

WAVE DATA RECORDING PROGRAMME

TOWNSVILLE REGION



Beach Protection Authority of Queensland.

REPORT NO. W 03.1

WAVE DATA RECORDING PROGRAM

TOWNSVILLE REGION

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Prepared by the Beach Protection Authority

November 1979

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 Townsville in Northern Queensland. Data was recorded using a Datawell "Waverider" buoy owned by the Townsville Harbour Board and operated by the Authority, and covers the period July 16, 1975 to February 23, 1979. 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 Programme, Cairns Region (Report No. W 01.1)
Wave Data Recording Programme, Mackay Region (Report No. W 02.1)

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WAVE DATA RECORDING PROGRAM

TOWNSVILLE REGION

REPORT NO. W 03.1

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 Townsville 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 RECORDING AND ANALYSIS PROCEDURES

In general 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.

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 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 RECORD LOSSES

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

Losses in the first two categories are usually non-recoverable. Records 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 records 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 records. Such reinstatement however, is only carried out if the errors constitute a significant proportion of the total number of records.

Details of record losses in the Townsville 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 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:- Townsville Region

Buoy Location:-

Co-ordinates:- 174°03' East 19°08'30" South

Description:- 6 kilometres North East of Cape Cleveland (see Figure 1)

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

Location of Recording Station:- Cape Cleveland Lighthouse Reserve.

Period of Data Collection:- July 16, 1975 to February 23, 1979 (1318 days)

Normal Recording Interval:- Two twenty minute records daily at 0300 hours and 1500 hours.

Total Number of Records Analysed:- 2235

Number of Records Lost due to

Field equipment failure:- 360

Losses during analysis:- 39

Damaged Accelerometer Cables:- 12 (no records reinstated)

Periods during which four recordings per day were taken:-

February 16 - 21, 1977

Assessment of Data Quality:- Good

SUMMARY SHEET 2

MAJOR METEOROLOGICAL EVENTS

TOWNSVILLE REGION

| Cyclone Name | Date | Estimated Closest Point of Cyclone Track to Buoy | Maximum Hsig Recorded | Maximum Hmax Recorded |
|--------------|----------------------|--|--|--|
| David | January 17, 1976 | 700 km SE | 0.95 m | 1.98 m |
| Alan | February 1-2, 1976 | 300 km N | 1.18 m | 1.86 m |
| Beth | February 16-17, 1976 | 350 km NE | 1.37 m | 2.47 m |
| Colin | February 27, 1976 | 900 km E | 0.65 m | 1.17 m |
| Dawn | March 4, 1976 | 100 km E | 1.21 m | 2.08 m |
| Hope | March 12, 1976 | 1 100 km E | 0.83 m | 1.75 m |
| Watorea | April 27-28, 1976 | 300 km E | 1.46 m | 2.20 m |
| Ted | December 20, 1976 | 500 km W | 1.71 m | 3.01 m |
| Keith | February 1, 1977 | 40 km E | 1.89 m | 3.30 m |
| Nancy | February 12, 1977 | 300 km N | 1.59 m | 3.00 m |
| Otto | March 6, 1977 | 100 km NE | 1.78 m | 3.08 m |
| Gwen | January 27, 1978 | 70 km NE | Recorder Malfunction | Recorder Malfunction |
| Peter | January 5, 1979 | 300 km N | 2.35 m | 4.70 m |
| Gordon | January 11, 1979 | 500 km SE | 1.19 m | 2.02 m |
| Greta | January 11, 1979 | 400 km N | 1.19 m | 2.02 m |
| Kerry | February 17, 1979 | - | Recorder not Functioning February 17-23, 1979 | Recorder not Functioning February 17-23, 1979 |

Highest Significant Wave Height (Hsig) Recorded was 2.35 m on January 5, 1977 during cyclone "Peter".

Highest Wave Recorded (Hmax) was 4.70 m on January 5, 1977 during cyclone "Peter".

WAVE STATISTICS

WAVE PERIOD/WAVE HEIGHT OCCURRENCES

ALL DATA, ALL DIRECTIONS

| Wave Height (metres) | 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 - 0.2 | 12.75 | 9.00 | 13.25 | 2.50 | 0.50 | 3.25 | 0 | 0 | 0 | 0 | 41.25 |
| 0.21 - 0.4 | 65.50 | 103.08 | 80.42 | 43.50 | 0.50 | 1.50 | 0 | 0 | 0 | 0 | 294.50 |
| 0.41 - 0.6 | 9.75 | 180.54 | 41.00 | 15.00 | 2.00 | 0.50 | 0 | 0 | 0 | 0 | 248.79 |
| 0.61 - 0.8 | 0 | 128.13 | 72.42 | 4.50 | 1.00 | 0 | 0 | 0 | 0 | 0 | 206.05 |
| 0.81 - 1.0 | 0 | 50.50 | 97.83 | 2.50 | 0 | 1.00 | 0 | 0 | 0 | 0 | 151.83 |
| 1.01 - 1.5 | 0 | 23.25 | 138.58 | 0.50 | 0.50 | 0.50 | 0 | 0 | 0 | 0 | 163.33 |
| 1.51 - 2.0 | 0 | 0.50 | 21.00 | 0.50 | 0 | 0 | 0 | 0 | 0 | 0 | 22.00 |
| 2.01 - 2.5 | 0 | 0 | 2.00 | 0.50 | 0 | 0 | 0 | 0 | 0 | 0 | 2.50 |
| 2.51 - 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTALS | 88.00 | 495.00 | 466.50 | 69.50 | 4.50 | 6.75 | 0 | 0 | 0 | 0 | 1130.25 |

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

Table 1

WAVE STATISTICS

WAVE PERIOD/WAVE HEIGHT OCCURRENCES

SUMMER DATA, ALL DIRECTIONS

| Wave Height (metres) | 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 - 0.2 | 3.25 | 6.00 | 4.50 | 1.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14.75 |
| 0.21 - 0.4 | 35.50 | 63.58 | 31.92 | 11.00 | 0.50 | 1.00 | 0 | 0 | 0 | 0 | 0 | 143.50 |
| 0.41 - 0.6 | 6.50 | 87.79 | 19.25 | 7.50 | 2.00 | 0.50 | 0 | 0 | 0 | 0 | 0 | 123.54 |
| 0.61 - 0.8 | 0 | 52.88 | 25.92 | 2.50 | 1.00 | 0 | 0 | 0 | 0 | 0 | 0 | 82.30 |
| 0.81 - 1.0 | 0 | 26.25 | 29.83 | 2.50 | 0 | 1.00 | 0 | 0 | 0 | 0 | 0 | 59.58 |
| 1.01 - 1.5 | 0 | 10.50 | 61.33 | 0.50 | 0.50 | 0.50 | 0 | 0 | 0 | 0 | 0 | 73.33 |
| 1.51 - 2.0 | 0 | 0.50 | 15.50 | 0.50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16.50 |
| 2.01 - 2.5 | 0 | 0 | 2.00 | 0.50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.50 |
| 2.51 - 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTALS | 45.25 | 247.50 | 190.25 | 26.00 | 4.00 | 3.00 | 0 | 0 | 0 | 0 | 0 | 516.00 |

