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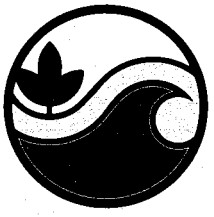

Beach Protection Authority Queensland

WAVE DATA RECORDING PROGRAMME

MORETON ISLAND REGION (NORTH EAST SHIPPING CHANNEL)

HARBOURS MARINE

Caring for our coast

WAVE DATA RECORDING PROGRAMME

MORETON ISLAND REGION (NORTH EAST SHIPPING CHANNEL)

REPORT NO. W11.1

Beach Protection Authority

November 1988

This report has been prepared by the Beach Protection Branch of the Harbours and Marine Department on behalf of the Beach Protection Authority.

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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- Moreton Island Region (North East Shipping Channel)

DATE:- November 1988

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ABSTRACT:-

This report provides summaries of primary analysis of wave data recorded in 13 metres of water offshore near Moreton Island in Southern Queensland. Data was recorded using a Datawell 'Waverider' buoy, and covers the period June 15, 1983 to April 12, 1985. The data was divided into seasonal groupings for analysis and no estimations of wave directional data have been provided.

The installation of the Moreton Island 'Waverider' buoy and recording station was at the request of the Port of Brisbane Authority and was funded by that Authority. The analysed data was used in the Port of Brisbane Authority's North East Shipping Channel Feasibility Study. Data is published with the permission of the Port of Brisbane Authority.

OTHERS AVAILABLE IN THIS SERIES:-

Wave Data Recording Programme, Cairns Region (Report No. W01.1)
Wave Data Recording Programme, Cairns Region (Report No. W01.2)
Wave Data Recording Programme, Mackay Region (Report No. W02.1)
Wave Data Recording Programme, Mackay Region (Report No. W02.2)
Wave Data Recording Programme, Townsville Region (Report No. W.03.1)
Wave Data Recording Programme, Townsville Region (Report No. W.03.2)
Wave Data Recording Programme, Sunshine Coast Region (Report No. W04.1)
Wave Data Recording Programme, Burnett Heads Region (Report. No. W05.1)
Wave Data Recording Programme, Abbot Point Region (Report No. W06.1)
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WAVE DATA RECORDING PROGRAMME

MORETON ISLAND REGION (NORTH EAST SHIPPING CHANNEL)

REPORT NO. W011.1

1.0 INTRODUCTION

The Port of Brisbane Authority, as part of its North East Shipping Channel Feasibility Study, commissioned the Beach Protection Authority to record and analyse wave data offshore near Moreton Island.

This report summarizes the primary analysis of wave data collected in the Moreton Island 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.

The Bribie Island installation comprised a Waverider 6000 series buoy transmitting to a shore based WAREP Mark II receiver which in turn was coupled to an ANMA analogue recording unit.

This system utilised a buoy mounted accelerometer to follow the water surface movements and transmitted a frequency modulated analogue signal of these water level movements to a shore based receiver (WAREP). The WAREP receiver provided a paper chart of the recording and relayed the analogue signal to the ANMA analogue recorder.

3.0 WAVE RECORDING AND ANALYSIS PROCEDURES

In general between June 15, 1983 and April 12, 1985 four recordings of water levels each of 20 minutes duration were made each day with the timing of the recordings set at 0300 hours, 0900 hours, 1500 hours and 2100 hours respectively.

Digitization of the analogue data tapes 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 digitizer which was specifically developed for this purpose.

Routine and spectral analysis of digital wave data was performed by a computer program to obtain the following 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 (zero upward crossing).
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.

These parameters are the basis for the summary plots and tables attached to this report.

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 data.

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

5.0 WAVE CLIMATE

5.1 General

The wave climate presented in this report is based on statistical analyses of the parameters obtained from the recorded wave data.

Computer programs developed by the Authority provide statistical information on percentage of time occurrence and exceedance for wave heights and periods. The results of these analyses are presented in Tables 1, 2 and 3 and Figures 2, 3 and 4. In addition, similar analyses are carried out on the relationships between the various wave parameters and these are presented in Figure 5.

5.2 Wave Persistence

Wave height persistence is the duration for which any given wave height is exceeded in any single event. Persistence information has been calculated from the recorded data by linearly interpolating the times of exceedance of various wave heights. Wave height persistence data is presented in Figure 6.

5.3 Return Intervals

The percentage of time of exceedance data for various wave heights (Figure 2) is combined with the persistence data (Figure 6) to determine the average wave height recurrence intervals.

The technique used to calculate the return intervals presented in Figure 8 is given below:-

No. of hours per year of exceedance of a given wave height

$$H = \frac{Pe \times 8760 \text{ hrs}}{100}$$
$$= 87.6\ Pe \text{ hrs}$$

where Pe is the percentage of time of exceedance from Figure 2.

Average No. of events per year in which H is exceeded

$$= \frac{87.6\ Pe}{P}$$

where P is the average persistence (hours) of events of exceedance of the given wave height (H).

However, of this number of events, a certain percentage Pn will persist for at least the specified duration.
i.e. No. of events per year in which H is exceeded for at least the specified duration

$$= \frac{87.6\ Pe}{P} \times \frac{Pn}{100}$$

$$= \frac{0.876\ Pe \times Pn}{P}$$

where Pn may be determined from Figure 6.

By inverting this, the average return interval of the occurrence of an event in which H is exceeded for the given duration is given by -

Return Interval

$$= \frac{1}{\text{Ave. No. of occurrences per year}}$$

$$= \frac{P}{0.876\ Pe \times Pn}$$

It should be noted that the data presented in Figure 8 are for the average wave height recurrence interval and include all exceedance events of the given wave height without regard to duration of the event. In these calculations Pn was taken as 100 percent.

6.0 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. (Tp)

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

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

Figure 5: Wave Parameter Relationships.

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

Figure 7: Daily Wave Recordings.

Figure 8: Wave Height (Hsig) Recurrence Intervals.

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:- Moreton Island Region (North East Shipping Channel)

Buoy Location:-

Co-ordinates:- 153° 20'50" East 26° 57'45" South.
Description:- 10.5km north north west of Comboyuro Point (See Figure 1).

Water Depth at Buoy:- 13 metres relative to Australian Height Datum

Location of Recording Station:- Woorim Water Tower

Period of Data Collection:- June 15, 1983 to April 12, 1985

Normal Recording Interval:-

Four twenty minute records daily at 0300 hours, 0900 hours, 1500 hours and 2100 hours between June 15, 1983 and April 12, 1985.

Total No. of Records Analysed:- 2461

Number of Records Lost Due to:-

Rejected Records during Analysis	23
Field Equipment Failure	167
Damaged Accelerometer Cables	5

SUMMARY SHEET 2

MAJOR METEOROLOGICAL EVENTS

Meteorological Event	*Central Pressure (mb)	Date	*Estimated Position of Cyclone Relative to Buoy (km)	Maximum Hsig Recorded (metres)	Maximum Hmax Recorded (metres)	Tp (secs)
Low Pressure System over South East Queensland	1008	22/6/83		3.81	6.74	10.05
Low Pressure System over North Queensland and High Pressure system extending over Tasman Sea	1010 and 1020	21/11/83		2.74	4.35	8.59
Low Pressure System centered on Central Queensland Coast	1012	30/11/83		2.61	4.45	9.79
Low Pressure System extending over Coral Sea	1000	5/12/83		2.21	3.67	9.09
Cyclone Ingrid	1002	26/2/84	440 NE	2.38	3.47	9.70
Low Pressure System over Tasman Sea	1000	19/5/84		2.89	4.78	11.65
Low Pressure System over Tasman Sea	1012	27/7/84		2.92	4.64	7.26
Cyclone Monica	984	30/12/84	720 NE	2.81	4.64	12.51
Cyclone Pierre	985	22/2/85	470 NNW	2.08	3.78	10.16

Meteorological Event	*Central Pressure (mb)	Date	*Estimated Position of Cyclone Relative to Buoy (km)	Maximum Hsig Recorded (metres)	Maximum Hmax Recorded (metres)	Tp (secs)
Low Pressure System over Coral Sea and High Pressure System over Tasman Sea	1008 and 1029	10/3/85		2.39	3.58	9.34

Highest Significant Wave Height (Hsig) recorded was 3.81 m on June 22, 1983 due to a Low pressure system over South East Queensland.

