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WAVE DATA RECORDING PROGRAMME

GLADSTONE REGION

Beach Protection Authority of Queensland.

REPORT No. W 08.1

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Prepared by the Beach Protection Authority

March 1984

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All reasonable care and attention has been exercised in the collection, processing and compilation of the wave data included in this report. However, the accuracy and reliability of this information is not guaranteed in any way by the Beach Protection Authority and the Authority accepts no responsibility for the use of this information in any way whatsoever.

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ABSTRACT:–

This report provides summaries of primary analysis of raw wave data recorded in 20 metres of water offshore near Gladstone in Southern Queensland. Data was recorded using a Datawell "Waverider" buoy, and covers the period December 19, 1979 to May 16, 1983. The data is divided into seasonal groupings for analysis. No estimations of wave directional data have been provided.

OTHERS AVAILABLE IN THIS SERIES:–

Wave Data Recording Program, Cairns Region (Report No. W 01.1)
Wave Data Recording Program, Mackay Region (Report No. W 02.1)
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Wave Data Recording Program, Sunshine Coast Region (Report No. W 04.1)
Wave Data Recording Program, Burnett Heads Region (Report No. W 05.1)
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WAVE DATA RECORDING PROGRAM

GLADSTONE REGION

REPORT NO. W 08.1

1.0 INTRODUCTION

The Beach Protection Authority as part of its long term program of investigating erosion problems along Queensland's coastline has been recording wave characteristics through a network of wave recording stations since 1968.

This report summarizes the primary analysis of wave data collected in the Gladstone region. In addition brief details of the recording equipment, the method of handling raw data and the type of analysis employed are provided.

2.0 RECORDING EQUIPMENT

All wave recording installations operated by the Authority employ the "Waverider" system developed by Datawell b.v. of the Netherlands.

Each installation comprises a Waverider 6000 series buoy transmitting to a shore based WAREP Mark II receiver which in turn is coupled to an ANMA analogue recording unit.

This system utilises a buoy mounted accelerometer to follow the water surface movements and transmits a frequency modulated analogue representation of these water level movements to a shore based recorder. Both analogue magnetic tape and pen chart records are maintained at the shore based station.

3.0 WAVE RECORDNG AND ANALYSIS PROCEDURES

In general between December 19, 1979 and November 30, 1981 two recordings of water levels each of 20 minutes duration were made each day with the timing of the recordings set at 0300 hours and 1500 hours respectively.

During cyclonic events or other periods of severe wave action the recording frequency may be increased to 4 times daily. Twenty minute records are still maintained at such times.

From December 1, 1981 there have been 4 recordings per day each of 20 minutes duration at 0300 hours, 0900 hours, 1500 hours and 2100 hours.

The analogue magnetic tape recordings produced by the recording system were digitized for subsequent computer analysis to provide the following wave parameters:–

1.	Energy Density Spectrum	A representation of the distribution of wave energy over the component wave frequencies.
2.	Significant Wave Height (Hsig)	The average of the highest one third of waves in the record.
3.	Root Mean Square Wave Height (Hrms)	The root mean square of the wave heights from the record.

4.	Maximum Wave Height (Hmax)	The highest individual wave in the record.
5.	Peak Energy Period (Tp)	The wave period corresponding to the peak of the energy density spectrum.
6.	Significant Period (Tsig)	The average period of the highest one third of waves in the record.
7.	Zero Crossing Period (Tz)	The average period of all waves in the record based on upward zero crossings.
8.	Crest Period (Tc)	The average period of all the waves in the record based on successive crests.

Digitization was carried out at the Brisbane Office and the digital records held on 9 track digital tapes compatible with the computing facilities available to the Authority. In this process the analogue tapes produced in the field were sampled electronically at half second intervals and this information together with necessary administration information was transferred to the digital tape by a machine (digitizer) which was specifically developed for this purpose.

As the digitized tapes of wave records were produced, routine and spectral analysis of individual records were performed to obtain the previously defined parameters using computer programs developed by the Maritime Services Board of New South Wales. These parameters are the basis for the summary plots and tables attached to this report.

In preparing the summary plots and tables, computer programs developed by the Authority were used to further process the results obtained from the analysis of the individual wave records. As part of this process, durations were assigned to each 20 minute record equivalent to half the recording interval on either side of the record. Where the interval between successive records was longer than one day, the interval was not included in the analysis.

4.0 DATA LOSSES

Data losses can be divided into three categories – losses due to recording equipment failure, losses during routine processing and losses as a result of spurious data produced by twisted accelerometer cables within the Waverider buoy.

Losses in the first two categories are usually non-recoverable. Data produced when accelerometer cables are twisted, however, are generally recoverable. The twisting of the cables causes a low frequency component to be added to the analogue wave data at the recording stage. When analysis is carried out, the component is easily detected and may be eliminated during data editing following the completion of routine processing and spectral analysis of individual data.

Details of data losses in the Gladstone region are included in Summary Sheet 1, "Details of Wave Recorder Installation".

5.0 DATA PRESENTATION

No attempt has been made to interpret the recorded data for design purposes or to apply corrections for refraction, diffraction and shoaling to obtain equivalent deep water waves. Before any use is made of this data it is therefore necessary to note the exact location of the buoy and the water depth in which the buoy was moored. This data is shown on Summary Sheet 1, "Details of the Wave Recorder Installation".

The data herein presented does not include any information on wave directions. The "Waverider" recording system which is utilised by the Authority is designed to record vertical movements of the water surface only and any wave directions must be assigned to the individual wave records by other means.

Wherever major meteorological events such as cyclones have occurred during the recording period, these were noted and are summarized together with the maximum wave height recorded and any other relevant comments in Summary Sheet 2, "Major Meteorological Events".

In addition to the above Summary Sheets the following tables and figures are presented to complete this report.

Table 1: Wave Statistics; Wave Period/Wave Height Occurrences, All Data, All Directions.

Table 2: Wave Statistics; Wave Period/Wave Height Occurrences, Summer Data, All Directions.

Table 3: Wave Statistics; Wave Period/Wave Height Occurrences, Winter Data, All Directions.

Figure 1: Locality Map.

Figure 2: Percentage (of time) Exceedance of Wave Heights (Hsig) for All Wave Periods.

Figure 3: Histogram Percentage (of time) Occurrences of Wave Heights (Hsig) for All Wave Periods.

Figure 4: Histogram Percentage (of time) Occurrences of Wave Periods (Tp) for All Wave Heights.

Figure 5: Wave Parameter Relationships.

Figure 6: Average Duration of Exceedance of Wave Heights (Hsig).

Figure 7: Daily Wave Heights (Hsig).

Figure 8: Daily Wave Periods (Tp).

The above tables refer to data recorded in Summer and Winter. For the purposes of analysis, Summer has been taken as the period from November 1 to April 30 in the following year. Winter covers the period May 1 to October 31 in any one year.

SUMMARY SHEET 1

DETAILS OF WAVE RECORDER INSTALLATION

Region:– Gladstone Region

Buoy Location.–

Co-ordinates:– 151°34' East 23°55' South
Description:– 32 kms E.S.E. of Gladstone (See Figure 1)

Water Depth at Buoy:– 20 metres relative to Australian Height Datum

Location of Recording Station:– Gladstone Harbour Board Building, Yaroon Street, Gladstone

Period of Data Collection:– December 19, 1979 to May 16, 1983

Normal Recording Interval:– Two twenty minute records daily at 0300 hours and 1500 hours between December 19, 1979 and November 30, 1981
Four twenty minute records daily at 0300 hours, 0900 hours, 1500 hours and 2100 hours between December 1, 1981 and May 16, 1983

Total No. of Records Analysed:– 3 041

Number of Records Lost Due to:–

Field Equipment Failure	134
Losses during Analysis	214
Damaged Accelerometer Cables	59

Periods during which four recordings per day were taken:–

February 23 – 26, 1980
February 27 to March 1, 1981
December 1, 1981 to May 16, 1983

Assessment of Data Quality:– Good.

SUMMARY SHEET 2

MAJOR METEOROLOGICAL EVENTS

GLADSTONE REGION

Meteorological Event	*Central Pressure (mb)	Date	*Estimated Position of Cyclone Relative to Buoy (km)	Maximum Hsig Recorded (metres)	Maximum Hmax Recorded (metres)	Tp (secs)
Cyclone Paul	993	7.1.80	130 N	1.61	3.10	6.20
Cyclone Ruth	980	13.2.80	750 ENE	2.02	–	7.79
Cyclone Simon	963	26.2.80	100 NE	2.55	4.30	8.63
High over Tasman Sea	1024	9.12.80		1.70	3.21	6.22
Cyclone Freda	974	28.2.81	330 NE	2.00	3.58	9.67
Complex lows over Qld	1008	21.5.81		2.82	4.31	8.42
Complex low over Qld/NSW border	1024	20.10.81		1.88	3.46	5.66
High over Tasman Sea	1024	6.2.82		1.93	3.96	6.43
High near New Zealand and low in Coral Sea	1028 & 1008	15.3.82		2.21	3.40	6.66
Cyclone Bernie	950	6.4.82	660 ENE	1.90	4.46	7.80
High over Tasman Sea	1028	18.5.82		1.70	2.91	6.45
Low off Fraser Island		12.3.83		2.14	3.94	8.31
Low over Southern Qld	1000	20.3.83		1.77	3.01	6.16
High over Tasman Sea	1028	13.5.83		1.73	2.70	6.19

Highest Significant Wave Height (Hsig) recorded was 2.82 m on May 21, 1981 due to Low pressure systems over Queensland.

Highest Maximum Wave Height (Hmax) recorded was 4.31 m on May 21, 1981 due to Low pressure systems over Queensland.

Meteorological information obtained from the "Monthly Weather Review" published by Bureau of Meteorology.

*Central pressure and position of cyclone at time of maximum wave conditions.

