ISSN 0158-7757

WAVE DATA RECORDING PROGRAM

BRISBANE REGION

Beach Protection Authority of Queensland.
REPORT No. W 09.1

ISSN 0158–7757

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Prepared by the Beach Protection Authority

January 1985

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.

DOCUMENTATION PAGE

REPORT NO.:– W 09.1

TITLE:– Report – Wave Data Recording Program – Brisbane Region

DATE:– January 1985

TYPE OF REPORT:– Technical Memorandum

ISSUING ORGANISATION:– Beach Protection Authority
G.P.O. Box 2195
BRISBANE QLD 4001
AUSTRALIA

DISTRIBUTION:– Public Distribution

ABSTRACT:–

This report provides summaries of primary analysis of raw wave data recorded in 60 metres of water offshore near Brisbane in Southern Queensland. Data was recorded using a Datawell "Waverider" buoy, and covers the period October 30, 1976 to June 30, 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, Weipa Region (Report No. W 07.1)
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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 Brisbane 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 October 30, 1976 and June 16, 1982 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 June 17, 1982 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. 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 Brisbane 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) are 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 9 is given below:-

$$\text{No. of hours per year of exceedance of a given wave height (H)} = \frac{(pe) \times 8760 \text{ hrs}}{100}$$
$$= 87.6 \text{ pe hrs}$$

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

$$\text{Average No. of events per year in which H is exceeded} = \frac{87.6 \text{ pe}}{P}$$

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

$$= \frac{87.6 \text{ pe}}{P} \times \frac{pn}{100}$$
$$= \frac{0.876 \text{ pe} \times pn}{P}$$

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 -

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

$$= \frac{P}{0.876 \text{ Pe} \times pn}$$

It should be noted that the data presented in Figure 9 are for the average wave height recurrence interval and include all exceedance events of the given wave height without regard for 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.

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).

Figure 9: 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:–Brisbane Region

Buoy Location:–

Co-ordinates:– 153°35' East 27°23' South
Description:– 7 kms N.N.E. of Point Lookout (See Figure 1)

Water Depth at Buoy:– 60 metres relative to Australian Height Datum

Location of Recording Station:– Harbours and Marine Department Depot, Pinkenba

Period of Data Collection:– October 30, 1976 to June 30, 1983

Normal Recording Interval:– Two twenty minute records daily at 0300 hours and 1500 hours between October 30, 1976 and June 16, 1982

Four twenty minute records daily at 0300 hours and 0900 hours, 1500 hours and 2100 hours between June 17, 1982 and June 30, 1983.

Total No. of Records Analysed:– 4444

Number of Records Lost Due to:–

Field Equipment Failure	293
Losses during Analysis	837
Damaged Accelerometer Cables	28

Periods during which four recordings per day were taken:–

February 6-8, 1978
July 20-27, 1978
January 10, 1979
January 31 - February 25, 1979
January 7, 1980
February 14 - 20, 1981
April 7 - 10, 1981
April 8 - 16, 1982
June 17, 1982 to June 30, 1983

Periods during which five recordings per day were taken:-

January 27, 1982

Periods during which eight recordings per day were taken: -

February 27-28, 1980

Assessment of Data Quality:– Fair (Data losses have been due to a large transmission distance from buoy to receiver, a high occurrence of CB radio waves and signal interference from industrial buildings near the receiver site).

SUMMARY SHEET 2

MAJOR METEOROLOGICAL EVENTS

BRISBANE 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)
Low pressure system offshore from Brisbane	1004	19/5/77		4.38	6.26	12.32
Low pressure system in Tasman Sea and high pressure system near Adelaide	996 and 1032	12/6/77		3.58	5.20	10.64
Low pressure system offshore from Brisbane	1000	14/4/78		3.41	4.78	9.79
Low pressure system in Coral Sea and High pressure system in Tasman Sea	1008 and 1028	19/7/78		3.27	4.92	12.63
High pressure system in Tasman Sea	1024	8/2/79		3.27	5.54	8.41
Low pressure system offshore from Brisbane	1008	30/7/79		4.67	8.73	10.99
Cyclone Paul	992	8/1/80	530ESE	4.25	9.84	9.28
Cyclone Ruth	998	14/2/80	610NE	4.02	6.30	9.83
Cyclone Simon	972	27/2/80	160ENE	3.29	6.42	8.12
Cyclone Sina and high pressure system near Tasmania	1002 and 1032	10/3/80	1250NNE	3.70	5.27	8.41
Low pressure system offshore from Brisbane	1008	8/5/80		5.21	8.06	11.73
Cyclone Cliff	994	15/2/81	220NNE	4.33	7.16	9.64
Low pressure system offshore near Fraser Island	1012	22/5/81		3.75	5.21	8.54

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 Abigail	984	27/1/82	790NE	4.00	5.37	9.73
High Pressure system in Tasman Sea	1041	22/9/82		3.62	5.89	9.77
Low pressure system east of Cape Moreton	–	10/3/83		3.61	5.25	9.04
Low pressure system in Tasman Sea	1004	14/4/83		3.67	5.52	10.30
High pressure system in Tasman Sea	1040	4/6/83		5.27	10.04	11.02
Low pressure system offshore from Brisbane	1008	22/6/83		3.81	5.78	8.75

Highest Significant Wave Height (Hsig) recorded was 5.27 m on June 4, 1983.

Highest Maximum Wave Height (Hmax) recorded was 10.04 m on June 4, 1983.

Meteorological information obtained from the "Monthly Weather Review" published by the 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	0	0	0	0	0	0	0	0	0.00
0.20 – 0.40	0.50	0	0.50	0	0	0	0	0	1.00
0.40 – 0.60	0	1.00	3.50	10.75	18.00	2.75	0.75	0	36.75
0.60 – 0.80	0	13.75	18.50	54.75	62.13	11.63	1.50	0	162.25
0.80 – 1.00	0	20.13	49.88	137.85	118.50	22.88	0.25	0	349.48
1.00 – 1.20	0	19.00	62.54	165.33	131.00	18.13	0	0	396.00
1.20 – 1.40	0	6.25	58.00	133.88	112.75	15.00	0.50	0	326.38
1.40 – 1.60	0	1.38	46.50	109.38	84.13	9.63	0	0	251.00
1.60 – 1.80	0	0	27.75	88.63	68.75	11.63	0.50	0	197.25
1.80 – 2.00	0	0	13.75	69.06	48.50	6.50	0	0	137.81
2.00 – 2.20	0	0	7.50	43.75	39.88	5.88	0	0	97.00
2.20 – 2.40	0	0	2.88	32.56	17.50	5.13	0.75	0	59.06
2.40 – 2.60	0	0	1.38	28.13	20.13	3.25	0	0	52.88
2.60 – 2.80	0	0	0	14.81	9.88	4.00	0.75	0	29.44
2.80 – 3.00	0	0	0	10.50	7.88	2.88	0	0	21.25
3.00 – 3.20	0	0	0	3.25	1.75	0.50	0	0	5.50
3.20 – 3.40	0	0	0	0.38	2.50	3.25	0	0	6.13
3.40 – 3.60	0	0	0	0.88	2.25	0	0	0	3.13
3.60 – 3.80	0	0	0	1.88	2.81	0	0	0	4.69
3.80 – 4.00	0	0	0	0.25	0.50	0.25	0	0	1.00
4.00 – 4.20	0	0	0	0.25	0.50	0	0	0	0.75
4.20 – 4.40	0	0	0	0	2.13	0.75	0	0	2.88
4.40 – 4.60	0	0	0	0	1.00	0.50	0	0	1.50
4.60 – 4.80	0	0	0	0	0.50	0	0	0	0.50
4.80 – 5.00	0	0	0	0	0	0	0	0	0.00
5.00 – 5.20	0	0	0	0	0.63	0	0	0	0.63
5.20 – 5.40	0	0	0	0	0	1.00	0	0	1.00
TOTALS	**0.50**	**61.50**	**292.67**	**906.25**	**753.81**	**125.50**	**5.00**	**0.00**	**2145.23**

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

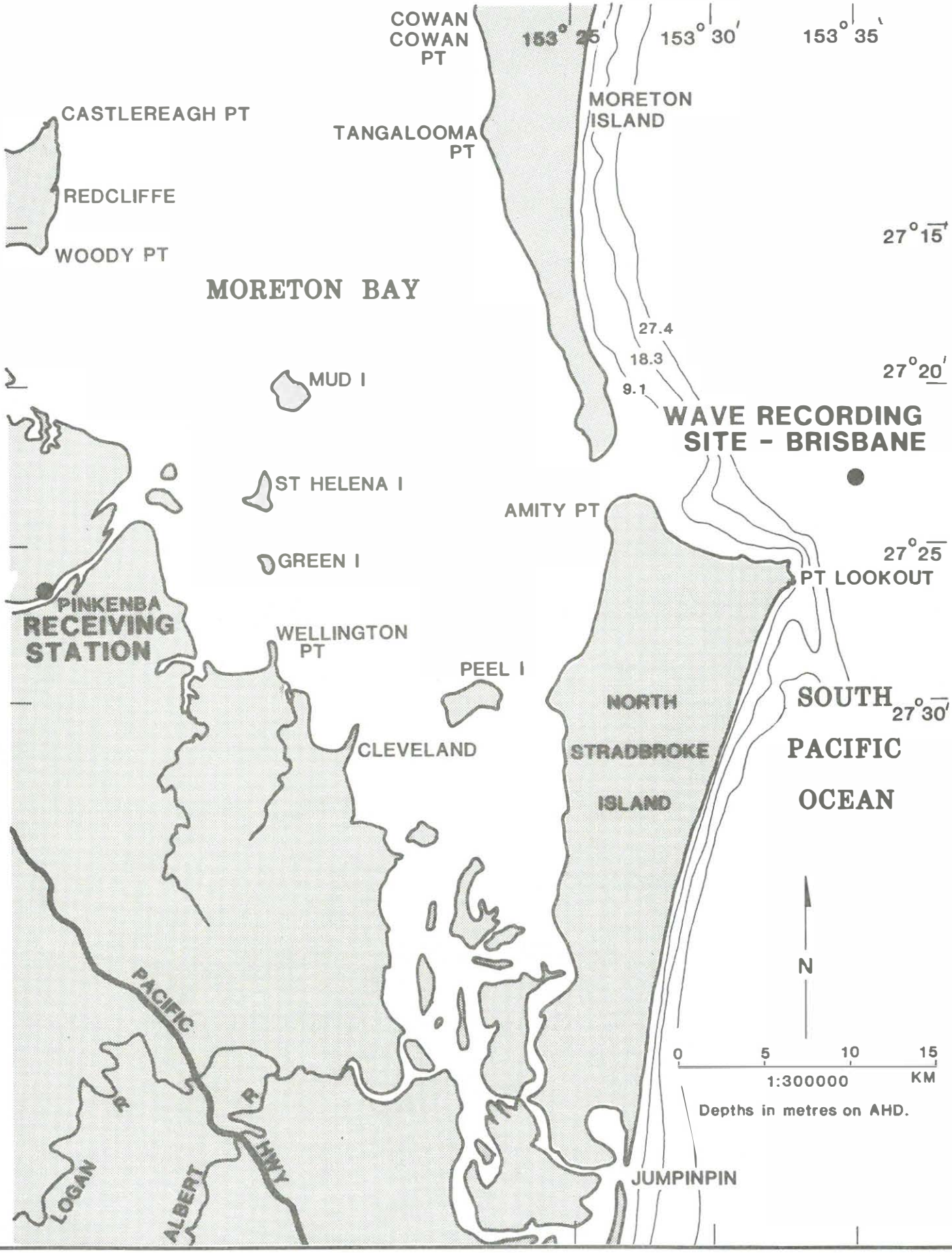
Significant Wave Height (metres)	Peak Energy Wave Period (Seconds)								Totals
	0 – 2.99	3 – 4.99	5 – 6.99	7 – 8.99	9 – 10.99	11 – 12.99	13 – 14.99	>14.99	
0.00 – 0.20	0	0	0	0	0	0	0	0	0.00
0.20 – 0.40	0	0	0	0	0	0	0	0	0.00
0.40 – 0.60	0	0.50	1.25	3.75	5.25	0	0	0	10.75
0.60 – 0.80	0	6.13	8.75	25.25	15.88	2.75	0	0	58.75
0.80 – 1.00	0	13.75	32.50	82.23	50.75	10.25	0	0	189.48
1.00 – 1.20	0	13.38	34.04	87.21	62.38	8.13	0	0	205.12
1.20 – 1.40	0	3.38	34.00	78.75	51.13	3.50	0	0	170.75
1.40 – 1.60	0	0.88	25.38	68.50	39.63	1.88	0	0	136.25
1.60 – 1.80	0	0	13.88	50.25	32.75	5.63	0	0	102.50
1.80 – 2.00	0	0	2.63	39.69	23.50	3.25	0	0	69.06
2.00 – 2.20	0	0	3.50	24.13	23.25	1.50	0	0	52.38
2.20 – 2.40	0	0	1.88	22.06	10.00	3.75	0.75	0	38.44
2.40 – 2.60	0	0	0.50	17.25	8.25	1.50	0	0	27.50
2.60 – 2.80	0	0	0	9.19	6.38	1.50	0.75	0	17.81
2.80 – 3.00	0	0	0	7.63	3.88	1.38	0	0	12.88
3.00 – 3.20	0	0	0	2.25	1.50	0.25	0	0	4.00
3.20 – 3.40	0	0	0	0.38	1.50	0.50	0	0	2.38
3.40 – 3.60	0	0	0	0.88	0.50	0	0	0	1.38
3.60 – 3.80	0	0	0	0.50	2.06	0	0	0	2.56
3.80 – 4.00	0	0	0	0	0.25	0	0	0	0.25
4.00 – 4.20	0	0	0	0	0.50	0	0	0	0.50
4.20 – 4.40	0	0	0	0	1.13	0	0	0	1.13
TOTALS	**0.00**	**38.00**	**158.29**	**519.87**	**340.44**	**45.75**	**1.50**	**0.00**	**1103.85**

