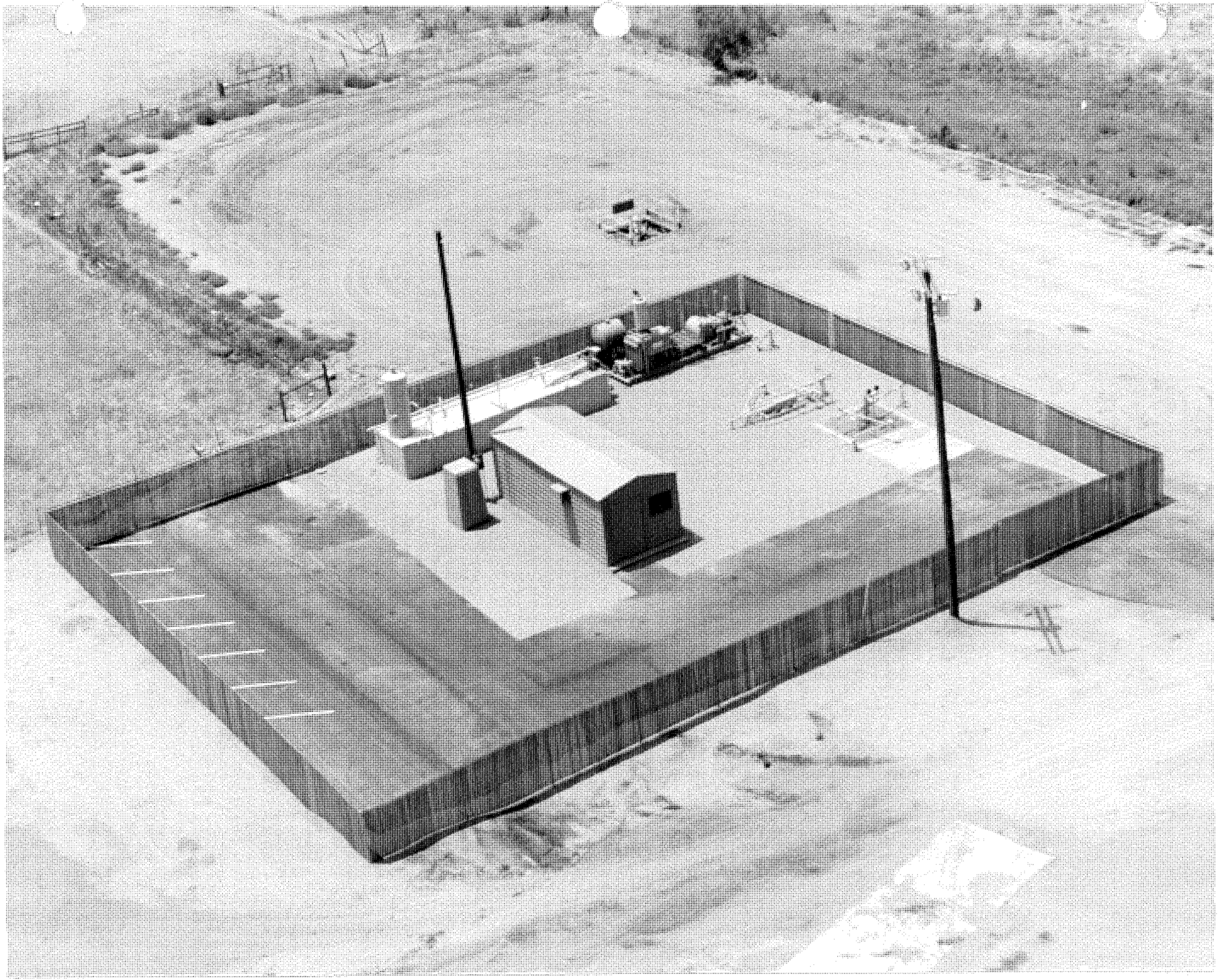
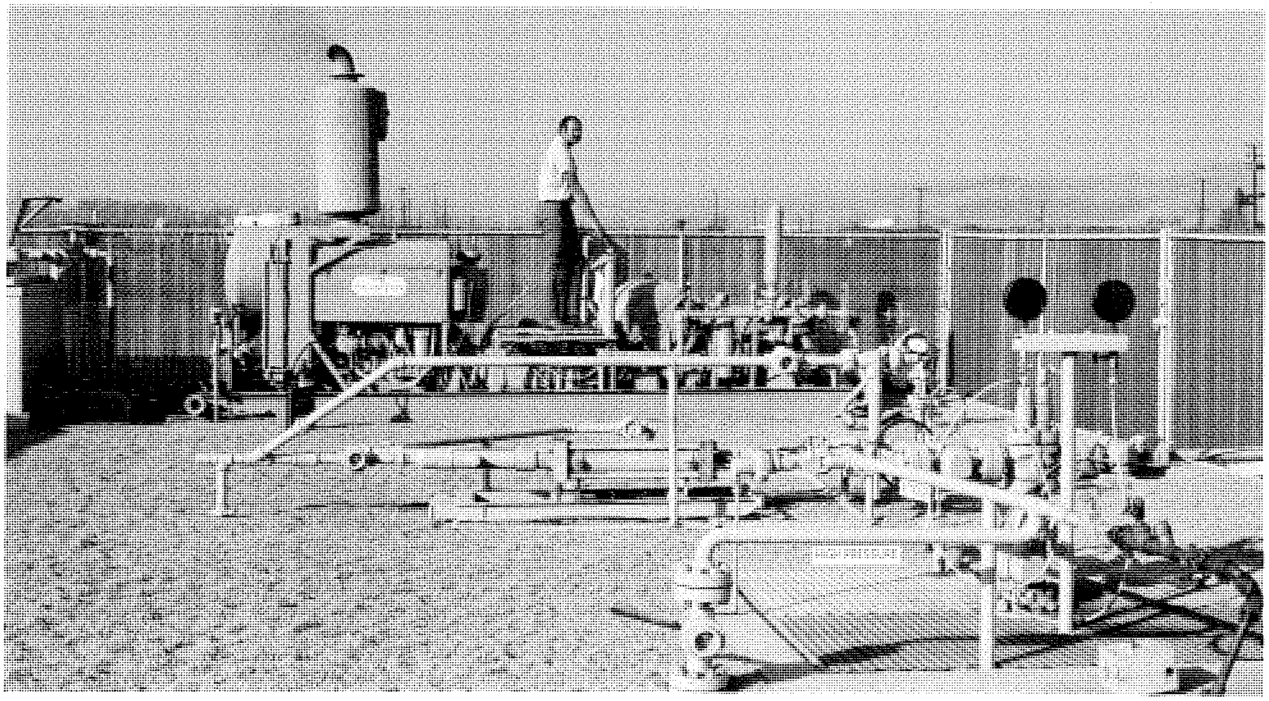


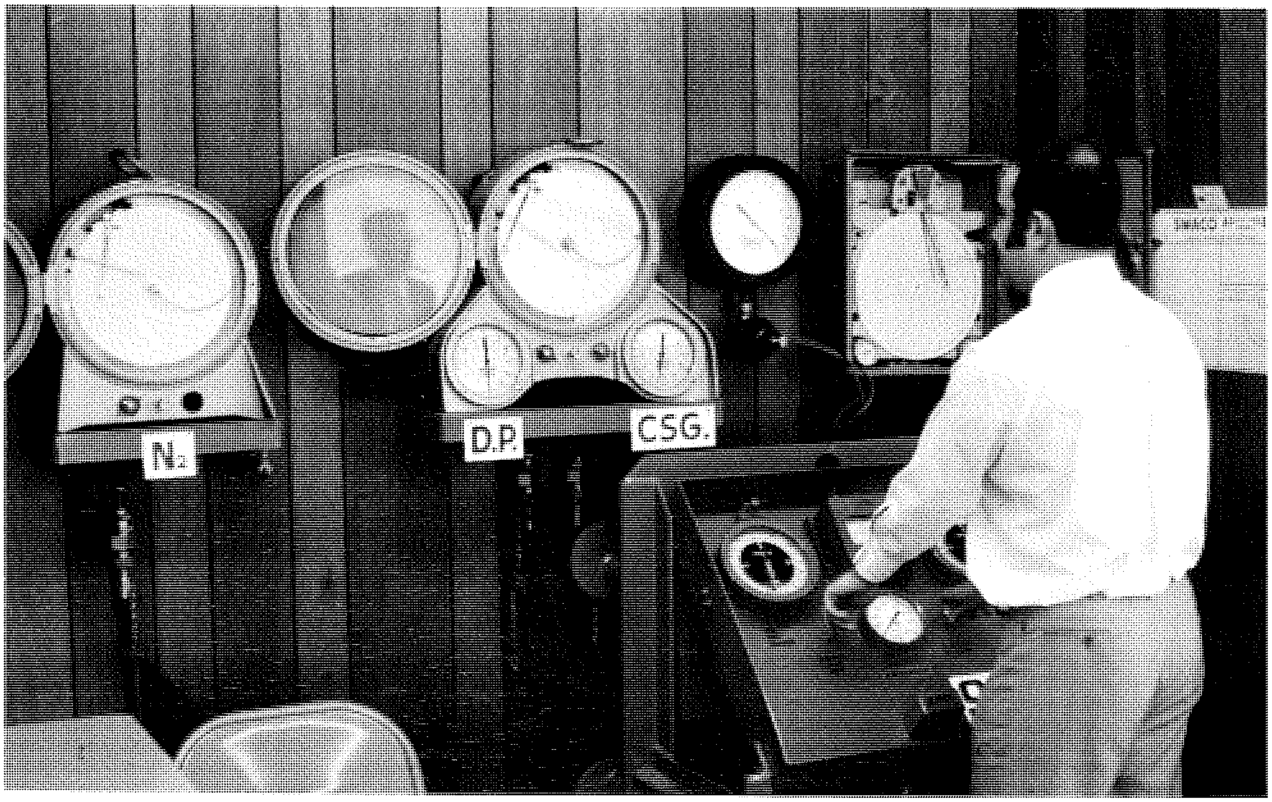
Figure 2



AERIAL VIEW — WELL CONTROL TRAINING FACILITY



WELL CONTROL TRAINING FACILITY
(PRACTICE WELL, CHOKE MANIFOLD & MUD PUMP)



WELL CONTROL INSTRUMENT PANEL

APPENDIX 6.6

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.6

Safety and Emergency Operations Manual For the Santa Barbara Channel Area

Humble Oil & Refining Company

October, 1971

SAFETY AND EMERGENCY OPERATIONS MANUAL
FOR THE SANTA BARBARA CHANNEL AREA

Western Division

Humble Oil & Refining Company

GENERAL TABLE OF CONTENTS

SANTA BARBARA CHANNEL AREA

SAFETY AND EMERGENCY OPERATIONS MANUAL

INTRODUCTION

This manual has been prepared to provide guidelines for safe operations and general procedures for emergency situations. It is the responsibility of all Division personnel to become thoroughly familiar with the contents of this manual to insure safe, consistent practices and effective coordinated action in emergencies throughout the Division's operations.

The manual is divided into three main sections:

- I - EMERGENCY OPERATIONS ORGANIZATION
- II - SAFETY PROCEDURES
- III - POLLUTION PREVENTION AND CONTROL

It is not practical to anticipate, nor provide for, every conceivable emergency situation that might occur; therefore, specific action requirements may differ from those prescribed herein. It is the primary intent of this manual to provide the following:

1. An emergency organization and communications network for immediate action.
2. Guidelines for safe practices and personnel training.
3. General procedures for emergency operations.
4. Guidelines for pollution prevention and control.

SECTION I

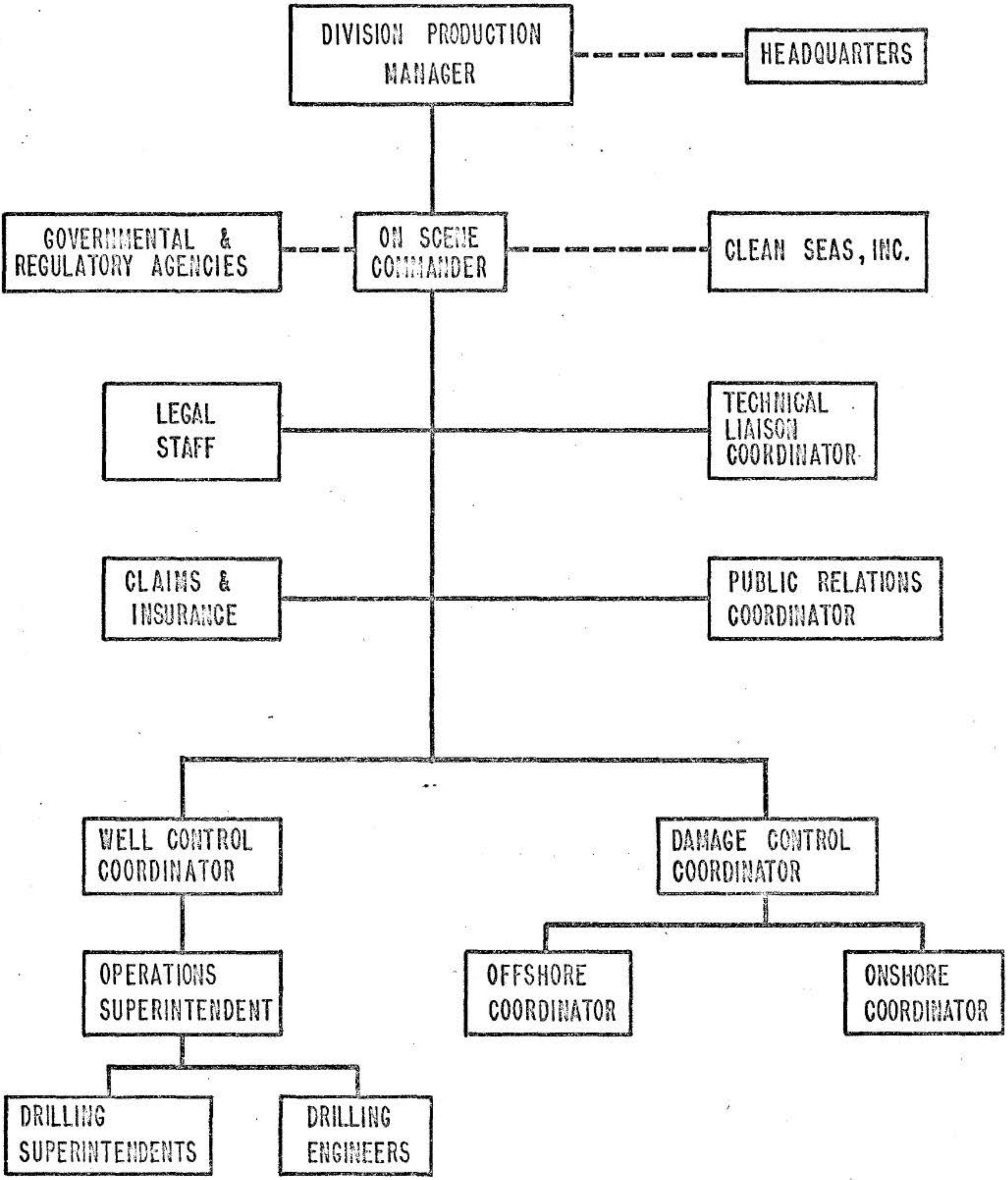
EMERGENCY OPERATIONS ORGANIZATION

EMERGENCY OPERATIONS ORGANIZATION

CONTENTS

EMERGENCY OPERATIONS TEAM

SANTA BARBARA CHANNEL OPERATIONS
EMERGENCY OPERATIONS TEAM



S B C AREA MAPS

SANTA BARBARA CHANNEL

AREA MAPS

Working copies of this manual contain the following U. S. Geological Survey quadrangle maps covering the Santa Barbara Channel beach area from Point Conception to Point Mugu:

I. Point Conception
II. Sacate
III. Gaviota
IV. Tajiguas
V. Dos Pueblos Canyon
VI. Goleta
VII. Santa Barbara
VIII. Carpinteria
IX. Pitas Point (with portion of White Ledge Peak)
X. Ventura
XI. Oxnard
XII. Point Mugu

TELEPHONE DIRECTORY

REGULATORY AGENCIES

Telephone List

U. S. GOVERNMENT:

1. Environmental Protection Agency
760 Market Street
San Francisco, California 94102

24-Hour Phone (415) 556-3333

Paul DeFalco- Manager
Richard Pierce - Water Quality Engineer

2. U. S. Army Engineer District, Los Angeles
300 North Los Angeles Street
Los Angeles, California 90053

24-Hour Phone (213) 688-5522

Mr. Wendell Reese

3. U. S. Coast Guard
Eleventh Coast Guard District Office
Heartwell Building
19 Pine Avenue
Long Beach, California 90802

For spills occurring between Mexican Border and mouth of Sànta Maria River

24-Hour Phone (213) 590-2225

Capt. George W. Walker	(213) 590-2224	(Chief of Operations)
Commander, Long Beach	(213) 590-2211	
Commander, Santa Barbara	(805) 962-7430	

After hours - Lt. C. W. Waage (805) 965-0250

Twelfth Coast Guard District Office
630 Sansome Street
San Francisco, California 94126

For spills occurring north of mouth of Santa Maria River

24-Hour Phone (415) 556-5500

4. United States Geological Survey
300 North Los Angeles Street
Los Angeles, California 90012

Don W. Solanas (213) 688-2850

Room 209 Post Office Building
Santa Barbara, California 93105

H. T. Cypher	Office	(805) 963-3611
	Home	(805) 967-9548
Ed. Guynn	Home	(805) 964-2944

REGULATORY AGENCIES

Telephone List

STATE OF CALIFORNIA:

1. California Department of Fish & Game
350 Golden Shore
Long Beach, California 90802

Capt. Walter H. Putman	Office	(213) 435-7741
	Home	(213) 436-8861

2. California Disaster Office, Emergency Service Office, Region I
107 S. Broadway
Los Angeles, California (213) 620-5607

3. California Division of Oil and Gas
Oil and Gas Engineer, Offshore Unit
830 N. La Brea Avenue
Inglewood, California 90302

Elbert R. Wilkinson	Office	(213) 678-7274
	Home	(213) 532-7071

4. California Water Resources Control Board
1416 9th Street (Rm 1140)
Sacramento, California 95814

Jerome B. Gilbert	Office	(916) 445-3085
	Home	(916) 756-5186
Paul R. Bonderson	Office	(916) 445-7971

California Regional Water Quality Control Boards

1. Central Coast Region
2238 Broad Street
San Luis Obispo, California 93401

Kenneth R. Jones	Office	(805) 543-5671
	Home	(805) 543-9154
Thomas E. Bailey	Office	(805) 543-5671
	Home	(805) 544-4863

2. Los Angeles Region
107 S. Broadway (Rm 9026)
Los Angeles, California 90012

Raymond M. Hertel	Office	(213) 620-4460
	Home	(213) 281-3371
Richard A. Harris	Office	(213) 620-4460
	Home	(213) 798-2231

PUBLIC SERVICE AGENCIES

Telephone List

Fire Departments

Port Hueneme (County)	(805)482-2777
Oxnard City	(805)483-2211
Ventura City	(805)643-6121
Ventura (County)	(805)648-7711
Carpinteria-Summerland	(805)684-4111
Santa Barbara City	(805)965-5252
Santa Barbara County (Goleta)	(805)967-1211
Santa Barbara County (Santa Maria)	(805)922-7771

Police Departments

Oxnard Police	(805)486-1663
Ventura County Sheriff	(805)648-3311
Carpinteria Police	(805)684-4561
Santa Barbara County Sheriff (Santa Maria)	(805)922-5775 Ext. 28
Santa Barbara County Sheriff (Santa Barbara)- Don Sweet	(805)963-1611
Santa Barbara Police	(805)965-5151

Harbor Masters

Oxnard	(805)487-5511
Ventura	(805)642-8538
Santa Barbara	(805)963-1737

THIRD PARTY AND OTHER

Telephone List

INDUSTRY CLEANUP ORGANIZATIONS:

1. Clean Seas, Inc. (CSI)
   18 Marine Bldg. - Breakwater
   Santa Barbara, California 93109

Reese Norton	Office	(805) 963-3488
	Home	(805) 967-5340

2. Petroleum Industry Coastal Emergency Cooperative (PICE)
   P. O. Box 758
   Wilmington, California 90744

   A. J. Bush Office (213) 433-8346

3. Clean Bay, Inc. (CBI)
   Concord, California

   Forrest M. Smith 24-Hour Phone: (415) 685-2800

WEATHER FORECAST SERVICE

1. Oceanographic Services
   135 E. Ortega Street
   Santa Barbara, California

   Office (805) 965-6575

2. U. S. Coast Guard
   Marine Breakwater
   Santa Barbara, California

   Office (805) 962-7430

EMERGENCY RADIO SERVICES

1. Tri-County Communications
   1435 Callens Road
   Ventura, California

Ed Barrett	Office	(805) 642-6017
	Home	(805) 647-6028

2. Motorola Communications
   542 Amhurst Drive
   Goleta, California

   Office (805) 967-4115

EMERGENCY TRANSPORTATION SERVICES (See Section III; Appendix B)

MEDICAL FACILITIES

(RECOMMENDED DOCTORS, HOSPITALS & AMBULANCE SERVICES, GROUPED TO COVER PRINCIPAL WORKING AREAS)

Telephone List

SANTA MARIA:

Dr. Albert Beekler	301 E. Chapel	925-2409 or 925-4072
Marian Hospital	1400 East Church St.	922-5811
Profess. Ambulance Service	111 East Cook	925-9555

SOLVANG:

Dr. Frank Barranco	2030 Viborg	688-5531
Dr. Wm. B. Valin	2030 Viborg	688-5531

GOLETA:

Goleta Valley Community Hospital (Helicopter landing facilities available)	351 S. Patterson Ave.	967-3411

SANTA BARBARA:

Dr. L. B. Burgess	2320 Bath Street	965-8511
Dr. Michael J. Lemus	101 West Arrellaga	963-1824
Dr. Gordon Smith	2324 Bath Street	965-8521
Dr. W. B. Withers	231 West Pueblo	962-8611
Santa Barbara Medical Clinic	215 Pesetas Lane	964-6211
Cottage Hospital	321 West Pueblo	963-1661
St. Francis Hospital	601 East Micheltorena	962-7661
Coast Ambulance	1913 State Street	963-3561

CARPINTERIA:

Dr. Horace Coshow	5210 Carpinteria Avenue	684-3613
Dr. K. E. Wagner	5565 Carpinteria Avenue	684-4119
Physicians Exchange	213 W. Canon Perdido	966-4181
Coast Ambulance Service	691 Walnut	684-3318

MEDICAL FACILITIES (continued)

VENTURA:

Dr. W. Sterling Clark	3170 Loma Vista Rd.	648-5353
Ventura Medical Group	3003 Loma Vista Rd.	643-2161
Buenaventura Medical Clinic	2705 Loma Vista Rd.	648-2571
Community Memorial Hosp. of San Buenaventura	2800 Loma Vista Rd.	648-3201
Courtesy-Ventura Ambulance	3110 Loma Vista Rd.	643-5496

OXNARD:

Dr. J. R. Monahan	314 W. 4th Street	483-1624
Dr. Nobel A. Powell	1200 N. Ventura Rd.	483-0131
St. Johns Hospital	333 North "F" Street	483-1141
Oxnard Ambulance Service	321 South "C" Street	486-6333

SECTION II

SAFETY PROCEDURES

SAFETY PROCEDURES

CONTENTS

GENERAL MARINE PRECAUTIONS

GENERAL PRECAUTIONS

Establishing precautionary measures as general practice will minimize delay and possibility of error when an emergency or hazardous condition develops. These measures are presented for Marine Operations, Drilling Operations, Well Control, Personnel Movement and Injury, Helicopter & Boat Accidents, and Missile Launchings.

I. Marine Structure and Vessel Operations

Station Bill. A Station Bill describing alarm signals, duties and emergency reporting stations for each person will be posted in the crew's quarters, mess hall, and other conspicuous places aboard the offshore structure or marine vessel.

It is mandatory that each person be familiar with this Station Bill and know his individual emergency station and duties. The individual's knowledge of such signals, stations and duties will be checked by the Ship's Captain, Barge Master or Platform Superintendent. Assistance in acquainting all personnel with emergency signals, stations, rules and procedures will be the responsibility of these individuals.

Drills. To assure that all personnel become familiar with emergency procedures and remain alert to possible hazards, periodic drills will be conducted for fire, man overboard, life boat, and abandon ship. More frequent drills may be conducted at the request of either Humble's Superintendent or Contractor's Toolpusher, Ship's Captain, Barge Master or Platform Superintendent to assure that all responsible personnel are thoroughly familiar with the procedures. Each drill will be entered into the daily logs noting the time required to perform each function.

Weather. A weather forecast service will provide a daily and long-range forecast on a routine basis. Additional forecasts will be furnished by the service whenever significant changes are in prospect, or as requested by Humble. These forecasts will be relayed to all supervisory personnel.

Communications. In addition to the Humble microwave communications system, land base radio stations of Humble and Contractors will be available for communicating with offshore units at all times. The location and telephone number of the nearest Coast Guard and Helicopter Rescue Station will be posted so they may be immediately notified in any emergency. Humble communications operators will hold all permits required by the Federal Communications Commission.

<u>Access Opening</u>. All hatches, doorways and other openings so marked shall be closed whenever not in use.

<u>Fire Prevention and Control</u>. It is the duty and responsibility of everyone to be constantly alert for fire, to give the alarm, and to assist in fighting the fire. In this regard, each person must be familiar with the location of alarm controls, with alarm signals listed in the Station Bill, and with the location and operation of each of the fire-fighting devices. Firefighting will be under the direction of the Ship's Captain, Barge Master or Platform Superintendent. Smoking will be permitted in approved areas only. Humble's Superintendent shall approve the commencement of any work requiring arc welding or open flame cutting.

When the fire alarm is sounded, all persons aboard shall put on life jackets and proceed to stations set forth in the posted Station Bill.

The Humble Superintendent in charge should see that the shore station is notified immediately, and that the crew boat and/or helicopter, if not in the vicinity, is dispatched to the offshore location area immediately. The shore station, as well as the offshore unit will immediately notify the Coast Guard of the situation and request assistance if needed.

DRILLING OPERATIONS

DRILLING OPERATIONS

During normal drilling operations, the following practices will be observed:

1. Do not leave the derrick floor unattended.
2. If repairs not requiring cement plugs become necessary, the procedure outlined below should be followed, if possible:
   a. Drill pipe in open hole
      1. Pull up into last string of casing set.
      2. Install Hydril safety valve (full opening - ball valve).

   b. Out of hole
      1. RIH to shoe of last casing set and proceed according to Steps outlined above.
3. Circulate bottoms-up prior to pulling out of hole.
4. When tripping the drill pipe, fill the annulus between drill pipe and casing when a maximum of 5 stands are pulled. Mud volume required to fill the hole each time must be observed to assure that it corresponds with the displacement of pipe pulled. If the string must be pulled wet, a volume equivalent to the capacity and displacement of the pipe pulled is required to fill the hole. Watch for swabbing action when pulling out of hole. When running in the hole, a volume increase equivalent to the displacement of the pipe inserted should be noted at the surface.
5. Functionally test blowout preventers daily when the drill pipe is in use and log on the daily drilling report. Check all valves on the rig manifold to insure ease of opening and closing. Pressure test the blowout preventers with the BOP test tool at least once each week and log on the daily drilling report. Do not close the Hydril on the open hole except in case of emergency.
6. Each Driller coming on tour will note the availability and operation of each of the following items:
   a. Combustible gas detection system (mud logging unit).

b. Pit level indicator and mud return indicator ("flo-sho").

c. Emergency drill pipe hang-off tool (right-hand rotation release).

d. Kelly stop cock above Kelly.

e. Full opening Hydril (ball-type) safety valve run below Kelly and one spare for drill string in use on rig floor.

f. Mud volume measuring device for accurately measuring volumes required to fill the hole on trips.