Highest Maximum Wave Height (Hmax) recorded was 6.74 m on June 22, 1983 due to a Low pressure system over South East 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 conditons.

Note: The mean Hsig value for the total two year period was 0.95m. A value of 2.0 times the mean Hsig has been adopted for this station to determine a Major Meteorological Event based on significant wave height.

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	
.00 - .20	*	*	*	*	*	*	*	*	0.00
.21 - .40	*	*	0.25	0.50	1.75	0.50	0.25	*	3.25
.41 - .60	0.50	4.00	5.38	9.25	24.25	9.75	1.25	*	54.38
.61 - .80	0.75	17.75	20.63	32.13	47.25	23.00	2.25	0.25	144.00
.81 - 1.00	*	18.25	28.13	38.38	46.13	26.75	2.75	1.25	161.63
1.01 - 1.20	*	12.13	15.13	32.25	28.00	14.88	1.25	*	103.63
1.21 - 1.40	*	3.13	10.75	22.13	21.00	11.13	0.75	*	68.88
1.41 - 1.60	*	*	6.75	16.00	15.63	3.75	0.25	*	42.38
1.61 - 1.80	*	*	2.75	9.25	11.13	2.25	0.50	*	25.88
1.81 - 2.00	*	*	0.75	5.25	5.00	1.75	0.25	*	13.00
2.01 - 2.20	*	*	*	3.75	2.50	1.00	*	*	7.25
2.21 - 2.40	*	*	*	0.50	3.00	0.75	*	*	4.25
2.41 - 2.60	*	*	*	0.50	1.50	*	*	*	2.00
2.61 - 2.80	*	*	*	1.00	0.75	0.50	*	*	2.25
2.81 - 3.00	*	*	*	0.25	*	1.00	*	*	1.25
3.01 - 3.20	*	*	*	0.25	*	*	*	*	0.25
3.21 - 3.40	*	*	*	*	*	*	*	*	0.00
3.41 - 3.60	*	*	*	*	*	*	*	*	0.00
3.61 - 3.80	*	*	*	*	*	*	*	*	0.00
3.81 - 4.00	*	*	*	*	0.25	*	*	*	0.25
TOTALS	1.25	55.25	90.50	171.38	208.13	97.00	9.50	1.50	634.50

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	
.00 - .20	*	*	*	*	*	*	*	*	0.00
.21 - .40	*	*	*	0.50	0.50	*	*	*	1.00
.41 - .60	*	2.50	2.88	4.50	7.88	1.00	*	*	18.75
.61 - .80	*	8.75	12.25	18.13	22.75	4.50	*	0.25	66.63
.81 - 1.00	*	7.25	15.63	26.63	28.38	5.50	0.50	0.25	84.13
1.01 - 1.20	*	7.25	5.75	19.00	15.63	4.50	0.25	*	52.38
1.21 - 1.40	*	1.50	5.75	14.38	14.25	3.50	0.25	*	39.63
1.41 - 1.60	*	*	3.75	10.00	11.50	0.50	*	*	25.75
1.61 - 1.80	*	*	1.25	5.25	7.25	1.00	*	*	14.75
1.81 - 2.00	*	*	*	3.00	3.25	0.75	*	*	7.00
2.01 - 2.20	*	*	*	1.50	1.25	*	*	*	2.75
2.21 - 2.40	*	*	*	*	1.25	0.25	*	*	1.50
2.41 - 2.60	*	*	*	*	0.25	*	*	*	0.25
2.61 - 2.80	*	*	*	0.50	0.25	0.50	*	*	1.25
2.81 - 3.00	*	*	*	*	*	0.25	*	*	0.25
TOTALS	0.00	27.25	47.25	103.38	114.38	22.25	1.00	0.50	316.00