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	
0.00 – 0.20	0	0	0	0	0	0	0	0	0.00
0.20 – 0.40	0.50	0	0.50	0	0	0	0	0	1.00
0.40 – 0.60	0	0.50	2.25	7.00	12.75	2.75	0.75	0	26.00
0.60 – 0.80	0	7.63	9.75	29.50	46.25	8.88	1.50	0	103.50
0.80 – 1.00	0	6.38	17.38	55.63	67.75	12.63	0.25	0	160.00
1.00 – 1.20	0	5.63	28.50	78.13	68.63	10.00	0	0	190.88
1.20 – 1.40	0	2.88	24.00	55.13	61.63	11.50	0.50	0	155.63
1.40 – 1.60	0	0.50	21.13	40.88	44.50	7.75	0	0	114.75
1.60 – 1.80	0	0	13.88	38.88	36.00	6.00	0.50	0	94.75
1.80 – 2.00	0	0	11.13	29.38	25.00	3.25	0	0	68.75
2.00 – 2.20	0	0	4.00	19.63	16.63	4.38	0	0	44.63
2.20 – 2.40	0	0	1.00	10.50	7.50	1.38	0	0	20.63
2.40 – 2.60	0	0	0.88	10.88	11.88	1.75	0	0	25.38
2.60 – 2.80	0	0	0	5.63	3.50	2.50	0	0	11.63
2.80 – 3.00	0	0	0	2.88	4.00	1.50	0	0	8.38
3.00 – 3.20	0	0	0	1.00	0.25	0.25	0	0	1.50
3.20 – 3.40	0	0	0	0	1.00	2.75	0	0	3.75
3.40 – 3.60	0	0	0	0	1.75	0	0	0	1.75
3.60 – 3.80	0	0	0	1.38	0.75	0	0	0	2.13
3.80 – 4.00	0	0	0	0.25	0.25	0.25	0	0	0.75
4.00 – 4.20	0	0	0	0.25	0	0	0	0	0.25
4.20 – 4.40	0	0	0	0	1.00	0.75	0	0	1.75
4.40 – 4.60	0	0	0	0	1.00	0.50	0	0	1.50
4.60 – 4.80	0	0	0	0	0.50	0	0	0	0.50
4.80 – 5.00	0	0	0	0	0	0	0	0	0.00
5.00 – 5.20	0	0	0	0	0.63	0	0	0	0.63
5.20 – 5.40	0	0	0	0	0	1.00	0	0	1.00
TOTALS	**0.50**	**23.50**	**134.38**	**386.38**	**413.38**	**79.75**	**3.50**	**0.00**	**1041.38**

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

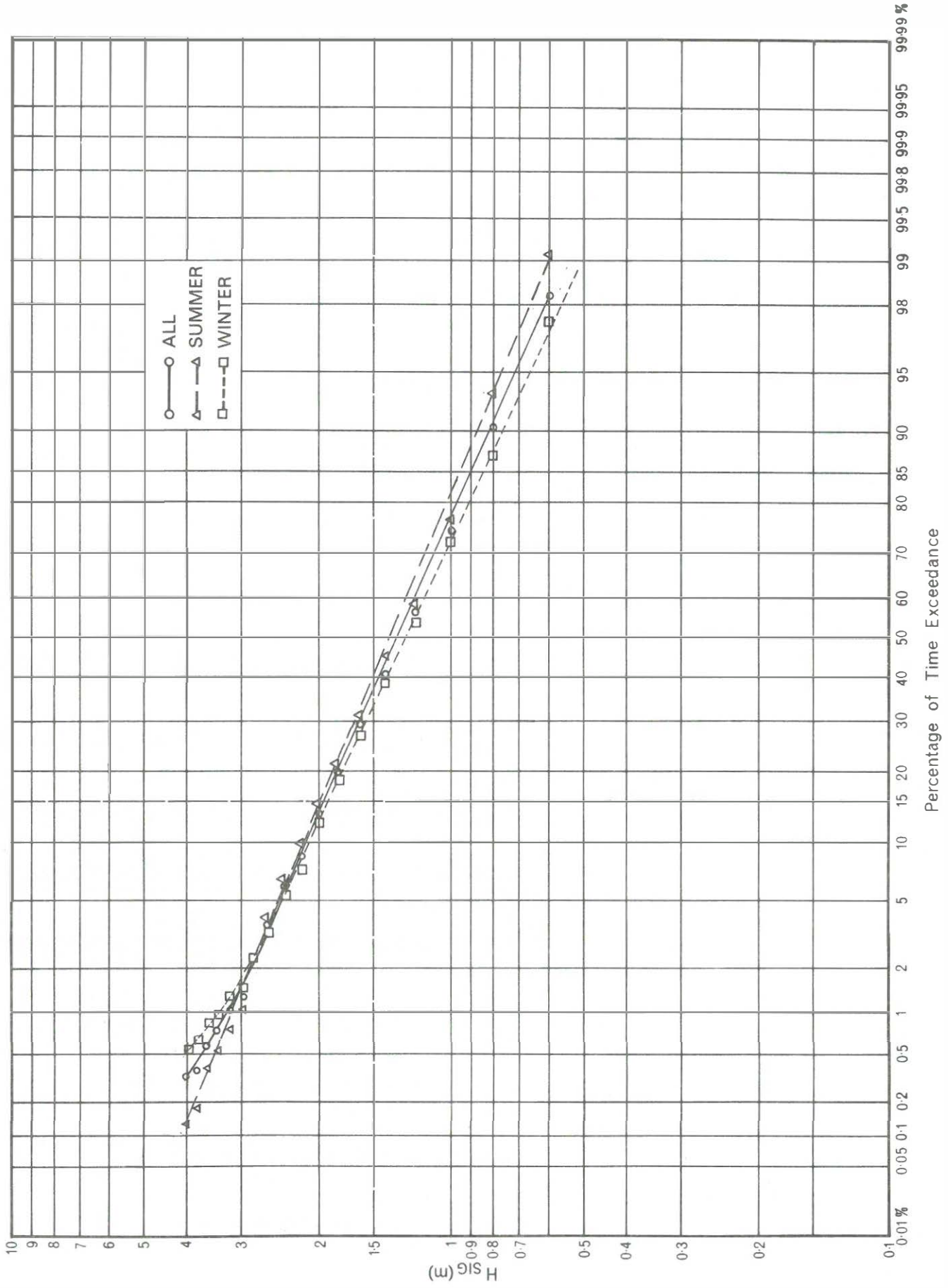


Beach Protection Authority

LOCALITY MAP

Wave Data Recording Program
Brisbane Region

Figure 1
W 09·1



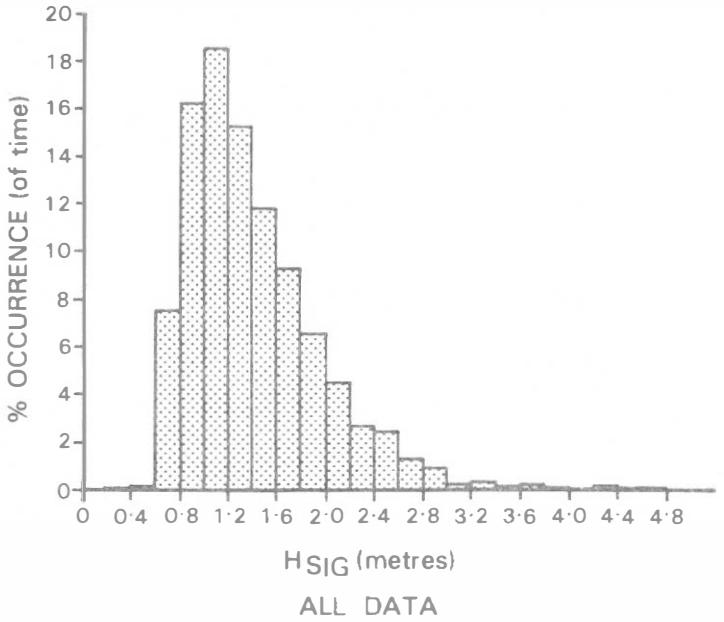
Beach Protection Authority

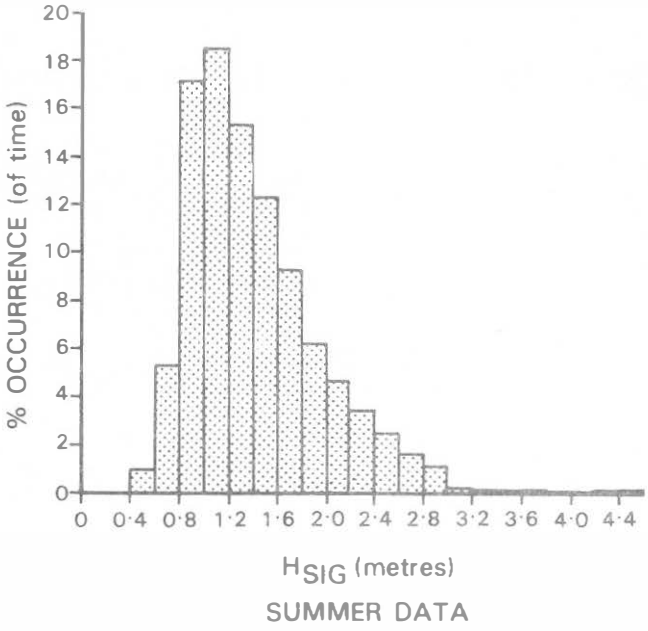
PERCENTAGE (OF TIME) EXCEEDANCE OF WAVE HEIGHTS (H_{sig}) FOR ALL WAVE PERIODS

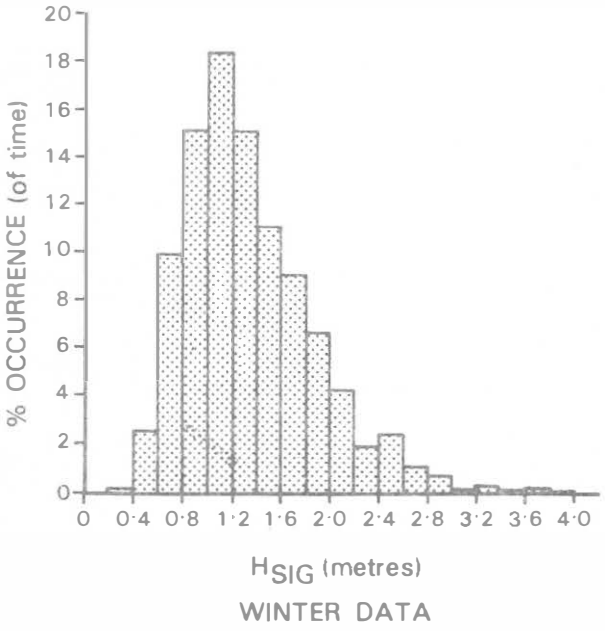
30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 2
W 09:1







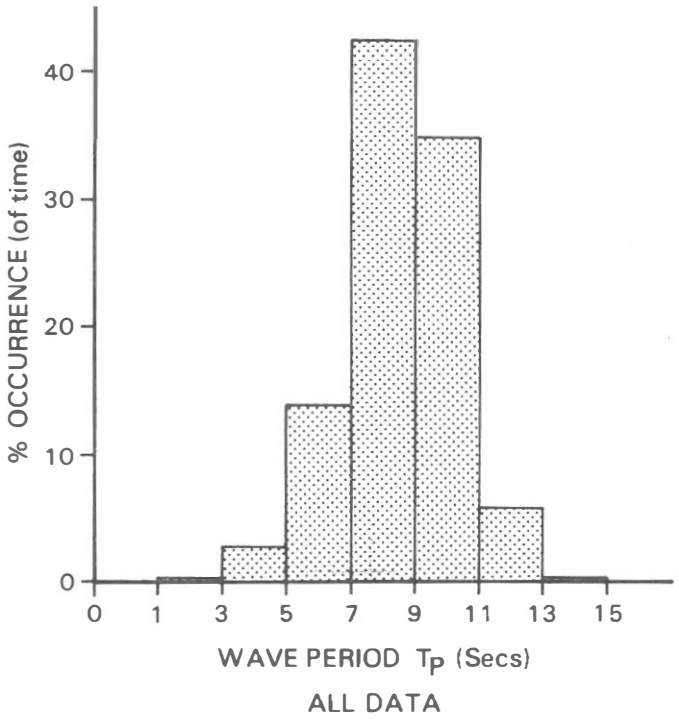
Beach Protection Authority

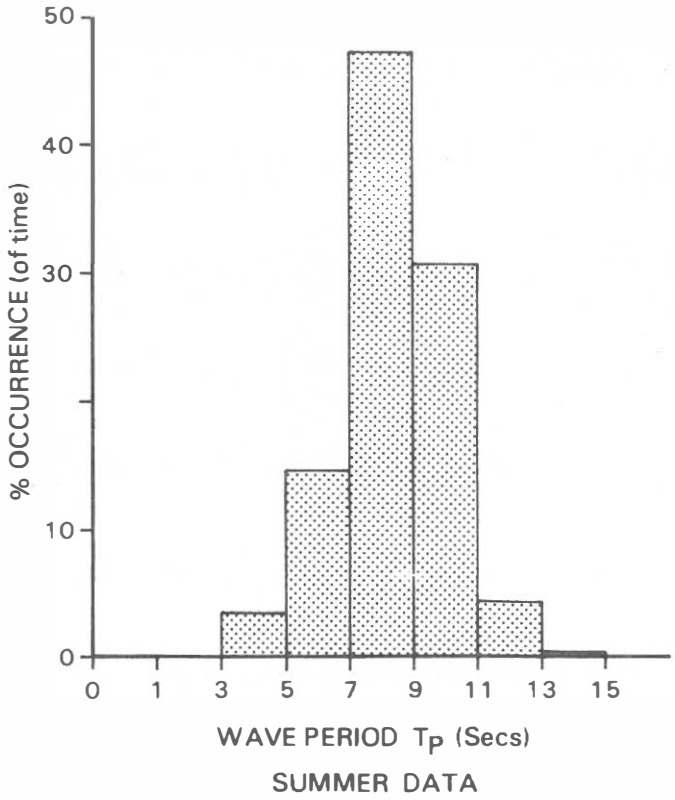
HISTOGRAM PERCENTAGE (OF TIME) OCCURRENCE OF WAVE HEIGHTS (H_{sig}) FOR ALL WAVE PERIODS