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

Table 2

WAVE STATISTICS

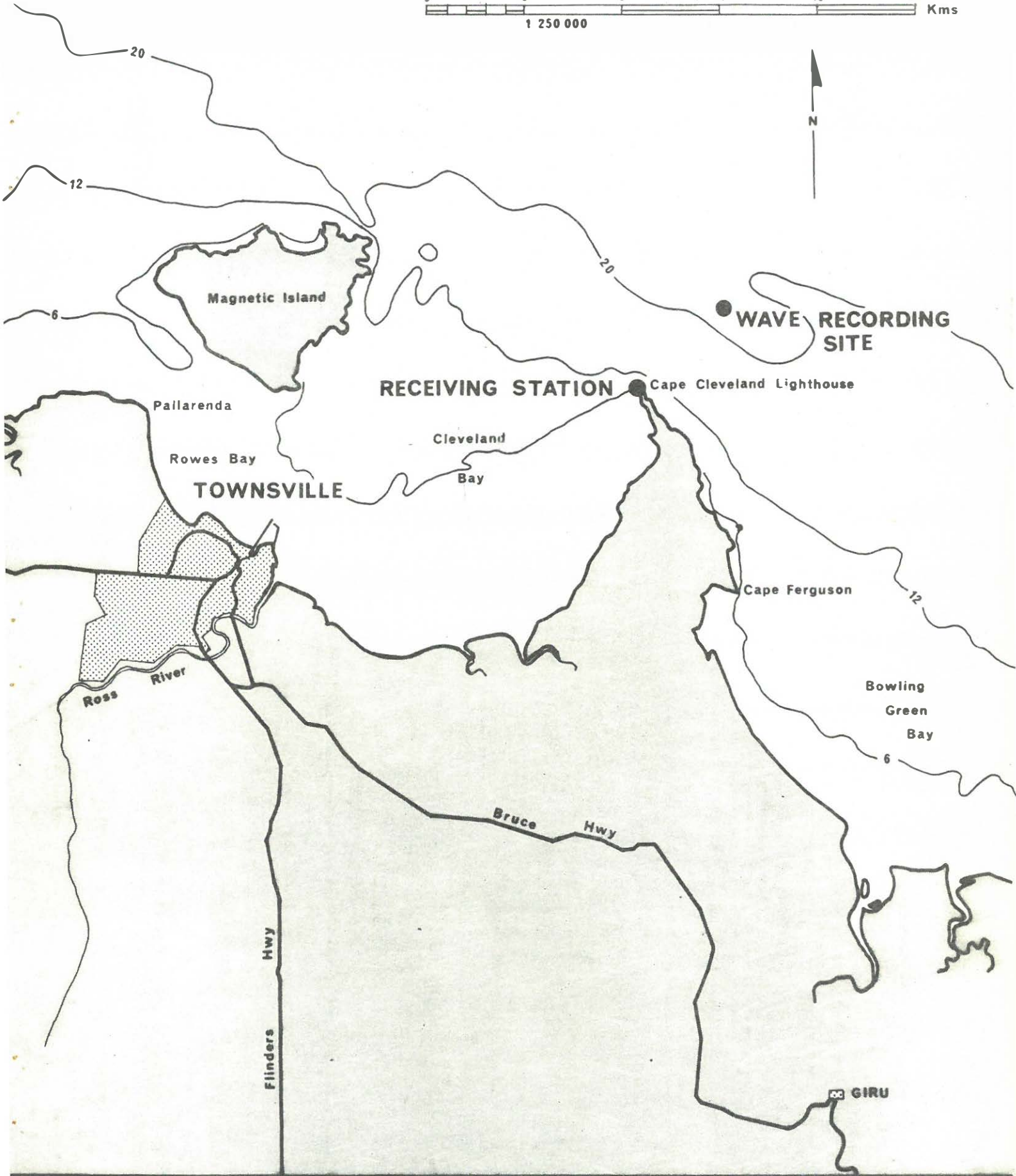
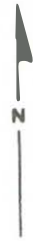
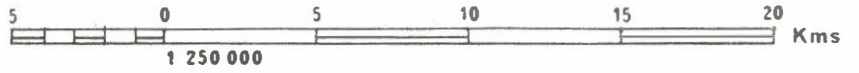
WAVE PERIOD/WAVE HEIGHT OCCURRENCES

WINTER DATA, ALL DIRECTIONS

| Wave Height (metres) | 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 - 0.2 | 9.50 | 3.00 | 8.75 | 1.50 | 0.50 | 3.25 | 0 | 0 | 0 | 0 | 26.50 |
| 0.21 - 0.4 | 30.00 | 39.50 | 48.50 | 32.50 | 0 | 0.50 | 0 | 0 | 0 | 0 | 151.00 |
| 0.41 - 0.6 | 3.25 | 92.75 | 21.75 | 7.50 | 0 | 0 | 0 | 0 | 0 | 0 | 125.25 |
| 0.61 - 0.8 | 0 | 74.75 | 46.50 | 2.00 | 0 | 0 | 0 | 0 | 0 | 0 | 123.25 |
| 0.81 - 1.0 | 0 | 24.25 | 67.50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91.75 |
| 1.01 - 1.5 | 0 | 12.75 | 77.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90.00 |
| 1.51 - 2.0 | 0 | 0 | 5.50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.50 |
| 2.01 - 2.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.51 - 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTALS | 42.75 | 247.00 | 275.75 | 43.50 | 0.50 | 3.75 | 0 | 0 | 0 | 0 | 613.25 |

