Department of Science, Information Technology and Innovation

Beach Surveys and Data Assessment, Mackay Region

COPE Report – Seaforth Beach

Coastal Impacts Unit

2015

Queensland Government

Prepared by

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Acknowledgements

This report has been prepared by the Department of Science, Information Technology and Innovation. Acknowledgement is made of all of the identified volunteers that contributed their time and effort in collecting the COPE data.

Front Cover Photo: Seaforth Beach South July 1995 looking North Source: BPA file

April 2015

Contents

List of tables

List of figures

1 Introduction

1.1 Preamble

The Coastal Observation Program Engineering (COPE) data collection system was designed to collect data at selected sites along the Queensland coast to assist in the understanding of coastal processes and the way these processes affect the coast line. COPE was managed for the Beach Protection Authority (BPA) (now disbanded) by the Department of Harbours and Marine up until 1989 and then by the Coastal Management Branch in what is now the Department of Environment and Heritage Protection (DEHP). COPE data was progressively analysed and reports at selected sites were compiled up to mid-1996[1] when the program was abandoned. After that date very little further analysis was carried out, however all data was archived for possible future use. Custodianship of this data rests with the Coastal Impacts Unit of the Department of Science, Information Technology, and Innovation (DSITI).

For this report, raw data was provided by DSITI for Seaforth North Beach – COPE Station Number 20060 and Seaforth South Beach – COPE Station Number 20020. This data had not been pre-processed to identify errors in the recordings and/or errors from the transfer of the data from the recording sheets to the computer data file.

In February 2015, the Coastal Impacts Unit of DSITI commissioned GHD to compile a report on the COPE data from the Seaforth North and South Beach sites, with Seaforth North being located north Hibiscus St and south of Woodyard St and Seaforth South being located north of Elizabeth St and south of Hansen St. The report is modelled on the Bilinga site report compiled in February 2014 by GHD for the Department of Science, Information Technology and Innovation (DSITI).

DSITI provided the following data:

1. Recorded raw data in the form of a text file – this was data compiled directly from the recording sheets;
2. Sieve data from the analysis of the sand samples collected by the observers at the site;
3. Beach profile data collected by the observers at the site and subsequent data collected by staff from DSITI at Deagon; and
4. Photographs and other relevant information about the Seaforth Beach COPE Station extracted from the BPA files.

GHD, through its Principal Coastal Engineer, Paul O'Keeffe, a former engineer to the BPA, was able to source other background information on the COPE program and make assessments of the data analysis based on first-hand experience with the COPE program.

In addition, the BPA Beach Conservation newsletters were reviewed for any articles on the COPE program relating to the Seaforth Beach site. However, no articles that provided additional information on the Seaforth Beach COPE station were identified.

Reference documents and technical papers that have been used to assist in the preparation of this report are listed in Section 4.

[1] This date concurs with the recollection of Paul O'Keeffe (GHD) and Sel Sultmann (DEHP), Coastal Engineer and Dune Conservationist respectively for the BPA at the time that the COPE program was finalised.

1.2 The Program

The BPA required basic data on the behaviour of Queensland's beaches in order to provide evidence-based coastal management advice to Local Authorities. The COPE project aimed to collect information on wind, waves and beach behaviour in areas where extensive investigations were not practical and where otherwise little or no data existed.

The project was based on the recruitment of volunteer observers who were prepared to record a series of basic parameters daily for at least a three year period. The COPE project was operational from late in 1971 to about mid-1996[2].

1.3 Site Selection

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

1. The general shoreline configuration and the possibility of extrapolation of data to other adjacent beaches;
2. The distribution of stations along Queensland's coastline; and
3. The need to correlate the COPE data with planned or existing data collection programs.

1.4 Instruments

The COPE observers were supplied with a basic kit of recording instruments including:

1. 30 m tape measure;
2. Wind meter;
3. Stop watch;
4. 2.0 m measuring sticks;
5. Recording forms;
6. Fluorescent dye (Rhodamine or Flourescene);
7. 1.5 m support stick (as suggested by Appendix A – Instructions for filling out COPE recording form);
8. Hand held level (as suggested by Appendix A – Instructions for filling out COPE recording form); and
9. Plastic bags and envelopes for sand samples, mailing envelopes for the return of recording sheets, clipboard, pencils and erasers.

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

1.5 Observers

The majority of COPE observers were volunteers. Some stations were also operated by Government and Local Authority employees who carried out the observations as part of their official duties.