NOTE: Humble Superintendent and Contract Toolpusher to note the above daily.

7. Well Control Procedures

Continued observation of the pit level and a frequent check of the mud weight are the most positive means of detecting possible blow-out conditions. A mud logging unit will normally be in service; however, it must not be relied upon as the primary means of detecting troublesome conditions. The practice of circulating out drilling breaks will normally not be followed except as requested by the Geologist.

If significant drilling breaks are encountered, the driller will cease drilling, pickup off bottom and shut down the pumps. If flow continues in the annulus, follow the steps to control potential blowouts as outlined on the posted Well Control Procedure (see Well Control). An updated Well Control Procedure will be calculated and posted as each casing string is set and whenever mud weights are changed.

The Driller, normally always being on the rig floor, has the first responsibility for anticipating and detecting blowout conditions. When adverse conditions arise, it will be his responsibility to inform the Contract Toolpusher and Humble Superintendent on duty.

In any event, he should immediately shut down the pumps, check for flow, and proceed as prescribed on the posted Well Control Procedure. If the Toolpusher or Humble Superintendent cannot be located or notified immediately, the Driller must assume the Toolpusher's responsibilities and act in accordance with the posted Well Control Procedure. If for any reason the Driller is incapacitated, the Derrickman will assume the Driller's responsibilities.

8. Blowout System Test Procedure

Each crew and toolpusher must become proficient in performing their individual functions in preparing to control a threatened blowout. Humble's Superintendent should assure that contract personnel are familiar with and capable of performing their respective duties. The following test procedures will serve as a guide in determining the efficiency which may be expected under blowout conditions:

After setting casing:

a. Pressure test casing below the blind rams. Maintain pressure for 30 minutes. If pressure declines more than 10% during this period, remedial action will be taken. Unless otherwise specified in the procedure for drilling a specific well, the following test pressures should be used.

Casing Size		Test Pressures
20"		200
16"		1000
10-3/4"		1000
7" or 7-5/8"	greater of	1500 psi or 0.2 psi/ft.TVD

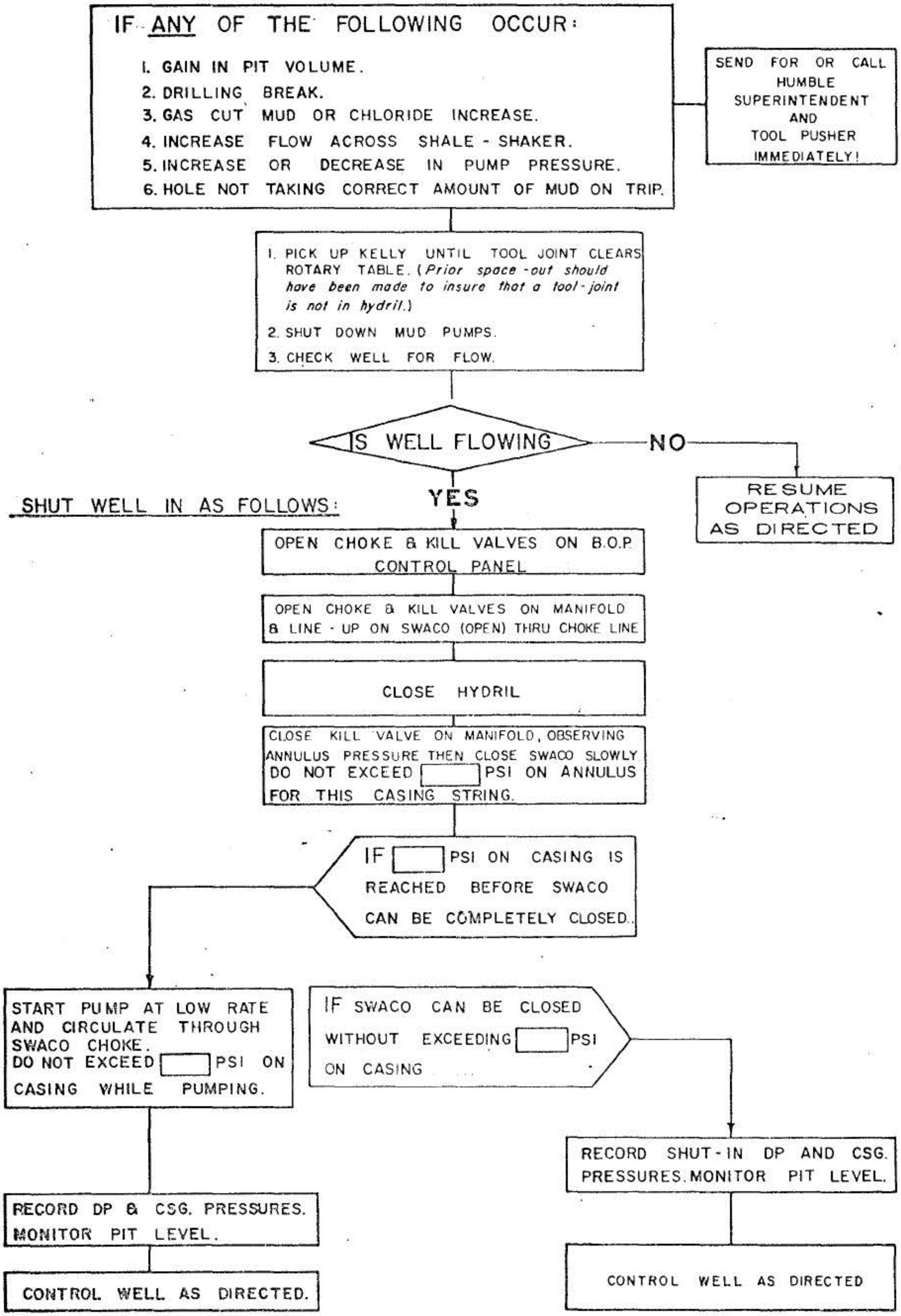
b. RIH with drilling assembly to top of cement. Prior to drilling out cement, close Hydril, open choke valves and circulate mud down drill pipe and out choke line at a rate of 3-5 barrels per minute. Without exceeding test pressures, vary the choke size to acquire a feel for the sensitivity of the SWACO Adjustable Choke. Operationally check the degasser.

c. Blowout prevention drills will be conducted at least weekly and should be conducted as often as necessary to insure that all personnel are familiar with procedures to be followed in an emergency.

d. Drillers and Toolpushers will be schooled and trained in Well Control Procedures by taking simulated kicks at the Humble operated Well Control Training Facility located in the Saticoy Field, Ventura County, California.

WELL CONTROL PROCEDURES

WELL CONTROL PROCEDURE



IF ANY OF THE FOLLOWING OCCUR:

1. GAIN IN PIT VOLUME.
2. DRILLING BREAK.
3. GAS CUT MUD OR CHLORIDE INCREASE.
4. INCREASE FLOW ACROSS SHALE - SHAKER.
5. INCREASE OR DECREASE IN PUMP PRESSURE.
6. HOLE NOT TAKING CORRECT AMOUNT OF MUD ON TRIP.

SEND FOR OR CALL HUMBLE SUPERINTENDENT AND TOOL PUSHER IMMEDIATELY!

1. PICK UP KELLY UNTIL TOOL JOINT CLEARS ROTARY TABLE. (*Prior space-out should have been made to insure that a tool-joint is not in hydril.*)
2. SHUT DOWN MUD PUMPS.
3. CHECK WELL FOR FLOW.

IS WELL FLOWING

NO

RESUME OPERATIONS AS DIRECTED

YES

SHUT WELL IN AS FOLLOWS:

OPEN CHOKE & KILL VALVES ON B.O.P. CONTROL PANEL

OPEN CHOKE & KILL VALVES ON MANIFOLD & LINE - UP ON SWACO (OPEN) THRU CHOKE LINE

CLOSE HYDRIL

CLOSE KILL VALVE ON MANIFOLD, OBSERVING ANNULUS PRESSURE THEN CLOSE SWACO SLOWLY DO NOT EXCEED ☐ PSI ON ANNULUS FOR THIS CASING STRING.

IF ☐ PSI ON CASING IS REACHED BEFORE SWACO CAN BE COMPLETELY CLOSED.

START PUMP AT LOW RATE AND CIRCULATE THROUGH SWACO CHOKE. DO NOT EXCEED ☐ PSI ON CASING WHILE PUMPING.

RECORD DP & CSG. PRESSURES. MONITOR PIT LEVEL.

CONTROL WELL AS DIRECTED.

IF SWACO CAN BE CLOSED WITHOUT EXCEEDING ☐ PSI ON CASING

RECORD SHUT-IN DP AND CSG. PRESSURES. MONITOR PIT LEVEL.

CONTROL WELL AS DIRECTED

An updated Well Control Procedure will be calculated and posted as each successive casing string is set and whenever mud weights are changed.

PERSONNEL MOVEMENT
AND INJURIES

PERSONNEL MOVEMENT AND INJURIES

Normal Transportation Procedure. Offshore units will be serviced by both helicopter and boat. Humble Superintendents are responsible for coordination of boat and helicopter movements.

Control of personnel and vehicle movements must be timely and complete. Methods are as follows:

HELICOPTER

Communications relative to transportation control are the responsibility of Rotor Aids. Locations or course of helicopters are to be known at all times. Delays in scheduled arrivals at destinations will be immediately investigated.

No personnel will be permitted on the Helicopter pad during take-off or landing.

The decision of the pilot of the aircraft in regard to loading, weight distribution and flight operations is final.

Records of passengers will be provided by "Passenger Lists" prepared in duplicate at the point of departure. Copies will be distributed to provide records of all flights at (1) the onshore Heliport, and (2) Offshore Unit Control Room.

BOAT

Communications relative to transportation control are the responsibility of the Ship's Captain, Barge Master or Platform Superintendent.

Injury to Personnel. First aid to any personnel injured offshore will be under the direction of the Ship's Captain, Barge Master or Platform Superintendent. If it is necessary to send the injured personnel to shore, helicopter transport will normally be used. In this event, the injured would be flown to the Goleta Valley Community Hospital for treatment or to the heliport for automobile transportation to the hospital if the injured's condition is not critical. Medical facilities and personnel are listed in the Telephone Directory in SECTION I.

Communications relative to transport of injured personnel will normally be directed to Rotor Aids' Dispatcher or to the heliport. Notice of critical injuries should be immediately relayed to Humble's Office and to the Contractor's shore base Station.

Missiles. The Air Force has designated some areas in which offshore units might operate as missile "downrange areas". Arrangements for adequate notification of missile firings have been made with officials of Vandenberg Air Force Base. When launches occur that require any precautions, instructions will be issued from Humble's Office. Humble's Superintendent will authorize execution of procedures required to follow these instructions. See "Missile Launchings" for more detail.

HELICOPTER OR BOAT ACCIDENTS

VESSEL COLLISION, HELICOPTER CRASH, BOAT ACCIDENT

EMERGENCY ACTION

1. Sound "General Alarm" and initiate immediate action to insure personnel safety.

2. Call USCG to aid in rescue operations. Give the following information:

   a. Vessel or Aircraft description and location.

   b. Nature of emergency.

   c. Extent of damage.

   d. Number of personnel involved.

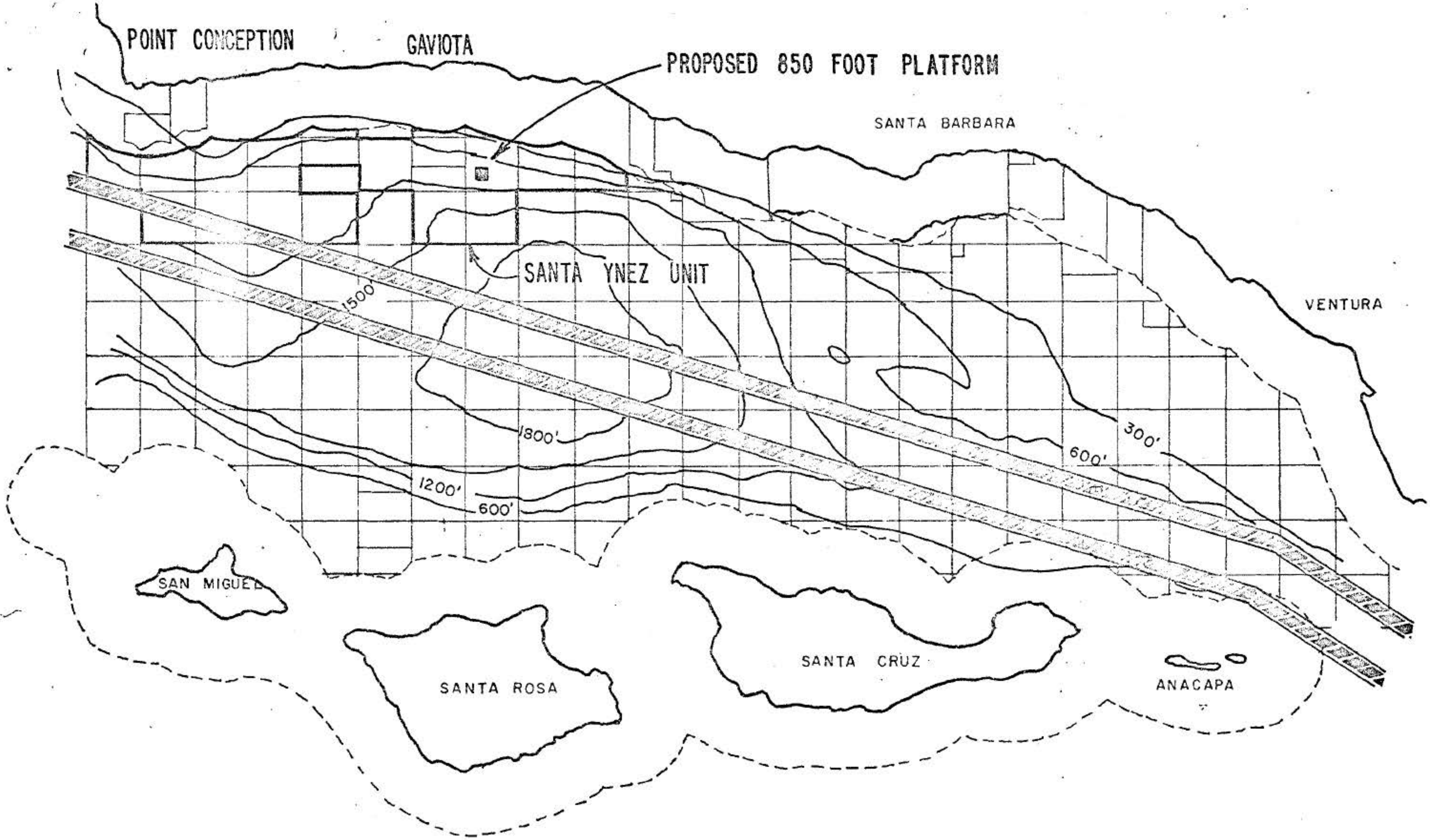
   e. Present action being taken.

3. Route all available boats and air support to the disaster site to aid in the search and rescue operations.

4. Call Humble's Operations Superintendent and inform him as to damage control status, time of occurrence and action being taken.

5. Company management and outside contacts will be informed according to the plan outlined in the "Emergency Operations Organization," Section I.

NOTE: Figure 1 depicts the shipping lanes in the Santa Barbara Channel.



OFFSHORE VENTURA BASIN

SEA LANES

FIGURE 1

MISSILE LAUNCHING

MISSILE LAUNCHINGS

A. GENERAL ALERT SEQUENCE

1. WAFTR[*] advises Western Division and District offices of scheduled launches at the first of each month by letter.
2. WAFTR advises Division and District offices by telephone 72 hours prior to launch.
3. WAFTR and the Humble Operations Superintendent arrange for WAFTR Offshore Unit communications contact by Marine radio 24 hours prior to launch. Definition of the offshore unit position relative to the "TARGET ZERO AREA" (Fig. 1) is made at this time.

B. ALTERNATIVE PROCEDURES

1. Unit In (or Immediately Adjacent to) "TARGET ZERO AREA" at T-24 Hrs.
    - a. Secure operations.
    - b. Crew and supply boats should be brought alongside at T-8 hours.
    - c. Helicopters should be put on alert at T-8 hours in the event weather prohibits personnel evacuation by boat. If this is the case, personnel evacuation should be commenced by helicopter at T-4 hours.
    - d. If weather permits personnel transfer by boats, evacuation of all personnel except the Humble Superintendent and other preselected personnel should begin at T-2 hours. Boats will then proceed to a safe designated area outside the "TARGET ZERO AREA" and stand by for further orders.
    - e. At T-1/2 hours, the remaining personnel will evacuate the unit via helicopter, which will hover outside of the "TARGET ZERO AREA" at a safe prescribed distance until the "all-clear" signal is received.

(*) WESTERN AIR FORCE TEST RANGE - Vandenberg Air Force Base

2. Unit Outside of "TARGET ZERO AREA" at T-24 Hours.

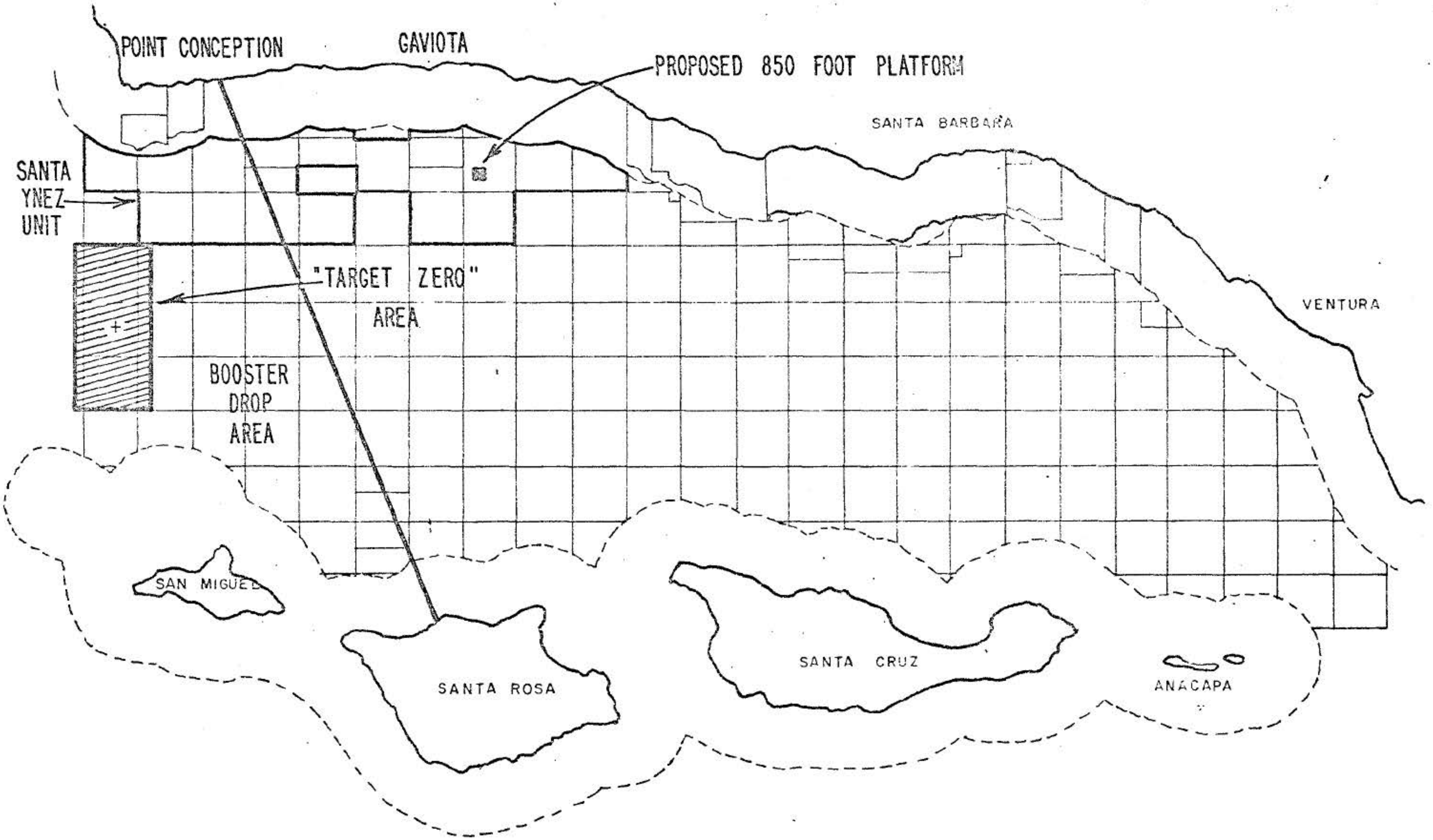
   a. Continue normal operations with the following precautionary actions being taken:

      1) Schedule crew and supply boats to be alongside at T-8 hours.

      2) Alert helicopters for readiness in the event inclement weather may occur and prevent possible personnel evacuation by boat.

   b. At T-1/4 hours, all personnel will move to preselected safety areas until the "all-clear" signal from WAFTR is received. (NOTE: Radio contact with WAFTR is maintained via remote control communications facilities provided for this purpose.)

      NOTE: Figure 1 depicts the "Booster Drop Area." The "Target Zero Area" is not necessarily located in the position shown. It will, however, be located within the confines of the "Booster Drop Area."



OFFSHORE VENTURA BASIN

"TARGET ZERO" AREA-SCHEMATIC

FIGURE I

SECTION III

POLLUTION PREVENTION AND CONTROL

POLLUTION PREVENTION AND CONTROL

CONTENTS

APPENDICES:

A. STANDBY POLLUTION CONTROL EQUIPMENT

B. LISTS OF COMMERCIALLY AVAILABLE EQUIPMENT AND SERVICES

1. Aircraft
2. Service Boats
3. Tugs & Barges
4. Booms & Skimmers
5. Sorbent Materials & Applicators
6. Beach Clean-Up Services, Equipment, Disposal Sites
7. Temporary Quarters, Storage Areas

INTRODUCTION

INTRODUCTION

This program covers the procedures, responsibilities, equipment and material for the prevention and handling of oil spills and prevention of pollution. The program will be revised as needed to permit changes and additions due to:

A. Organization changes.

B. Changes in regulations, regulatory agencies, and cooperative plans.

C. Improved methods and technology.

D. New Products.

Unless the context otherwise indicates, the Division program encompasses oil spills and all sources of pollution.

SUMMARY

SUMMARY GUIDELINES FOR OPERATING PERSONNEL

A. WHAT TO DO IF SPILLS OCCUR

1. Close-in or reroute fluids to eliminate the cause of the spill.
2. Initiate repairs or action to prevent future pollution.
3. Call Operations Superintendent or District Superintendent as soon as possible.
4. Initiate action as directed to contain, remove and clean up the spill.
5. Record the following on the Oil Spill Report Form:
    - a. Classification of spill
    - b. Location of spill
    - c. Name of rig, platform or facility involved
    - d. Time of spill
    - e. Time corrected
    - f. Cause of spill, if determined
    - g. Type of oil
    - h. Amount of oil spilled
    - i. Extent of spill (area covered)
    - j. Method of correction

B. WHAT TO DO IF CITED

1. Take immediate action to eliminate pollution.
2. Accept citations courteously and cooperate with enforcement officials.
3. Do not make statements based on assumptions.
4. Call Operations Superintendent or District Superintendent as soon as possible.

5. Write down all details possible at earliest opportunity, including:

   a. Dates and times

   b. Description of water area seen by officers

   c. Discussion of the charge by the officer

   d. Amount of actual pollution known

   e. Other possible sources for pollutants

   f. Changes in operating routine before citation

   g. Results of subsequent changes in operating routine

   h. Take pictures if possible

OIL SPILL REPORT FORM

Humble Oil & Refining Company
Western Division
_______ District

CLASSIFICATION OF SPILL: TYPE*__________ TIME__________ DATE__________

NAME OF FACILITY__________

LOCATION __________

CAUSE FOR SPILLAGE, IF KNOWN: __________

____

____

ACTION TAKEN: __________

____

____

____

____

ESTIMATED VOLUME OF SPILL __________ DIRECTION MOVING__________

PRESENT WIND __________ WAVES__________ DIRECTION__________

DURATION OF SPILL: HOURS__________ STOPPED AT: TIME__________ DATE__________

AGENCIES AND PERSONS NOTIFIED: __________

____

____

____

SIGNED__________

TIME__________ DATE__________

* i.e., Crude, Fuel Oil
Refined Products, etc.

POLLUTION PREVENTION

PREVENTION OF POLLUTION

"Prevention is and shall be the primary objective".

I. PREVENTION PROGRAM

This phase of the program shall be accomplished by the means of the following:

A. Personnel education through meetings, personal consultations, posters, literature distribution, etc.

B. Periodic pollution inspections and follow-up on corrective action.

C. Drills which include boom and skimmer deployment and operating of chemical spray equipment should be conducted to familiarize key personnel.

D. Semi-annual storm choke inspection (in applicable wells).

E. Periodic review of Humble's well control procedures.

F. Critical review of operating procedures by all personnel from a pollution prevention viewpoint.

G. Design of new facilities and improvement of existing facilities to minimize the occurrences of oil spills and the volume of oil spilled should a spill occur.

H. Daily inspection of manned facilities and the inspection at frequent intervals (as prescribed by the USGS District Engineer) of unattended facilities, including those equipped with remote control monitoring systems.

II. OFFSHORE DRILLING

All personnel serving offshore operations must be constantly alert to Humble's intentions not to pollute the water in which operations are conducted.

Procedures to prevent pollution and to correct accidental pollution are as follows:

A. USGS orders will be posted in conspicuous places on offshore units, shore bases, and boats.

B. Trash and garbage will be transported to shore for disposal. Containers constructed to prevent accidental loss on board or enroute will be used.

C. Sewage will be discharged in accordance with Coast Guard requirements.

D. Cuttings from oil-free mud systems will be dumped at least 20' below the water line. Drill cuttings, sand and other solids containing oil will be transported out of the area for disposal.

E. Drilling fluids without oil will be discharged near the ocean floor. Drilling fluids which contain oil will be transported out of the area for disposal.

F. Oil containment booms and skimmers will be maintained at each offshore structure location. Supplies of Enjay Corexit 7664 Oil Slick Dispersant will also be maintained at each platform, the heliport, and at onshore storage areas. Supply boats and platforms will be equipped with skid-mounted centrifugal pumps, monitors, and spray equipment for effective application of the chemical dispersant. Procedures for oil spill containment and clean-up, and pertinent information concerning the location and type of equipment maintained for this purpose, is contained in the Oil Spill Contingency Plan.

III. WASTE CONTROL AND DISPOSAL

The following liquid and solid materials shall not be discharged or disposed of into offshore waters, streams, reservoirs, lakes or any other body of water:

A. Liquids:

1. Oil of any kind or any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

2. Liquid waste materials containing substances which may be harmful to aquatic life or wildlife, or injurious in any manner to life and property.

B. Solid Wastes:

1. Drill cuttings, sand, and other solids containing oil.

2. Trash, paper, mud containers, plastic, other solid waste and other non-edible waste. Waste will be hauled to appropriate disposal areas.