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

Table 3

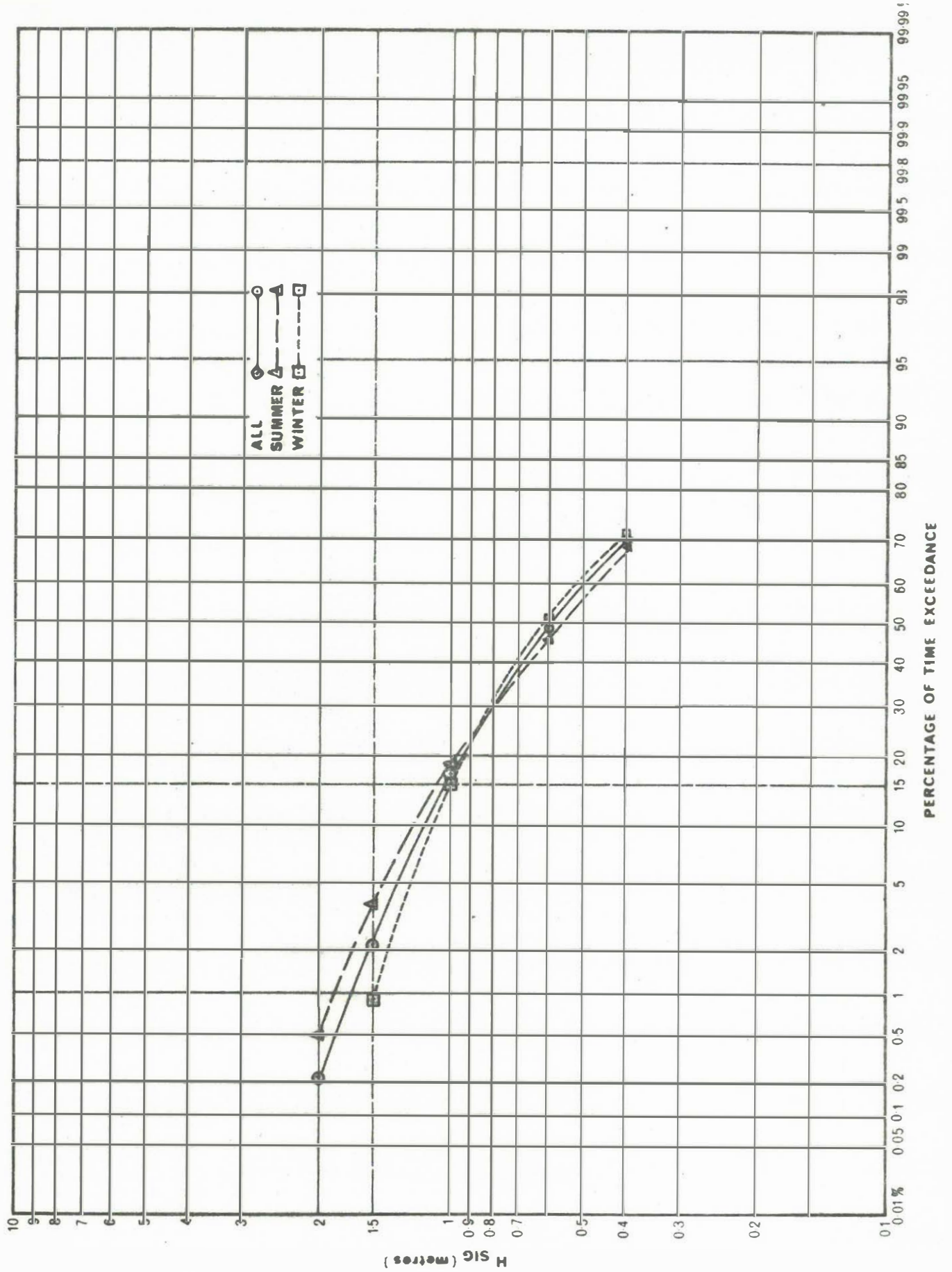


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LOCALITY MAP

Wave Data Recording Program
Townsville Region

Figure 1
W 03-1



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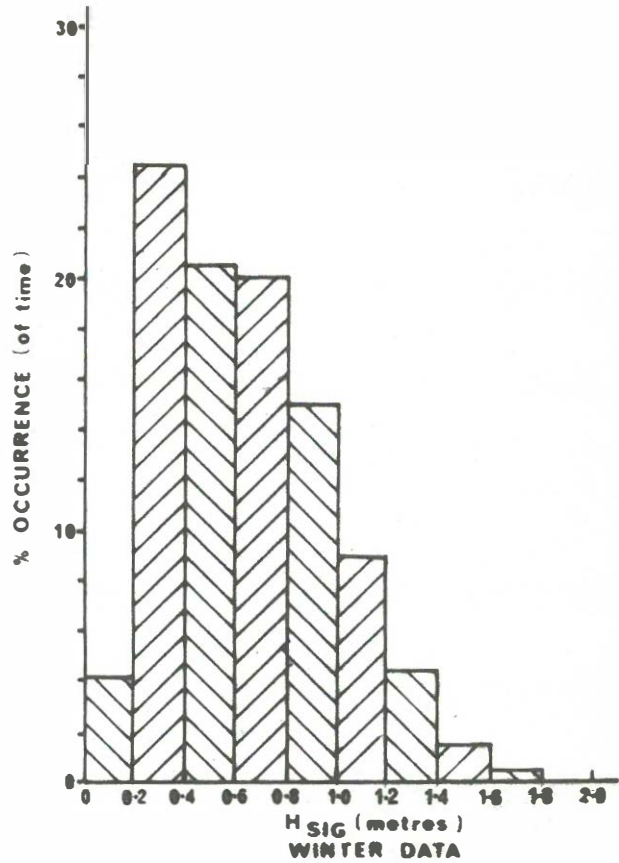
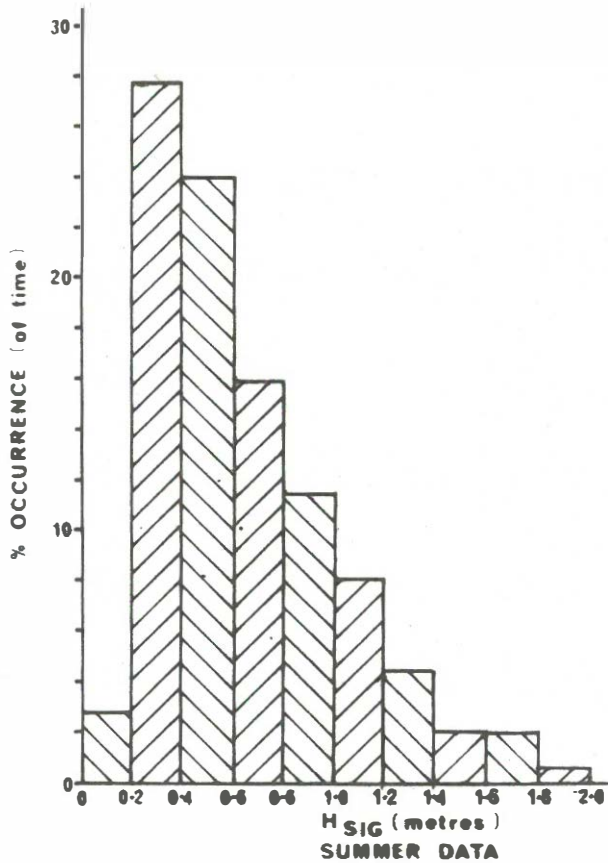
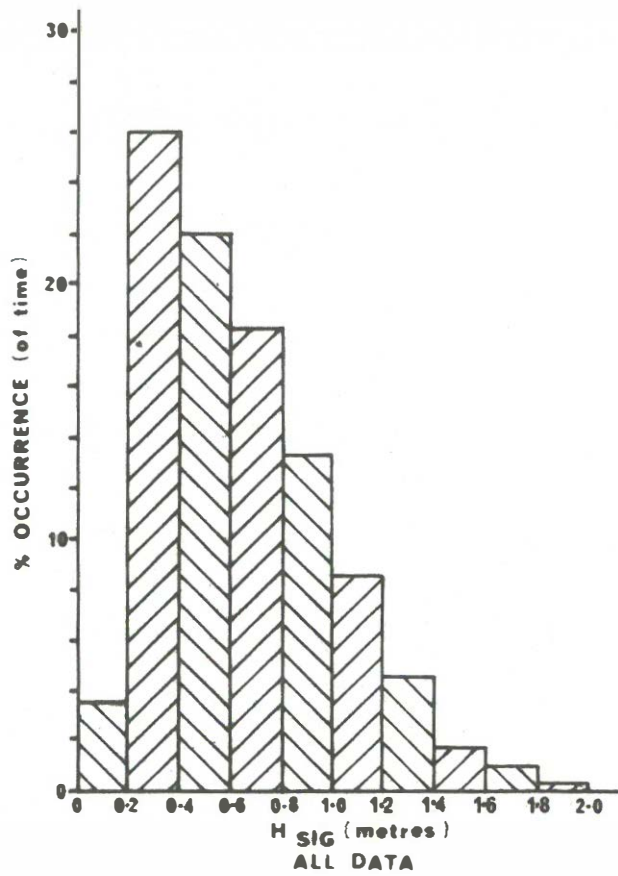
**PERCENTAGE (OF TIME) EXCEEDANCE
OF WAVE HEIGHTS (H_{sig}) FOR ALL
WAVE PERIODS**

16th July 1975 to 23rd Feb 1979

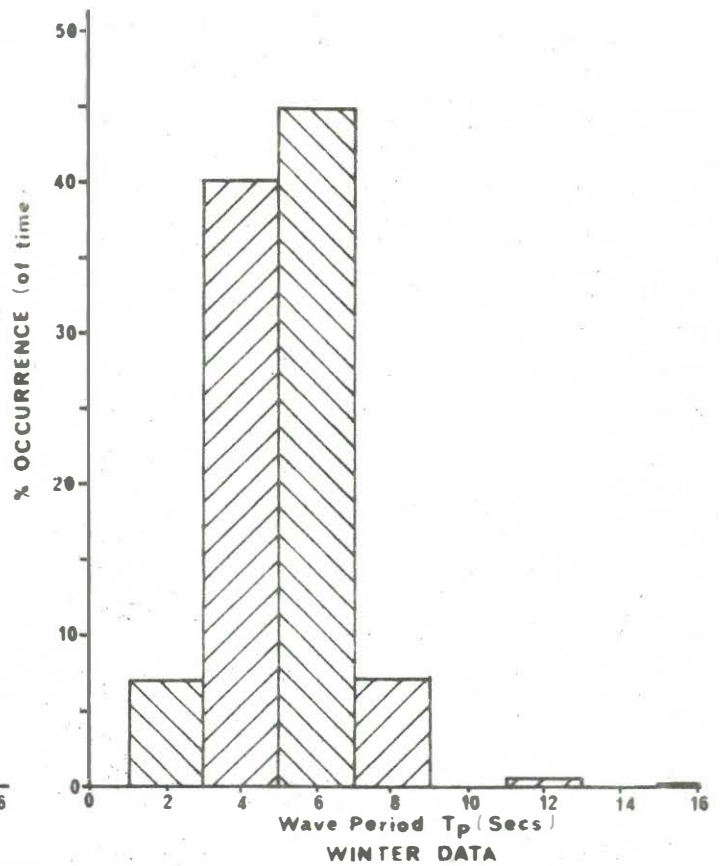
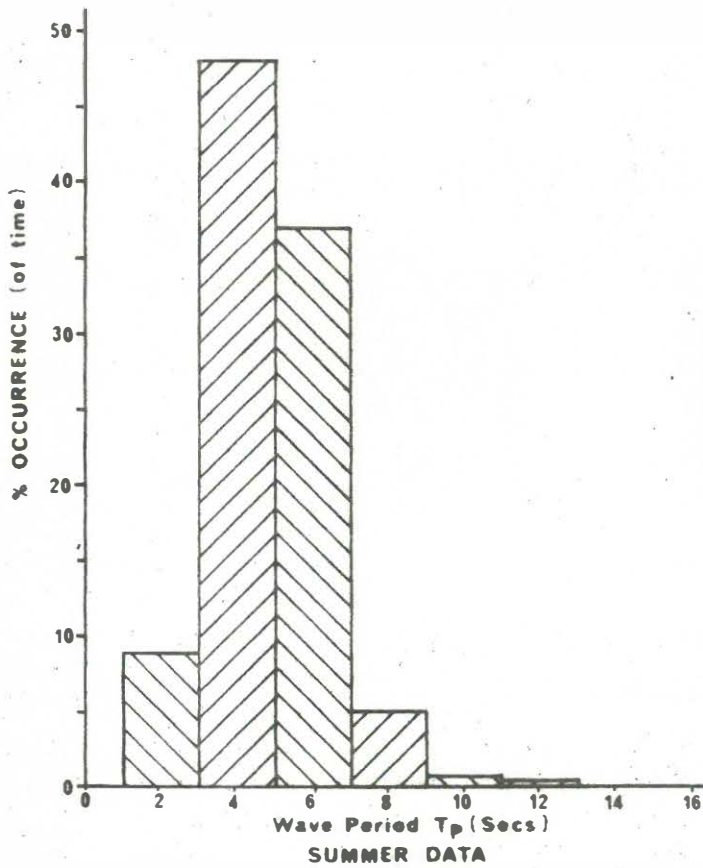
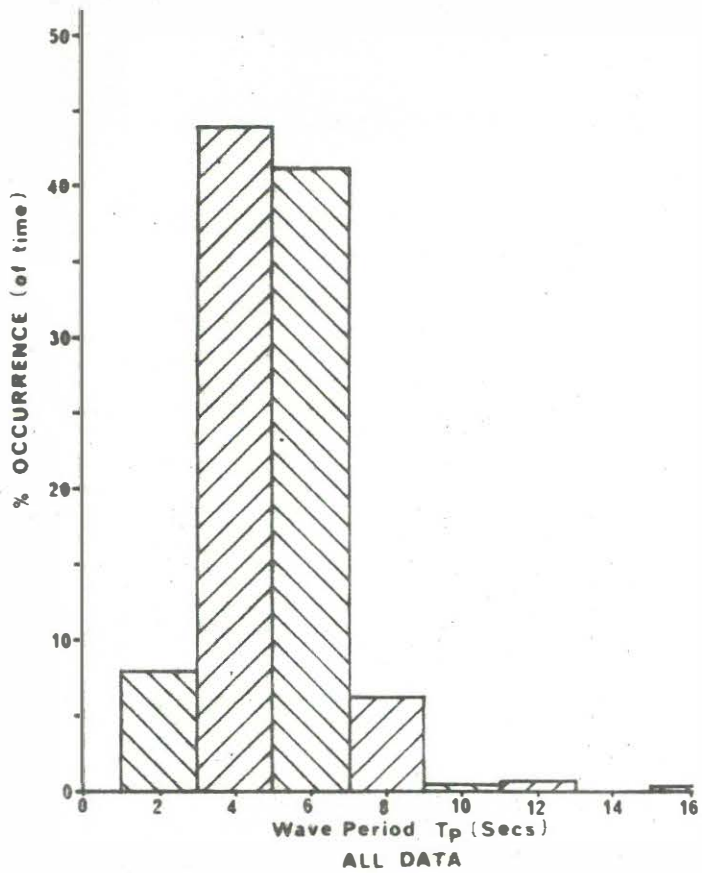
Wave Data Recording Program