[2] Refer previous footnote

1.6 Accuracy

Individual observers differed in their subjective assessment of the various parameters recorded as part of the COPE program. Wave parameters such as height, and angle of approach together with surf zone width and the location of vegetation line all required visual assessment. The accuracy of recorded details varied from observer to observer and possibly from recording to recording. Although the BPA was confident that all observers made their observations to the best of their ability and accepted these observations without adjustment, the existence of random and non-random errors in the recorded data was to be expected.

Problems associated with the use of data containing these errors are minimised in a number of ways as follows:

1. Regular visits were made to the COPE stations by the BPA's COPE Field Officer to provide a check on any bias introduced into the recordings by incorrect observation procedures.
2. It was determined that, with a large number of observations taken on a regular basis, a reasonable assessment can be made of the average values of the observed parameters provided the observation errors are random. A minimum recording period of three years was adopted for the analysis and publication of the data, in order to minimise the effects of random errors.
3. Five day moving averages are applied to observations of the various beach width and foreshore slope parameters to filter out random errors.
4. Pre-processing of the raw data was undertaken to remove obvious errors from either recording errors and/or errors from the transfer of the data from the recording sheets to the computer data file. For this report, these errors and how they were corrected have been documented in the Data Presentation section.

For these reasons, the BPA concluded that published COPE data can be used with confidence provided the above inherent limitations are recognised.

1.7 Presentation of Data

The purpose of this report is to present COPE data for Seaforth North Beach for the six and half years' worth of data taken between 1976 and 1994, and Seaforth South Beach for the 2.25 years' worth of data taken between 1977 and 1982 and the continued profile data supplied by DSITI from April 1981 to May 1996 in a useful statistical form.

At Seaforth North during the above period, there was approximately 6.5 years of recorded data collected by the observers, and at Seaforth South the amount of recorded data was approximately 2.25 years. The 6.5 year period at Seaforth North can be considered to be representative of the long term average meteorological condition and the statistics presented on wind, wave and beach movements can be regarded as typical of the ambient conditions. However, the 2.25 year period at Seaforth South falls short of being considered to be representative of the long term average meteorological condition and therefore should be used with caution in relation to being representative of typical ambient conditions.

In addition, the overall 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 given to the influence of such events on trends of long term beach behaviour.

2 Station Particulars

2.1 Location

Seaforth Beach is located approximately 36 kilometres north of Mackay on the Eastern Queensland coastline. The beach is approximately four kilometres long extending from Seaforth Creek in the south to Finlayson Point (opposite Redcliffe Island) in the north. The location of the Seaforth North site is north Hibiscus St and south of Woodyard St and the Seaforth South site is located north of Elizabeth St and south of Hansen St as shown on Figure 10, Figure 11 and Figure 12.

2.2 Observers

From information available, the main observer for the Seaforth North site was Mr Ted Tyzack. He took daily measurements from July 1987 to June 1994. The main observers for the Seaforth South site were Trevor and Myra Iseppi. They took daily measurements from November 1977 to April 1979. Several other observers participated in the program and their involvement is summarised in Table 1.

Figure 1 COPE observer at Seaforth Beach taking wind measurements in August 1976.

Table 1 Summary of Seaforth Beach observers

Year	Observer	Year	Observer
1976	Jean Murray (Seaforth North)	1986	-
1977	Jean Murray (Seaforth North) and Trevor & Myra Iseppi (Seaforth South)	1987	Mr Ted Tyzack (Seaforth North)
1978	Trevor & Myra Iseppi (Seaforth South)	1988	Mr Ted Tyzack (Seaforth North)
1979	Trevor & Myra Iseppi (Seaforth South)	1989	Mr Ted Tyzack (Seaforth North)
1980	-	1990	Mr Ted Tyzack (Seaforth North)
1981	Alan Patson (Seaforth South)	1991	Mr Ted Tyzack (Seaforth North)
1982	Alan Patson (Seaforth South)	1992	Mr Ted Tyzack (Seaforth North)
1983	-	1993	Mr Ted Tyzack (Seaforth North)
1984	-	1994	Mr Ted Tyzack (Seaforth North)
1985	-		

Note: Ted Tyzack carried out daily observations without the aid of a COPE Pole at Seaforth North and measured profiles and collected sand samples at Seaforth South COPE Pole from 1987 to 1994.