IV. PRODUCTION FACILITIES

A. All production facilities, such as separators, tanks, treaters, and other equipment necessary to control the maximum anticipated pressures and production of oil and gas and shall be maintained at all times in a manner necessary to prevent pollution.

B. All platforms and structures shall be curbed and connected by drains to a collecting tank or sump. In lieu thereof, drip pans, or equivalents, may be placed under equipment from which oil and/or greases might spill. Drip pans will be piped to a tank or sump.

OIL SPILLS

OIL SPILLS

I. DEFINITION

The provisions contained in the National Contingency Plan prohibit the discharge of oil in "harmful quantities" on navigable waters or into contiguous zones of the United States.

"Harmful quantities" are further defined as:

A. Those quantities which violate applicable water quality standards; or

B. Those quantities which cause a visible film, sheen or discoloration of the surface of the water on adjoining shorelines.

II. CLASSIFICATION

Major Spill . . . 10,000 gallons (internal waters)
100,000 gallons (offshore waters)

Moderate Spill . . 100 gals. to 10,000 gals. (internal waters)
1,000 gals. to 100,000 gals. (offshore waters)

Minor Spill . . . 100 gallons (internal waters)
1,000 gallons (offshore waters)

III. RESPONSIBILITY

Outlined in SECTION I are the primary responsibilities of the Emergency Operation Team (EOT). It is not anticipated that this team will be fully mobilized for emergencies other than a major or moderate oil spill or an uncontrolled well flow with associated spill problem. It does, however, provide for an effective communications network to insure that in any emergency, Division and Company Management are fully informed and the proper State and Federal Agencies have been contacted.

Minor oil spills will be handled primarily by the District office with the cleanup operational plans approved by Division Management. Recommendations as to methods and equipment will be provided by the Emergency Operations Team (EOT) members. If a major or moderate spill is experienced, the Emergency Operations Team will be mobilized as outlined in SECTION I and proceed as described in the Oil Spill Contingency Plan.

In all instances, major, moderate or minor, inquiries from the news media will be referred to the Division Public Relations Coordinator. When this is not possible, guidelines for responding to the news media are contained in a following section of this manual.

IV. REPORTING

Any person observing an oil spill should report it to the Field or Operational Superintendent, or the ranking Humble employee then available.

All discharges of oil (in quantities defined in paragraph I) on navigable waters and into the contiguous zone of the United States shall be immediately reported to the U. S. Coast Guard and U. S. Geological Survey. Spill volume, rate, time, date, circumstances, location and other such pertinent information as required by USCG and USGS shall be provided. These records shall be made available to those agencies upon demand. In addition, all spills will be reported to State and Federal Agencies as required.

The "Oil Spill Report Form" will be completed for all spills and will be maintained as a permanent record in the District office with copies submitted to the Division Office. Any other forms required by the USCG, USGS, EPA and various State Agencies will be processed in likewise manner.

Other Operators will be notified when spills are observed in their operational areas.

PUBLIC RELATIONS

PUBLIC RELATIONS EMERGENCY PLAN

It is our policy to promptly direct to the news media information of interest to the public about the Company. With the increased emphasis on anti-pollution efforts, both from the public and industry, as well as the varied and widespread nature of the Company's operations; it is highly probable that any significant occurrence in our business will receive considerable news coverage. Recent experiences such as the Torrey Canyon, Santa Barbara Channel, and Offshore Louisiana incidents have proven the need for a prompt, effective and organized program to provide factual information to the news media. It is for this purpose that the following "Emergency Plan" has been formulated.

A. General Guidelines:

1. News media queries should be referred to the Division Public Relations Coordinator. The company representative should obtain the following information from the individual making the query:

    - Name of Individual
    - Company or Organization Represented
    - Telephone Number

    This information should then be submitted to the Division Public Relations Coorginator in order to provide the party with a prompt reply.

2. Authorized news media representatives should be given courteous assistance at all times.

3. The importance of prompt communication with the news media in the event of a serious emergency cannot be o overemphasized. The prompt reporting of factual data to the news media is necessary to avoid the broadcast of distorted or speculative accounts of the incident which could irreparably damage the public image of the Company. The initial and subsequent reports to news media should be formulated within the framework of the following guidelines:

    a. The report should contain no speculation.

    b. Existing restrictions on release of competitive or confidential information are not to be compromised.

    c. The names of severely or fatally injured personnel should not be released until proper notification of their next of kin.

    d. Reference to the extent of monetary loss should be avoided.

4. With the above guidelines in mind, the report to news media should contain the following factual information:

    a. The nature of the emergency and where it occurred.

    b. The number of people injured or killed and the nature of their injuries.

    c. The steps being taken to care for injured personnel.

    d. The cause of the emergency (if known).

    e. The nature and extent of property damage but not monetary loss.

    f. A statement of actions being taken to correct the emergency.

    g. To the extent that it applies, reference should also be made to plans and efforts being made to safeguard local residents and to protect beaches and property.

B. Duties Of The Public Relations Coordinator:

1. Determine the information necessary to prepare the news releases.

2. Prepare statements for:

    a. Company and Division management.

    b. Employee information.

    c. News media.

3. Establish a news bureau for information distribution.

    a. Minor Spill Category - establish news bureau at the District office.

    b. Major Spill Category - establish news bureau at some convenient location away from office or area of incident to minimize interference with pollution control activities.

    c. In each of the above, insure that appropriate governmental and regulatory agency spokesmen are notified of the news bureau location and are provided with ready access to the bureau.

    d. News Bureau Requirements:

        1) Newsroom equipment, materials, and supplies required:

            a) Map of operations area.
            b) Nomenclature of equipment involved.

c) Company information.
d) Phones for newsmen.
e) PBX senders.
f) Typewriters
g) Lights for TV and photography.
h) File cabinet for news clips.

2) Establish and publish time most suitable for twice-a-day news conferences.

3) Get spokesman from contracting firms, service companies and governmental and regulatory agencies, if needed or deemed appropriate.

4) Establish sub-news bureau at Division Office to answer simple inquiries.

OIL SPILL CONTINGENCY PLAN

OIL SPILL CONTINGENCY PLAN

Santa Barbara Channel
Humble Oil & Refining Company

BASIC REFERENCES:

1. National Oil and Hazardous Materials Pollution Contingency Plan.
2. Region IX Multi-Agency Oil and Hazardous Materials Pollution Contingency Plans.
3. State of California Oil Spill Disaster Contingency Plan (Tentative Version).
4. Standard Oil Company (N.J.) Oil Spill Cleanup Manual.
5. Clean Seas, Inc. Oil Spill Prevention and Control Manual.
6. Clean Seas, Inc. Oil Spill Cleanup Manual.

CONTINGENCY PLAN - OFFSHORE OIL SPILL:

Upon discovery or notification of an oil spill condition, the following contingency plan will be activated and implemented immediately;

PLAN OF ACTION - PHASE I:

1. Initiate all actions necessary to insure personnel safety and structural integrity.

2. Notify the Humble Operations Superintendent or Senior Humble Representative then available. The following information should be provided:
    - a. Were there any injuries and is immediate assistance required for evacuation of personnel?
    - b. What is the current status of the disaster:
        - 1) Is there a fire?
        - 2) Are toxic gases present?
        - 3) If wells are involved:
            - a) How many?
            - b) Are the wellheads intact?
            - c) Are the BOP's operable?
            - d) Would attempts to shut in the well be feasible?
            - e) What is the status of other wells on the platform?
    - c. Does an oil spill condition exist?
    - d. What is the current activity in progress?

3. Initiate interim emergency actions as prescribed by the Operations Superintendent or Humble Representative.

4. Notify the U. S. Coast Guard, U. S. Geological Survey, Environmental Protection Agency, and all State and Local Agencies as required.

5. Activate the Western Division Emergency Operations Team (EOT). The EOT organization is outlined in SECTION I. This team provides for an effective communications and liaison network to insure that in any emergency:
    - a. All information needed to control the disaster is obtained. This information will include:
        - 1) Plats - wells - surface, subsurface, mechanical and directional.
        - 2) Plats - platforms.
        - 3) Plats - pipelines and distributio systems.
        - 4) Production histories and capabilities of wells.

5) Casing pressure histories on all strings and all wells.
6) Structure maps and cross sections on the producing zones creating the problem.

b. Coordinated pollution control and cleanup activities are maintained.

c. Proper Federal State and Local Agencies have been contacted and that liaison and full cooperation with the National, Regional, State and Local Response Teams which have been activated are initiated and maintained.

d. Interfacing of all Federal, Regional, State and Local Contingency Plans is accomplished as necessary.

e. Division and Company management are fully informed.

6. Notify CLEAN SEAS, INC. of the spill condition. Begin interfacing of the CSI Oil Spills Contingency Plan with the Western Division's Contingency Plan. Interfacing would consist primarily of providing the manpower, liaison and coordination between CSI and Humble in the capacities outlined in the CSI Contingency Plan.

PLAN OF ACTION - PHASE II:

1. Route all immediately available transportation and equipment to the spill area to aid in rescue operations and immediate response equipment deployment.

2. Utilizing STANDBY POLLUTION CONTROL EQUIPMENT (see Appendix A), deploy booms and skimmers in desired patterns.

3. Utilize skid-mounted pump and monitor packages to spray dispersant or for fire fighting, whichever is applicable.

NOTE: Spraying of dispersant will be conducted only with approval of the EPA and the Pacific Region USGS Supervisor. If approval has been obtained, dispersant will be applied at the rates and volumes prescribed by the

EPA and only if the spill falls within the definitions outlined under "Dispersant Application" (see MATERIALS AND EQUIPMENT SUMMARY).

As the immediate response equipment is being deployed and the initial containment and recovery operations are being undertaken, the following additional specific actions will also be immediately undertaken:

4. Assist in the mobilization and deployment of all CSI skimmers, booms and ancillary support equipment in addition to utilizing the talents and expertise of the CSI member company representatives in the capacities outlined in the CSI Contingency Plan.

5. Mobilization, transport and deployment of all additional Humble Oil boom, skimmer and ancillary support equipment available within the Western Division area of operations.

6. Mobilization transport and deployment of all additional boom, skimmer and ancillary support equipment available from other industry operators within the Santa Barbara Channel area.

7. Mobilization of all necessary boats, labor, tanks, barges and other support equipment to place the above items into immediate service.

8. Alert beach cleanup and harbor protection service companies to standby for immediate operations as as necessary.

9. Continue operations as directed by the "On Scene Commander " and designated Emergency Operations Team, National, Regional, State and Local Response Team, and CSI coordinators. Provide the manpower and guidance necessary to maximize the utilization of all equipment and personnel involved in combating the oil spill condition.

PLAN OF ACTION - PHASE III:

Depending on the magnitude and extent of the spill, and on the containment and recovery capability being experienced after the mobilization and deployment of available Santa Barbara Channel equipment, the following additional actions may also be taken as required:

1. Request from all other West Coast Oil Spill Cleanup Organizations and Cooperatives all available equipment for shipment to the Santa Barbara Channel on a priority basis.

2. Request from all West Coast industry operators and from all other divisions of Humble all available equipment for shipment to the Santa Barbara Channel on a priority basis

3. Request from all Gulf Coast industry operators all available equipment for shipment to the Santa Barbara Channel on a priority basis.

4. Initiate purchases or construction of additional containment boom and recovery systems as needs dictate.

5. Arrange for additional boats, labor, tankage, and other ancillary support equipment to place this additional containment/recovery equipment in operation upon arrival.

6. Begin deployment of personnel and equipment required for harbor protection and/or beach cleanup activities as needs dictate.

   NOTE: Cleanup of land areas, beaches, boats and boat harbors will be necessary should oil reach these areas. Depending on the concentration and areal extent, cleanup will require removal and disposal by manual and/or mechanical methods. Burning of oil on land or water, or chemical cleaning of land areas, will not be attempted unless approved by Division management. Selection of methods and materials for cleanup operations will be based on technical advice from the Emergency Operations Team staff. Service companies, necessary equipment sources and approved disposal sites are listed in Appendix B.

PLAN OF ACTION - PHASE IV (CONCLUDING PHASE):

1. Insure that all onshore and offshore cleanup operations have been successfully concluded.

2. Recover and demobilize all equipment used to combat the oil spill.

3. Clean, repair or replace and return all equipment to the proper locations.

4. Complete any salvage operations which may be required or necessary.

5. Complete documentation and recording of all activities occurring during the time of the emergency. Prepare the final report for review and future reference.
6. Complete demobilization of all personnel.
7. Return to normal activities as conditions permit.

MATERIALS AND EQUIPMENT - SUMMARY:

EQUIPMENT:

Humble standby oil spill control equipment is maintained at offshore unit locations, on supply boats and at land base locations as outlined in Appendix A. This equipment includes containment booms, skimming apparatus, approved chemical dispersants, skid-mounted pump packages (monitors, hose, chemical injection pumps, etc.) and spray booms for boats and aircraft. This equipment shall be maintained in good condition and be regularly inspected. The District Superintendent or Operations Superintendent is responsible for the inspection and maintenance of all standby oil spill control equipment, for reporting its status to the Division Operations Manager, and for notifying the United States Geological Survey Supervisor of its location.

A. Boom Installation - When sea conditions permit, booms will be moved by work boat from the storage areas to the desired location. Positioning will be accomplished by the use of anchors and buoys in the immediate vicinity, existing mooring crown buoys, or by the offshore unit itself. These methods of boom positioning place strong emphasis on equipment mobility to respond quickly to changing wind and sea conditions.

B. Skimming Apparatus Utilization - When the situation necessitates oil recovery at sea, floating skimmers will be used for picking up the oil. These skimmers can be readily transferred to work boats for quick usage.

MATERIALS:

Collecting Agents (straw, polyurethane, etc.) - Generally acceptable providing that the materials do not in themselves or in combination with the oil increase the pollution hazard.

Sinking Agents (kaolinite, talc, aluminum silicate, etc.) - Sinking agents may be used only in marine waters exceeding 330 feet in depth where currents are not predominantly onshore, and only if other control methods are judged by the EPA to be inadequate or not feasible.

Chemicals - Chemicals are stocked at central locations in sufficient quantities to initiate and continue application until a resupply can be received. Properly equipped workboats and skid-mounted pumps on offshore units are available for dispersant application. In the event of rough seas, spray planes can quickly cover large areas with the wave forces providing the needed agitation for effective dispersion. These planes can operate from Goleta, Carpinteria, or Ventura depending on the location of the problem area. Technical assistance in the application of chemicals will be furnished by District and Division engineers and/or Enjay engineers. No chemical dispersant will be used in State waters.

A. Dispersant Application - Unless otherwise specified by the Environmental Protection Agency (EPA), DISPERSANTS SHALL NOT BE USED:

1. On any distillate fuel oil.

2. On any spill of oil less than 200 bbls. in quantity.

3. On any shoreline.

4. In any waters less than 100 feet deep.

5. In any waters containing major populations or breeding or passage areas for species of fish or marine life which may be damaged or rendered commercially less marketable by exposure to dispersants or dispersed oil.

6. In any waters where winds and/or currents are of such velocity and direction that dispersed oil mixtures would likely in the judgment of the EPA be carried to shore areas within 24 hours.

7. In any waters where such use may affect water supplies.

B. In the event the EPA judges other control methods inadequate and permits the use of approved dispersants, the following limitations shall prevail unless otherwise specifically ordered by the EPA:

1. No dispersant shall be applied in quantities exceeding 5 gallons per acre per 24 hours.

   This maximum will be in effect until standard toxicity levels have been determined.

2. Upon determining standard toxicity levels, the maximum dispersant permitted will be the lesser of:

   a. Gals/Acre/24 hours = (TL50,ppm)x (.1086) where TL_{50}=96 hour toxicity level value of the most sensitive species tested in ppm

   OR

   b. 540 gallons/Acre/24 hours

   OR

   c. 1/5 of the total volume spilled

APPENDIX
EQUIPMENT INVENTORY

APPENDIX A

Standby Pollution Control Equipment

Humble Oil & Refining Company

STANDBY POLLUTION CONTROL EQUIPMENT

Santa Barbara Channel
Humble Oil & Refining Company
October, 1971

I. Booms:

a. Two-thousand feet of containment boom is located within the Santa Barbara Channel area of operations.

b. Provisions to secure these booms will be provided by one or more of the following methods:

1. A 3-ton anchor system with a 5-foot O.D. crown buoy (bridled). Anchoring units are now stored with each boom unit.
2. Any buoy system already existing in the area of the boom deployment.
3. The offshore structures themselves, and/or small boats, will provide additional anchor points.

II. Recovery Devices:

Three skimming devices are located within the Channel area of operations. These devices can be transferred to one or more workboats which will provide mobility in skimming oil from within the boom. Workboat ballast tanks, and/or Baker tanks and Humble test tanks (four 250 bbl - USCG approved) transferred to the workboats, will serve to separate oil and water. Oil will be transferred as necessary to other boats or barges brought alongside the workboats.

NOTE:

Additional boom and skimmer equipment is currently available for immediate use from other industry operators within the Santa Barbara Channel area. Refer to Appendix B for locations.

III. Dispersants:

a. Corexit supply: Approximately 300 drums are stockpiled within the Santa Barbara Channel area. Additional chemicals may be obtained from stockpoints outside the Channel area and from the manufacturing firms.

b. Two complete systems consisting of skid mounted centrifugal pumps, hose, monitors, and chemical injection pumps are available.

c. Two large work boats (Cal Tide and Pike I) are equipped with spray booms for immediate dispersant application. Provisions on each boat have been made for the installation of the skid-mounted pump packages.

d. Two Grumman Ag-Cat spray planes located at the Santa Barbara Airport are capable of being rapidly equipped for immediate dispersant application.

e. Additional dispersant supply, boats, and planes are available within 24 hours to cope with a disaster of large magnitude.

IV. Minimum Equipment Inventory At Each Offshore Location:

a. 1,000' slickbar oil spill boom.

b. One 5' buoy.

c. One 3-ton anchor.

d. 1,500' - 3/4" wire rope with socket end connections.

e. One skimmer unit.

f. Hose and floats to connect skimmer to storage tanks.

g. Skid-mounted centrifugal pump, hose, monitor, and chemical injection pump.

APPENDIX B

LISTS OF CURRENTLY AVAILABLE EQUIPMENT AND SERVICES

HELICOPTER AIRCRAFT AVAILABLE FOR EMERGENCY WORK

Owner	Type of Craft
Rotor Aids Offshore, Inc. Santa Barbara Airport	Sikorsky S-55 6 passenger, 1200# payload
(805) 967-1314 (805) 642-8584	Sikorsky S-55 6 passenger, 1200# payload
	Bell 47-J 3 passenger, 600# payload
	Bell 47-J 3 passenger, 600# payload
Condor Helicopters and Aviation, Inc. Ventura County Airport (805) 487-5451 (Day) (805) 642-6142 (Night)	Bell G-3-B1 2 passenger, 600# payload equipped for spraying liquid chemicals, 100 gallon capacity tanks.
	Bell G-5 2 passenger, 600# payload, equipped for spraying liquid chemicals, 100 gallon capacity tanks.
	FH-1100 4 passenger, 900# payload
	Bell G-2

FIXED WING AIRCRAFT AVAILABLE FOR EMERGENCY WORK

Owner	Type of Craft
Condor Helicopters and Aviation, Inc. Ventura County Airport (805) 487-5451 (Day) (805) 642-6142 (Night)	Grumman Ag-Cat 2000# payload, 220 gallon capacity tanks.
Coastal Chemical Company, Aviation Division Ventura County Airport (805) 483-3234 (805) 487-4961	Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks. Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks. Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks.

APPENDIX B

SERVICE BOATS AVAILABLE FOR EMERGENCY WORK

Owner	Name of Boat	Type of Boat
Tidewater Marine Pacific, Inc. Santa Barbara (805) 963-1774	Cal Tide	165' Supply
	Calcasieu	120' Supply
	Kyle Tide	136' Supply
	Lib Tide	43' Crew
	Lou Tide	50' Crew
	Luck Tide	43' Crew
	Port Tide	76' Supply
	Run Tide	50' Crew
	Pam Tide	50' Crew
	Low Tide	136' Supply
	Warm Tide	65' Crew
	Royal Tide	50' Crew
	Pacific Tide	80' Tug
	Unit	50' Crew
General Marine Transport (Sea Tenders) Santa Barbara (805) 963-3808 (Day) (805) 965-6465 (Night)	Mallard	65' Crew
	Sea Scope	185' Research
	Winn	130' Supply
	Cameron	130' Supply
	Swallow	59' Crew
Western Offshore Drilling and Exploration Co. Santa Barbara (805) 963-7808 (Day) (805) 965-0510 (Night)	Pike I	135' Supply
	Pike VI	60' Crew
	Pike VIII	60' Crew
	Pike X	60' Crew
Santa Fe International Corp. (Caspary-Wendell, Inc.) Santa Barbara (805) 488-4716	Del Mar	120' Supply
Ryan Contracting Corp. Santa Barbara (805) 963-4237 (Day) (805) 965-8903 (Night)	San Clemente	70' Tug
Joe Greco Santa Barbara (805) 969-2087	El Greco	65' Utility

SERVICE BOATS AVAILABLE FOR EMERGENCY WORK (CONTINUED)

Owner	Name of Boat	Type of Boat
Milt Ashkins or Perry Salter Santa Barbara (805) 942-4874 (805) 965-0898	Fall Guy	56' Utility
Port Hueneme Industrial Port Hueneme (805) 488-3681	Oil City	100' Supply
United Boat Service, Inc. Santa Barbara (805) 965-8330 (Day) (805) 964-3798 (Night)	Colleen Judy Laura Tona	43' Crew 40' Crew 45' Crew 45' Crew

TUGS AND BARGES

Tugs:

USN Station	
Long Beach	
Port Services Officer	(213) 547-6627
Operations Officer	(213) 547-6817
Tug Dispatcher	(213) 547-6275
Donohugh Boat Service	(213) 831-0217
Berth 117	
San Pedro	
Pacific Towboat & Salvage Co.	(213) 432-6487
Pier D, Berth 35	
Long Beach	
San Pedro Tugboat Co.	(213) 832-1158
Berth 88	
San Pedro	
Wilmington Transportation Co.	(213) 832-4292
Berth 86	
San Pedro	

Barges:

Naval Weapons Station	(213) 596-5511
Seal Beach (22 barges)	
Connolly-Pacific Co.	(213) 437-2831
1925 Water Street	
Long Beach (11 barges)	
Healy Tibbets Construction Co.	(213) 436-1542
1500 West 7th	
Long Beach (9 barges)	
United Towing Company	(213) 547-4441
Berth 122	
San Pedro (12 barges)	

APPENDIX B

BOOMS AND SKIMMERS CURRENTLY AVAILABLE LOCALLY FOR EMERGENCY WORK

(Partial List Only)

Clean Seas, Inc. c/o Harbor Services 321 Ponoma Street Port Hueneme (805) 488-7595 or (805) 488-5652	CSI Skimmer No. 1 "Sea Dragon" Skimmer MK-II Skimmer (2) 480' Sea Curtain Boom 520' BT Boom
Atlantic Richfield Co. Rincon Island	1000' Anchor Canvas Co. Boom
Phillips Petroleum Co. Platform Hogan	500' Slickbar Boom Acme Saucer Skimmer
Platform Houchin	500' Slickbar Boom Acme Saucer Skimmer
Standard Oil of California Carpenteria	500' Navy Boom
Sun Oil Co. Platform Hillhouse	1000' Slickbar Boom Acme Saucer Skimmer
Union Oil Co. Port Hueneme	Union Skimmer 400' T-T Boom 300' Spillguard Boom
Platform A	1000' Slickbar Boom Acme Saucer Skimmer
Platform B	700' Slickbar Boom Acme Saucer Skimmer
Crosby & Overton Inc. 1620 W. 16th Street Long Beach	About 6000' of boom plus skimmers
W. H. Hutchison & Sons, Inc. 217 N. Lagoon Avenue Wilmington	About 6000' of boom plus skimmers

(Note: See Section 1300 of the Clean Seas "Oil Spill Cleanup Manual" for additional sources including manufacturing outlets)

SORBENT MATERIALS AND APPLICATORS

(Partial List Only)

SORBENTS:

1. Baled Straw

   a) El Monte Hay Market
   10900 Railroad Avenue
   El Monte (213) 283-3291

   b) Purche Ranch
   178th & Main (213) 324-1819
   Compton (213) 830-1207

   c) Smith & Reynolds Erosion Control,
   Inc.
   1501 Hillside Avenue (714) 737-6778
   Morco (714) 737-7287

   d) Valentine Feed & Seed
   1660 South Oxnard
   Oxnard (805) 483-2545

2. Fiberperl

   Grefco, Inc.
   630 Shatto Place (213) 381-5081
   Los Angeles (213) 775-2781

3. Poly-Pro

   a) Western Textile Products, Inc.
   128 S. Cypress Street (714) 538-3527
   Orange (714) 538-9303

   b) Chemline Industries
   P. O. Box 2371
   Palos Verdes Peninsula (213) 373-2969

4. Strickite

   a) Strickman Industries, Inc.
   P. O. Box 140
   Orangeburg, New York 10962 (914) 359-2400

   b) Col. Vito S. Pedone
   1600 S. Eads St., Room 238S
   Arlington, Virginia 22202 (703) 521-2329

5. 3M Brand Oil Sorbent

   3M Company (612) 733-1110
   St. Paul, Minnesota 55101 (612) 733-4043

SORBENT MATERIALS AND APPLICATORS (CONTINUED)

STRAW BLOWERS:

1. Smith and Renolds (714) 737-6778
   Morco (714) 737-7287

2. Billy Greenfield
   McFarland

SPRAYING CONTRACTORS:

1. Coastal Chemical Company
   1015 Wooley Road
   Oxnard (805) 487-4961

2. Western Exterminators
   Main Street
   Ventura (805) 642-0464

APPENDIX B

BEACH AND SHORE CLEANUP

SERVICES:

1. Crosby & Overton Inc.
   1620 West 16th Street
   Long Beach (213) 432-5447

   Heavy duty cleanup organization with all necessary equipment.

2. Hutchison & Sons Inc.
   217 North Lagoon Avenue
   Wilmington (213) 830-1720

   Heavy duty cleanup organization with all necessary booms, skimmers and beach cleanup equipment.

3. Mar-Len Supply Inc.
   1963 National Avenue
   Hayward (415) 782-3555

4. Petroleum Construction Inc.
   1452 E. Harvard Boulevard
   Santa Paula (805) 525-2144

5. URS Research Company
   155 Bovet Road
   San Mateo (415) 574-5000

   Can furnish expertise and supervise work and equipment.

