COASTAL OBSERVATION PROGRAMME - ENGINEERING (COPE)

CARDWELL – CARDWELL SHIRE

For the Years 1976 to 1979

Beach Protection Authority

March 1984

All reasonable care and attention has been exercised in the collection, processing and compilation of the COPE 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.: C 09.1

TITLE: REPORT - COASTAL OBSERVATION PROGRAMME - ENGINEERING (COPE), CARDWELL, CARDWELL SHIRE

DATE: March 1984

TYPE OF REPORT: Technical Memorandum

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

DISTRIBUTION: Public Distribution

ABSTRACT:

This report provides a summary of primary analyses of COPE data on wind, wave and beach processes observed at Cardwell in the Cardwell Shire in northern Queensland. The data were recorded by volunteer observers Mr. Cliff Freney and Mr. Barry Chapman, during the period April 1976 to the end of December 1979. The recordings were made daily during the three year period and the information published is considered representative and reliable.

OTHERS AVAILABLE IN THIS SERIES:

Coastal Observation Program - Engineering (COPE), Machans Beach - Mulgrave Shire, August 1979 (Report C 01.1).

Coastal Observation Program - Engineering (COPE), Baffle Creek - Miriam Vale Shire, October 1980 (Report C 02.1).

Coastal Observation Program - Engineering (COPE), Flying Fish Point - Johnstone Shire, November 1980 (Report C 03.1).

Coastal Observation Program - Engineering (COPE), Woodgate - Isis Shire, November 1980 (Report C 04.1).

Coastal Observation Programme - Engineering (COPE), Shelly Beach - Landsborough Shire, March 1984 (Report C 05.1).

Coastal Observation Programme - Engineering (COPE), Eurong - Maryborough City, March 1984 (Report C 06.1).

Coastal Observation Programme - Engineering (COPE), Lammermoor Beach - Livingstone Shire, March 1984 (Report C 07.1).

Coastal Observation Programme - Engineering (COPE), Noah Creek - Douglas Shire, March 1984 (Report C 08.1).

REFERENCES:

1. ROBINSON D.A. and JONES C.M.

Queensland Volunteer Coastal Observation Program - Engineering (COPE). 3rd Australian Conference on Coastal and Ocean Engineering, Melbourne, April 1979.

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1.0 INTRODUCTION

1.1 The Programme

The Beach Protection Authority requires basic data on the behaviour of Queensland's beaches in order to provide well founded advice on coastal management to local Authorities. The COPE project aims to collect information on wind, waves and beach behaviour in areas where extensive investigations are not practical and where otherwise little or no data exist.

The project is based on the recruitment of volunteer observers who are prepared to record a series of basic parameters once or twice daily for at least a three year period.

1.2 Site Selection

In selecting a site for a COPE station, consideration is given to:-

(a) the general shoreline configuration and the possibility of extrapolation of data to other adjacent beaches;

(b) the distribution of stations along Queensland's coastline;

(c) the need to correlate the COPE data with planned or existing data collection programmes.

1.3 Instrumentation

Each COPE observer is supplied with a basic kit of recording instruments including:-

- 30 metre Tape
- Wind Meter
- Abney Level
- 1.5 metre Sighting Support
- Recording Forms
- Fluorescent Dye.

A graduated reference pole is installed on the beach to serve as the base point for all plan measurements and the control for vertical levelling.

1.4. Observers

The majority of COPE observers are volunteers who may be local business people, local residents or school children. Some stations are manned by Government employees who carry out the observations as part of their official duties.

1.5 Accuracy

Individual observers differ in their subjective assessment of the various parameters recorded as part of the COPE programme. Wave parameters such as type, height, and angle of approach together with surf zone width and the location of the vegetation line all require visual assessment, the accuracy of which will vary from observer to observer and from recording to recording.

Although the Authority is confident that all observers make their observations to the best of their ability and accepts these observations without adjustment, the existence of random and non - random errors in the recorded data is to be expected.

Problems associated with the use of data containing these errors are minimised in two ways. Firstly, regular visits are made to the COPE stations by the Authority's COPE Field Officer to provide a check on any bias introduced into the recordings by incorrect observation procedures. Secondly, it has been found that, with a large number of observations taken on a regular basis, a reasonable assessment can be made of the average climatologies of the observed parameters provided the observation errors are random. A minimum recording period of three years has been adopted for the analysis and publication of the data. Five day moving averages are applied to observations of the various beach width and foreshore slope parameters to smooth out random errors.

For these reasons, the Authority is of the opinion that published COPE data can be used with confidence provided the above inherent limitations are recognised.

1.6 Presentation of Data

The purpose of this report is to present COPE data for the three year period 1976 to 1979 in a useful statistical form. No attempt has been made to interpret the observed data.

If this three year period is representative of the long term average meteorological conditions, the wind, wave and beach movement climatologies presented can be regarded as typical. However, this recording period is too short to be representative in terms of the average occurrence of extreme events such as cyclones and floods, and this should be taken into account when consideration is being given to the influence of such events on trends of long term beach behaviour.

2.0 STATION PARTICULARS

2.1 Location

Cardwell is located within the Cardwell Shire and is 45 kilometres north of Ingham in northern Queensland. It forms part of a 6.5 kilometre gently curving stretch of the coastline between the mouth of Meunga Creek and Oyster Point lying in the lee of Hinchinbrook Island. Cardwell is immediately adjacent to the COPE station. The location of the Cardwell COPE station is shown in Figure 1.

2.2 Observers

This station has been manned by Mr. Cliff Freney, assisted by Mr. Barry Chapman, during the period April 1976 to December 1979. Mr. Freney and Mr. Chapman are residents of Cardwell who live near the COPE station.

2.3 Observed Parameters

The observer at this station usually recorded at either 10.00 a.m. or 4.00 p.m. daily during the period 1976 to 1979.

This station has recorded:

- Wave Period
- Wave Height
- Wave Angle
- Wave Type
- Surf Zone Width
- Presence of Offshore Bar
- Wind Speed
- Wind Direction
- State of Tide
- Fixed Contour Level
- Distance to Fixed Contour
- Distance to Vegetation
- Foreshore Slope
- Longshore Current Speed
- Longshore Current Direction

In addition, a sand sample was collected at the station each month and a profile of the beach recorded monthly also.

2.4 Tidal Information

Tidal information for this station is presented below. Datum is Low Water Datum.

M.H.W.S. : 3.1 metres
M.H.W.N.: 2.2 metres
M.S.L. : 1.82 metres
M.L.W.N. : 1.4 metres
M.L.W.S.: 0.6 metres.

2.5 Description of the Beach

The beach at Cardwell station exhibits the following characteristics:

- Typical beach slopes: foreshore slope 1 in 8 (7^{o}).

- Beach width: typically 2 to 10 metres from vegetation line.

- D50 sand size: 0.87 mm averaged over three years.

- Adjoining Landform: low secondary beach ridge backed by a relatively flat hind ridge which is approximately 3m above mean sea level.

- Vegetation: Goat's foot Convolvulus (Ipomoea pes - caprae) herbland occurs at the upper beach and seaward slope of the beach ridge. Remnants of pink bloodwood - brown salwood (Eucalyptus intermedia - Acacia crassicarpa) woodland occur in a narrow band on the ridge crest. Most of the vegetation has been selectively cleared and large areas are mowed.

2.6 Supervision of Station

The observer was instructed in the recording program by the COPE Field Officer and the initial instruction period was followed up with visits to the station during the period of recordings presented in this report.

Installation and maintenance of the reference pole for this station has been carried out by the Cardwell Shire Council. The Authority wishes to thank the Council for its assistance in all matters associated with the COPE project.

3.0 DATA

3.1 General

COPE data for this station for the three year period April 1976 to December 1979 are presented on the attached figures. The data have been analysed statistically and/or smoothed to reveal long term averages or trends. A brief description of each of the observed parameters is given below with the relevant figure references.

3.2 Wind

The observer recorded the wind speed at the beach using a hand held wind meter at 1.5 metres above beach level. Wind direction is estimated to the nearest compass sector.

A summary of annual wind speed and direction percentage occurences are shown as a wind rose in Figure 2. Where applicable, morning and afternoon readings as well as the overall average are shown.

3.3 Waves

The average breaker height (trough to crest) is usually estimated to the nearest 0.1 metre. From experience this estimate has been found to be comparable with the equivalent deep water significant wave height.

The observer estimates the wave period by recording the time taken for eleven wave crests (the duration of 10 waves) to pass a point.

The wave direction is estimated as one of five direction sectors indicating the angle to the shoreline alignment from which the waves are approaching the beach. These sectors have been selected as:-

Sector 1 - 0^{o} to 60^{o}
Sector 2 - 60^{o} to 85^{o}
Sector 3 - 85^{o} to 95^{o}
Sector 4 - 95^{o} to 120^{o}
Sector 5 - 120^{o} to 180^{o}

Note: 0^{o} is the beach alignment to the left of the observer when facing seaward.

Statistical representations of the observed wave data include:-

(a) the percentage of wave height recordings which exceed any given wave height for all directions combined (Figure 3).

(b) the percentage occurrence of various combinations of wave heights and periods and directions (Figure 4 and Figure 5).

(c) surf zone width with an indication of the existence or otherwise of an offshore bar in Figures 6 to 13.

(d) tabulation of the occurrence of various wave heights, periods, types and directions (Tables 1 to 4).

3.4 Longshore Currents

The observer measured the distance parallel to the shoreline that a dye patch in the surf zone moved in one minute. Current direction is either upcoast or downcoast, upcoast being to the left when facing the sea from the beach.

The readings are converted to a velocity which is plotted on a daily basis (Figure 14 to Figure 21). Mean upcoast and downcoast components and the overall annual means are also presented.

3.5 Beach Profile Parameters

Beach profile parameters were measured using an Abney level, tape measure and reference pole. These include:

- distance from the reference pole to the 1.1 metre, relative to A.H.D., fixed contour level.
- distance from reference pole to the vegetation line (usually front face of fore-dune).
- the foreshore slope.

Changes in these parameters with time indicate how the beach moves in response to varying wave attack. Plots of these parameters are shown in Figures 22 to 25 which provide a visual representation of the data.

TABLE 1

MONTHLY AND ANNUAL
MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION
OCCURRENCES

YEAR 1976

MONTH	MEAN WAVE PERIOD (Secs)	MEAN WAVE HEIGHT (Metres)	Percentage Occurrences - Wave Type /Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY													
FEBRUARY													
MARCH													
APRIL	3.0	0.16	–	83.3	–	–	16.7	–	–	75.0	8.3	–	16.7
MAY	3.1	0.14	6.7	76.7	–	–	16.7	–	–	80.0	3.3	–	16.7
JUNE	2.8	0.07	25.0	50.0	–	–	25.0	–	–	75.0	–	–	25.0
JULY	3.7	0.21	20.0	60.0	–	6.7	13.3	–	10.0	6.7	43.3	26.7	13.3
AUGUST	2.9	0.28	10.0	57.6	–	–	32.4	–	–	25.7	41.9	–	32.4
SEPTEMBER	3.0	0.11	3.6	17.9	–	–	78.6	–	–	14.2	7.1	–	78.7
OCTOBER	3.4	0.11	10.0	13.3	–	–	76.7	–	–	13.3	10.0	–	76.7
NOVEMBER	3.1	0.07	7.1	10.7	–	–	82.1	–	–	14.2	3.6	–	82.2
DECEMBER	3.3	0.22	20.0	16.0	–	–	64.0	–	–	24.0	12.0	–	64.0
WHOLE YEAR	3.2	0.15	11.4	42.9	0.0	0.8	44.9	0.0	1.2	11.0	38.6	4.3	44.9

SP — Spilling
PL — Plunging
SP/PL — Combined spilling and plunging

TABLE 2

MONTHLY AND ANNUAL
MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION
OCCURRENCES

YEAR 1977

MONTH	MEAN WAVE PERIOD (Secs)	MEAN WAVE HEIGHT (Metres)	Percentage Occurrences - Wave Type /Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.4	0.18	12.5	25.0	–	4.2	58.3	–	–	12.5	16.7	12.5	58.3
FEBRUARY	3.1	0.10	34.8	–	–	–	65.2	–	–	8.7	26.1	–	65.2
MARCH	2.8	0.07	7.7	7.7	–	–	84.6	–	–	–	15.4	–	84.6
APRIL	3.1	0.10	60.9	–	–	–	39.1	–	–	–	60.9	–	39.1
MAY	3.6	0.03	4.0	12.0	–	–	84.0	–	–	8.0	8.0	–	84.0
JUNE	2.7	0.12	44.0	–	–	–	56.0	–	–	–	44.0	–	56.0
JULY	2.6	0.22	69.6	–	–	–	30.4	–	–	–	69.6	–	30.4
AUGUST	2.5	0.18	56.5	–	–	4.3	39.1	–	4.3	4.3	48.0	4.3	39.1
SEPTEMBER	3.7	0.12	28.0	4.0	–	8.0	60.0	–	–	8.0	28.0	4.0	60.0
OCTOBER	3.0	0.13	54.5	–	–	–	45.5	–	–	27.2	27.3	–	45.5
NOVEMBER	3.1	0.17	20.8	25.0	–	4.2	50.0	–	8.3	25.1	8.3	8.3	50.0
DECEMBER	2.9	0.12	27.3	22.7	–	9.1	40.9	–	22.7	13.6	13.6	9.2	40.9
WHOLE YEAR	3.0	0.13	34.4	8.1	0.0	2.5	55.1	0.0	2.9	8.9	29.9	3.2	55.1

SP – Spilling
PL – Plunging
SP/PL – Combined spilling and plunging

TABLE 3

MONTHLY AND ANNUAL
MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION
OCCURRENCES

YEAR 1978

MONTH	MEAN WAVE PERIOD (Secs)	MEAN WAVE HEIGHT (Metres)	Percentage Occurrences - Wave Type /Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.0	0.09	30.4	–	–	–	69.6	–	–	8.7	21.7	–	69.6
FEBRUARY	2.7	0.10	40.9	–	–	–	59.1	–	–	9.1	31.8	–	59.1
MARCH	2.6	0.12	34.8	–	–	–	65.2	–	–	–	34.8	–	65.2
APRIL	2.4	0.03	35.0	–	–	–	65.0	–	–	–	35.0	–	65.0
MAY	2.5	0.07	45.0	–	–	–	55.0	–	–	–	45.0	–	55.0
JUNE	2.1	0.03	21.1	–	–	–	78.9	–	–	–	21.1	–	78.9
JULY	2.5	0.02	25.0	–	–	–	75.0	–	–	8.3	16.7	–	75.0
AUGUST	2.4	0.08	61.9	–	–	–	38.1	–	–	–	61.9	–	38.1
SEPTEMBER	2.5	0.07	40.9	–	–	–	59.1	–	–	18.2	22.7	–	59.1
OCTOBER	2.5	0.06	50.0	–	–	–	50.0	–	–	10.0	40.0	–	50.0
NOVEMBER	2.5	0.17	45.0	–	–	–	55.0	–	5.0	25.0	15.0	–	55.0
DECEMBER	2.7	0.04	21.4	–	–	–	78.6	–	21.4	–	–	–	78.6
WHOLE YEAR	2.5	0.08	34.8	0.0	0.0	0.0	65.2	0.0	1.7	6.8	26.3	0.0	65.2

