COASTAL OBSERVATION PROGRAM - ENGINEERING (COPE)

MACHANS BEACH - MULGRAVE SHIRE

FOR THE YEARS 1972 TO 1978

Prepared by the Beach Protection Authority

August 1979

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.

REPORT NO: C 01.1

TITLE: REPORT - COASTAL OBSERVATION PROGRAM - ENGINEERING (COPE), MACHANS BEACH, MULGRAVE SHIRE

DATE: August 1979

TYPE OF REPORT: Technical Memorandum

ISSUING ORGANISATION: Beach Protection Authority
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DISTRIBUTION: Public Distribution

ABSTRACT: This report provides a summary of primary analyses of COPE data on wind, wave and beach processes observed at Machans Beach near Cairns in the Mulgrave Shire in North Queensland. The data was recorded by volunteer observer Merrill Mathews during the period September 1972 to the end of August 1978. The recordings were made twice daily during the six year period and the information obtained is considered representative and reliable.

OTHER REPORTS AVAILABLE IN THIS SERIES: Nil at date of issue.
(Report W 01.1 - Wave Data Recording Program, Cairns Region, was published in November 1978.)

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 Program

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 exists.

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 -

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

(ii) the spacing and number of sites in relation to other stations;

(iii) the need to correlate the COPE data with planned or existing data collection programs.

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 volunteer members of the public 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 program. 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. Seven 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 COPE data can be used with confidence provided its inherent limitations are recognised.

1.6 Presentation of Data

The purpose of this report is to present COPE data for the six year period 1972 to 1978 in a useful statistical form. No attempt has been made to interpret the observed data. It should be noted that data from Machans Beach is not necessarily representative of the region generally, being adjacent to the Barron River mouth and in the lee of Cape Grafton in relation to the predominant south-east waves.

If this six 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

Machans Beach is located within the Mulgrave Shire and is 8 kilometres north of Cairns in North Queensland. It forms part of a 10 kilometre relatively straight stretch of beach between Casuarina Point and Yorkeys Knob and lies between the main Barron River mouth and the secondary delta channel of Barr Creek. It contains the smaller outlet of Redden Creek. The location of the COPE station is shown on Fig. 1.

2.2 Observers

This station has been manned by Merrill Mathews during the period September 1972 to August 1978. Mr Mathews is a retired resident of Machans Beach living near the COPE station.

2.3 Observed Parameters

The observer at this station usually recorded at 9.00 a.m. and 3.00 p.m. daily during the six year period 1972 to 1978.

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 based on Cairns. Datum is Low Water Datum.

M.H.W.S. - 2.3 metres
M.H.W.N. - 1.6 metres
M.S.L. - 1.4 metres
M.L.W.N. - 1.2 metres
M.L.W.S. - 0.5 metres

2.5 Description of the Beach

Machans Beach is a sandy beach deriving sediment from the nearby Barron River delta channels. It is presently experiencing a serious erosion problem and exhibits the following characteristics:

- Typical beach slopes: Foreshore slope 1 in 10, with nearshore flats 1 in 250.
- Beach width: rock wall coincides with high water mark.
- D50 sand size: 0.43 mm averaged over several years.
- Dunal system: low and flat, developed to high water mark.
- Vegetation: non-existent - rock wall constructed.

2.6 Supervision of Station

The observer was instructed in the recording program by the COPE Field Officer, Mr N. Saal of the Department of Harbours and Marine, and the initial instruction period has been followed up with regular visits by Mr Saal 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 Mulgrave Shire Council and the Authority wishes to thank 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 six year period September 1972 to August 1978 is presented on the attached figures. The data has 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 together 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 occurrences are shown as a wind rose in Fig. 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 is 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° to 60°
Sector 2 - 60° to 85°
Sector 3 - 85° to 95°
Sector 4 - 95° to 120°
Sector 5 - 120° to 180°

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 (Fig. 3).

(b) The percentage occurrence of various combinations of wave heights, periods and directions (Fig. 4 and Fig. 5).

(c) surf zone width with an indication of the existence or otherwise of an offshore bar on Figs. 6 to 19.

(d) tabulation of the occurrence of various wave heights, periods, types and directions (Tables 1 to 7).

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 (Fig. 20 to Fig. 29). Mean upcoast and downcoast components and the overall yearly 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 reference pole to the fixed contour level.
- distance from reference pole to the vegetation line (usually front face of foredune). This is not relevant to Machans Beach where a serious erosion problem has led to rock wall construction.
- 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 Figs. 30 to 36 which provide a visual representation of the data.

TABLE NO. 1

MONTHLY AND ANNUAL

MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION

OCCURRENCES

YEAR 1972

Month	Mean Wave Period (secs)	Mean Wave Height (metres)	Percentage Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY													
FEBRUARY													
MARCH													
APRIL													
MAY													
JUNE													
JULY													
AUGUST													
SEPTEMBER	4.6	.38	45.0	1.7	-	53.3	-	-	-	81.7	18.3	-	-
OCTOBER	4.2	.38	41.9	-	-	58.1	-	1.6	12.9	58.1	27.4	-	-
NOVEMBER	3.9	.41	45.0	-	-	55.0	-	5.0	10.0	55.0	30.0	-	-
DECEMBER	3.5	.41	54.8	-	-	45.2	-	1.5	8.1	64.5	25.8	-	-
WHOLE YEAR	-	-	-	-	-	-	-	-	-	-	-	-	-

SP spilling
PL plunging

TABLE NO. 2

MONTHLY AND ANNUAL

MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION

OCCURRENCES

YEAR 1973

Month	Mean Wave Period (secs)	Mean Wave Height (metres)	Percentage Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.3	.40	75.8	-	-	24.2	-	-	21.0	46.8	32.3	-	-
FEBRUARY	3.2	.35	82.1	-	-	17.9	-	1.8	39.3	33.9	25.0	-	-
MARCH	3.2	.58	40.3	-	-	59.7	-	1.6	8.1	64.5	25.8	-	-
APRIL	3.7	.54	41.7	-	-	58.3	-	-	5.0	73.3	20.0	1.7	-
MAY	3.7	.47	67.2	-	-	32.8	-	-	9.8	60.7	29.5	-	-
JUNE	3.7	.43	87.3	-	-	12.7	-	-	23.6	50.9	25.5	-	-
JULY	4.0	.38	67.8	-	-	32.2	-	-	23.7	50.8	25.4	-	-
AUGUST	3.4	.46	48.4	-	-	51.6	-	-	12.9	61.3	25.8	-	-
SEPTEMBER	3.4	.55	56.7	-	-	43.3	-	-	11.7	60.0	28.3	-	-
OCTOBER	3.0	.47	56.5	-	-	43.5	-	-	11.3	54.8	33.9	-	-
NOVEMBER	3.2	.37	81.4	-	-	18.6	-	-	35.6	44.1	20.3	-	-
DECEMBER	3.4	.45	35.5	1.6	25.8	37.1	-	1.6	16.1	62.9	19.4	-	-
WHOLE YEAR	3.4	.46	61.2	.1	2.2	36.4	-	.4	17.9	55.6	26.0	.1	-

SP spilling
PL plunging

TABLE NO. 3

MONTHLY AND ANNUAL

MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION

OCCURRENCES

YEAR 1974

Month	Mean Wave Period (secs)	Mean Wave Height (metres)	Percentage Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.4	.33	16.1	-	82.3	1.6	-	-	91.9	8.1	-	-	-
FEBRUARY	3.5	.34	67.9	-	25.0	7.1	-	1.8	25.0	62.5	10.7	-	-
MARCH	4.5	.43	50.8	-	41.0	8.2	-	-	41.9	56.5	1.6	-	-
APRIL	4.0	.32	90.0	-	1.7	8.3	-	-	6.7	83.3	10.0	-	-
MAY	3.7	.40	75.4	-	9.8	14.8	-	-	1.6	83.6	11.9	-	-
JUNE	3.8	.32	81.4	-	11.9	6.8	-	-	6.8	81.4	11.9	-	-
JULY	4.2	.33	60.0	-	28.3	11.7	-	1.7	23.3	55.0	20.0	-	-
AUGUST	4.0	.31	55.0	-	38.3	6.7	-	-	33.3	51.7	15.0	-	-
SEPTEMBER	4.0	.42	55.0	3.3	35.0	5.0	1.7	-	15.0	63.3	21.7	-	-
OCTOBER	3.4	.42	61.3	1.6	33.9	3.2	-	-	12.9	58.7	27.4	-	-
NOVEMBER	3.0	.32	43.3	-	50.0	6.7	-	-	26.7	50.0	23.3	-	-
DECEMBER	3.2	.39	43.5	-	48.4	8.1	-	-	24.2	51.6	24.2	-	-
WHOLE YEAR	3.7	.36	58.1	.4	34.0	7.3	.1	.3	26.0	58.7	15.1	-	-

SP spilling
PL plunging

TABLE NO. 4

MONTHLY AND ANNUAL

MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION

OCCURRENCES

YEAR 1975

Month	Mean Wave Period (secs)	Mean Wave Height (metres)	Percentage Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.8	.33	53.2	-	43.5	3.2	-	-	29.0	56.5	14.5	-	-
FEBRUARY	3.6	.50	60.7	-	30.4	8.9	-	-	21.4	69.6	8.9	-	-
MARCH	3.3	.33	45.2	-	50.0	4.8	-	-	17.7	50.0	32.3	-	-
APRIL	3.6	.39	70.0	-	20.0	10.0	-	-	1.7	73.3	25.0	-	-
MAY	4.1	.32	79.0	-	14.5	6.5	-	-	-	85.5	14.5	-	-
JUNE	4.1	.31	50.0	-	16.7	33.3	-	-	10.0	78.3	11.7	-	-
JULY	4.0	.36	37.1	-	22.6	40.3	-	-	17.7	72.6	9.7	-	-
AUGUST	3.8	.27	53.2	-	27.4	19.4	-	-	16.1	69.4	14.5	-	-
SEPTEMBER	3.9	.29	38.3	-	18.3	43.3	-	-	5.0	73.3	21.7	-	-
OCTOBER	3.6	.24	27.4	-	38.7	33.9	-	-	27.4	61.3	11.3	-	-
NOVEMBER	3.5	.21	38.9	-	33.3	27.8	-	-	11.1	52.8	36.1	-	-
DECEMBER	3.8	.24	41.3	2.2	21.7	34.8	-	-	45.7	45.7	8.7	-	-
WHOLE YEAR	3.8	.32	50.0	.1	28.1	21.7	-	-	16.5	66.5	17.0	-	-

SP spilling
PL plunging

TABLE NO. 5

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 Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.8	.21	43.5	-	19.4	37.1	-	-	35.5	54.8	9.7	-	-
FEBRUARY	4.4	.24	65.5	-	10.3	24.1	-	-	20.7	75.9	3.4	-	-
MARCH	4.0	.19	58.1	-	14.5	27.4	-	-	29.0	53.2	17.7	-	-
APRIL	4.1	.24	50.8	-	3.4	45.8	-	-	1.7	85.0	13.3	-	-
MAY	4.1	.18	56.7	-	6.7	36.7	-	-	-	85.2	14.8	-	-
JUNE	4.2	.19	55.9	-	3.4	40.7	-	-	1.7	84.7	13.6	-	-
JULY	4.5	.21	55.6	-	1.6	42.9	-	-	12.7	74.6	12.7	-	-
AUGUST	3.9	.18	45.1	-	6.5	48.4	-	-	11.3	66.1	22.6	-	-
SEPTEMBER	3.6	.19	51.0	2.0	-	46.9	-	-	20.4	63.3	16.3	-	-
OCTOBER	3.3	.18	37.1	-	3.2	59.7	-	3.2	38.7	50.0	8.1	-	-
NOVEMBER	3.3	.18	68.3	-	1.7	30.0	-	-	48.3	40.0	11.7	-	-
DECEMBER	3.6	.18	45.9	-	3.3	50.8	-	-	41.0	44.3	14.8	-	-
WHOLE YEAR	3.9	.20	52.7	.1	6.3	40.9	-	.3	21.8	64.7	13.2	-	-

SP spilling
PL plunging

TABLE NO. 6

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 Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	3.7	.19	48.4	-	-	51.6	-	-	11.3	67.7	21.0	-	-
FEBRUARY	3.9	.17	51.8	-	3.6	44.6	-	-	23.2	73.2	3.6	-	-
MARCH	4.6	.20	50.0	-	4.8	45.2	-	1.6	29.0	59.7	9.7	-	-
APRIL	4.4	.27	11.7	1.7	-	86.7	-	-	5.0	85.0	10.0	-	-
MAY	4.8	.14	73.2	-	-	26.8	-	-	10.7	78.6	10.7	-	-
JUNE	4.2	.17	57.1	-	-	42.9	-	-	1.7	81.0	17.2	-	-
JULY	4.6	.17	60.3	-	-	39.7	-	-	13.6	76.3	10.2	-	-
AUGUST	4.2	.20	54.8	-	-	45.2	-	-	11.3	66.1	22.6	-	-
SEPTEMBER	3.9	.19	30.0	3.3	-	66.7	-	1.7	13.3	58.3	26.7	-	-
OCTOBER	3.9	.21	16.1	-	-	83.9	-	-	6.5	59.7	33.9	-	-
NOVEMBER	3.5	.15	38.3	-	-	61.7	-	3.3	28.3	43.3	25.0	-	-
DECEMBER	4.0	.17	32.3	3.2	8.1	56.5	-	3.2	30.6	41.9	24.2	-	-
WHOLE YEAR	4.1	.19	43.3	.7	1.4	54.6	-	.8	15.4	65.6	18.1	-	-

SP spilling
PL plunging

TABLE NO. 7

MONTHLY AND ANNUAL

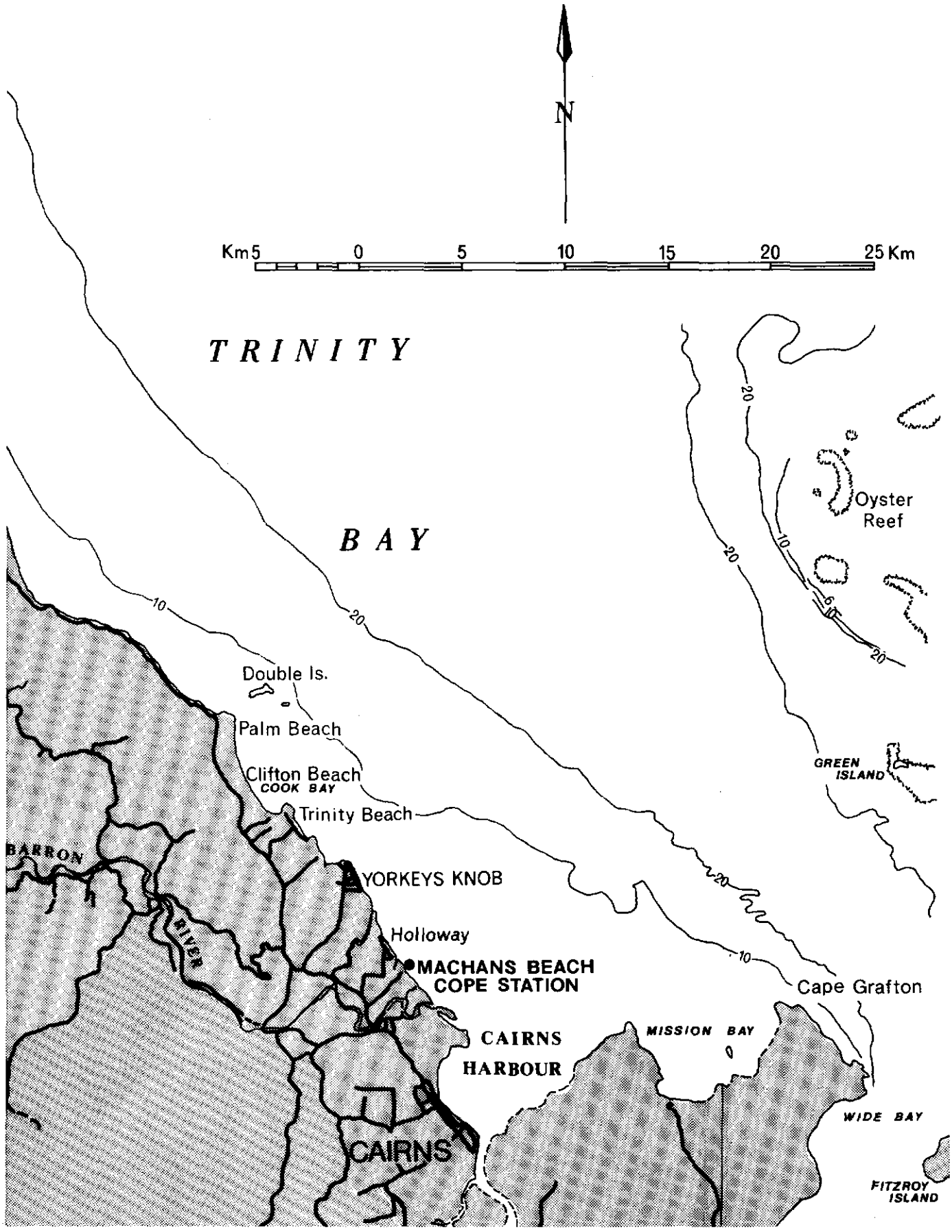
MEAN WAVE HEIGHT/MEAN WAVE PERIOD AND WAVE TYPE/WAVE DIRECTION

OCCURRENCES

YEAR 1978

Month	Mean Wave Period (secs)	Mean Wave Height (metres)	Percentage Occurrence - Wave Type/Wave Direction										
			Wave Type					Wave Direction					
			SP	PL	Surge	SP/PL	Calm	1	2	3	4	5	Calm
JANUARY	4.1	.18	35.5	-	4.8	58.7	-	3.2	17.7	53.2	25.8	-	-
FEBRUARY	4.4	.19	41.1	-	10.7	48.2	-	7.1	21.4	51.8	19.6	-	-
MARCH	4.0	.15	45.2	-	6.5	48.4	-	12.9	14.5	58.1	14.5	-	-
APRIL	4.9	.16	35.0	-	-	65.0	-	-	15.0	68.3	16.7	-	-
MAY	5.4	.19	22.6	-	-	77.4	-	-	11.3	77.4	11.3	-	-
JUNE	4.3	.14	49.2	-	-	50.8	-	-	16.7	63.3	20.0	-	-
JULY	4.7	.19	32.2	-	-	67.8	-	-	31.1	49.2	19.7	-	-
AUGUST	4.8	.19	44.3	1.6	-	54.1	-	-	18.0	62.3	19.7	-	-
SEPTEMBER													
OCTOBER													
NOVEMBER													
DECEMBER													
WHOLE YEAR	-	-	-	-	-	-	-	-	-	-	-	-	-

SP spilling
PL plunging



Beach Protection Authority

LOCALITY PLAN

COPE
Machans Beach

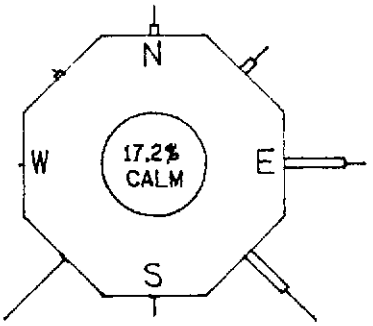
Figure 1
C 01.1

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

WIND GRAPH SEPT 1972 TO AUG 1978

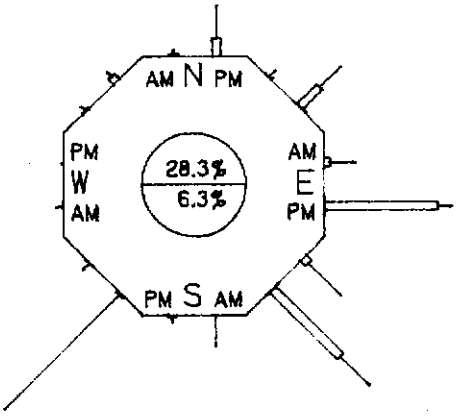
MULGRAVE SHIRE ... MACHANS BEACH ... 2901

ALL OBSERVATIONS



TOTAL NO OF OBSERVATIONS 4250

MORNING / AFTERNOON OBSERVATIONS

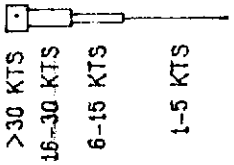


NOTES

FIGURES IN CENTRAL CIRCLE REPRESENT PERCENTAGE OF CALM OBSERVATIONS.