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

TABLE 3

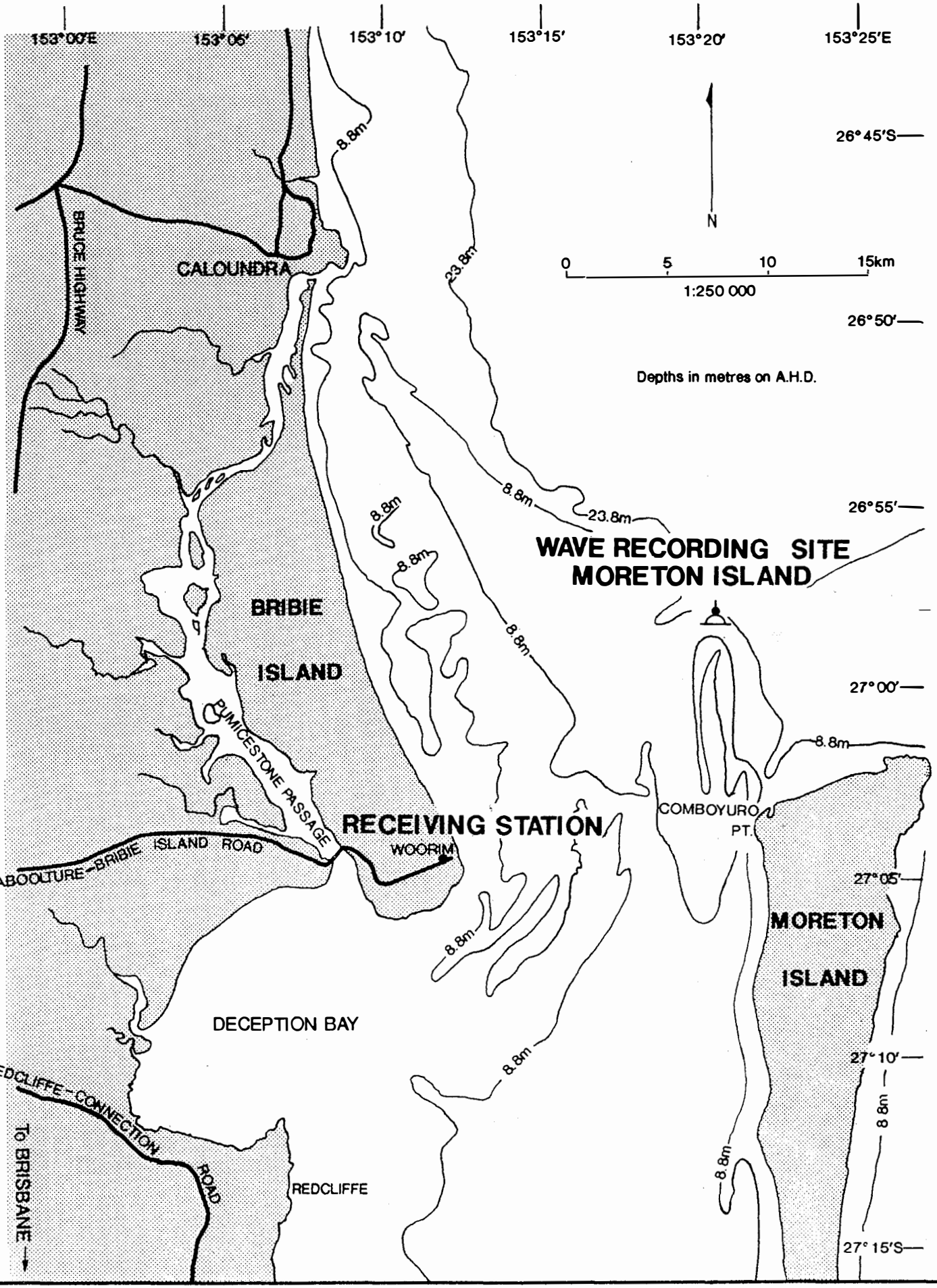
WAVE STATISTICS

WAVE PERIOD/WAVE HEIGHT OCCURRENCES

WINTER DATA, ALL DIRECTIONS

Significant Wave Height (metres)	Peak Energy Wave Period (Seconds)								Totals
	0 - 2.99	3 - 4.99	5 - 6.99	7 - 8.99	9 - 10.99	11 - 12.99	13 - 14.99	> 14.99	
.00 - .20	*	*	*	*	*	*	*	*	0.00
.21 - .40	*	*	0.25	*	1.25	0.50	0.25	*	2.25
.41 - .60	0.50	1.50	2.50	4.75	16.38	8.75	1.25	*	35.63
.61 - .80	0.75	9.00	8.38	14.00	24.50	18.50	2.25	*	77.38
.81 - 1.00	*	11.00	12.50	11.75	17.75	21.25	2.25	1.00	77.50
1.01 - 1.20	*	4.88	9.38	13.25	12.38	10.38	1.00	*	51.25
1.21 - 1.40	*	1.63	5.00	7.75	6.75	7.63	0.50	*	29.25
1.41 - 1.60	*	*	3.00	6.00	4.13	3.25	0.25	*	16.63
1.61 - 1.80	*	*	1.50	4.00	3.88	1.25	0.50	*	11.13
1.81 - 2.00	*	*	0.75	2.25	1.75	1.00	0.25	*	6.00
2.01 - 2.20	*	*	*	2.25	1.25	1.00	*	*	4.50
2.21 - 2.40	*	*	*	0.50	1.75	0.50	*	*	2.75
2.41 - 2.60	*	*	*	0.50	1.25	*	*	*	1.75
2.61 - 2.80	*	*	*	0.50	0.50	*	*	*	1.00
2.81 - 3.00	*	*	*	0.25	*	0.75	*	*	1.00
3.01 - 3.20	*	*	*	0.25	*	*	*	*	0.25
3.21 - 3.40	*	*	*	*	*	*	*	*	0.00
3.41 - 3.60	*	*	*	*	*	*	*	*	0.00
3.61 - 3.80	*	*	*	*	*	*	*	*	0.00
3.81 - 4.00	*	*	*	*	0.25	*	*	*	0.25
TOTALS	1.25	28.00	43.25	68.00	93.75	74.75	8.50	1.00	318.50