TABLE 1

WAVE STATISTICS
WAVE PERIOD/WAVE HEIGHT OCCURRENCES
ALL DATA, ALL DIRECTIONS

Significant Wave Height (metres)	Peak Energy Wave Period (Seconds)								Totals
	0 – 2.99	3 – 4.99	5 – 6.99	7 – 8.99	9 – 10.99	11 – 12.99	13 – 14.99	>14.99	
0.00 – 0.20	.50	0	.50	.50	2.50	.50	0	0	4.50
0.20 – 0.40	19.50	14.75	29.63	35.75	35.00	14.13	0.50	0	149.25
0.40 – 0.60	23.13	90.75	77.13	66.75	27.50	8.00	0.50	0	293.75
0.60 – 0.80	.25	96.00	92.75	58.50	20.13	4.13	0	0	271.75
0.80 – 1.00	0	49.75	107.63	34.50	7.63	2.25	0	0	201.75
1.00 – 1.20	0	12.50	89.13	30.88	5.88	1.75	0	0	140.13
1.20 – 1.40	0	2.25	42.88	19.38	4.38	2.50	0	0	71.38
1.40 – 1.60	0	0	13.25	13.75	1.50	.25	0	0	28.75
1.60 – 1.80	0	0	9.00	4.50	.50	0	0	0	14.00
1.80 – 2.00	0	0	1.50	3.88	1.88	.50	0	0	7.75
2.00 – 2.20	0	0	.25	1.46	0	0	0	0	1.71
2.20 – 2.40	0	0	.25	0	0	0	0	0	.25
2.40 – 2.60	0	0	0	.92	0	0	0	0	.92
2.60 – 2.80	0	0	0	0	0	0	0	0	.00
2.80 – 3.00	0	0	0	1.00	0	0	0	0	1.00
TOTALS	43.38	266.00	463.88	271.75	106.88	34.00	1.00	.00	1186.87

Values in the above table are durations in days and have been rounded to the second decimal place.

TABLE 2

WAVE STATISTICS
WAVE PERIOD/WAVE HEIGHT OCCURRENCES
SUMMER DATA, ALL DIRECTIONS

Significant Wave Height (metres)	Peak Energy Wave Period (Seconds)								Totals
	0 – 2.99	3 – 4.99	5 – 6.99	7 – 8.99	9 – 10.99	11 – 12.99	13 – 14.99	>14.99	
0.00 – 0.20	0	0	0	0	0	0	0	0	0.00
0.20 – 0.40	2.00	3.50	6.25	8.50	8.50	2.25	0	0	31.00
0.40 – 0.60	5.50	44.88	42.13	30.38	15.50	1.25	0	0	139.63
0.60 – 0.80	.25	55.25	55.63	32.00	14.25	2.38	0	0	159.75
0.80 – 1.00	0	36.25	66.50	19.63	5.13	1.75	0	0	129.25
1.00 – 1.20	0	11.00	56.63	16.38	2.63	1.25	0	0	87.88
1.20 – 1.40	0	1.00	31.63	10.25	4.38	2.00	0	0	49.25
1.40 – 1.60	0	0	9.88	8.13	1.50	.25	0	0	19.75
1.60 – 1.80	0	0	6.75	2.88	.50	0	0	0	10.13
1.80 – 2.00	0	0	.75	1.88	1.13	.50	0	0	4.25
2.00 – 2.20	0	0	.25	1.46	0	0	0	0	1.71
2.20 – 2.40	0	0	.25	0	0	0	0	0	.25
2.40 – 2.60	0	0	0	.92	0	0	0	0	.92
TOTALS	7.75	151.88	276.63	132.37	53.50	11.63	.00	.00	633.75

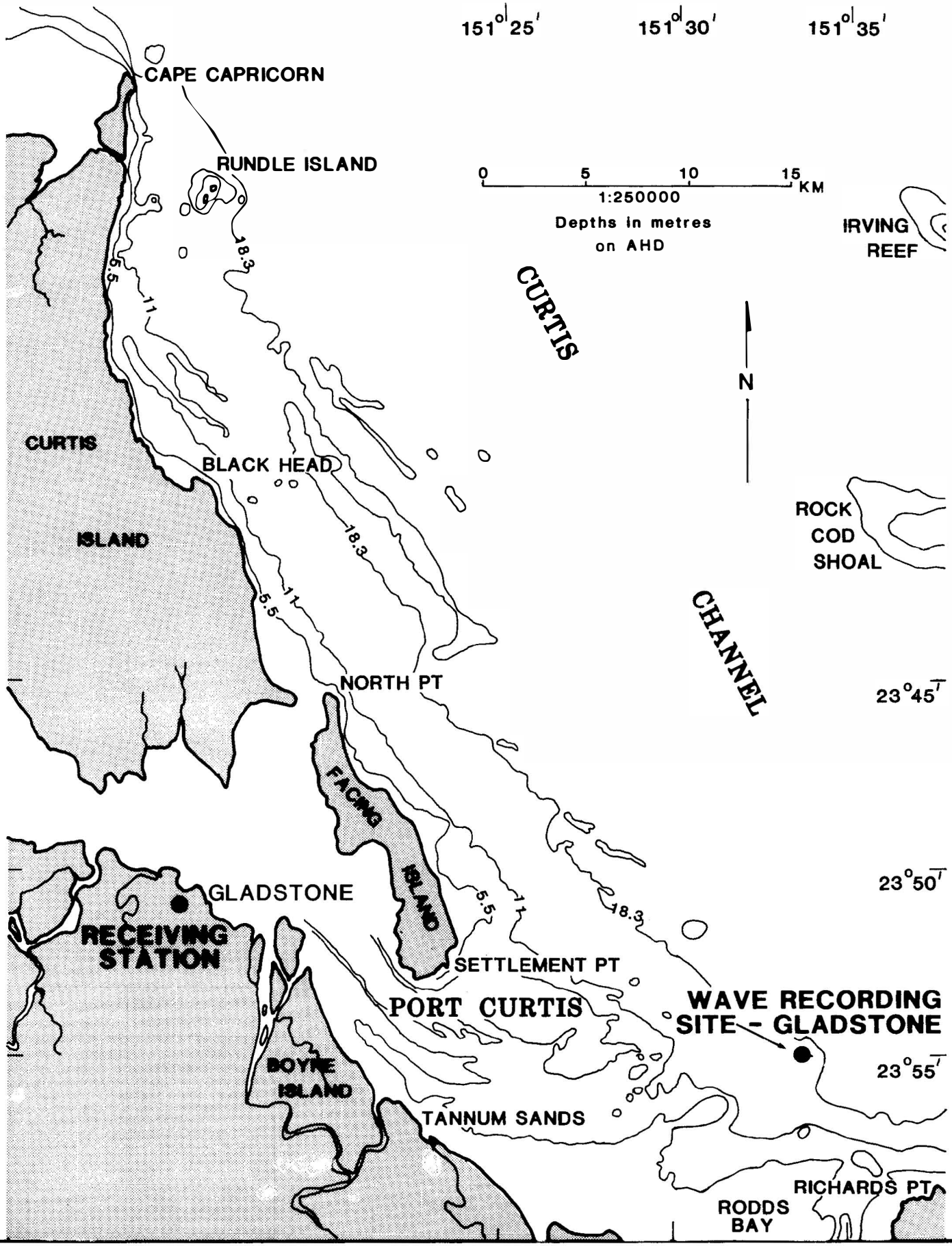
Values in the above table are durations in days and have been rounded to the second decimal place.

TABLE 3

WAVE STATISTICS
WAVE PERIOD/WAVE HEIGHT OCCURRENCES
WINTER DATA, ALL DIRECTIONS

Significant Wave Height (metres)	Peak Energy Wave Period (Seconds)							>14.99	Totals
	0 – 2.99	3 – 4.99	5 – 6.99	7 – 8.99	9 – 10.99	11 – 12.99	13 – 14.99		
0.00 – 0.20	.50	0	.50	.50	2.50	.50	0	0	4.50
0.20 – 0.40	17.50	11.25	23.38	27.25	26.50	11.88	.50	0	118.25
0.40 – 0.60	17.63	45.88	35.00	36.38	12.00	6.75	.50	0	154.13
0.60 – 0.80	0	40.75	37.13	26.50	5.88	1.75	0	0	112.00
0.80 – 1.00	0	13.50	41.13	14.88	2.50	.50	0	0	72.50
1.00 – 1.20	0	1.50	32.50	14.50	3.25	.50	0	0	52.25
1.20 – 1.40	0	1.25	11.25	9.13	0	.50	0	0	22.13
1.40 – 1.60	0	0	3.38	5.63	0	0	0	0	9.00
1.60 – 1.80	0	0	2.25	1.63	0	0	0	0	3.88
1.80 – 2.00	0	0	.75	2.00	.75	0	0	0	3.50
2.00 – 2.20	0	0	0	0	0	0	0	0	0.00
2.20 – 2.40	0	0	0	0	0	0	0	0	0.00
2.40 – 2.60	0	0	0	0	0	0	0	0	0.00
2.60 – 2.80	0	0	0	0	0	0	0	0	0.00
2.80 – 3.00	0	0	0	1.00	0	0	0	0	1.00
TOTALS	35.63	114.13	187.25	139.38	53.38	22.38	1.00	0.00	553.13

Values in the above table are durations in days and have been rounded to the second decimal place.