Townsville Region

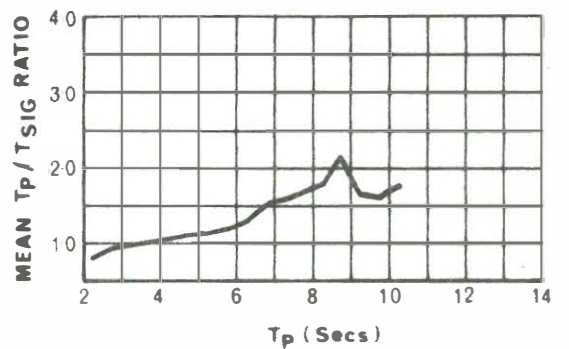
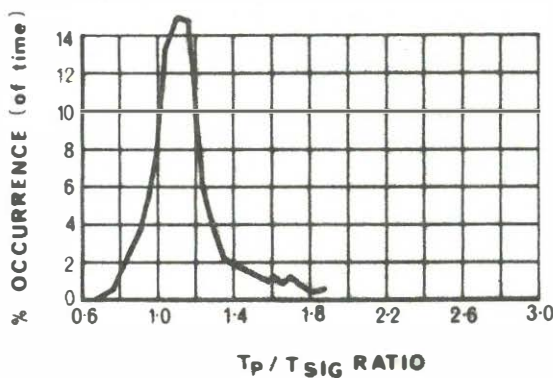
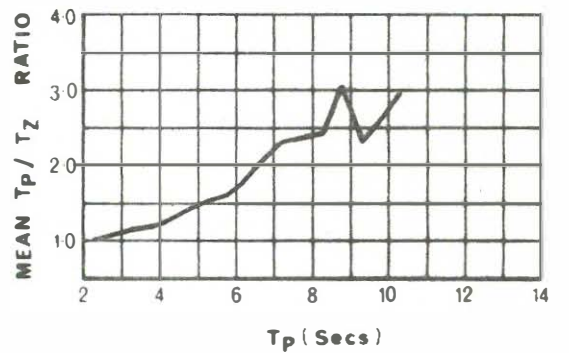
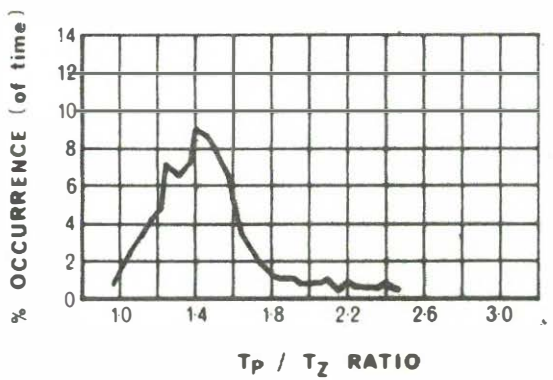
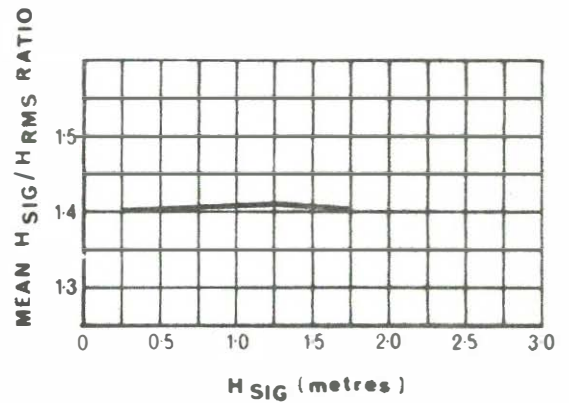
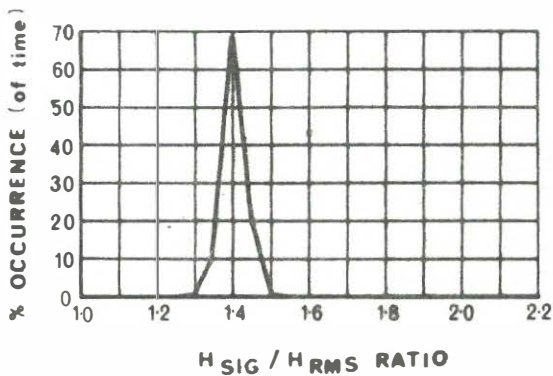
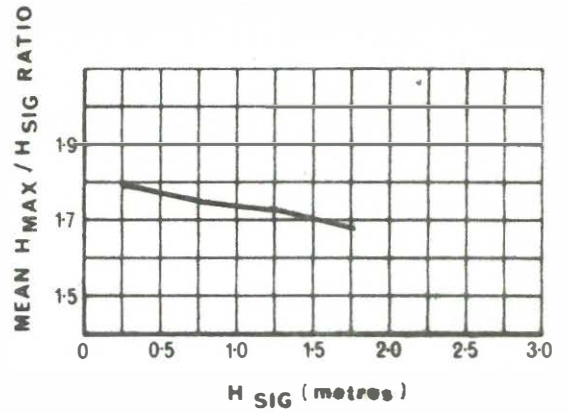
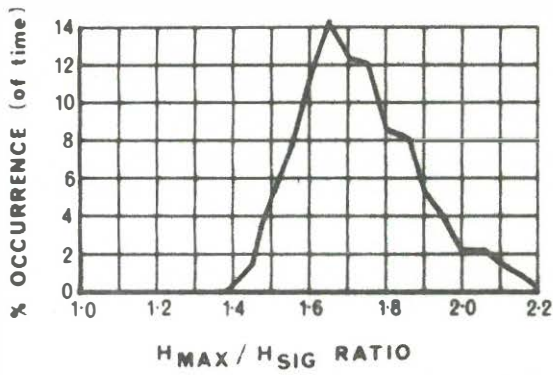
Figure 2
W 03-1