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



Beach Protection Authority

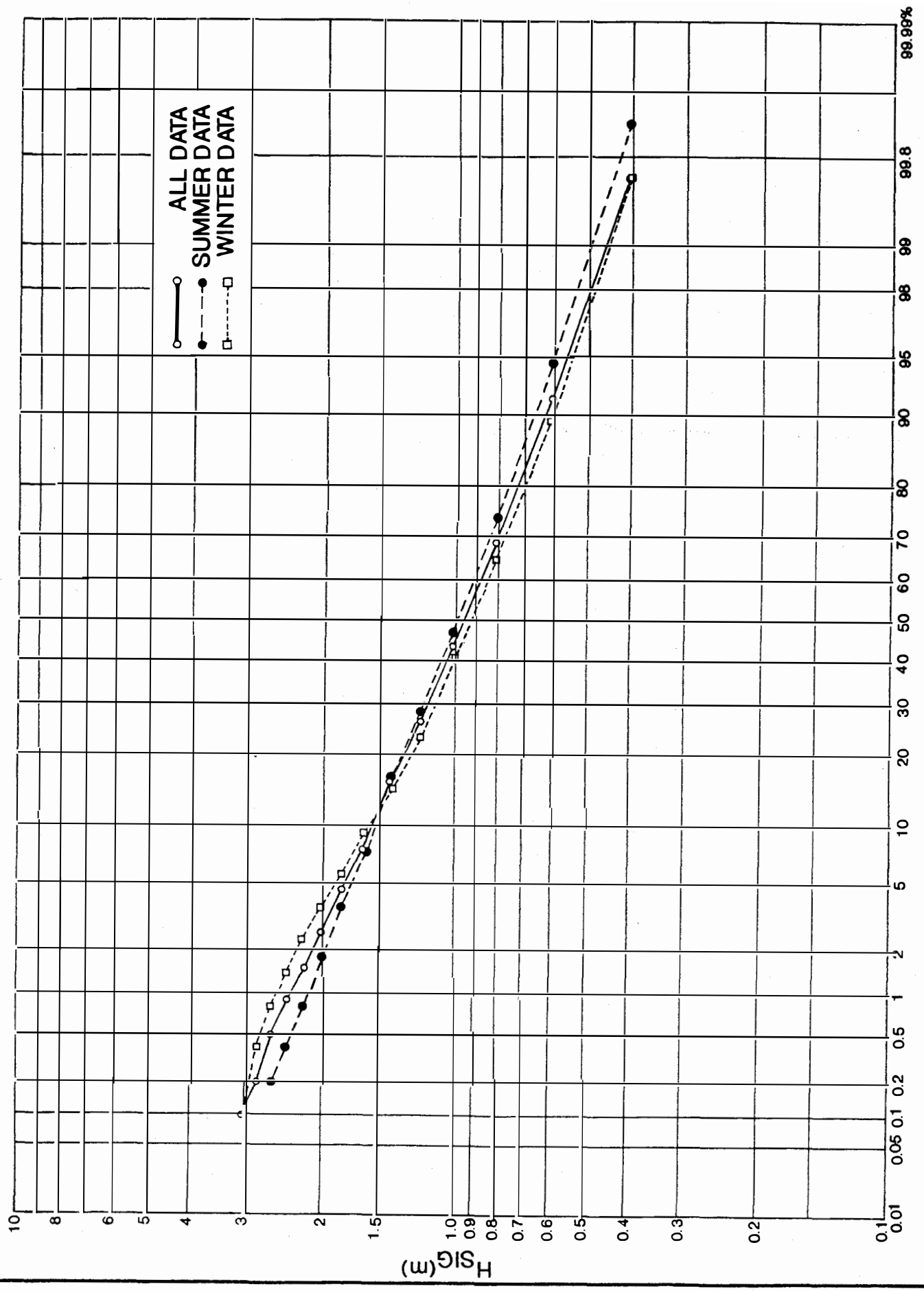
LOCALITY MAP

Wave Data Recording Programme

Moreton Island

Figure 1

W 11.1



Beach Protection Authority

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

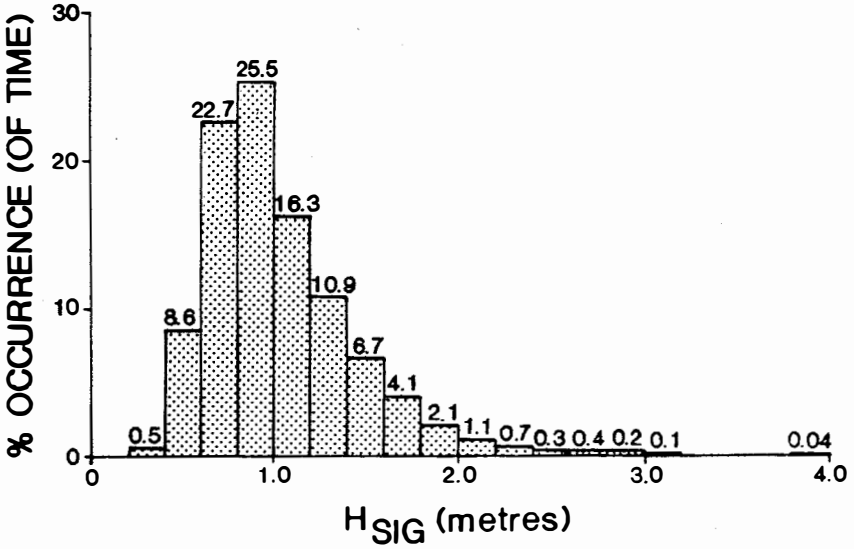
15th June 1983 to 12th April 1985

Wave Data Recording Programm

Moreton Island

Figure 2

W 11.1



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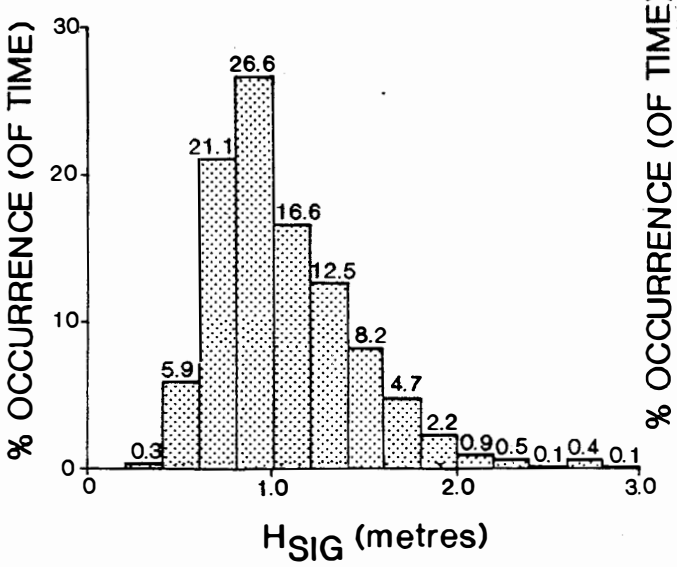

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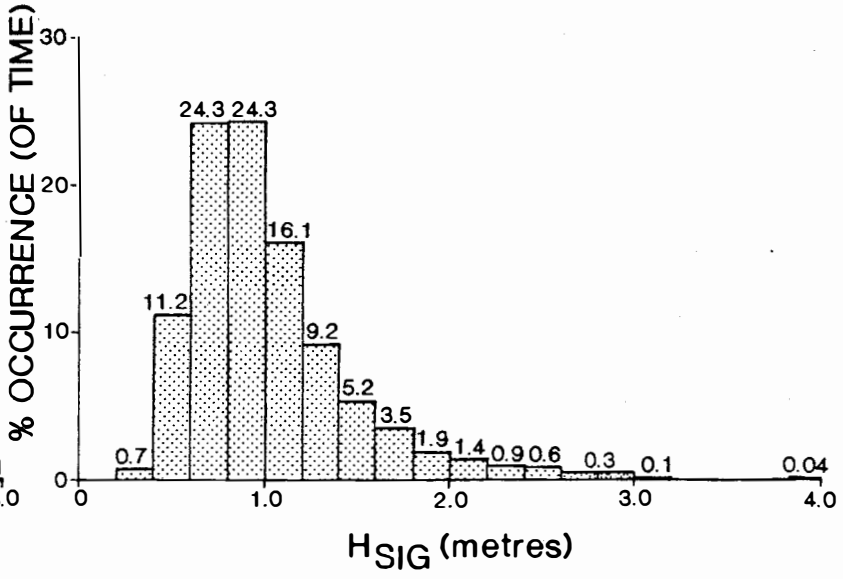


WINTER DATA ONLY

Beach Protection Authority

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

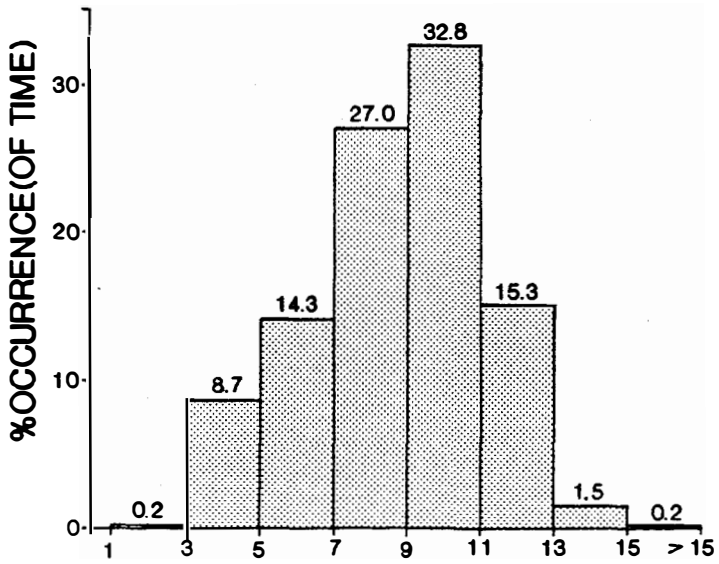
15th June 1983 to 12th April 1985

Wave Data Recording Programme

Moreton Island

Figure 3

W 11.1



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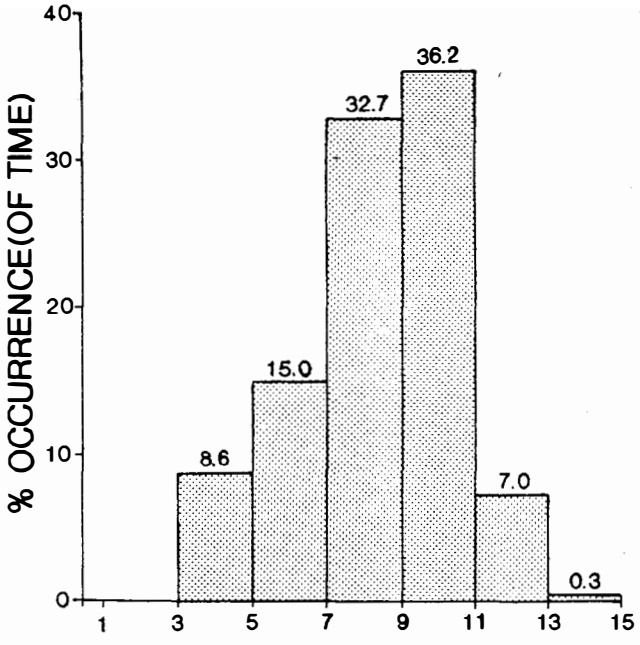