Wave Data Recording Program

Gladstone Region

LOCALITY MAP

Figure 1
W 08.1

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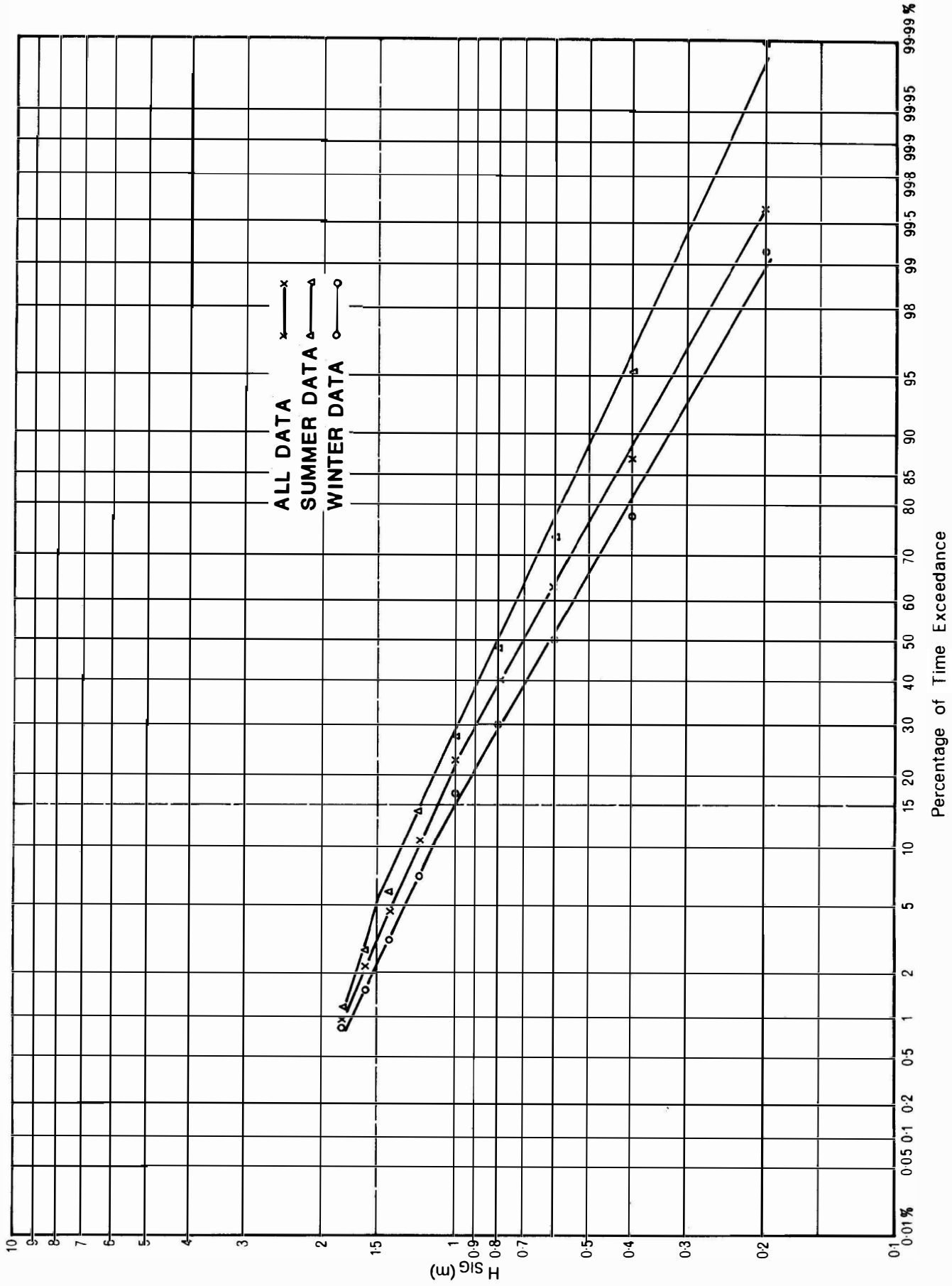

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PERCENTAGE (OF TIME) EXCEEDANCE OF WAVE HEIGHTS (H_{sig}) FOR ALL WAVE PERIODS

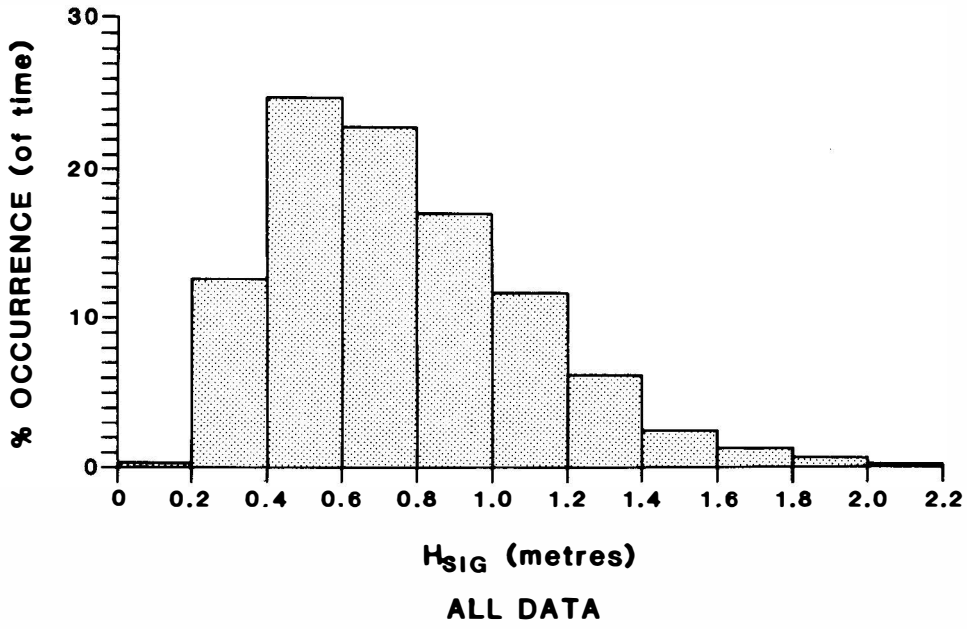
19th December 1979 to 16th May 1983

Wave Data Recording Program

Gladstone Region

Figure 2

W 08.1



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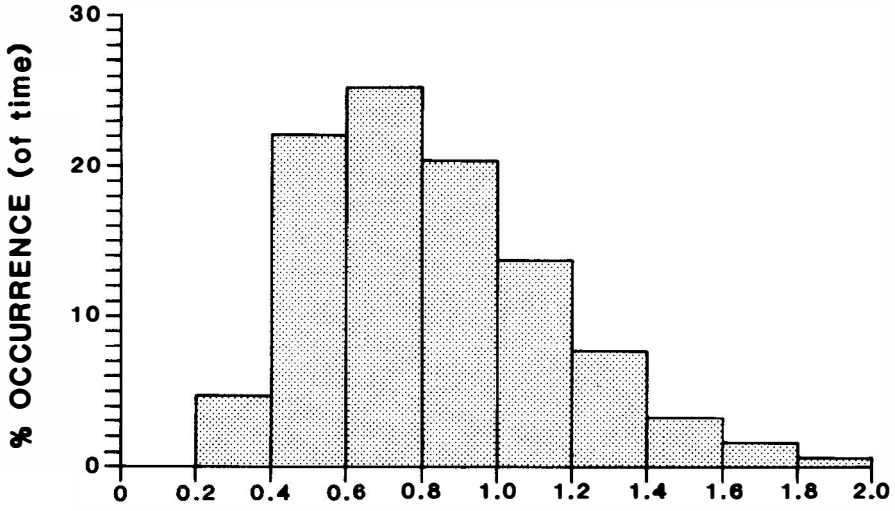

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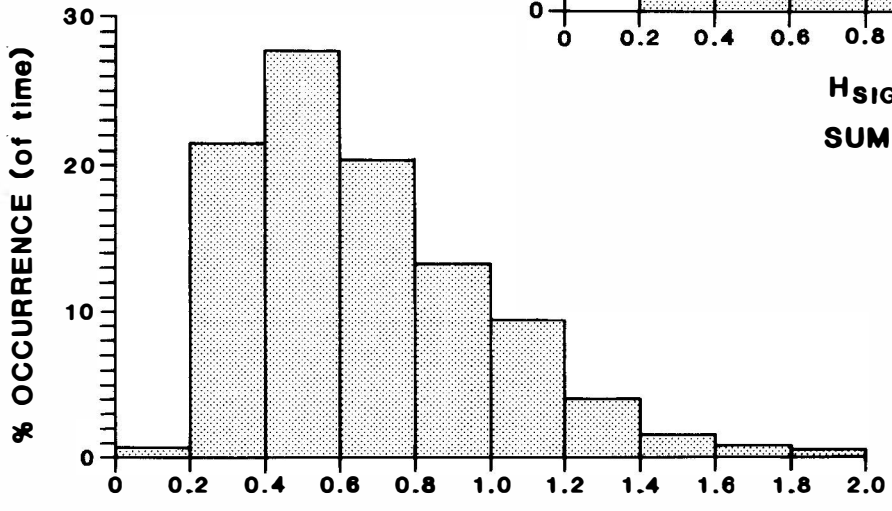

WINTER DATA

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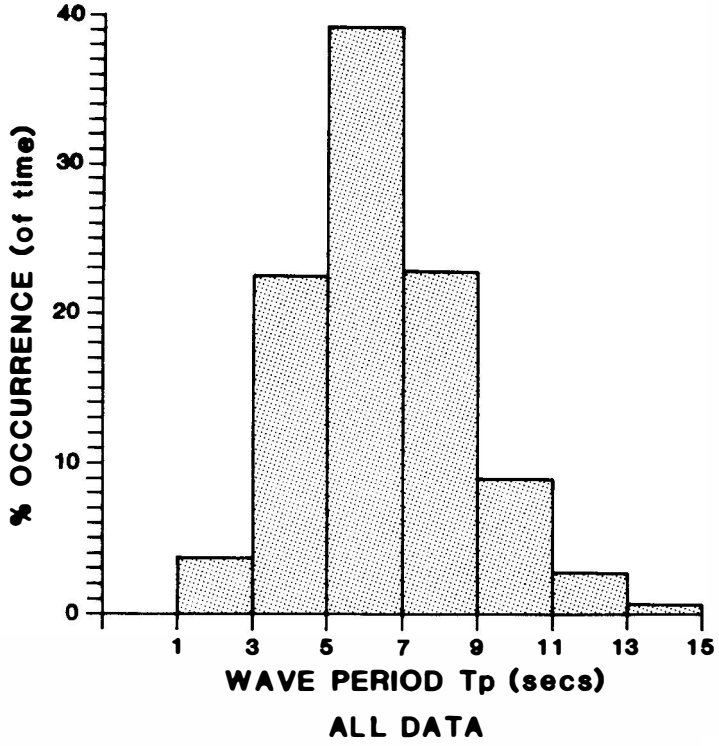
HISTOGRAM PERCENTAGE (OF TIME) OCCURRENCE OF WAVE HEIGHTS (H_{sig}) FOR ALL WAVE PERIODS