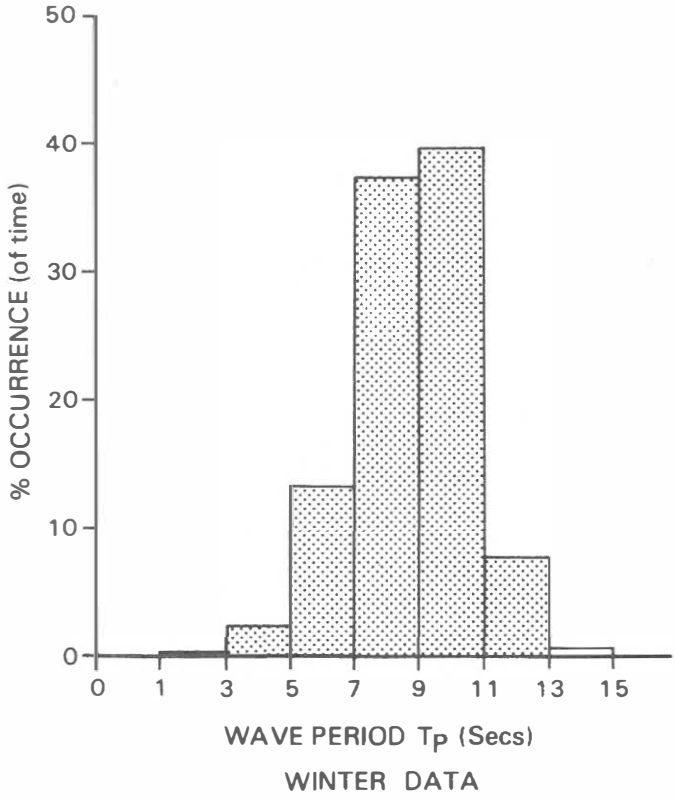
30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 3
W 09:1







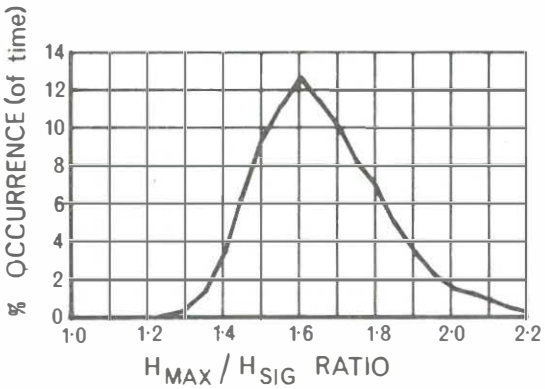
Beach Protection Authority

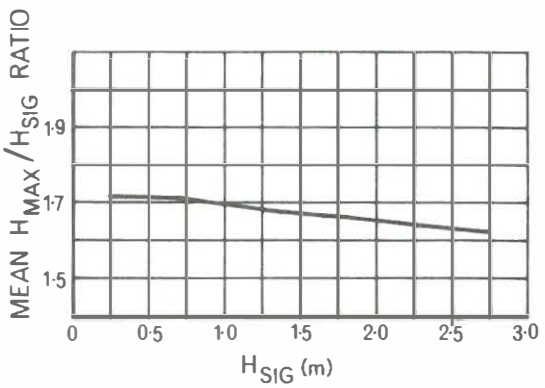
HISTOGRAM PERCENTAGE (OF TIME) OCCURRENCE OF WAVE PERIODS (Tp) FOR ALL WAVE HEIGHTS

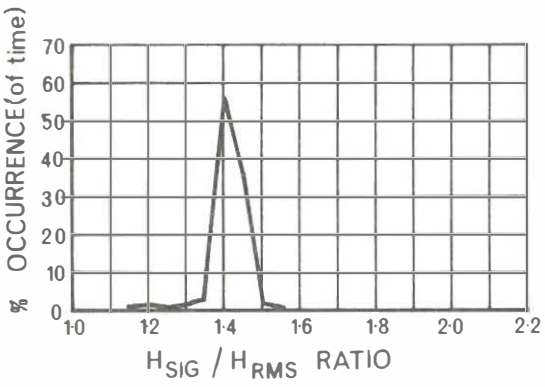
30th October 1976 to 30th June 1983

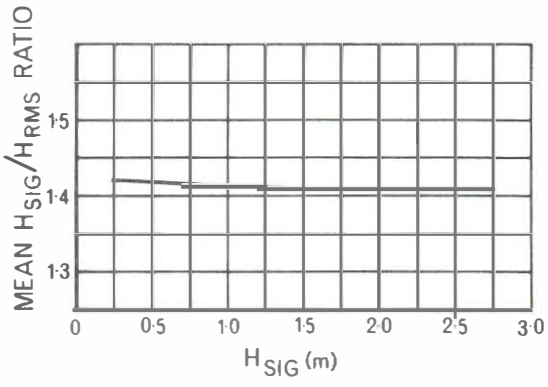
Wave Data Recording Program
Brisbane Region

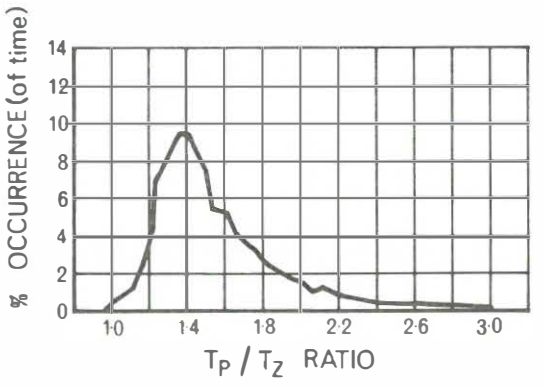
Figure 4
W 09:1

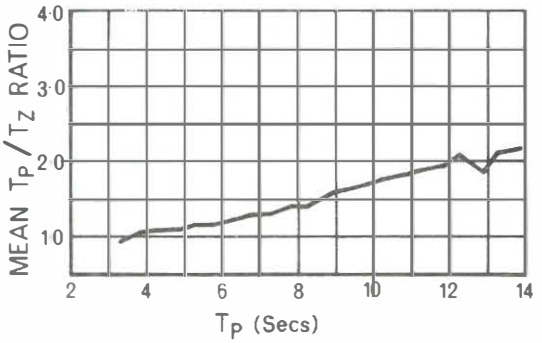


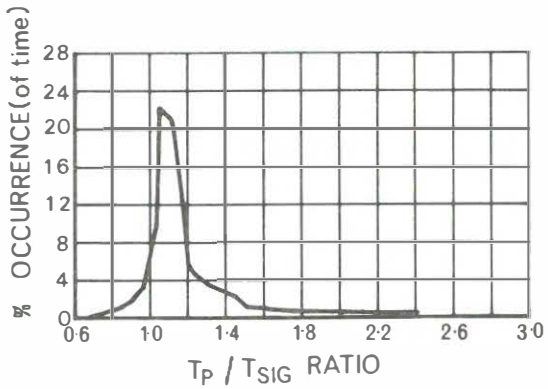


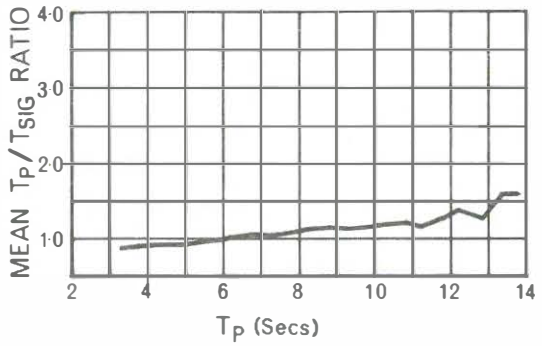












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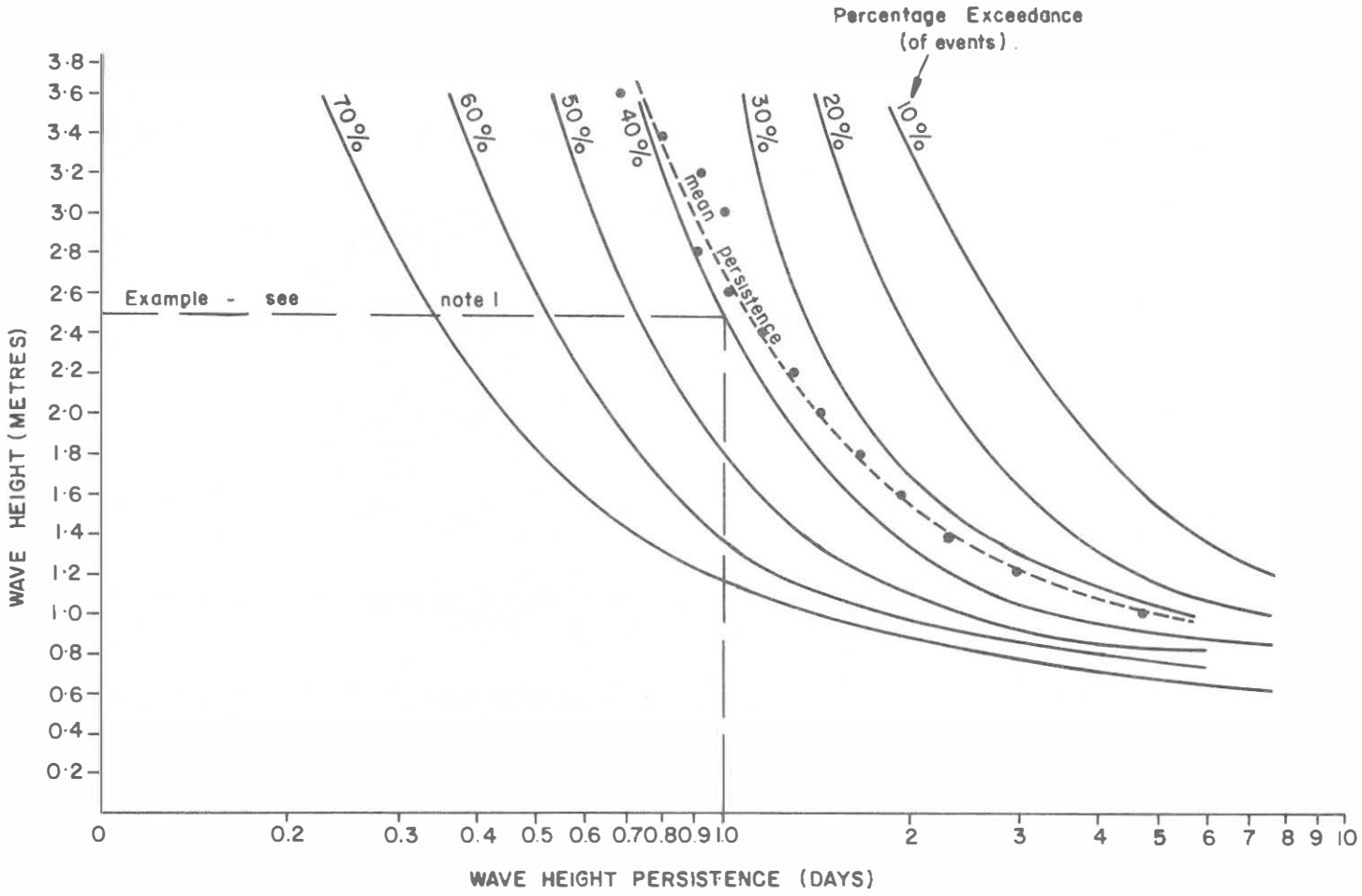
WAVE PARAMETER RELATIONSHIPS

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 5
W 09:1



Note:-

1. Wave height persistence is the duration for which a given significant wave height is continuously exceeded. As an example, given a 2.5 metre significant wave height, there is a 40 % 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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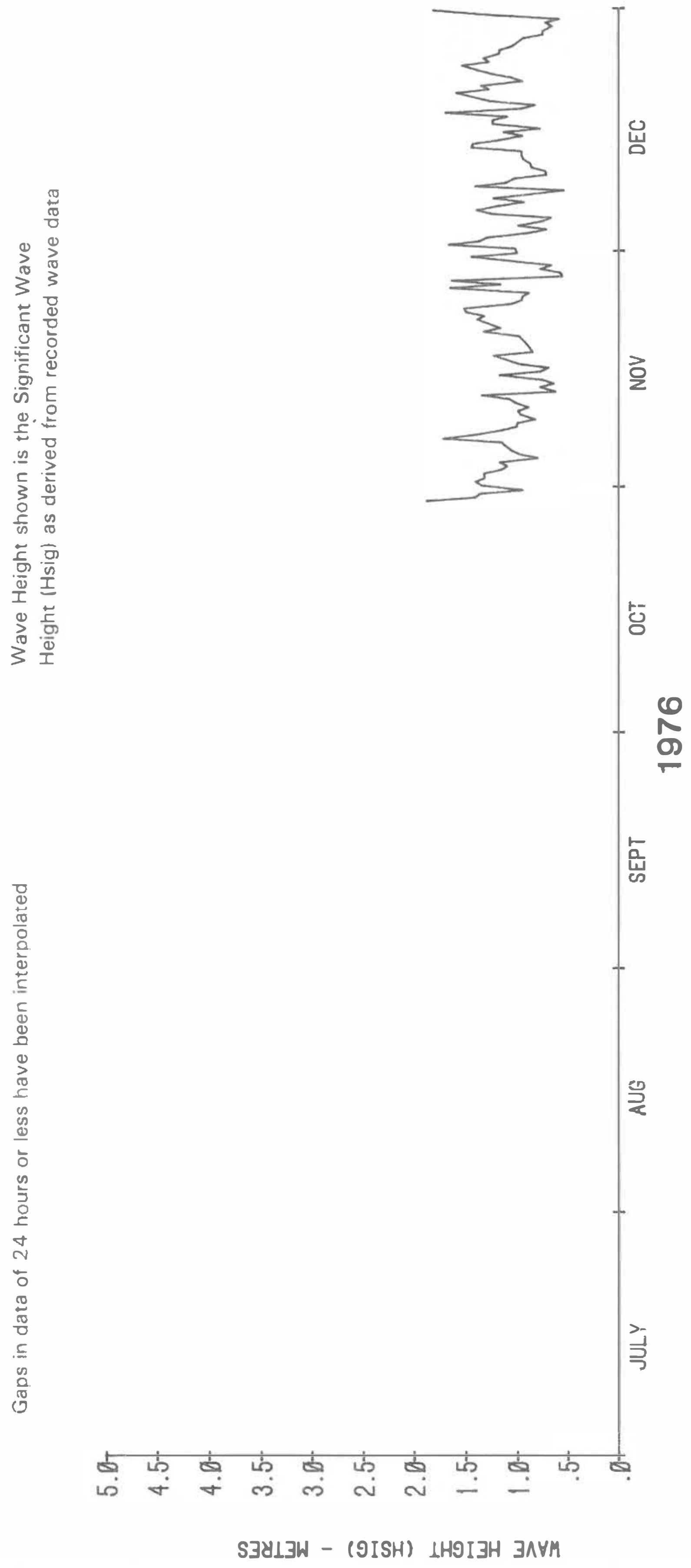
AVERAGE DURATION OF EXCEEDANCE OF WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 6
W 09:1