6. Van Construction Company
   1585 South Lirio Street
   Saticoy (805) 647-1103

HEAVY EQUIPMENT & TRANSPORTATION:

1. Allied Construction and Engineering Company
   2320 North Ventura Avenue
   Ventura (805) 648-3141

2. C. W. Berry
   4157 State Street
   Santa Barbara (805) 967-4004

3. Cloer Construction Company
   Las Varas Canyon
   Goleta (805) 968-6490

4. F. Feliciarro
   110 E. Vettera Via (805) 925-8624
   Santa Maria (805) 937-1257

5. Eldon H. Haskell
   2 South Quarantina
   Santa Barbara (805) 963-3851

BEACH AND SHORE CLEANUP (CONTINUED)

6. Hudson Contr. Corp.
   1051 S. Beach Boulevard
   La Habra (213) 697-6144

7. Clarence & Jack Lambert, Inc.
   110 Salsipuedes Street
   Santa Barbara (805) 963-3591

8. Lang Transportation
   2459 North Ventura Avenue
   Ventura (805) 648-1821

9. Leal Corp.
   736 Mission Road (805) 525-4214
   Santa Paula (805) 485-5904

10. Petroleum Construction, Inc.
    1452 E. Harvard Avenue
    Santa Paula (805) 525-2144

11. Van Construction Company
    1585 S. Lirio Street
    Saticoy (805) 647-1103

VACUUM TRUCKS:

1. Barnett Vacuum Truck Service
   32 Telegraph Road
   Fillmore (805) 524-2377

2. Chancellor & Ogden, Inc.
   3031 East "I" Street
   Wilmington (213) 432-8461

3. Fix & Brain Vacuum Truck Service
   233 East "D" Street
   Wilmington (213) 432-5510

4. Eddie Hanks Vacuum Truck Co.
   Newhall (805) 259-1546

5. J. & G. Oilwell Service
   215 E. Rocklite Road
   Ventura (805) 643-3680

6. Routh Transportation
   800 W. 15th Street
   Long Beach (213) 435-4823

7. Max Rudolph Co.
   1313 Ventura Street (805) 525-4458
   Santa Paula (805) 525-6606

BEACH AND SHORE CLEANUP (CONTINUED)

VACUUM TRUCKS (CONTINUED)

8. Speed's Oil Tool Service, Inc.
110 E. Betteravia Road (805) 925-1369
Santa Maria (805) 925-4510

9. Superior Vacuum Trucks
221 N. Mar Vista
Wilmington (213) 830-3330

DISPOSAL SITES:

CLASS I SITES: May take any type of waste, including liquid oil.

CLASS II SITES: May take normal household garbage, oily straw, but no liquids.

CLASS I SITES:

1.	Elkins Ranch (Ventura County)	Operates ponds, etc., for liquids. Special arrangements required for oily waste. On Highway 23, 1/4 mile south of Fillmore, turn left on Guiberson. Turn right by schoolhouse to dump. (805) 524-1781.
2.	J & G Oil Well Service (Ventura County)	Operates private site at 5th & Harbor, Oxnard. Special arrangements required if used by other's trucks. (805) 643-3680.
3.	Landfill No. 5 Calabasas (Los Angeles County)	Operated by Los Angeles County Sanitation District. West on Ventura Freeway to Lost Hills Road, go north to end of road. (213) 889-1430.
4.	Simi Valley Landfill (Ventura County)	Some Class I area. Left side of Highway 118, north of Simi on Union Oil lease.

CLASS II SITES:

1.	Tajiguas Landfill (Santa Barbara County)	Can take oily straw. Approximately 6 miles east of Gaviota, behind Shell Service Station on left. Dump is 1/2 mile off Highway 101. (805) 968-4515.
2.	Toland Road Dump (Ventura County)	Four miles east of Santa Paula. Take Toland Road left to dump site. (805) 525-8217
3.	Ventura Coastal Refuse Co. (Ventura County)	Can take oily straw. S. on Harbor from Oxnard, left on Gonzales Rd. to 4105. (805) 642-7127

APPENDIX B

TEMPORARY QUARTERS, STORAGE AREAS

TEMPORARY QUARTERS:

1. Angelus Mobile Office Rentals
   1134 Santa Anita Avenue
   South El Monte (213) 443-1715

2. Scotsman Mobile Lease Co.
   18010 S. Figuero
   Gardena (213) 532-0583

3. State of California Disaster Office
   Los Angeles (213) 620-5607

4. Tri-Counties Vehicle Center
   7760 Hollister Avenue
   Goleta (805) 968-1565

5. Van Construction Company
   1585 S. Lirio Street
   Saticoy (805) 647-1103

STORAGE AREAS:

1. Harbor Services Company
   321 Ponoma Street (805) 488-5652
   Port Hueneme (805) 488-4646

2. Gene Kullins Realty
   Santa Barbara (805) 962-8000

   Has warehouse storage area back of
   Spanish Restaurant on Cabrillo

3. Romines Trucking & Construction Co. (805) 488-4904
   Port Hueneme (805) 488-1381

   Has heavy cranes, forklifts, crews
   and cleanup capability.

APPENDIX 6.7

SUPPLEMENTAL PLAN OF OPERATIONS

SANTA YNEZ UNIT

APPENDIX 6.7

CSI Oil Spill Cleanup Manual

Clean Seas, Inc.

September, 1971

CLEAN SEAS INCORPORATED

OIL SPILL CLEANUP MANUAL

PREPARED FOR: CLEAN SEAS INCORPORATED
ATLANTIC RICHFIELD COMPANY
CITIES SERVICE OIL COMPANY
CONTINENTAL OIL COMPANY
GETTY OIL COMPANY
GULF OIL COMPANY
HUMBLE OIL & REFINING COMPANY
MARATHON OIL COMPANY
MOBIL OIL CORPORATION
PHILLIPS PETROLEUM COMPANY
SHELL OIL COMPANY
SIGNAL OIL & GAS COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
SUN OIL COMPANY
TEXACO INC.
UNION OIL COMPANY OF CALIFORNIA

OFFICERS: C. C. TAYLOR - PRESIDENT
D. E. CRAGGS - 1ST VICE PRESIDENT & TREASURER
J. B. TAYLOR - SECRETARY

REESE W. NORTON
EXECUTIVE VICE PRESIDENT

SEPTEMBER 1, 1971

CLEAN SEAS INCORPORATED

24 Hour Phone (805) 963-3488

R. W. NORTON
Executive Vice President

18 MARINE CENTER BUILDING ◦ BREAKWATER ◦ SANTA BARBARA, CALIF. 93109

FROM: Executive Vice President
TO: Distribution List
SUBJECT: CSI Oil Spill Cleanup Manual

1. The CSI Oil Spill Cleanup Manual and Contingency Plan of September 1, 1971 is effective upon receipt.

2. The CSI Oil Spill Cleanup Manual and Contingency Plan supersedes the Clean Seas Inc. Response Plan contained in Section X, Clean Seas Inc. Oil Spill Prevention and Control - Summary and Recommendations - dated October, 1970, Prepared by: Engineering Study Subcommittee. However, this "Blue Book" should be consulted freely for additional information and data referred to but not contained in subject Manual.

3. This Manual shall remain in effect until superseded.

4. Procedures for changes and amendments are contained in the Manual.

5. This Manual is a non-registered, unclassified publication. Extracts may be made.

6. Comments and recommendations concerning this Manual are invited and should be addressed to the Executive Vice President, Clean Seas Incorporated.

7. A copy of this Manual is distributed to each Member and Director and each person assigned to work on oil spill cleanup. In event of transfer or termination, effected person should give his copy to his replacement and notify the Executive Vice President or return copy to Clean Seas Incorporated.

Reese W. Norton

Reese W. Norton

10 — CONTENTS

10 TABLE OF CONTENTS

20 — TELEPHONE LISTS

20 CSI PERSONNEL TELEPHONE LIST

	Office	Home
Reese W. Norton - Exec. Vice Pres.	(805)963-3488	(805)967-5340
Atlantic Richfield Co.		
R. O. Pollard - Member	(805)831-1600	(805)831-2113
J. B. Hundley, Jr. - Director	(805)831-1600	(805)832-3916
Private Office	(805)831-5265	
C. E. Ensley	(213)437-1284	(213)431-7309
C. E. Robertson	(805)648-3027	(805)525-4088
Lee Gefvert	(805)831-1600	(805)872-2745
A. H. Smith	(805)831-1600	(805)832-7776
Dick Grunder	(805)648-3027	(805)646-5720
C. J. Campbell	(805)831-1600	(805)323-8804
Cities Service Oil Company		
K. D. Van Horn - Member & Director	(805)497-3986	
Continental Oil Co.		
F. E. Ellis - Member	(713)225-1511	(713)444-5819
H. D. Haley - Director	(805)642-8154	(805)647-1666
G. E. Fraker	(805)642-8154	(805)647-3617
Jack L. Driggs	(805)642-8154	(805)644-3909
Ralph T. Hanson	(805)642-8154	(805)647-3423
Getty Oil Company		
R. A. Griffith - Member	(209)935-2021	(805)935-1307
C. B. Merithew - Director	(805)643-2154	(805)642-5260
Gulf Oil Company		
Hoyt Austin - Member	(805)324-6031	
L. L. Keyes - Director	(805)324-6031	
Humble Oil & Refining Company		
C. C. Taylor - Member & Director	(213)879-2700	(213)341-7068
Night Office	(213)879-2849	
D. I. Bolding	(213)879-2700	(213)762-2811
G. R. Cunningham	(213)879-2700	(213)396-2210
D. C. Hurst	(213)879-2700	(805)642-4151
R. G. Tonkin	(213)636-9177	(213)431-0570
G. A. Daugherty	(213)636-9177	(213)430-4375
H. P. Bezner	(805)644-1811	(213)341-9363
H. A. Weeks	(213)636-9177	(714)893-4495
J. T. Taylor	(805)644-1811	(805)642-7655
T. R. Hicks	(805)644-1811	(805)647-6853
John D. Gonnerman - Engr. Marine Dept. Houston, Texas 77001	(713)221-3949	(713)729-6014
Marathon Oil Company		
W. C. Sylvester - Member & Director	(307)235-2511	
J. E. Fosher - Alternate	(213)628-3251	

	Office	Home
Mobil Oil Corporation		
W. D. Fritz - Member	(213)626-5711	(213)691-1034
B. O. Sims, Jr. - Director	(213)626-5711	(213)377-5891
N. H. Smith, Jr.	(213)626-5711	(213)375-3815
P. E. Patterson	(213)723-8631	(213)581-4250
R. D. Lathan	(805)643-5451	(805)646-6897
Rincon Facility	(805)643-7211	
Phillips Petroleum Company		
C. W. Corbett - Member	(303)771-6600	
R. D. Schropp - Director	(805)963-3751	(805)967-2224
Ben Piester	(805)963-3751	(805)967-5807
C. G. Fewell	(805)963-3751	(805)968-0020
J. K. Daniel	(805)963-3751	(805)964-1457
Shell Oil Company		
Ed. C. Sumner - Member & Director	(213)482-3131	
Ted F. Ritchie	(805)643-5221	(805)529-1267
Jim W. Haney	(805)526-1044	(805)527-8927
Jack D. Hall	(213)427-4113	(714)539-4450
C. L. Thomas	(213)482-3131	(714)527-7977
C. H. Long	(213)482-3131	(213)349-7590
Signal Oil & Gas Co.		
T. A. Gould - Member	(213)482-0722	
R. T. Togni - Director	(805)968-1697	
Standard Oil Company of California		
R. E. France - Member	(213)691-2251	(213)696-8434
G. L. Laurent - Director	(805)684-4531	(805)969-1990
W. T. Wilson	(213)691-2251	(213)697-8455
Henry Schoelhorn	(213)691-2251	(213)697-7006
R. V. Scott	(213)691-2251	(213)697-1958
M. A. Stewart	(805)937-6333	(805)937-2839
Larry Benolkin	(805)684-2631	(805)968-5605
John R. Herring	(805)684-4531	(805)967-7607
W. Fischer	(213)691-2251	(714)525-3038
Night Office	(213)691-2243	
Sun Oil Company		
M. R. Elliott - Member & Director	(805)648-3251	(805)644-3311
B. F. Brawley	(805)648-3251	(805)647-2992
R. A. Seefeld	(805)648-3251	(805)644-3038
D. W. Phillips	(805)648-3251	(805)642-6069
J. F. Woodman	(805)648-3251	(805)642-0548
G. J. Welsh	(805)648-3251	(805)647-5242
R. P. Naremore	(805)648-3251	(805)644-4450
Texaco Inc.		
W. F. Allinder - Member	(213)385-0515	
O. W. Chonette - Director	(213)385-0515	

	Office	Home
Texaco Inc. (Continued)		
R. F. Vincent	(805)525-4601	(805)525-5826
J. E. Cushing	Gaviota 52	(805)967-0841
J. B. Coffee	(805)642-6781	(805)642-7775
L. Southwick	(805)525-8008	(805)524-0309
Union Oil Company		
C. H. Chadband - Member	(213)482-7600	(714)638-4556
D. E. Craggs - Director	(805)642-0376	(805)642-7633
	or (805)963-6404	
T. H. Gaines	(213)482-7600	(213)838-4712
T. C. Bangs	(213)945-1221	
Paul Gooder	(213)482-7600	(213)592-1556
D. C. Gullickson	(805)543-6927	(805)489-2643
D. J. Van Harreveld	(805)543-7600	(805)544-2650
Dick Gillen	(805)642-0376	(805)644-3098
	or (805)963-6404	
Tom Whittaker	(805)642-0376	(805)642-1867
	or (805)963-6404	
Frank Lemmon	(805)642-0376	(805)644-3281
	or (805)963-6404	
The John Kemp Company	(805)687-3404	(805)964-3842
Harbor Services Co.		
Jim Petrovich	(805)488-5652	(805)486-7283

21 MEMBER COMPANY SPECIAL AGENTS

	Office	Home
Atlantic Richfield Co.		
F. W. Evans, Jr.	(213)629-4111	(213)790-0353
Gulf Oil Company		
Ken Sleeger	(213)879-0560	
Humble Oil & Refining Company		
Bill Zanone	(213)879-2700 Ext. 246	(213)868-2701
Tom Strong	(213)879-2700 Ext. 246	(213)280-2601
Mobil Oil Corporation		
Aksel Pederson	(213)626-5711	
Shell Oil Company		
Ed Koller	(213)481-1566	
Signal Oil & Gas Co.		
Earl A. Smith	(23-)482-0722	
Standard Oil Company of California		
Herb R. Force	(213)624-2711	(714)847-7390
Texaco, Inc.		
Robert B. Farrell	(213)385-0515 Ext. 509	(714)774-7238
Union Oil Company of California		
Paul R. Schooling	(213)482-7600 Ext. 2134	
Jack E. Chiquet	(213)482-7600 Ext. 2134	

30 GOVERNMENT AGENCIES TELEPHONE LIST

U. S. Coast Guard

For spills occurring between Mexican Border and mouth of Santa Maria River:

Eleventh Coast Guard District Office
Heartwell Building
19 Pine Avenue
Long Beach, California 90802

24-Hour phone (213) 590-2225

Capt. George W. Walker	(213)590-2224	(Chief of Operations)
Commander, Long Beach	(213)590-2211	
Commander, Santa Barbara	(805)962-7430	
After hours - Lt. C. W. Waage	(805)965-0250	

For spills occurring north of mouth of Santa Maria River:

Twelfth Coast Guard District Office
630 Sansome Street
San Francisco, California 94126

24-Hour phone (415) 556-5500

United States Geological Survey

300 North Los Angeles Street
Los Angeles, California 90012

Don W. Solanas (213)688-2850

Room 209 Post Office Building
Santa Barbara, California 93105

H. T. Cypher	Office	(805)963-3611
	Home	(805)967-9548
Ed. Guynn	Home	(805)964-2944

State Division of Oil and Gas

Oil and Gas Engineer, Offshore Unit
830 N. La Brea Avenue
Inglewood, California 90302

Elbert R. Wilkinson	Office	(213)678-7274
	Home	(213)532-7071

U. S. Army Engineer District, Los Angeles

300 North Los Angeles Street
Los Angeles, California 90053

Mr. Wendell Reese

24-Hour phone (213)688-5522

California Department of Fish & Game

350 Golden Shore
Long Beach, California 90802

Capt. Walter H. Putman	Office	(213)435-7741
	Home	(213)436-8861

California Disaster Office, Emergency Service Office, Region I

107 S. Broadway
Los Angeles, California (213)620-5607

31 PUBLIC AGENCIES TELEPHONE LIST

Fire Departments

Port Hueneme (County)	(805)482-2777
Oxnard City	(805)483-2211
Ventura City	(805)643-6121
Ventura (County)	(805)648-7711
Carpinteria-Summerland	(805)684-4111
Santa Barbara City	(805)965-5252
Santa Barbara County (Goleta)	(805)967-1211
Santa Barbara County (Santa Maria)	(805)922-7771 (805)922-5848

Police Departments

Oxnard Police	(805)486-1663
Ventura County Sheriff	(805)648-3311
Carpinteria Police	(805)684-4561
Santa Barbara County Sheriff (Santa Maria)	(805)922-5775 Ext. 28
Santa Barbara County Sheriff (Santa Barbara) Don Sweet	(805)963-1611
Santa Barbara Police	(805)965-5151

Harbor Masters

Oxnard	(805)487-5511
Ventura	(805)642-8538
Santa Barbara	(805)963-1737

District Attorney's Office

Santa Barbara	(805)963-1441

32 RECOMMENDED DOCTORS, HOSPITALS & AMBULANCE SERVICES, GROUPED TO COVER PRINCIPAL WORKING AREAS OF OXNARD, VENTURA, SANTA MARIA, AND SANTA BARBARA

OXNARD:

Dr. Nobel A. Powell	1200 N. Ventura Rd.	483-0131
Dr. J. R. Monahan	314 W. 4th Street	483-1624
Oxnard Ambulance Service	321 South "C" Street	486-6333
St. Johns Hospital	333 North "F" Street	483-1141

VENTURA:

Ventura Medical Group	3003 Loma Vista Road	643-2161
Courtesy-Ventura Ambulance	3110 Loma Vista Road	643-5496
Community Memorial Hosp. of San Buenaventura	2800 Loma Vista Road	648-3201

SANTA MARIA:

Dr. Albert Beekler	301 E. Chapel	925-2409
		or 925-4072
Profess. Ambulance Service	111 East Cook	925-9555
Marian Hospital	1400 East Church Street	922-5811

SANTA BARBARA:

Dr. Michael J. Lemus	101 West Arrellaga	963-1824
		or 966-4181
Coast Ambulance	1913 State Street	963-3561
Cottage Hospital	320 West Pueblo	963-1661
St. Francis Hospital	601 East Micheltorena	962-7661
		or 966-1531

ORTHOPEDIC:

Dr. Gordon Smith	2324 Bath Street	965-8521
Dr. W. B. Withers	231 West Pueblo	962-8611
Dr. L. B. Burgess	2320 Bath Street	965-8511
Dr. W. Sterling Clark	3170 Loma Vista Rd., Ventura	648-5353

CARPINTERIA:

Dr. K. E. Wagner	5565 Carpinteria Avenue	684-4119
Dr. Horace Coshow	5210 Carpinteria Avenue	684-3613
Coast Ambulance Service	691 Walnut	684-3318
Cottage Hospital	320 W. Pueblo, Santa Barbara	963-1661
St. Francis Hospital	601 E. Micheltorena, S. B.	962-7661
Physician's Exchange	213 W. Canon Perdido	966-4181

SOLVANG:

Dr. Wm. B. Van Valin	2030 Viborg	688-5531
Dr. Frank Barranco	2030 Viborg	688-5531

100 — INTRODUCTION

100 INTRODUCTION

100.1 Nothing has had a greater impact on the petroleum industry than the problems and implications associated with oil spill pollution. Our continued operations within the confines of the CLEAN SEAS INCORPORATED domain depend heavily on a program of continued improvement in oil spill prevention and cleanup. The attainment of this goal is contingent upon the early development and implementation of an effective industry oil spill prevention program--one which will make oil spills a rare occurrence. We must develop the expertise to cope with this problem. Oil spill cleanup capability alone will not solve the problem. It has often been stated, "The best way to combat an oil spill is to prevent its occurrence in the first place." Since, in the public view, prevention cannot be separated from cleanup, prevention must become an integral part of CLEAN SEAS INCORPORATED's efforts. It must become an all-out individual and collective effort.

100.2 If, in spite of the best care, accidental spills do occur, they will require the immediate coordination of local efforts with assistance from CLEAN SEAS INCORPORATED and government agencies. Each operating function has the potential for an oil spill. Many spills, but for prompt and effective action, have the potential to become major spills. Each spill, in addition, has the potential of receiving much adverse publicity with resultant public and possible legislative reaction.

100.3 The purpose of the CLEAN SEAS INCORPORATED Oil Spill Cleanup Manual is to help Member Company personnel develop maximum capability to avoid spills and, when an accidental spill does occur, to respond quickly and effectively to the problems presented. A foremost goal in all of our operations is to avoid damage to property, wildlife, and the environment; and the consequential adverse effects which result.

100.4 The primary responsibility to develop oil spill prevention and control techniques rests with local management of each Member Company. However, the resources of CLEAN SEAS INCORPORATED are available to assist a Member Company as required both in preparedness planning and in the cleanup measures required as a result of a major spill.

100.5 Continued monitoring and updating of this plan is required to keep it current because the people involved will change occasionally through transfers, retirements, etc., and materials, equipment, and contractors are changing almost continuously.

100.6 Each recipient of this plan should record any pertinent changes or additions that come to his attention on his copy of the plan and also notify the Executive Vice President of CLEAN SEAS INCORPORATED of these changes. The Executive Vice President will be responsible for notifying the other recipients of any significant changes which come to his attention. Additionally, the Executive Vice President will be responsible for formally reviewing, updating, revising and issuing revisions to this plan periodically.

200 — SPILL PREVENTION

200 PREVENTION OF OIL SPILLS

201 Introduction

201.1 As first issued, this section deals largely in generalities but suggests the approach that should be pursued promptly and thoroughly by operating management if gains are to be made in this important field. Careful consideration at this time is therefore considered to be vital.

201.2 Later additions and revisions are expected to include findings resulting from such management action at various points of operation. It is our hope that Member Companies will keep the CSI Executive Vice President fully informed regarding oil spills and subsequent analysis of data on causes so that additional items of importance to spill prevention can be included herein.

201.3 This section of the CSI Oil Spill Cleanup Manual is taken from work done by the Board of Engineers, Standard Oil Company of California. The information and suggestions are considered important for all Member Companies and are therefore included here for the benefit of all personnel.

202 Scope

202.1 As considered here, prevention includes measures taken to:

1. Avoid spills.
2. Limit the size and consequences of those spills that do occur.

203 Sources of Spills

203.1 It is difficult to list the sources of spills in order of importance. This has been done for major spills by an analysis of some 38 major oil spills during the past 15 years (See Vol. 1: Analysis of Oil Spills and Control Materials, by Dillingham Environmental Co., under API Contract OS-1). In this study, ship mishaps (principally tankers) rank first in number of incidents, with refineries, offshore operations, and "other" sharing second place about equally. Major spills are of great importance because of the damage they do and the unfavorable publicity they attract. However, the smaller but very much more numerous accidental and "operational" spills undoubtedly are the more important with respect to both volume of oil put into public waters and effect upon marine life. On a composite basis, the data does not exist to permit a verified order of importance in the following list.

1. Tanker operation.
2. Terminals (tanker, barge, other ships, truck, RR).
3. Offshore and onshore drilling and production.
4. Pipelines (including submarine).
5. Onshore tankage and other equipment.
6. Refinery and other industry effluent discharge accidents.

204 Basic Elements of Spill Cause and Prevention

204.1 The relationship between a spill cause and the prevention measures needed is direct and evident in most instances. Such measures, however, may not be easy to accomplish. Following is a tabulation expressing, on the left, basic cause elements predisposing toward oil spillage and, on the right, some of the corresponding prevention measures that should be considered:

CAUSE	POSSIBLE REMEDY
1. The basic function being performed is highly vulnerable to oil spill accident.	1.a. Can the function be eliminated? b. Can an inherently safer function be substituted?
2. The method or process design chosen to accomplish the function involves high oil spill risk.	2. Consider possible improvements in method/process design to lessen the risk.
3. Inferior mechanical design and/or construction quality.	3. Are there specific weaknesses or inadequacies that should be corrected?
4. Inadequate maintenance inspection/state of repair.	4. Establish and enforce an adequate inspection schedule, and keep needed repairs up-to-date.
5. Operating procedures have not been clearly established or are inadequate.	5. Establish comprehensive, well-conceived operating procedures; preferably as an operating standard, clearly written and readily available to operating personnel.
6. Established operating procedures not being followed.	6.a. Check for, and insist upon, regular, consistent compliance. b. Is operator training and/or closer supervision needed?

204.2 Means other than the above may be used in breaking down oil spill cause and remedy; however, the above is useful in self-examination or survey of an operation. Further, within knowledge of recent significant spills there are examples of each of the above basic elements.

204.3 No. 6 above might be combined with No. 5. They were separated to lend emphasis to each, particularly to No. 6 which has figured prominently in at least several sizeable spills.

205 Self-Examination

205.1 The penetration employed in investigating a serious mishap after it has happened is usually exemplary. So, also, is the corrective action taken despite some tendency to over-react in the climate that then exists. The key to Prevention is to conduct a similar investigation and take comparable corrective action before the "next" spill occurs.

205.2 Little need be included here on how to conduct an examination of an operation. It may be done by line management if sufficient impetus is provided and if the supervisors involved are properly lined up and have time to do the job. An in-house survey team may be established for the purpose. Or, survey team members completely from outside of the organization may be employed. A balanced team consisting of members both from within and from outside has proved to be most effective in some situations and is recommended for serious consideration.

205.3 The person or group assigned to perform the examination may start logically with the framework steps suggested in the immediately foregoing subsection. This outline of fundamental considerations can be expanded to include, as sub-items, all of the detailed steps and considerations appropriate to the operation involved. As indicated above under SCOPE, intended to be included in the coverage are measures that should be taken to limit the size and consequences of spills that do take place despite all reasonable preventive measures taken otherwise.

205.4 It is again emphasized that each operating unit at every location capable of having a spill should be accorded a careful review of the type proposed, now (if it has not been done recently) and at appropriate future intervals. This is the principal action that can be taken to effect a reduction in spills. It is up to management to initiate it and to follow through in implementing justifiable recommendations.

206 Partial Check List

206.1 The following list of items to be checked in making an examination for spill prevention is not intended to be complete. A number of the items are considered important. Others are products of other experience and subsequent observations in connection with a number of oil spills, both large and small. Any survey of a specific operation will reveal many additional points of potential vulnerability specific to that particular location.

207 To Prevent Spill Occurrence

1. Cross-train personnel in related operating units to assure understanding of the coordination required; e.g. shipboard and shoreside operators should be given opportunity to observe and understand each others' activities.

2. Where coordination is so important, insure that the communication links are adequate and reliable. Consider use of check-off forms for critical operations such as ship and barge loading and unloading and for other complicated operations, particularly where two or more operating groups are involved.

3. Consider installation of level alarms on selected shoreside tanks and on ships' cargo and bunker tanks to prevent overfilling.

4. Appraise adequacy of terminals' degree of insistence that ships and barges follow required practices while at dock, e.g. plugging of scuppers, etc.

5. Consider requiring bulwarks (gunwhale extensions) on barges to contain any deck spillage. Consider, also, requiring equipment for evacuating cargo lines after use.

6. Check cargo/transfer hose use and swing joint assemblies carefully including (a) initial selection (b) handling equipment and practices (c) protection against overpressuring (d) periodic testing/inspection, etc. Consider the use of dry-break couplers.

7. Check coating protection, cathodic protection, inspection practices, regularity of hydrostatic testing and "line pack" procedures, integrity of supports, etc. on all pipelines over or near public waters or where a spill due to rupture could flow to same.

8. Check for presence of sun pressure relief valves on lines and equipment where needed.

9. Remove "dead" piping and temporary connections, particularly hose connections when purpose has been served.

10. Consider replacement of cast iron and brass fittings.

11. Replace Dresser-type couplings, and check presence of drip trays under necessary slip-type expansion joints as well as at all locations where connections are broken in regular operations such as where cargo hose is connected and disconnected.