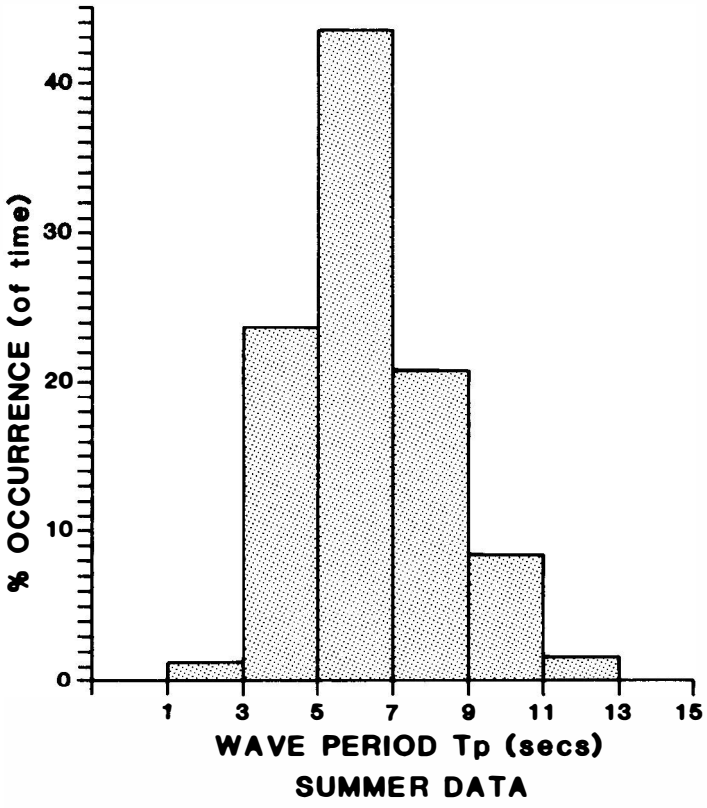
19th December 1979 to 16th May 1983

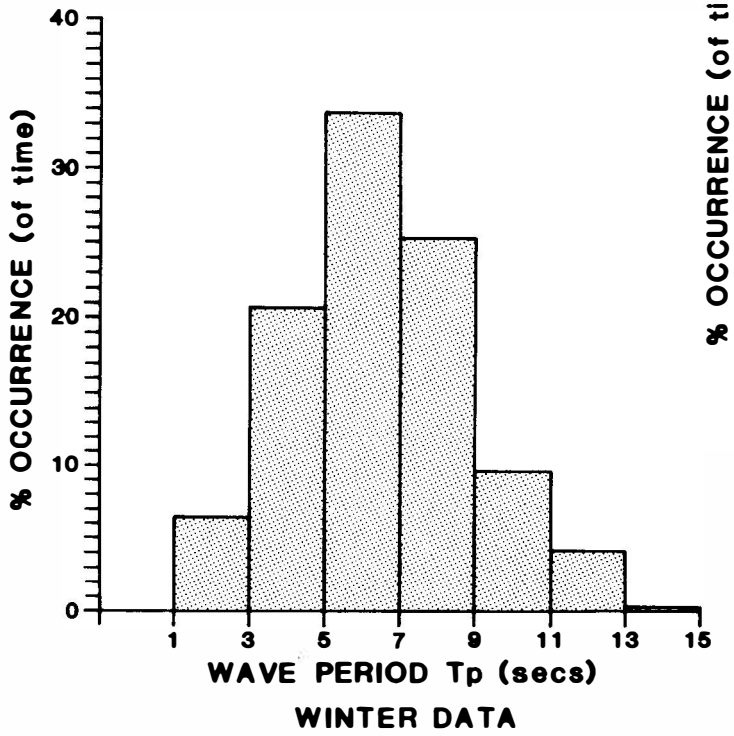
Wave Data Recording Program

Gladstone Region

Figure 3
W 08.1







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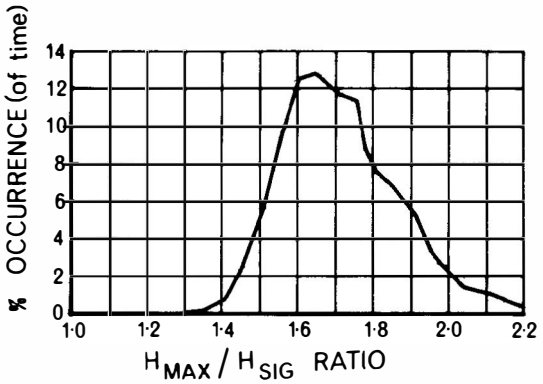
Wave Data Recording Program

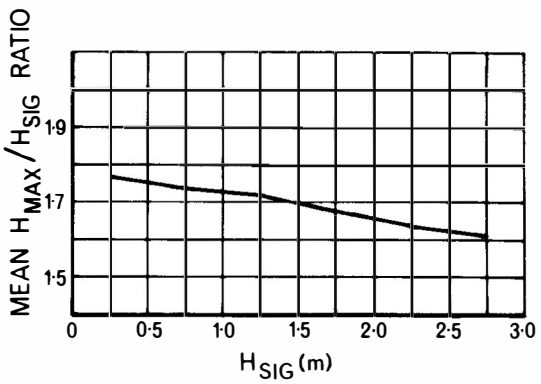
Gladstone Region

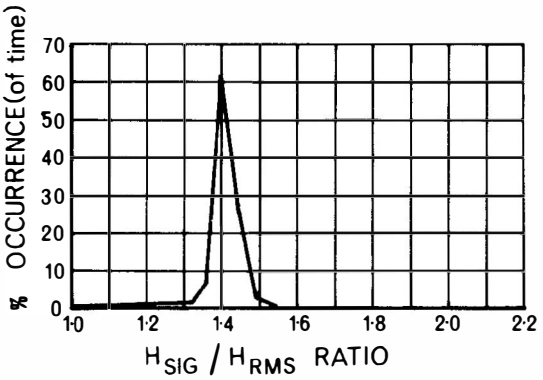
HISTOGRAM PERCENTAGE (OF TIME) OCCURRENCE OF WAVE PERIODS (Tp) FOR ALL WAVE HEIGHTS

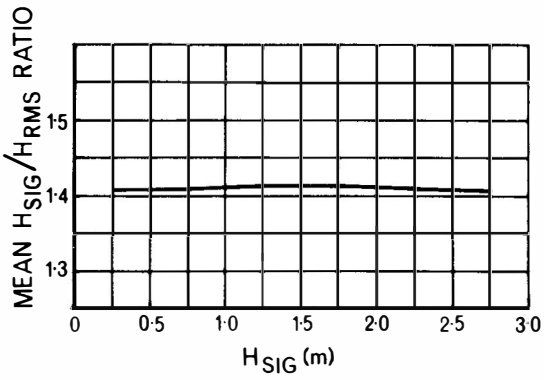
19th December 1979 to 16th May 1983

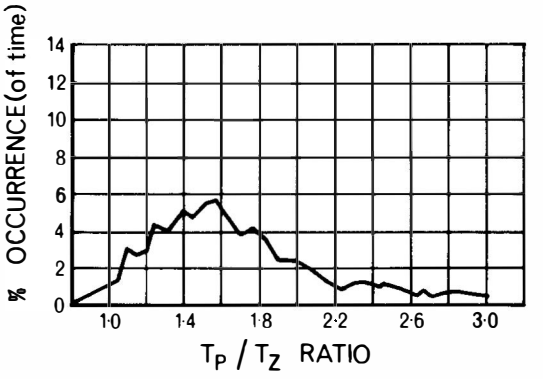
Figure 4
W 08.1

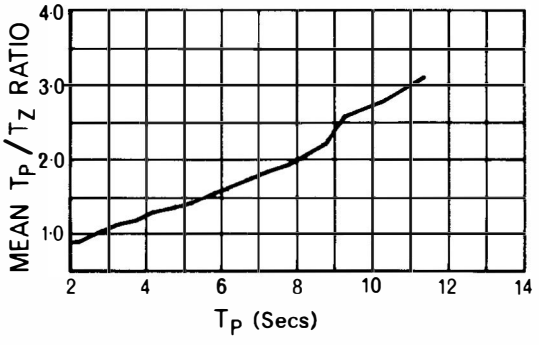


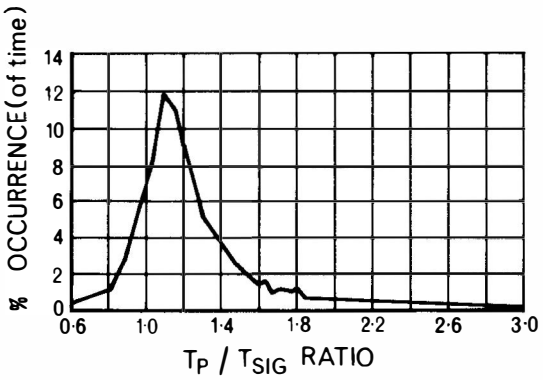


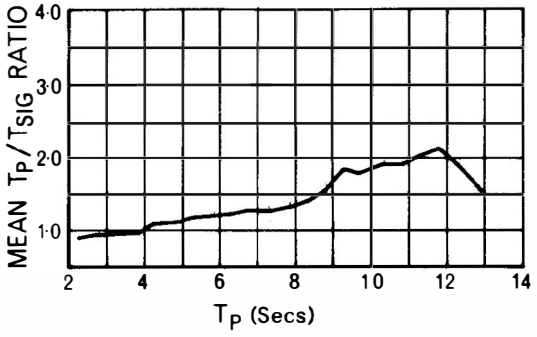












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WAVE PARAMETER RELATIONSHIPS