UPPER FIGURE FOR AM
LOWER FIGURE FOR PM

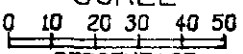
LEGEND



NO OF MORNING OBSERVATIONS 2102
NO OF AFTERNOON OBSERVATIONS 2148

MEAN TIME :- MORNING OBS. 830. HRS
MEAN TIME :- AFTERNOON OBS. 1500. HRS

SCALE



Beach Protection Authority

WIND DATA

COPE
Machans Beach

Figure 2
C 01.1

Beach Protection Authority

WAVE HEIGHT % EXCEEDANCE

COPE

Machans Beach

Figure 3
C 01.1

COPE - COASTAL OBSERVATION PROGRAM — ENGINEERING

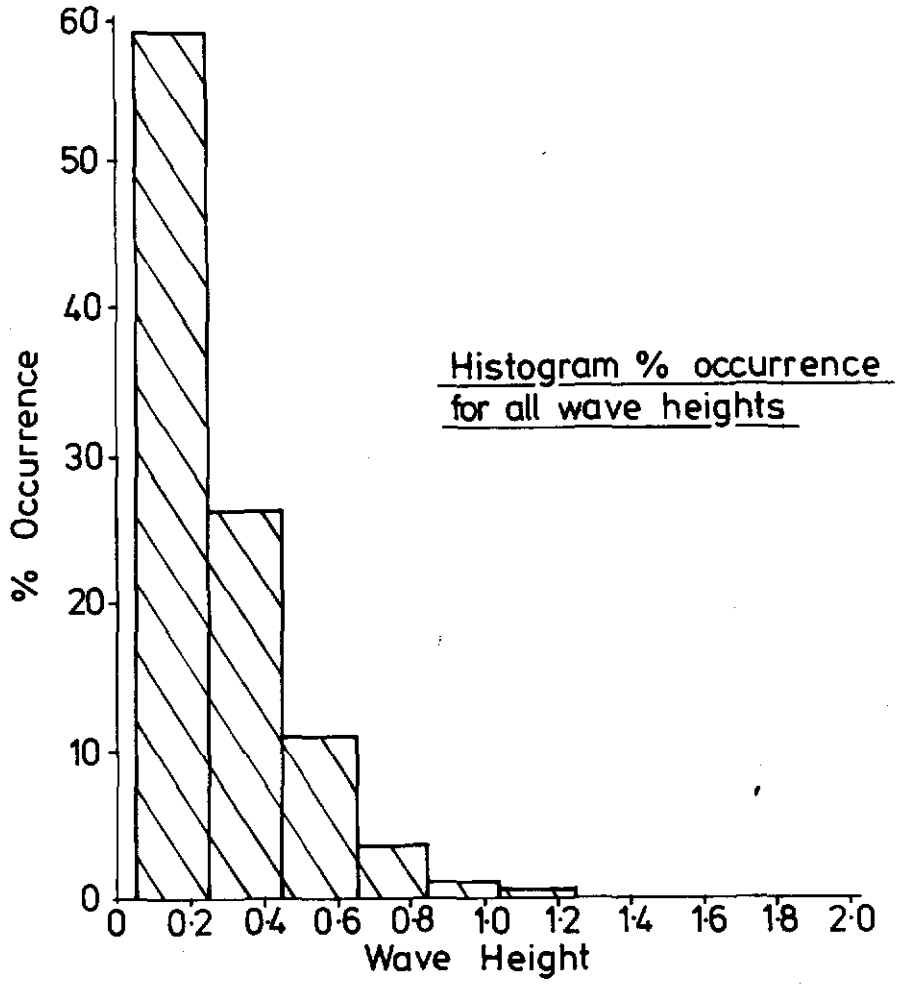
Station: MACHANS BEACH
Recording Period: Sept 1972 Aug 1974
No. of Recordings: 4290

BREAKING WAVE HEIGHT (Metres)

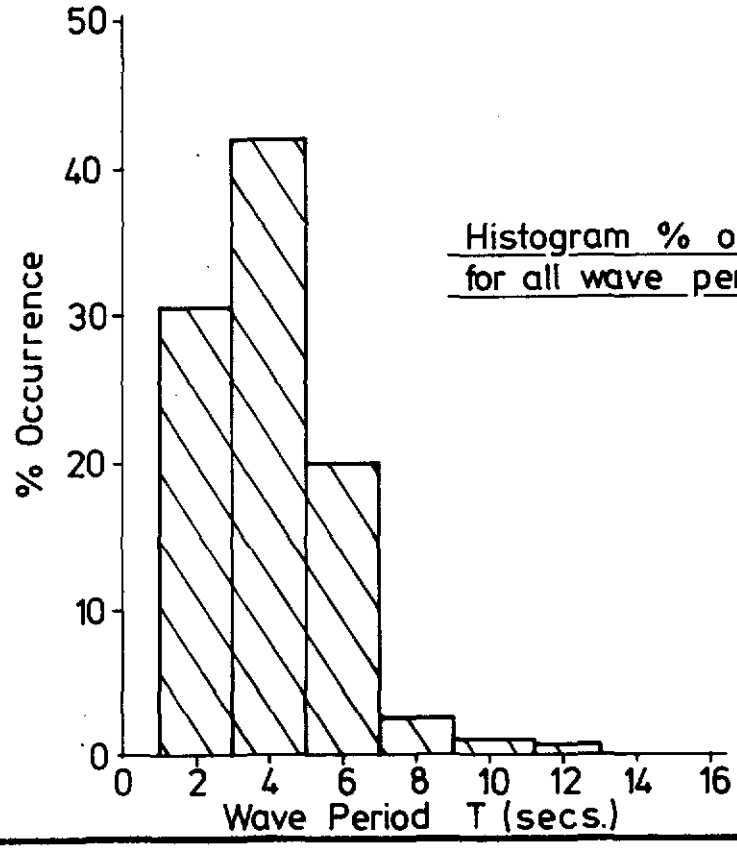
10 9 8 7 6 5 4 3.5 3 2.5 2 1.5 1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1

0.01% 0.05 0.1 0.2 0.5 1 2 5 10 15 20 30 40 50 60 70 80 85 90 95 98 99 99.5 99.8 99.9 99.95 99.99%

PERCENTAGE OF RECORDINGS WHERE A GIVEN BREAKER HEIGHT IS EXCEEDED



Histogram % occurrence for all wave heights



Histogram % occurrence for all wave periods T.

Beach Protection Authority

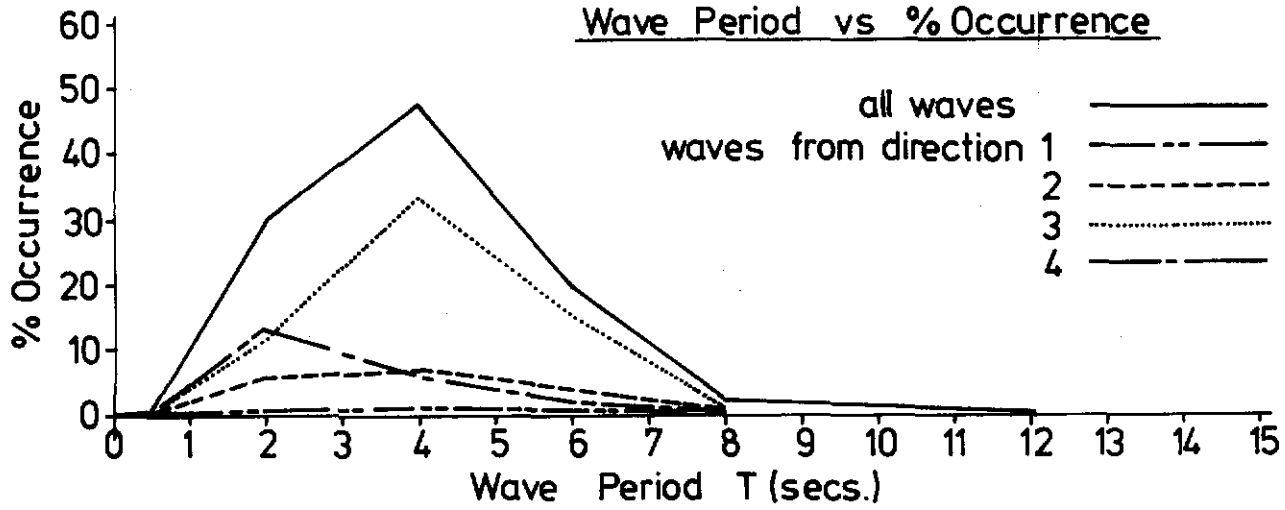
WAVE HEIGHT AND PERIOD % OCCURRENCE

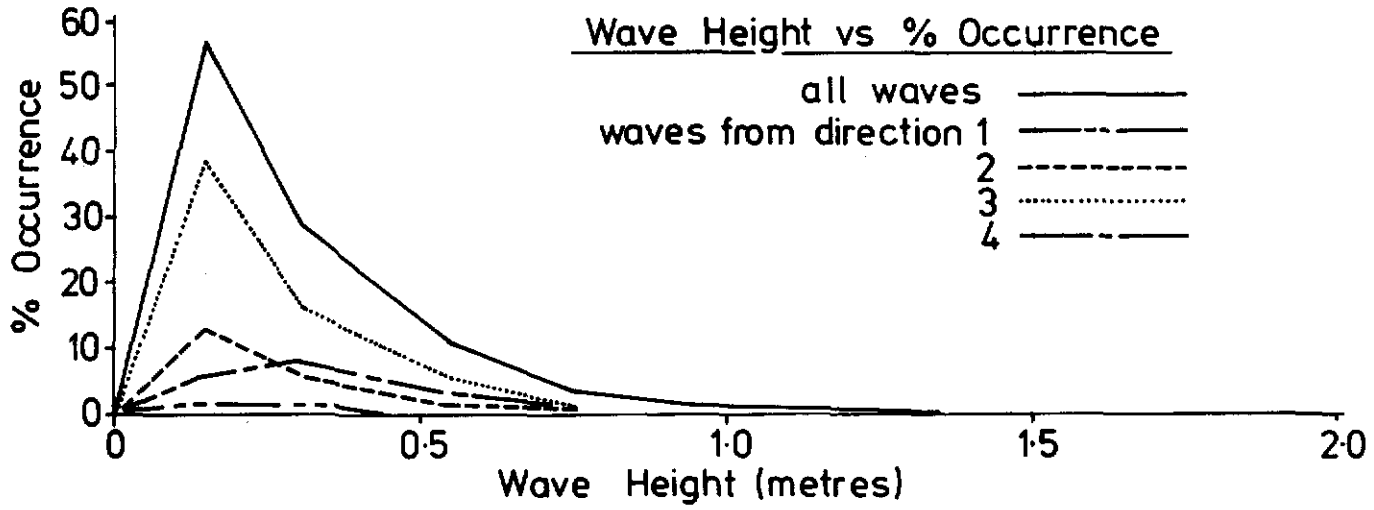
COPE

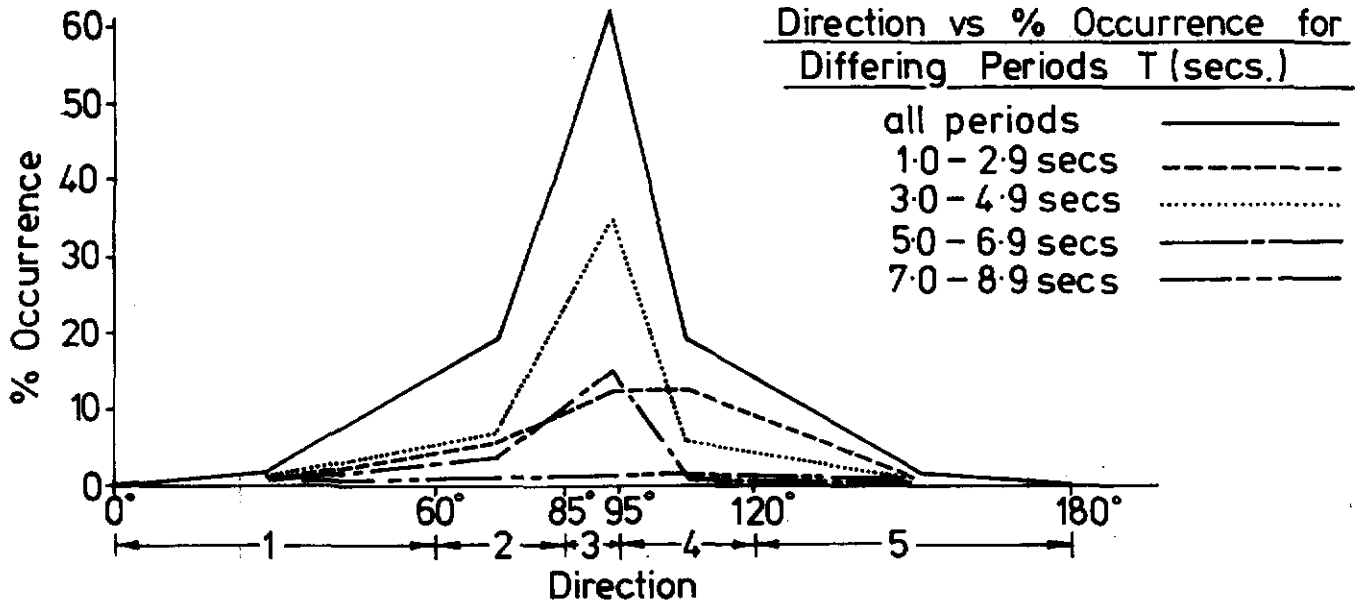
Machans Beach

Figure 4

C 01.1







Beach Protection Authority

WAVE DIRECTION ANALYSIS

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Figure 5
C 01.1

Beach Protection Authority

COPE

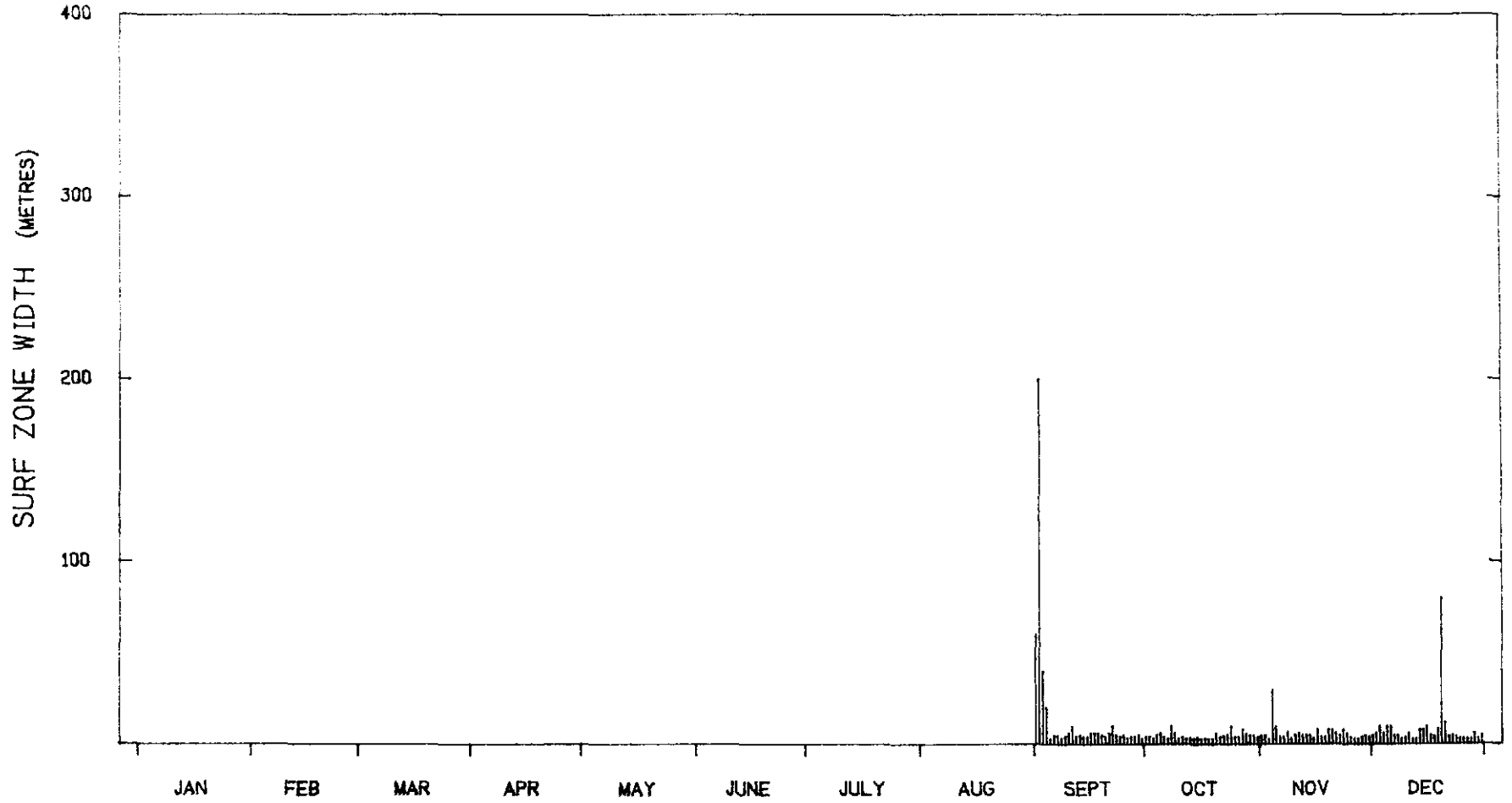
Machans Beach

SURF ZONE WIDTH — MORNING 1972

Figure 6
C 01.1

COPE - COASTAL OBSERVATION
PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1972