2.3 Reports from Beach Conservation

Beach Conservation was the title of the newsletter of the Beach Protection Authority of Queensland and was published quarterly between September 1970 and June 1990. Various aspects of the COPE program were frequently featured in the newsletter including two main articles on the operation of the program in April 1977 (Issue No 27) and June 1990 (Issue No 69). However, no articles that provided additional information on the Seaforth Beach COPE station were identified.

2.4 Site History

Seaforth North

Listed below is information compiled from the BPA files for the Seaforth North site, including details of the installation and maintenance of the COPE pole. A photograph of the installed COPE pole is shown in Figure 2.

1. 5 August 1976 – Observations commenced (Murray) and pole installed at Seaforth North,
2. 19 April 1977 – Observation suspended
3. 19 April 1978 – Seaforth North pole removed and Seaforth South pole installed,
4. 30 July 1987 – Recordings resumed (Tyzack)
5. 10 June 1994 – Daily observations ceased, monthly profiles and sand samples continued at Seaforth South
6. 21 January 1995 – All observations ceased

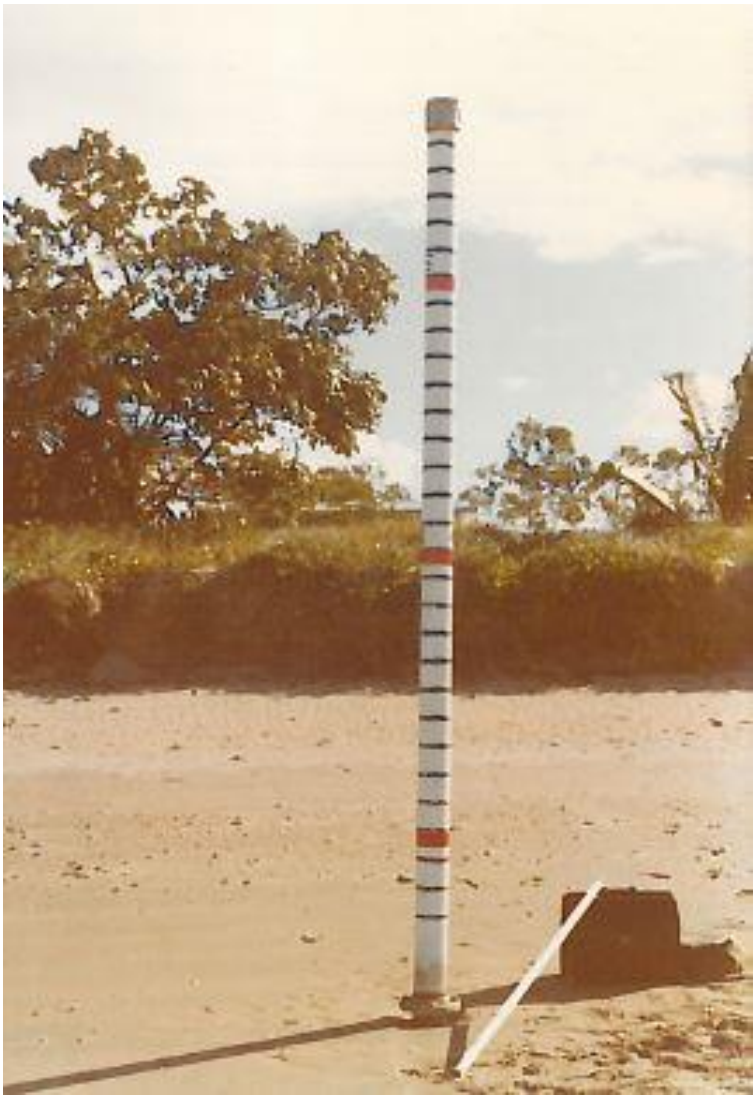

Figure 2 Seaforth North COPE pole, 7 June 1977

Seaforth South

Listed below is information compiled from the BPA files for the Seaforth South site, including details of the installation and maintenance of the COPE pole. A photograph of the installed COPE pole is shown in Figure 3.

1. 9 November 1977 – Observations commenced (Iseppi),
2. 19 April 1978 – Pole installed,
3. 28 February 1982 – Daily observations ceased, monthly profiles and sand samples continued by Tyzack,
4. 2 August 1983 – Pole repainted,
5. 11 May 1988 – Pole repainted,
6. 27 September 1991 – Top section of pole replaced,
7. 27 November 1996 – All observations ceased.

Figure 3 Seaforth South COPE pole, May 1986

2.5 Observed Parameters

The observers at the North and South station recorded the majority of observations in the afternoon around 12 pm and 1 pm throughout the recording period.