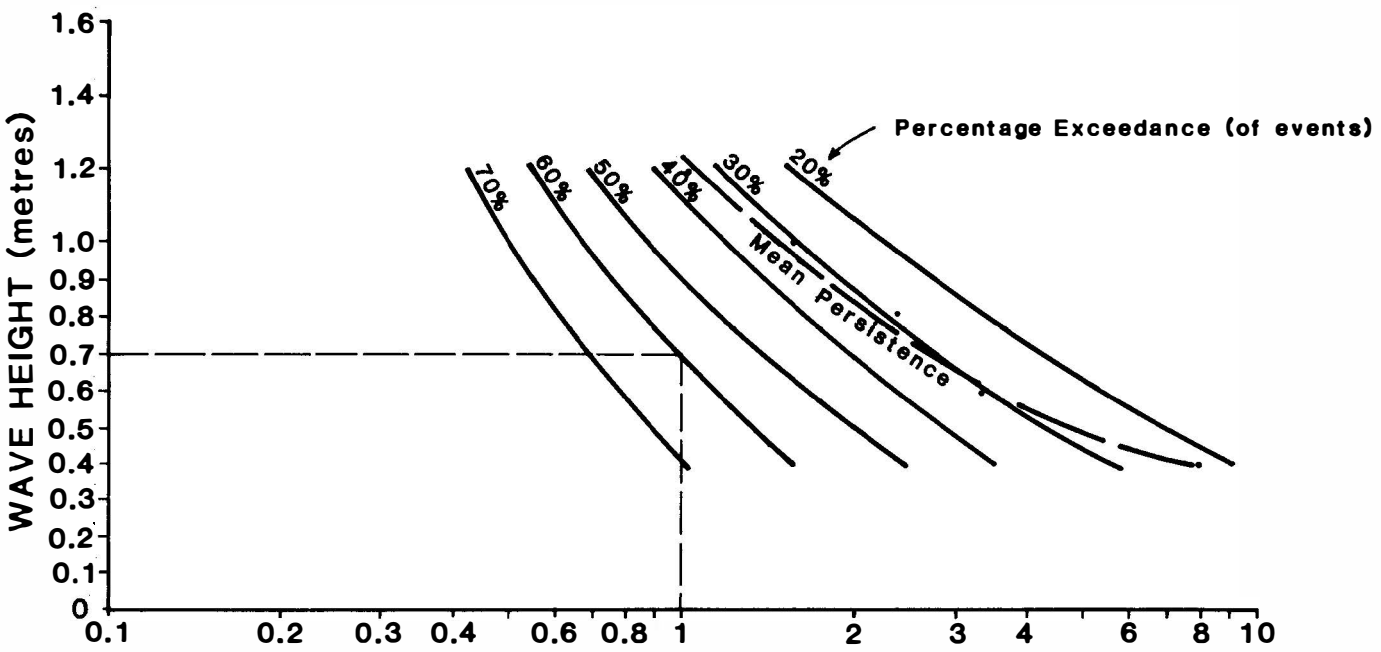
Wave Data Recording Program

Gladstone Region

Figure 5

W 08. 1

19th December 1979 to 16th May 1983



Note:-

1. Wave height persistence is the duration for which a given significant wave height is continuously exceeded. As an example, given a **0.7** metre significant wave height, there is a **60%** probability that this wave height or greater will persist for more than one day.
2. The mean persistence line plotted represents the average persistence of all events having a given significant wave height or greater.

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AVERAGE DURATION OF EXCEEDANCE OF WAVE HEIGHTS (H_{sig})

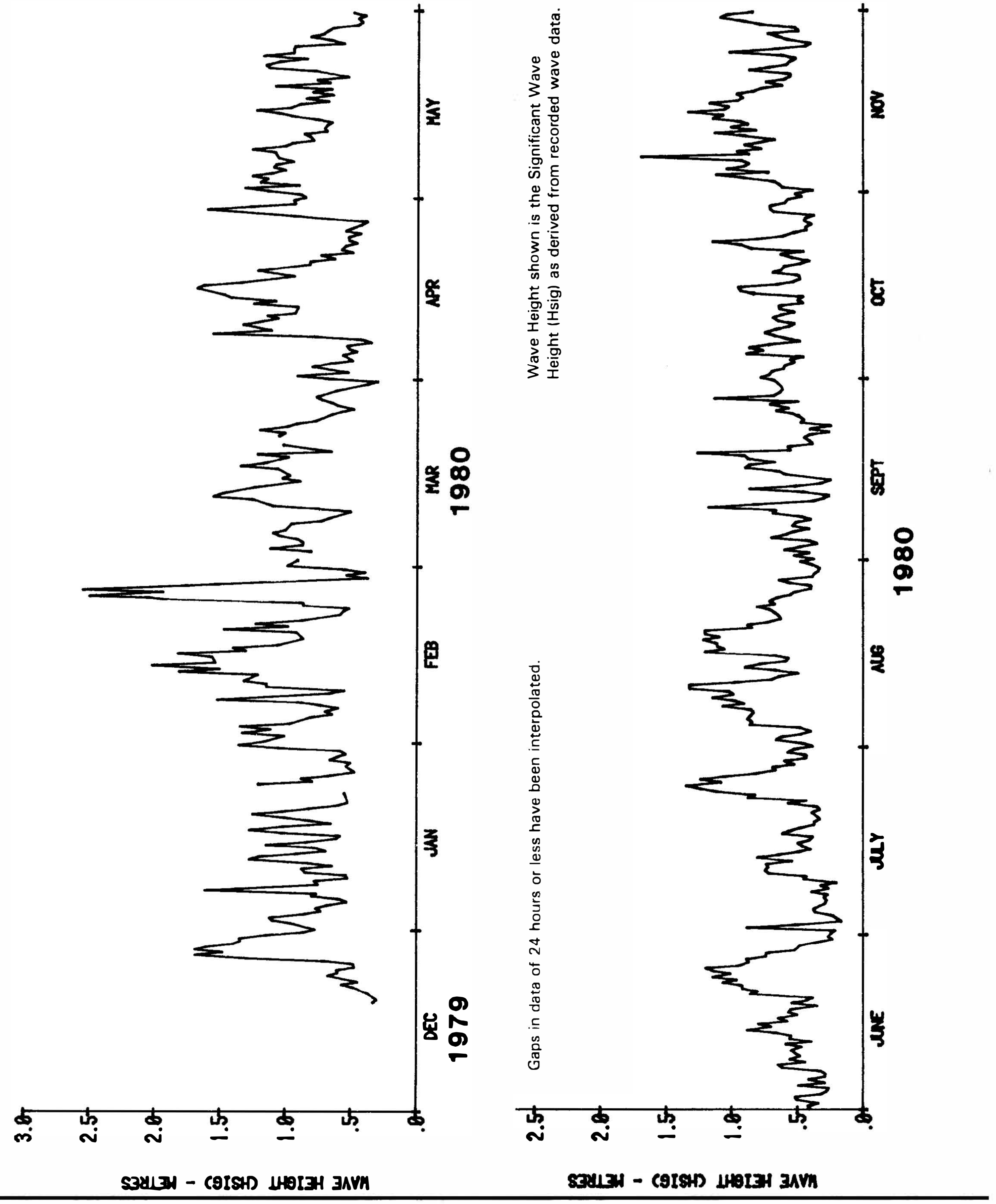
19th December 1979 to 16th May 1983

Wave Data Recording Program

Gladstone Region

Figure 6

W 08. 1



Wave Data Recording Program

Gladstone Region

DAILY WAVE HEIGHTS (H_{sig})

Figure 7

W 08. 1

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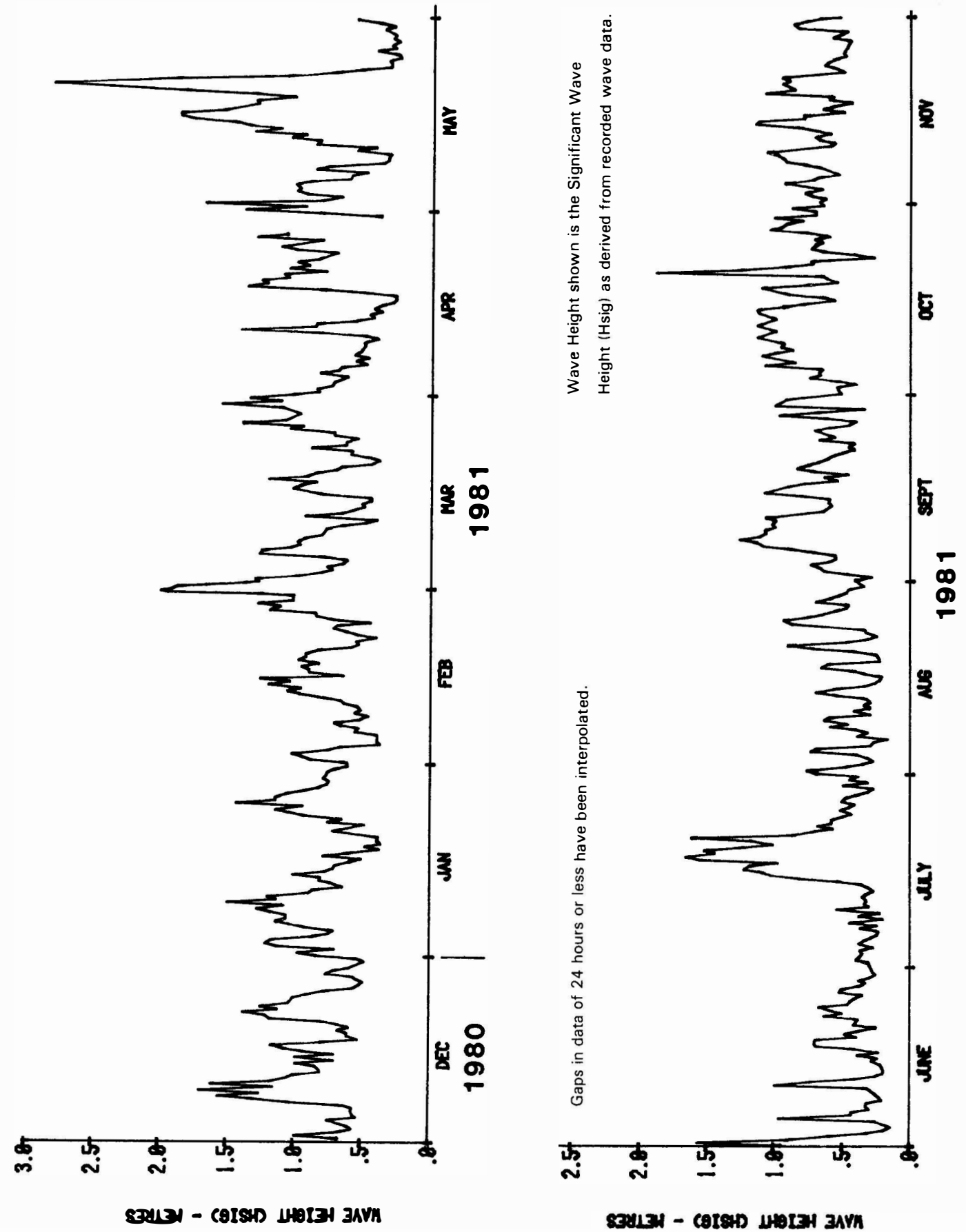
19th December 1979 to 16th May 1983