MORNING OBSERVATIONS

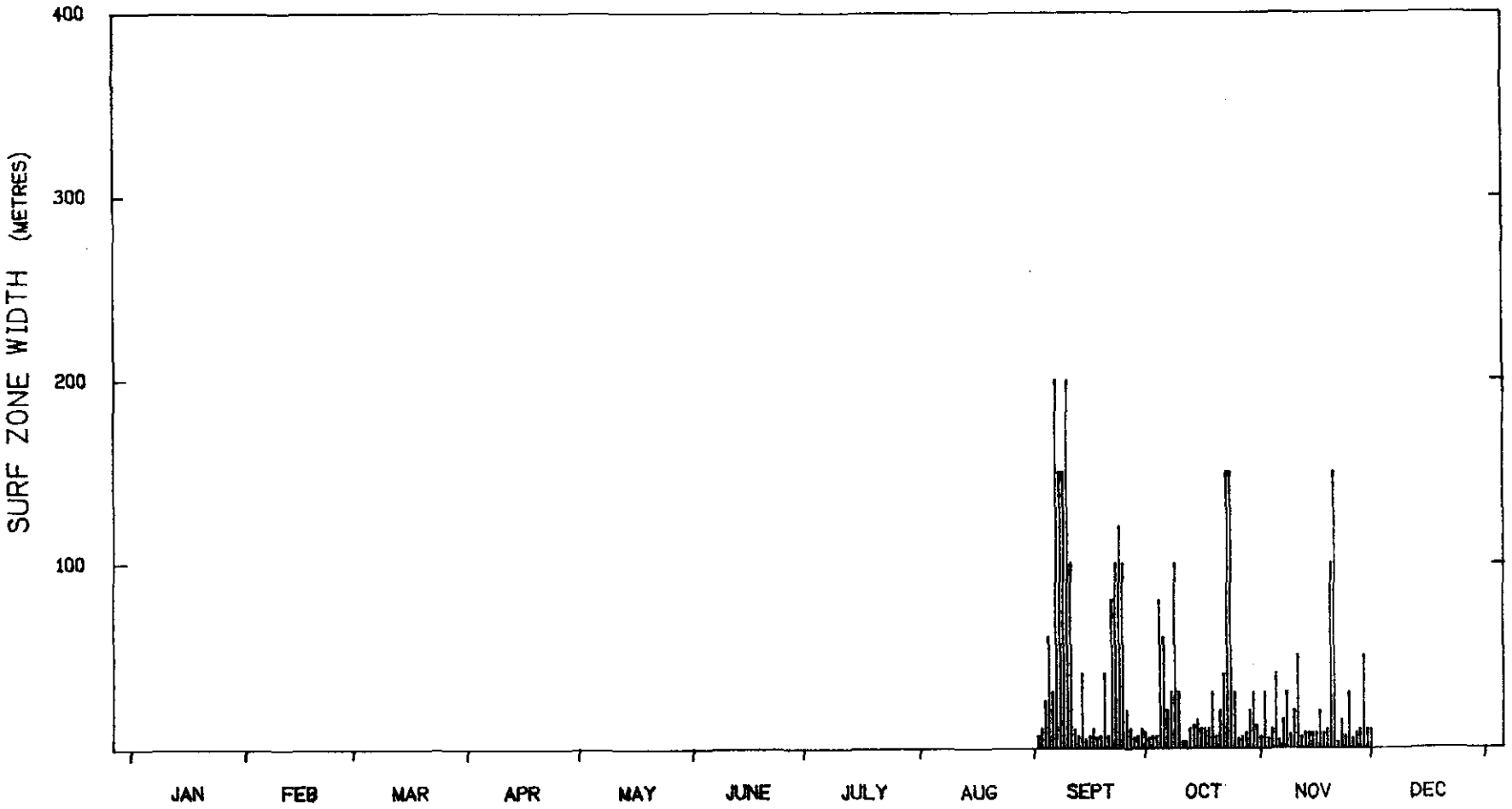
NO. OF VALUES 122

MEAN SURF ZONE WIDTH 8.4 M

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1972

AFTERNOON OBSERVATIONS

NO. OF VALUES 122

MEAN SURF ZONE WIDTH 32.3 M

SURF ZONE WIDTH — AFTERNOON 1972

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Machans Beach

Figure 7

C 01.1

Beach Protection Authority

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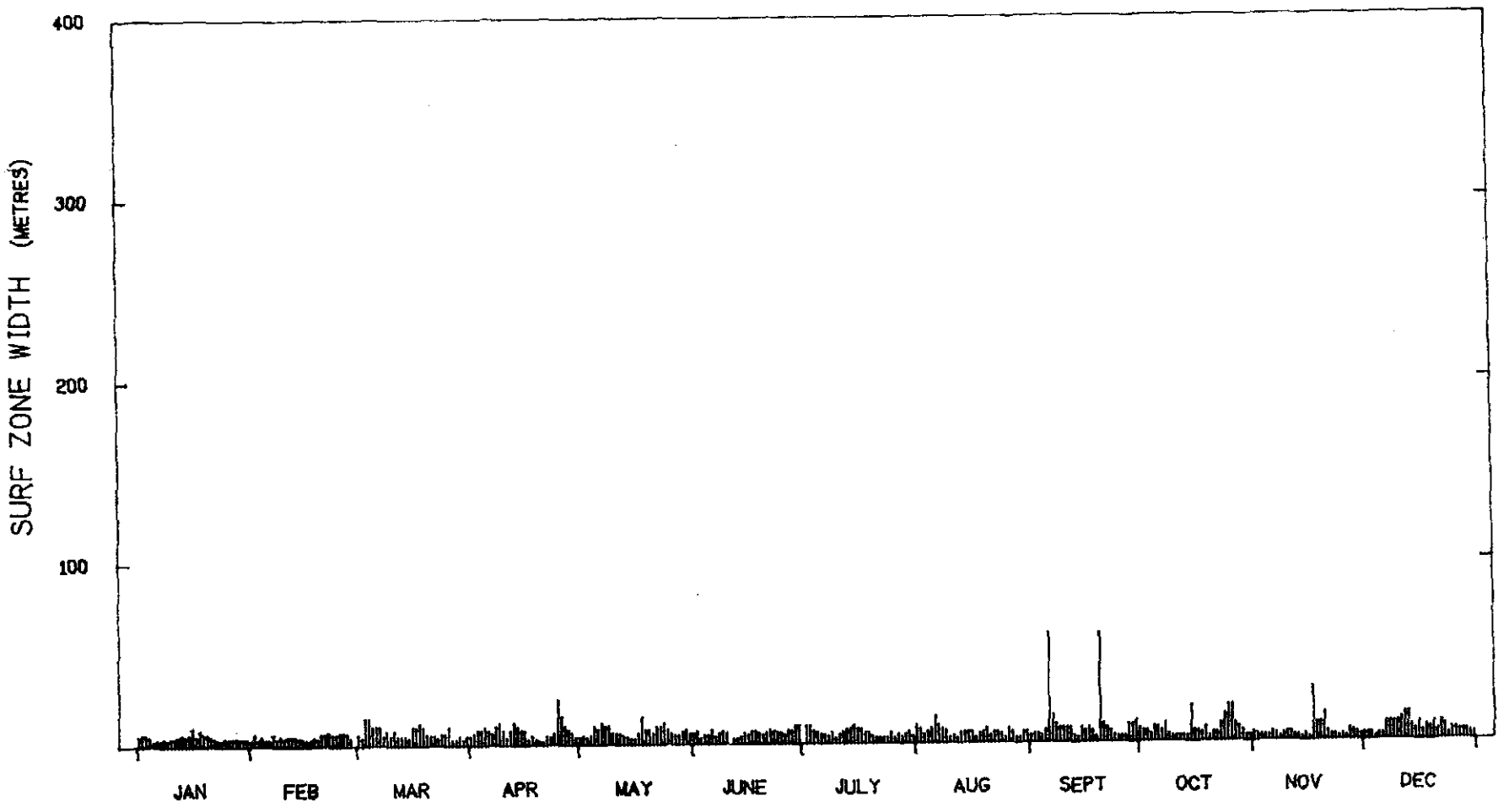
MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1973