SP – Spilling
PL – Plunging
SP/PL – Combined spilling and plunging

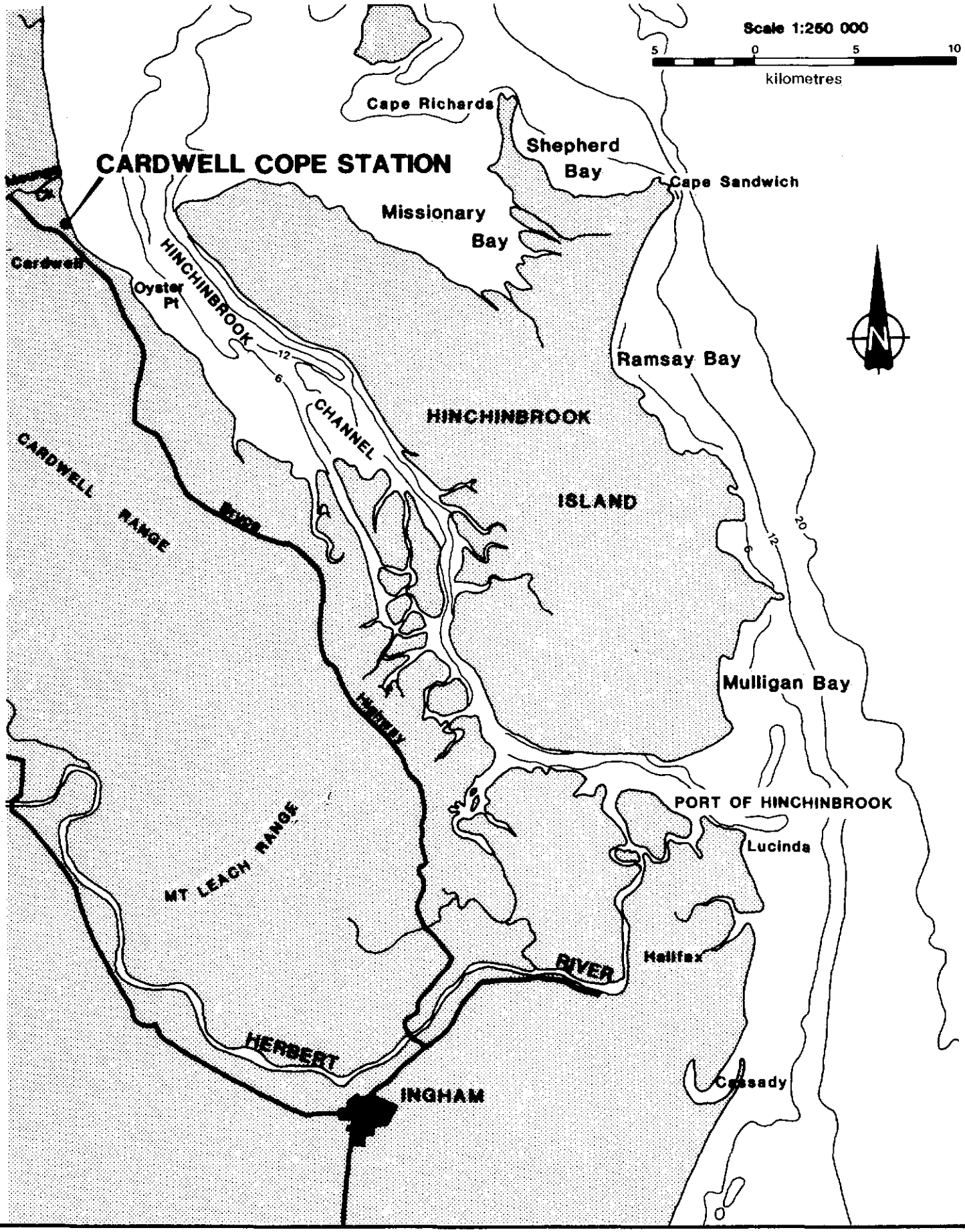
TABLE 4

MONTHLY AND ANNUAL
MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION
OCCURRENCES

YEAR 1979

MONTH	MEAN WAVE PERIOD (Secs)	MEAN WAVE HEIGHT (Metres)	Percentage Occurrences - Wave Type /Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.3	0.21	40.0	20.0	–	–	40.0	–	6.7	26.7	26.7	–	40.0
FEBRUARY	2.9	0.09	41.7	–	–	–	58.3	–	–	41.7	–	–	58.3
MARCH	2.8	0.09	33.3	–	–	–	66.7	–	–	26.7	6.6	–	66.7
APRIL	2.8	0.08	35.7	–	–	–	64.3	–	–	35.7	–	–	64.3
MAY	2.7	0.08	43.8	–	–	–	56.3	–	–	37.5	6.2	–	56.3
JUNE	2.5	0.12	50.0	–	–	–	50.0	–	–	50.0	–	–	50.0
JULY	2.6	0.16	54.5	–	–	9.1	36.4	–	–	54.5	–	9.1	36.4
AUGUST	–	–	–	–	–	–	–	–	–	–	–	–	–
SEPTEMBER	–	–	–	–	–	–	–	–	–	–	–	–	–
OCTOBER	2.8	0.23	16.7	33.3	–	–	50.0	–	–	50.0	–	–	50.0
NOVEMBER	2.9	0.25	73.3	–	–	–	26.7	–	–	73.3	–	–	26.7
DECEMBER	2.5	0.12	33.3	–	–	–	66.7	–	33.3	–	–	–	66.7
WHOLE YEAR	2.8	0.14	44.3	4.1	0.0	0.8	50.8	0.0	2.5	41.0	4.9	0.8	50.8

SP — Spilling
PL — Plunging
SP/PL — Combined spilling and plunging



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LOCALITY PLAN

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Figure 1
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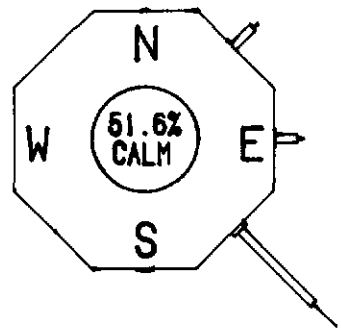
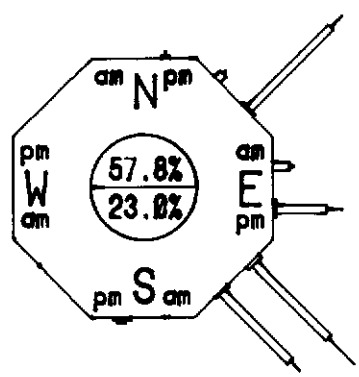
CARDWELL SHIRE CARDWELL 2701

ALL OBSERVATIONS



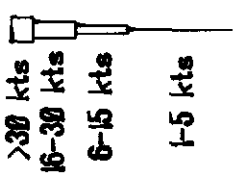
Total No. of Observations : 884

MORNING - AFTERNOON OBSERVATIONS



NOTES :
Figures in Central Circle Represent Percentage of CALM Observations.
Upper Figure for AM
Lower Figure for PM

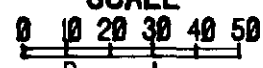
LEGEND



No. of Morning Observations : 733
No. of Afternoon Observations : 161

Mean Time :- Morning Obs : 0949 hrs
Mean Time :- Afternoon Obs : 1549 hrs

SCALE



WIND DATA - APR 1976 to DEC 1979

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WAVE HEIGHT % EXCEEDANCE
ALL DATA

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Figure 3
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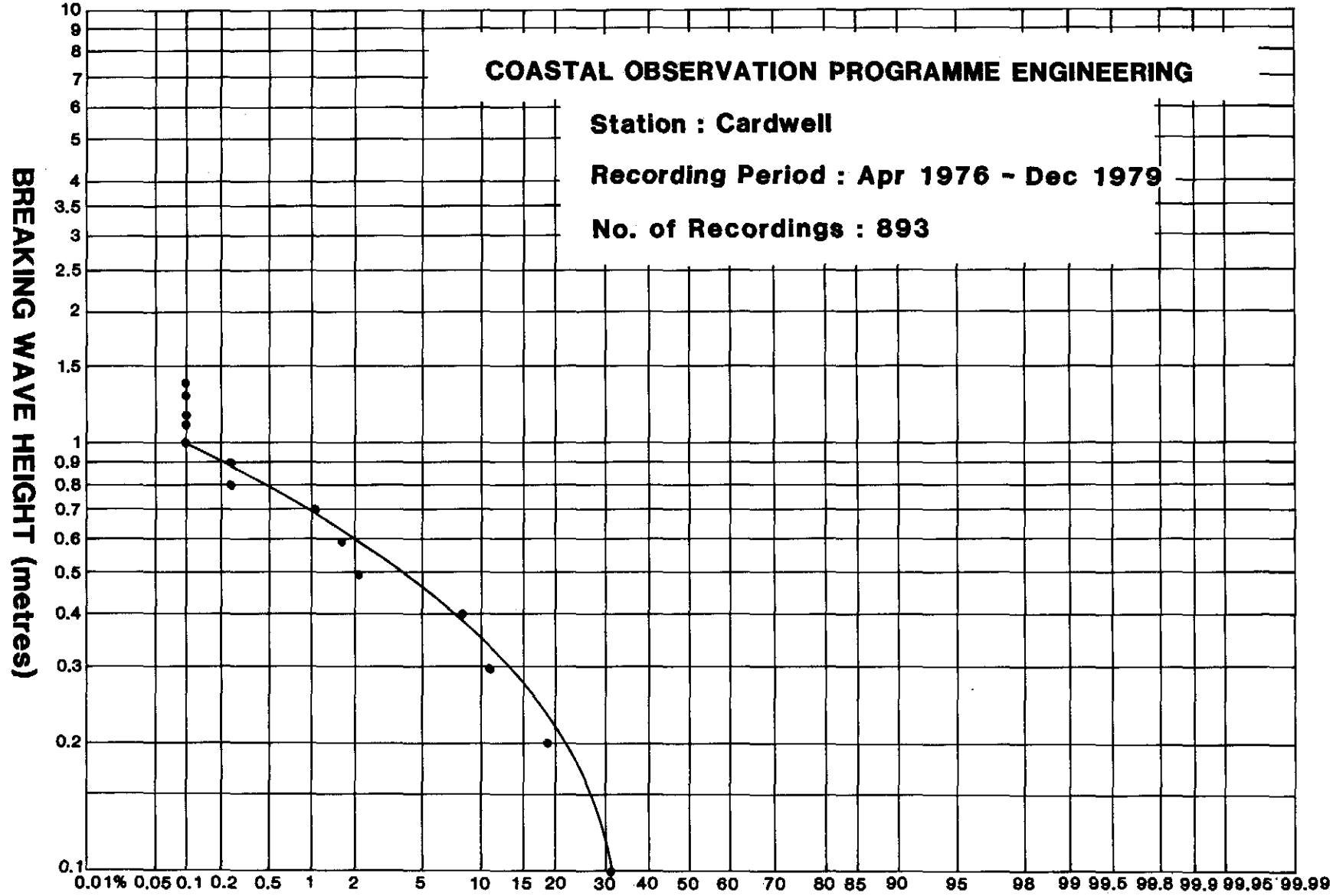