**HISTOGRAM PERCENTAGE (OF TIME)
OCCURRENCE OF WAVE HEIGHTS (H_{sig})
FOR ALL WAVE PERIODS
16 th July 1975 to 23rd Feb 1979**



**HISTOGRAM PERCENTAGE (OF TIME)
OCCURRENCE OF WAVE PERIODS (T_p)
FOR ALL WAVE HEIGHTS
16 th July 1975 to 23rd Feb 1979**

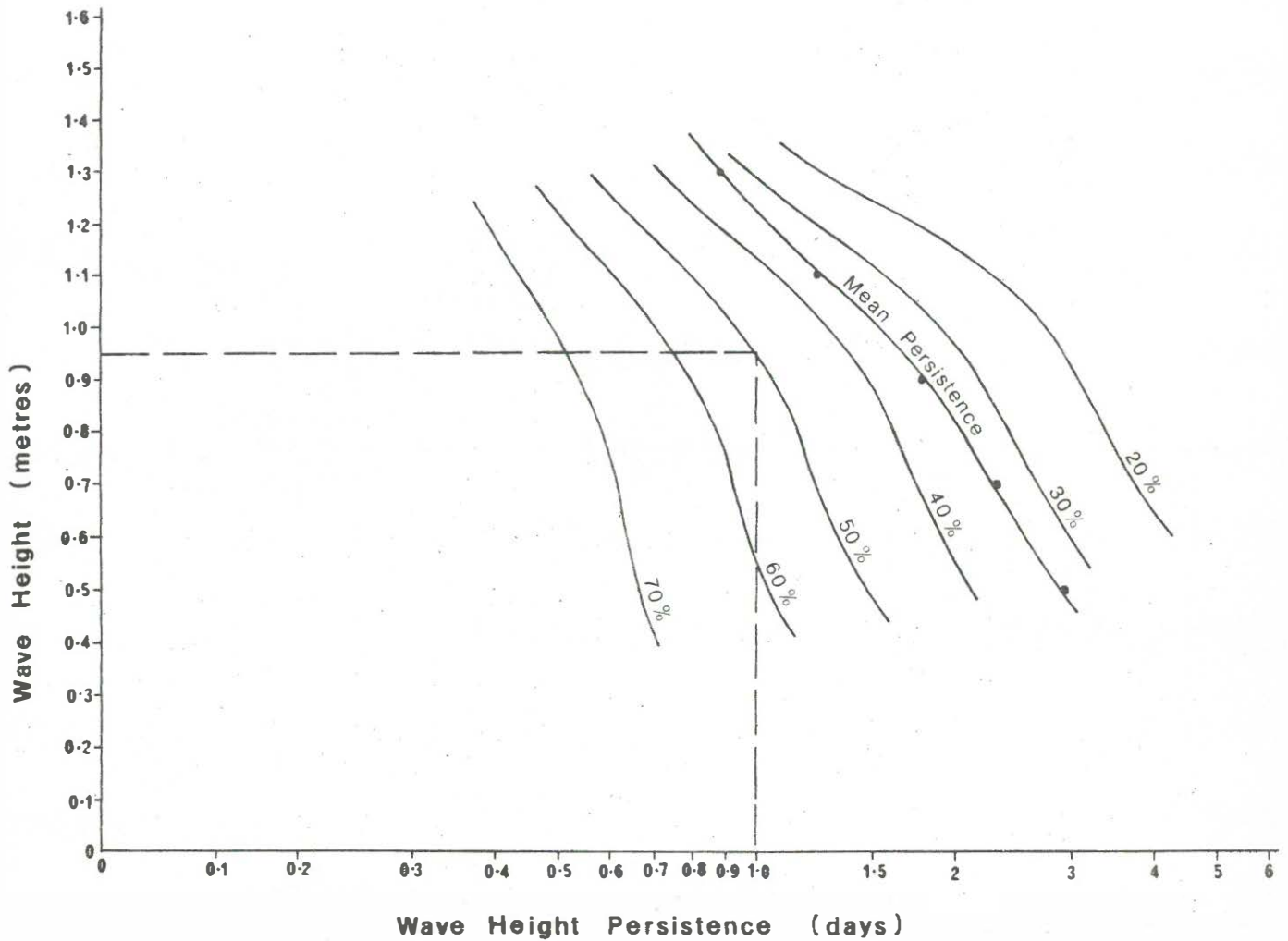


WAVE PARAMETER RELATIONSHIPS

16th July 1975 to 23rd Feb 1979

Wave Data Recording Program
Townsville Region

Figure 5
W 03-1



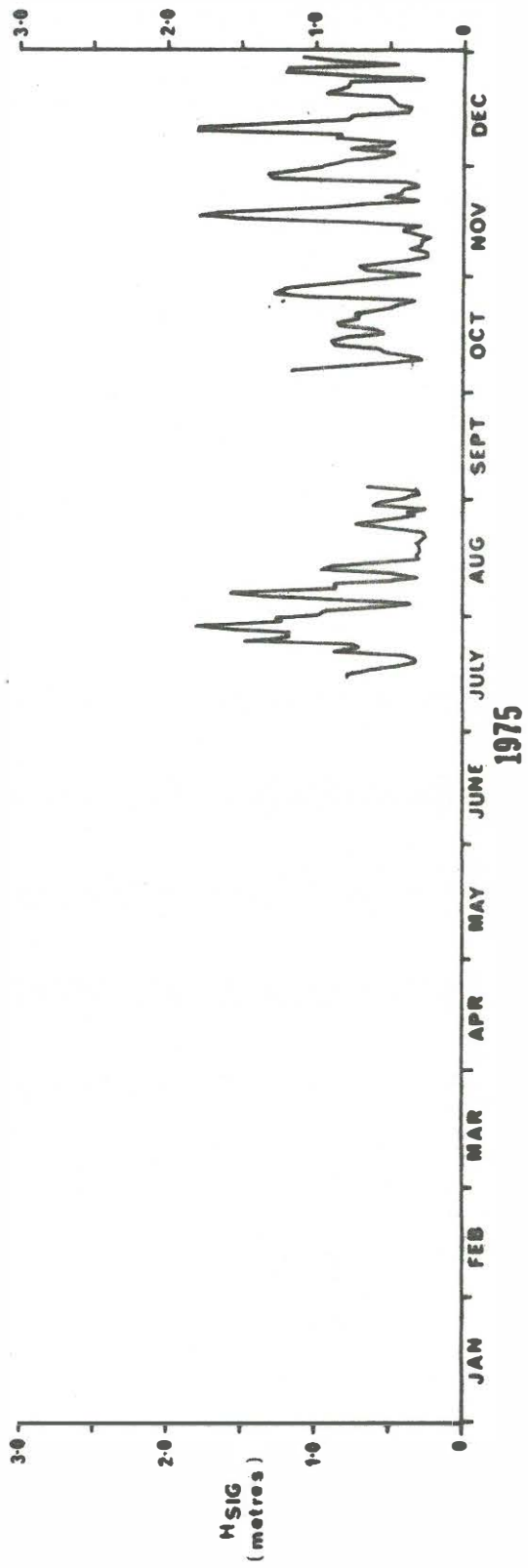
Note:-

1. Wave height persistence is the duration for which a given significant wave height is continuously exceeded. As an example, given a 0.95 metre significant wave height, there is a 50 % 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.