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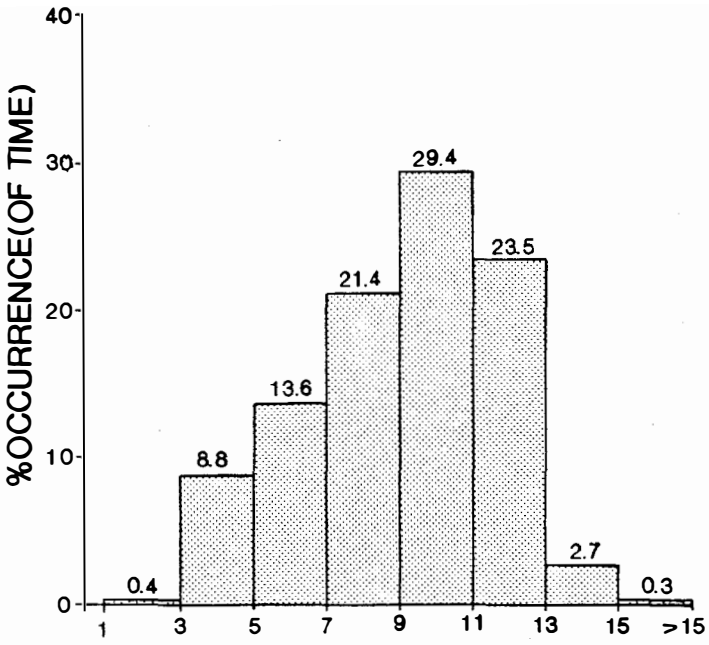


WINTER DATA ONLY

Beach Protection Authority

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

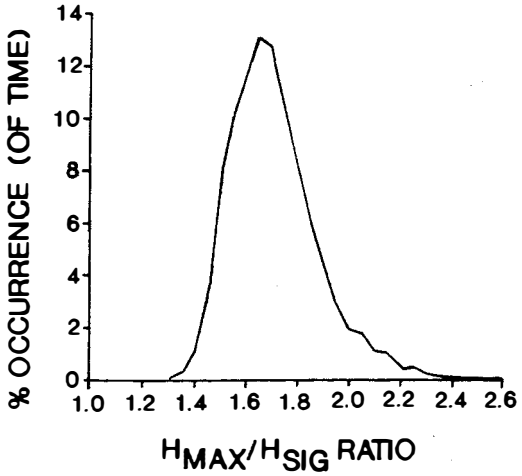
15th June 1983 to 12th April 1985

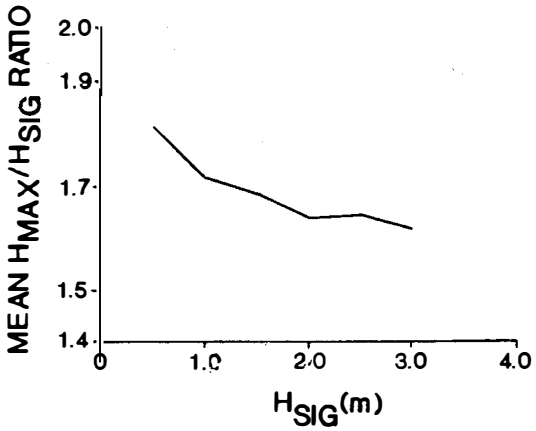
Wave Data Recording Programme

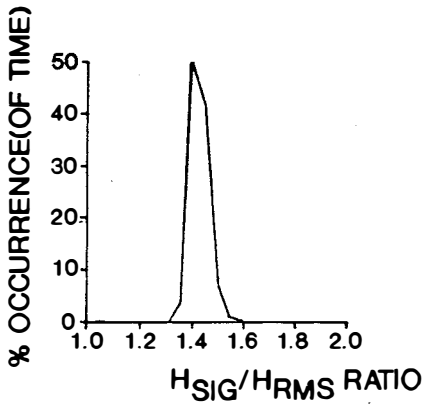
Moreton Island

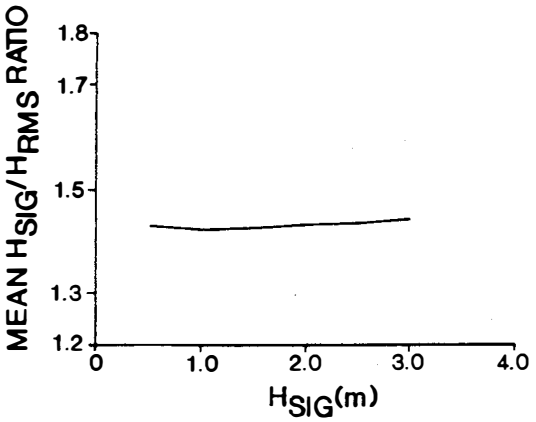
Figure 4

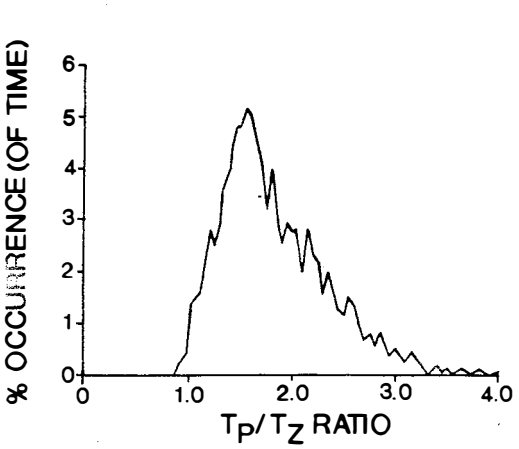
W 11.1

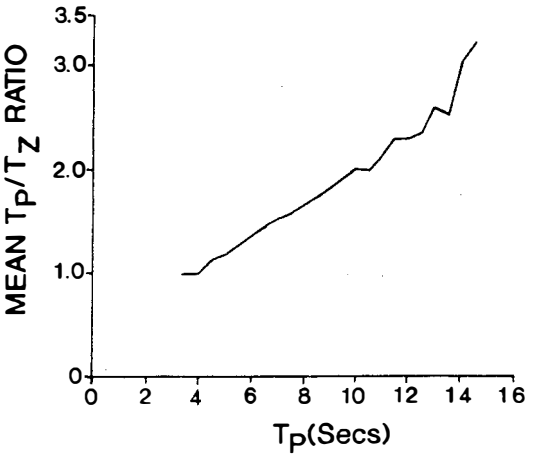


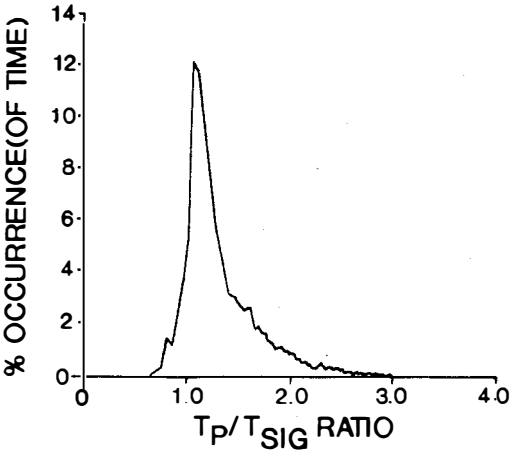


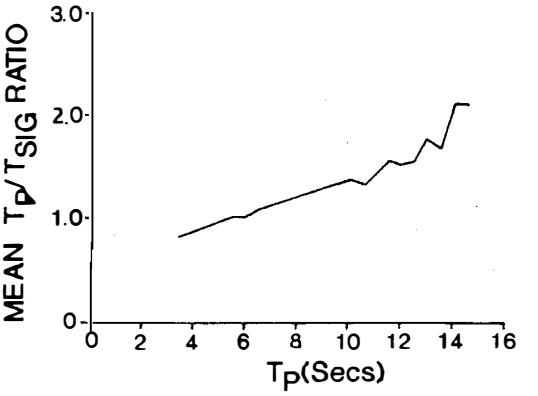












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WAVE PARAMETER RELATIONSHIPS