Sheet 1 of 4



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DAILY WAVE HEIGHTS (H_{sig})

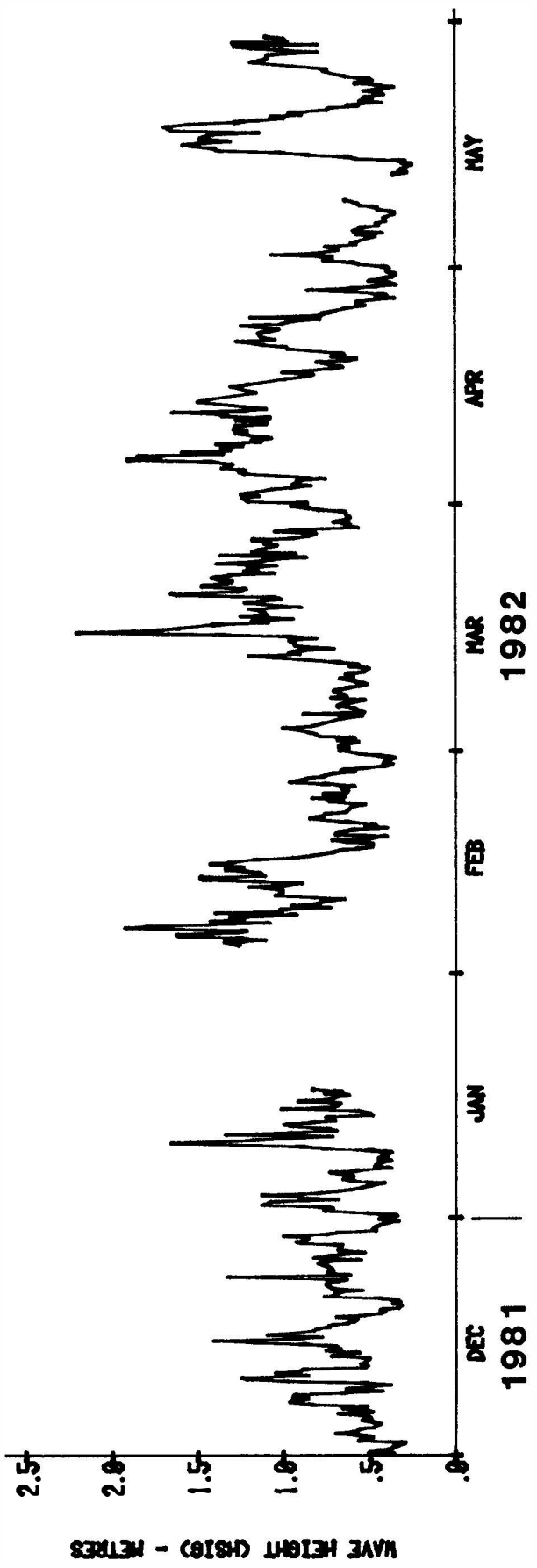
19th December 1979 to 16th May 1983

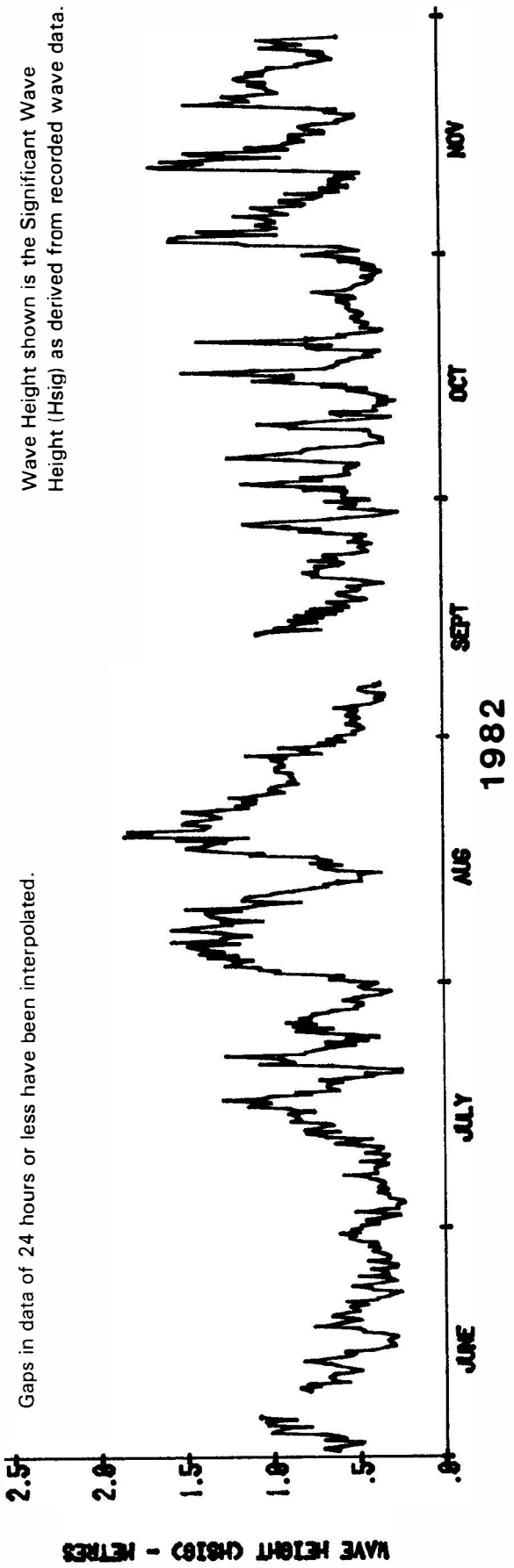
Wave Data Recording Program

Gladstone Region

Figure 7
W 08. 1

Sheet 2 of 4





Wave Height shown is the Significant Wave Height (Hsig) as derived from recorded wave data.

Gaps in data of 24 hours or less have been interpolated.

Beach Protection Authority

DAILY WAVE HEIGHTS (H_{sig})

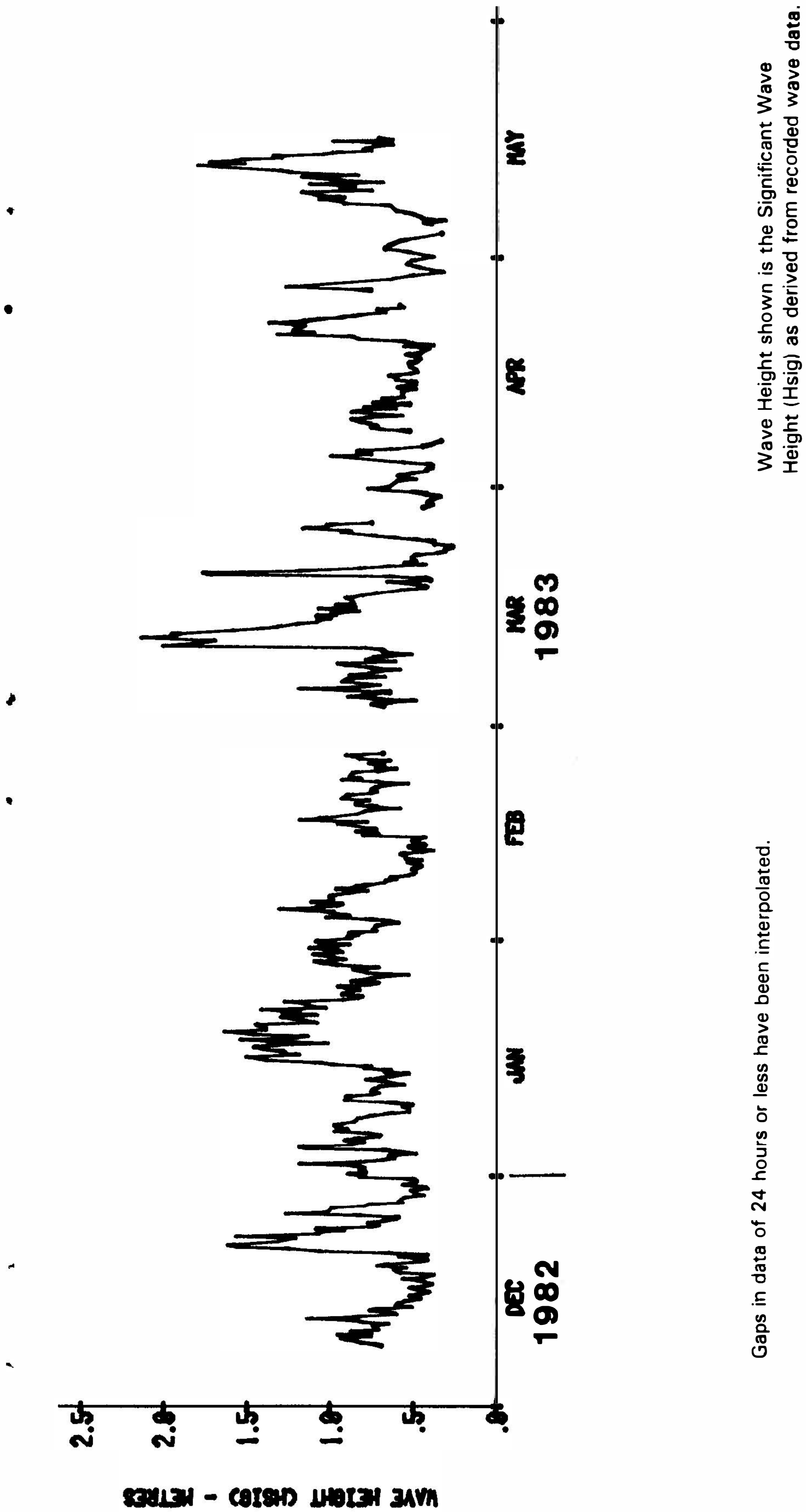
19th December 1979 to 16th May 1983

Wave Data Recording Program

Gladstone Region

Figure 7
W 08. 1

Sheet 3 of 4



Wave Data Recording Program

Gladstone Region

DAILY WAVE HEIGHTS (H_{sig})