MORNING OBSERVATIONS

MEAN SURF ZONE WIDTH 6.6 M

NO. OF VALUES 365

SURF ZONE WIDTH — MORNING 1973

COPE

Machans Beach

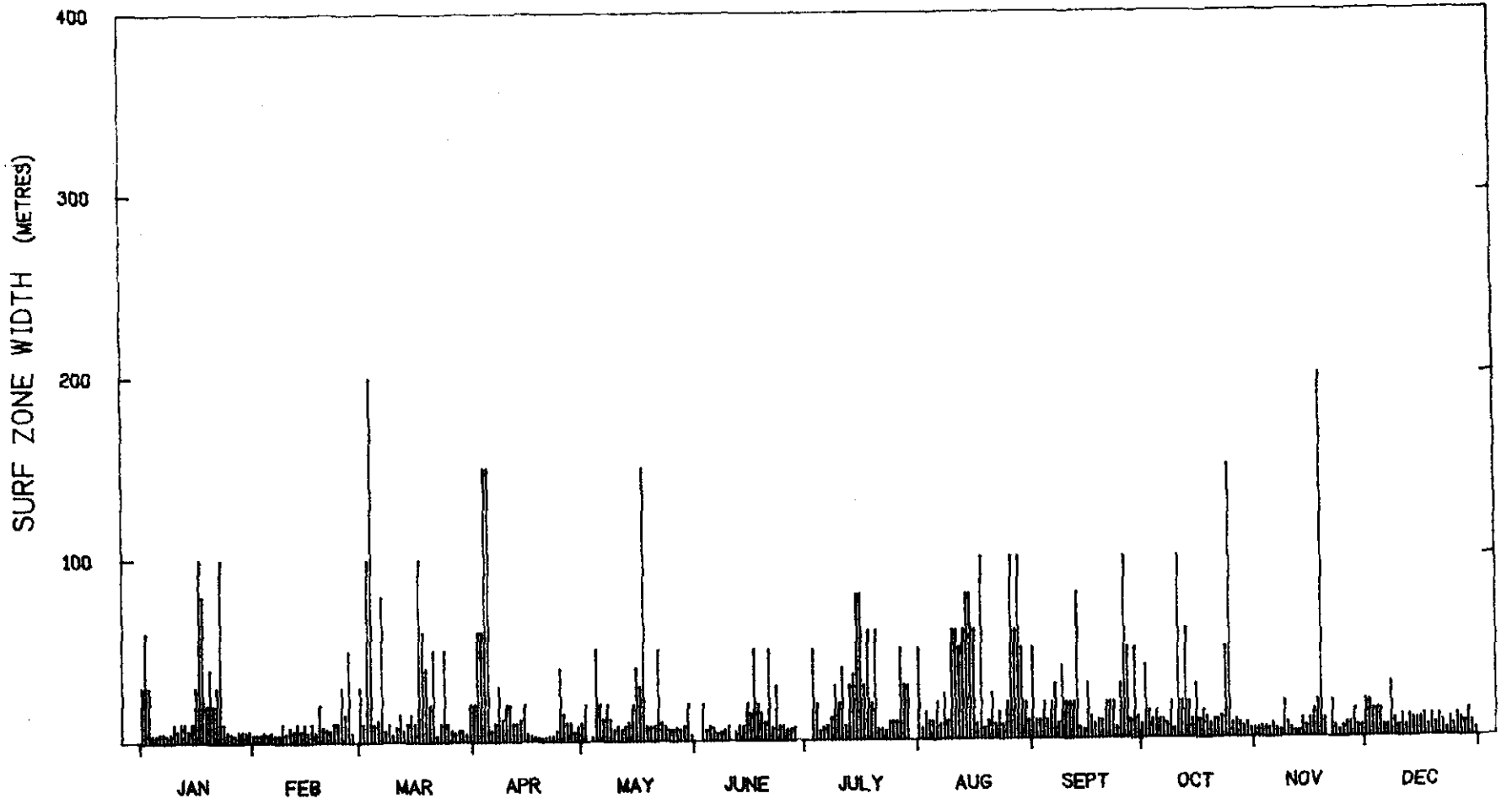
Figure 8

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1973

AFTERNOON OBSERVATIONS

MEAN SURF ZONE WIDTH 214 M

NO. OF VALUES 355

SURF ZONE WIDTH — AFTERNOON 1973

COPE

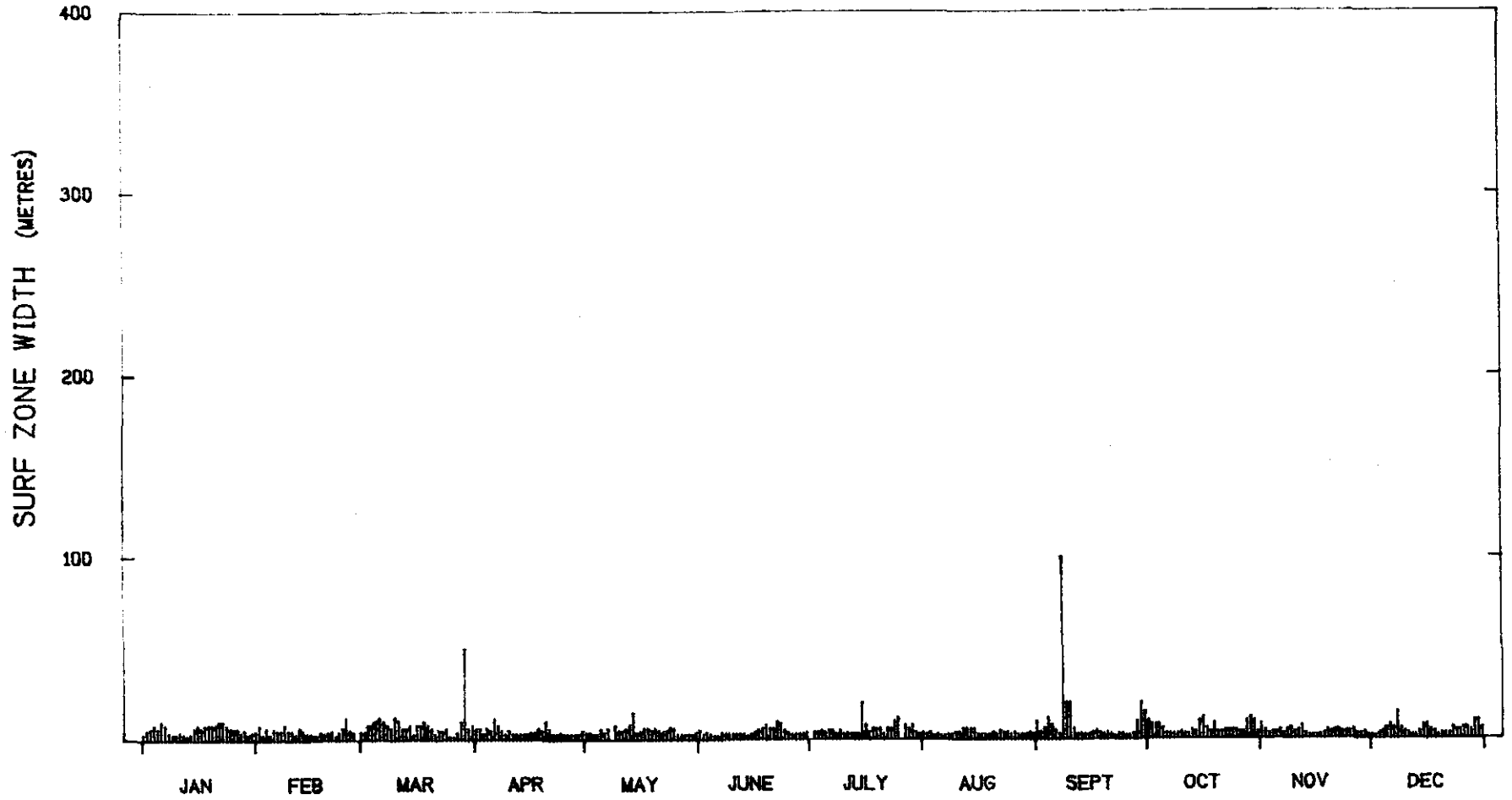
Machans Beach

Figure 9
C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY – 1974

MORNING OBSERVATIONS

NO. OF VALUES 365

MEAN SURF ZONE WIDTH 5.6 M

SURF ZONE WIDTH – MORNING 1974

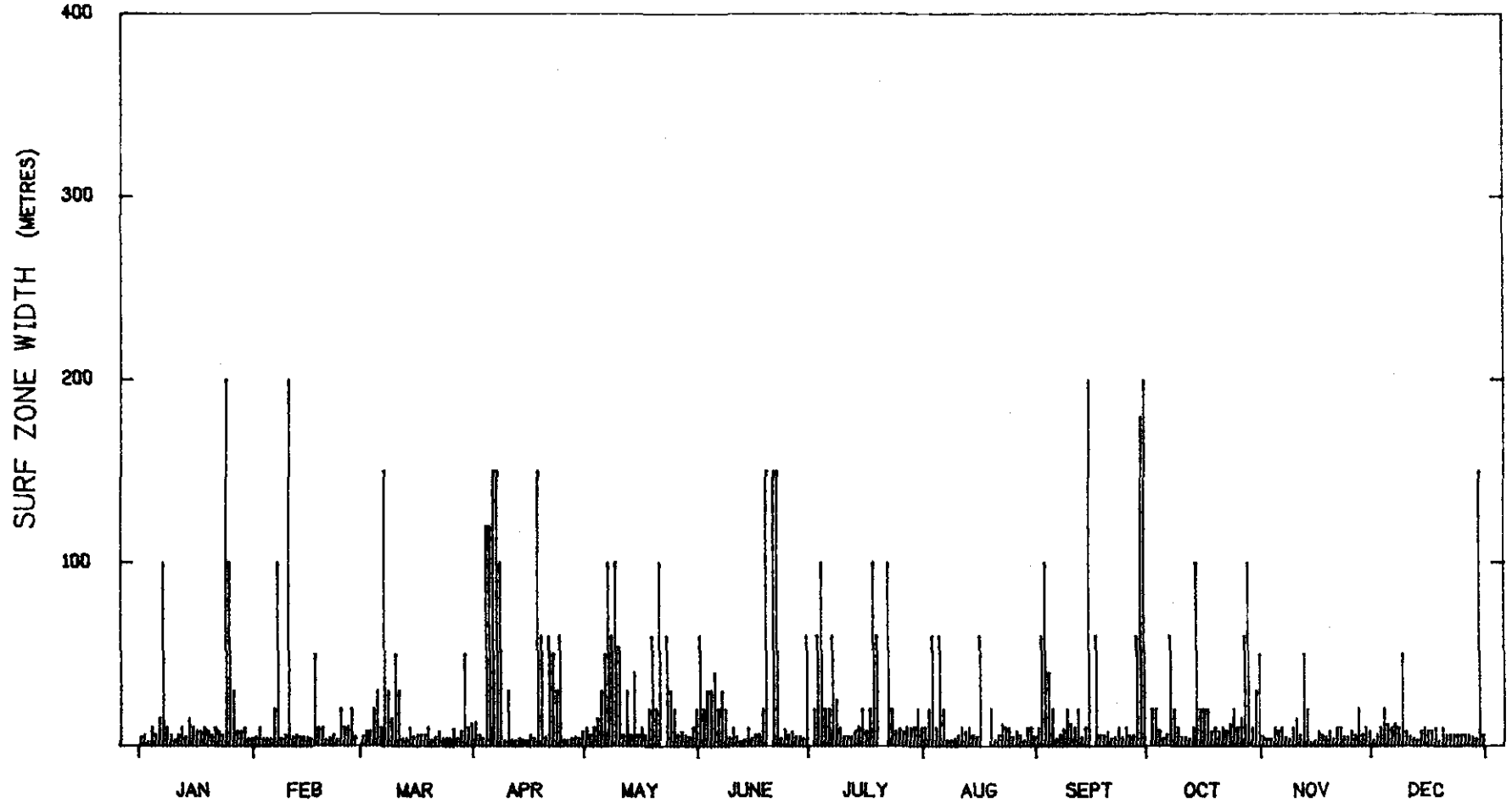
COPE
Machans Beach

Figure 10
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1974

AFTERNOON OBSERVATIONS

NO. OF VALUES 358

MEAN SURF ZONE WIDTH 23.1 M

SURF ZONE WIDTH - AFTERNOON 1974

COPE

Machans Beach

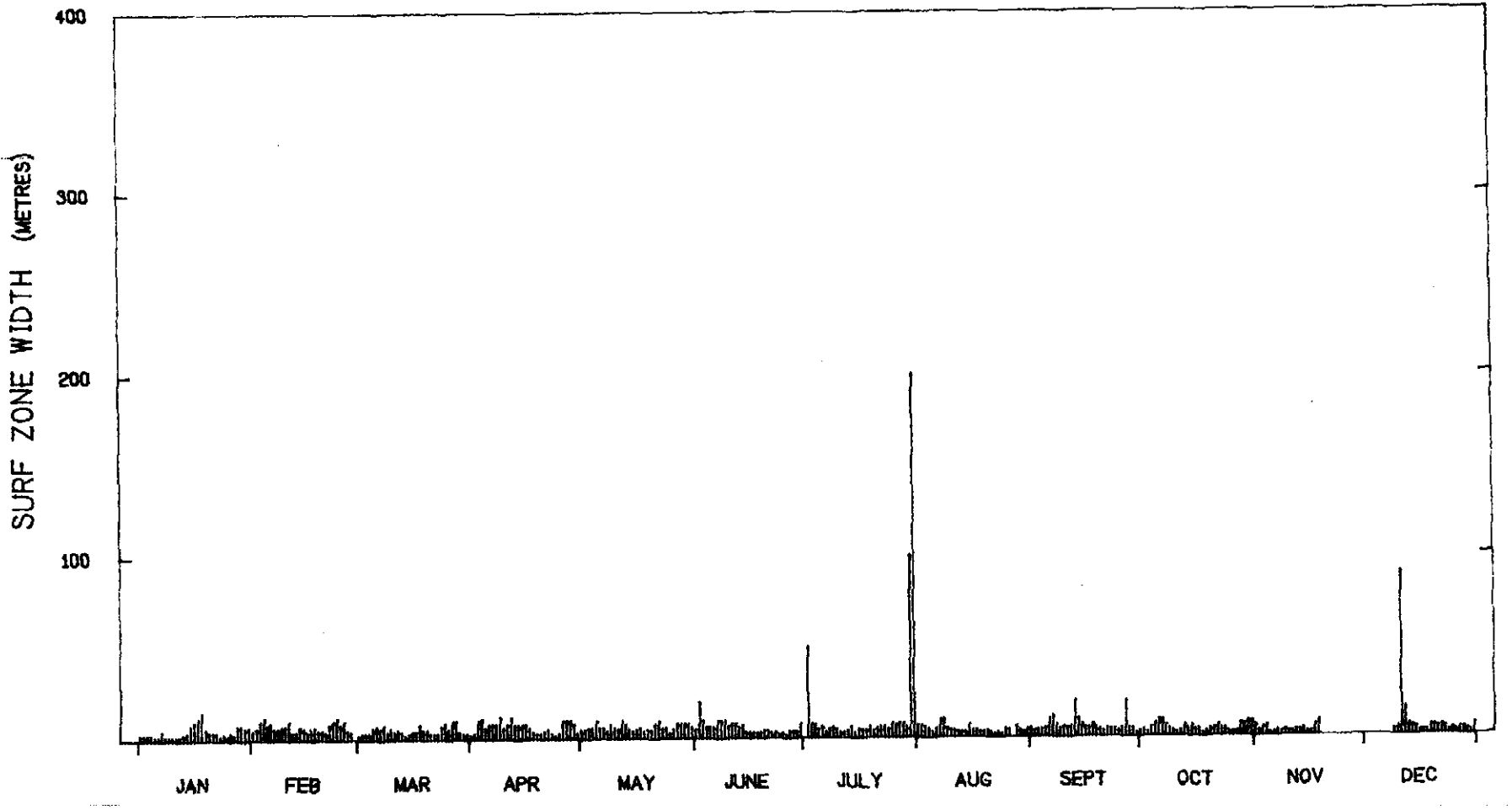
Figure 11

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1975

MORNING OBSERVATIONS

MEAN SURF ZONE WIDTH 6.8 M

NO. OF VALUES 345

SURF ZONE WIDTH - MORNING 1975

COPE

Machans Beach

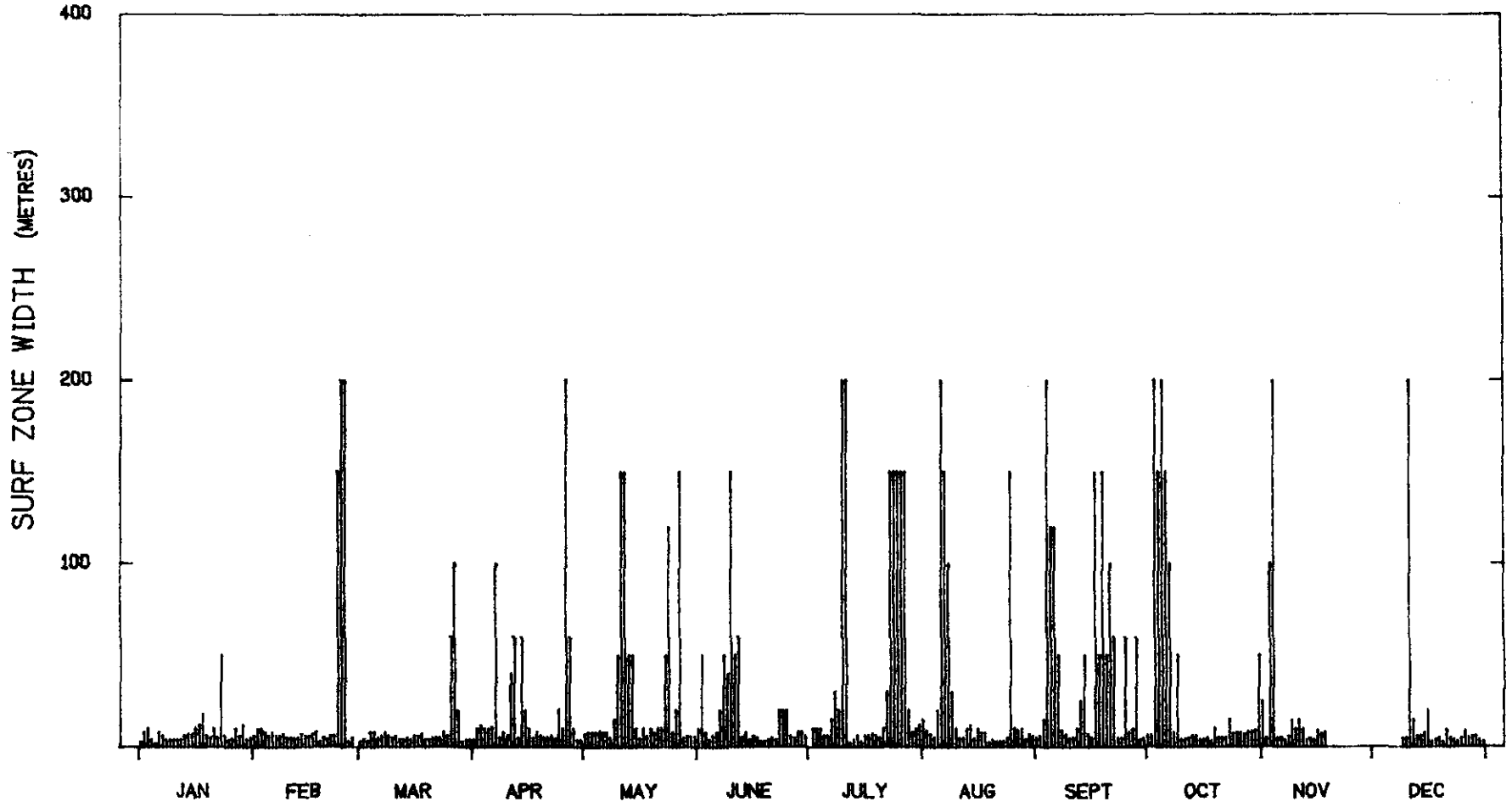
Figure 12

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY – 1975

AFTERNOON OBSERVATIONS

NO. OF VALUES 345

MEAN SURF ZONE WIDTH 26.0 M

SURF ZONE WIDTH – AFTERNOON 1975

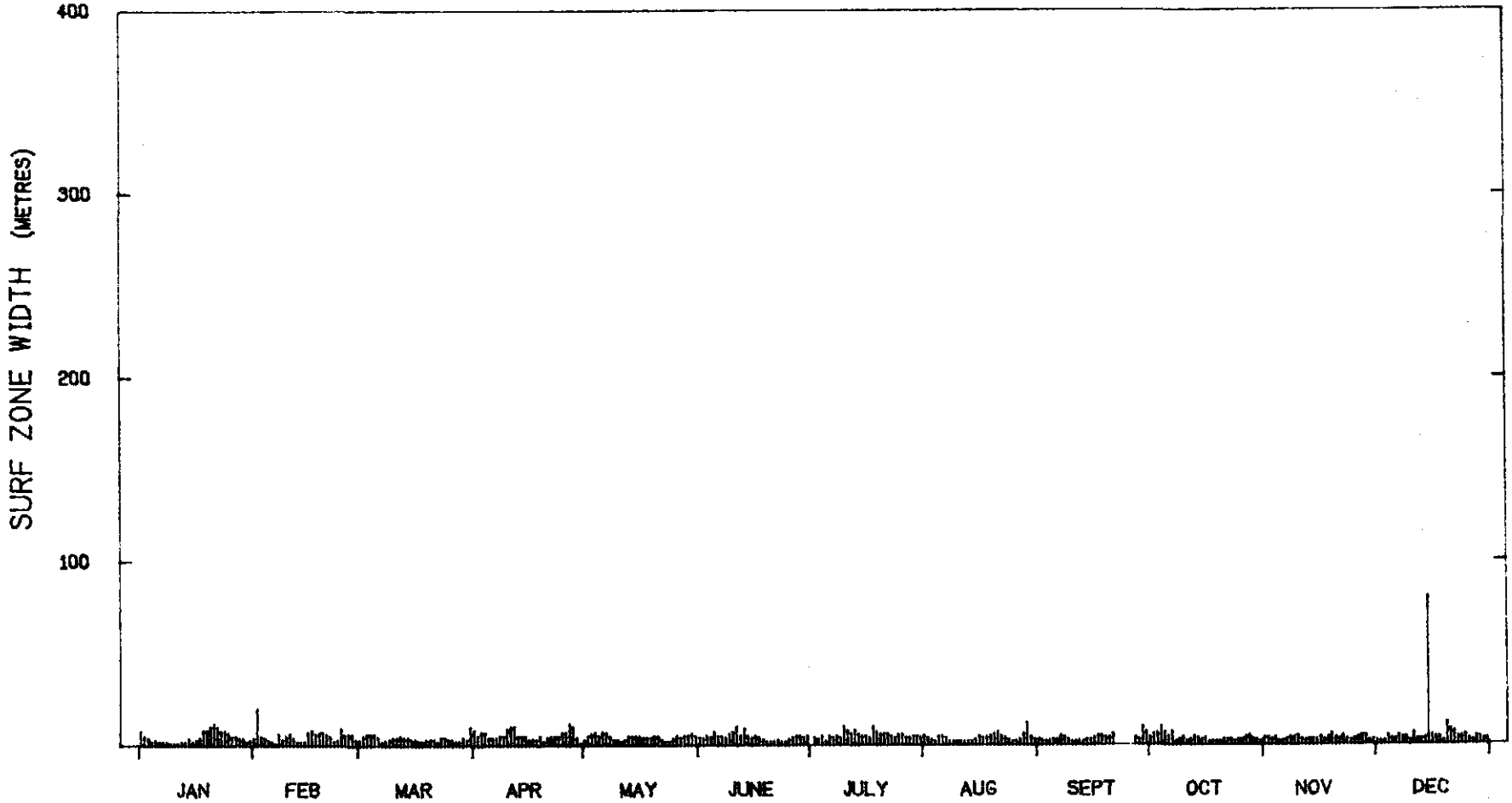
COPE
Machans Beach