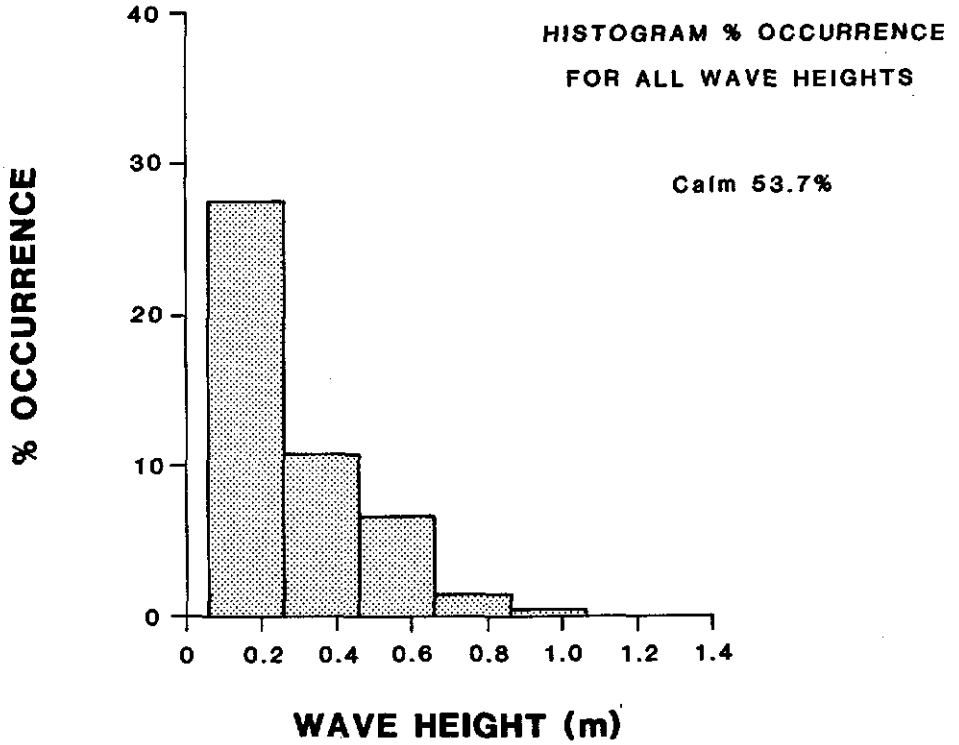

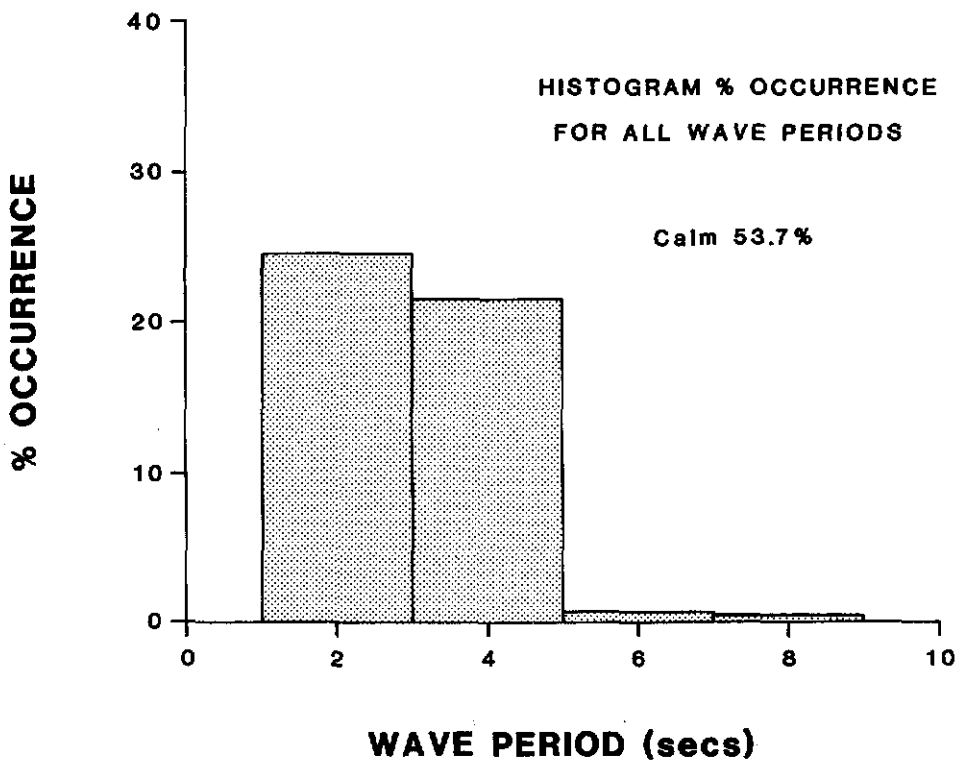

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WAVE HEIGHT AND PERIOD % OCCURRENCE
ALL DATA

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Figure 4

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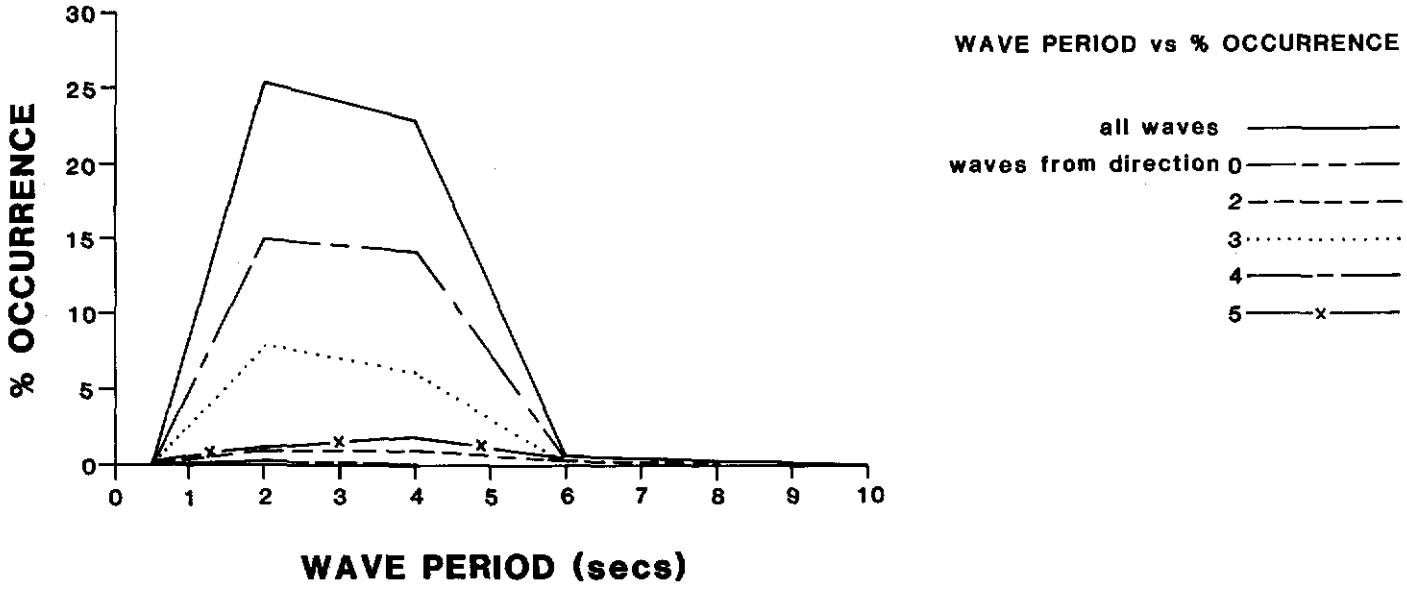

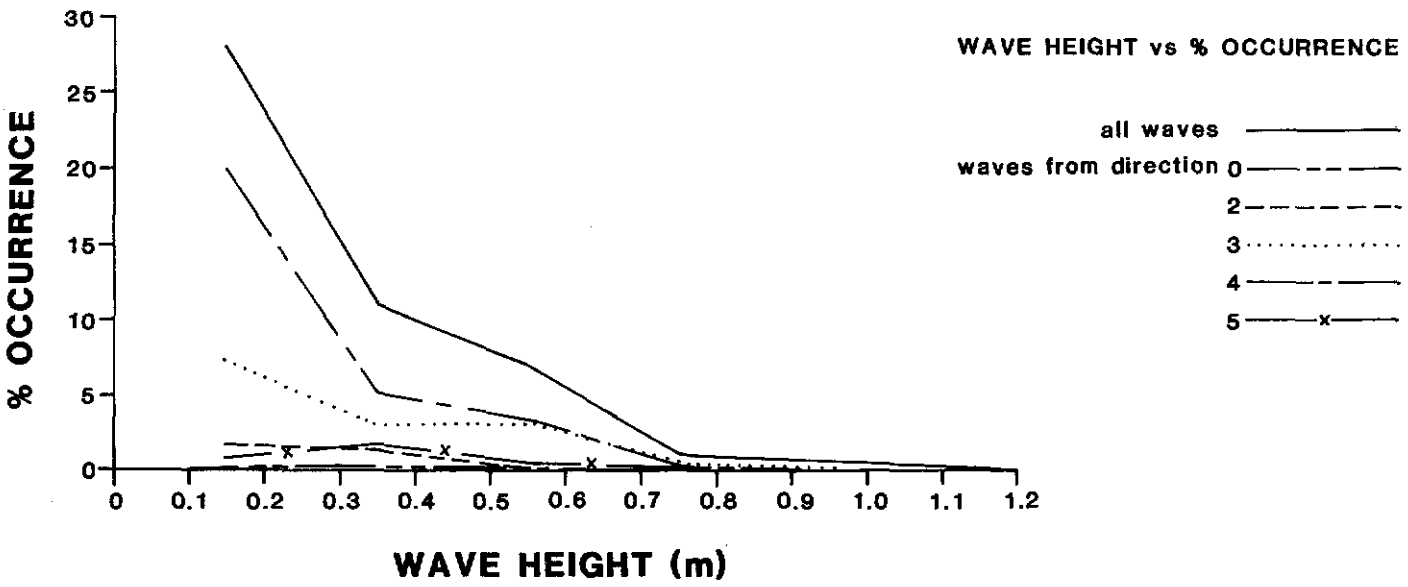

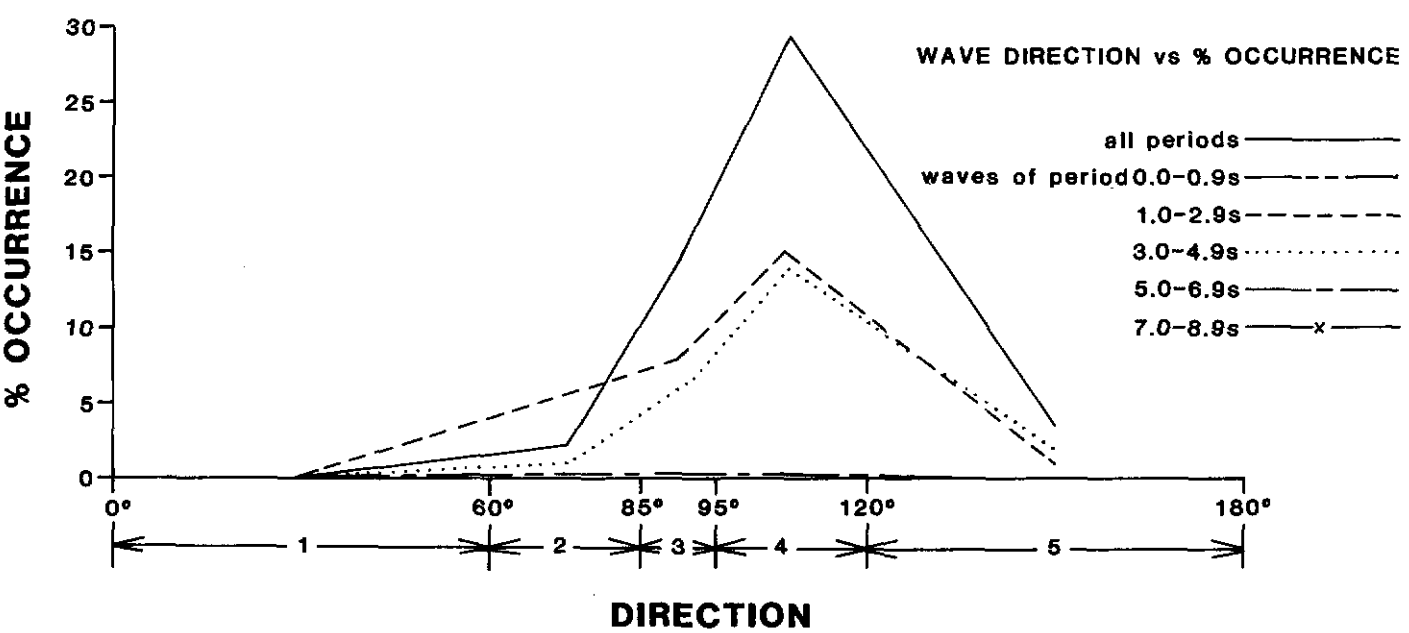

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WAVE DIRECTION ANALYSIS
ALL DATA

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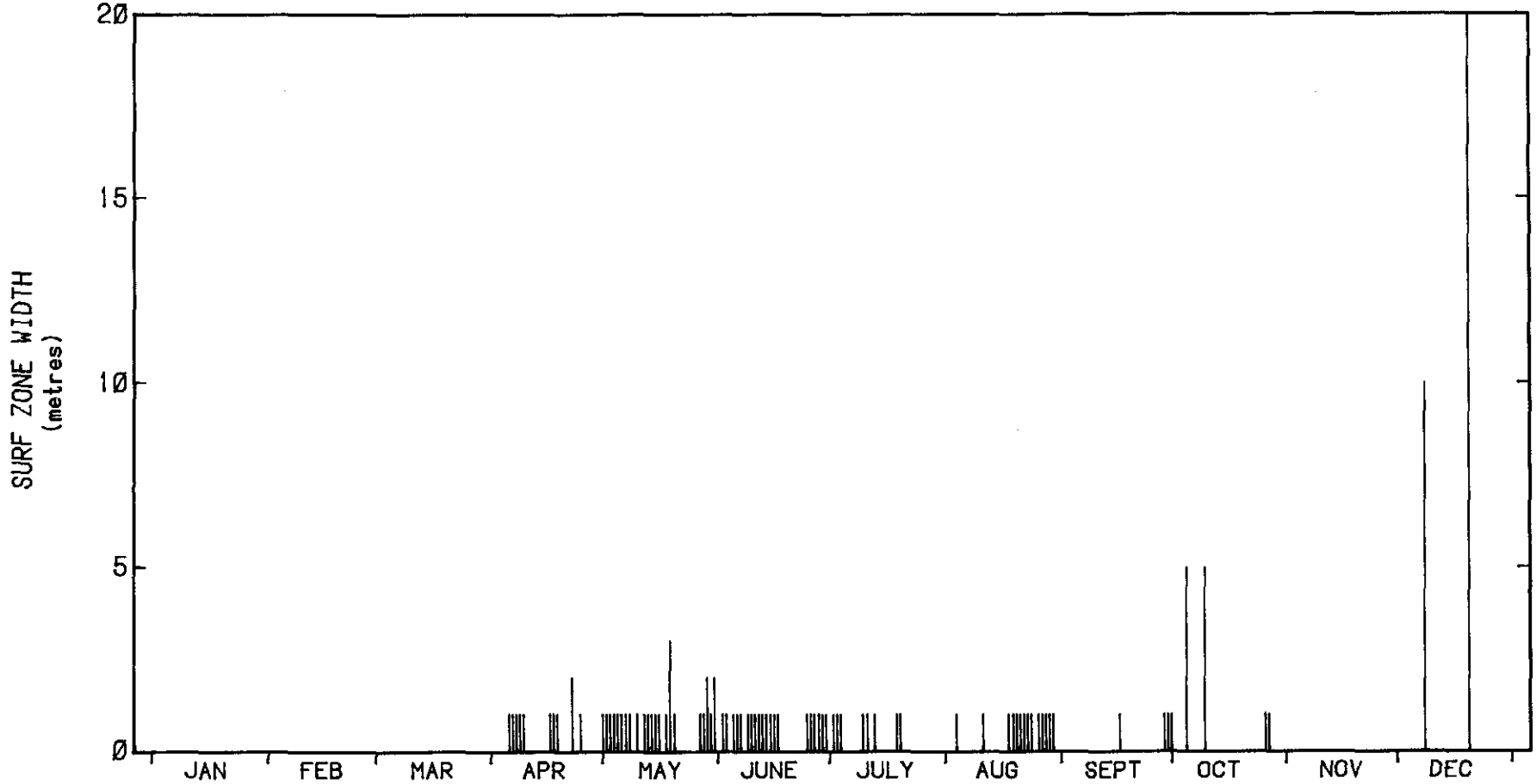
CARDWELL SHIRE

2701



SURF ZONE WIDTH SUMMARY - 1976

No. of Observations : 197

MORNING OBSERVATIONS

Mean Surf Zone Width = .6 m

SURF ZONE WIDTH - MORNING 1976

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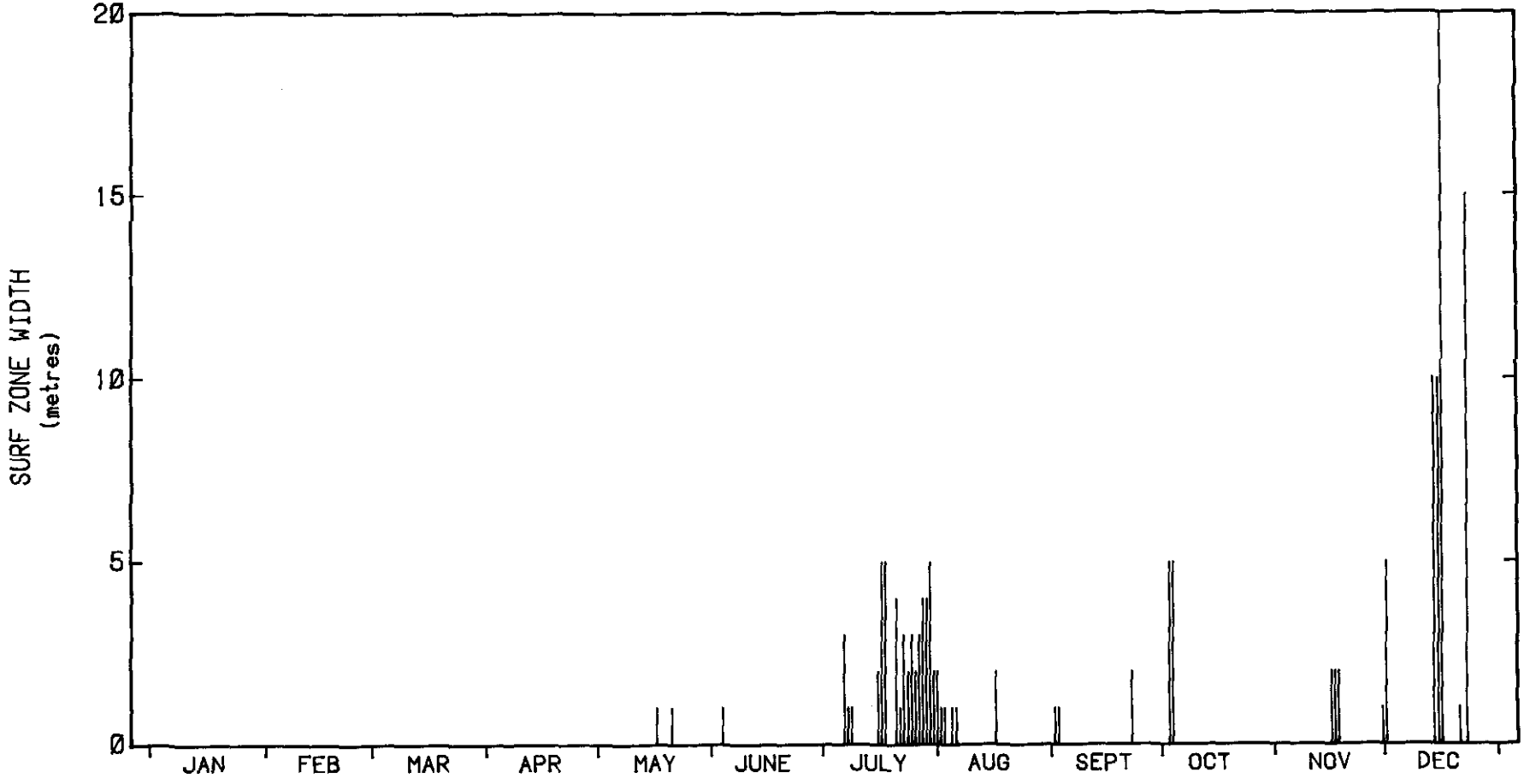