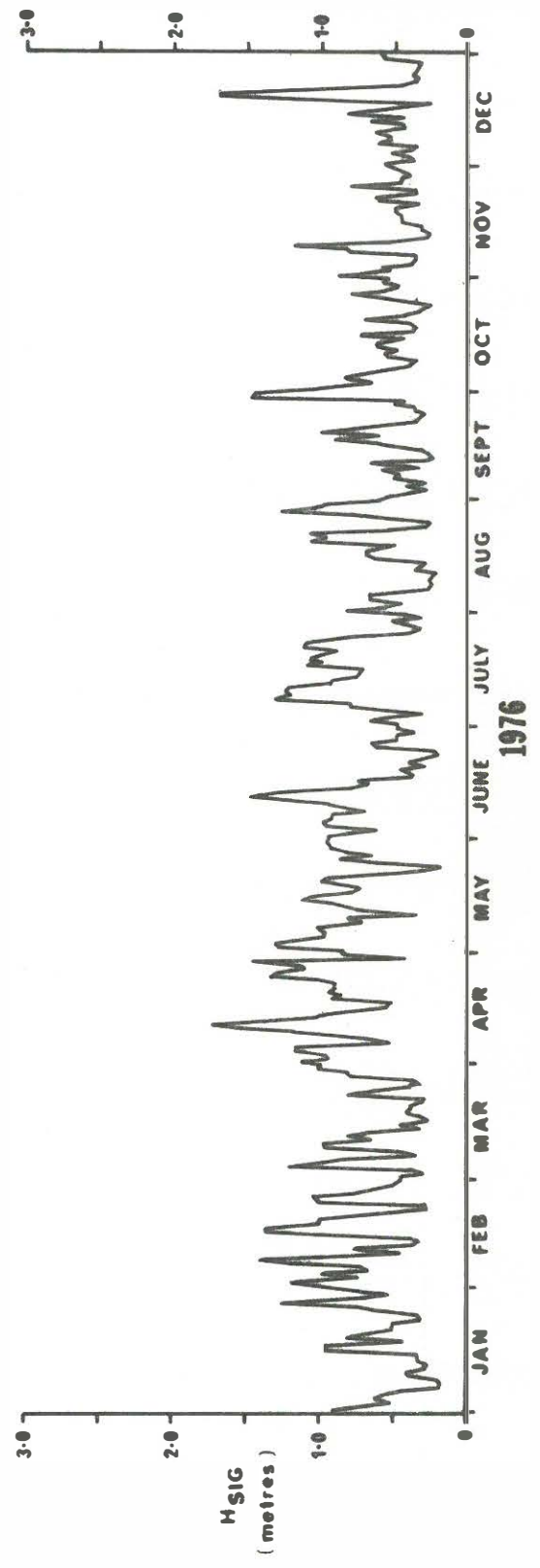


**AVERAGE DURATION OF
EXCEEDANCE OF WAVE
HEIGHTS (H_{sig})**

16th July 1975 to 23rd Feb 1979



NOTE : Wave Height shown is the Significant Wave Height (H SIG) as derived from recorded wave data.



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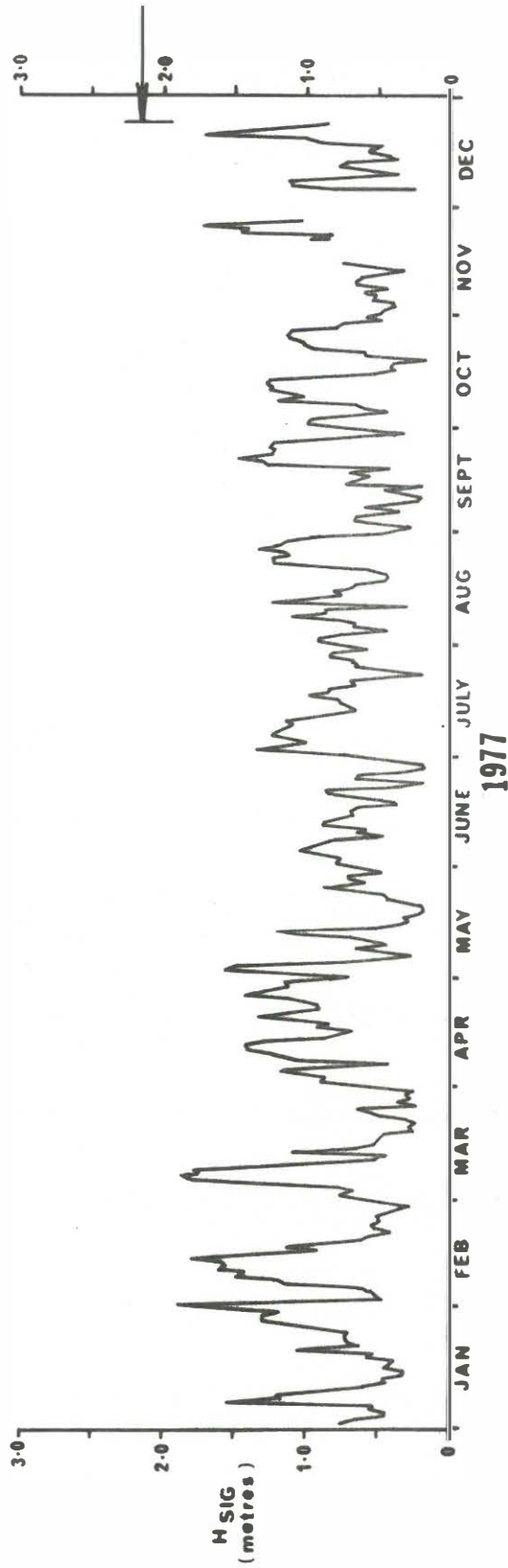
DAILY WAVE HEIGHTS (H_{sig})

16th July 1975 to 23rd Feb 1979

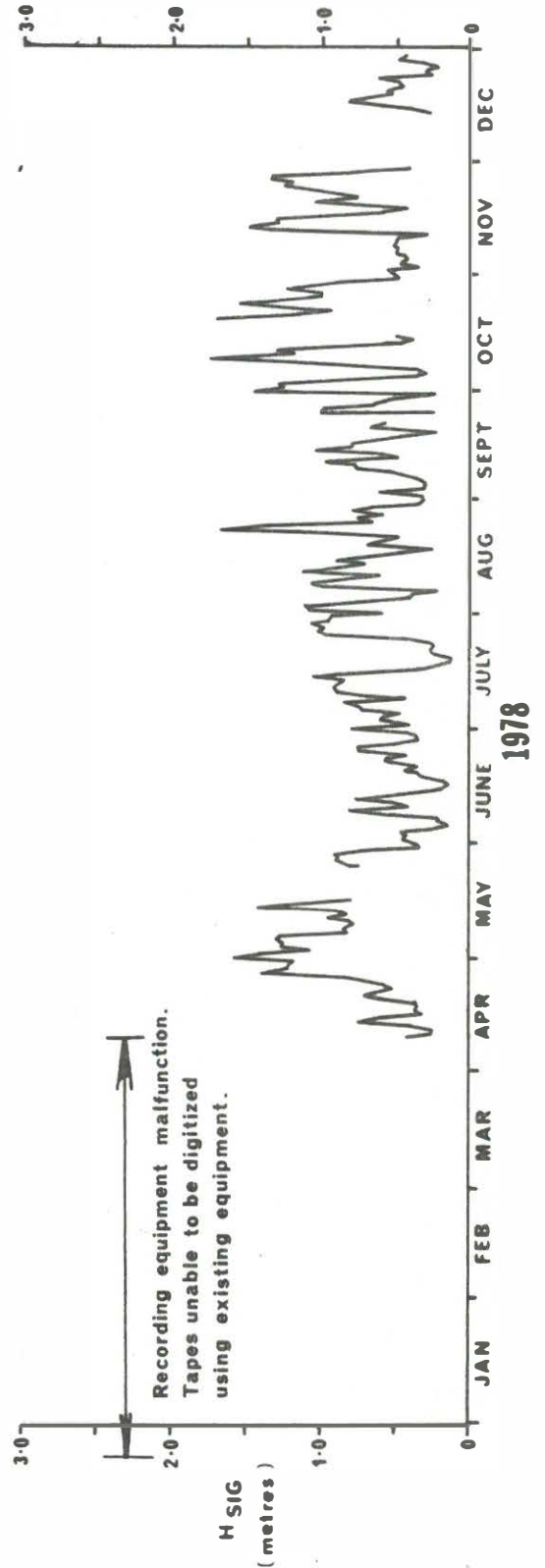
Wave Data Recording Program
Townsville Region

Figure 7
W 03-1

Sheet 1 of 3



NOTE : Wave Height shown is the Significant Wave Height (H SIG) as derived from recorded wave data.