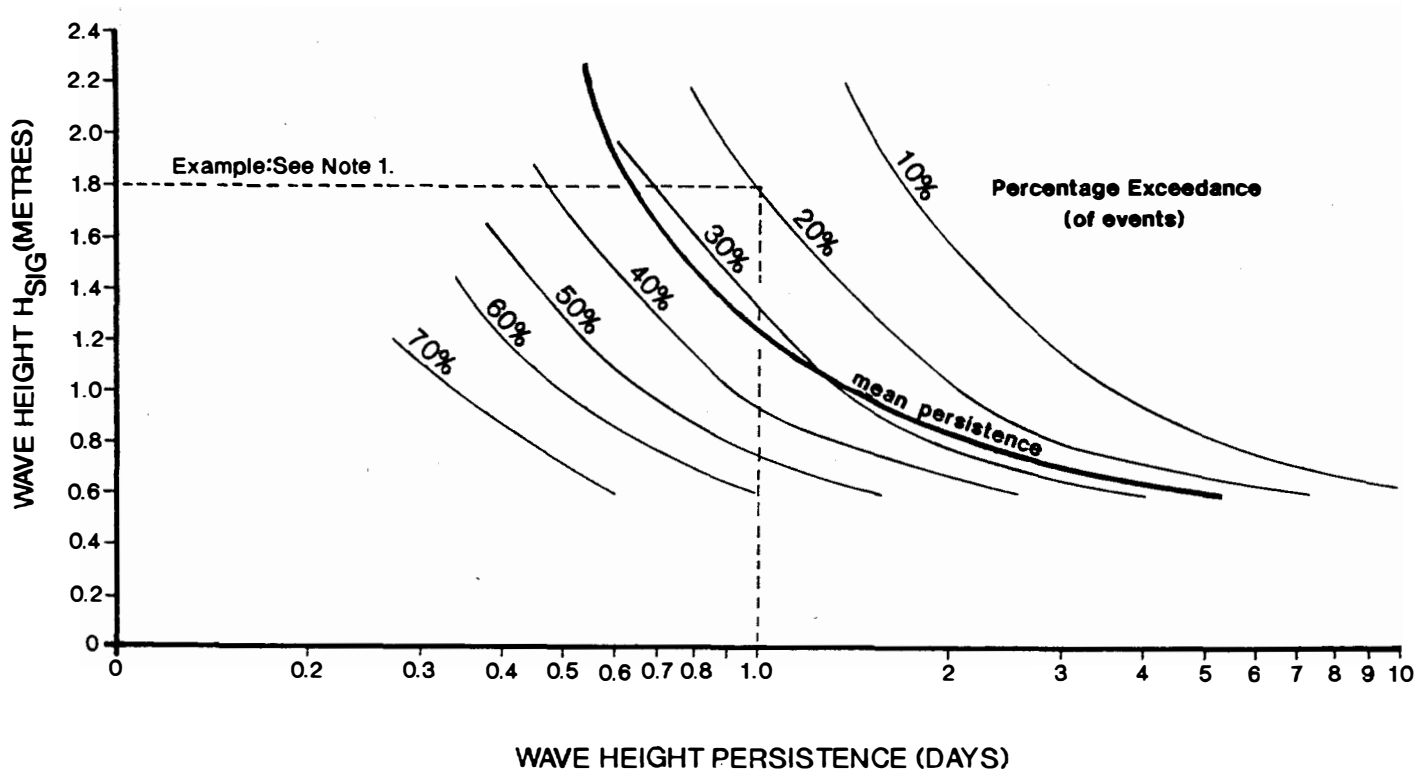
15th June 1983 to 12th April 1985

Wave Data Recording Programme

Moreton Island

Figure 5

W 11.1



NOTE:

1. Wave height persistence is the duration for which a given significant wave height is continuously exceeded. As an example, given a 1.8 metre significant wave height, there is a 20% probability that this wave height or greater will persist for more than 1 day.