12. Remove or reinforce small pipe connections, particularly if they support weight such as a valve, and most particularly if subject to any vibration. Note: This has been a source of many serious mishaps including spills.

13. Review water draw valve hardware including adequacy of locking and plugging practices.

14. Review inspection/knowledge of tank shell thicknesses and need for reduction in safe filling heights.

15. Check for <u>uneven</u> tank bottom settlement. Note: Overstressing of bottoms due to this cause has resulted in a number of incipient and actual failures including one serious spill.

16. On operations not continuously attended, consider extending alarm functions to locations with 24 hours/day attendance.

17. Review degree of reliability of remote supervisory systems in critical operations.

18. Consider generally the adequacy of operator surveillance.

19. Critically review all procedures and operating practices employed by your non-operated joint ventures or by outsiders using your facilities.

208 To Limit Spill Size and Effects

1. Check adequacy of the local Contingency Plan including spill detection, alert/notification procedure, containment/cleanup methods and equipment, organization and training of personnel.

2. Consider the need for permanent, in-place containment booms or walls; or booms, tethered in the water, ready for more rapid placement.

3. Check systems for adequacy of block valves and other isolating devices.

4. At the dock, consider installation of check valves in all lines used only for unloading to prevent backflow from receiving tanks and large spill in case of hose or fitting failure.

5. Consider motorized and remote controlled mechanical operators on valves where time is of the essence in case of failure of vulnerable equipment or operating procedure.

6. Particularly consider need for a valve of the right type at shoreline, and/or an evacuation system, on submarine lines.

7. Review carefully the need for and adequacy of impounding basins. Outlet valves from the basins should be installed on the outside wall and should not be left open without attendance.

8. Review other retention walls, dikes and diversion walls; these can be most important in controlling spillage and retaining on property.

9. On extensive pipeline and some other systems, consider need for and adequacy of instrumentation to promptly detect and alarm in case of imbalance between flow in and flow out.

10. Consider drainage and effluent systems and adequacy of ability to detect an upset and impound a spill before loss beyond boundary discharge point.

11. Assess leak patrol practices of critical systems.

12. Consider generally the adequacy of operator surveillance.

300 — CSI CONTIGENCY PLAN

300 CLEAN SEAS INCORPORATED OIL SPILL CONTINGENCY PLAN

301 Introduction

301.1 In the advance planning for organization and staffing of actual oil spill cleanup operations, it is important for the individual CLEAN SEAS INCORPORATED member companies to understand the industry position in the area of interest involved. All Operators must:

1. Make an even greater effort toward OIL SPILL PREVENTION, and
2. Prepare now for the rare spill which could occur with PROMPT, EFFICIENT, AND THOROUGH OIL SPILL CLEANUP KNOW-HOW AND EQUIPMENT.

301.2 Every oil spill must be handled promptly, efficiently and thoroughly -- even though it may be the first experience for the member company involved. Consequently, it behooves all members to carefully consider the scope and complexity of the problem and cooperate accordingly in the staffing of CLEAN SEAS. Cleaning up an oil spill remains a tremendous undertaking.

301.3 CLEAN SEAS INCORPORATED is comprised of 15 operating companies with facilities in the area of interest who have joined in a major effort to combat oil spill pollution. The Membership Agreement allows the member companies involved to use all, any part of, or none of the CSI organization. The portion of CSI organization not used may be replaced by the spill member's own or contract personnel; or these positions may be omitted at the spill member's option. In the case of an extremely small spill, a "go-it-alone" approach may be entirely in order, and the spill may actually be most expeditiously handled in this manner. There is, however, much to be said for working together on oil spill problems under the direction of the "spill member." The results achieved, good or bad, will reflect on the entire industry. Each member company should coordinate its own contingency plan for handling spills of all sizes with CSI to facilitate working together on oil spill problems.

302 Response Plan

302.1 The Response Plan to follow represents an effort to prepare a workable plan which will encompass the multiple variables and problems that can be encountered in oil industry operations.

303 Oil Spill Cleanup Organization

303.1 The primary consideration is that of a "Member Company Oil Spill in the CSI Area of Interest." Other spill situations in which CSI may be involved include a non-member spill in the CSI area of interest and spills of undefined origin outside of the CSI area of interest. Fig. 1 (Section 1000) is presented to show the optimum organization required to handle most spill situations within the CSI area of interest. Other spill situations may require all of, or only parts of, the organization as presented.

304 Mandatory Staffing

304.1 The Mandatory Staffing guarantees that CSI will receive direction from the company incurring the spill, reimbursement for all costs incurred by CSI, and full indemnification against possible liabilities, etc. incurred by CSI. It includes those functions which are absolutely necessary to any company incurring a spill -- particularly those concerned with present and future legal action, claims, public relations, etc. These positions are:

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310	Top Management (Company Headquarters Personnel)	4
311	Division Manager	4
312	On-Scene Commander	5
313	Public Relations	6
314	Legal Advisor	7
315	Government Liaison	7
316	Damage Control	8
317	Documentation	8

305 Probable Staffing

305.1 The company involved in a spill may wish to staff these positions to assure an "in-house" control of high costs which will accrue. Experienced trained personnel are also available in CSI to handle these functions or to aid the company personnel.

		Page No.
318	Procurement Coordinator	9
319	Volunteer Help Coordinator	9

306 Optional Staffing

306.1 The CSI Executive Vice President will normally function as primary advisor to the On-Scene Commander.

		Page No.
320	Executive Vice President	10

307 Staffing Either by CSI or by Member Incurring Spill

307.1 These are areas of expertise in which CSI would probably have capabilities superior to any single member company. The member company may wish to fill some of these positions with their own people but, if so, the CSI staff should be called on for advice and counsel.

		Page No.
321	Consultants and Advisors	10
322	Technical Evaluator	10
323	Oceanographic Coordinator	10
324	Communication Coordinator	11
325	Surveillance	11

308 Optimum Staff -- Non-Member Spill in CSI Area

308.1 Fig. 2 (Section 1000) represents the optimum organization that should be considered for any oil spill in the CSI area when the originator of the spill is a non-member or when the spill is unidentified as to originator. It differs from Fig. 1 in the top positions and in the elimination of the "Damage Control" consideration. In this instance, oil spill cleanup is being performed for a non-member, and "Damage Control" will be staffed by the company or agency involved.

308.2 In a case of this kind, CSI will act only when requested to do so by the non-member originator of the spill or the Government Agency having jurisdiction. In either case, such request must carry with it a guarantee of cleanup direction, reimbursement for all costs incurred by CSI and full indemnification against possible liabilities, etc. incurred by CSI.

308.3 Such a spill cleanup would clearly be a CLEAN SEAS operation which would therefore place the CSI Executive Vice President directly under the On-Scene Commander from the requesting company or agency. The agency or company originating the spill would also staff those positions necessary to control present and future legal actions, claims, public relations, etc. (See Fig. 1, Mandatory Staffing). CSI would require capable representatives for cleanup and "Backup Support," to insure an effective operation.

308.4 The two remaining oil spill situations in which CSI might become involved; namely an Unidentified Spill In the CSI area of interest and a Spill of Undefined Origin Outside of the CSI area of interest, would be handled as shown in Fig. 2 with the Government Agency having jurisdiction making the request and thereby assuming the responsibility of cleanup direction, reimbursement of all costs incurred by CSI, and a full indemnification against possible liabilities, etc. incurred by CSI. The only difference in these two is that the latter case (outside the CSI area of interest) requires approval of the CSI membership.

309 Duties -- Oil Spill Cleanup Organization Personnel

309.1 The unique structuring of this multi-member, flexible approach, multi-situation operation reduces definition to something less than precise. The following comments and listing of duties are based on experience from the few oil spill cleanup operations of record. Place of duty will not be covered here but instead under a separate heading involving command post, on-site bases, etc. (See Sections 333 & 334)

310 Top Management

310.1 Although Top (Headquarters) Management is vitally interested in all aspects of an oil spill and will, in cases of massive spills, almost certainly become involved in making major decisions, the overall day-by-day cleanup effort will be directed by Operating Department managerial personnel from the area involved. The actual degree of Top Management direct involvement will depend on circumstances -- particularly damage and liability potential, public relations and other pertinent ramifications. Top Management's role will primarily include the development of decisions, policy, and guidance necessary to cope with the situation, whose scope is beyond the authority of Operating Department managerial personnel involved.

310.2 The Top Management is from the member company incurring the spill. This is in keeping with the requirement that this company direct the cleanup effort, fully reimburse CSI for all costs incurred and indemnify CSI against all liabilities incurred.

310.3 In the case of a "Non-Member Spill in the CSI Area" or an "Unidentified Spill in the CSI Area," the Top Management position may be filled by a Government Agency such as the U. S. Coast Guard or may be filled by Top Management from the non-member company. Prior written agreement must be obtained from the non-member company or government agency involved that this company or agency direct the cleanup effort, fully reimburse CSI for all costs incurred, and indemnify CSI against all liabilities incurred.

311 Division Manager

311.1 Top Management will hold the Division Manager responsible for the proper and effective conduct of the cleanup effort. In this direct involvement with the problem, the Division Manager will exercise vested authority above and beyond that held by the On-Scene Commander in the conduct of his duties, which will include:

1. Maintaining overall surveillance and giving direction and guidance thru the On-Scene Commander.
2. Promptly and regularly informing Top Management of all pertinent events and progress associated with the cleanup and related effort.
3. Promptly implementing the instructions of Top Management.
4. Exercising vested authority in rendering necessary decisions for the On-Scene Commander.
5. Establishing and maintaining the necessary contact, communication and good rapport with pertinent Government and Industry Officials.
6. Devising and effecting a program to promote the best possible public relations, acting thru the Public Relations Supervisor.

311.2 The Division Manager is from the member company incurring the spill. This is in keeping with the requirement that this company direct the cleanup effort, fully reimburse CSI for all costs incurred, and indemnify CSI against all liabilities incurred.

311.3 In the case of a "Non-Member Spill in the CSI Area" or an "Unidentified Spill in the CSI Area," the Division Manager position will be filled by an appropriate manager from the non-member company or by an On-Scene Commander from the appropriate Government Agency. Duties are essentially as outlined above for Division Manager, modified as the situation may require.

312 On-Scene Commander (OSC)

312.1 The Division Manager will hold the On-Scene Commander responsible for the proper and effective conduct of the cleanup effort. In this direct area of involvement with the problem, the On-Scene Commander will exercise vested authority above and beyond that held by the CLEAN SEAS INCORPORATED Executive Vice President, should his member company elect to utilize this service; and that of all supporting supervisors, be they from his own member company or from those assigned from other member companies. While it is strongly recommended that the member company incurring an oil spill proceed with no less than the organization shown under "Functional Organization for Oil Spill Cleanup -- Member Company Spill -- in CSI Area" (Fig. 1), and thus involving the most experienced and best talent available; this company may at its option elect to proceed with any variation of this structure it chooses. The On-Scene Commander's (OSC) duties will include:

1. Exercising immediate judgment from which to develop the related decision as to the degree of CLEAN SEAS INCORPORATED involvement sought.
2. Directing and supervising the overall cleanup effort, acting with the full authority vested in him thru those supervisors and others reporting directly to him.
3. Promptly and regularly informing the Division Manager of all pertinent events and progress associated with the cleanup and related effort.

312.2 The OSC is from the member company incurring the spill. This is in keeping with the requirement that this company direct the cleanup effort, fully reimburse CSI for all costs incurred, and indemnify CSI against all liabilities incurred.

312.3 Non-member companies and Government Agencies may not have personnel qualified to fill this position, and certainly in unidentified spill situations, there would be no one to fill this position. It would then become necessary for the CSI Executive Vice President to carry out the duties listed above, functioning under the immediate direction of a specifically designated representative of the requesting company or agency. The Executive Vice President will assure himself that all necessary agreements have been obtained to fully reimburse CSI for all costs incurred and indemnify CSI against all liabilities incurred.

313 Public Relations

313.1 Contact with news media and other public relations functions are to be handled exclusively by the member company or the requesting company or agency. They will assign public relations personnel to establish such requirements as: 1) location of "press room," 2) supplies, 3) public information disclosure procedures, and 4) support requirements. The CSI Public Relations representative will be available to serve in an advisory capacity to the member or requesting company representative.

313.2 Normal functions of member or requesting company Public Relations personnel would include:

1. Assess the effect of the emergency on the public.
2. Based on this assessment, develop and obtain approval from Division Management for basic procedures to follow to keep the public advised of the progress of the emergency operation.
   (Most companies have Public Relations Policies to be followed. Consideration should be given to the use of regular press conferences, appearance of qualified spokesmen on TV and radio programs and the possible purchase of advertising space in local newspapers, when necessary, to present an undistorted, factual report on what is taking place. Provision should also be made to allow the news media to personally witness certain parts of the operation from a safe observation post where their presence will not interfere with operations.
3. Make, subject to approval by Division Manager, news releases on the operation.
4. Maintain good communications with all other members of the Oil Spill Cleanup Organization so that he will be well informed on what is taking place and so that he can continually remind other members of the team to refer all news media personnel to the Public Relations Coordinator.
5. Maintain contact with the Management of all news media in the area and urge them not to jeopardize the effectiveness of the operation by seeking "on-the-scene" interviews with Operating Supervisors who are extremely busy and who are not authorized to issue news releases or offer opinions on any phase of the operation.
6. Provide information to Top Management so that satisfactory public relations contacts with high level government officials may be conducted.

314 Legal Advisor

314.1 Continuing duties of the CSI Legal Advisor include assisting the EVP on legal matters associated with routine corporation operations. It will be his primary function to outline procedural guidelines, staff and support requirements for "spill situations." This will include advance sessions with the legal representatives from all of the member companies to insure a consensus as to the necessary requirements.

314.2 The position of On-Scene Legal Advisor will be filled by the member company and the primary functions shall be:

1. To be thoroughly familiar with all legal ramifications of a major oil spill, including the liabilities involved and the legal precedence that has been set in prior major oil spills.
2. To render legal advice to Top Management, Division Management, and the On-Scene Commander.
3. To provide qualified claims adjustors to investigate alleged claims of damage.
4. To advise the Division Manager when it appears desirable from a public relations standpoint to immediately negotiate to settle damage claims where settlement can be made in full.
5. When a Marine Surveyor is being used to supervise cleanup of yacht harbors and boats, the Legal Advisor should work closely with the Marine Surveyor in settling claims involving boats.

315 Government Liaison

315.1 Continuing duties of CSI Government Liaison include maintaining a current roster of designated governmental agency representatives assigned to positions outlined in the National Contingency Plan; awareness of revisions and modifications of pertinent rules and regulations; surveillance of governmental research and development programs; and the incorporation of pertinent legislation into the CSI Response Plan where applicable.

315.2 In a "spill situation," the Government Liaison representative is responsible for liaison efforts with the governmental agency representatives and reports directly to the member company On-Scene Commander. This position is filled from the member company, with assistance and counsel by CSI personnel. The specific functions of the Government Liaison Coordinator will be:

1. To keep up-to-date on the activities, policies, and regulations of Federal, State, and other government bodies with respect to their position on major oil spills so that he will know how to work with the various agencies when a spill occurs. (In this regard, he should become personally acquainted with local representatives of these government bodies.)

2. To insure that all appropriate regulatory bodies have been advised of the spill.
3. To be stationed in the command post and contact all representatives of the Federal, State, County, and City Governments in order to be of assistance to them while they are carrying out their legally constituted responsibilities with regard to the spill.
4. To maintain liaison with representatives of the various governmental bodies and convey information, requests, and legally constituted directives to the OSC or to appropriate members of his staff.
5. To seek approval from appropriate governmental agencies for specific operations which are subject to regulations by law, such as the use of chemicals, burning of oil on the open sea, utilization of government equipment or materials, access to government-owned lands, etc.
6. To obtain clearance from the OSC of any release of information to various representatives of the different government agencies to insure that such information is consistent with what the Public Relations Coordinator releases to the news media.

315.3 The Government Liaison Coordinator shall have authority to conduct government representatives on observation tours to the scene of the emergency, provided such visits can be made safely and without interference with the operations in progress.

316 Damage Control

316.1 This function may require one or more individuals depending on the nature of the spill incident; i.e. uncontrolled well flow, platform fire, pipeline rupture, tanker grounding, etc. These representatives are not members of the CSI "staff", but are assigned specifically from the member company involved in the spill incident at the time of the incident. These representatives report directly to the member company On-Scene Commander.

317 Spill Documentation

317.1 Documentation of oil spills and movement of oil becomes very important in settling claims, public relations and government relations. Similarly, documentation of all related events, contacts, orders, discussions, and approvals, are most important. This is a very important function to be filled in the command post by the member or requesting company or agency.

317.2 In concert with Public Relations, Government Liaison, Spill Surveillance, On-Scene Commander and other important functions, this position will maintain a detailed record of the emergency operation, documenting significant operations and events as they occur so that a complete chronological history of the operation is obtained. Particular attention should be given to documenting all contacts and discussions with government representatives and the approvals obtained from various representatives of regulatory bodies for specific operations, such as the use of chemicals to disperse the oil, etc. Obtain photographs of everything.

318 Procurement Coordinator

318.1 Continuous duties include the preparation of guidelines and procedures to assist the Executive Vice President in equipment acquisition, inventory control, and cost accounting.

318.2 In a "spill situation," this position becomes very important in procurement and expediting functions requested by the various supervisors in carrying out their assigned duties. This will involve the direction of activities at the Field Command Post (Port Hueneme) and other facilities selected for loading or unloading operations. Specific functions of the Procurement Coordinator shall be:

1. To purchase, rent, borrow, or otherwise obtain the following as specified by the On-Scene Commander or other members of his organization:
    a. Manpower necessary to carry out the damage control and containment and cleanup operations, acting thru a manpower recruiter on his staff.
    b. Equipment and Materials required to be purchased for damage control, containment and cleanup, acting thru a purchasing agent on his staff.
    c. Provide for services for all those engaged in the operations, including food, lodging, clothing, safety and protective equipment, tools and supplies, first-aid equipment, etc., acting thru a Safety Engineer and others on the staff handling food and housing.
2. Acting thru the Safety Engineers, make adequate arrangement with local doctors, ambulance services and hospitals for handling and care of injured personnel.

319 Volunteer Help Coordinator

319.1 During an oil spill, there are many young people of high school age on up who insist on "helping." In many respects, this volunteer help becomes more of a problem than help and results in unsupervised, indiscriminate scattering of straw, plunging into dangerous surf to rescue birds, etc. The Volunteer Help Coordinator is needed, therefore, to:

1. Set up an office and phone lines where volunteers can call and to where they can be directed in order that their energies can be directed to safe areas where manpower is needed and can be supervised (beach cleanup crews, bird cleaning stations, etc.).
2. Publicize thru radio, TV and newspapers the telephone number where volunteers may call for work direction.
3. Keep accurate record of names, addresses and hours worked.
4. Work closely with the Procurement Coordinator and his staff.

320 CSI Executive Vice President

320.1 The Executive Vice President is the only paid employee of CLEAN SEAS INCORPORATED. His primary responsibility is to manage CLEAN SEAS INCORPORATED and carry out all functions pertinent thereto. This is an extremely important position as it may represent the only continuity in the CSI operations.

320.2 The CSI Executive Vice President may be called upon to act in any capacity from an On-Scene Commander Alternate to a part-time advisor in cleanup work. In the normal case, he would work directly with the OSC on all matters pertaining to oil spill cleanup, and this would reasonably extend to direct contact with the cleanup coordinator and his cleanup operations. Detailed job description for this position will be found in Section 1100.

321 Consultants and Advisors

321.1 In any major spill there are a number of Conslultants and Advisors who may be required to assist the Division Manager. Some of these may be from the member company experiencing the spill and others may be furnished thru CSI personnel from other member companies. These people are:

1. Fire Prevention and Control
2. Drilling Superintendent
3. Production Superintendent
4. Pipeline Superintendent
5. Marine Department Captain
6. Health and Toxicology

321.2 The list is not complete, but it is expected that the people shown will be made available as required when a major spill occurs and thus should become familiar with this Contingency Plan and keep up-to-date on new technology in their specialized fields so that they can make effective recommendations to control and clean up a major oil spill.

322 Technical Evaluator

322.1 Continuing duties include the evaluation and analysis of proposals and equipment related to oil spill cleanup operations; with recommendations to the EVP as to applicability or feasibility, operational performance and developmental considerations.

322.2 In a "spill situation," this "staff" member would be responsible for screening all manufacturers, promoters, inventors, etc. of oil spill recovery devices and submit his recommendations to the OSC.

323 Oceanographic Coordinator

323.1 Continuing duties of the Oceanographic Coordinator will be to make a complete historical review of sea states, ocean currents, wind direction and velocity, temperatures of air and water and prepare charts covering the entire CSI Area of Interest. He should also set up a forecasting service covering, on a regular basis, weather, currents, wind direction and velocity and sea state.

323.2 The functions provided by this position require knowledge, experience and expertise not normally found in the oil industry. It also requires access to data from remote reporting stations established in the CSI Area of Interest. Accordingly, it is planned to use an outside firm, "Oceanographic Services," to provide these services under supervision of the Oceanographic Coordinator.

324 Communications Supervisor

324.1 Continuing duties include the acquisition, installation and maintenance of the recommended communication system. Prior to the purchase of equipment, it will be necessary to obtain frequency clearance from the PFCC (Petroleum Frequency Coordinating Committee) and an FCC license.

324.2 "Spill situation" duties include providing for, and the supervision, operation, and maintenance of the communications system to insure "100% reliability" during oil spill cleanup operations.

325 Surveillance

325.1 Primary duty includes surveillance of oil slicks and predictions of movement utilizing both aerial and surface sensors to provide a complete monitoring system. A variety of monitoring and observation techniques are available and have been tried in examining the extent, dynamics, and effects of an oil spill. These include visual observations on the ground, from the shore, surface craft, or aircraft, and photographic methods or other more sophisticated remote sensing techniques from low and high flying aircraft. Additionally, there are remote sensing capabilities from satellites.

325.2 Based on his reconnaissance, the Surveillance Coordinator will submit recommendations to the On-Scene Commander as to further protective action required for shorelines and beaches and deployment of additional equipment for "open sea" operations.

325.3 This position will work closely with the Documentation Coordinator and the Public Relations Manager. He will also work closely with the Oceanographic Coordinator in order to maximize the usefulness of all these related data to the On-Scene Commander.

326 Oil Spill Cleanup Coordinator (OSCC)

326.1 The Oil Spill Cleanup Coordinator is the "front line" man for oil spill control and cleanup operations. He and his alternate(s) will be drawn from the member companies on the basis of experience and capabilities in cleanup operations. The unique flexibility built into the CSI organization allows the member company incurring the spill to use the OSCC's services, use them in part, not use them at all, or use the OSCC in an advisory capacity to back up its own Oil Spill Cleanup Coordinator. His duties will be divided between the Central Command Post, the Field Command Post, and "on-site" operations. Detailed job description for this position will be found in Section 1200.

327 Offshore Cleanup Supervisor

327.1 It will be the duty of this supervisor(s) and his alternate(s) to prepare detailed deployment and operational procedures for all "open sea" equipment in the CSI inventory. This will include the supervision of "fire-drill" operations with contract personnel, conducted on at least a semi-annual basis or as new equipment is acquired by CSI. He will confer regularly with the Oil Spill Cleanup Coordinator(s) and Executive Vice President to review the "Plan of Action" as related to offshore cleanup operations.

327.2 "Spill duties" will include the direction of all offshore oil spill cleanup operations under the direct supervision of the Oil Spill Cleanup Coordinator(s).

328 Onshore Cleanup Supervisor

328.1 It will be the duty of this supervisor(s) and his alternate(s) to prepare detailed deployment and operational procedures for all "calm water and onshore" equipment in the CSI inventory. This will include supervision of "fire-drill" operations with contract personnel. He will confer regularly with the Oil Spill Cleanup Coordinator(s) and Executive Vice President to review the "Plan of Action" as related to onshore cleanup operations. "Spill duties" will include the direction of all onshore cleanup operations, under the direct supervision of the Oil Spill Cleanup Coordinator.

329 Onshore Staging Area Supervisor

329.1 The duties of the Staging Area Supervisor(s) and his alternate(s) will include the organization of the staging area; preparation and coordination of all equipment, materials and supplies to be dispatched to the operation; inventory and status control; maintaining a detailed check list as to "readiness" of equipment. His duties will also include maintaining close liaison with the Transportation and Purchasing supervisors to insure a coordinated effort. This will include obtaining rental office trailers to be used as Mobile Field Command Posts, and close contact on a regular basis to assure a continuing supply of equipment and materials.

330 Wildlife Preservation

330.1 During an oil spill, there is much concern by all for wildlife, its preservation and protection. Consequently, this position becomes most important. The Wildlife Preservation Supervisor must develop background data on the wildlife existing in areas where a spill could occur. (This would be accomplished by working with qualified contract Marine Biologist, Ornithologist, and others and would include information on the existing type of life forms, their condition and general population and would encompass creatures that inhabit the air, water, or land, and the vegetation in the sea or on adjacent land masses.)

330.2 In a "spill situation," the Wildlife Preservation Supervisor will work in close harmony with the State Department of Fish and Game in carrying out the functions of this position.

331 Transportation

331.1 In a "spill situation," this representative will organize and direct all transportation of equipment and personnel as related to the oil spill cleanup operations. This will involve making the necessary precontractural arrangements and operating agreements for air, land and marine vehicles. Specifically, the functions of the Transportation Coordinator shall be:

1. To arrange transportation for equipment, material, and personnel needed to carry out the containment and cleanup and damage control operations.
2. To work with local authorities (City, County, State and Federal) in setting up land, sea and air routes which will expedite movements of supplies to the scene and disposal of waste products from the scene of the spill.

332 Command Post Staffing

332.1 Desired operational efficiencies in an emergency situation will best be achieved by the use of both a Central and a Field Command Post. Under normal operating conditions, the Central Command Post will have minimum staffing consisting of the CSI Executive Vice President and a secretary; the Field Command Post will not exist. Under "spill" conditions, however, the Central Command Post staff will immediately be expanded as outlined, and the Field Command Post will be activated. Requirements for each command post are as follows.

333 Central Command Post

333.1 The Central Command Post headquarters has been established at 18 Marine Center Building, Breakwater, Santa Barbara Harbor. In a "spill situation," it is expected that command post will contain the following staff:

1 - Division Manager (Member Company)
1 - On-Scene Commander (Member Company)
1 - Executive Vice President (CSI)
1 - Public Relations Coordinator (Member Company)
1 - Legal and Claims Representative (Member Company)
1 - Government Liaison (Member Company)
2 - Procurement Coordinators
1 - Oceanographic Coordinator
1 - Volunteer Help Coordinator
1 - Spill Surveillance
1 - Documentation
2 - Support Personnel (Secretary and T.A.)

14 People

333.2 In order to provide communication with all operating personnel and for the use of personnel in the Central Command Post, provision will be made for additional telephone lines, phones and the main station for radio communication.

333.3 To avoid confusion and provide for most efficient operation, it is important to decentralize as quickly as possible. As an example, it has been found to be much better to have the Government Liaison man work very closely with the Coast Guard and Fish and Game people in the Coast Guard Command Post instead of bringing the Government people into the Company Command Post. Also, the Volunteer Help Coordinator should set up an office at some location away from the Central Command Post to keep the volunteers out of the way.