Figure 7

W 08. 1

Beach Protection Authority

19th December 1979 to 16th May 1983

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Beach Protection Authority

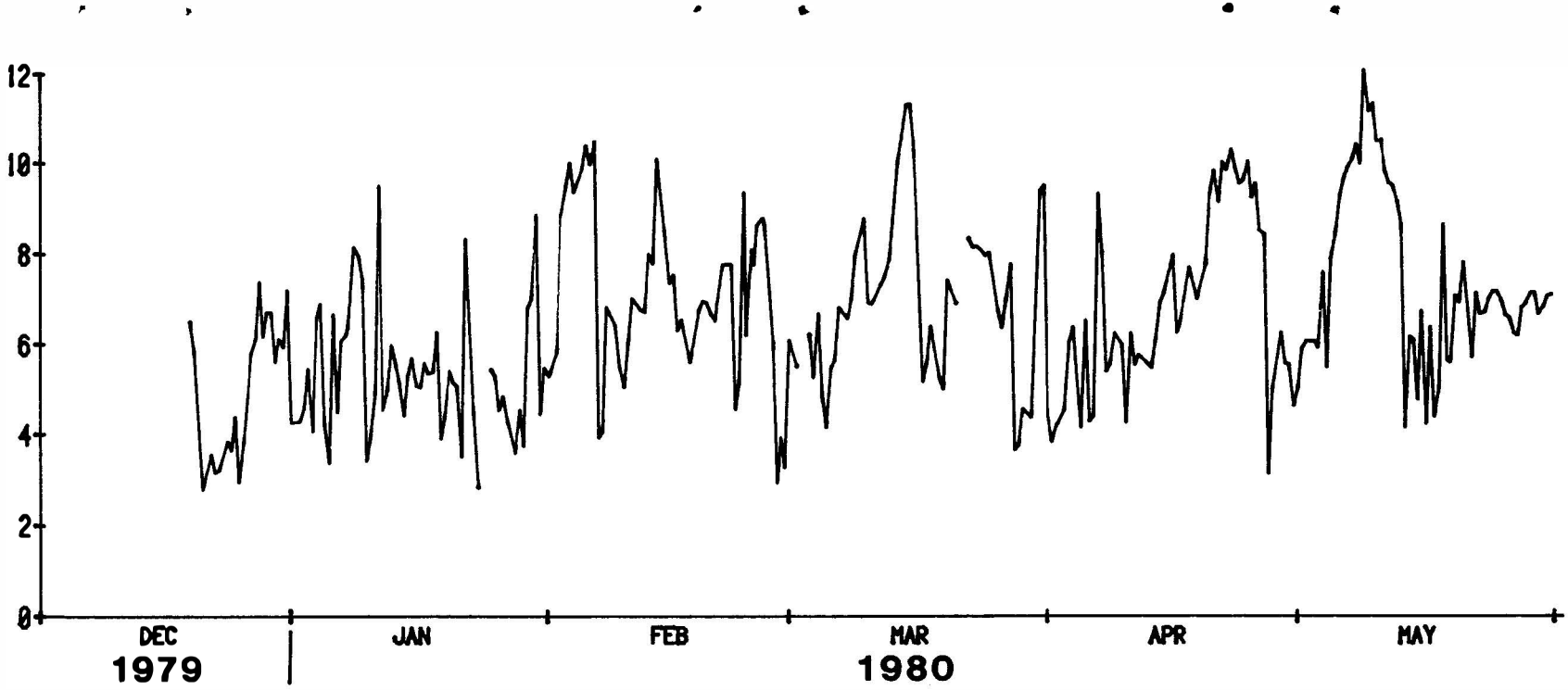
DAILY WAVE PERIODS

19th December 1979 to 16th May 1983

Wave Data Recording Program

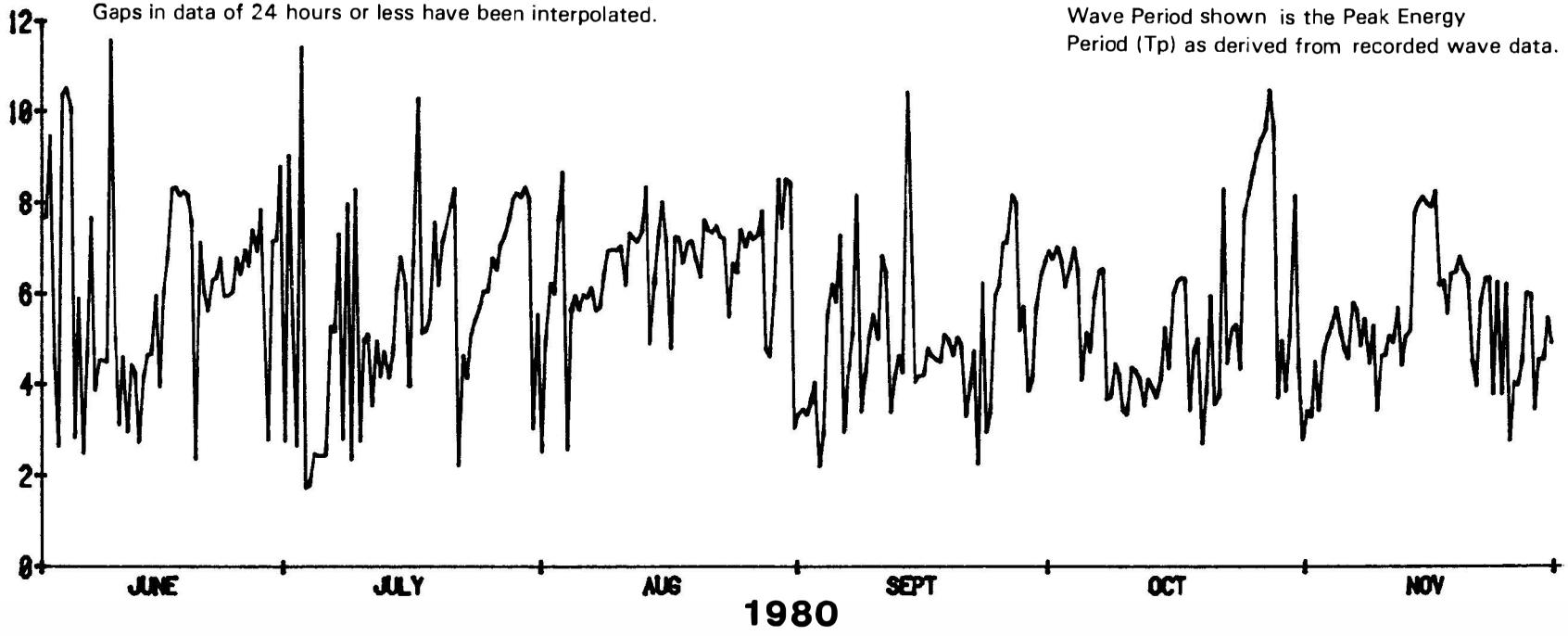
Gladstone Region

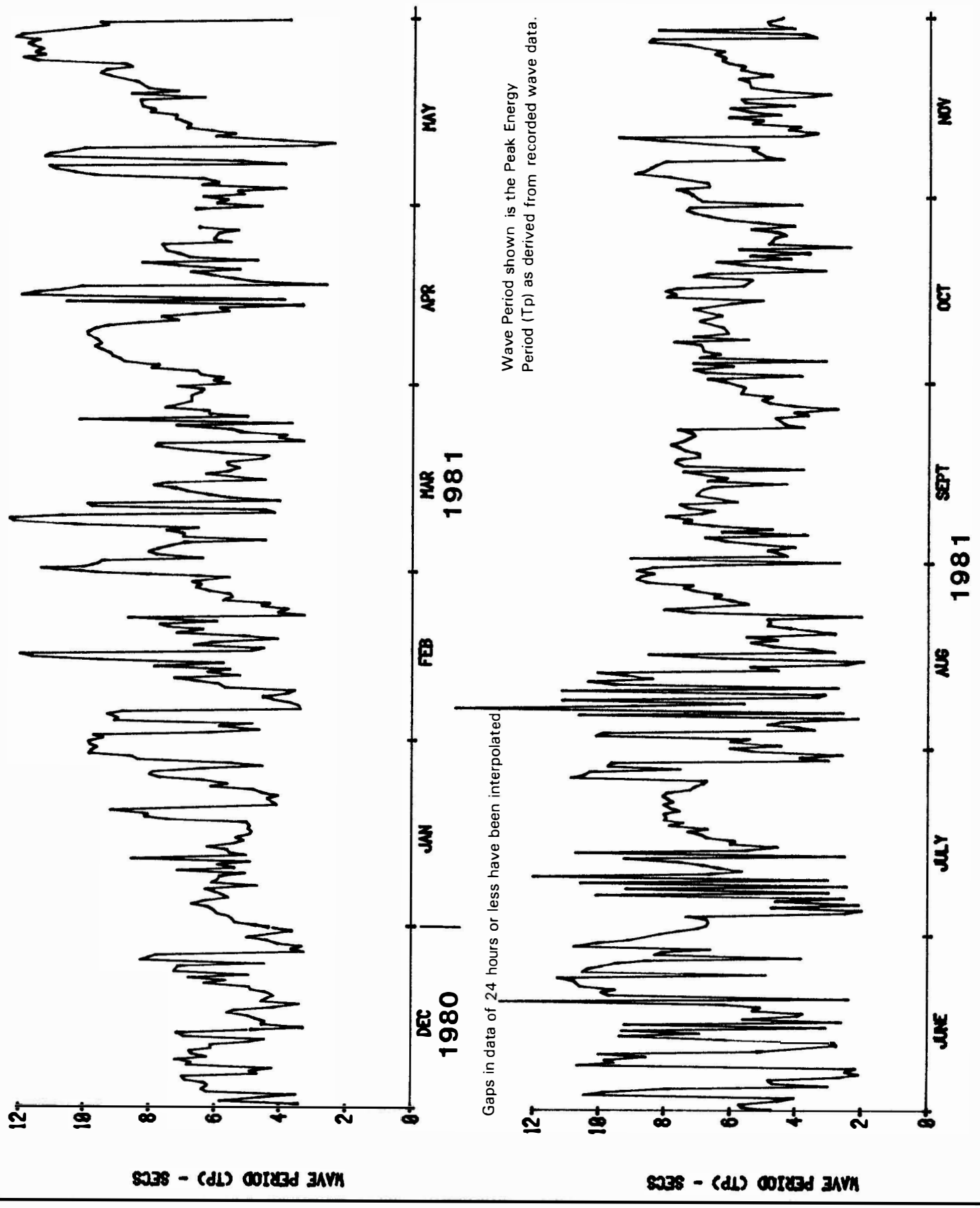
Figure 8
W 08. 1
Sheet 1 of 4



Gaps in data of 24 hours or less have been interpolated.

Wave Period shown is the Peak Energy Period (Tp) as derived from recorded wave data.





Beach Protection Authority

DAILY WAVE PERIODS