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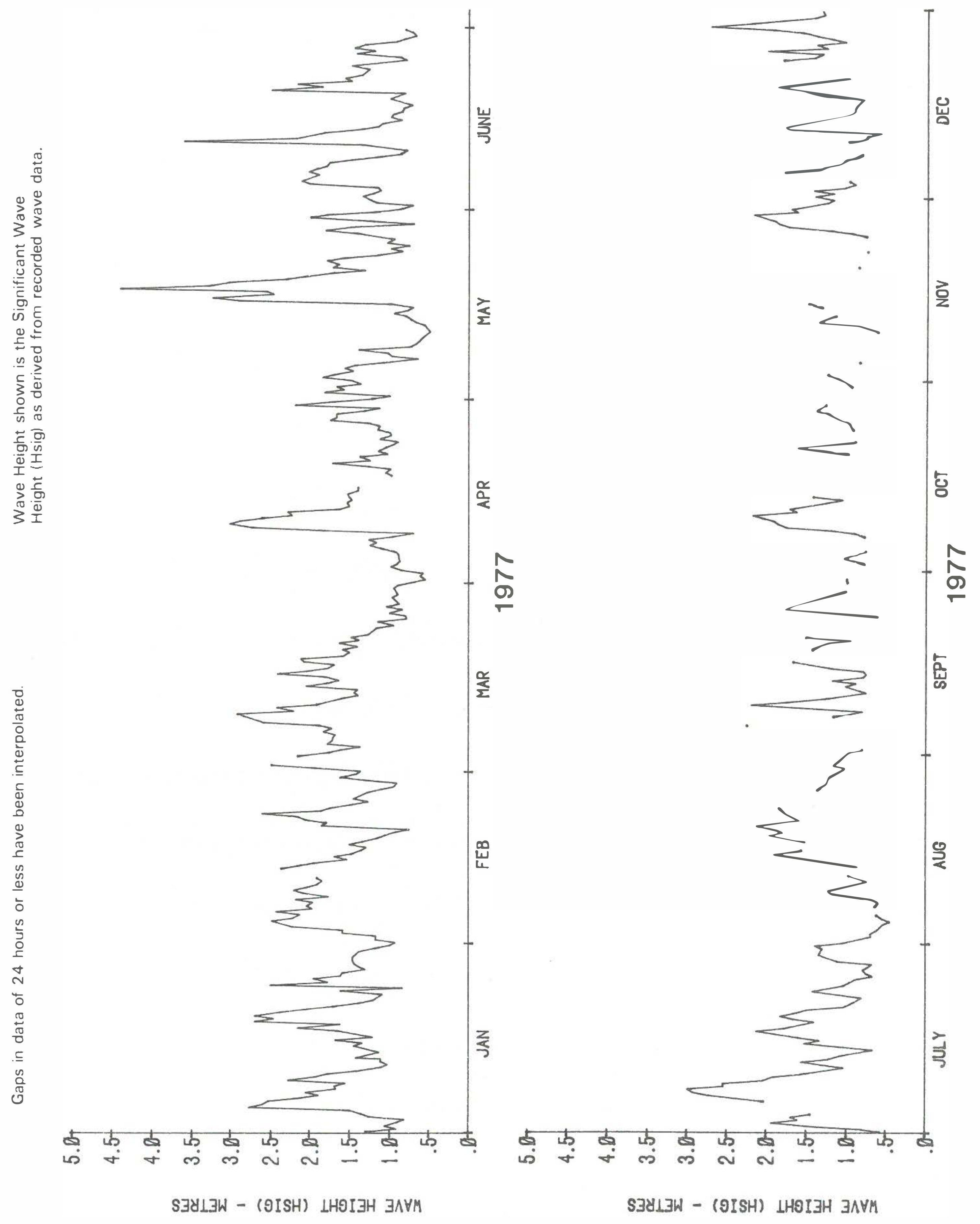
DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 7
W 09:1

Sheet 1 of 8



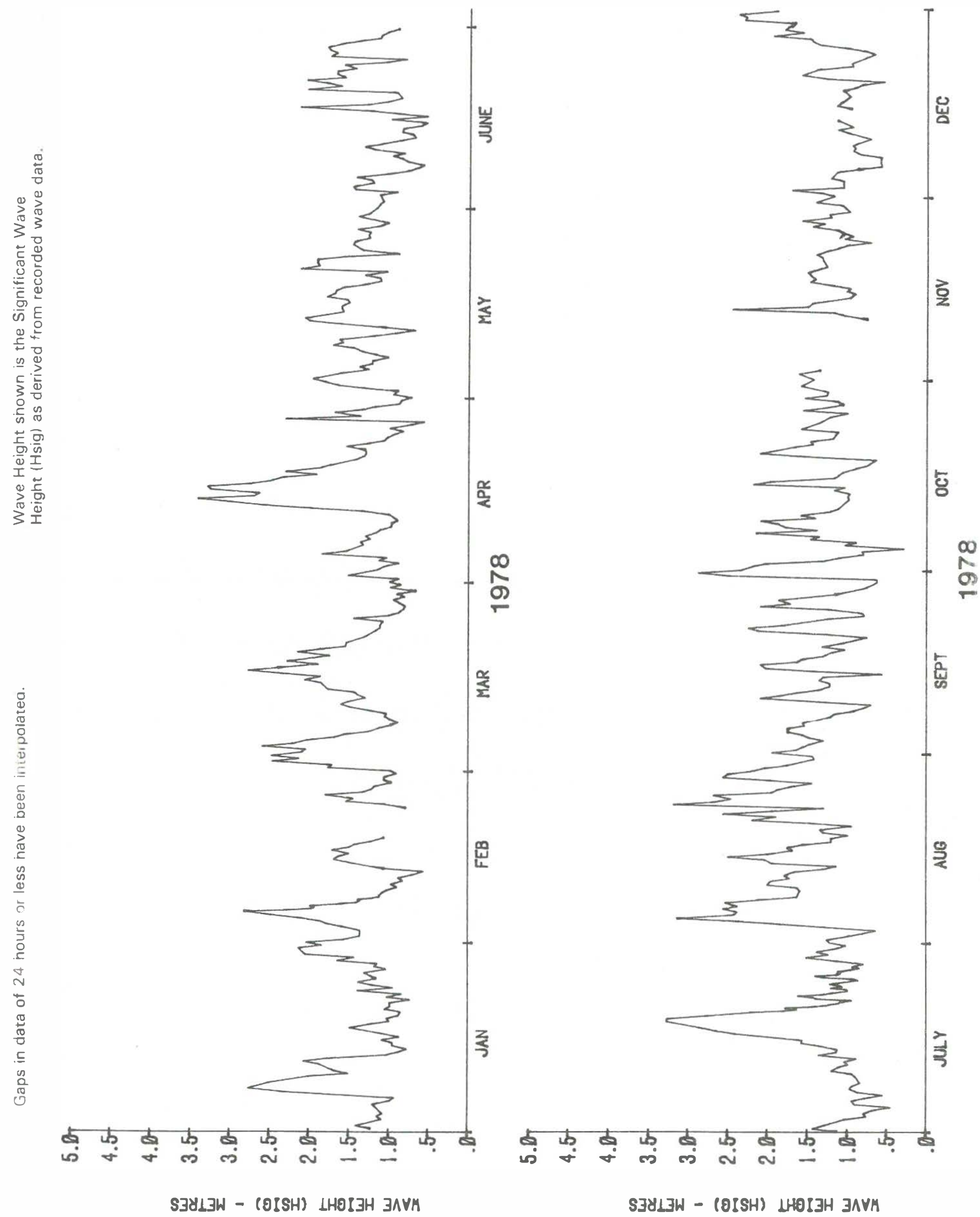
Wave Data Recording Program
Brisbane Region

Beach Protection Authority

DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Figure 7
W 09:1
Sheet 2 of 8



Wave Data Recording Program
Brisbane Region

DAILY WAVE HEIGHTS (H_{sig})

Figure 7
W 09:1

30th October 1976 to 30th June 1983

Beach Protection Authority

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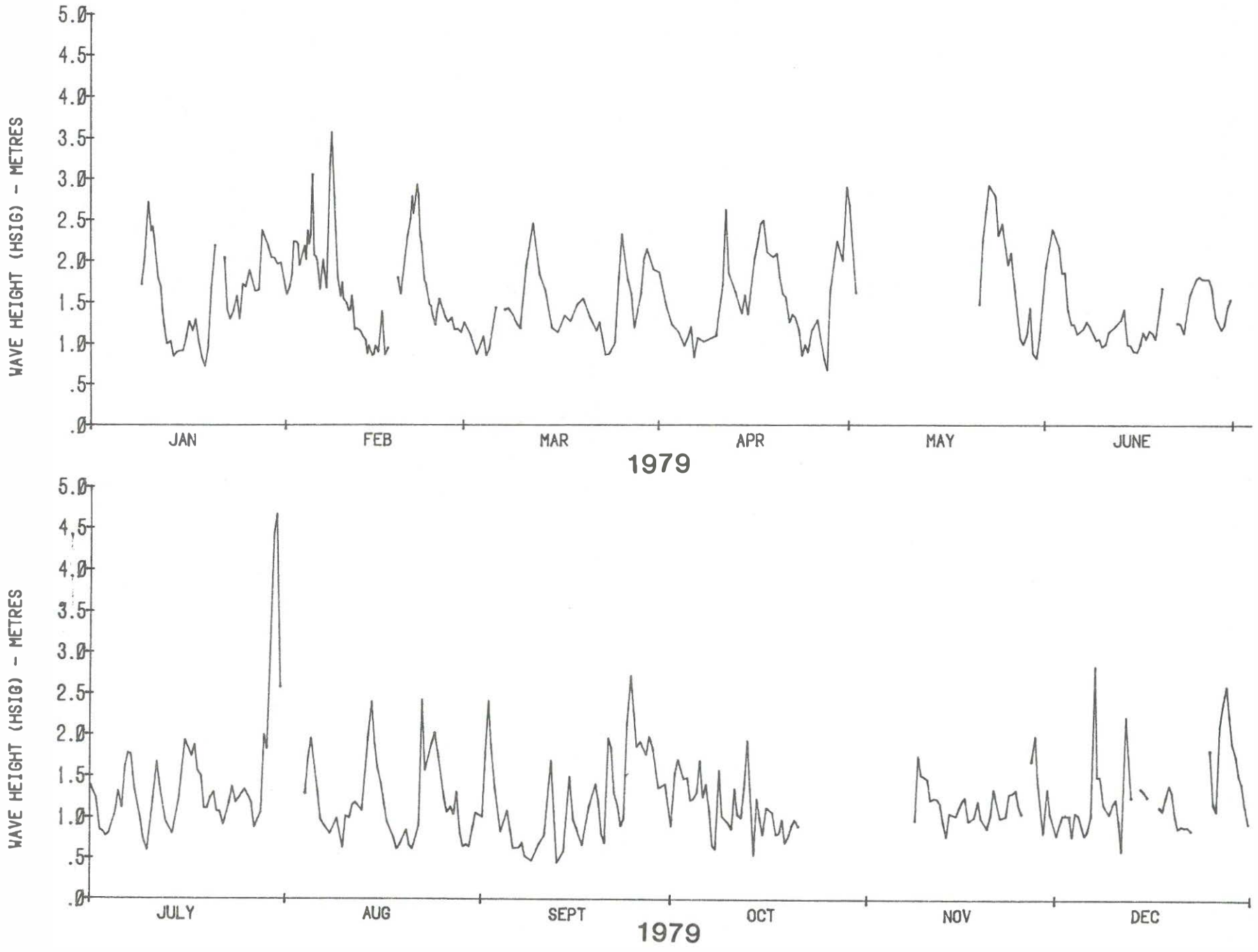
Gaps in data of 24 hours or less have been interpolated.