334 Field Command Post

334.1 The Field Command Post is located at Port Hueneme where CSI equipment is stored. In a "spill situation" the following personnel will make use of this location:

1 - Oil Spill Cleanup Coordinator
1 - Damage Control Supervisor
1 - Offshore Cleanup Supervisor
1 - Onshore Cleanup Supervisor
1 - Onshore Staging Area Coordinator
1 - Transportation Coordinator
1 - Wildlife Preservation Coordinator
5 or 6 Support Personnel (T.A.'s, Purchasing, Manpower, Communication, etc.)

13 People

334.2 In addition to the above, and depending on location and size of spill, mobile Field Command Posts will be provided by rental of 12' X 50' mobile offices. This mobile Field Command Post(s) will be staffed with additional supervisors as needed. These will be the on-scene supervisors working under the direction of the staff in the Field Command Post at Port Hueneme. The mobile post(s) will also serve as an alternate base for the Field Command Post Staff.

1000 — ORGANIZATION CHARTS

FUNCTIONAL ORGANIZATION FOR OIL SPILL CLEAN UP
MEMBER COMPANY SPILL IN C.S.I. AREA

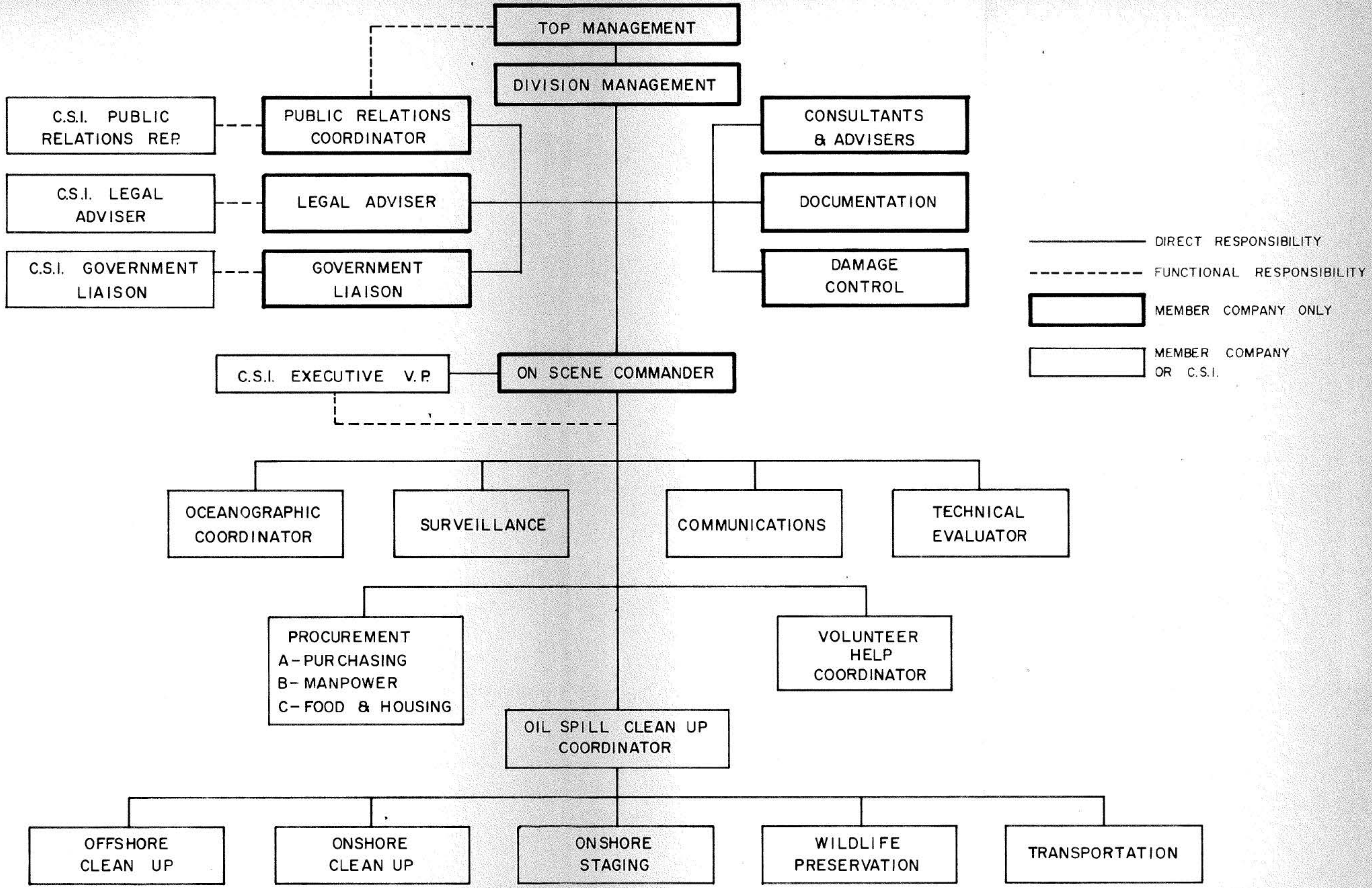


FIG. 1

FUNCTIONAL ORGANIZATION FOR OIL SPILL CLEAN UP
NON-MEMBER SPILL IN C.S.I. AREA

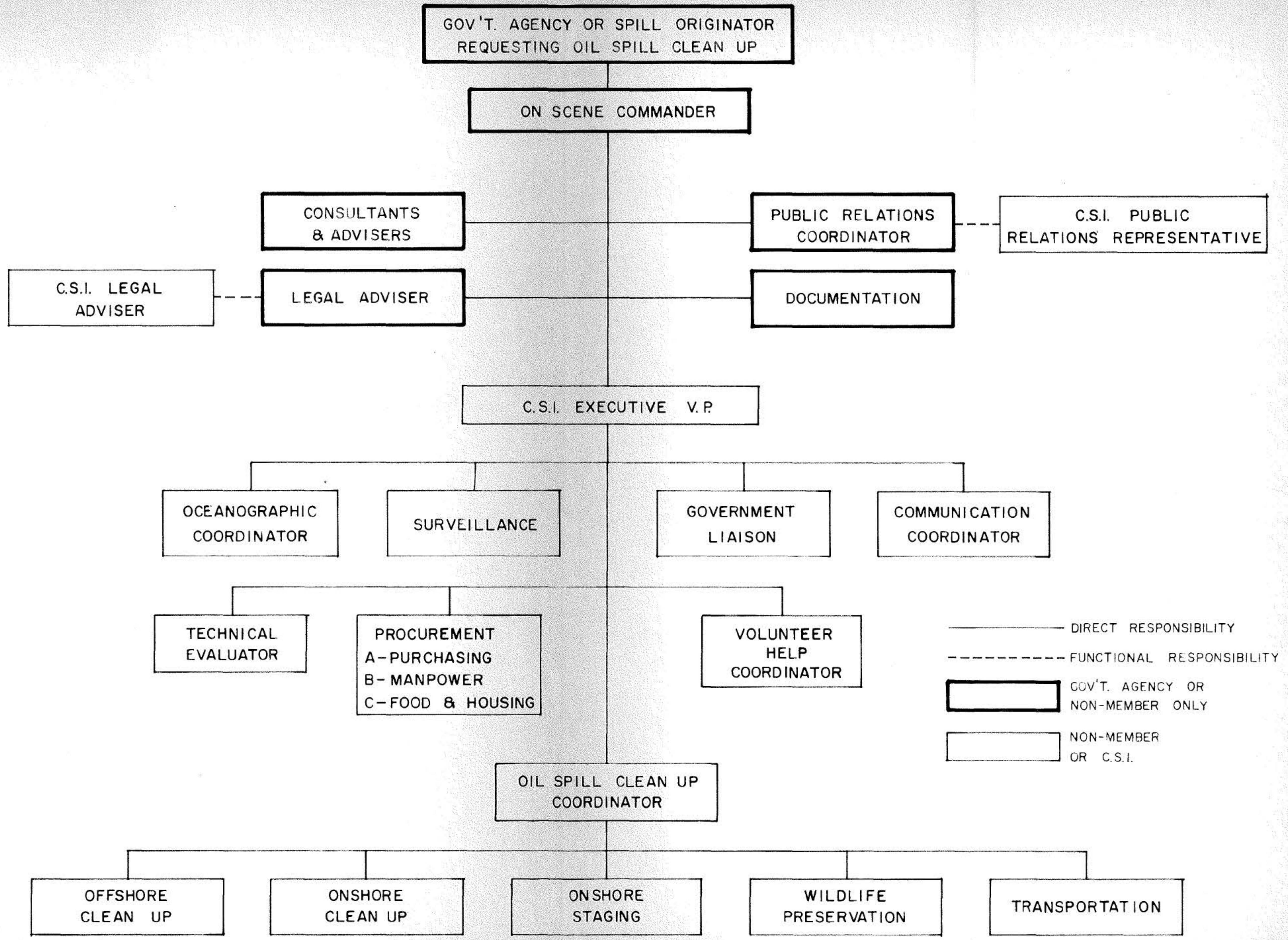


FIG. 2

1100 — EXECUTIVE VICE PRES.

1100 EXECUTIVE VICE PRESIDENT

1101 CSI Personnel

1101.1 The Executive Vice President is the only paid employee of CLEAN SEAS INCORPORATED. His primary responsibility is to manage CLEAN SEAS INCORPORATED and carry out all functions pertinent thereto. As a back-up to the EVP, the Executive Committee members should be called on as needed. They would also provide coverage for CSI activities in event of absence of the EVP.

R. W. Norton	-	Executive Vice President Office (805)963-3488 Home (805)967-5340

Executive Committee

C. C. Taylor	-	President Office (213)879-2700 Home (213)341-7068
D. E. Craggs	-	Vice President Office (805)642-0376 Home (805)642-7633
J. B. Hundley, Jr.	-	Director Office (805)831-5265 Home (805)832-3916
R. D. Schropp	-	Director Office (805)963-3751 Home (805)967-2224
M. R. Elliott	-	Director Office (805)648-3251 Home (805)644-3311

1101.2 As the full-time Manager, the Executive Vice President is responsible for all activities of the corporation. The following list outlines some of the major functions of this position in carrying out the normal daily activities:

1. Communicate and work closely with the CSI Executive Committee and Board of Directors.
2. Develop organizational guidelines for the successful implementation and operation of the CSI group effort.
3. Establish corporate objectives for CSI Board of Directors review and action.
4. Establish a plan for regular and special communication and meetings with the member companies.
5. Establish a plan which will assure the development and safe keeping of all CSI business and related records.
6. Develop a proposed annual budget for the Board of Directors to review and submit to the Members.
    a. Review budget semi-annually and submit supplements if needed.
7. Work closely with the Engineering Committee on oil spill control and cleanup equipment evaluation, revision, procurement and testing.
8. Request subcommittee support from the Executive Committee whenever this is needed and/or will further the art.
9. Supervise building and testing of new equipment and materials.
10. Develop and implement training programs for member company personnel assigned to functions in the contingency plan, including:
    a. Talks, still pictures and movies on oil spill pollution prevention and control.
    b. Fire-drills using CSI cleanup equipment in simulated oil spills in the open ocean.
    c. "Mail-outs" to all personnel teaching oil spill pollution prevention and control, promising new equipment, etc.
11. Carry out the day-to-day Public Relations functions of the corporation: meeting with government agencies, public and news media and presenting talks before civic groups.
12. Maintain an informal daily log of significant events, advise the member companies of these on regular intervals. (Newsletter)

13. Arrange necessary insurance on employees, office and equipment.
14. Set up and maintain approved accounting system for all money management matters such as paying bills, employee payroll, tax withholding, etc. This will include maintaining the bank account, administering cash calls and receiving of money from members.
15. Keep abreast of new developments in oil spill containment and cleanup equipment and materials.
16. Arrange for storage of all CSI equipment and materials and maintain in a state of readiness for fast deployment in event of a spill.
17. Develop improved and more effective means for cleanup equipment deployment and use in typical areas within the CSI Area of Interest.
18. Review each member company's response plan and make recommendations for revision to provide for smooth interface with CSI Contingency Plan.

1101.3 When requested by a company suffering an oil spill or a government agency in charge of an oil spill cleanup, for help in cleaning up an oil spill, the EVP will:

1. In the case of a non-member or government agency, make sure that CSI has a valid written request from that non-member or agency which guarantees indemnification and reimbursement for expenses and that the CSI members agree to the operation.
2. Determine location, nature and amount of spill from the discharger or agency and determine that all necessary government agencies have been notified.
3. Call out appropriate CSI personnel to supervise operation of all CSI equipment and necessary contract equipment.
4. Activate the Central Command Post and Field Command Post and put the CSI Oil Spill Cleanup Plan into action.
5. During containment and cleanup operations, he will provide advice and counsel to all parties and coordinate all efforts.
6. After cleanup operations, supervise the cleaning, maintenance, repair and storage of all equipment.
7. Conduct debriefing sessions with all involved CSI personnel and prepare a complete report covering CSI operations.

1200 — CLEANUP COORDINATOR

1200 OIL SPILL CLEANUP COORDINATOR (OSCC)

1201 CSI Personnel

1201.1 In case of an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise the oil spill cleanup, working under the direction of the On-Scene Commander:

Lee Gefvert - Atlantic Richfield Co.
Office (805)831-1600
Home (805)872-2745

H. P. Bezner - Humble Oil & Refining Co.
Office (805)644-1811
Home (213)341-9363

P. E. Patterson - Mobil Oil Corporation
Office (213)723-8631
Home (213)581-4250

R. A. Seefeld - Sun Oil Company
Office (805)648-3251
Home (805)644-3038

Dick Gillen - Union Oil Company
Office (805)963-6404
Home (805 644-3098

1201.2 The Oil Spill Cleanup Coordinator is the "front line" man for oil spill control and cleanup operations. He and his alternate(s) will be drawn from the member companies on the basis of experience and capabilities in cleanup operations. The unique flexibility built into the CSI organization allows the member company incurring the spill to use the OSCC's services, use them in part, not use them at all, or use the OSCC in an advisory capacity to back up its own Oil Spill Cleanup Coordinator. His duties will be divided between the Central Command Post, the Field Command Post, and "on-site" operations.

1201.3 The functions and responsibilities of the Oil Spill Cleanup Coordinator are as follows:

1. Determine from the OSC his duties as divided between the Central Command Post, the Field Command Post, and "on-site" operations and what function the CSI EVP has been designated.
2. Establish and maintain a firm schedule of communications with the OSC office and with the EVP, if the OSC so directs.
3. Organize, direct and manage the five supervisors (Figure 1, Section 1000) in their establishment of such special emergency facilities as may be required.
4. Become familiar with any spill cleanup contingency plans presently developed by member companies and review them with the EVP.
5. Select or develop a firm cleanup plan to include:
   a) a specific operational plan for a particular spill,
   b) the type of equipment and materials to be used, and
   c) the number and type of workmen to initiate each phase of the plan.
6. Review and clear plan with the OSC designated by the respective member companies.
7. Determine the manpower, moving, supplies, food, communication, and other requirements for carrying out the cleanup plan, and supervise the related procurements.
8. To implement and/or use the ideas, equipment and materials proposed by the Technical Evaluator, and to utilize any sound ideas, equipment or materials which may be helpful in minimizing pollution.
9. Communicate with all groups and operations which have a bearing on cleanup operations; i.e. government agencies, Oceanographic Coordinator, Surveillance, etc.; and coordinate information with cleanup supervisors.
10. Insure, thru supervisors, that all cleanup work assignments are being carried out.

11. Prepare and forward daily any special progress reports.
12. Advise member companies as requested.

1201.4 The necessary equipment, materials and manpower required to carry out the job of cleaning up an oil spill are listed under each of the supervisors working under the direction of the OSCC. (See Sections 1300 through 1700)

1300 — OFFSHORE CLEANUP

1300 OFFSHORE CLEANUP SUPERVISOR

1301 CSI Personnel

1301.1 In an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise all open sea cleanup efforts, working under the direction of the Oil Spill Cleanup Coordinator:

T. R. Hicks - Humble Oil & Refining Co.
Office (805)644-1811
Home (805)647-6853

R. D. Lathan - Mobil Oil Corporation
Office (805)643-5451
Home (805)646-6897

C. G. Fewell - Phillips Petroleum Company
Office (805)963-3751
Home (805)968-0020

John R. Herring - Standard Oil Company of California
Office (805)684-4531
Home (805)967-7607

J. E. Cushing - Texaco, Inc.
Office Gaviota 52
Home (805)967-0841

Frank Lemmon - Union Oil Company
Office (805)642-0376
Home (805)644-3281

1301.2 It will be the duty of this supervisor(s) and his alternate(s) to prepare detailed deployment and operational procedures for all "open sea" equipment in the CSI inventory. This will include the supervision of "fire drill" operations with contract personnel, conducted on at least a semi-annual basis or as new equipment is acquired by CSI. He will confer regularly with the "Oil Spill Cleanup Coordinator(s)" and Executive Vice President on a regular basis for review of the "Plan of Action" as related to offshore cleanup operations.

1301.3 When an oil spill occurs, this supervisor(s) will be called into active duty by the Oil Spill Cleanup Coordinator or CSI Executive Vice President. This supervisor(s) will have first been designated by his company to work in this position and he will be relieved of his regular duties for a reasonable period of time in order that he can work full time for CSI on the spill cleanup. Upon being called, this supervisor(s) will proceed to the CSI Field Command Post - Port Hueneme - where the majority of CSI's cleanup equipment is stored.

1301.4 Functions and responsibilities of the Offshore Cleanup Supervisor shall be as follows:

1. Ascertain location and extent of spill, direction of travel and other pertinent aspects of spill and discuss plan of action with Oil Spill Cleanup Coordinator.

2. Based on 1. above, order out appropriate equipment and contractors and initiate plan of action.

3. Coordinate with Communication Supervisor to provide necessary radio equipment for all offshore units and aircraft.

4. Consult with Oceanographic Coordinator and Spill Surveillance people frequently, working through the Oil Spill Cleanup Coordinator, and make appropriate modifications to plan of action.

5. CSI now has effective open contracts signed with most contractors, but Offshore Cleanup Supervisor must ascertain that each contractor has a valid contract or arrange to sign a new contract.

6. Keep accurate records of equipment used, hours worked, number and grade of men worked and hours.

1301.5 The following pages list Resources for most equipment, materials, and manpower needed for offshore cleanup operations.

1302 Absorbents - Powders, Liners, Blankets

1302.1 Strickite - Powder form or in liners or blankets for backup to booms.

Strickman Industries, Inc.
P. O. Box 140
Orangeburg, New York 10962 (914)359-2400

Col. Vito S. Pedone
1600 S. Eads St., Room 238S
Arlington, Virginia 22202 (703)521-2329

1302.2 Fiberperl - Mixture of expanded perlite and cellulosic fiber.

Grefco, Inc.
630 Shatto Place
Los Angeles, California 90005 (213)381-5081
S. H. Matthews (213)775-2781

1302.3 Oil Mop - Petrophilic hydrophobic, fibers or ribbons, called knap, interwoven into a rope.
Mop Machines - Pulls mop thru oil slick and wrings oil out thru rollers.

Oil Mop Incorporated
1101 Edwards Avenue
New Orleans, Louisiana 70121
Don Wendell
or Richard M. Page (504)733-6870

1302.4 3M Brand Oil Sorbent - Webs, Sheets, and Particulate (cotton ball-like chunks).
3M Company
St. Paul, Minnesota 55101 (612)733-1110
J. F. Evert (612)733-4043

1302.5 Poly-Pro - Poly-propylene fibers used in weaving textile products.
Has been used by Crosby & Overton to mop up last traces.
25¢ / lb.

a) Western Textile Products, Inc.
128 S. Cypress St. (714)538-3527
Orange, California 92666 (714)538-9303

b) Chemline Industries
P. O. Box 2371
Palos Verdes Peninsula, Calif.
O. F. Hansen (213)373-2969

1302.6 Baled Straw - See Section V, "Operator and Contractor Capability" in Clean Seas Incorporated "Blue Book" for addresses of suppliers of straw, straw blowers, hay mulchers, etc. For other small dealers, check yellow pages under "Feed Dealers."

1302.7 Shell Oil Herder - This product is now available commercially and stocks are being established on the West Coast by Shell Oil Company. Application has also been made for licensing in California.

Transportation Sales Department
Shell Oil Company
One Shell Plaza
Houston, Texas 77002

Has been approved by E.P.A. at application rate of 2 gallons per linear mile in 6 hour period per application. 3 applications per 24 hours.

1303 AIRCRAFT AVAILABLE FOR EMERGENCY WORK

Owner	Type of Craft	Home Base	Telephone
1303.1 HELICOPTERS			
Rotor Aids Offshore, Inc.	Sikorsky S-55 6 passenger, 1200# payload	Santa Barbara Airport	(805)967-1314 (805)642-8584
	Sikorsky S-55 6 passenger, 1200# payload		
	Bell 47-J 3 passenger, 600# payload		
	Bell 47-J 3 passenger, 600# payload		
Condor Helicopters and Aviation, Inc.	Bell G-3-B1 2 passenger, 600# payload equipped for spraying liquid chemicals, 100 gallon capacity tanks.	Ventura County Airport	(805)487-5451 (Day) (805)642-6142 (Night)
	Bell G-5 2 passenger, 600# payload, equipped for spraying liquid chemicals, 100 gallon capacity tanks.		
	FH-1100 4 passenger, 900# payload		
	Bell G-2		

1303 AIRCRAFT AVAILABLE FOR EMERGENCY WORK

1303.2 FIXED WING AIRCRAFT

Owner	Type of Craft	Home Base	Telephone
Condor Helicopters and Aviation, Inc.	Grumman Ag-Cat 2000# payload, 220 gallon capacity tanks.	Ventura County Airport	(805)487-5451 (Day) (805)642-6142 (Night)
Coastal Chemical Company, Aviation Division	Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks.	Ventura County Airport	(805)483-3234 (805)487-4961
	Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks.		
	Grumman Ag-Cat 2000# payload, 300 gallon capacity tanks.		

1304 Anchors, Chain, Sinkers

1304.1 Anchors

USN Shipyard, Long Beach

Commanding Officer/PIO/Admin. Asst.	(213)547-7717
Ship Salvage Supt.	(213)547-6341
Ship Salvage Supt. Lt. Cdr. E. L. Borden	(213)547-7755
After hours - Duty Officer	(213)547-6226

1304.2 Anchor Chain & Sinkers

USCG Base, Terminal Island	(213)831-9281 Ext. 311

1305 Barges

1305.1	Naval Weapons Station Seal Beach (22 barges)	(213)596-5511
1305.2	Connolly-Pacific Co. 1925 Water Street Long Beach (11 barges)	(213)437-2831
1305.3	Healy Tibbets Construction Co. 1500 West 7th Long Beach (9 barges)	(213)436-1542
1305.4	United Towing Company Berth 122 San Pedro (12 barges)	(213)547-4441

1306 SERVICE BOATS AVAILABLE FOR EMERGENCY WORK

IN THE SANTA BARBARA CHANNEL

Owner	Name of Boat	Type of Boat	Home Port	Telephone
Tidewater Marine	Cal Tide	165' Supply	Santa Barbara	(805)963-1774
Pacific, Inc.	Calcasieu	120' Supply (3 man crew)	"	
	Kyle Tide	136' Supply-Fire monitors installed	"	Howard Hogue
	Lib Tide	43' Crew	"	Don Sutton
	Lou Tide	50' Crew	"	
	Luck Tide	43' Crew (2 man crew)	"	
	Port Tide	76' Supply (2 man crew)	"	
	Run Tide	50' Crew	"	
	Pam Tide	50' Crew	"	
	Low Tide	136' Supply (4 man crew)	Long Beach	
	Warm Tide	65' Crew	Santa Barbara	
	Royal Tide	50' Crew	"	
	Pacific Tide	80' Tug (5 man crew)	Long Beach	
	Unit	50' Crew	Santa Barbara	
General Marine	Mallard	65' Crew	Santa Barbara	(805)963-3808 (Day)
Transport	Sea Scope	185' Research		(805)965-6465 (Night)
(Sea Tenders)	Winn	130' Supply		
	Cameron	130' Supply		Dave Walton
	Swallow	59' Crew		Ken Elmes (805)962-1915
				M. W. "Sherry" Sherwood
Western Offshore	Pike I	135' Supply	Santa Barbara	(805)963-7808 (Day)
Drilling and	Pike VI	60' Crew		(805)965-0510 (Night)
Exploration Co.	Pike VIII	60' Crew		or
	Pike X	60' Crew		(805)965-0519
Santa Fe International Corp.	Del Mar	120' Supply	Santa Barbara	(805)488-4716
(Caspary-Wendell, Inc.)				

1306 SERVICE BOATS AVAILABLE FOR EMERGENCY WORK

IN THE SANTA BARBARA CHANNEL (Continued)

Owner	Name of Boat	Type of Boat	Home Port	Telephone
Ryan Contracting Corporation	San Clemente	70' Tug	Santa Barbara	(805)963-4237 (Day) (805)965-8903 (Night)
Joe Greco	El Greco	65' Utility	Santa Barbara	(805)969-2087
Milt Ashkins or Perry Salter	Fall Guy	56' Utility	Santa Barbara	(805)942-4874 (805)965-0898
Port Hueneme Industrial	Oil City	100' Supply	Port Hueneme	(805)488-3681
United Boat Service, Inc.	Colleen	43' Crew	Santa Barbara	(805)965-8330 (Day) (805)964-3798 (Night)
	Judy	40' Crew		
	Laura	45' Crew		
	Tona	45' Crew		
Associated	Spoonbill	36' Diving Vessel	154 Norman Firestone Road, Goleta (Airport)	(805)967-8118 Pete Brumis
	Amphibious Duck	For working surf zone		
Manuel Gorgita	Mary K	40' Fishing (Skiff with outboard)	Santa Barbara	(805)965-7403

1307 Booms - Refer to Section V, "Operator and Contractor Capability" in the Clean Seas Incorporated "Blue Book". In addition to booms listed there, some of the major sources of boom are listed below:

1307.1 Crosby & Overton Inc. (213)432-5447
1620 West 16th Street
Long Beach, California 90813
E. K. "Gene" Thompson. - About 6000' available.

1307.2 Wm. H. Hutchison & Sons Inc. (213)830-1720
217 North Lagoon Avenue
Wilmington, California 90744
Lee Covin. - About 6000' available.

1307.3 Bennett Pollution Controls Ltd. Office 682-1027
Suite 980, Guinness Tower Home 921-7697
1055 W. Hastings
Vancouver 1, B.C., Canada
John Bennett

1307.4 U. S. Navy

Naval Station, San Diego	(714)235-2011
Naval Weapons Station, Seal Beach	(213)596-5511
Naval Fuel Depot, San Pedro	(213)832-1292
Construction Battalion Center, Port Hueneme	(805)982-4711

1307.5 Murphy Pacific Marine Salvage Co. (415)658-8730
4300 Eastshore Hiway
Emeryville, California 94608
Eugene H. Simpson

1307.6 CSI - Kepner 30" Sea Curtain (805)488-7595
Clean Seas Incorporated Storage
321 Ponoma Street Harbor Services (805)488-5652
Port Hueneme, California or (805)488-4646
Jim Petrovich Home (805)486-7283

1307.7 Humble B-T Boom
Same as #6 above.

1308 Chemicals - Refer to Section V, "Operator and Contractor Capability" in the Clean Seas Incorporated "Blue Book." Suppliers of various chemicals are as follows:

1308.1 Polycomplex A-11 and A-11D

A-11 cost $197.00/drum (55 gal.)
A-11D cost $100.00/drum (40% water plus preservative)
Guardian Chemical Co.
Dave Titlow - Agent (213)396-7531
34 Driftwood Street
Marina Del Rey
Have 200 drums of A-11 available in Lyon Van & Storage at Santa Barbara.