SURF ZONE WIDTH SUMMARY - 1976

No. of Observations : 44

AFTERNOON OBSERVATIONS

Mean Surf Zone Width = 3.3 m

SURF ZONE WIDTH - AFTERNOON 1976

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Figure 7
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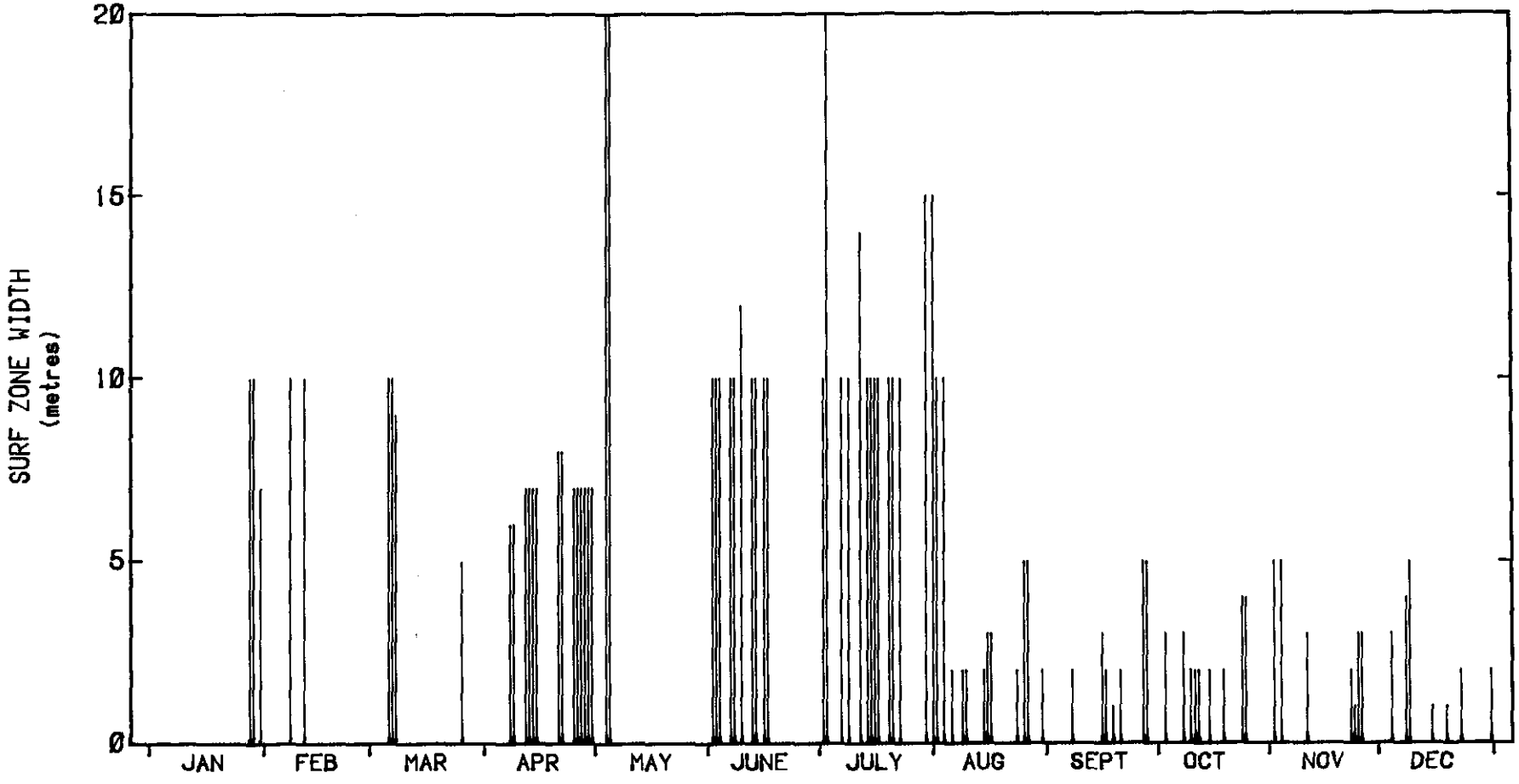

SURF ZONE WIDTH SUMMARY - 1977

No. of Observations : 240

MORNING OBSERVATIONS

Mean Surf Zone Width = 2.6 m

SURF ZONE WIDTH - MORNING 1977

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Figure 8
C 09.1

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Programme Engineering

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CARDWELL SHIRE

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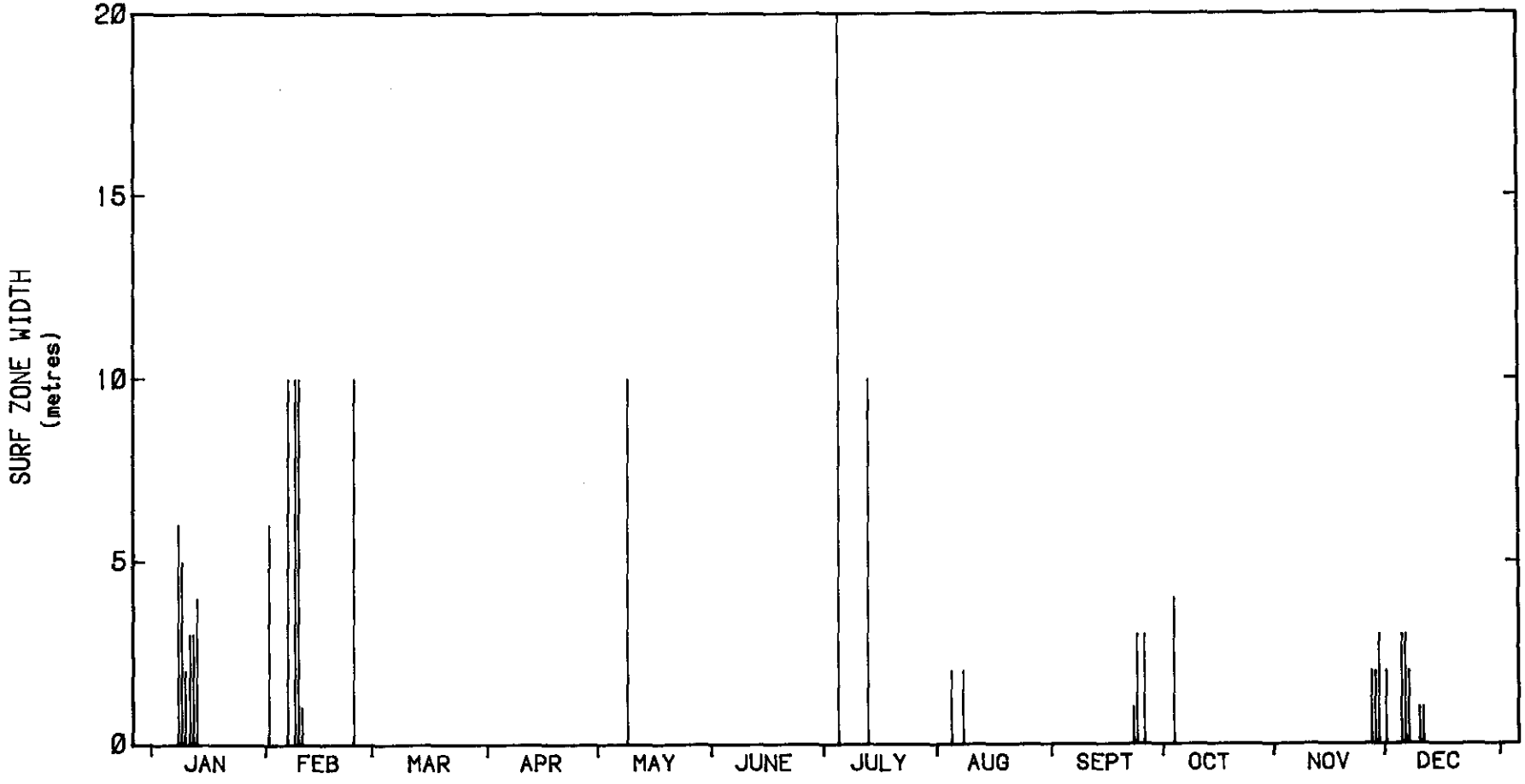

SURF ZONE WIDTH SUMMARY - 1977

No. of Observations : 39

AFTERNOON OBSERVATIONS

Mean Surf Zone Width = 3.7 m

SURF ZONE WIDTH - AFTERNOON 1977

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Figure 9
C 09.1

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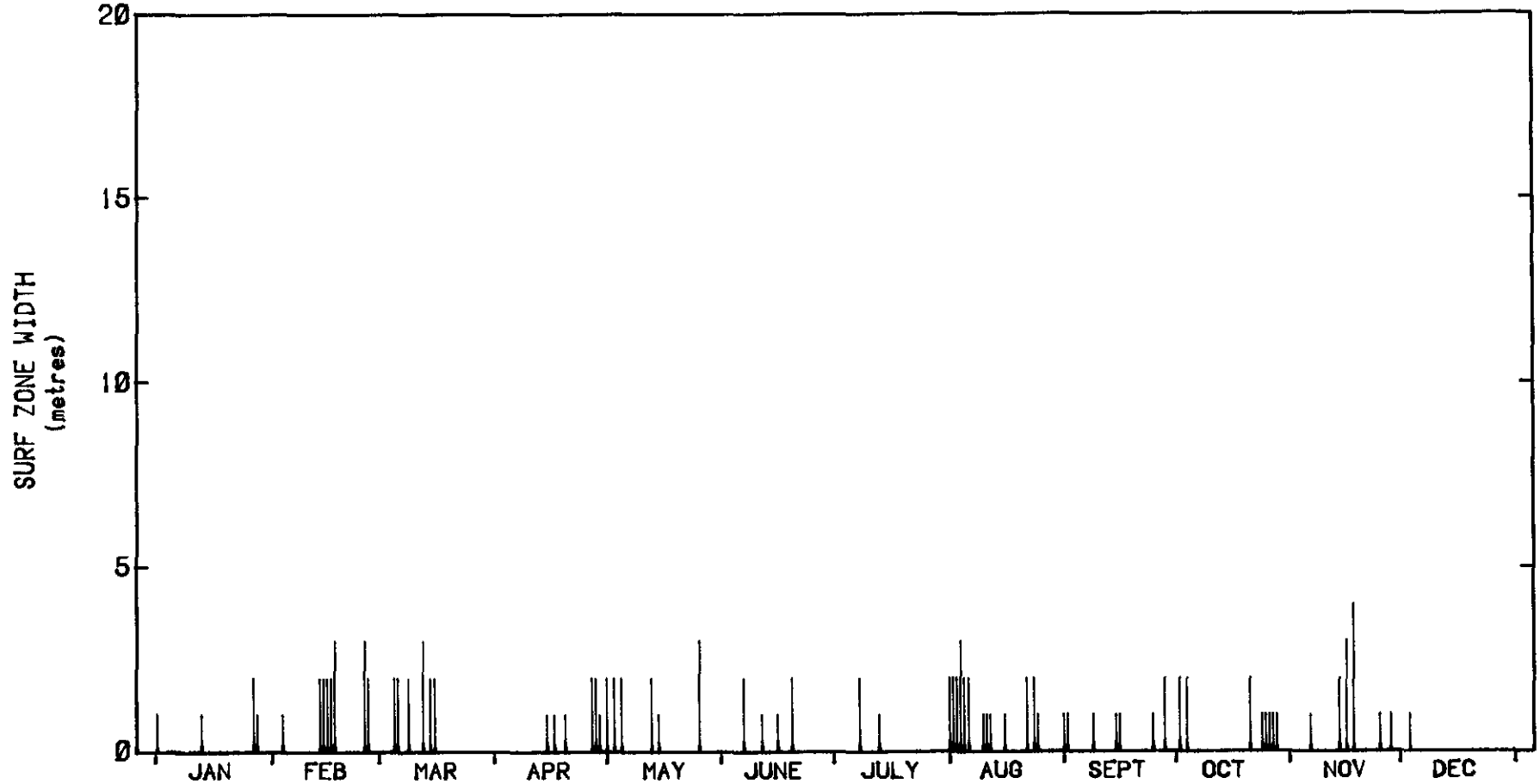