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



DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

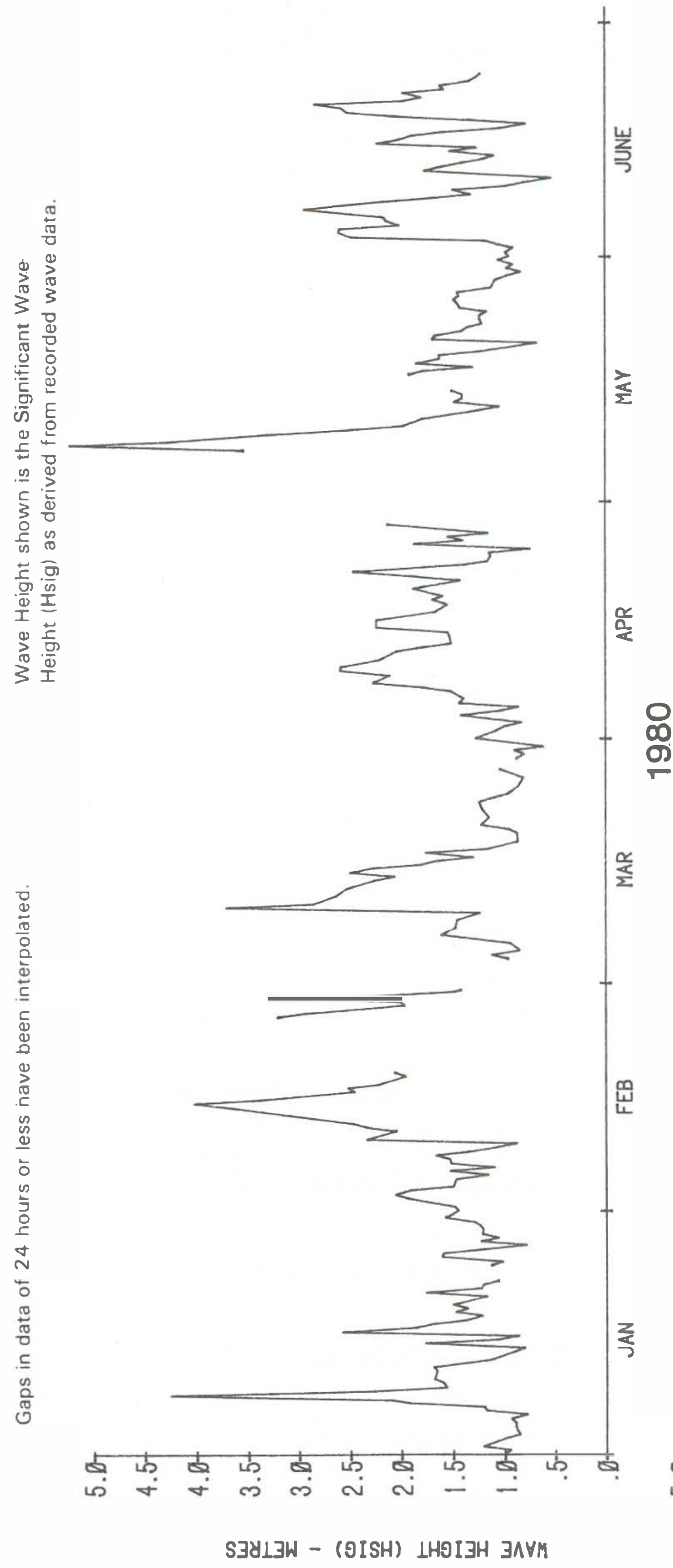
Wave Data Recording Program

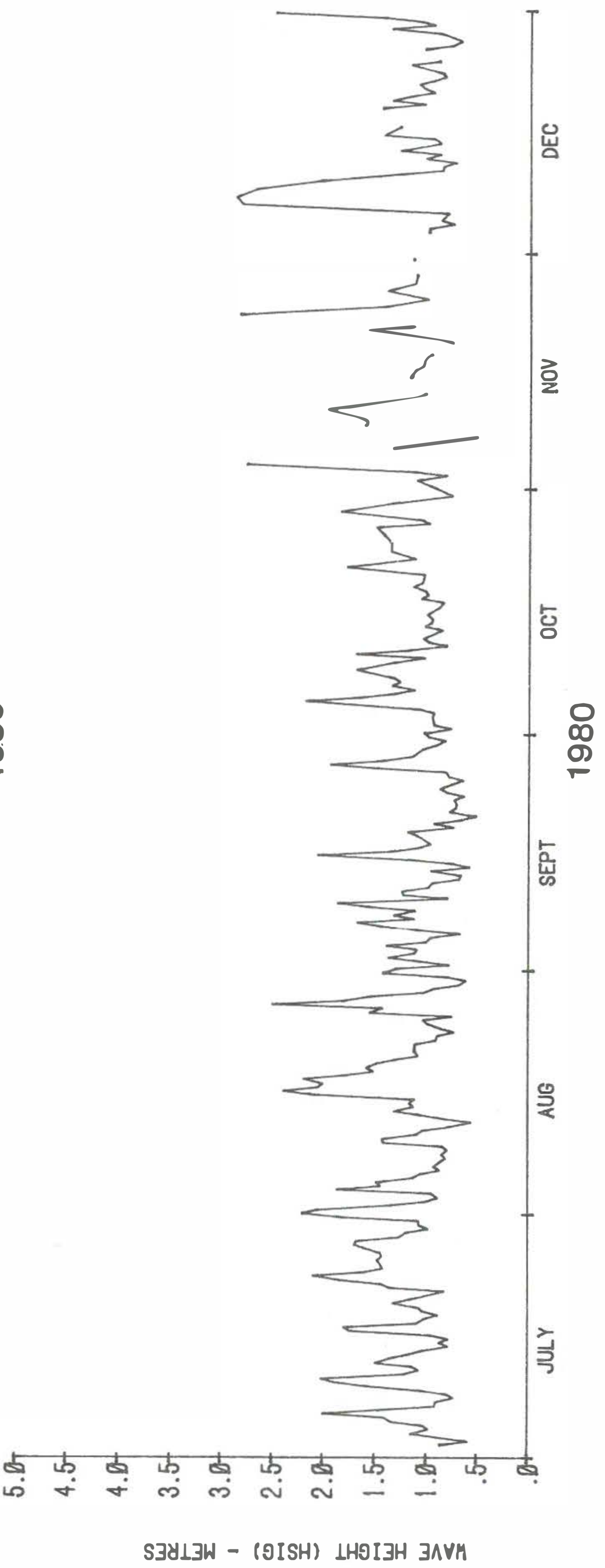
Brisbane Region

Figure 7

W 09:1

Sheet 4 of 8





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DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 7
W 09:1

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DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Wave Data Recording Program

Brisbane Region

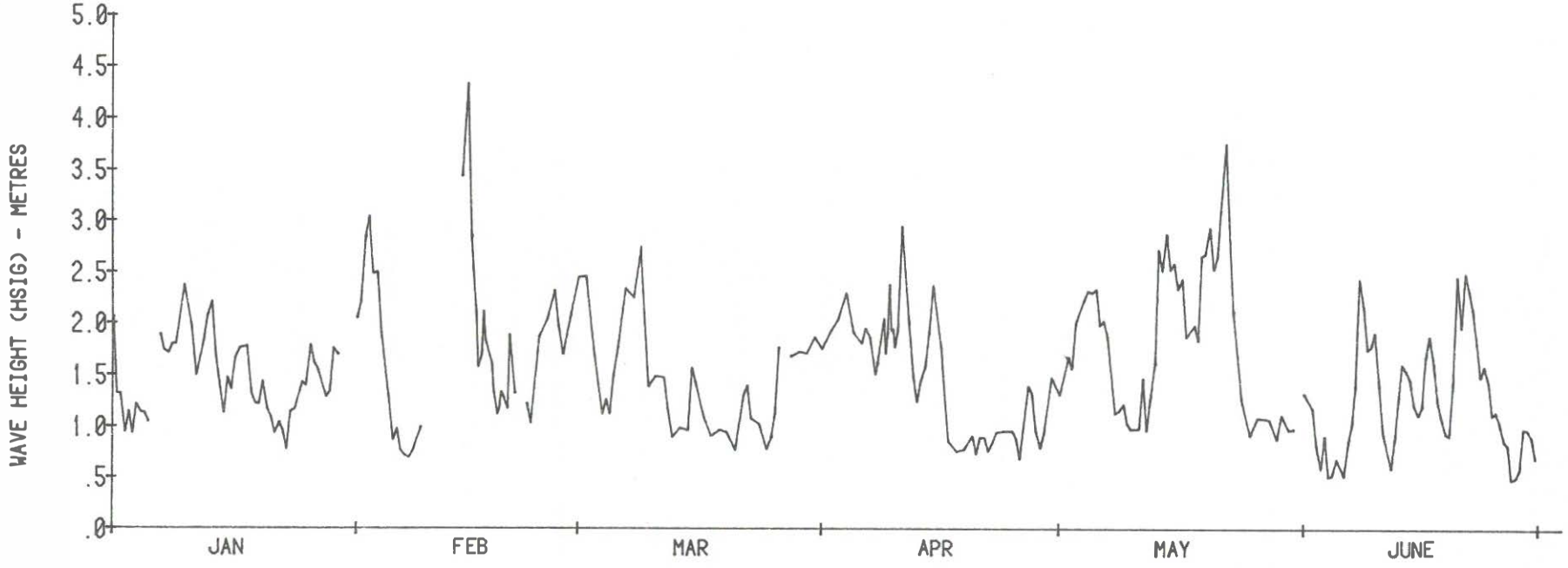
Figure 7

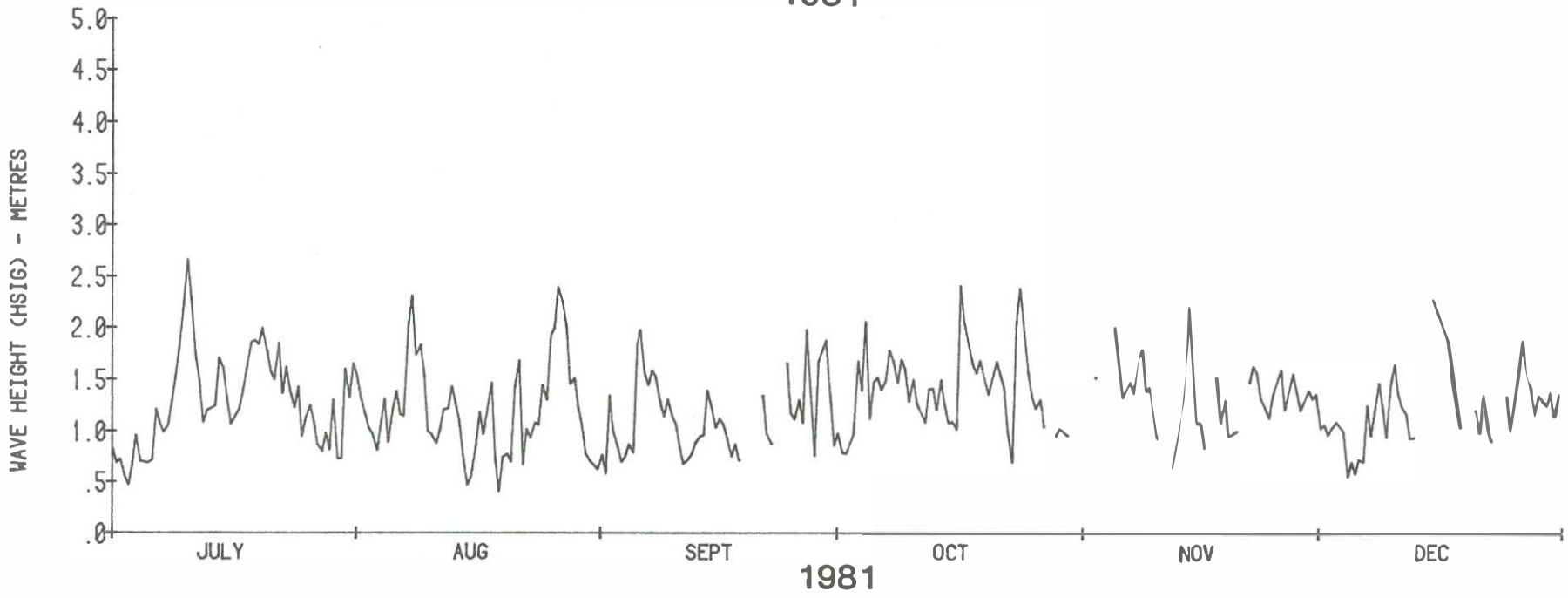
W 09:1

Sheet 6 of 8

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

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





Beach Protection Authority

DAILY WAVE HEIGHTS (H_{sig})