2. The mean persistence line 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})

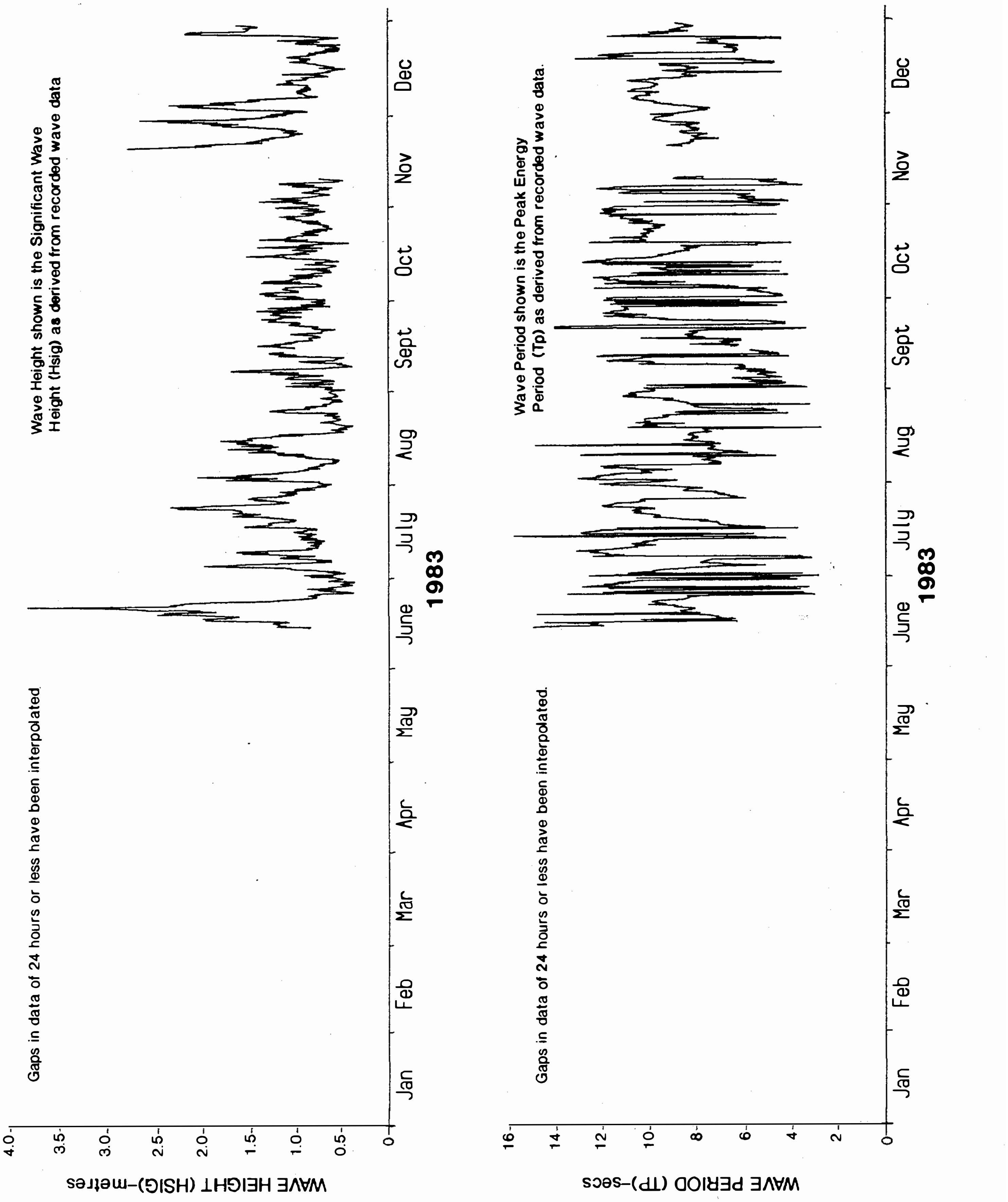
15th June 1983 to 12th April 1985

Wave Data Recording Programme

Moreton Island

Figure 6

W 11.1



Beach Protection Authority

DAILY WAVE RECORDINGS

15th June 1983 to 31st December 1983

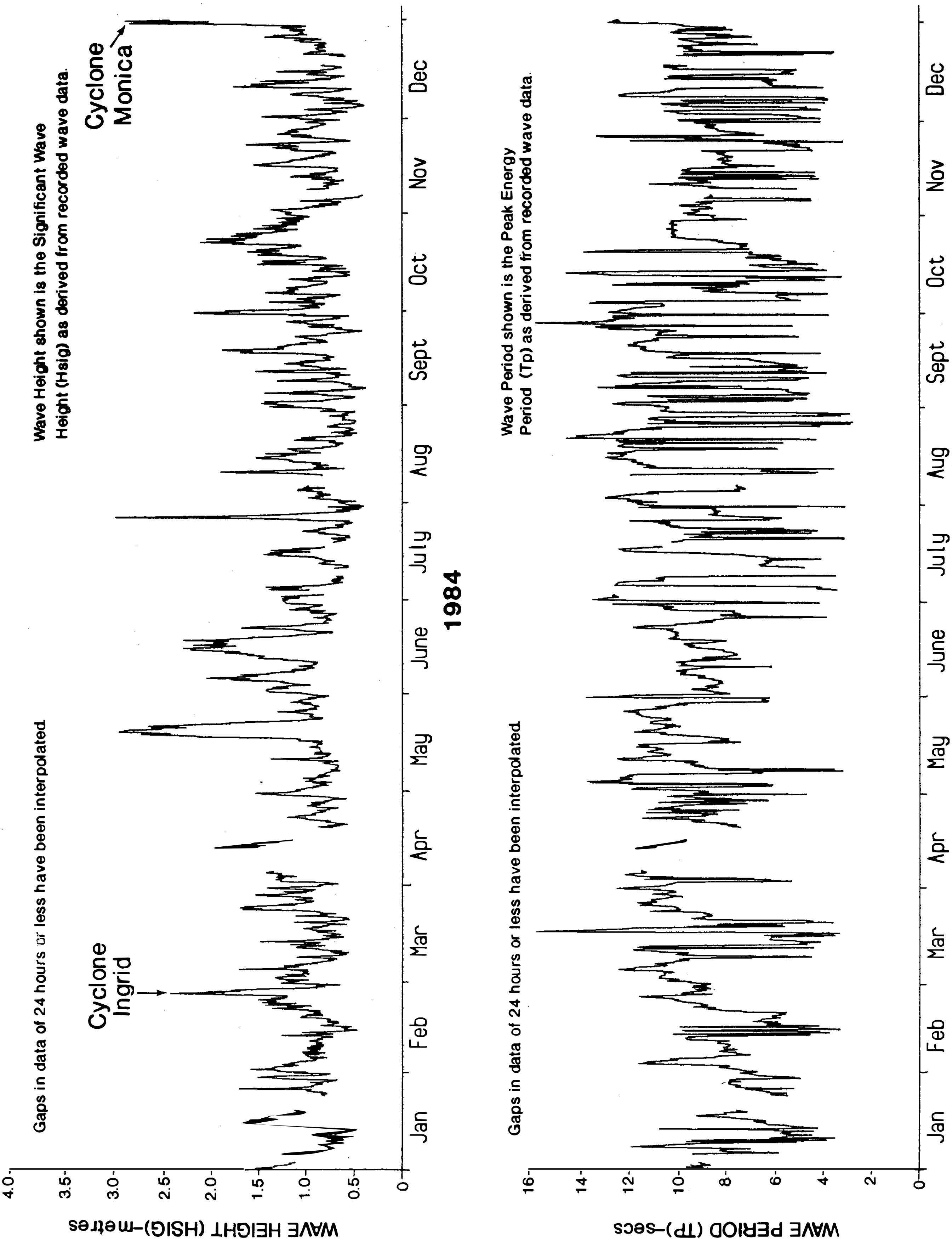
Wave Data Recording Programme

Moreton Island

Figure 7

W 11.1

Sheet 1 of 3



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DAILY WAVE RECORDINGS

1st January 1984 to 31st December 1984

Wave Data Recording Programme