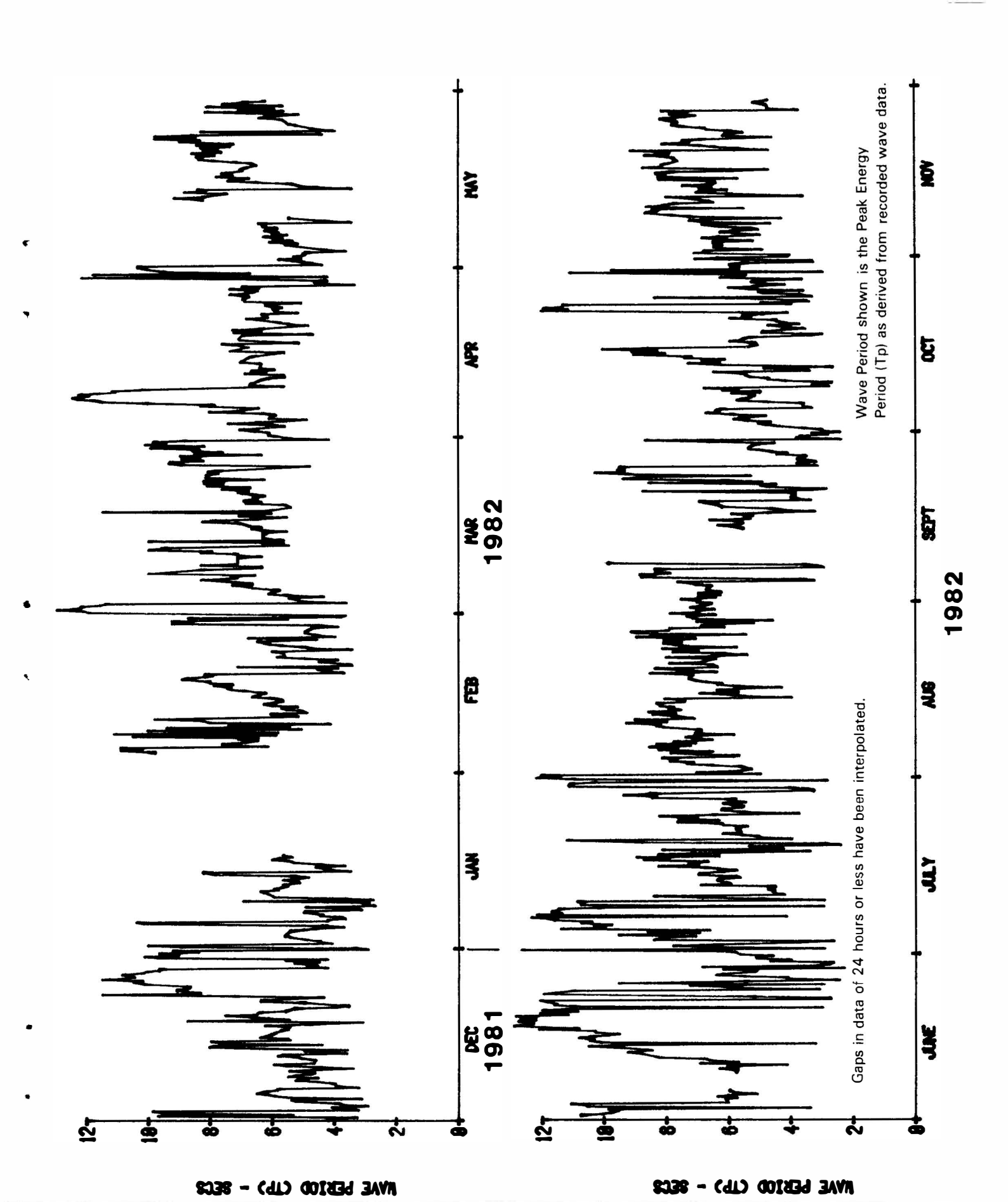
19th December 1979 to 16th May 1983

Wave Data Recording Program

Gladstone Region

Figure 8
W 08. 1

Sheet 2 of 4



Beach Protection Authority

DAILY WAVE PERIODS

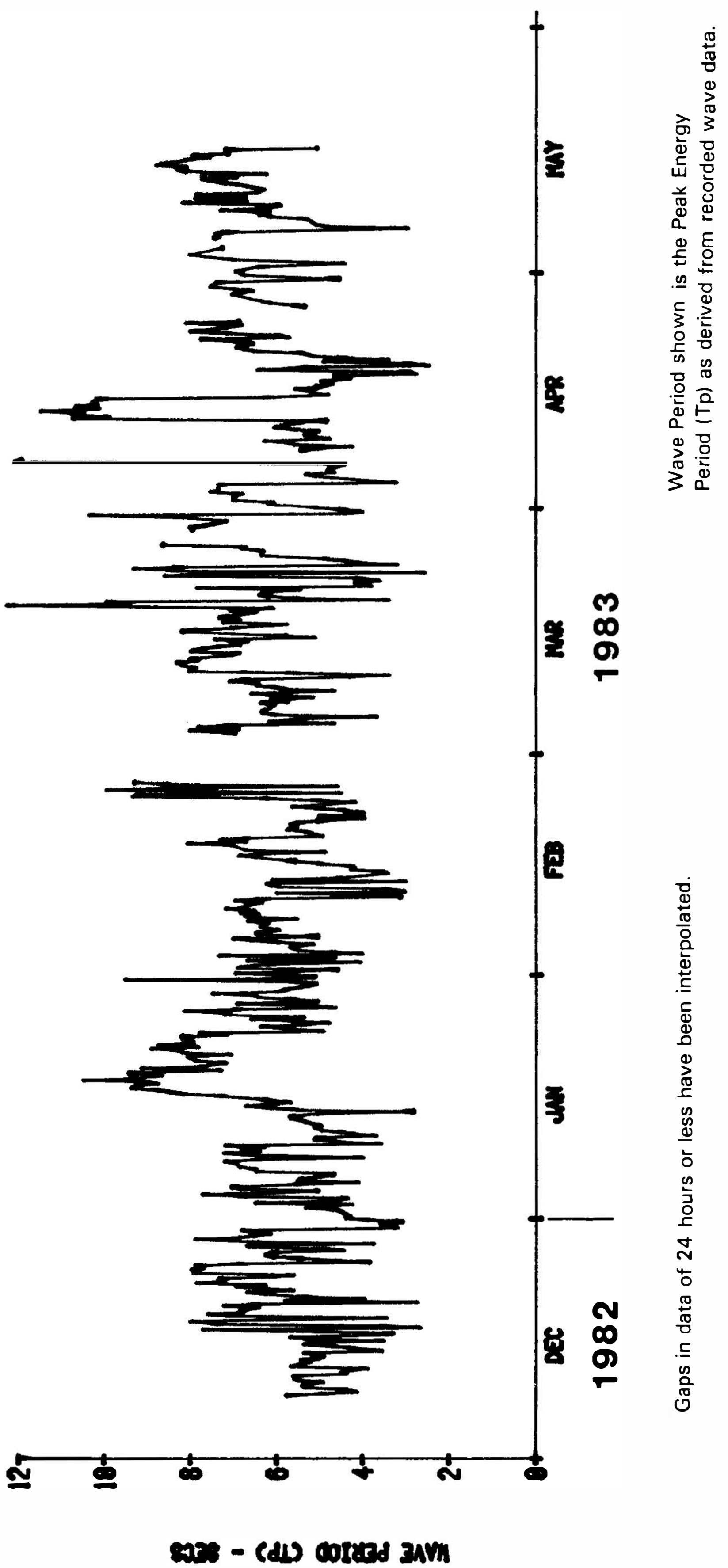
19th December 1979 to 16th May 1983

Wave Data Recording Program

Gladstone Region

Figure 8
W 08. 1

Sheet 3 of 4



Wave Data Recording Program

Gladstone Region

DAILY WAVE PERIODS

Figure 8

W 08. 1

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19th December 1979 to 16th May 1983

Beach Protection Authority

Beach Protection Authority of Queensland