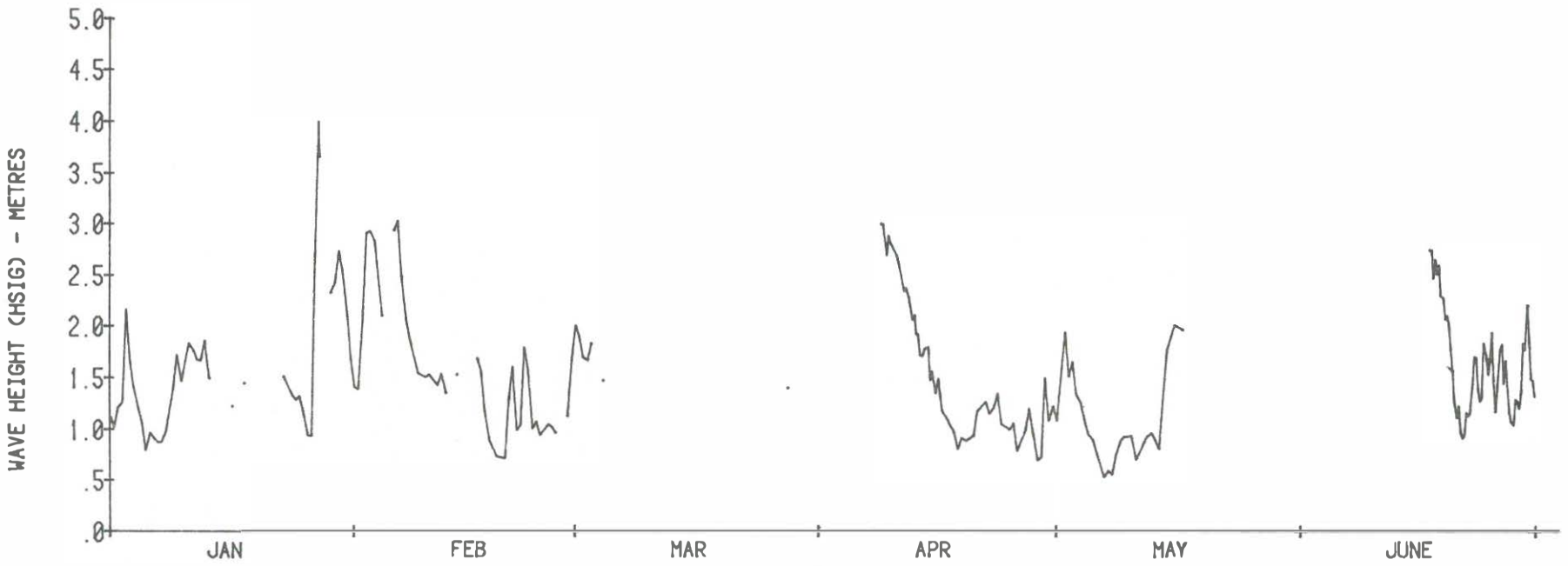
30th October 1976 to 30th June 1983

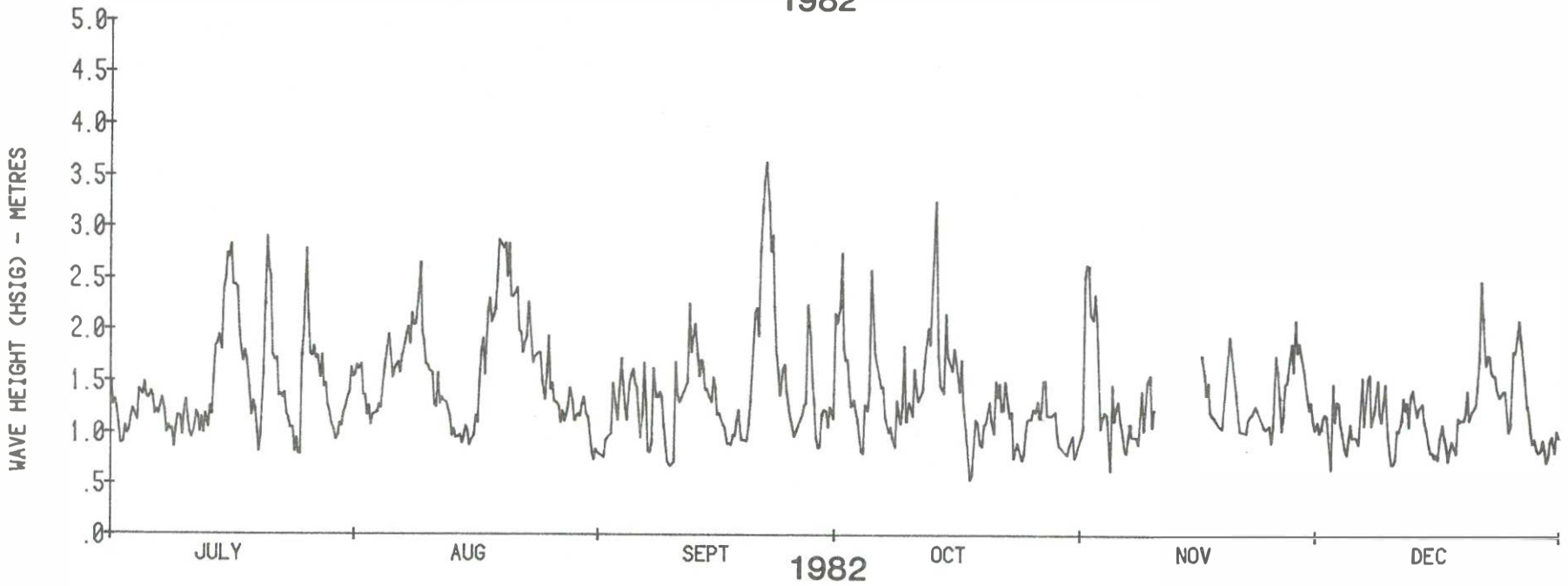
Wave Data Recording Program
Brisbane Region

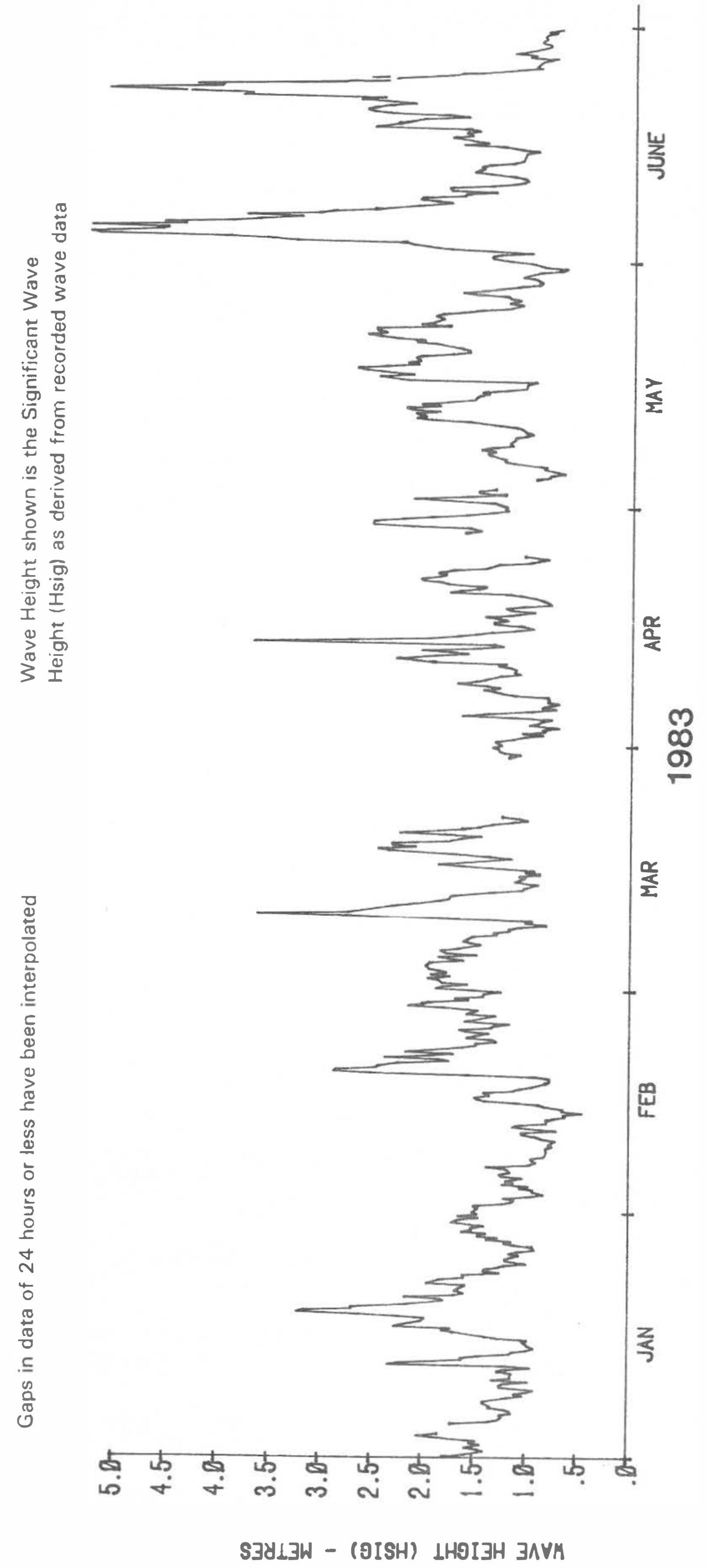
Figure 7
W 09:1
Sheet 7 of 8

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

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







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DAILY WAVE HEIGHTS (H_{sig})

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 7
W 09 :1

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Beach Protection Authority

DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program

Brisbane Region

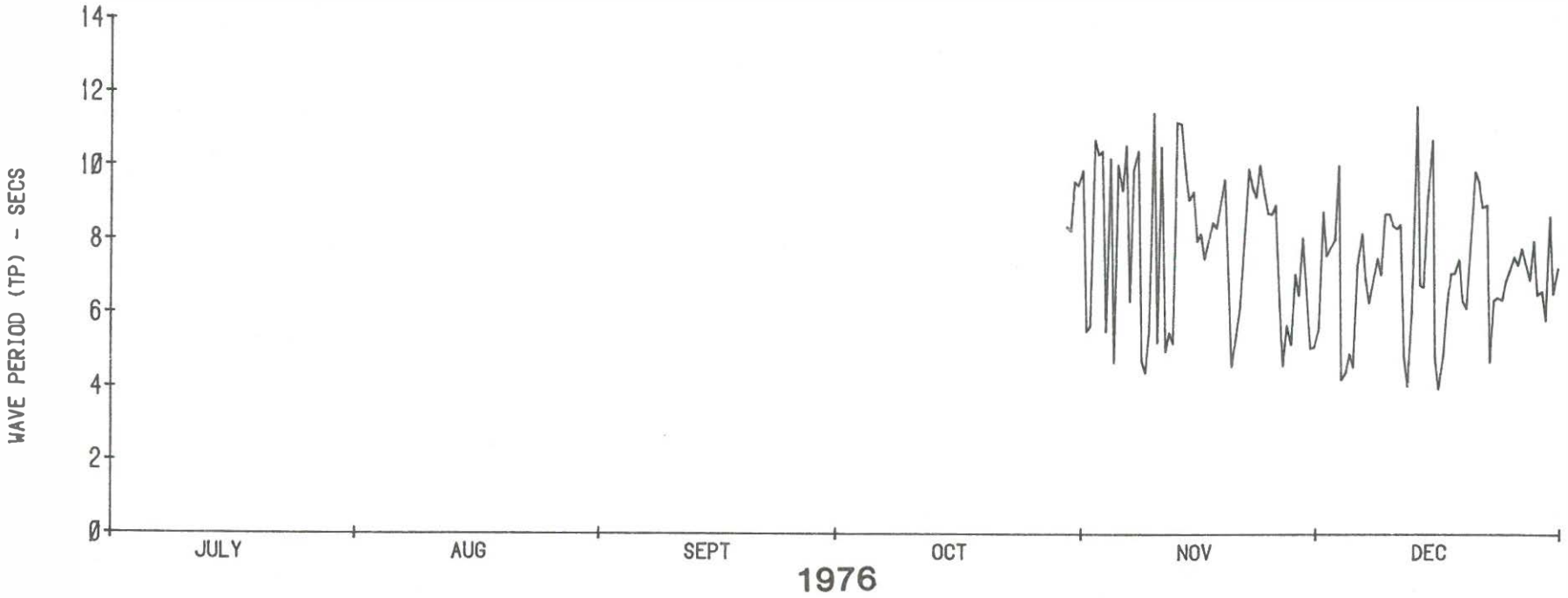
Figure 8

W 09:1

Sheet 1 of 8

Gaps in data of 24 hours or less have been interpolated

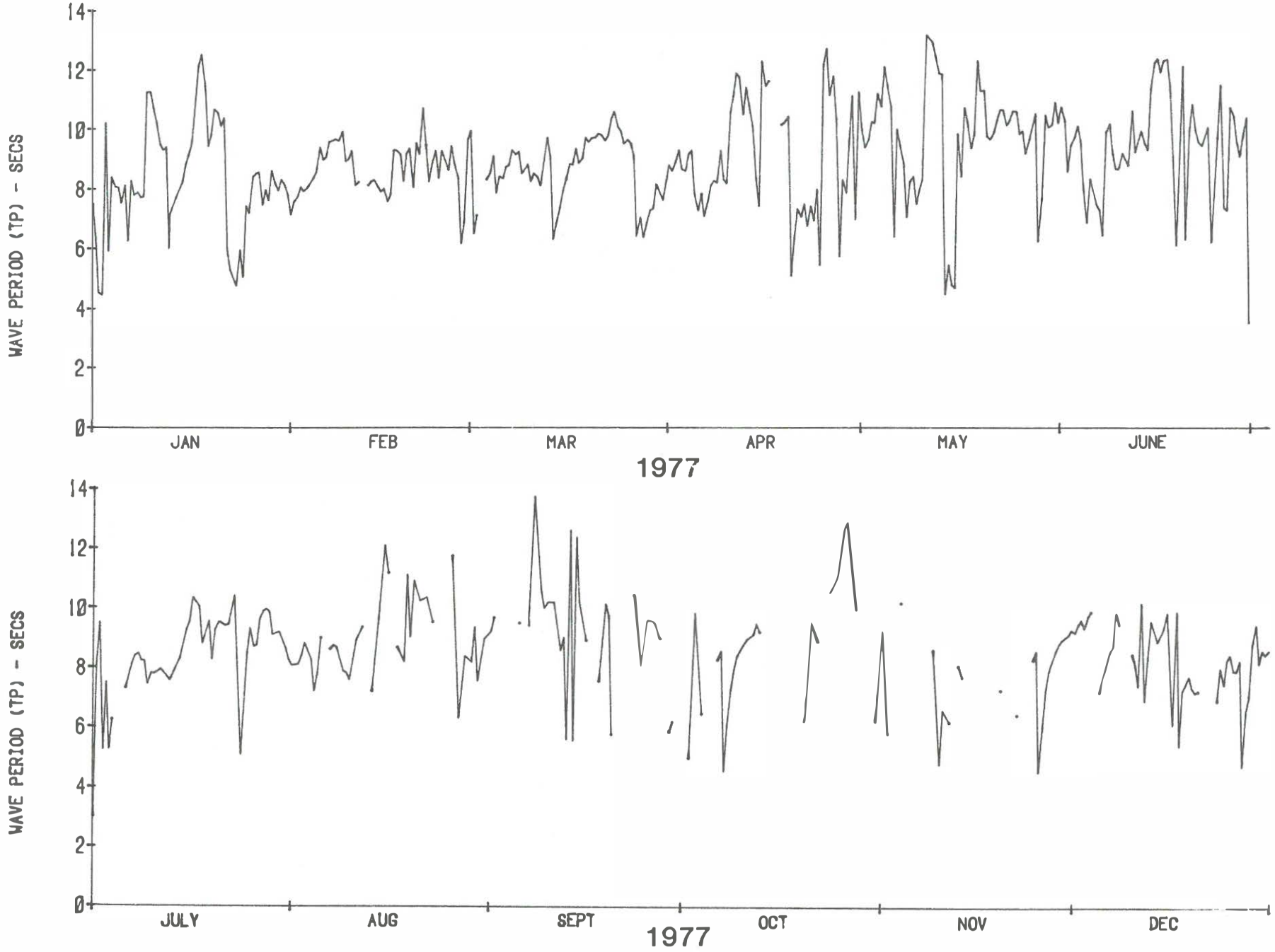
Wave Period is the Peak Energy Period (Tp) as derived from record recorded wave data.