SURF ZONE WIDTH - MORNING 1978

SURF ZONE WIDTH SUMMARY - 1978

No. of Observations : 187

MORNING OBSERVATIONS

Mean Surf Zone Width = .6 m

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Figure 10
C 08.1

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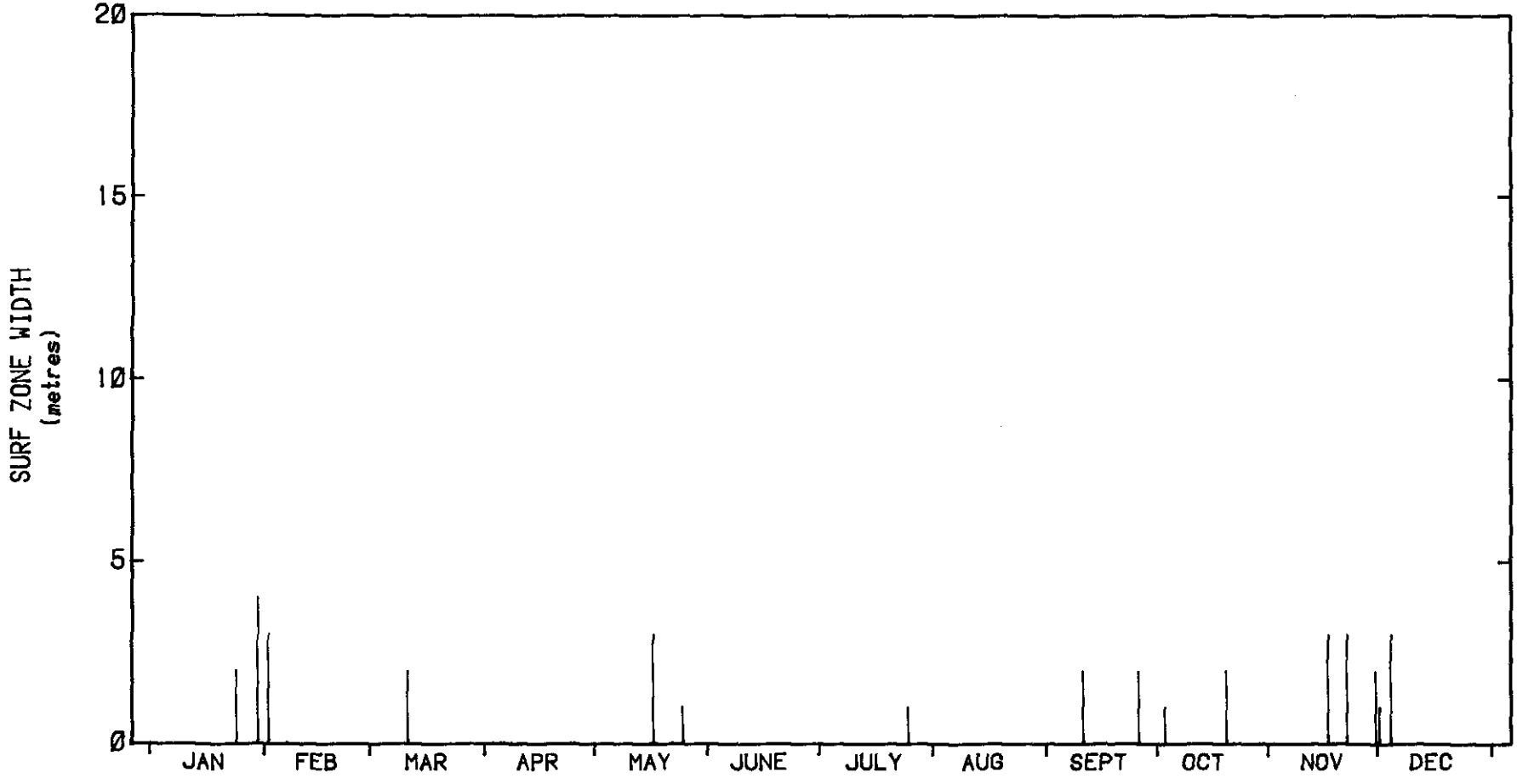

SURF ZONE WIDTH SUMMARY - 1978

No. of Observations : 35

AFTERNOON OBSERVATIONS

Mean Surf Zone Width = 1.0 m

SURF ZONE WIDTH - AFTERNOON 1978

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Figure 11
C 09.1

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CARDWELL SHIRE

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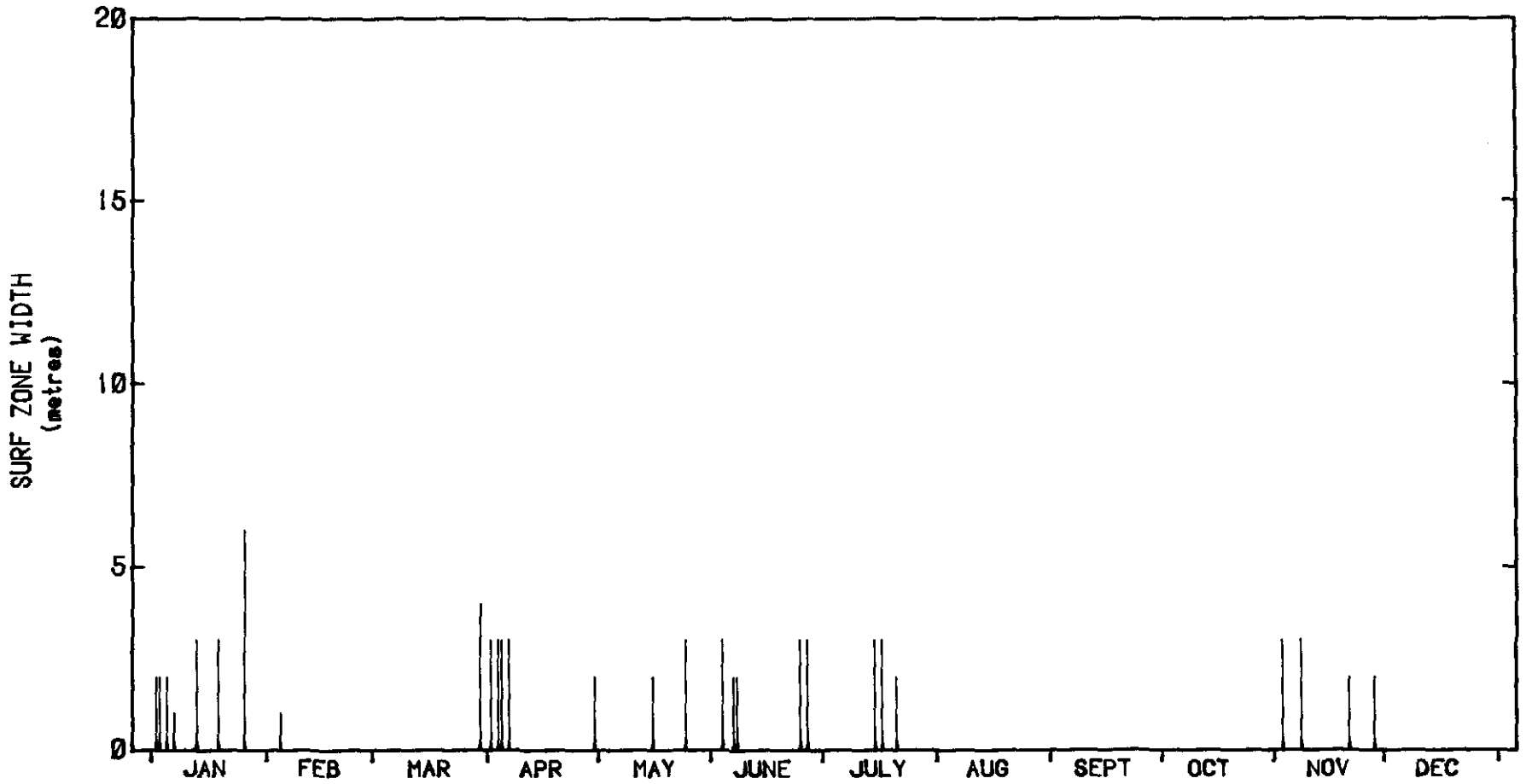

SURF ZONE WIDTH - MORNING 1979

SURF ZONE WIDTH SUMMARY - 1979

No. of Observations : 77

MORNING OBSERVATIONS

Mean Surf Zone Width = 1.0 m

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Figure 12
C 09.1

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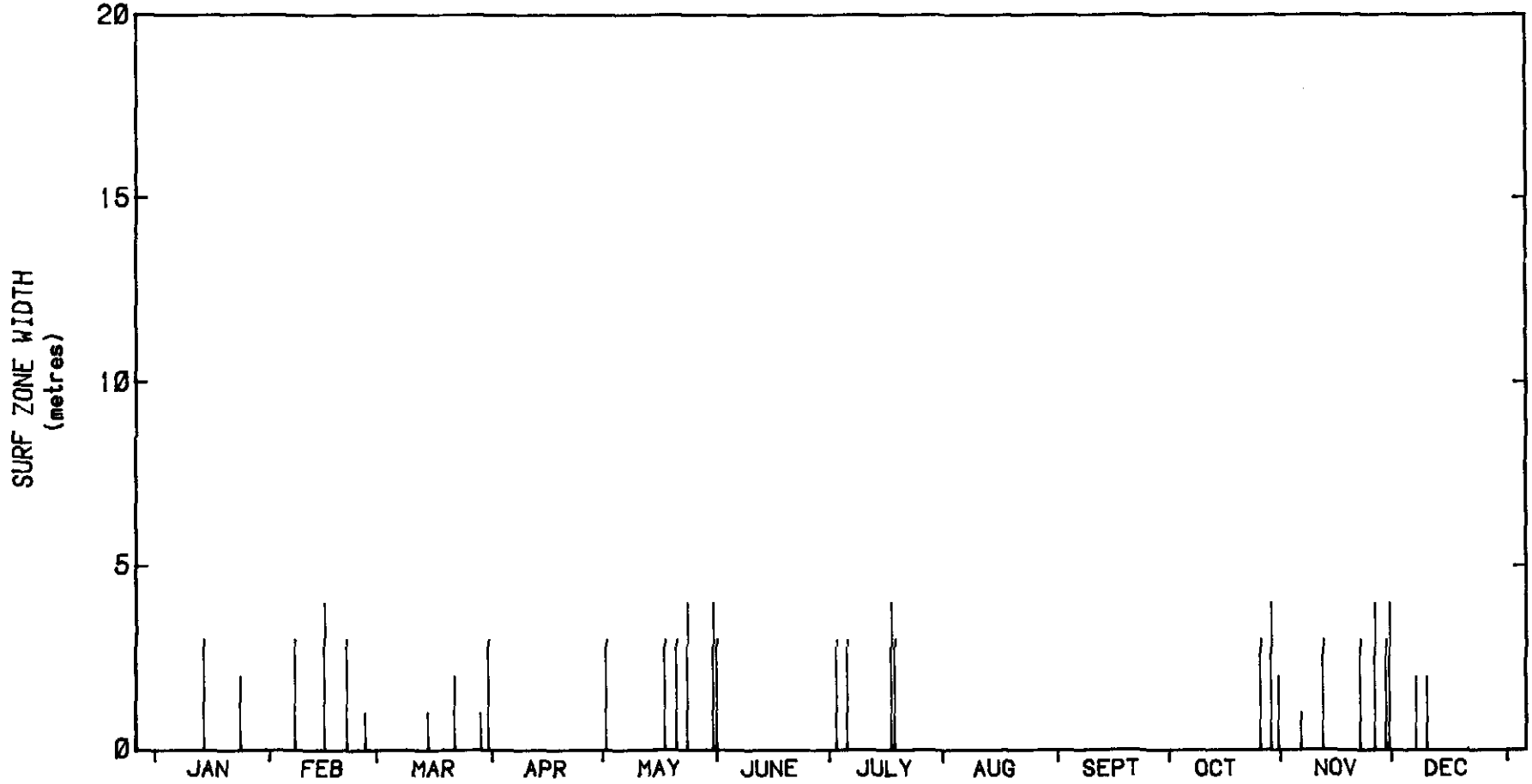

SURF ZONE WIDTH - AFTERNOON 1979

SURF ZONE WIDTH SUMMARY - 1979

No. of Observations : 43

AFTERNOON OBSERVATIONS

Mean Surf Zone Width = 2.0 m

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Figure 13
C 09.1

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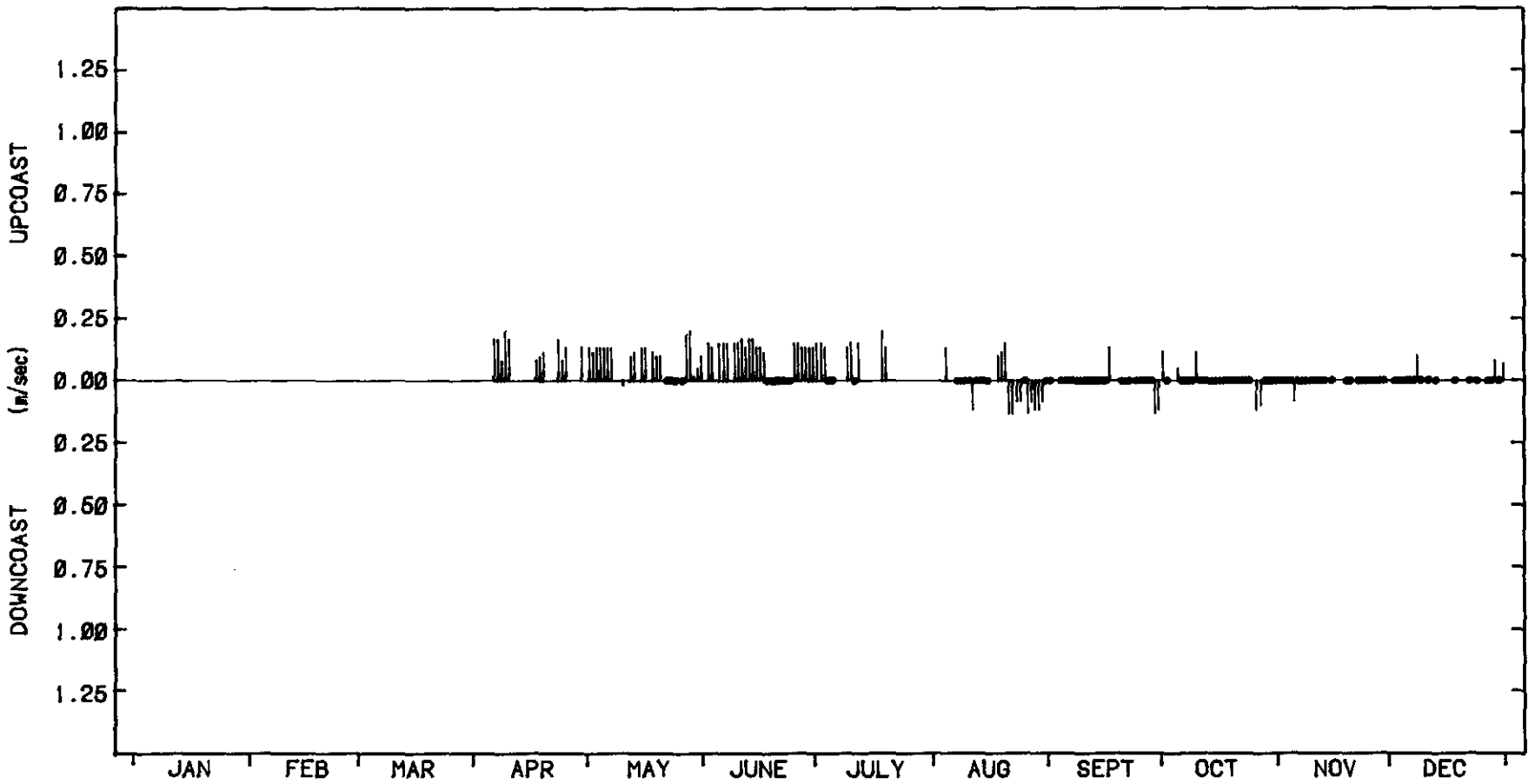
CARDWELL SHIRE CARDWELL 2701



LITTORAL CURRENT SUMMARY - 1976

Mean Vel = 0.039 m/sec (up) Mean Upcoast Vel = 0.130 m/sec Mean Downcoast Vel = 0.103 m/sec