Figure 13
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1976

MORNING OBSERVATIONS

NO. OF VALUES 361

MEAN SURF ZONE WIDTH 4.6 M

SURF ZONE WIDTH — MORNING 1976

COPE

Machans Beach

Figure 14

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901

SURF ZONE WIDTH SUMMARY - 1976

AFTERNOON OBSERVATIONS

NO. OF VALUES 353

MEAN SURF ZONE WIDTH 23.1 M

SURF ZONE WIDTH - AFTERNOON 1976

COPE

Machans Beach

Figure 15

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901

SURF ZONE WIDTH SUMMARY - 1977

MORNING OBSERVATIONS

NO. OF VALUES 361

MEAN SURF ZONE WIDTH 4.2 M

SURF ZONE WIDTH - MORNING 1977

COPE

Machans Beach

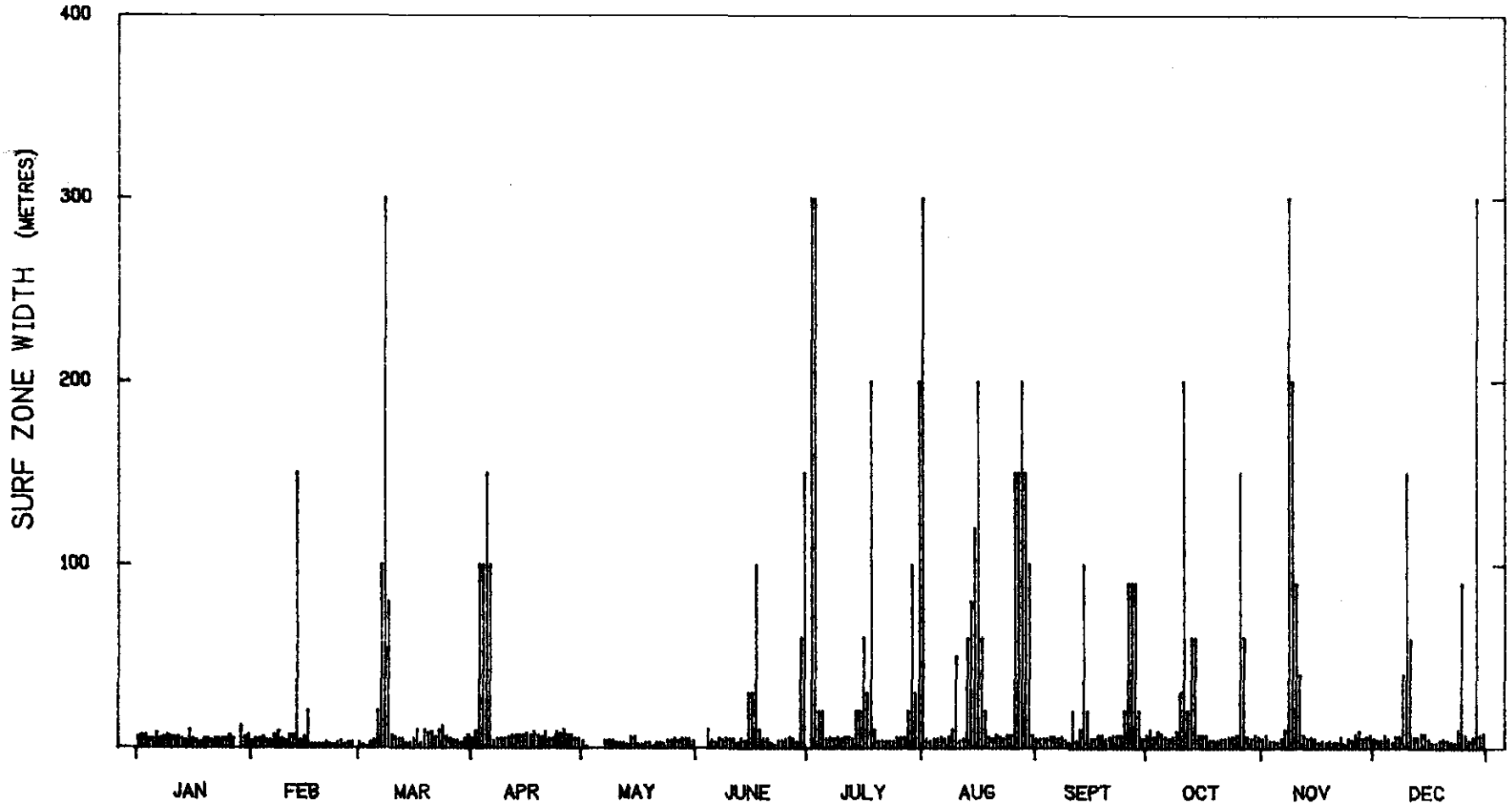
Figure 16

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1977

AFTERNOON OBSERVATIONS

NO. OF VALUES 359

MEAN SURF ZONE WIDTH 24.0 M

SURF ZONE WIDTH — AFTERNOON 1977

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Machans Beach

Figure 17
C 01.1

Beach Protection Authority

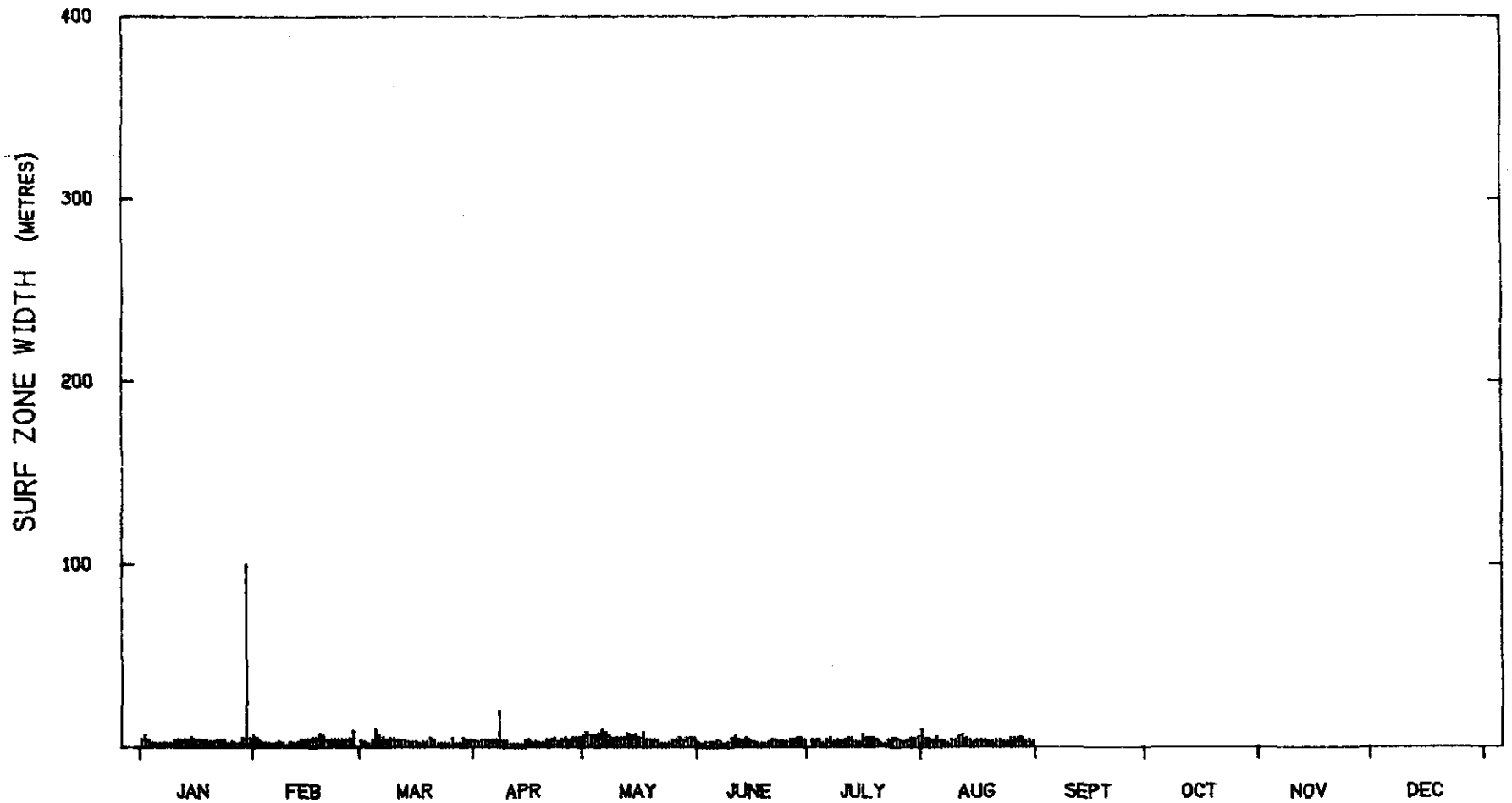
SURF ZONE WIDTH — MORNING 1978

COPE
Machans Beach

Figure 18
C 01.1

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1978

MORNING OBSERVATIONS

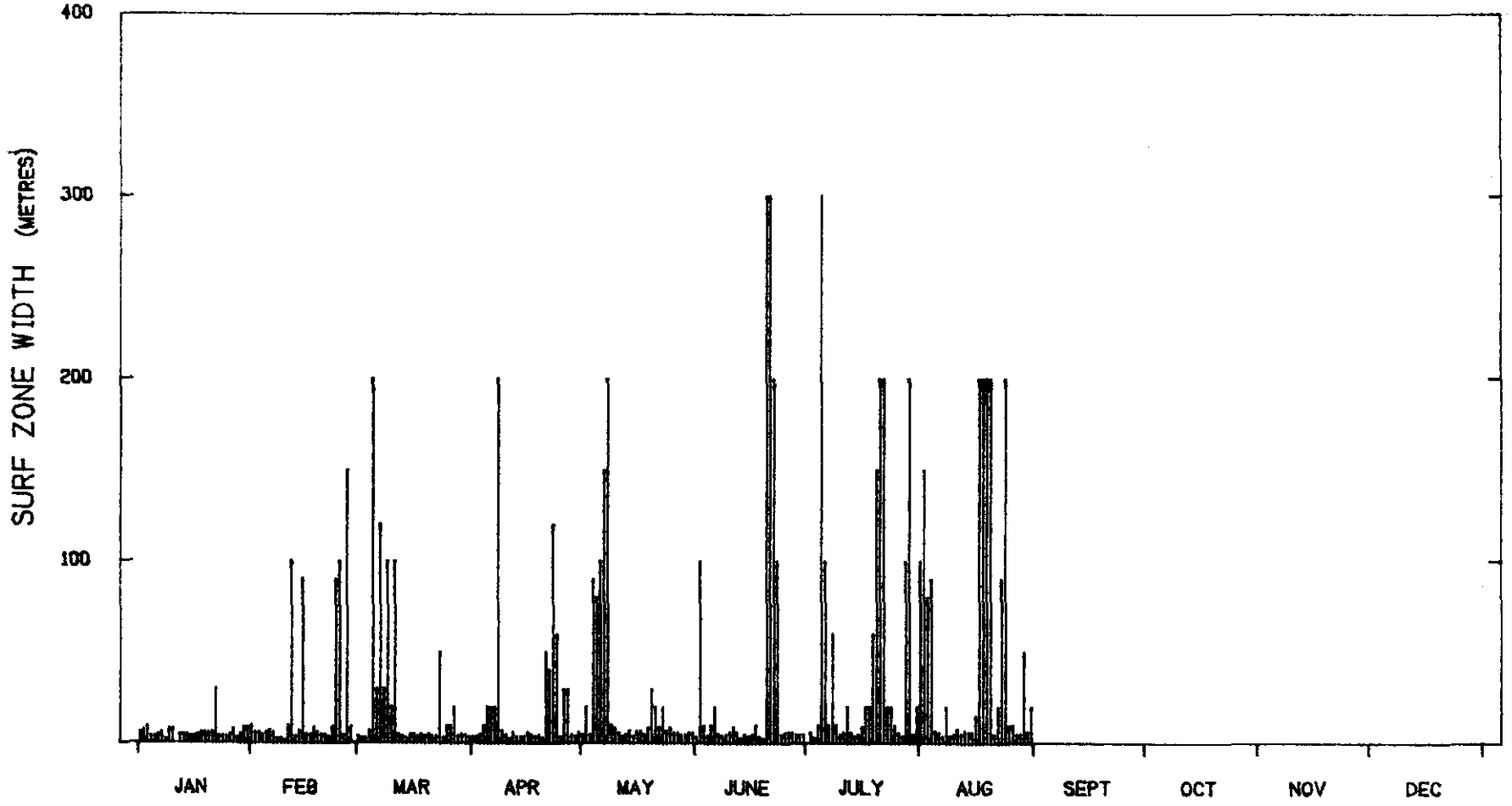
MEAN SURF ZONE WIDTH 4.5 M

NO. OF VALUES 243

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MACHANS BEACH .... MULGRAVE SHIRE 2901