1308.2 Corexit 7664

Enjay Chemical Co. (213)597-8491
5199 E. Pacific Coast Highway
Long Beach, California 90804
Allen Mitchell - Home (714)842-1273
Betty Coughey - Home (714)541-9308

1308.3 Gold Crew

Ara-Chem, Inc. (714)442-3346
808 Gable Way
El Cajon, California

1309 Divers - Underwater Welding

1309.1 Ocean Systems, Inc. (805)965-3321 or 966-2193
108 Los Aguajes Avenue
Santa Barbara, California 93102
Whitey Stefens, Manager
Del E. Thomason
A. K. McCready

Complete diving and underwater repair capability.
Decompression tanks.
Underwater closed circuit TV.
Pipeline repair clamps.

1309.2 Associated Divers, Inc. (805)967-8118
154 Norman Firestone Rd.
Goleta, California (Airport)
Pete Brumis

Have amphibious "Duck" for working in surf zone.
Spoonbill - 36' Diving Vessel.

1310 Salvage Vessels

1310.1 COMELEVEN (0) (714)235-3544
(USN Station, San Diego)

1310.2 Pacific Towboat & Salvage Co. (213)432-6487
Pier D, Berth 35
Long Beach, California

1310.3 USNS Tug GEAR, Chartered to (213)833-3046
Murphy-Pacific Marine Salvage Co.
Berth 37
San Pedro, California

1311 Storage Areas for Skimmers and Material

1311.1 Romines Trucking & Construction Co. Office (805)488-3415
P. O. Box 697 Res. (805)488-4904
Port Hueneme, California
W. R. "Doc" Romines

Has heavy cranes, forklifts, crews and cleanup capability.
Outside storage @ 1¢/sq. ft.
Covered storage @ 4¢ to 7¢ /sq. ft.

1311.2 Gene Kullins Realty Office (805)962-8000
Home (805)687-8382

Has warehouse storage area back of Spanish Restaurant on Cabrillo - IMC Mud Storage were in it - 10¢/sq. ft.

1311.3 CSI Skimmer and Equipment Stored at:
Harbor Services Company Office (805)488-5652 or
321 Ponoma Street 488-4646
Port Hueneme, California
Jim Petrovich, Owner Home (805)486-7283
CSI Phone in this office - (805)488-7595

1312 Tugs

1312.1	USN Station, Long Beach	
	Port Services Officer	(213)547-6627
	Operations Officer	(213)547-6817
	Tug Dispatcher	(213)547-6275
1312.2	Donohugh Boat Service Berth 117, San Pedro	(213)831-0217
1312.3	Pacific Towboat & Salvage Co. Pier D, Berth 35, Long Beach	(213)432-6487
1312.4	San Pedro Tugboat Co. Berth 88, San Pedro	(213)832-1158
1312.5	Wilmington Transportation Co. Berth 86, San Pedro	(213)832-4292

1313 Vacuum Trucks

1313.1 Barnett Vacuum Truck Service (805)524-2377
32 Telegraph Road
Fillmore, California 93015

1313.2 Chancellor & Ogden, Inc. (213)432-8461
3031 East "I" Street
Wilmington, California 90744
M. C. Chancellor Home (213)422-2249
J. E. Ogden Home (213)422-1695

1313.3 Crosby & Overton Transportation Co. (213)436-9723 24-Hour phone
1620 W. 16th Street
Long Beach, California

1313.4 Eddie Hanks Vacuum Truck Co. (805)259-1546
Newhall

1313.5 Fix & Brain Vacuum Truck Service (213)432-5510 24-Hour phone
233 East "D" Street
Wilmington, California

1313.6 Hutchison, Wm. H. & Sons, Inc. (213)830-1720
217 N. Lagoon Avenue
Wilmington, California

1313.7 J. & G. Oilwell Service (805)643-3680
215 E. Rocklite Road
Ventura

(Also has disposal site at Montalvo-Oxnard)

1313.8 Max Rudolph Co. (805)525-4458
1313 Ventura Street (805)525-6606
Santa Paula

1313.9 Routh Transportation (213)435-4823
800 W. 15th Street
Long Beach

1313.10 Speed's Oil Tool Service, Inc. (805)925-1369
110 E. Betteravia Road (805)925-4510
Santa Maria

1313.11 Superior Vacuum Trucks (213)830-3330
221 N. Mar Vista
Wilmington

1400 ONSHORE CLEANUP SUPERVISOR

1401 CSI Personnel

1401.1 In an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise the onshore cleanup efforts, working under the direction of the Oil Spill Cleanup Coordinator:

C. E. Robertson - Atlantic Richfield
Office (805)648-3027
Home (805)525-4088

Jim W. Haney - Shell Oil Company
Office (805)526-1044
Home (805)527-8927

J. B. Stump - Standard Oil Company
Office (805)684-4531
Home (805)684-2480

G. J. Welsh - Sun Oil Company
Office (805)648-3251
Home (805)647-5242

R. F. Vincent - Texaco, Inc.
Office (805)525-4601
Home (805)525-5826

D. J. Van Harreveld - Union Oil Company
Office (805)543-7600
Home (805)544-2650

Tom Whittaker - Union Oil Company
Office (805)963-6404
Home (805)642-1867

1401.2 It will be the duty of this supervisor(s) and his alternate(s) to prepare detailed deployment and operational procedures for all "calm water and onshore" equipment in the CSI inventory. This will include supervision of "fire-drill" operations with contract personnel. He will confer regularly with the Oil Spill Cleanup Coordinator(s) and EVP on a regular basis for the review of the "Plan of Action" as related to onshore cleanup operations. "Spill duties" will include the direction of all onshore cleanup operations, under the supervision of the OSCC.

1401.3 The functions and responsibilities of the Onshore Cleanup Supervisor shall be as follows:

1. Determine from the OSCC his duties as to shoreline, harbors, breakwaters cleanup and his duties and functions to the EVP.
2. Become familiar with any spill cleanup contingency plan presently developed by member companies; review with the EVP.
3. Establish a firm schedule of communications with the OSCC.
4. Review and clear plan of cleanup with the OSCC designated by the respective companies.
5. Determine the manpower, materials, equipment and other requirements needed and transmit to OSCC.
6. Direct, supervise, and coordinate the efforts of all manpower under such charge in their conduct of their work.
7. Prepare and forward daily progress reports.
8. Advise member companies as requested.

1401.4 On the following page(s) are listed materials, services and manpower that may be needed to effectively clean up the shoreline, harbors and boats.

1402 Beach and Rocky Shore Cleanup

1402.1 URS Research Company
155 Bovet Road
San Mateo, California 94402

James D. Sartor Office (415)574-5000
Home (415)368-6457

Can furnish expertise and supervise work and equipment. Had considerable experience in beach cleanup work in San Francisco Bay.

1402.2 Mar-Len Supply Inc.
1963 National Avenue
Hayward, California (415)782-3555

Mr. Rich Soares

Have hydro-jet equipment to clean rocks and sidewalks. Considerable experience in San Francisco Bay spill.

1402.3 Crosby & Overton Inc.
1620 West 16th Street
Long Beach, California 90813 (213)432-5447

E. K. "Gene" Thompson

Heavy duty cleanup organization with all necessary equipment. Designed primarily for harbor work, but very effective for beach cleanup.

1402.4 Wm. H. Hutchison & Sons Inc.
217 North Lagoon Avenue
Wilmington, California 90744 (213)830-1720

Lee Covin

Heavy duty cleanup organization with all necessary booms, skimmers and beach cleanup equipment.

1402.5 Petroleum Construction Inc.
1452 E. Harvard Boulevard (P.O.Box 592)
Santa Paula, California 93060 (805)525-2144

Harold Mears Home (805)525-4026
R. E. Fox

Small contract firm. Has had considerable experience in containing and cleaning up small spills.

1402.6 Van Construction Company
1585 South Lirio Street (P.O. Box 4295)
Saticoy, California 93003 (805)647-1103

John K. Leichliter

Men & equipment for beach cleanup or construction type work. Have portable trailer offices.

1403 Heavy Equipment

1403.1 Listed in Section 1700, Page 1700-4.

1404 Manpower

1404.1 Listed in Section 2200, Page 2200-3.

1405 Chemicals, Absorbents, Straw

1405.1 Listed in Section 1300, Pages 1300-3 & 4.

1406 Oil & Oil Soaked Trash Disposal Sites

1406.1 CLASS I SITES: May take any type of waste, including liquid oil.

1406.2 CLASS II SITES: May take normal household garbage, oily straw, but no liquids.

CONTRACTOR OR SUPPLIER	COMMENTS, LOCATIONS, PHONE NO.
1406.1 CLASS I SITES	
J & G OIL WELL SERVICE	Operates private site at 5th & Harbor, Oxnard. Charge 25¢/bbl. Special arrangements required if used by others trucks. (805)643-3680.
PARKER MARTIN, INC.	Same as above, (805)648-5238.
ELKINS RANCH - FILLMORE	Operates ponds, etc., for liquids. Special arrangements required for oily waste. On Highway 23, 1/4 mile south of Fillmore, turn left on Guiberson. Turn right by schoolhouse to dump. (805)524-1781.
LANDFILL No. 5 CALABASAS LOS ANGELES COUNTY	Operated by Los Angeles County Sanitation District. West on Ventura Freeway to Lost Hills Road, go north to end of road. (213)889-1430.
SIMI VALLEY LANDFILL VENTURA COUNTY, S.E.	Should open in early 1971, will have some Class I area. Left side of Highway 118, north of Simi on Union Oil lease.
1406.2 CLASS II SITES	
VENTURA COASTAL REFUSE CO. 4105 Gonzales Road, Oxnard, California. Frank Robinson	Can take oily straw, charge $1.25/ton, but estimate weight. Have charged $10 per load. South on Harbor, left on Gonzales. (805)642-7127.
SANTA PAULA, CALIFORNIA TOLAND ROAD DUMP.	Four miles east of Santa Paula. Take Toland Road left to dump site. (805)525-8217.
TAJIGUAS LANDFILL 17 miles N.W. of Santa Barbara. Santa Barbara County Works Dept. Mr. Frank Kitley.	Can take oily straw. Road and materials handling procedures have been improved since 1969 oil spill. Approximately 6 miles east of Gaviota, behind Shell Service Station on left. Dump is 1/2 mile off Highway 101. (805) 968-4515.

1500 — STAGING

1500 ONSHORE STAGING AREA SUPERVISOR

1501 CSI Personnel

1501.1 In the event of an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise the Onshore Staging Area, working under the direction of the Oil Spill Cleanup Coordinator:

A. H. Smith - Atlantic Richfield Co.
Office (805)831-1600
Home (805)832-7776

Jack L. Driggs - Continental Oil Co.
Office (805)642-8154
Home (805)644-3909

Ben Piester - Phillips Petroleum Company
Office (805)963-3751
Home (805)967-5807

Ted F. Ritchie - Shell Oil Company
Office (805)643-5221
Home (805)529-1267

M. A. Stewart - Standard Oil Company
Office (805)937-6333
Home (805)937-2839

1501.2 The Central Command Post at Santa Barbara and the Field Command Post at Port Hueneme will normally suffice for most spills. However, spills may occur in remote sections of the CSI Area of Interest such as Pismo Beach, Gaviota, or Malibu and it would become necessary to have Mobile Field Command Posts and Staging Areas in a convenient location in the vicinity of the spill. The Staging Area Supervisor(s) will handle this phase of the operation.

1501.3 The duties of the Staging Area Supervisor(s) and his alternate(s) will include the organization of the staging area; preparation and coordination of all equipment, materials and supplies to be dispatched to the operation; inventory and status control; maintaining a detailed check list as to "readiness" of equipment. His duties will also include maintaining close liaison with the Communication, Transportation, and Purchasing supervisors to insure a coordinated effort. This will include obtaining rental office trailers to be used as Mobile Field Command Posts, and close contact on a regular basis to assure a continuing supply of equipment and materials.

1501.4 The duties and responsibilities of the Onshore Staging Area Supervisor are as follows:

1. The Onshore Staging Area Supervisor will maintain close communications with the OSCC and work to expedite the needs of the OSCC.
2. He shall maintain an up-to-date file of all equipment that might be required to clean up an oil spill.
3. He will coordinate with the Communications Supervisor in establishing necessary telephone and radio installations and maintaining adequate communications with the Central and Field Command Posts.
4. He shall communicate regularly with the Transportation Supervisor and Purchasing Supervisor to expedite all equipment.
5. He shall maintain a daily file of all equipment used and shall inform the OSCC of inadequate equipment.

1501.5 A list of services that may help this supervisor are on the following pages.

1502 Trailer Rental

1502.1 State of California Disaster Office
Los Angeles

(213)620-5607

1502.2 Van Construction Company
1585 S. Lirio St., Saticoy

(805)647-1103

1502.3 Angelus Mobile Office Rentals
1134 Santa Anita Avenue, South El Monte

(213)443-1715

1502.4 Scotsman Mobile Lease Co.
18010 S. Figuero, Gardena

(213)532-0583

1502.5 Tri-Counties Vehicle Center
7760 Hollister Avenue, Goleta

(805)968-1565

1503 Storage Areas for Skimmers & Material

1503.1 Harbor Services Company
321 Ponoma Street, Port Hueneme

Office (805)488-5652
Home (805)486-7283
CSI Phone (805)488-7595

1503.2 Romines Trucking & Construction Co.
Port Hueneme

Office (805)488-3415
Home (805)488-4904

Outside Storage - $.01/Sq. Ft.
Inside Storage - $.04 to .07/Sq. Ft.

1504 Transportation

1504.1 Listed under Section 1700, Pages 1700-4 & 5.

1505 Other Services

1505.1 Listed in various sections.

1600 — WILDLIFE

1600 WILDLIFE PRESERVATION

1601 CSI Personnel

1601.1 This position is very important in an oil spill situation and must work closely with the State Department of Fish and Game. The following CSI Personnel may be called on to supervise recovery and cleaning of wildlife that may become involved in the spill:

H. A. Weeks - Humble Oil & Refining Company
Office (213)636-9177
Home (714)893-4495

R. V. Scott - Standard Oil Company of California
Office (213)691-2251
Home (213)697-1958

1601.2 Legal Aspects: Migratory birds are the property of the federal government. In order to pick them up legally. It is necessary to have a salvage permit from both State Fish and Game authorities and the U. S. Fish and Wildlife Service. Since it obviously is impossible to pick up an oiled bird on a beach and a permit to keep it under restraint at the same instant, wildlife authorities commonly relax legal restrictions during an emergency period.

1601.3 It will be the duty of the Wildlife Preservation Supervisor(s), working closely with State Fish and Game, to set up bird cleaning stations, holding pens, enlist aid from recognized authorities in wildlife rehabilitation, and conduct bird cleaning operations.

1601.4 Considerable research has been conducted by several recognized experts in the field of Wildlife Rehabilitation and they are listed under resources to be called in for consultation and advice.

1601.5 Wildlife Authorities

1601.51 Philip B. Stanton
Wildlife Rehabilitation Center
Grove Street
Upton, Massachusetts 01568

1601.52 James L. Naviaux, D.V.M.
Executive Director, National Wildlife Health Foundation
Pleasant Hills, California

1601.53 Prof. William L. Brisby
Moorpark College
7075 Campus Road Office (805)529-2321
Moorpark, California 90321 Home (805)524-2785

1601.54 Ed. W. Mertens
Standard Oil Co. - CRC Laboratories Office (415)237-4411
Richmond, California Home (415)234-5979

1602 Background Information on Wildlife

1602.1 Recovery and rehabilitation of oil-soaked birds is a relatively new subject and background information may be difficult to find. Therefore, included below is a summary of lessons learned from recent oil spill experiences. Much of the information is taken from an Oil Spill Prevention and Cleanup Manual prepared by the Board of Engineers of Standard Oil Company of California and is included below for the use of the Wildlife Preservation Supervisor(s).

1603 Dispersal of Birds

1603.1 It is sometimes possible that by harassment, birds can be frightened away from an oil spill and thereby not become involved. However, harassment is successful only if the birds have an alternate place to go that is equally suitable for them. Differences in environment that are seemingly insignificant to a layman are, in fact, critical to the various species of birds. For example, around even a relatively small lake the areas populated by the various species of birds will differ according to the species because of their different nesting, feeding and other requirements.

1603.2 The use of firearms and pyrotechnics is probably the most effective means of dispersing birds. The use of these methods generally is required periodically throughout the day between dawn and darkness. Shell crackers fired from shotguns, either from shore or from small boats, can be effective. Their use may be augmented by the use of large firecrackers and/or aerial bombs. Firing stations should be no more than one mile apart and firing intervals should be at 5 to 10 minute intervals. Movement from a station position between firings is advisable but such movement should be so coordinated that all stations are moving in the same direction at the same time. Stations should be placed more closely and firing intervals should be shortened if efforts are not satisfactory. For boats patrolling offshore, two men in each boat is advisable.

1603.3 Also helpful is the use of firecracker poles erected at no more than one-quarter mile intervals. Such poles are made by setting up a pole with enough fuse rope hanging from it, with firecrackers attached thereto, to give firing at 10 to 15 minute intervals throughout the daylight hours.

1603.4 Auxiliary methods include patrolling the area by low-flying helicopters, stationary scare-owls and keeping the beaches well covered with straw. However, birds quickly become used to scare-owls within a day or two; nevertheless, their use may prove effective until other systems such as described previously can be instituted. The use of straw on the beaches is effective for certain birds because evidently they dislike to walk upon it.

1604 Retrieval and Rehabilitation of Birds

1604.1 Retrieval

1604.11 Waterfowl are most likely to become oil-soaked while some distance offshore. However, upon becoming oiled, they tend to go ashore. Consequently, efforts to retrieve birds can be concentrated at or near the shoreline.

1604.12 The retrieval of birds is best accomplished at low tide. Collectors can best catch heavily oiled or sick birds left on the beach by the receding tide by placing themselves between the birds and the water. Generally, the birds can be readily caught by hand. A net is effective in catching more active birds, however.

1604.13 Care must be exercised in picking up and handling birds in order to minimize stress. Birds should be placed in boxes and brought in within an hour, if at all possible, to the cleaning station. Cardboard file boxes, approximately 10 inches by 12 inches by 14 inches, are satisfactory except for very large birds. Normally, no more than one bird should be placed in a box; although if the birds are quite small, two may be placed in the same box.

1604.14 Lids should be applied to darken the boxes so as to keep the bird quiet. Care must be taken that the boxes are adequately ventilated. Boxes should be shielded in cool weather to prevent chill and also in extremely warm weather to prevent heat prostration.

1604.15 If the bird washing facilities are some distance away from where the birds are being collected, temporary receiving stations may be desirable.

1604.16 Equipment most commonly needed includes boats, nets, waders or wet suits, and cardboard file boxes. To protect the retriever's eyes while capturing large birds, the use of safety goggles is recommended. (Large birds will often attempt to peck at his capturer's eyes.) A crew of two men per each boat is desirable. The use of nets is helpful in offshore retrieval of birds.

1604.2 <u>Treatment of Birds</u>

1604.21 If a bird cannot be cleaned immediately upon arrival at the washing station, it should be kept in its box in the shade in normally comfortable or warm weather. Special precautions must be taken in chilly or cold weather to keep the bird warm.

1604.22 The first step in cleaning a bird is to force-feed it one-half pat of butter. This acts as a mild laxative and helps clear ingested oil from its digestive tract. The bird should be allowed to stay in its box at least 15 minutes to allow the butter to act.

1604.23 Washing of birds is best done in galvanized wash tubs placed on benches or on sawhorses and planks. The temperature of the water should be lukewarm - at least 95°F., preferably 100-110°F. (The normal body temperature of most birds is 106°F.)

1604.24 The preferred detergent, or shampoo, is Polycomplex A-11[1] used at 1% concentration in water. The bird is immersed in this solution; and, by swishing and working the feathers, sand is loosened and the oil coating is penetrated. For lightly oiled birds, this treatment is adequate; and the bird is ready to be rinsed.

[1] Stanton, P. B., Modern Game Breeding, Pages 10-12, 27, May,,1969.

1604.25 At this time, the beak is also cleaned since preening by the bird of its feathers results in a heavy oil coating inside the mouth. Opening of the beak is generally accomplished by extending a finger - if the bird is large, gloves and goggles or face shields should be worn - as a target for the bird to bite on. The beak can then be kept open with relatively little force or danger of breaking. The use of cotton swabs and cod liver oil is recommended for cleaning beaks.

1604.26 The next step involved more intensive cleaning of the severely oiled areas, if any, of the bird. This is accomplished by the application of undiluted Polycomplex A-11 to the wet bird. This material should be worked into the feathers by stroking in the direction of the feather to avoid breaking or ruffling.

1604.27 After the washing operation is completed, the bird should be rinsed at least once and preferable twice. Thus, each washing unit should be comprised of two, preferably three, tubs and two to four people. If running warm water is available, the bird should be rinsed until the water remains clear. Towels or rags should be used to pat the bird dry. The bird should be wrapped and carried to the drying facilities immediately.

1604.28 As a worker gains experience, he will find that often, by placing a cloth over the bird, it becomes quiet and washing is easier and quicker. As a result, the bird is subjected to less stress. In washing large birds, two and sometimes more people will be required. If the birds are small or lightly oiled, as many as four to six birds may be washed before the water must be discarded. With larger or more heavily oiled birds, the water must be discarded after washing only one or two birds. Workers will find it advisable to wear rain garments and work shoes or boots while washing and rinsing birds. The average washing time is about 15 minutes per bird.

1604.29 If no one is available who is experienced and knowledgeable in cleaning and rehabilitating birds, obtaining the services of an expert in this field is highly recommended. The duties of this person would be to instruct the workers in the cleaning procedure, supervise them, direct the subsequent drying and treatment operations, and make sure that proper records are maintained.

1604.3 Postcleaning Treatment

1604.31 Immediately after the bird has been washed, it should be placed in a dry, roomy area. For most birds found in temperate climates, the temperature should be maintained between 55°F. and 65°F. If adequate, permanent facilities are not available, trailers or vans provide satisfactory housing. If the facility is unheated, heat may be supplied by using one heat lamp brooder for every eight birds. The hot spot under the heat lamp should be between 85°F. and 90°F. Birds should be able to leave heat at will.

1604.32 The floor should be covered with 4 inches of serval (crushed sugar cane). Serval is much preferred because this litter minimizes the occurrence of "Aspergillosis," a respiratory disease. Four inches of litter is required for those waterfowl that are not physiologically adapted to walking on land.

Breast sores and tumors develop if the litter is thinner. A lesser amount of litter may be used if such birds are not involved. If serval cannot be obtained, wood shavings may be used although it is much less satisfactory. The litter should be changed every 24-48 hours.

1604.33 The interior of the facility should be partitioned to separate the various types of birds. Birds should not be crowded because, by constant pecking, the stronger birds will prevent the weaker ones from obtaining adequate heat, food, and water. Perches should be provided for the perching birds.

1604.34 Birds can be watered by providing shallow pans covered with grates or by using poultry drinking fountains. Waterfoul should have access to drinking water only for the first two weeks. Thereafter, shallow bath pans or ramped swimming pools should be provided; otherwise, the birds may drown.

1604.35 Feeding is generally started the day after washing. For fish-eating birds, the fish they normally feed upon in the local area should be provided. If possible, the fish should be kept alive until they are fed to the birds. A diet of dead fish is believed to cause a thiamine deficiency in the birds. This may be corrected by sprinkling powdered thiamine on the dead fish. Alternatively, using trout chow or some feed that has a fishy smell should be used.

1604.36 Game bird chow and trout chow are usually preferred by most other species of birds. Grains can be used as supplements. Grit or crushed oyster shells should be provided to all birds.

1604.37 The birds should be kept in the temperature controlled facility for at least 12-24 hours. If space is available, they should be kept until the third day. Usually feathers begin to fluff within two hours; and with preening, the appearance of the birds improves remarkably.

1604.4 Long Term Aftercare

1604.41 The long term caring facilities should be located as close to the interim drying facilities just discussed as possible to minimize stress in handling during transfer. If suitable permanent facilities are not available, holding pens may be constructed from lumber and chicken wire. Shelter from inclement weather and cold nights is necessary. If permanent shelter is not available, heavy gaged polyethylene sheeting can be secured with heavy staples to the framing of holding pens. A drawing for the construction of such pens is attached. Although labor consuming, this method of providing shelter can be readily installed and removed as conditions require.

1604.42 Feeding and access to swimming pools as mentioned previously are essential. Feeding should occur two to four times daily. Birds should be segregated by species as required. The services of a pathologist to diagnose illnesses and deaths of birds and to advise corrective measures is recommended.

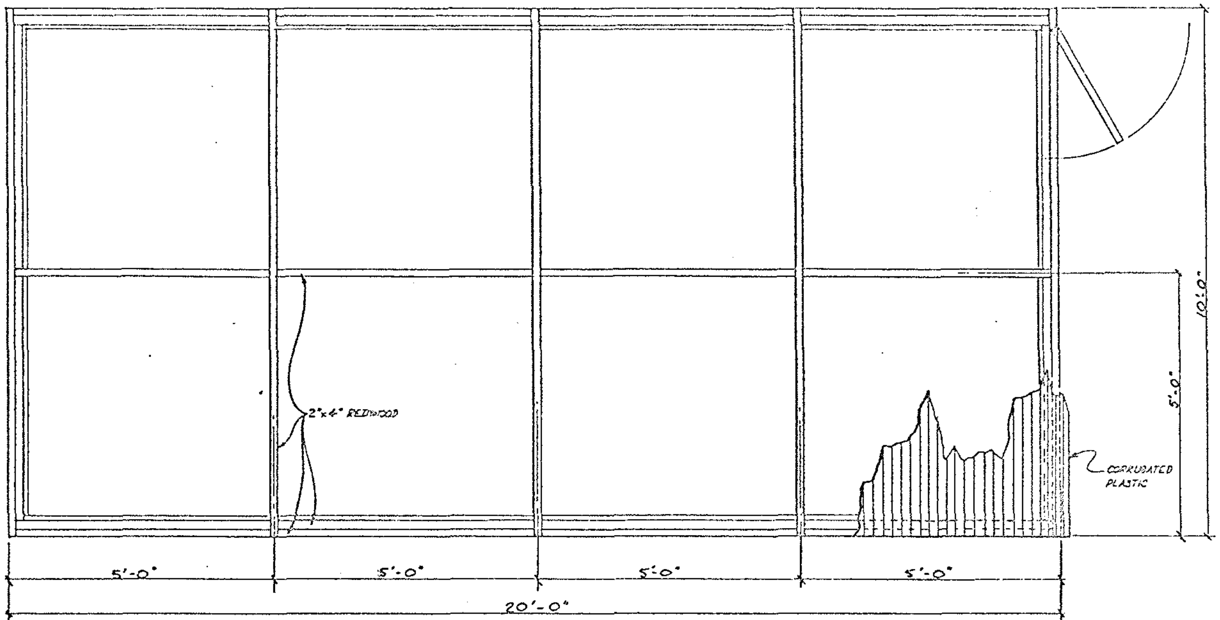
1604.43 Most birds, such as ducks, that rely on their natural waxes for waterproofing to keep themselves from drowning, must be kept in these facilities until their natural waxes are restored. This may not occur until the bird has

1600-8

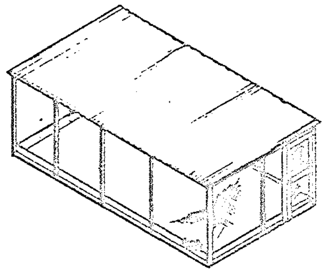
9-1-71

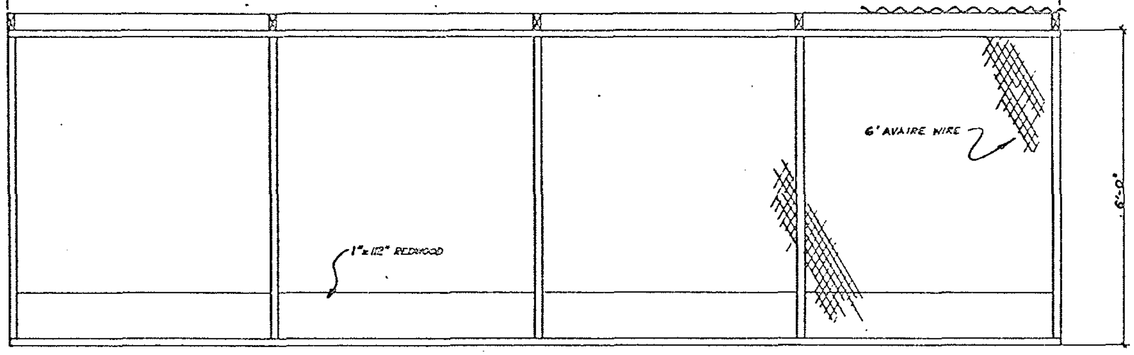
MATERIALS

16 d Galv. Nails.
2"x4" Redwood (Conc. Grade)
1"x12" Redwood (Conc. Grade).
6' Standard Aviary Wire.
3 Butt Hinges
Screen Door Spring.
Hook for Door.
Corrugated Plastic for Patio Roofing
10' long 30" Wide.