MORNING OBSERVATIONS - (193 recordings)

LITTORAL CURRENTS - MORNING 1976

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Figure 14
C 09.1

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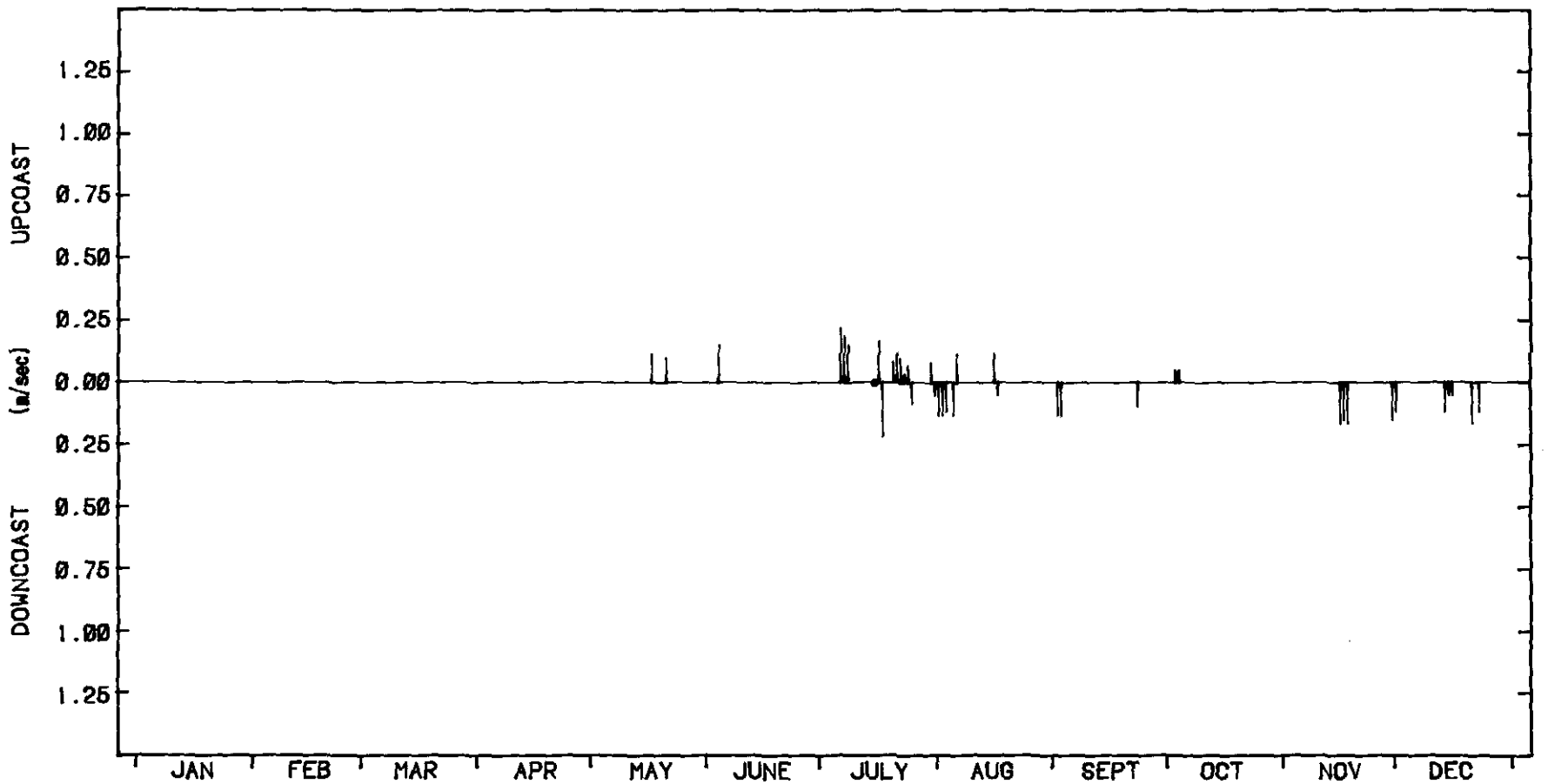
CARDWELL SHIRE

CARDWELL

2701



LITTORAL CURRENT SUMMARY - 1976

Mean Vel = -.016 m/sec (down) Mean Upcoast Vel = 0.112 m/sec Mean Downcoast Vel = 0.121 m/sec

AFTERNOON OBSERVATIONS - (39 recordings)

LITTORAL CURRENTS - AFTERNOON 1976

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Figure 15
C 09.1

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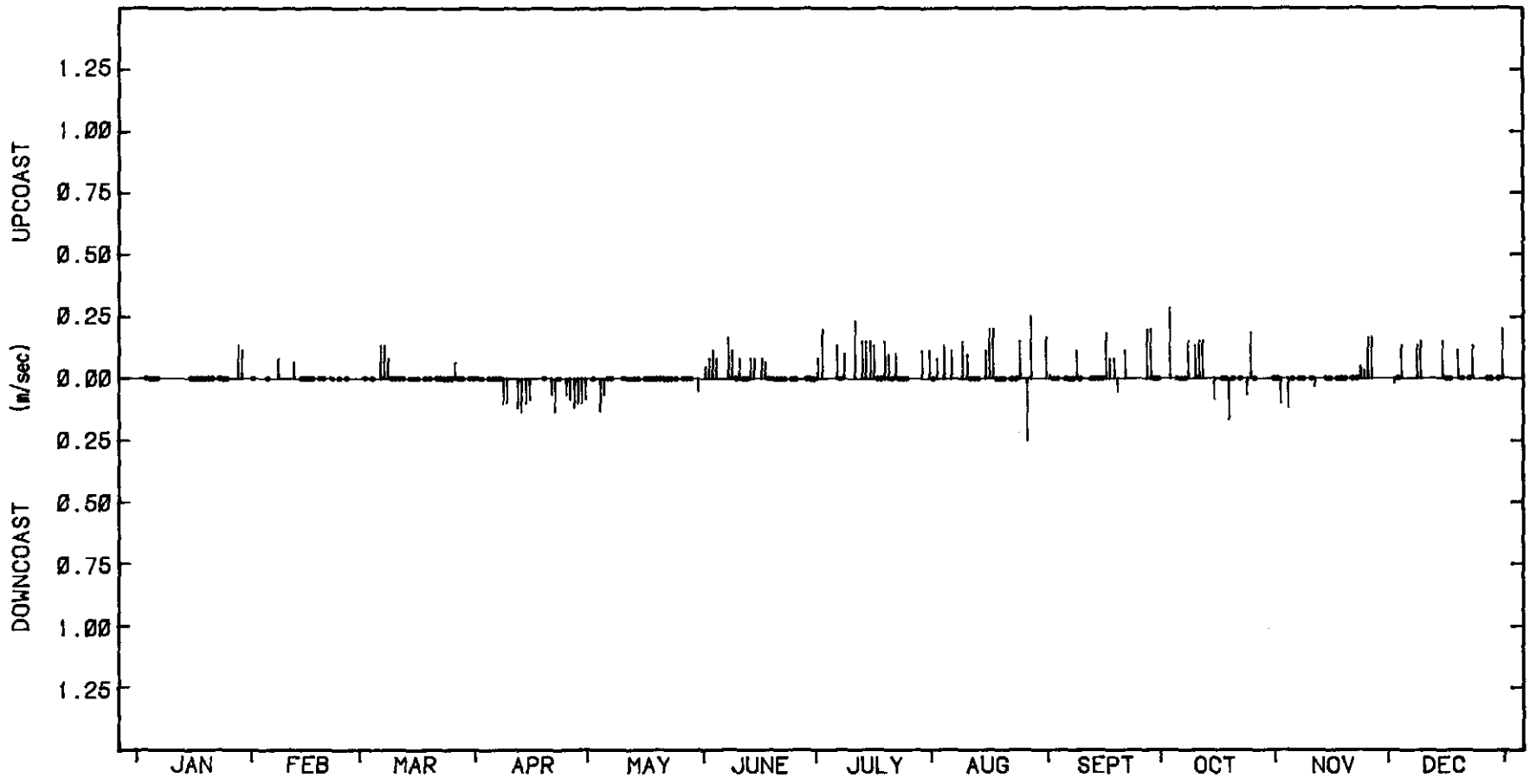
CARDWELL SHIRE CARDWELL 2701



LITTORAL CURRENT SUMMARY - 1977

Mean Vel = 0.027 m/sec (up) Mean Upcoast Vel = 0.129 m/sec Mean Downcoast Vel = 0.097 m/sec

MORNING OBSERVATIONS - (238 recordings)

LITTORAL CURRENTS - MORNING 1977

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Figure 16
C 09.1

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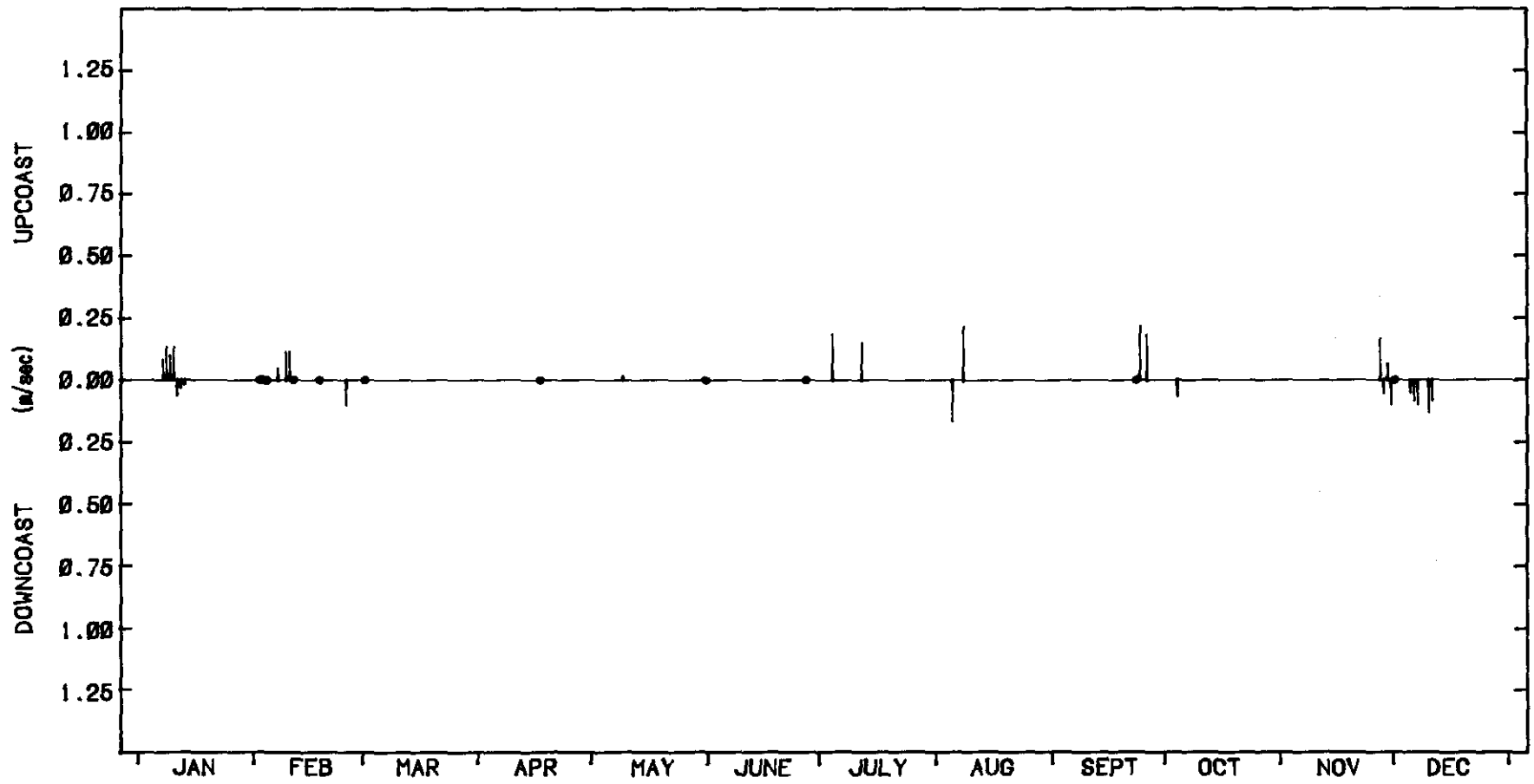
CARDWELL SHIRE

CARDWELL

2701



LITTORAL CURRENT SUMMARY - 1977

Mean Vel = 0.023 m/sec (up) Mean Upcoast Vel = 0.129 m/sec Mean Downcoast Vel = 0.081 m/sec

AFTERNOON OBSERVATIONS - (39 recordings)

LITTORAL CURRENTS - AFTERNOON 1977

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Figure 17
C 09.1

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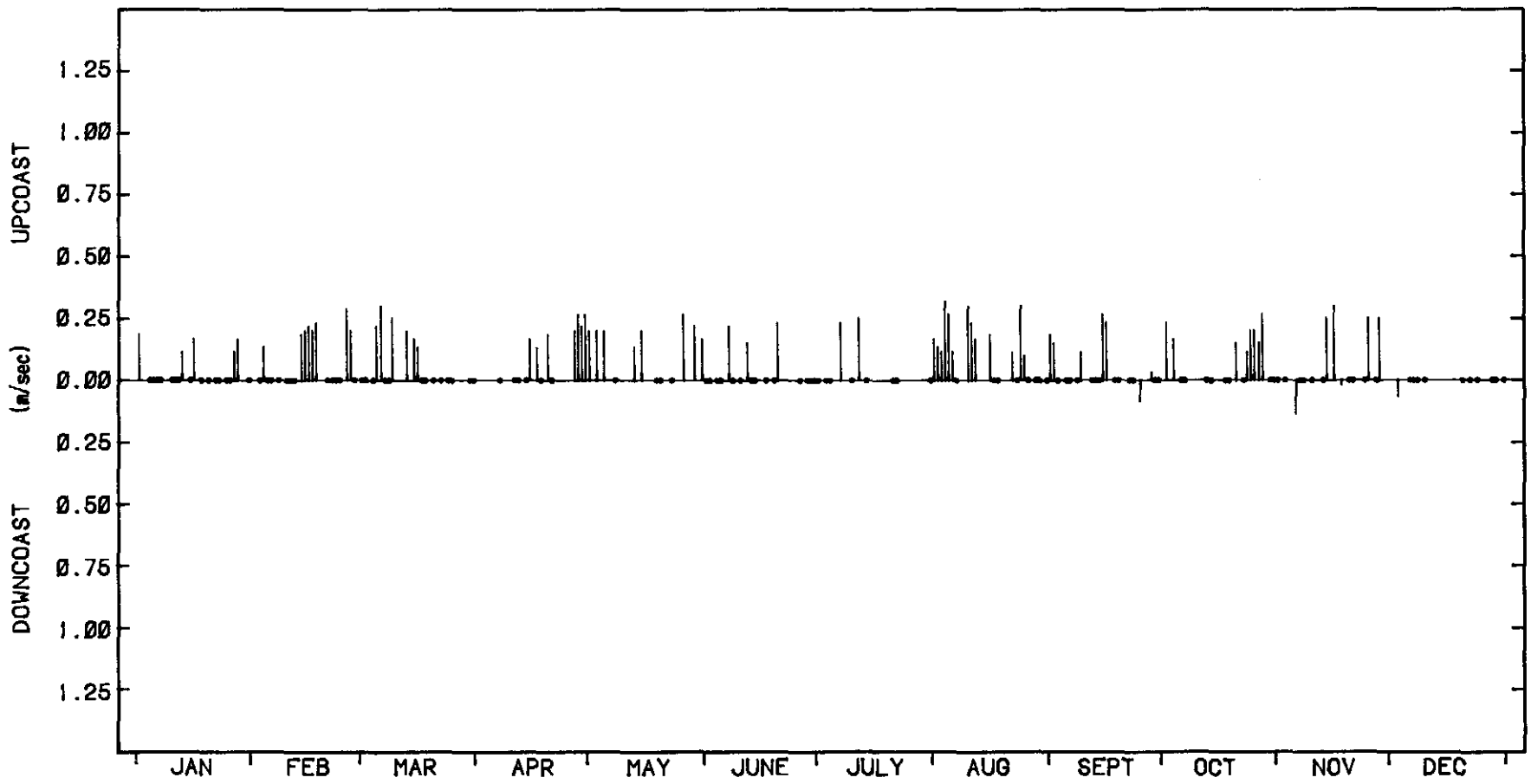
CARDWELL SHIRE CARDWELL 2701