Moreton Island

Figure 7

W 11.1

Sheet 2 of 3

Beach Protection Authority

DAILY WAVE RECORDINGS

1st January 1985 to 12th April 1985

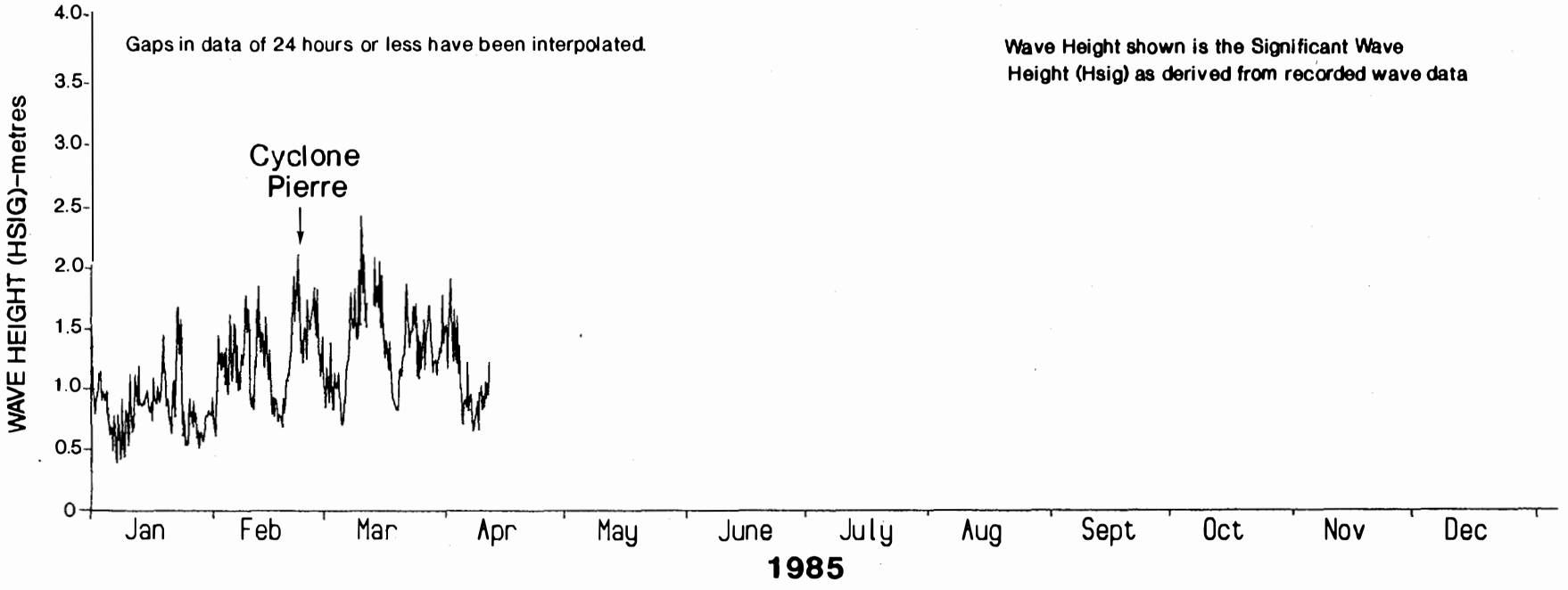
Wave Data Recording Programme

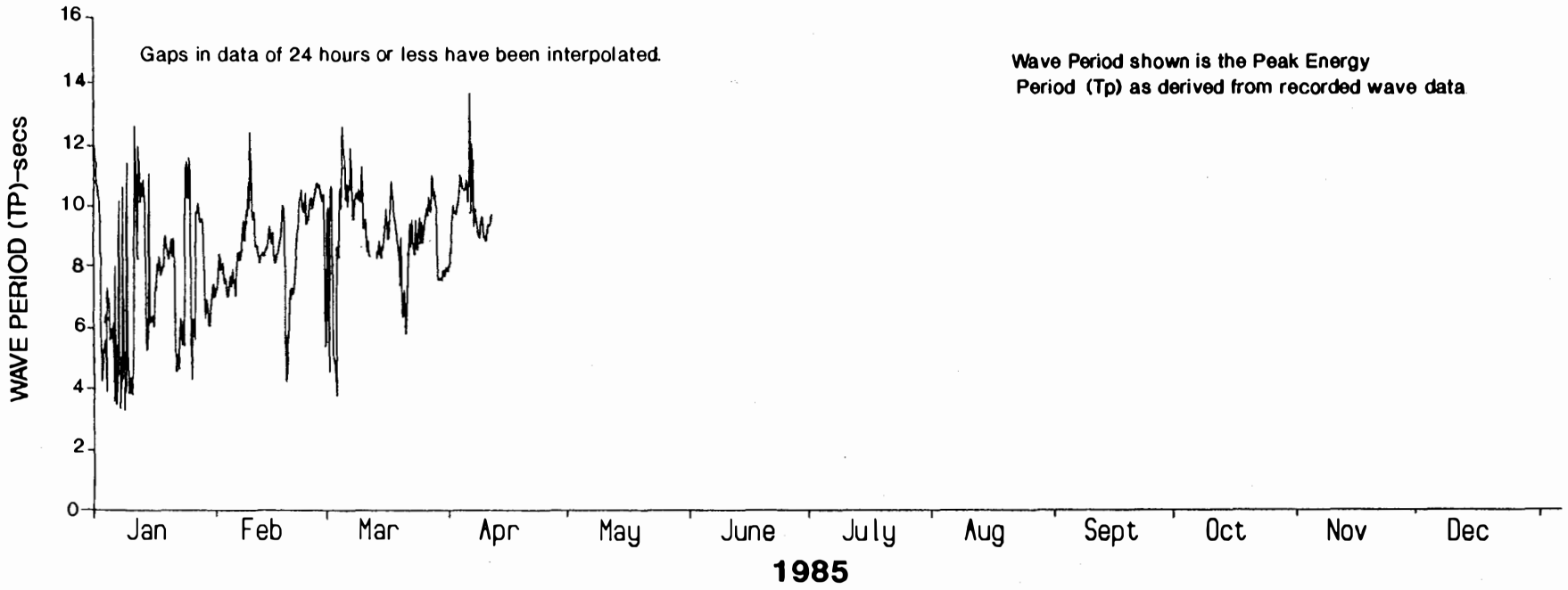
Moreton Island

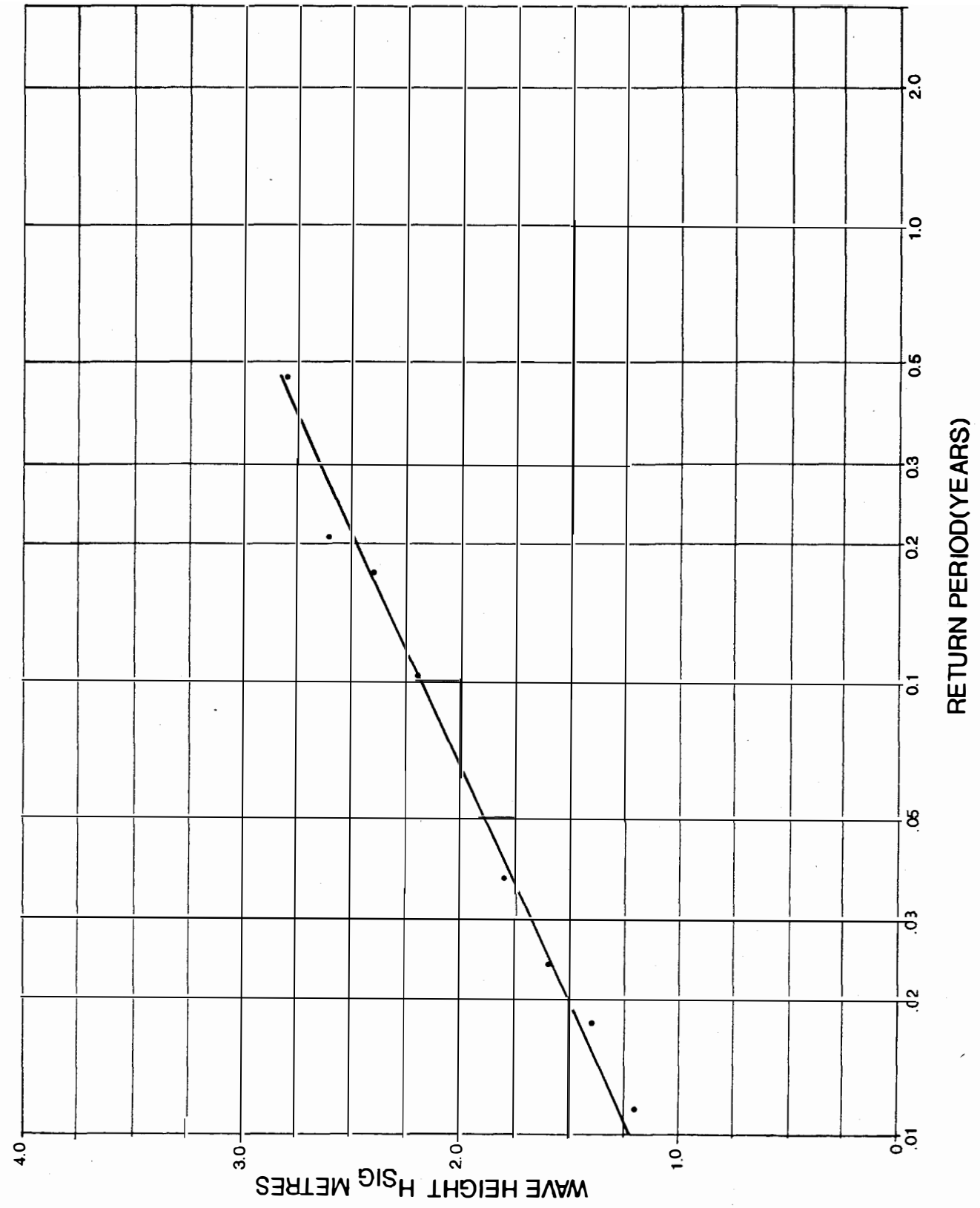
Figure 7

W 11.1

Sheet 3 of 3







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WAVE HEIGHT(H_{SIG})RECURRENCE INTERVAL

15th June 1983 to 12th April 1985

Wave Data Recording Programme

Moreton Island

Figure 8

W 11.1

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