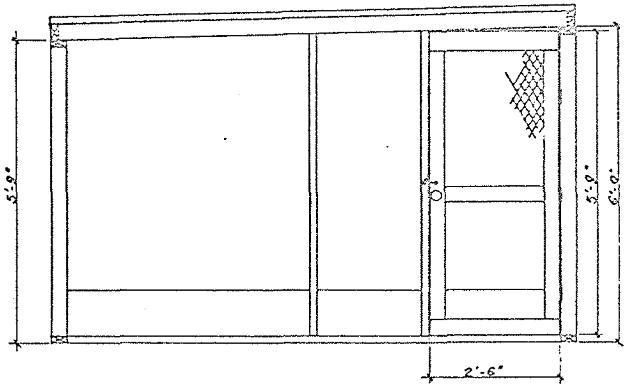


PLAN





SIDE ELEVATION



DOOR END ELEVATION

*SKETCH PROVIDED BY CHILDS ESTATE ZOO, SANTA-BARBARA. 8/23/70

REVISIONS

SCALE 3/4"=1'-0"
DATE 9-1-70
DR BDM
CH RCP 9-1-70
ENG.
APPR.

CHEVRON RESEARCH COMPANY
RICHMOND, CALIFORNIA

HOLDING FACILITIES FOR HANDLING OILED BIRDS*

DATE
12019
B
REVISION

1700 — TRANSPORTATION

1700 TRANSPORTATION SUPERVISOR

1701 CSI Personnel

1701.1 In case of an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise all transportation, land, sea and air, working under the direction of the Oil Spill Cleanup Coordinator:

Dick Grunder - Atlantic Richfield Co.
Office (805)648-3027
Home (805)646-5720

J. K. Daniel - Phillips Petroleum Company
Office (805)963-3751
Home (805)964-1457

Larry Benolkin - Standard Oil Company
Office (805)684-2631
Home (805)968-5605

L. Southwick - Texaco Inc.
Office (805)525-8008
Home (805)524-0309

1701.2 In a "spill situation," this representative will organize and direct all transportation of equipment and personnel as related to the oil spill cleanup operations. This will involve making the necessary precontractural arrangements and operating agreements for air, land and marine vehicles. Specifically, the functions of the Transportation Coordinator shall be:

1. To arrange transportation for equipment, material and personnel needed to carry out the containment and cleanup and damage control operations.
2. To work with local authorities (City, County, State and Federal) in setting up land, sea and air routes which will expedite movements of supplies to the scene and disposal of waste products from the scene of the spill.
3. This supervisor will maintain close communications with the OSCC and expedite any requests received.
4. He shall maintain a ready file of all equipment, air, land and marine, and from time to time update the file.
5. He shall make and supply daily, a record of all equipment use.
6. He shall work in a "fire-drill" operation to train all persons who might use CSI equipment.

1701.3 The following pages list equipment, land, sea and air, that may be used for an oil spill cleanup.

1702 Aircraft Available for Emergency Work in Channel

1702.1 Listed under Section 1300, Pages 1300-5 & 6.

1703 Barges

1703.1 Listed under Section 1300, Page 1300-7.

1704 Service Boats Available for Emergency Work in Channel

1704.1 Listed under Section 1300, Pages 1300-8 & 9.

1705 Salvage Vessels

1705.1 Listed under Section 1300, Page 1300-12.

1706 Tugs

1706.1 Listed under Section 1300, Page 1300-13.

1707 Vacuum Trucks

1707.1 Listed under Section 1300, Page 1300-14.

1708 Heavy Equipment

1708.1 Allied Construction and Engineering Company
2320 North Ventura Avenue, Ventura

(805)648-3141

1708.2 Cloer Construction Company
Las Varas Canyon, P. O. Box 278
Goleta

(805)968-6490

1708.3 Van Construction Company
1585 "F" Street, Saticoy

(805)647-1103

1708.4 Eldon H. Haskell
2 South Quarantina, Santa Barbara

(805)963-3851

1708.5 Clarence & Jack Lambert, Inc.
110 Salsipuedes Street, Santa Barbara

(805)963-3591

1708.6 El Monte Hay Market
10900 Railroad, El Monte

(213)283-3291

Unlimited supply - 2000 bales of hay can be delivered within 6 hours.

1709 Land (Bulldozing and Trucking)

1709.1	Petroleum Construction, Inc. 1452 E. Harvard Avenue, Santa Paula (805)525-2144	Manpower, bulldozers, and heavy equipment
1709.2	Leal Corp. 736 Mission Road, Santa Paula (805)525-4214 or (805)485-5904	Truck broker Truck broker
1709.3	Hudson Contr. Corp. 1051 S. Beach Boulevard, La Habra (213)697-6144	977 loaders and Michigan tire loaders
1709.4	C. W. Berry 4157 State Street, Santa Barbara (805)967-4004	Dump trucks
1709.5	Lang Transportation 2459 North Ventura Avenue Ventura, California (805)648-1821	
1709.6	F. Feliciarro 110 E. Vettera Via Santa Maria, California (805)925-8624 or (805)937-1257	Graders

1710 Straw Blowers

1710.1 Smith and Renolds
Morco, California

(714)737-6778 or (714)737-7287

1710.2 Billy Greenfield
McFarland, California

1711 Spraying Contractors

1711.1 Coastal Chemical Company
1015 Wooley Road, Oxnard

(805)487-4961

1711.2 Western Exterminators
Main Street, Ventura

(805)642-0464

1800 — OCEANOGRAPHIC

1800 OCEANOGRAPHIC COORDINATOR

1801 CSI Personnel

1801.1 In an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise the Oceanographic group, working under the direction of the On-Scene Commander and with the Oil Spill Cleanup Coordinator:

C. E. Ensley - Atlantic Richfield Company
Office (213)437-1284
Home (213)431-7309

R. G. Tonkin - Humble Oil & Refining Company
Office (213)636-9177
Home (213)430-4375

C. H. Long - Shell Oil Company
Office (213)482-3131
Home (213)349-7590

B. F. Brawley - Sun Oil Company
Office (805)648-3251
Home (805)647-2992

1802 Advisory Groups

1802.1 University of California, Santa Barbara

1802.2 Oceanographic Services
135 E. Ortega Street, Santa Barbara
(805)965-6575

1802.3 Ocean Systems, Inc.
108 Los Aguajes Avenue, Santa Barbara
(805)965-3321

1802.4 Ocean Design Engineering Corp.
600 E. Ocean Boulevard, Long Beach
(213)432-8983

1802.5 U. S. Coast Guard
Marine Breakwater, Santa Barbara
(805)962-7430

1900 — SURVEILLANCE

1900 SURVEILLANCE COORDINATOR

1901 CSI Personnel

1901.1 If an oil spill occurs, one or more of the following CSI Personnel may be called on to supervise the surveillance of the spill, noting all movements of the oil, working under the direction of the On-Scene Commander and with the Oil Spill Cleanup Coordinator:

G. A. Daugherty - Humble Oil & Refining Co.
Office (213)636-9177
Home (213)430-4375

J. T. Taylor - Humble Oil & Refining Co.
Office (805)644-1811
Home (805)642-7655

N. H. Smith - Mobil Oil Corporation
Office (213)626-5711
Home (213)375-3815

C. L. Thomas - Shell Oil Company
Office (213)482-3131
Home (714)527-7977

1901.2 Primary duty includes surveillance of oil slicks and predictions of movement utilizing both aerial and surface sensors to provide a complete monitoring system. A variety of monitoring and observation techniques are available and have been tried in examining the extent, dynamics, and effects of an oil spill. These include visual observations on the ground, from the shore, surface craft, or aircraft, and photographic methods or other more sophisticated remote sensing techniques from low and high flying aircraft. Additionally, there are remote sensing capabilities from satellites.

1901.3 The duties and responsibilities of the Surveillance Coordinator are as follows:

1. The primary duty includes surveillance of oil slicks and predictions of movement utilizing both aerial and surface sensors to provide a complete monitoring system.
2. He shall maintain close communications with the OSCC, EVP and Oceanographic Coordinator as to further protective action required for safeguard of shorelines and harbors.
3. He shall call on outside advice and counsel, as a considerable amount of research work has been undertaken by Mr. John E. Estes, Department of Geography, U.C.S.B.
4. Documentation of oil spills and movement of oil becomes very important in settling claims, public relations and government relations, and, therefore, the Spill Surveillance Coordinator should work closely with the Public Relations and the Documentation Coordinators.

1901.4 The following pages list resources for most equipment, materials and manpower needed for surveillance operations.

1902 Aircraft Available for Emergency Work

1902.1 Helicopters - Listed under Offshore Cleanup, Section 1303, Page 1303-5.

1902.2 Fixed Wing Aircraft - Listed under Offshore Cleanup, Section 1303, Page 1303-6.

1903 Service Boats Available for Emergency Work

1903.1 Listed under Offshore Cleanup, Section 1306, Pages 1303-8 & 9

1904 Aerial Photographs

1904.1 Space Division
North American Rockwell
12214 Lakewood Boulevard
Downey, California 90241

"Gabby" G. O. De Donato (213)594-3506
V. H. Henderson (213)594-3963

1904.2 Marine Advisors, Inc.
Bendix Corporation
P. O. Box 690
Solana Beach, California 92075

1904.3 Mr. Alan A. Allen
Marine Resource Consultants
1101 Colorado Avenue
Santa Monica, California 90404 (213)451-0781

1904.4 Texas Instruments Incorporated
P. O. Box 5621, MS 949
Dallas, Texas 75222 (214)238-3444

Ray Toole

2000 — COMMUNICATION

2000 COMMUNICATIONS SUPERVISOR

2001 CSI Personnel

2001.1 In the event of an oil spill emergency, the following CSI Personnel may be called to supervise the Communication network, working under the direction of the On-Scene Commander and with the Oil Spill Cleanup Coordinator:

Henry Schoelhorn - Standard Oil Company
Office (213)691-2251
Home (213)697-7006

R. P. Naremore - Sun Oil Company
Office (805)648-3251
Home (805)644-4450

Paul Gooder - Union Oil Company
Office (213)482-7600
Home (213)592-1556

2001.2 Continuing duties include the acquisition, installation and maintenance of the recommended communication system. Prior to the purchase of equipment, it will be necessary to obtain frequency clearance from the PFCC (Petroleum Frequency Coordinating Committee) and an FCC license.

2001.3 "Spill situation" duties include providing for, and the supervision, operation, and maintenance of the communications system to insure "100% reliability" during oil spill cleanup operations.

2001.4 The responsibilities and duties of a Communications Supervisor are as follows:

1. He shall provide necessary radio and telephone and other communication facilities in the Command Post and the Field location.
2. He shall maintain all radio equipment in a state of "readiness" for any emergency operations.
3. He must be available in the Command Post in order to maintain existing communications gear and to recommend to the OSCC and EVP the installation of any additional equipment that would facilitate coordination of the operation.
4. He shall rent or repair any communication equipment as authorized by the OSCC or EVP.

2001.5 On the following page(s) are listed the services that could be notified to help the Communications Supervisor in his duties.

2002 Radio Services

2002.1 Tri-County Communications
1435 Callens Road, Ventura (805)642-6017

Ed Barratt Home (805)647-6028
C. B. "Charlie" Ellis Home (805)644-3813

2002.2 Motorola Communications
542 Amhurst Drive, Goleta (805)967-4115

2003 Telephone Services

2003.1 General Telephone Company
101 West Canon Perdido, Santa Barbara (805)966-9161

George W. N. Robinson Home (805)963-7171

2004 Television

2004.1 R.C.A. Television Service
24 W. Gutierrez, Santa Barbara (805)965-6183

2100 — VOLUNTEERS

2100 VOLUNTEER HELP COORDINATOR

2101 CSI Personnel

2101.1 This section is still under study as to the optimum method of handling the "Volunteer" problem. In the meantime, if a spill should occur, the following CSI Personnel may be called on to coordinate volunteer help activities:

Ralph T. Hanson	-	Continental Oil Company	
		Office	(805)642-8154
		Home	(805)647-3423
Jack D. Hall	-	Shell Oil Company	
		Office	(213)427-4113
		Home	(714)539-4450
G. J. Welsh	-	Sun Oil Company	
		Office	(805)648-3251
		Home	(805)647-5242
B. C. Spradlin	-	Phillips Petroleum Company	
		Office	(805)963-3751
		Home	(805)968-2040

2101.2 As mentioned in Section 319.1, Page 300-9, there are many young people of high school age on up who insist on "helping" in an oil spill situation. No definite guide lines have been established on just how to handle this problem, and it is still under consideration by those preparing the EPA and the State Contingency Plans. For the present, it will be advisable to set up an office and procedure for guiding the energies of these young people into areas where they can be of maximum help and where their safety can be assured.

2101.3 The largest community of volunteers is located at Isla Vista, adjacent to the UCSB Campus. An organization known as JIVE (Joint Isla Vista Effort) is located with headquarters at 900 Embarcadero Del Mar, Suite A, and is made up mainly of students. There are several advisors to this group: Mr. C. Ray Varley, Chancellor of UCSB; Mr. Bob Mizerak, assistant to Mr. Varley; and Mr. Ken Van Leer.

2101.4 The JIVE organization has organized into teams and, working through UCSB, has the use of 4-wheel drive vehicles and other heavy University equipment. They have also arranged about 20 positions on the University switchboard for emergency use in order to have adequate communications.

2101.5 In the event of an oil spill and in order to handle the volunteer help situation, it would be advisable to immediately contact the JIVE organization and enlist the help of their leaders to coordinate the effort of all volunteers and keep things under control. The most reliable contact is:

Mr. Bob Mizerak, Assistant to the Chancellor
Office (805)961-3754

2200 — PROCUREMENT

2200 PROCUREMENT COORDINATOR

2201 CSI Personnel

2201.1 In an oil spill emergency, one or more of the following CSI Personnel may be called on to supervise all procurement efforts, working under the direction of the On-Scene Commander and with the Oil Spill Cleanup Coordinator:

H. D. Forrer - Phillips Petroleum Company
Office (805)963-3751
Home (805)968-6940

D. W. Phillips - Sun Oil Company
Office (805)648-3251
Home (805)642-6069

J. F. Woodman - Sun Oil Company
Office (805)648-3251
Home (805)642-0548

T. C. Bangs - Union Oil Company
Office (213)945-1221
Home

D. C. Gullickson - Union Oil Company
Office (805)543-6927
Home (805)489-2643

2201.2 Continuous duties include the preparation of guidelines and procedures to assist the Executive Vice President in equipment acquisition, inventory control, and cost accounting.

2201.3 In a "spill situation," this position becomes very important in procurement and expediting functions requested by the various supervisors in carrying out their assigned duties. This will involve the direction of activities at the Field Command Post (Port Hueneme) and other facilities selected for loading or unloading operations. Specific functions of the Procurement Coordinator shall be:

1. To purchase, rent, borrow, or otherwise obtain the following as specified by the On-Scene Commander or other members of his organization:
    a. Manpower necessary to carry out the damage control and containment and cleanup operations, acting thru a manpower recruiter on his staff.
    b. Equipment and Materials required to be purchased for damage control, containment and cleanup, acting thru a purchasing agent on his staff.
    c. Provide for services for all those engaged in the operations, including food, lodging, clothing, safety and protective equipment, tools and supplies, first-aid equipment, etc., acting thru a Safety Engineer and others on the staff handling food and housing.
2. Acting thru the Safety Engineers, make adequate arrangement with local doctors, ambulance services and hospitals for handling and care of injured personnel.

2201.4 The following page(s) list resources for most equipment, materials, and manpower needed for procurement work.

2202 Purchasing

2202.1 Baled Straw - Listed in Section 1300, Page 1300-3.

2202.2 Absorbents - Powders, Liners, Blankets - Listed in Section 1300, Page 1300-3.

2202.3 Booms - Listed in Section 1300, Page 1300-10.

2202.4 Chemicals - Listed in Section 1300, Page 1300-11.

2202.5 Various and Sundry Items - Check yellow pages of phone book.

2203 Manpower

2203.1 In addition to manpower available through the various contractors listed in Sections 1300 through 1700, a large reservoir of manpower is available as follows:

Inmates (up to 3000) from State Penal System and California Department of Conservation, Division of Forestry, may be obtained through arrangement with California Disaster Office. They will provide their own messing, berthing and transportation, logistic support.

California Disaster Office
Los Angeles (213)620-5607

2204 Food and Housing

2204.1 Housing listed under Trailer Rental, Section 1500, Page 1500-3.

2204.2 Food

Smart & Final Iris Co.
110 Anacapa, Santa Barbara
(805)962-3188

S. E. Rykoff Co.
761 Terminal, Los Angeles
(213)622-4131

Cenco Distributors
1582 Callens Road, Ventura
(805)644-1325

Mission Restaurant Supply
595 Paso Robles Dr., Santa Barbara
(805)963-3801

2300 — TECH. EVALUATOR

2300 TECHNICAL EVALUATOR

2301 CSI Personnel

2301.1 In the event of an oil spill emergency, one or more of the following CSI Personnel may be called on to evaluate materials, ideas and equipment, working under the direction of the On-Scene Commander and with the Oil Spill Cleanup Coordinator:

G. R. Cunningham - Humble Oil & Refining Co.
Office (213)879-2700
Home (213)396-2210

R. D. Schropp - Phillips Petroleum Company
Office (805)963-3751
Home (805)967-2224

William Fischer - Standard Oil Company
Office (213)691-2251
Home (714)525-3038

W. T. Wilson - Standard Oil Company
Office (213)691-2251
Home (213)697-8455

2301.2 Continuing duties include the evaluation and analysis of proposals and equipment related to oil spill cleanup operations; with recommendations to the EVP as to applicability or feasibility, operational performance and developmental considerations.

2301.3 In a "spill situation," this "staff" member would be responsible for screening all manufacturers, promoters, inventors, etc. of oil spill recovery devices and submit his recommendations to the OSCC.

2301.4 The functions and duties of the Technical Evaluator are as follows:

1. Maintain close communications with the OSCC and submit his recommendations to the OSCC and EVP.
2. To interview salesmen and private citizens who submit ideas, materials or equipment that might assist in the cleanup operation.
3. To create a record, in both written and pictorial form, of the events of this emergency and the part the equipment plays in effecting a cleanup.
4. He shall provide technical assistance to the OSCC in evaluating or using a new, promising idea.
5. He must keep and maintain an open mind to any new idea or material or equipment.

2301.5 The duties, as listed, for a Technical Evaluator are wide open, but he can consult with other personnel that have experienced an oil spill; these persons are listed on the following page.

2302 Advisory Personnel

2302.1 D. E. Craggs - Union Oil Company
Ventura

Office	(805)963-6404
Home	(805)642-7633

2302.2 T. H. Gaines - Union Oil Company
Los Angeles

Office	(213)482-7600
Home	(213)838-4712

2302.3 Forrest M. Smith
Clean Bay Incorporated
Concord, California

24-Hour phone (415)685-2800

2400 — CSI PUBLIC RELATIONS

2400 CSI PUBLIC RELATIONS REPRESENTATIVE

2401 CSI Personnel

2401.1 In an oil spill emergency, the following CSI Personnel will be called to provide advice and counsel to Member Company Public Relations Personnel and to handle PR duties for Clean Seas Incorporated:

John Kemp	-	The John Kemp Company Office (805)687-3404 Home (805)964-3842
D. I. Bolding	-	Humble Oil & Refining Company Office (213)879-2700 Home (213)762-2811

2401.2 Public Relations functions are spelled out in Section 313, Page 300-6. As an aid to the personnel handling CSI Public Relations, a Policy is below.

2401.3 Public Relations Policy

1. In the event of an oil spill, the company or agency requesting CSI assistance will be the sole spokesman in any matter concerning the spill itself, its cause and extent, the operations preceding it, actual or potential damage and pollution, and the current or projected degree of success in containment and cleanup.
2. The company or agency requesting CSI assistance has responsibility for setting up press room facilities, if required, and establishing the channels of communication through which the news media, governmental agencies and others entitled to information are adequately informed.
3. Information released by or through CSI will exclusively concern CSI equipment, its function and deployment. For this purpose, CSI will have previously-prepared fact sheets, photographs and drawings. Information regarding the degree of effectiveness of the equipment in the subject oil spill will be released only by the company or agency requesting CSI assistance.
4. CSI public relations personnel will be of assistance to member companies and requesting companies and agencies in:
    a. Making advance plans for handling public relations during an oil spill in the CSI Area, and
    b. Providing on-the-spot advice and local know-how in an actual oil spill situation.

2500 — CSI LEGAL ADVISER

2500 LEGAL ADVISOR

2501 CSI Personnel

2501.1 In an oil spill emergency, one or more of the following CSI Personnel may be called on to provide help to the Member Company Legal Advisor. The CSI Legal Advisor will provide counsel and advice to the Executive Vice President concerning cleanup activities being conducted by Clean Seas Incorporated for the requesting company or Government Agency:

Edgar Twine - Atlantic Richfield Co.
Office (213)629-4111

Gordon Mayberry - Continental Oil Co.
Office (303)244-4311

M. B. Dougherty - Getty Oil Company
Office (213)381-7151

Robert Fuller - Gulf Oil Company
Office (213)879-0560

J. B. Taylor - Humble Oil & Refining Company
Office (213)879-2700

Robert E. Friedman - Mobil Oil Corporation
Office (213)626-5711

C. Rex Boyd - Phillips Petroleum Company
Office (805)963-3751

Joseph Loeb - Signal Oil and Gas Company
Office (213)482-0722

James Cox - Standard Oil Company
Office (213)691-2251

Edwin M. Cage - Sun Oil Company
Office (805)648-3251

B. J. Roose - Texaco, Inc.
Office (213)385-0515

Robert Humphreys - Union Oil Company
Office (213)482-7600

2501.2 Continuing duties of the CSI Legal Advisor include assisting the EVP on legal matters associated with routine corporation operations. It will be his primary function to outline procedural guidelines, staff and support requirements for "spill situations." This will include advance sessions with the legal representatives from all of the member companies to insure a consensus as to the necessary requirements.

2501.3 The position of On-Scene Legal Advisor will be filled by the member company and the primary functions shall be:

1. To be thoroughly familiar with all legal ramifications of a major oil spill, including the liabilities involved and the legal precedence that has been set in prior major oil spills.
2. To render legal advice to Top Management, Division Management, and the On-Scene Commander.
3. To provide qualified claims adjustors to investigate alleged claims of damage.
4. To advise the Division Manager when it appears desirable from a public relations standpoint to immediately negotiate to settle damage claims where settlement can be made in full.
5. When a Marine Surveyor is being used to supervise cleanup of yacht harbors and boats, the Legal Advisor should work closely with the Marine Surveyor in settling claims involving boats.

2501.4 The services that may be of help to the Legal Advisor(s) are listed on the following page(s).

2502 Member Company Special Agents

2502.1 Listed in Section 21, Page 21-1.

2503 Governmental Agencies

2503.1 Listed in Section 30, Pages 30-1 & 2 and 31-1.

2504 Contingency Plan Telephone List

2504.1 Listed in Section 20, Pages 20-1, 2 and 3.

2600 — CSI GOV'T LIAISON

2600 CSI GOVERNMENT LIAISON

2601 CSI Personnel

2601.1 In case of an oil spill emergency, one or more of the following CSI Personnel may be called on to coordinate all government liaison, working under the direction of the Division Manager and with the company concerned Liaison Man:

Peter Bacon - Atlantic Richfield Co.
Office (805)831-1600
Home (805)831-2866

G. R. Cunningham - Humble Oil & Refining Co.
Office (213)879-2700
Home (213)396-2210

W. T. Wilson - Standard Oil Company
Office (213)691-2251
Home (213)697-8455

J. E. Klipp - Sun Oil Company
Office (215)985-1600
Home (609)235-6042

C. R. Boyd - Phillips Petroleum Company
San Mateo

2601.2 Continuing duties of CSI Government Liaison include maintaining a current roster of designated governmental agency representatives assigned to positions outlined in the National Contingency Plan; awareness of revisions and modifications of pertinent rules and regulations; surveillance of governmental research and development programs; and the incorporation of pertinent legislation into the CSI Response Plan where applicable.

2601.3 In a "spill situation," the Government Liaison representative is responsible for liaison efforts with the governmental agency representatives and reports directly to the member company On-Scene Commander. This position is filled from the member company, with assistance and counsel by CSI personnel. The specific functions of the Government Liaison Coordinator will be:

1. To keep up-to-date on the activities, policies, and regulations of Federal, State, and other government bodies with respect to their position on major oil spills so that he will know how to work with the various agencies when a spill occurs. (In this regard, he should become personally acquainted with local representatives of these government bodies.)
2. To insure that all appropriate regulatory bodies have been advised of the spill.
3. To be stationed in the Command Post and contact all representatives of the Federal, State, County, and City Governments in order to be of assistance to them while they are carrying out their legally constituted responsibilities with regard to the spill.
4. To maintain liaison with representatives of the various governmental bodies and convey information, requests, and legally constituted directives to the OSC or to appropriate members of his staff.
5. To seek approval from appropriate governmental agencies for specific operations which are subject to regulations by law, such as the use of chemicals, burning of oil on the open sea, utilization of government equipment or materials, access to government-owned lands, etc.
6. To obtain clearance from the OSC of any release of information to various representatives of the different government agencies to insure that such information is consistent with what the Public Relations Coordinator releases to the news media.

2601.4 The Government Liaison Coordinator shall have authority to conduct government representatives on observation tours to the scene of the emergency, provided such visits can be made safely and without interference with the operations in progress.

2601.5 A list of services and agencies that may be of help to the Liaison Man may be found on the following page(s).

2602 Government Agencies Listed

2602.1 Listed in Section 30, Pages 30-1 & 2.

2603 Public Agencies

2603.1 Listed in Section 31, Page 31-1.

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