LITTORAL CURRENT SUMMARY - 1978

Mean Vel = 0.069 m/sec (up) Mean Upcoast Vel = 0.197 m/sec Mean Downcoast Vel = 0.075 m/sec

MORNING OBSERVATIONS - (196 recordings)

LITTORAL CURRENTS - MORNING 1978

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Figure 18
C 09.1

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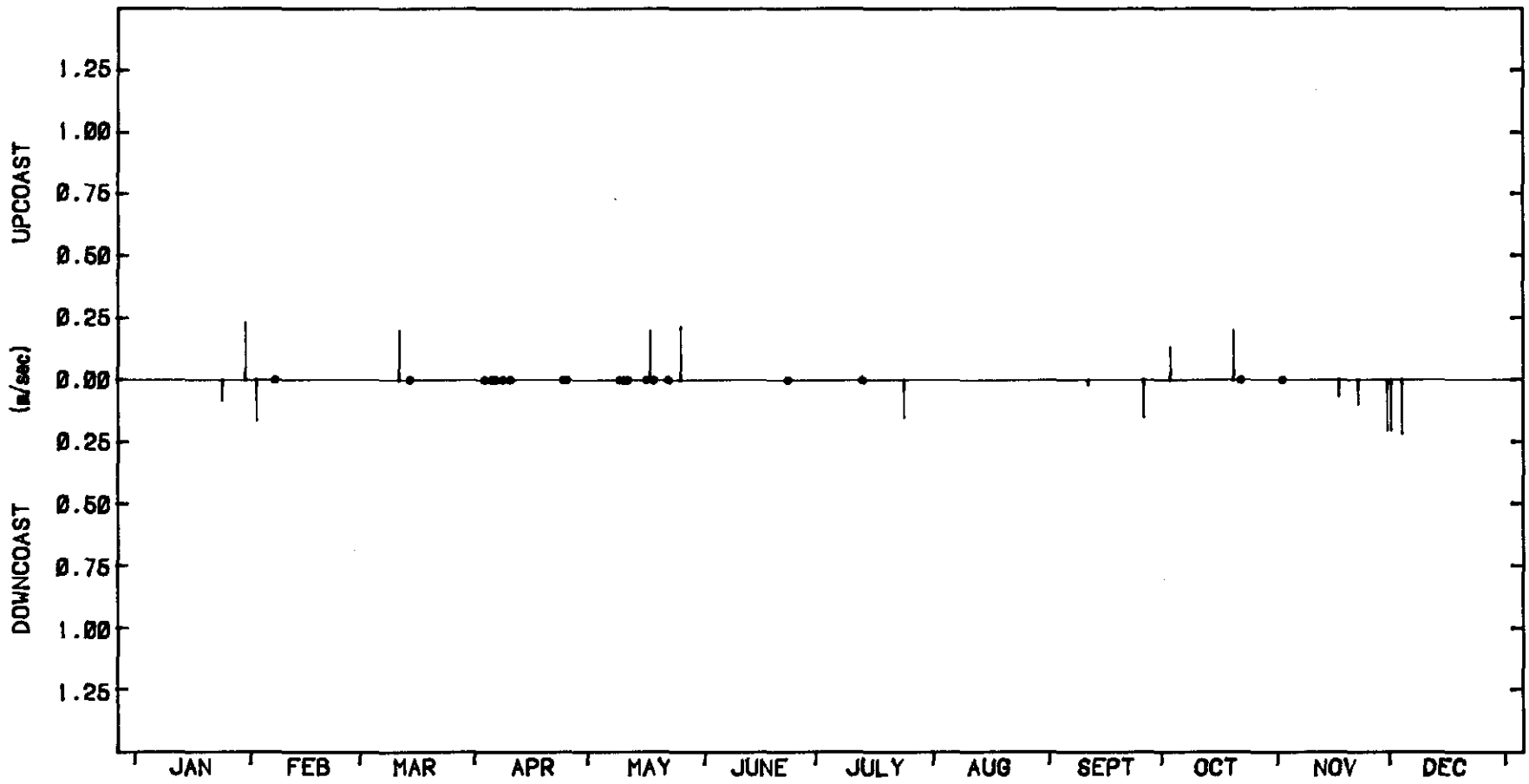
CARDWELL SHIRE CARDWELL 2701



LITTORAL CURRENT SUMMARY - 1978

Mean Vel = -.005 m/sec (down) Mean Upcoast Vel = 0.197 m/sec Mean Downcoast Vel = 0.135 m/sec

AFTERNOON OBSERVATIONS - (35 recordings)

LITTORAL CURRENTS - AFTERNOON 1978

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Figure 19
C 09.1

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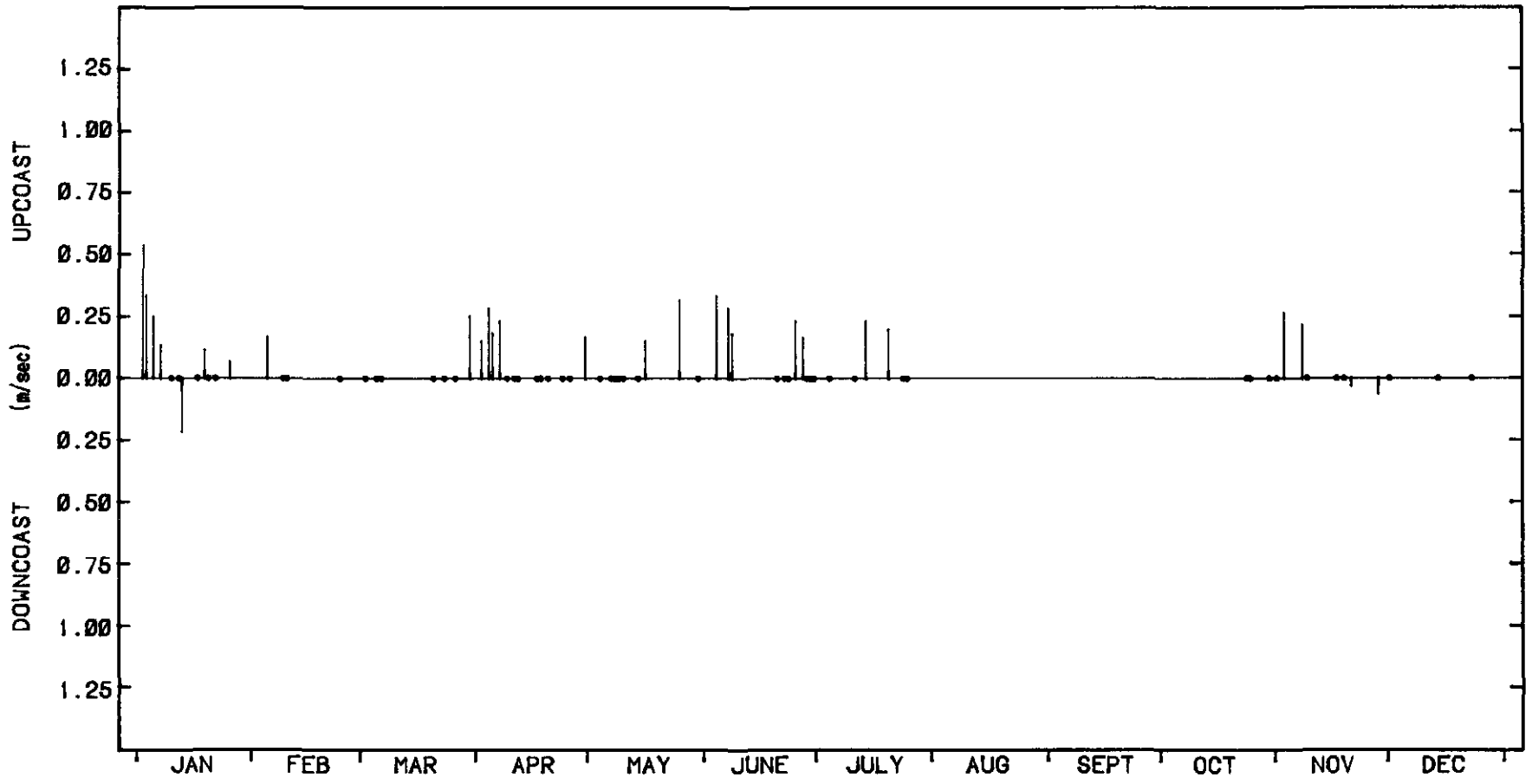
CARDWELL SHIRE CARDWELL 2701



LITTORAL CURRENT SUMMARY - 1979

Mean Vel = 0.068 m/sec (up) Mean Upcoast Vel = 0.227 m/sec Mean Downcoast Vel = 0.106 m/sec

MORNING OBSERVATIONS - (76 recordings)

LITTORAL CURRENTS - MORNING 1979

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Figure 20
C 09.1

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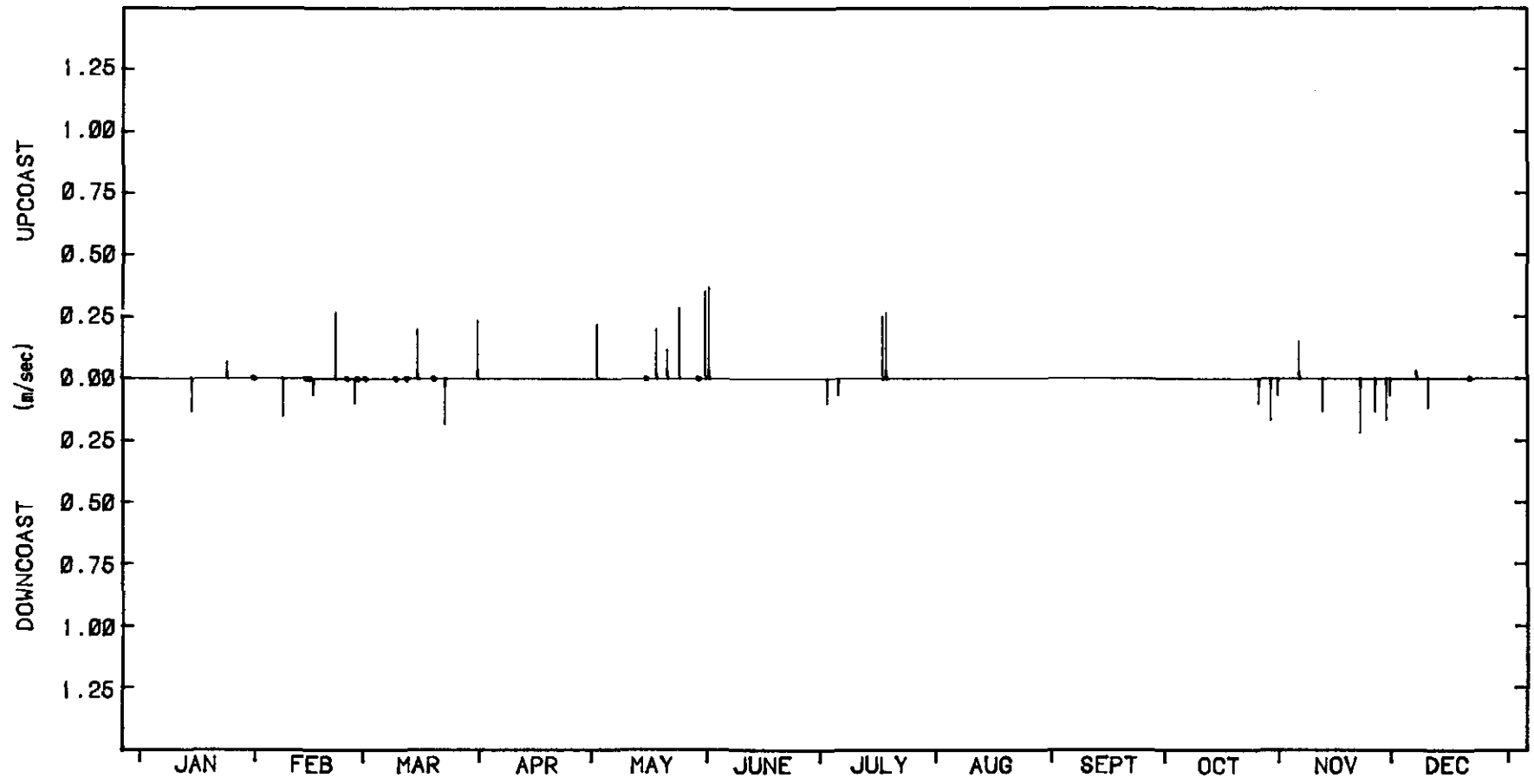

LITTORAL CURRENT SUMMARY - 1979

Mean Vel = 0.025 m/sec (up) Mean Upcoast Vel = 0.214 m/sec Mean Downcoast Vel = 0.123 m/sec

AFTERNOON OBSERVATIONS - (42 recordings)

LITTORAL CURRENTS - AFTERNOON 1979

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Figure 21
C 09.1

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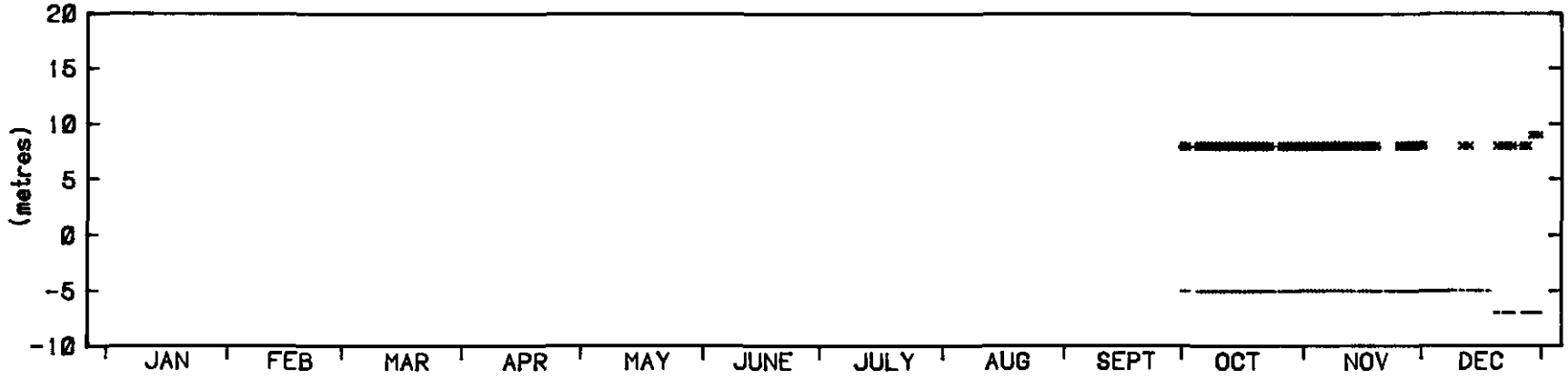
CARDWELL SHIRE CARDWELL 2701