SURF ZONE WIDTH SUMMARY - 1978

AFTERNOON OBSERVATIONS

NO. OF VALUES 243

MEAN SURF ZONE WIDTH 31.9 M

SURF ZONE WIDTH — AFTERNOON 1978

COPE

Machans Beach

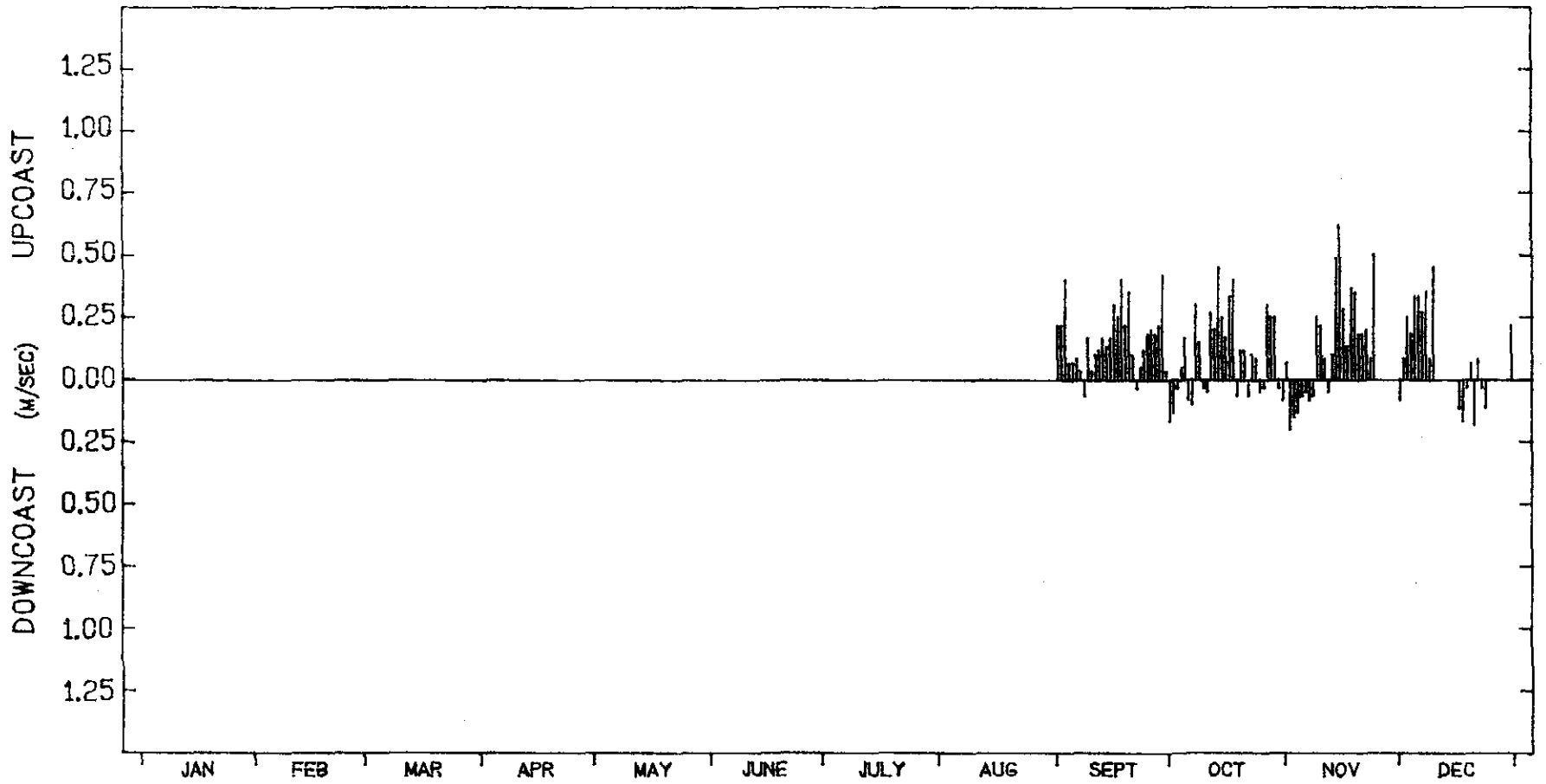
Figure 19

C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY – 1972

NO OF VALUES 104 MEAN VEL .127 M/SEC UP MEAN UPCOAST VEL .213 M/SEC MEAN DOWNCAST VEL .086 M/SEC

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS – AFTERNOON 1972

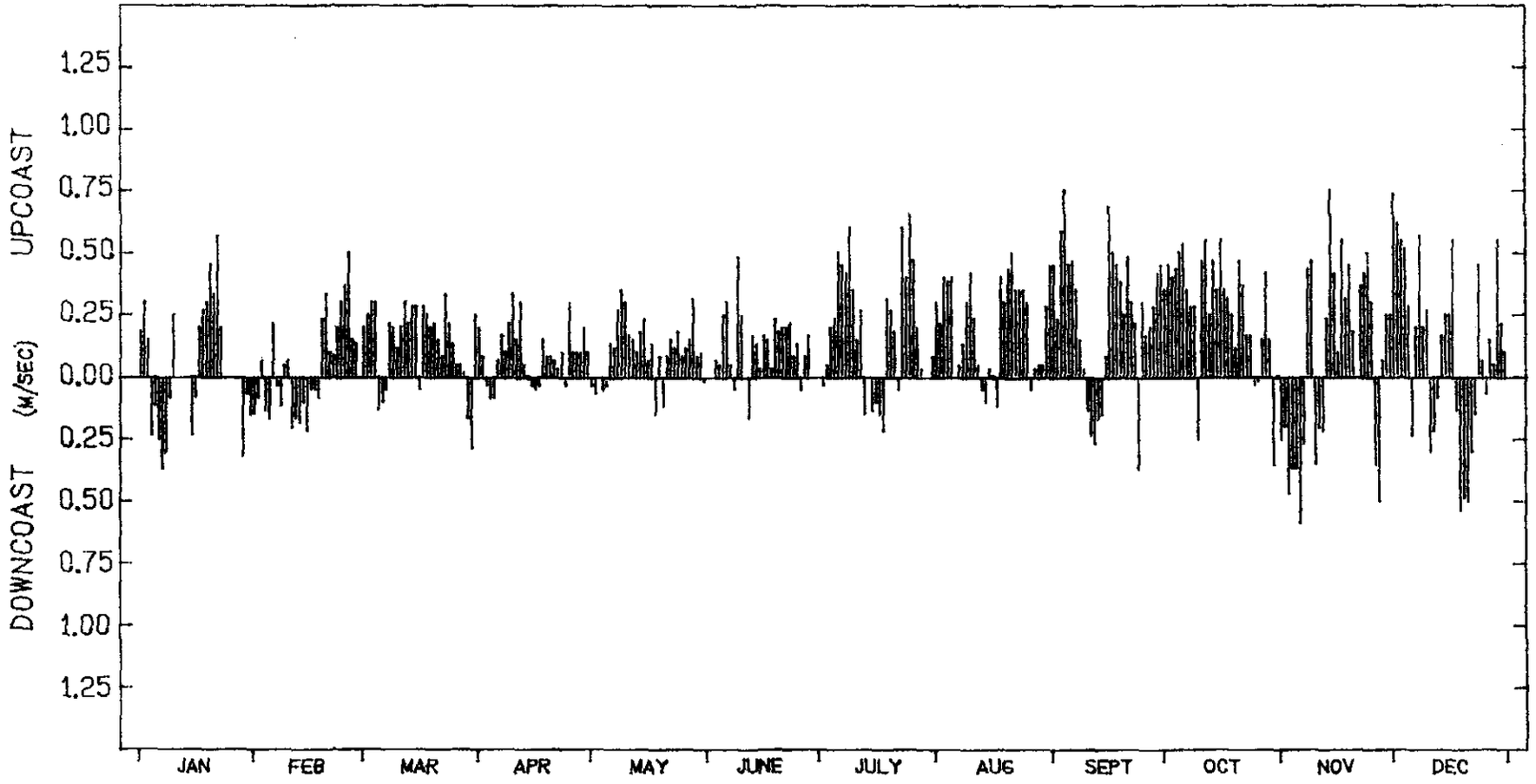
COPE
Machans Beach

Figure 20
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1973

NO OF VALUES 344 MEAN VEL .143 M/SEC UP MEAN UPCOAST VEL .262 M/SEC MEAN DOWNCOAST VEL .174 M/SEC

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS — AFTERNOON 1973

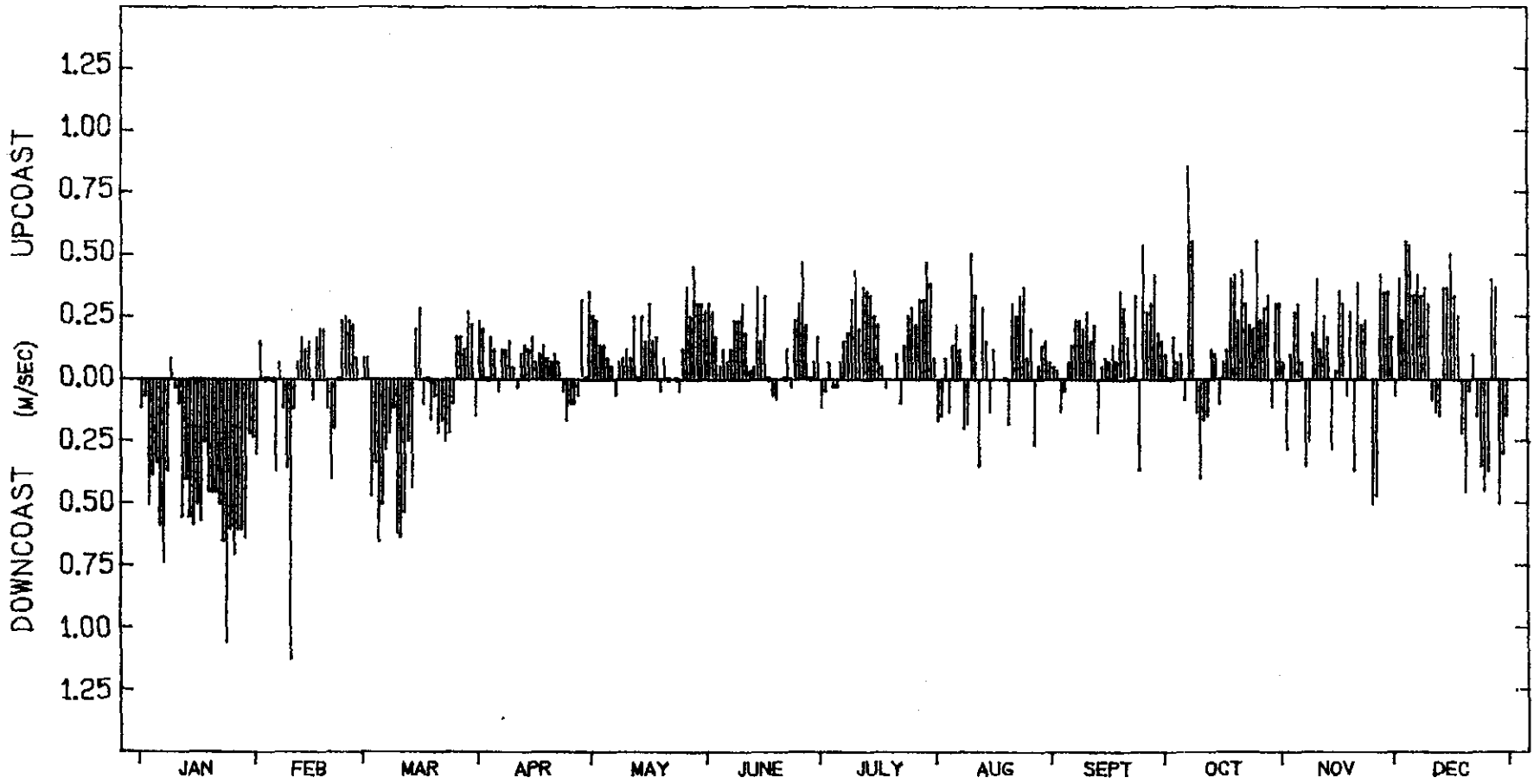
COPE
Machans Beach

Figure 21
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1974

NO OF VALUES 358 MEAN VEL .038 M/SEC UP MEAN UPCOAST VEL .218 M/SEC MEAN DOWNCOAST VEL .281 M/S

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS - AFTERNOON 1974

COPE

Machans Beach

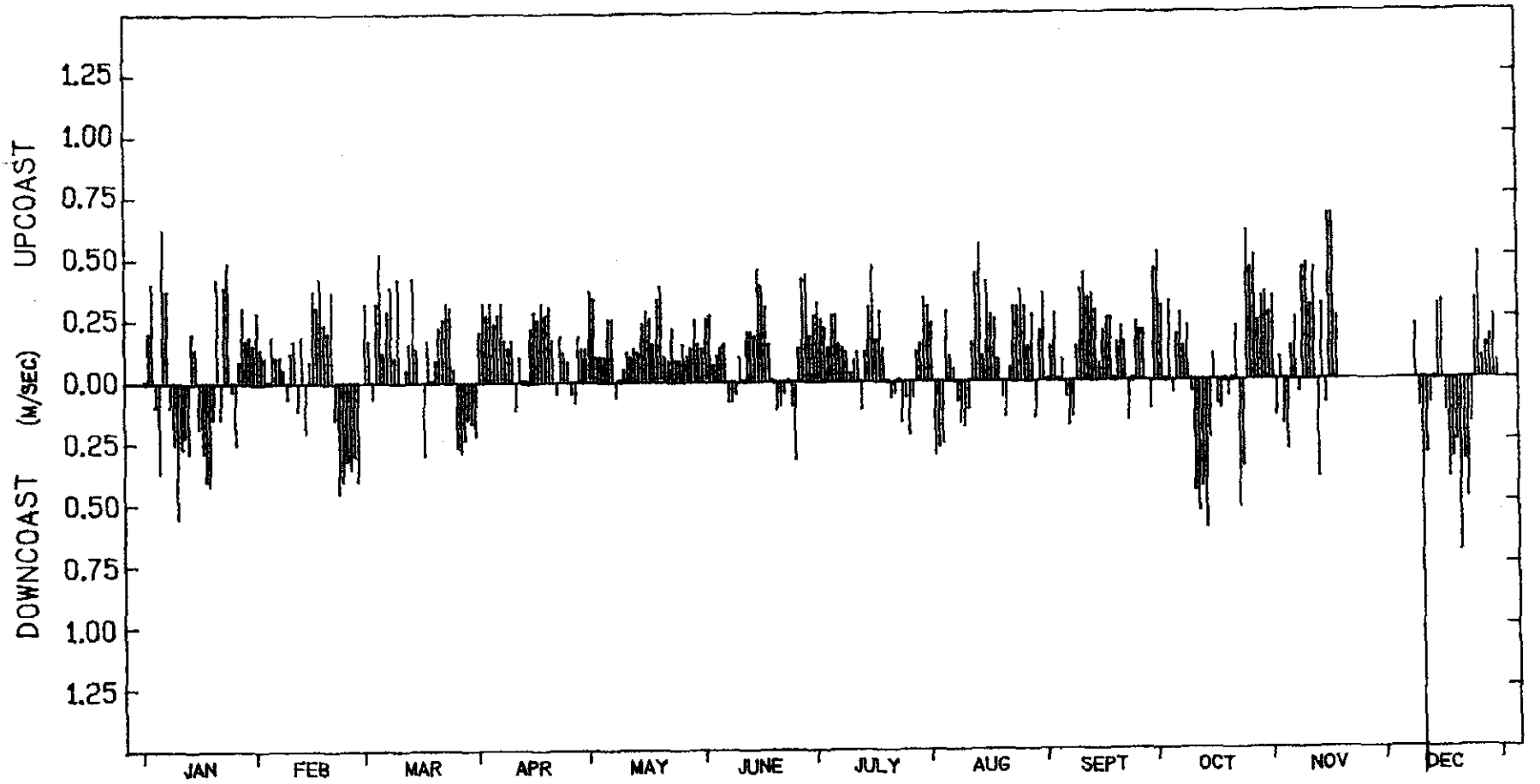
Figure 22

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1975

NO OF VALUES 342 MEAN VEL .089 M/SEC UP MEAN UPCOAST VEL .236 M/SEC MEAN DOWNCOAST VEL·227 M/SE

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS - AFTERNOON 1975

COPE

Machans Beach

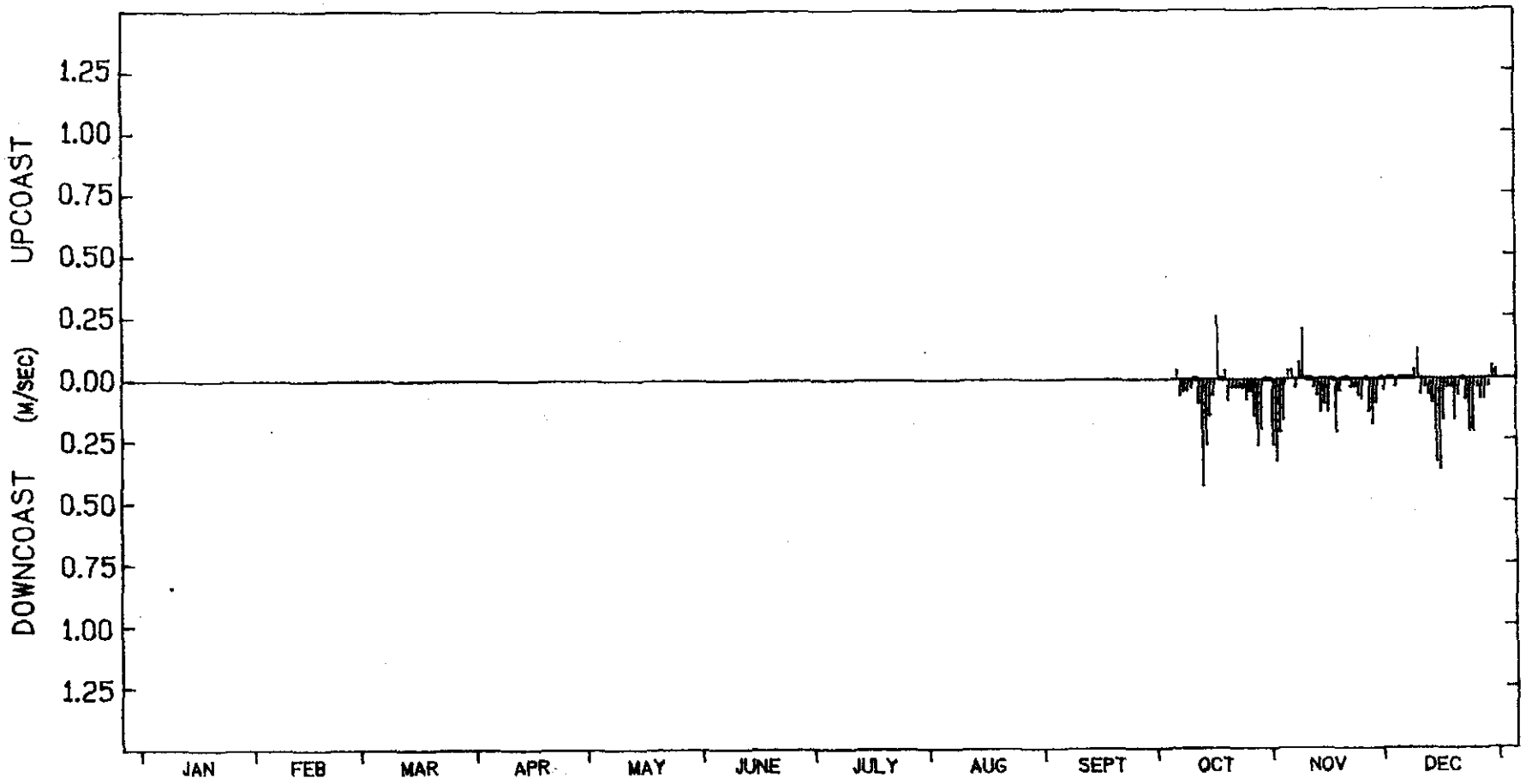
Figure 23

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1976

NO OF VALUES 87 MEAN VEL -.068 M/SEC DOWN MEAN UPCOAST VEL .080 M/SEC MEAN DOWNCOAST VEL .118 M/SEC

MORNING OBSERVATIONS

LITTORAL CURRENTS — MORNING 1976

COPE

Machans Beach

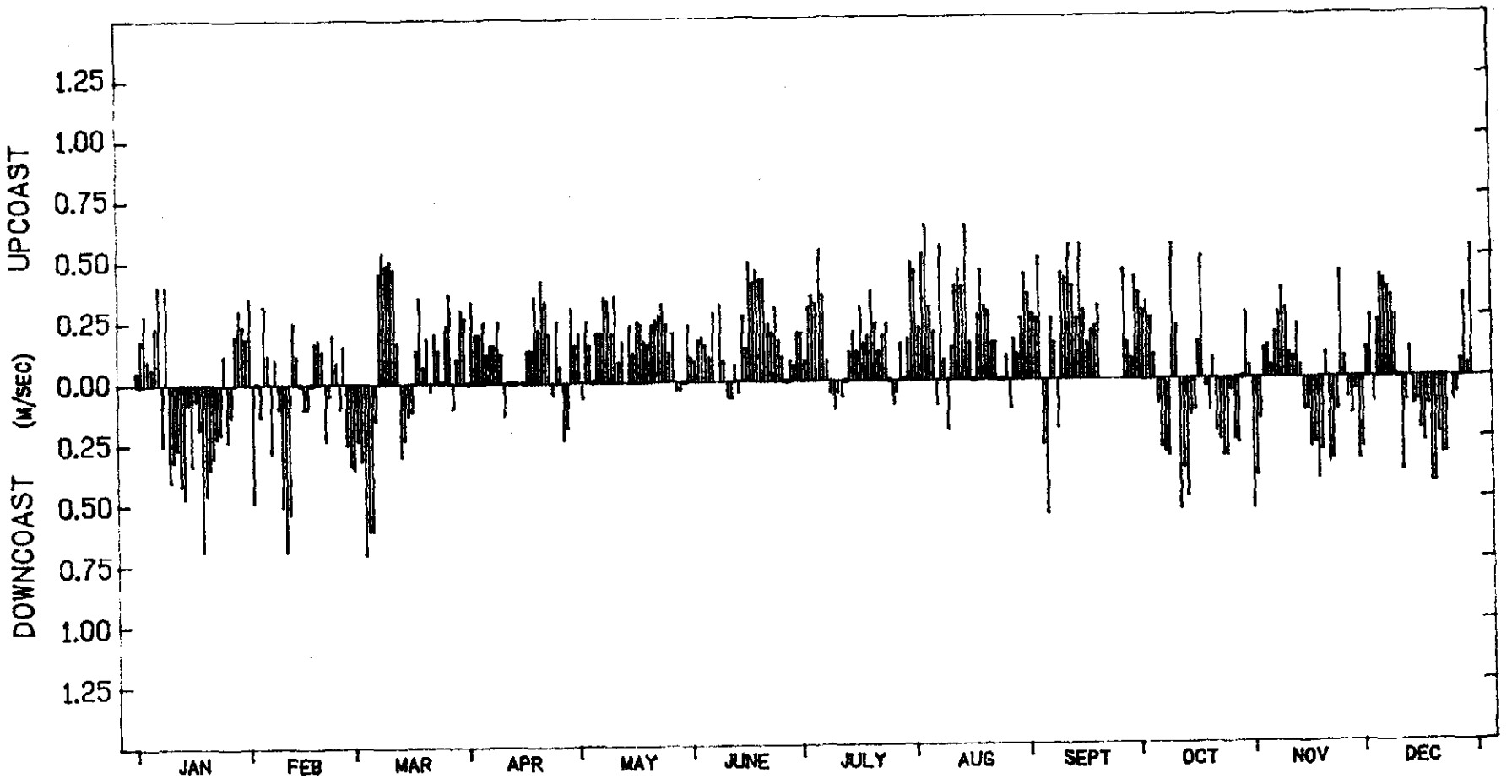
Figure 24

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION
PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1976