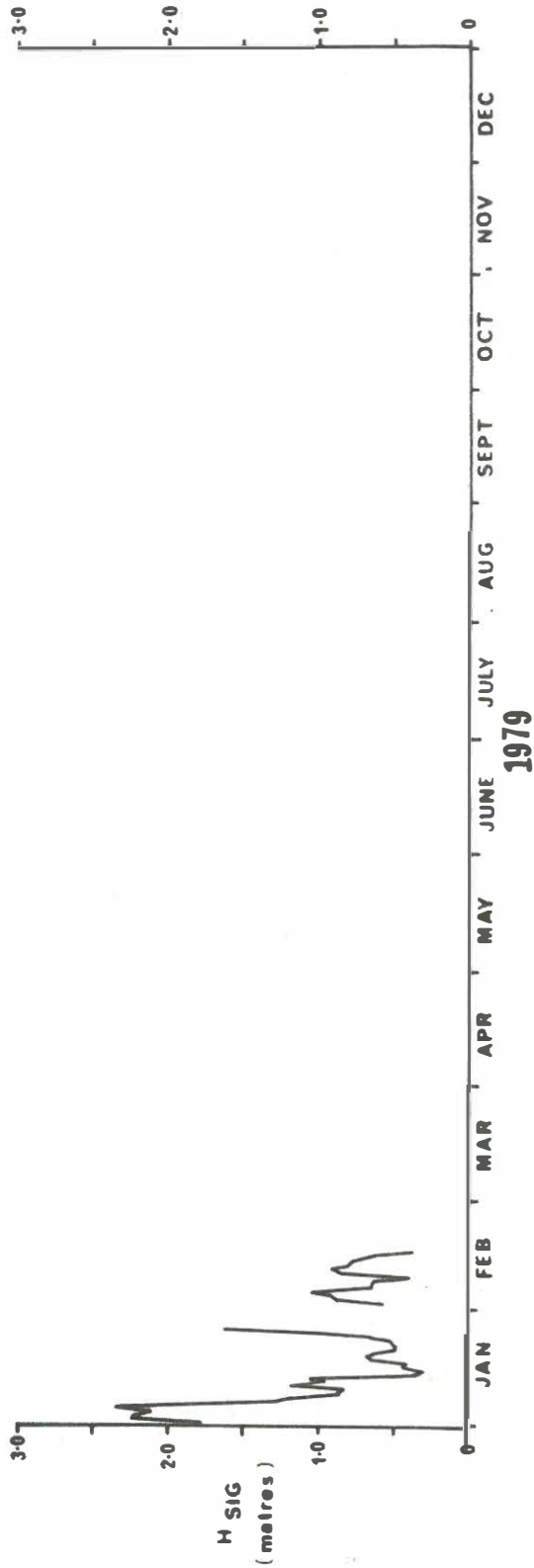
DAILY WAVE HEIGHTS (H_{sig})

16th July 1975 to 23rd Feb 1979

Wave Data Recording Program
Townsville Region

Figure 7
W 03-1

NOTE : Wave Height shown is the Significant Wave Height (H_{SIG}) as derived from recorded wave data.



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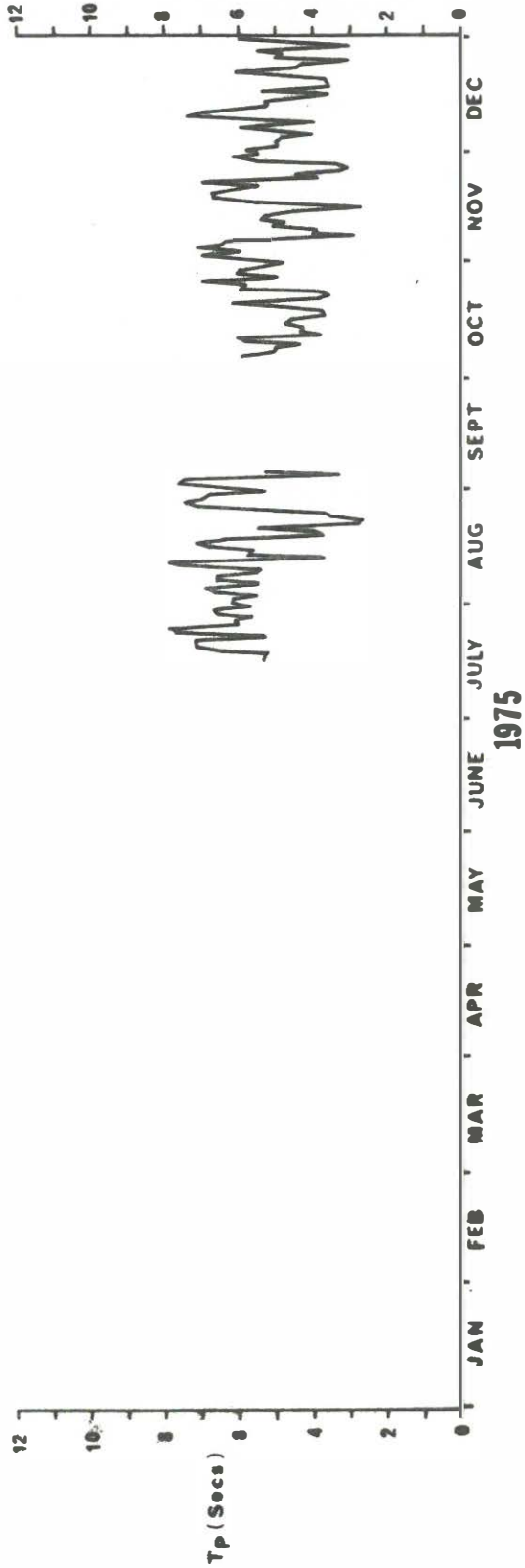
DAILY WAVE HEIGHTS (H_{sig})

16th July 1975 to 23rd Feb 1979

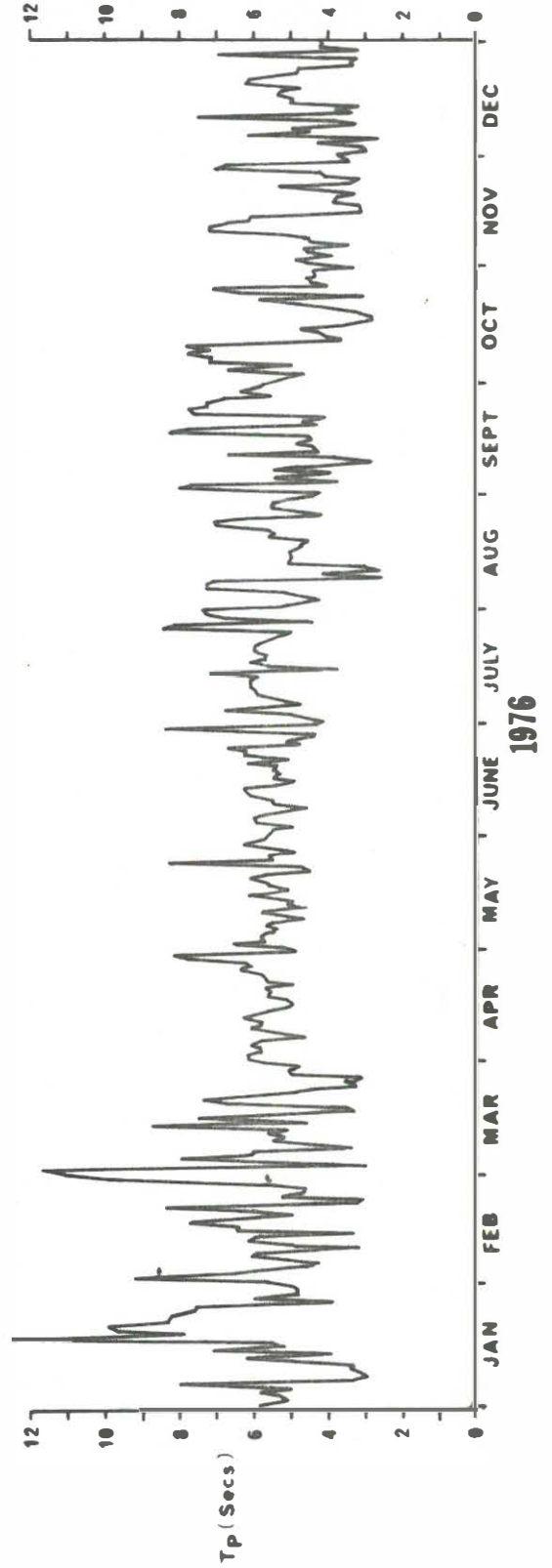
Wave Data Recording Program
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Figure 7
W 03.1