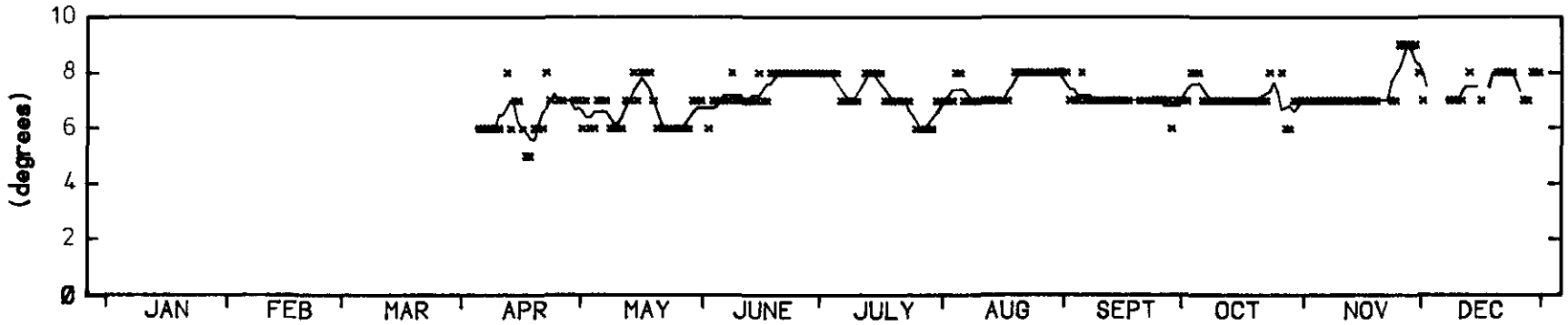
BEACH PROFILE PARAMETERS - 1976



DISTANCE TO FIXED CONTOUR AND VEGETATION LINE - 1976

xxxxx Indicates Distance to Fixed Contour : 63 Observations Fixed Contour Level is approx 1.1 m above AHD.

— Indicates Distance to Vegetation Line : 80 Observations



FORESHORE SLOPE - 1976

Five Day Moving Average

No. of Observations : 236

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Figure 22
C 09.1

Beach Protection Authority

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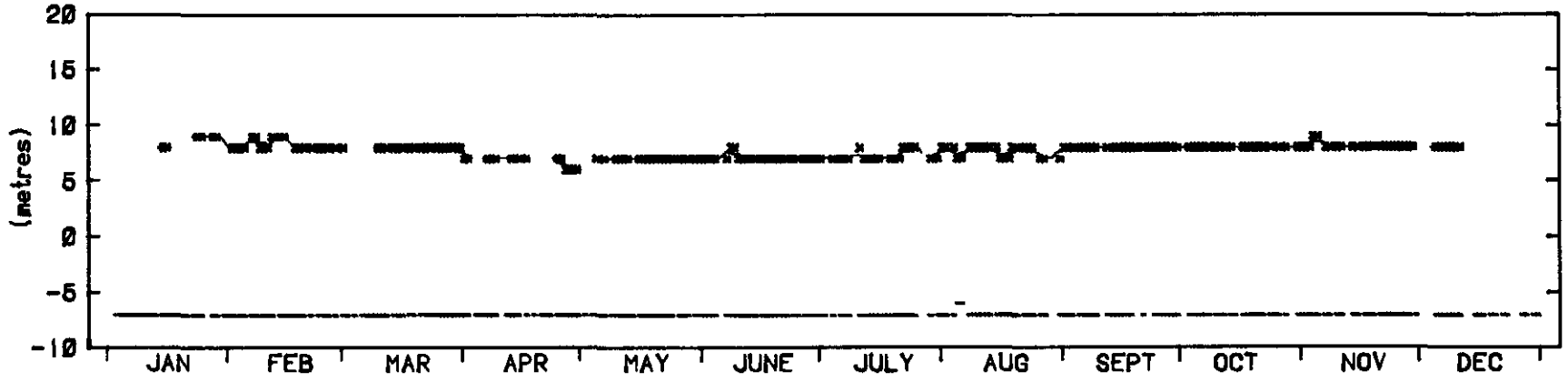
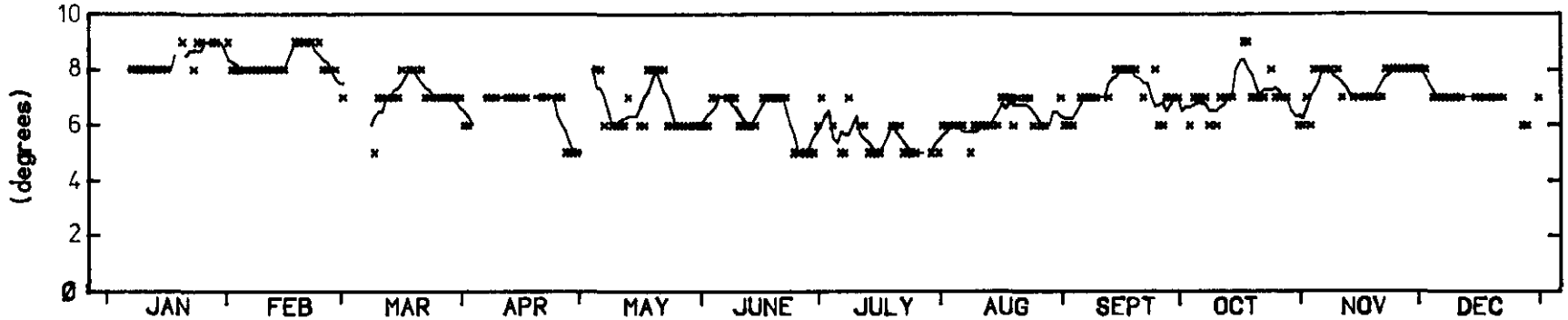
CARDWELL SHIRE CARDWELL 2701



DISTANCE TO FIXED CONTOUR AND VEGETATION LINE - 1977

xxxxx Indicates Distance to Fixed Contour : 221 Observations Fixed Contour Level is approx 1.1 m above A.H.D.

— Indicates Distance to Vegetation Line : 278 Observations



FORESHORE SLOPE - 1977

Five Day Moving Average

No. of Observations : 249

BEACH PROFILE PARAMETERS - 1977

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Figure 23
C 09.1

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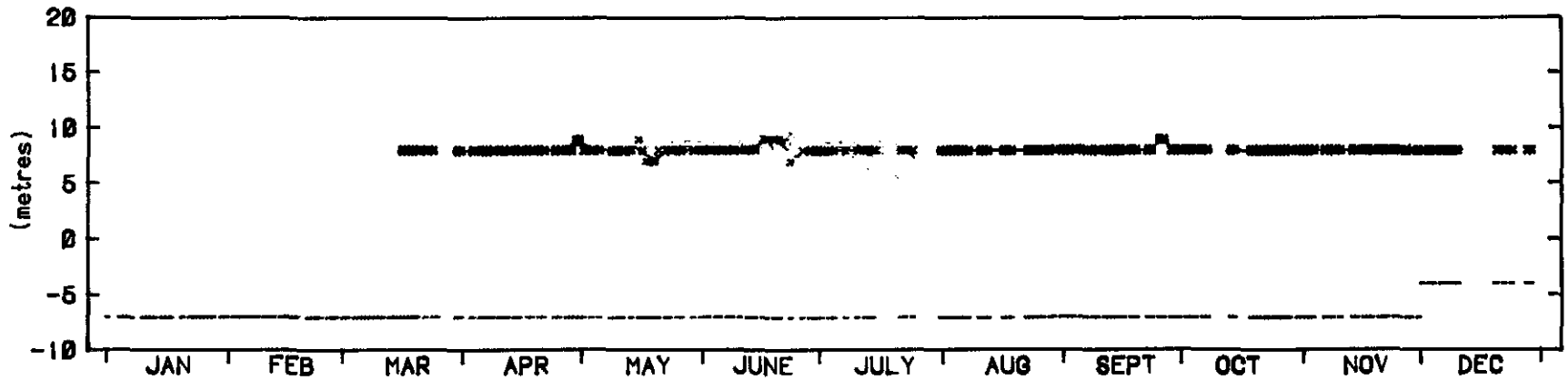
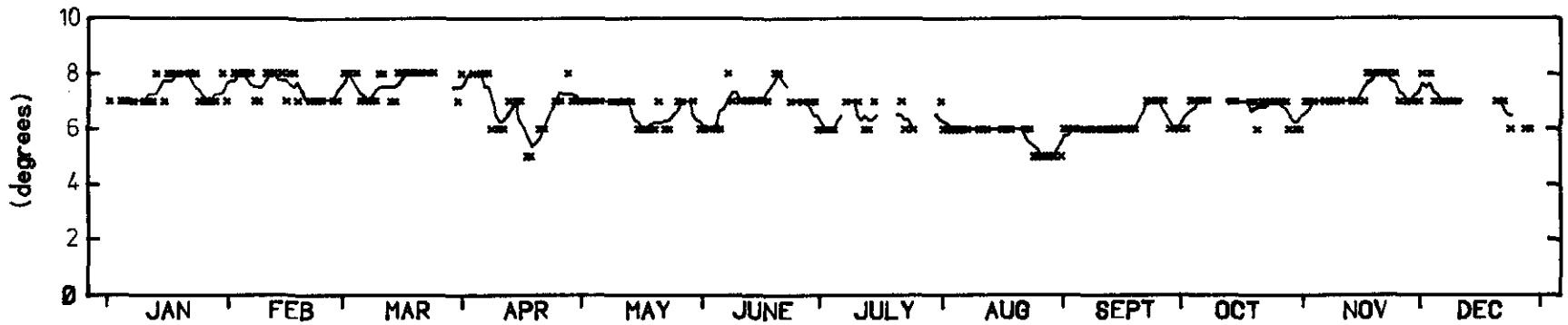


DISTANCE TO FIXED CONTOUR AND VEGETATION LINE - 1978

xxxxx Indicates Distance to Fixed Contour : 176 Observations Fixed Contour Level isapprox 1.1 m above A.H.D.

— Indicates Distance to Vegetation Line : 234 Observations



FORESHORE SLOPE - 1978

Five Day Moving Average

No. of Observations : 233

BEACH PROFILE PARAMETERS - 1978

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Figure 24
C 09.1

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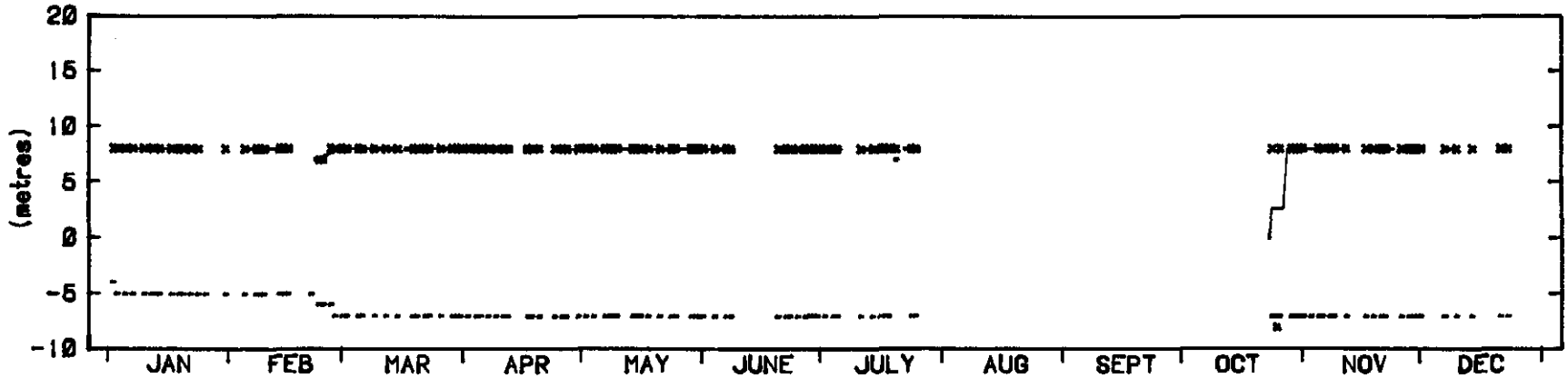
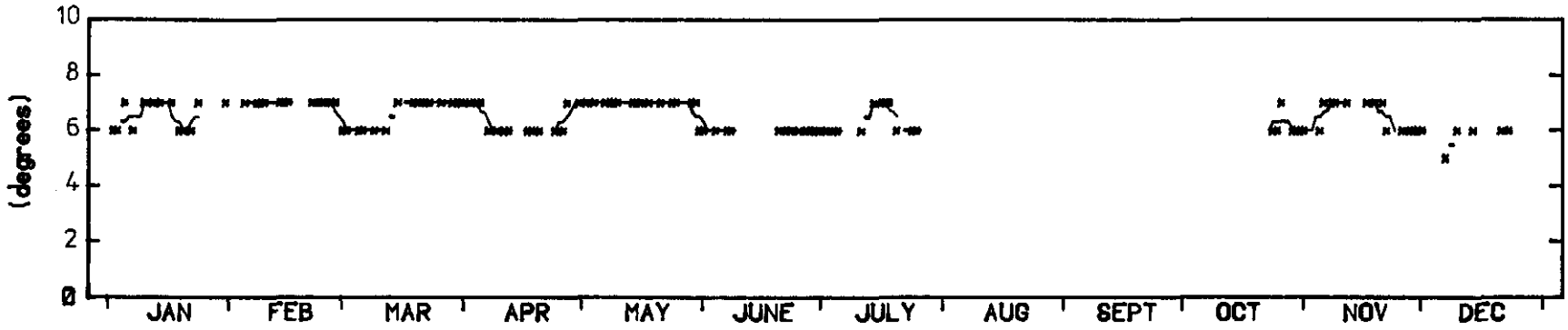


DISTANCE TO FIXED CONTOUR AND VEGETATION LINE - 1979

Indicates Distance to Fixed Contour : 118 Observations Fixed Contour Level is approx 1.1 m above A.H.D.

Indicates Distance to Vegetation Line : 122 Observations



FORESHORE SLOPE - 1979

Five Day Moving Average

No. of Observations : 119

BEACH PROFILE PARAMETERS - 1979

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Figure 25
C 09.1