NO OF VALUES 356 MEAN VEL .072 M/SEC UP MEAN UPCOAST VEL .245 M/SEC MEAN DOWNCOAST VEL .240 M/SE
AFTERNOON OBSERVATIONS

LITTORAL CURRENTS — AFTERNOON 1976

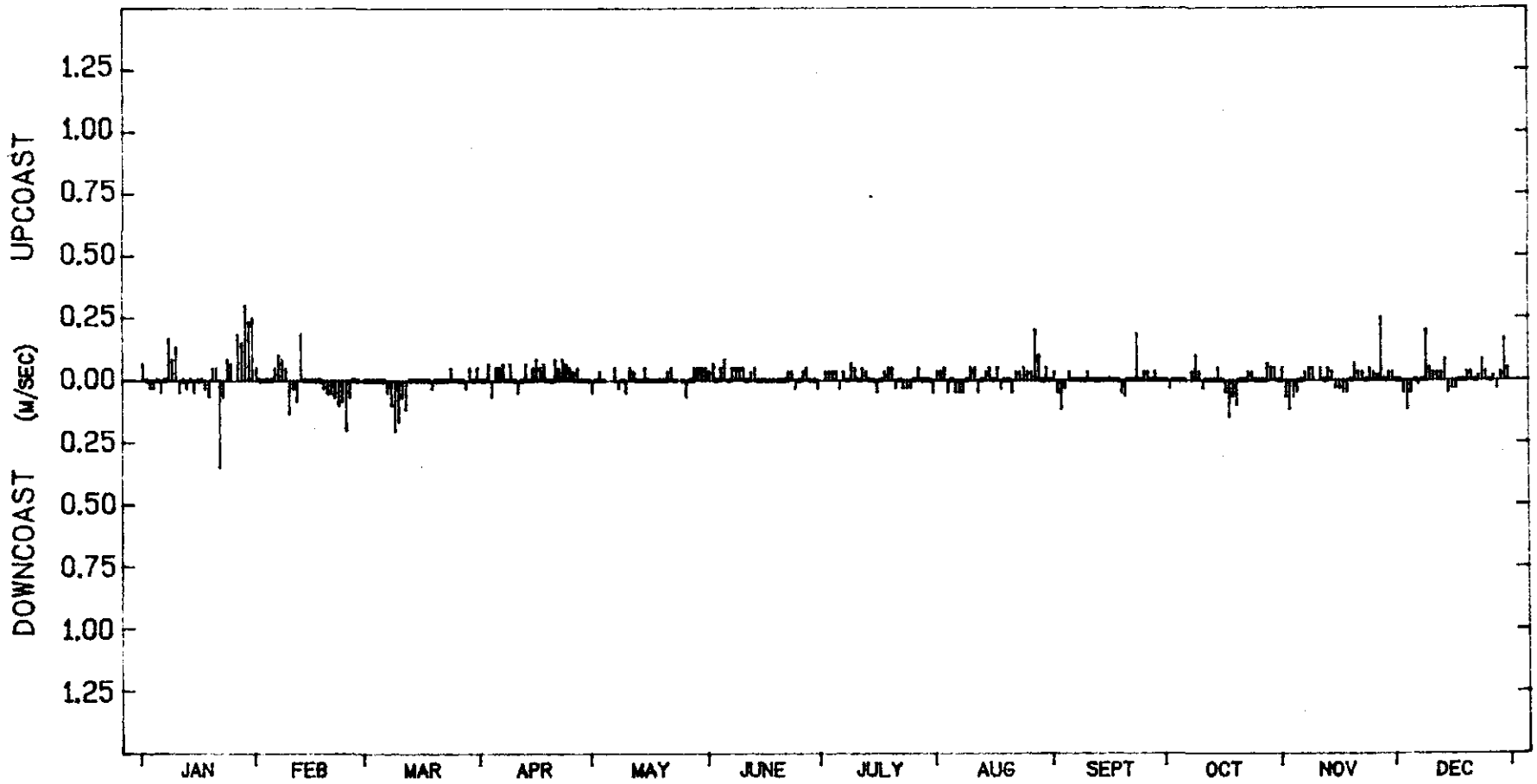
COPE
Machans Beach

Figure 25
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1977

NO OF VALUES 358 MEAN VEL .010 M/SEC UP MEAN UPCOAST VEL .062 M/SEC MEAN DOWNCOAST VEL .064 M/SEC

MORNING OBSERVATIONS

LITTORAL CURRENTS — MORNING 1977

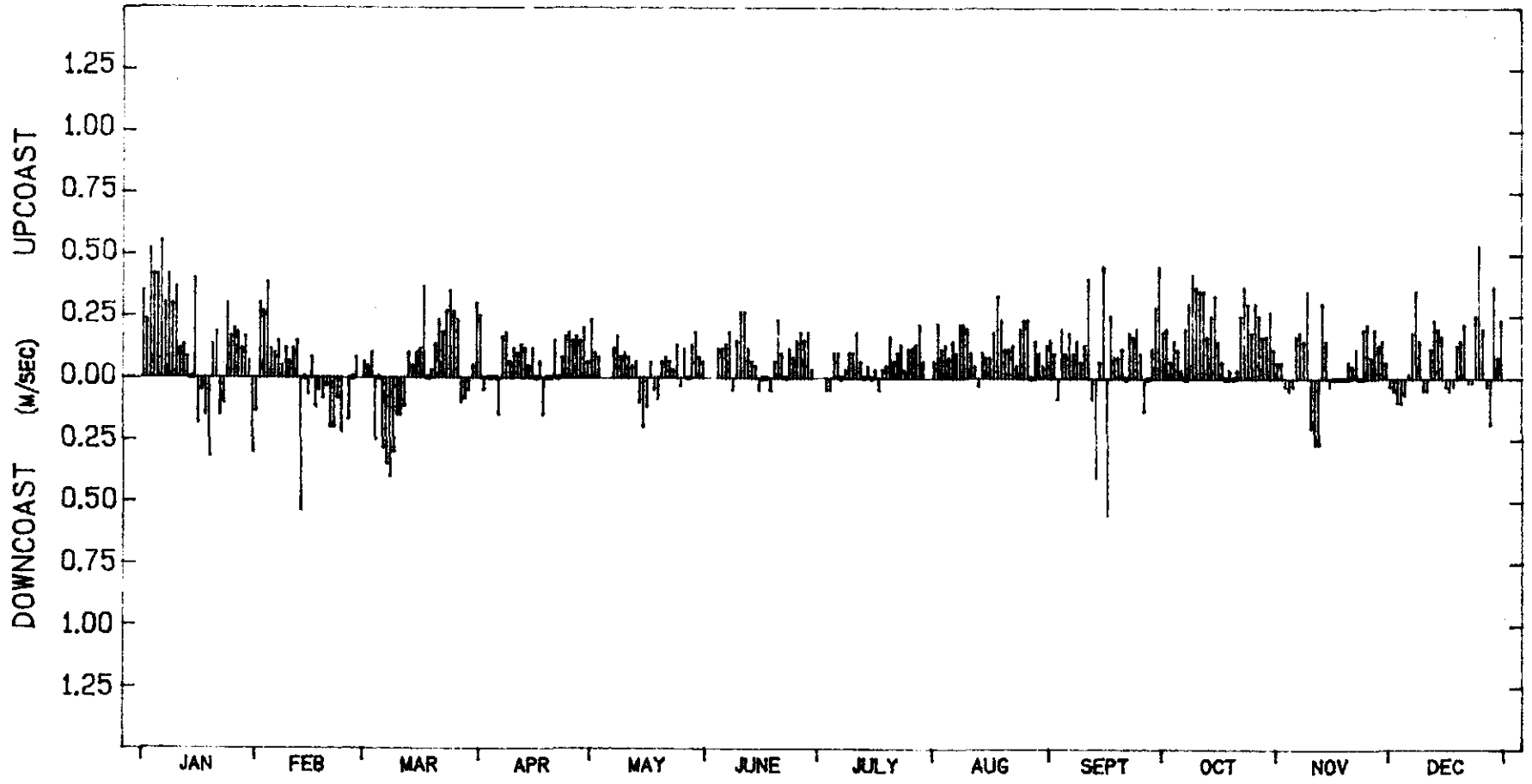
COPE
Machans Beach

Figure 26
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY - 1977

NO OF VALUES 354 MEAN VEL .090 M/SEC UP MEAN UPCOAST VEL .164 M/SEC MEAN DOWNCOAST VEL .133 M/SEC

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS — AFTERNOON 1977

COPE

Machans Beach

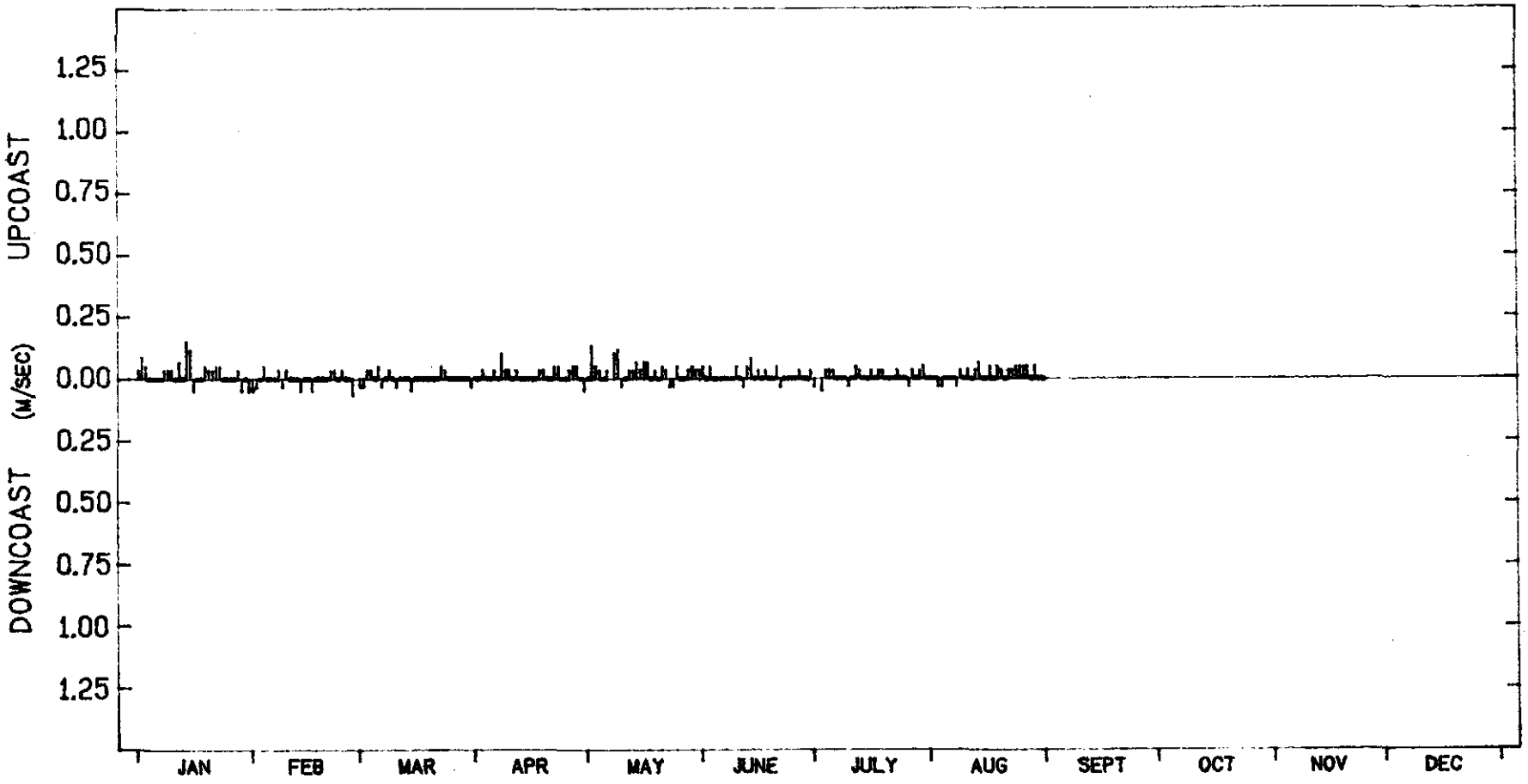
Figure 27

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENTS — MORNING 1978

LITTORAL CURRENT SUMMARY - 1978

NO OF VALUES 241 MEAN VEL .014 M/SEC UP MEAN UPCOAST VEL .047 M/SEC MEAN DOWNCOAST VEL .040 M/SE

MORNING OBSERVATIONS

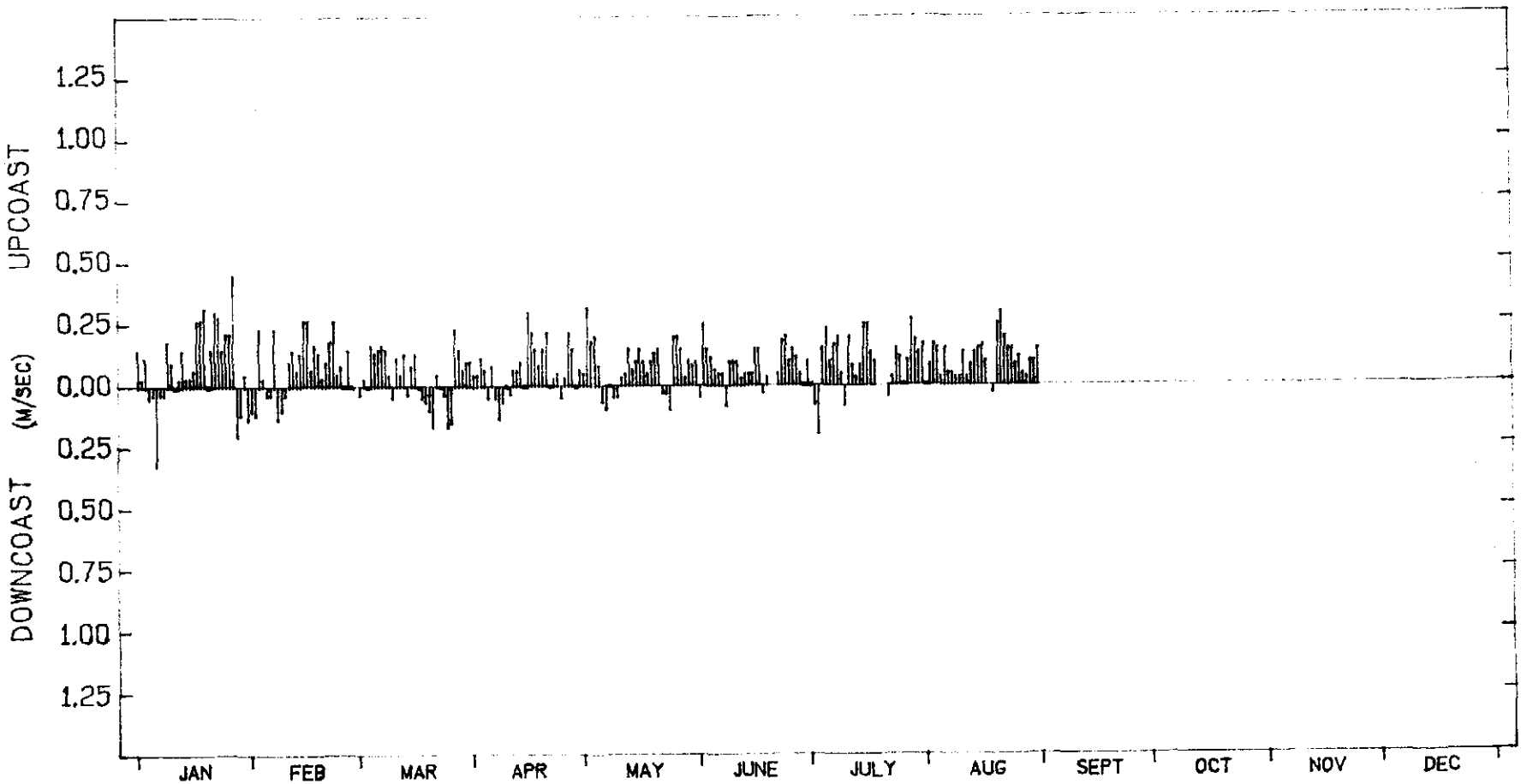
COPE
Machans Beach

Figure 28
C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

MULGRAVE SHIRE .... MACHANS BEACH 2901



LITTORAL CURRENT SUMMARY – 1978

NO OF VALUES 237 MEAN VEL .078 M/SEC UP MEAN UPCOAST VEL .127 M/SEC MEAN DOWNCOAST VEL .082 M/SEC

AFTERNOON OBSERVATIONS

LITTORAL CURRENTS – AFTERNOON 1978

COPE

Machans Beach

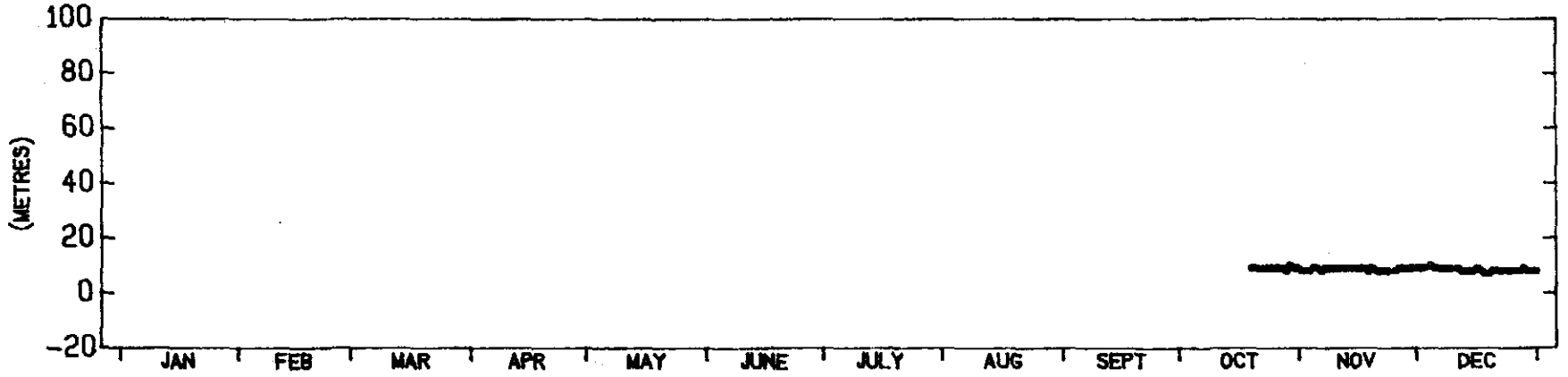
Figure 29

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

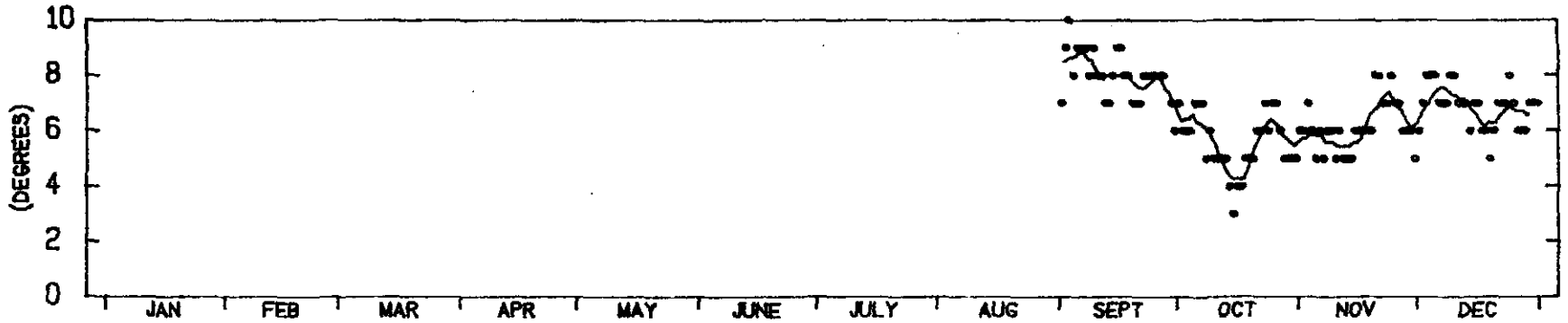
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1972



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

INDICATES FIXED CONTOUR : 71 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 121

BEACH PROFILE PARAMETERS 1972

COPE

Machans Beach

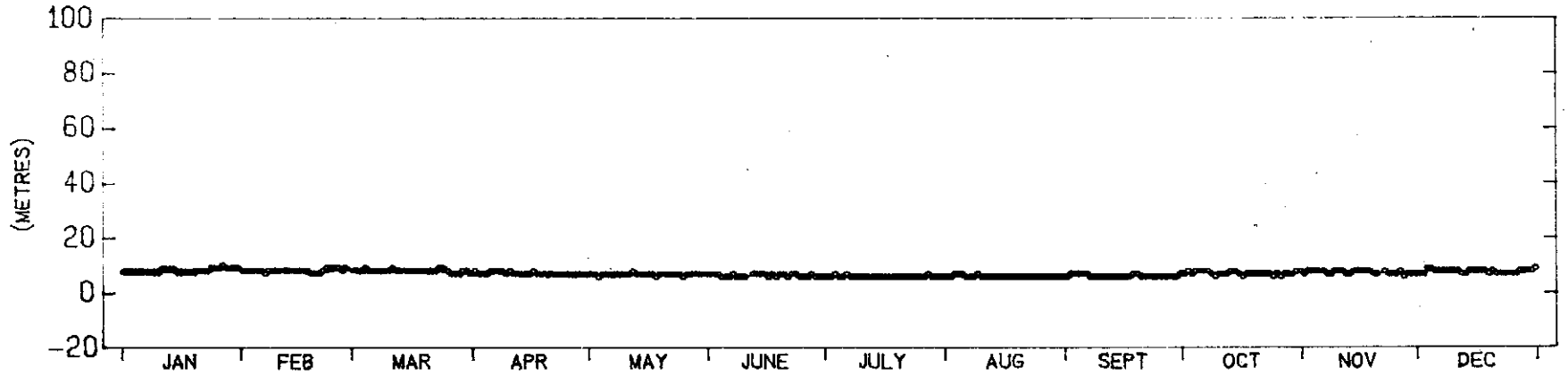
Figure 30

C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

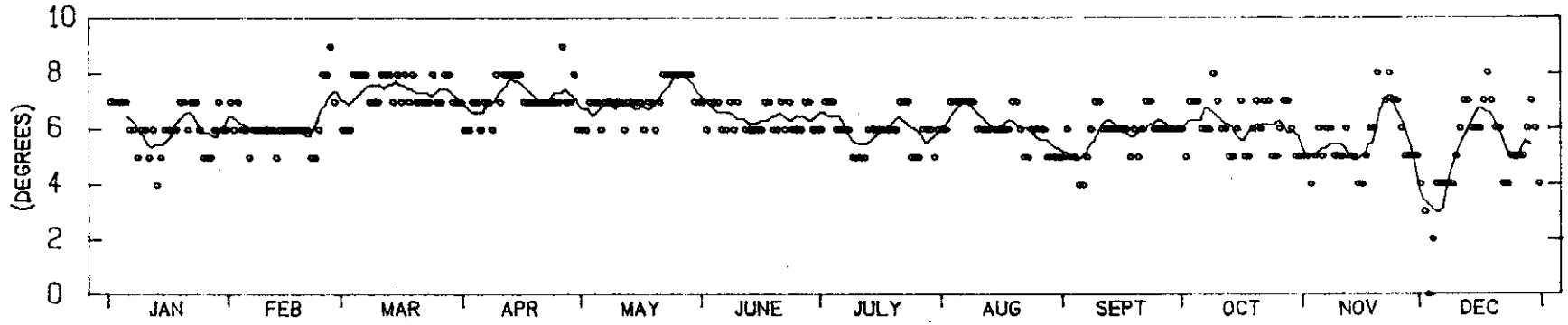
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1973



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

INDICATES FIXED CONTOUR : 363 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 363