Sheet 3 of 3



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



DAILY WAVE PERIODS

16th July 1975 to 23rd Feb 1979

Figure 8
W 03-1

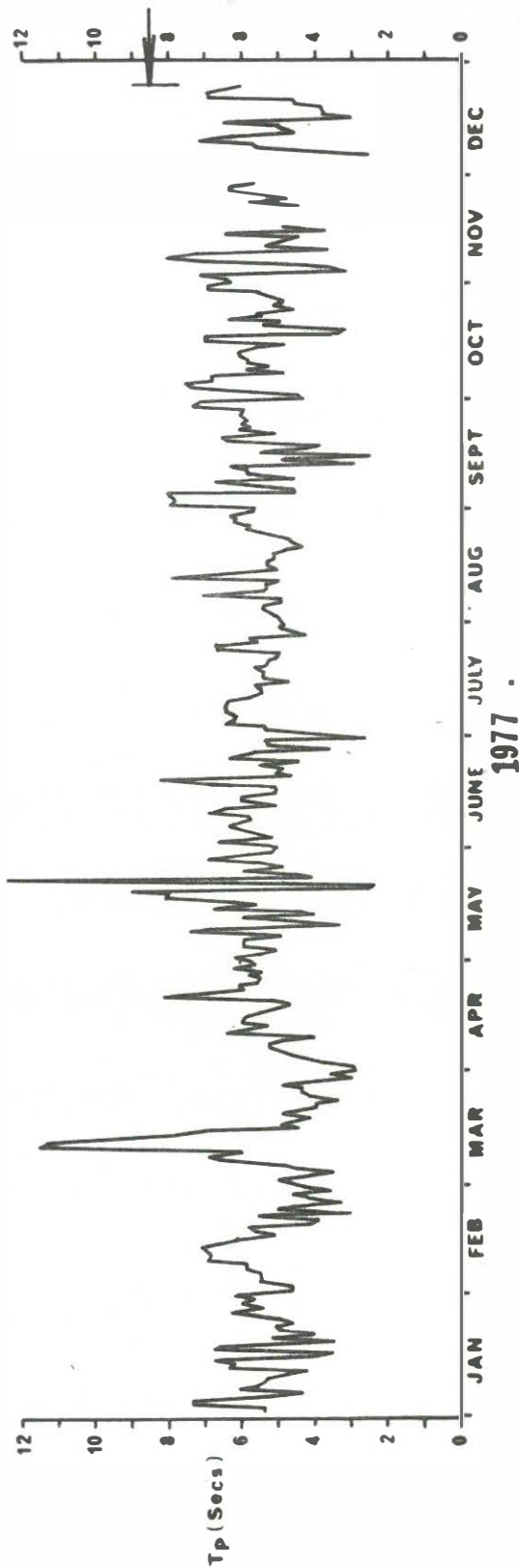


DAILY WAVE PERIODS

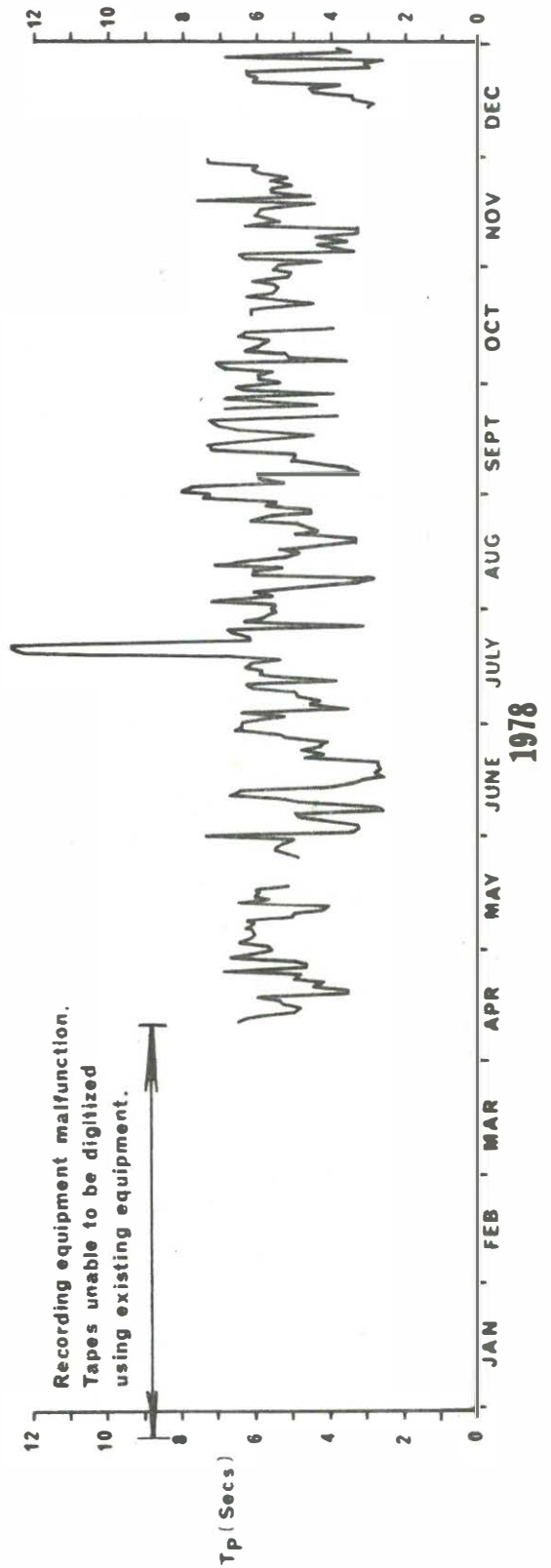
16th July 1975 to 23rd Feb 1979

Wave Data Recording Program
Townsville Region

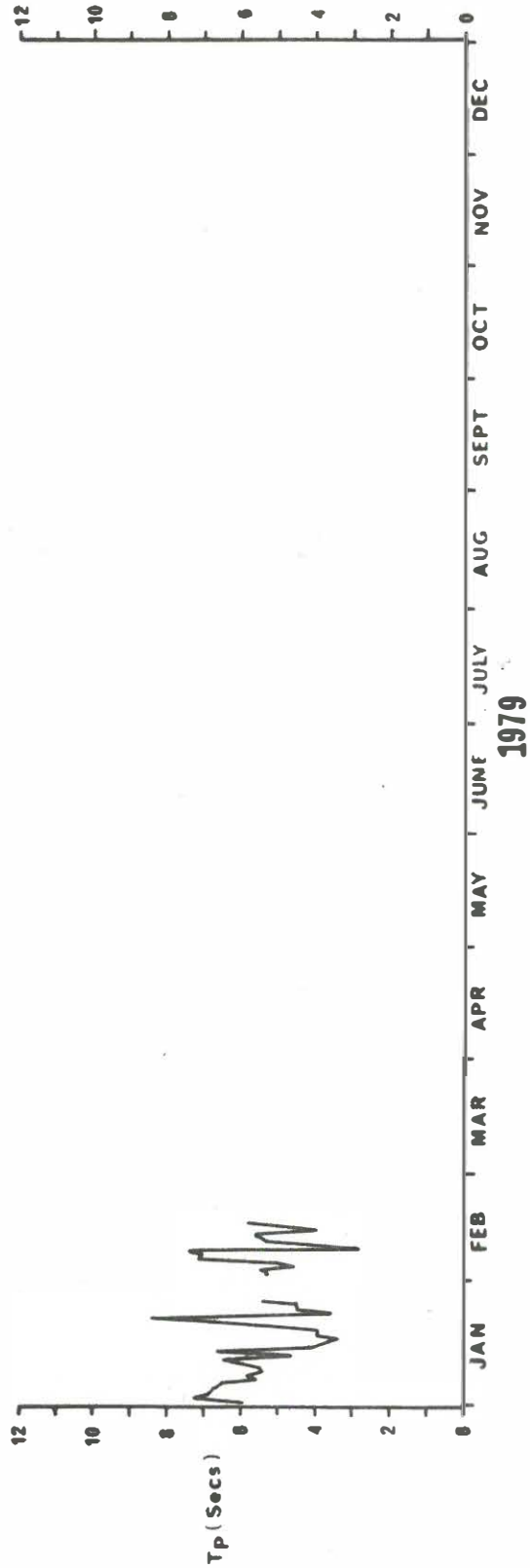
Figure 8
W 03-1



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

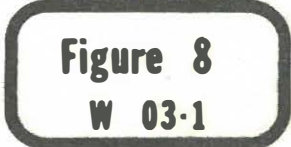


NOTE: Wave Period shown is the Peak Energy Period (Tp) as derived from recorded wave data.



DAILY WAVE PERIODS

16th July 1975 to 23rd Feb 1979





Beach Protection Authority of Queensland.