Beach Protection Authority

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.



DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program

Brisbane Region

Figure 8

W 09:1

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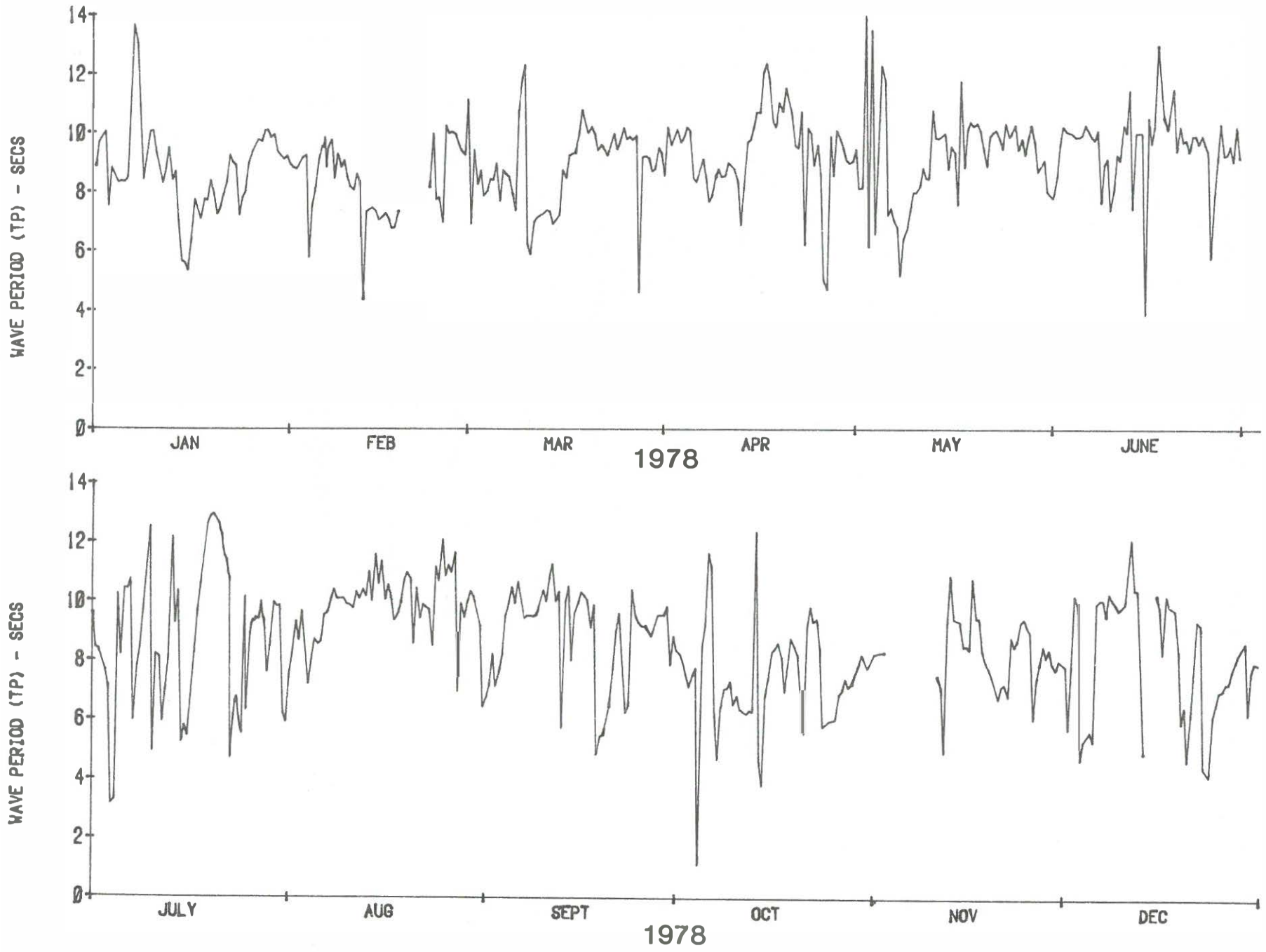
Beach Protection Authority

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.



DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program

Brisbane Region

Figure 8

W 09:1

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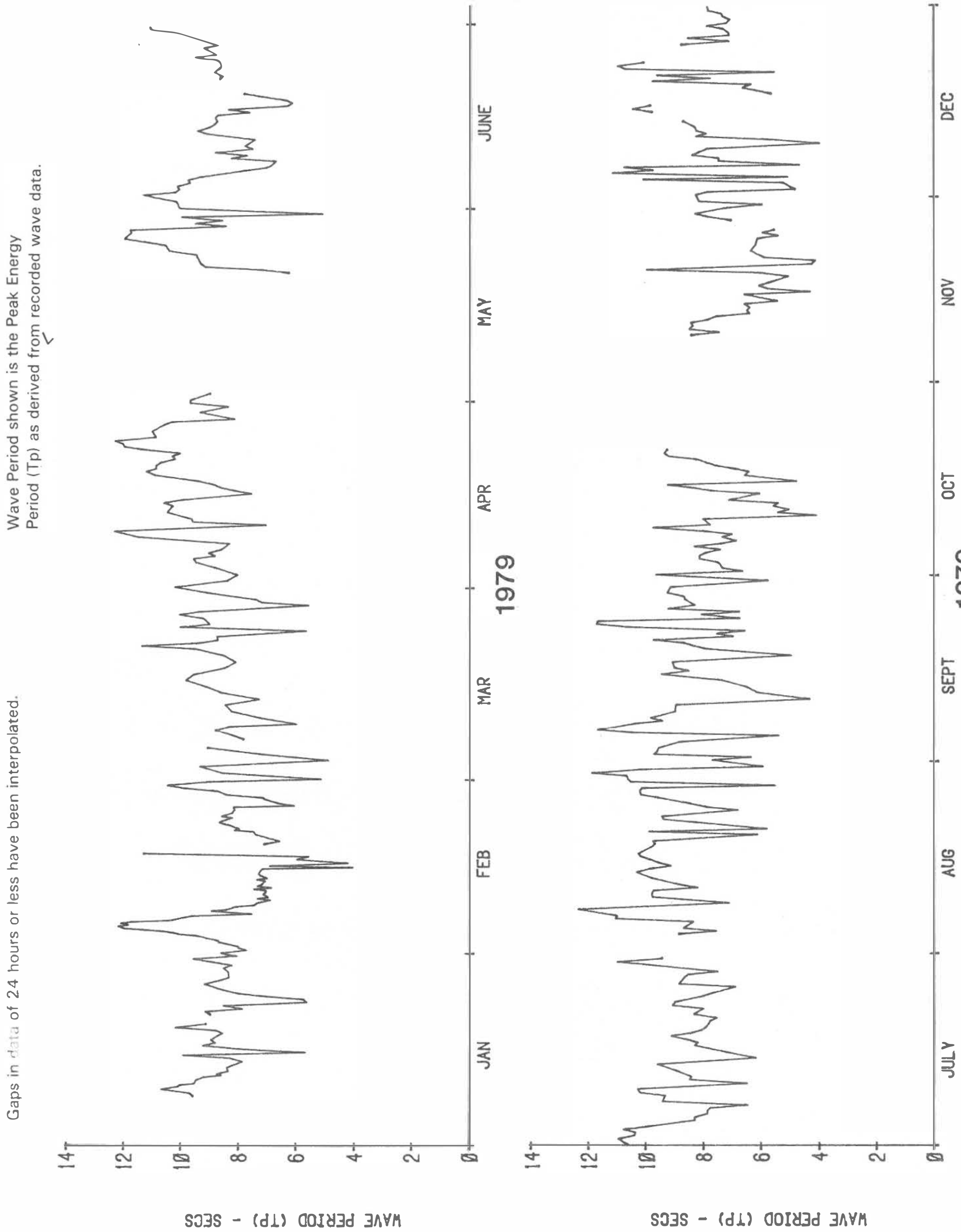

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DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 8
W 09:1

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Beach Protection Authority

DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program

Brisbane Region

Figure 8

W 09:1

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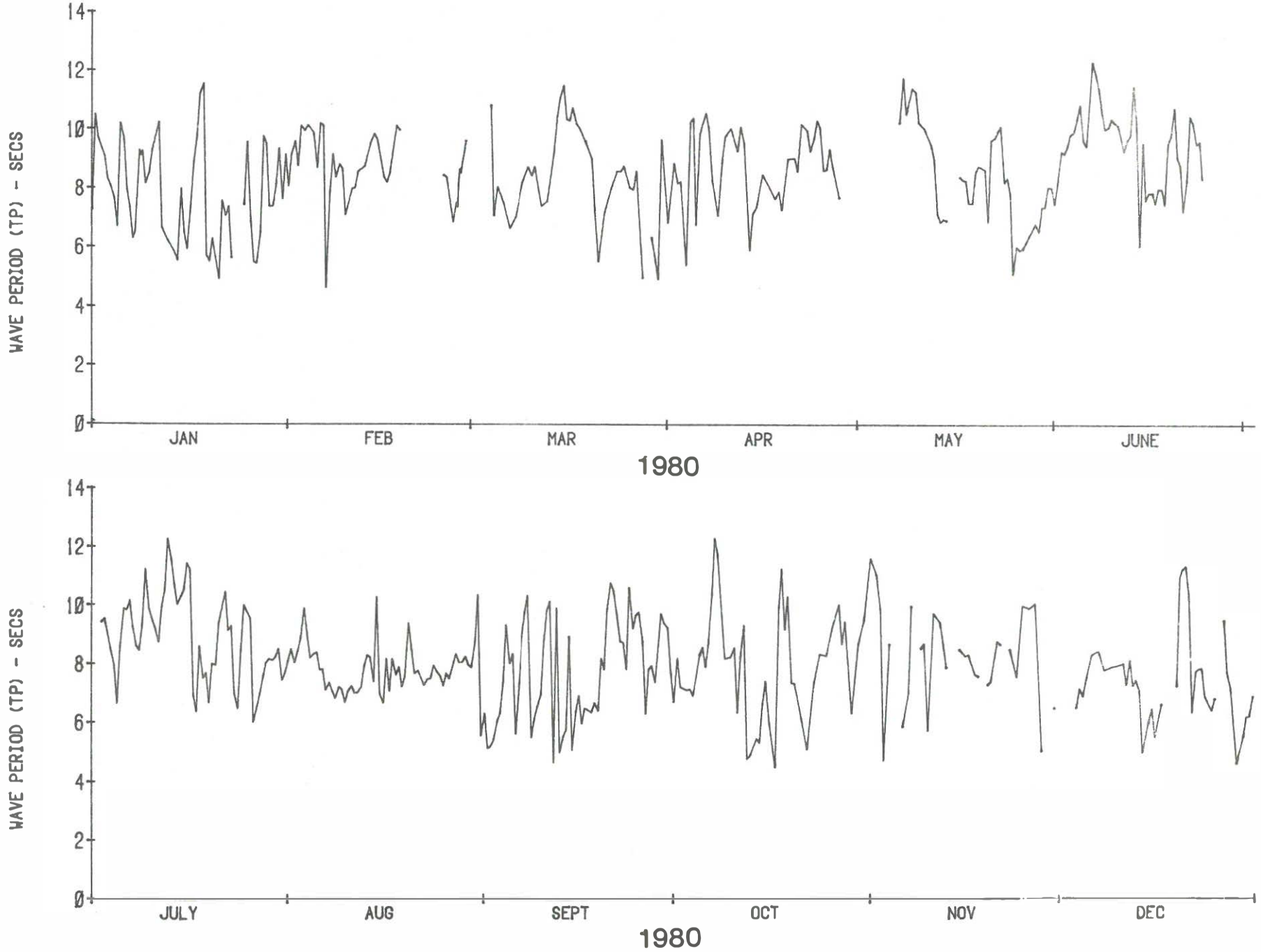
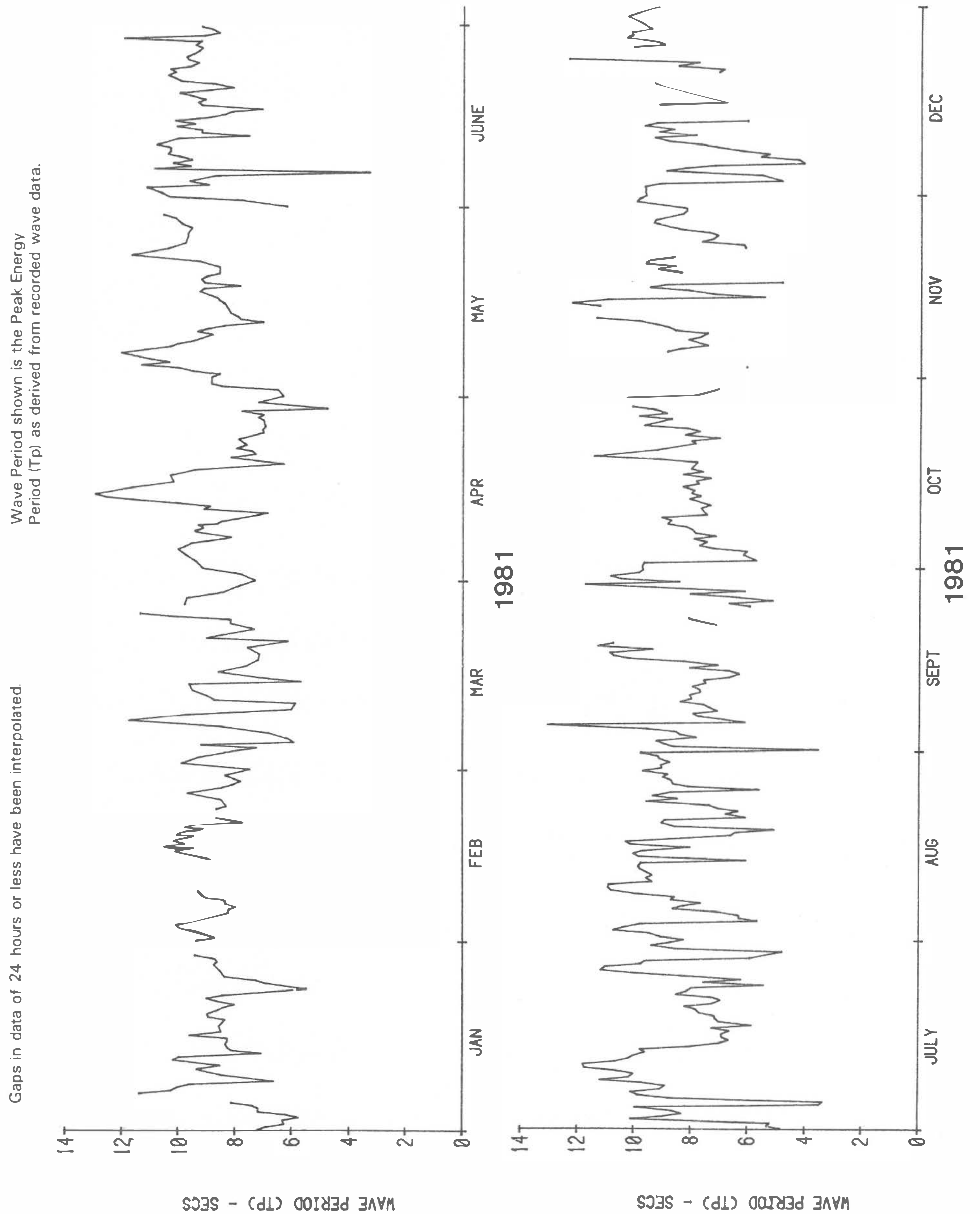
Gaps in data of 24 hours or less have been interpolated.