BEACH PROFILE PARAMETERS 1973

COPE

Machans Beach

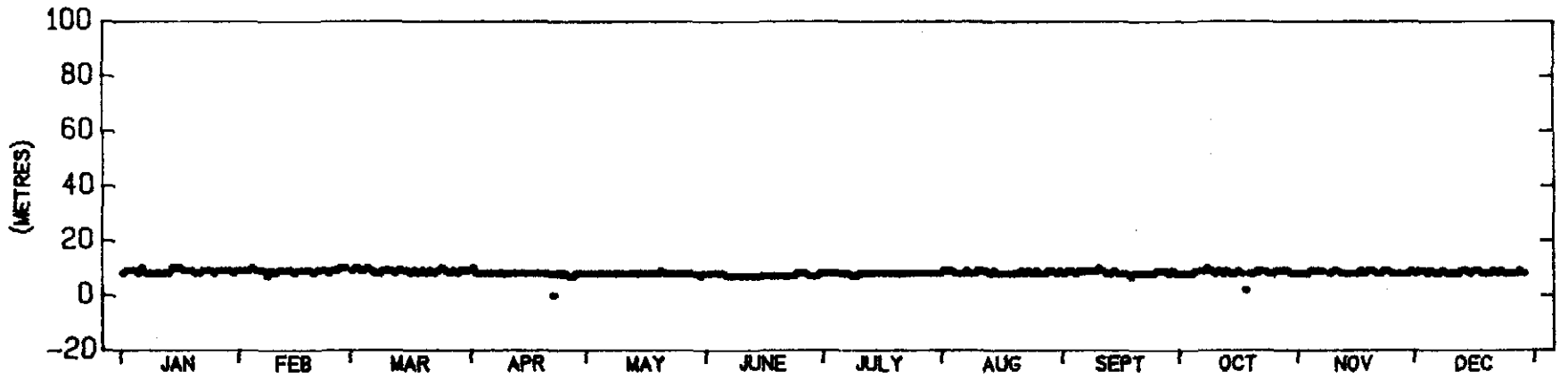
Figure 31

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

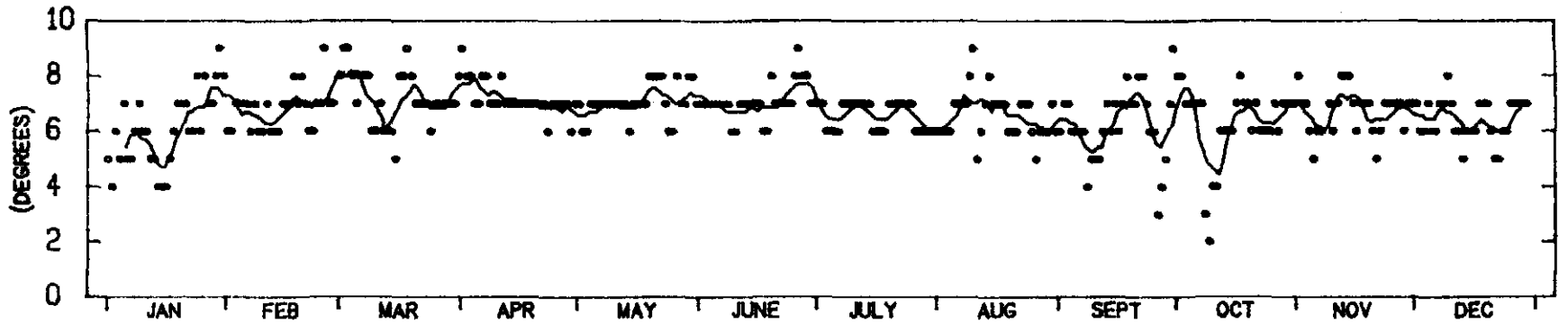
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1974



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

ooooo INDICATES FIXED CONTOUR : 364 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 364

BEACH PROFILE PARAMETERS 1974

COPE

Machans Beach

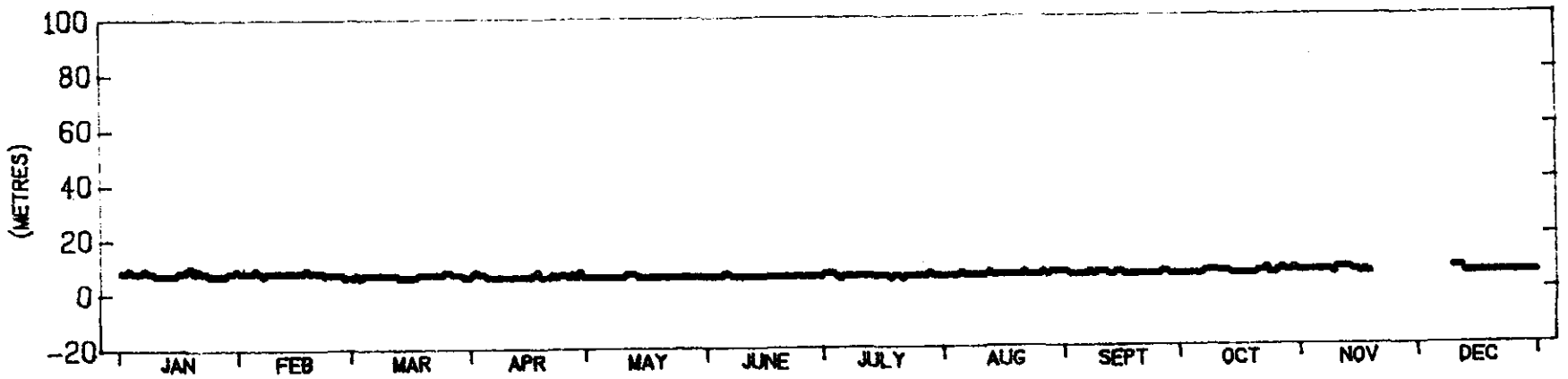
Figure 32

C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

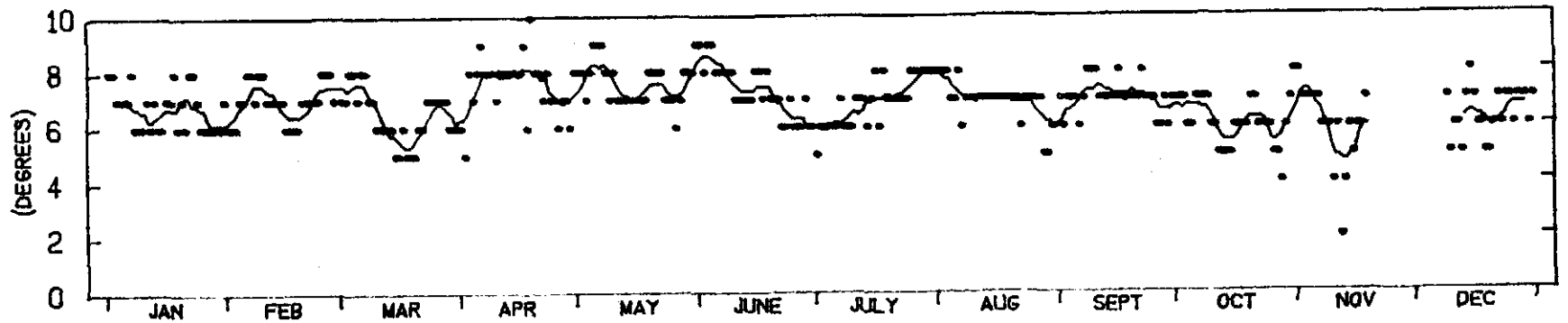
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1975



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

ooooo INDICATES FIXED CONTOUR : 344 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 345

BEACH PROFILE PARAMETERS 1975

COPE

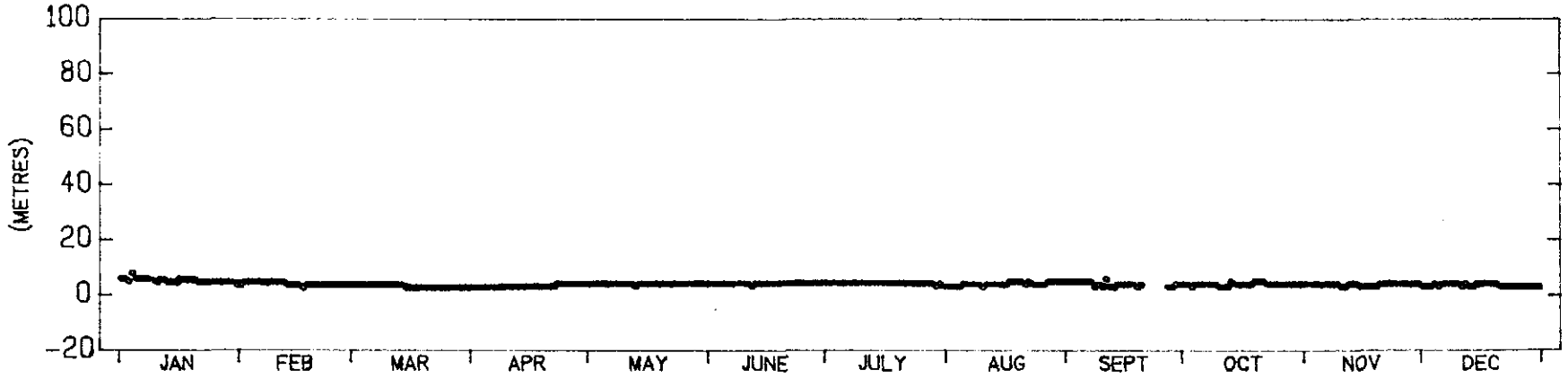
Machans Beach

Figure 33
C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

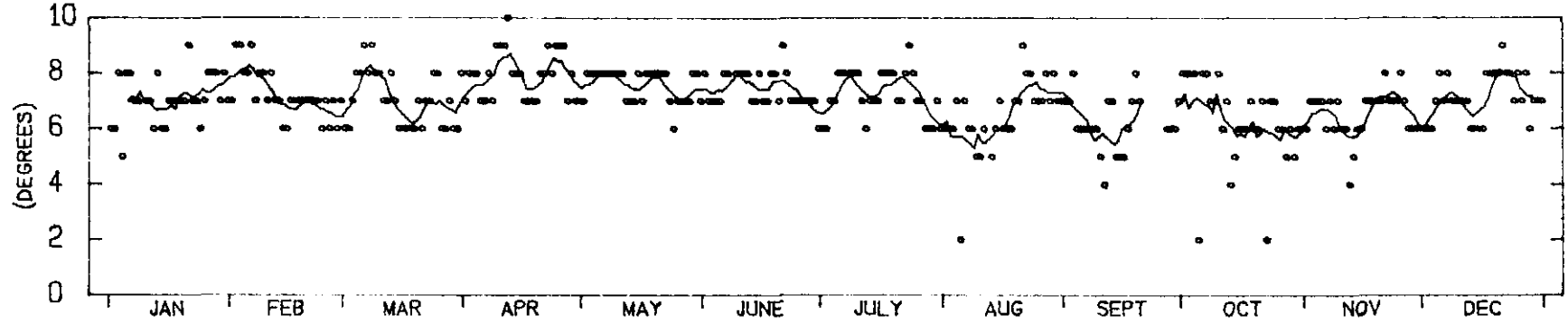
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1976



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

ooooo INDICATES FIXED CONTOUR : 357 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 357

BEACH PROFILE PARAMETERS 1976

COPE

Machans Beach

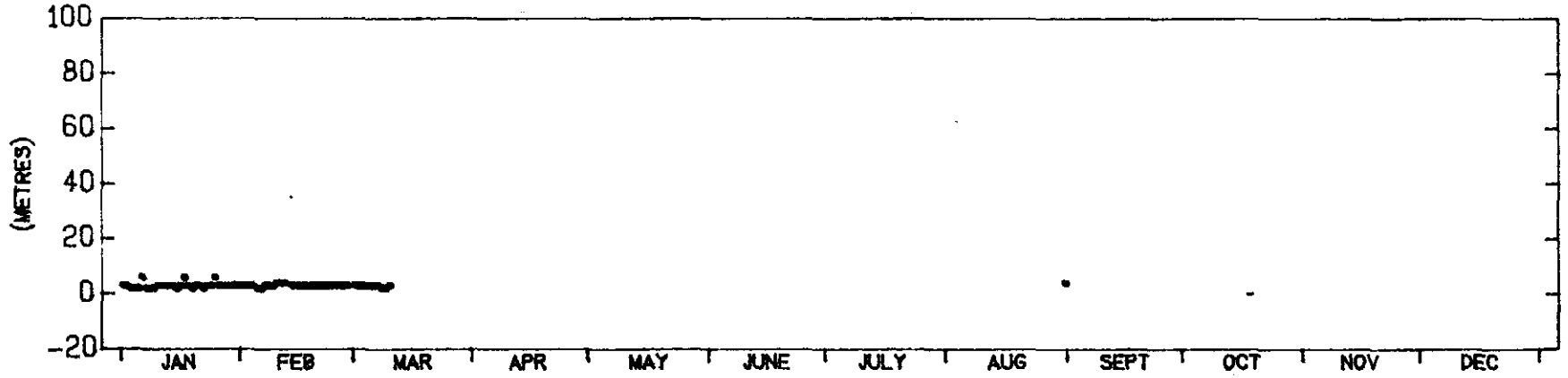
Figure 34

C 01.1

Beach Protection Authority

COPE – COASTAL OBSERVATION PROGRAMME ENGINEERING

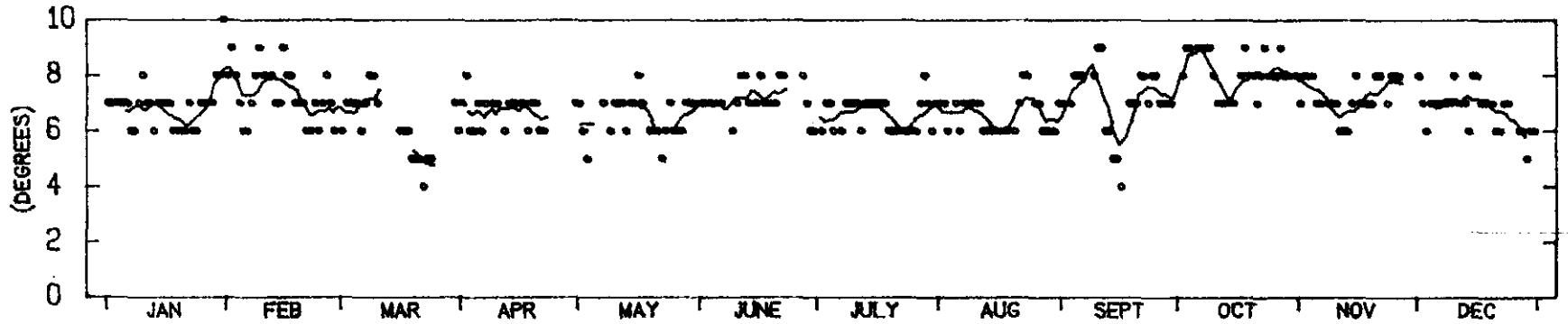
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1977



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

oooo INDICATES FIXED CONTOUR : 69 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 313

BEACH PROFILE PARAMETERS 1977

COPE

Machans Beach

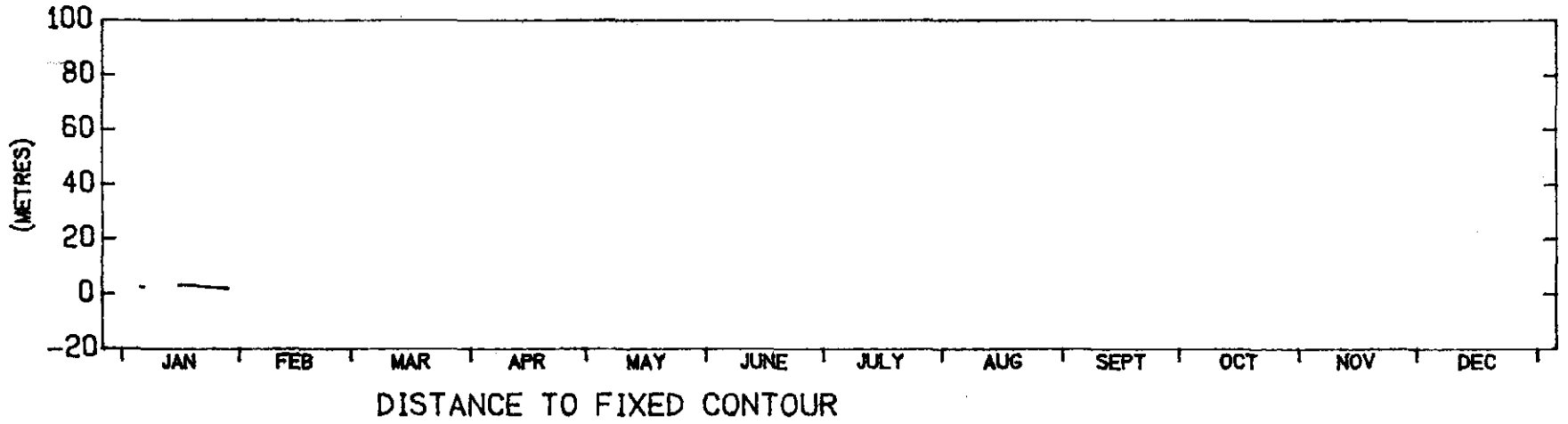
Figure 35

C 01.1

Beach Protection Authority

COPE - COASTAL OBSERVATION PROGRAMME ENGINEERING

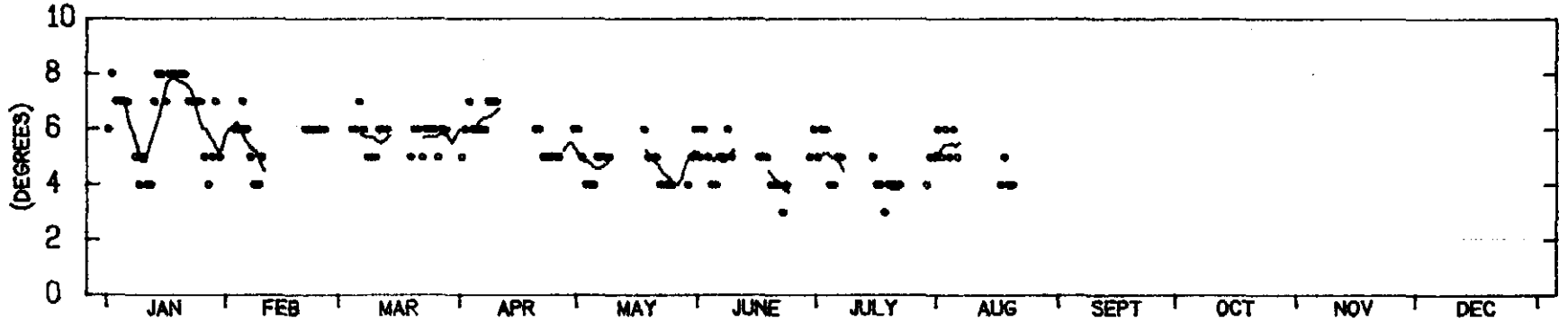
MULGRAVE SHIRE .... MACHANS BEACH .... 2901 YEAR : 1978



DISTANCE TO FIXED CONTOUR

FIXED CONTOUR LEVEL IS .5 M ABOVE MSL

oooo INDICATES FIXED CONTOUR : 20 OBSERVATIONS



FORESHORE SLOPE

SEVEN DAY MOVING AVERAGE

NO. OF OBSERVATIONS 149

BEACH PROFILE PARAMETERS 1978

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Machans Beach

Figure 36

C 01.1