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





Beach Protection Authority

DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 8
W 09:1

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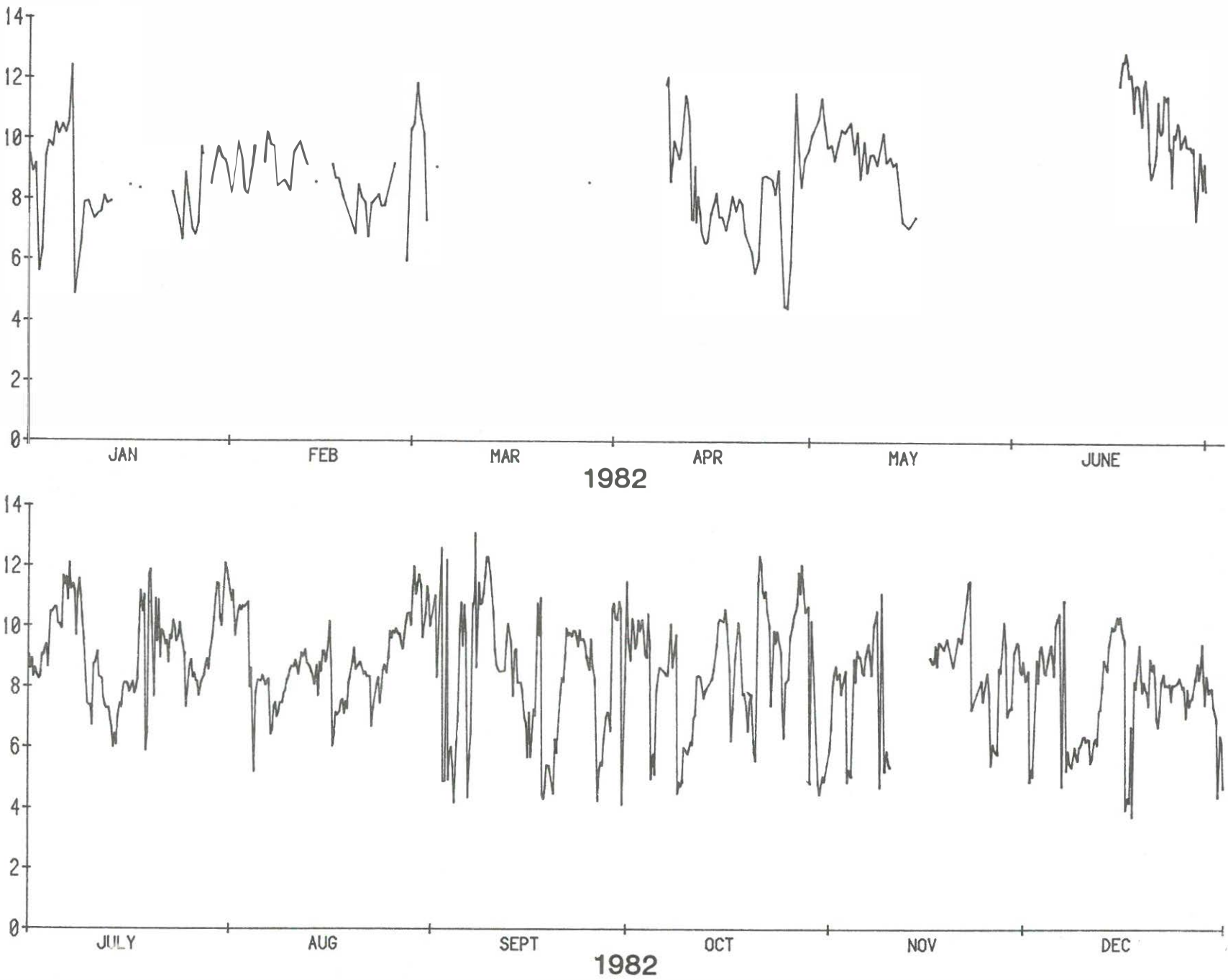
Beach Protection Authority

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.

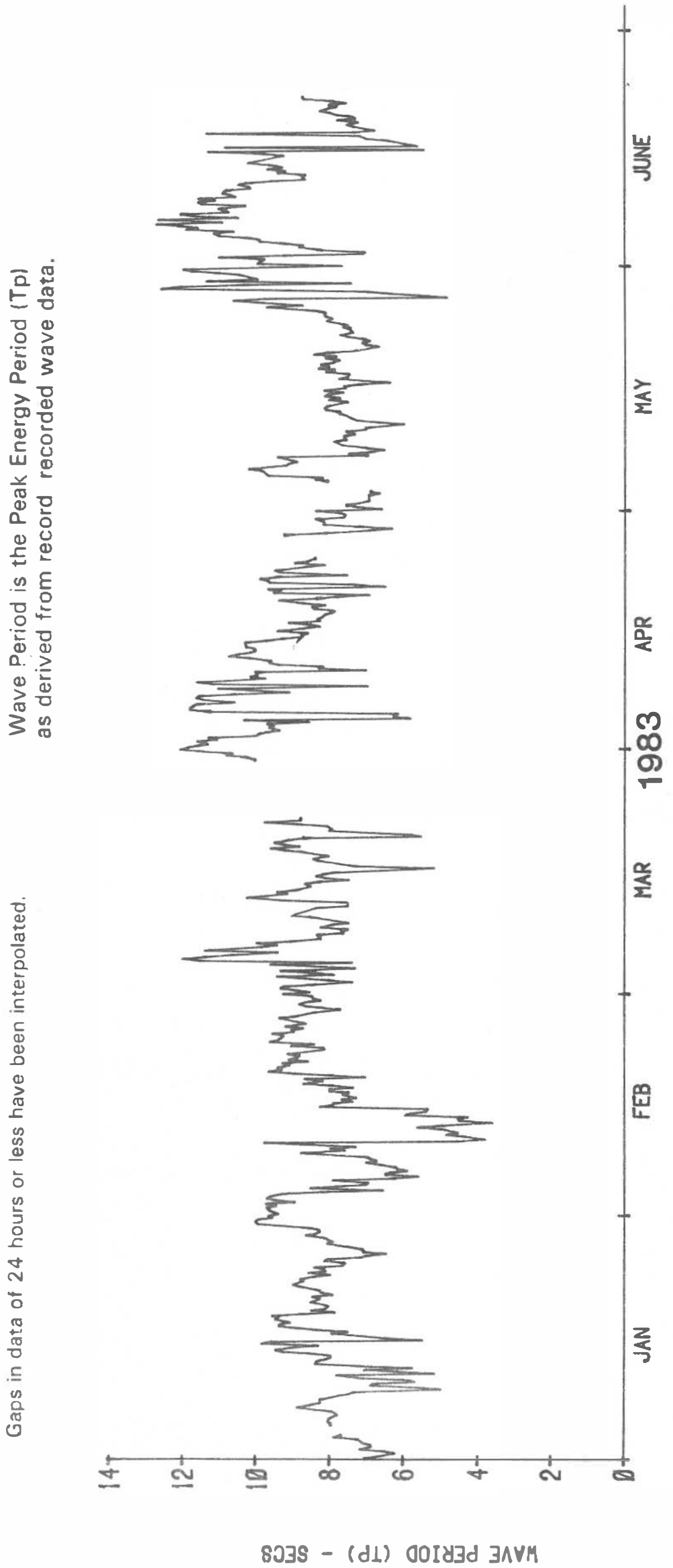


DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 8
W 09:1
Sheet 7 of 8



Wave Data Recording Program

Brisbane Region

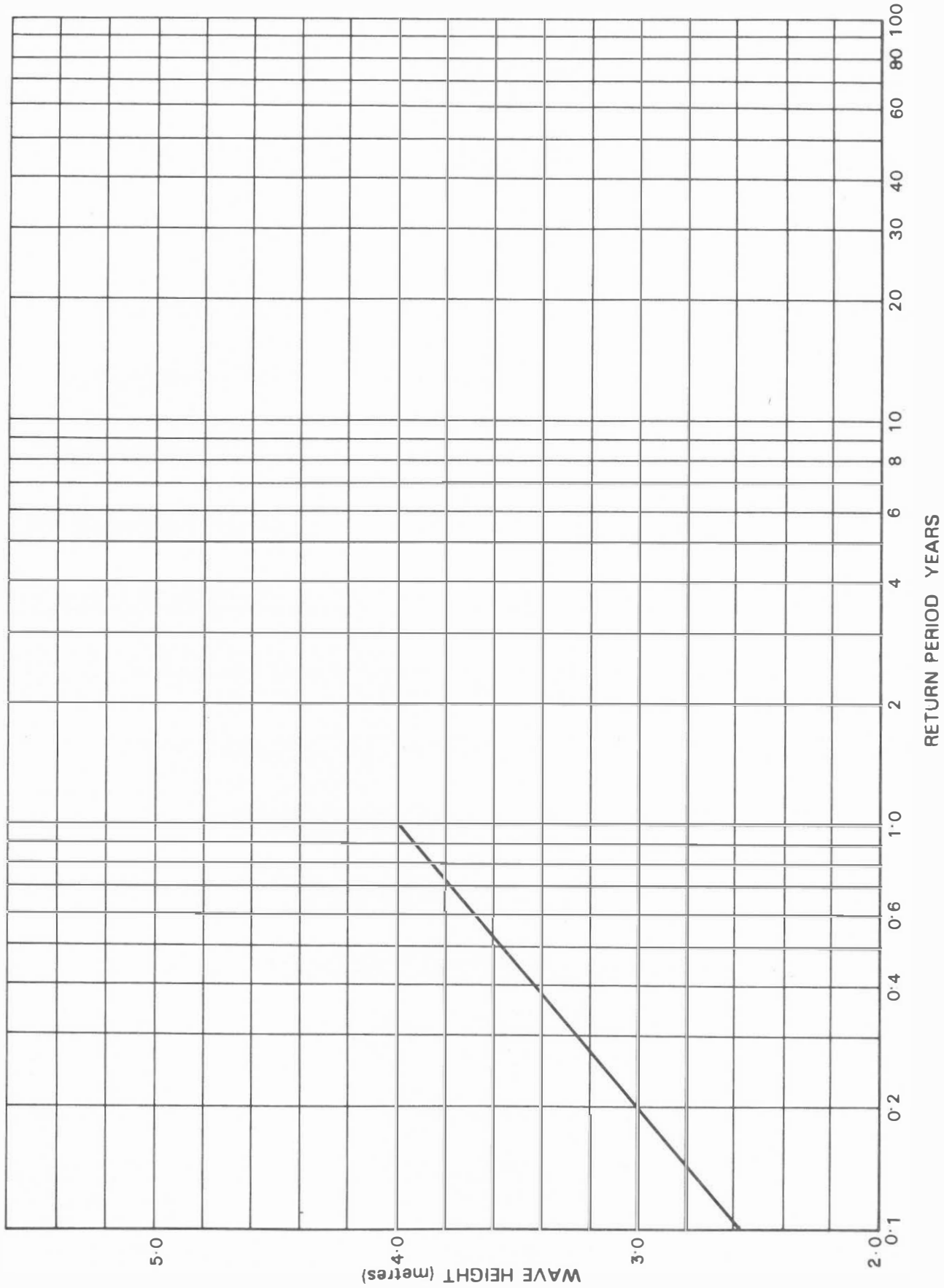
DAILY WAVE PERIODS

30th October 1976 to 30th June 1983

Figure 8

W 09:1

Beach Protection Authority



Beach Protection Authority

WAVE HEIGHT (H_{sig}) RECURRENCE INTERVALS

30th October 1976 to 30th June 1983

Wave Data Recording Program
Brisbane Region

Figure 9
W 09:1

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