Data was recorded on the original recording sheet shown in Figure 13 from 5 August 1976 to 28 February 1982, with the following parameters being recorded:

- Wave period (s);
- Wave height (average) (m);

- Wave angle (degrees);
- Wave type;
- Surf zone width (s);
- Offshore bar (presence);
- Wind speed (mph);
- Wind direction (degrees);
- State of tide;
- Berm elevation (m);
- Distance to berm (m);
- Distance to the vegetation (m);
- Foreshore slope (degrees);
- Current speed longshore (m/min);
- Current direction longshore;
- Sand sample;
- Sand level at pole (COPE reference pole) (m).

Data was recorded on the new recording sheet shown in Figure 15 from 30 July 1987 to 10 June 1994, with the following parameters being recorded:

- Wave height (average) (m);
- Wave height (maximum) (m);
- Wave height method;
- Wave period (s);
- Wave direction (degrees);
- Surf zone width (s);
- Current speed longshore (m/min);
- Current direction longshore;
- Distance from shore (m);
- Offshore bar presence;
- Wind speed (mph);
- Wind direction (degrees);
- Fixed contour elevation (m);
- Distance to fixed contour (m);
- Distance to the vegetation (m);
- Sand level at pole (COPE reference pole) (m); and
- Sand sample.

Surf zone width on the original recording sheet was the estimated distance between the shore and the breakers offshore. With the new recording sheet surf zone width was measured as the time (in seconds) it took for a wave to traverse the surf zone from its break point until its final run-up position.

All directions in this report are magnetic. Sector bearings derived from True North were converted to magnetic bearings using the magnetic variation shown on marine charts.

The first recorded sand sample was taken in August 1976, and from then on, samples were taken every few months. Samples collected up to 19 April 1977 were from Seaforth North and all samples after that date were from Seaforth South.

A profile of the beach was recorded semi frequently throughout the recording period with additional profiles recorded within the month depending on the state of the beach and the occurrence of storm events from 1976 to 1996. Beach profiles commenced in January 1979 at Seaforth South and are shown in Figure 71 to Figure 87. It should be noted that the COPE location is always located at chainage 0 and that the first beach profile recorded in 3 January 1979 has been repeated on each chart as a reference level. All profiles were measured at the Seaforth South site

2.6 Tidal Information

Tidal information from the 1976 Official Tide Tables (H&M 1976) for Finlayson Point (at the northern end of Seaforth Beach) is presented in Table 2. The levels are on Mackay Port Datum.

It should be noted that in 2010, the tidal plane levels were updated for the current Tidal Datum Epoch 1992 - 2011, using the latest available tidal observations, prediction information and allowance for sea level rise. The current tidal plane levels are provided in the 2015 Official Tide Tables (MSQ 2015) and the levels for Finlayson Point (being the nearest location to Seaforth Beach) are presented in Table 2. The datum is LAT.

Table 2 Tidal planes

Tidal Plane	1976 (m mackay Port Datum)	2015 (m LAT)
	Finlayson Point	Finlayson Point
1. Highest Astronomical Tide (HAT)		6.71
2. Mean High Water Springs (MHWS)	5.1	5.40
3. Mean High Water Neaps (MHWN)	3.7	4.15
4. Australian Height Datum (AHD)		2.63
5. Mean Sea Level (MSL)	2.77	3.07
6. Mean Low Water Neaps (MLWN)	1.7	2.00

7. Mean Low Water Springs (MLWS)	0.4	0.75
8. Lowest Astronomical Tide (LAT)		o.o

Assuming that the 1976 datum is similar to the current LAT datum, the level of MLWS and MHWS has increased by 0.35 m and 0.30 m respectively.

2.7 Beach Description

Seaforth North

The beach at the Seaforth North COPE station exhibits the following characteristics:

- Typical beach slopes: Based on the original recording between 5 August 1976 and 19 April 1977 the beach slope oscillated between 1 and 2 degrees, with an average of 1.55 degrees; as shown on Figure 102.
- Beach width: No information is available on the beach width as there are no monthly beach profiles available for this site.;
- D_{50} grain size: 0.25 mm averaged over 5 samples collected over the two years (1976 – 1977); and
- Adjoining landform: Low vegetated dune seaward of residential housing.

Images of the beach are provided in Figure 4 and Figure 5.

Figure 4 Seaforth North, June 1977 – Looking north

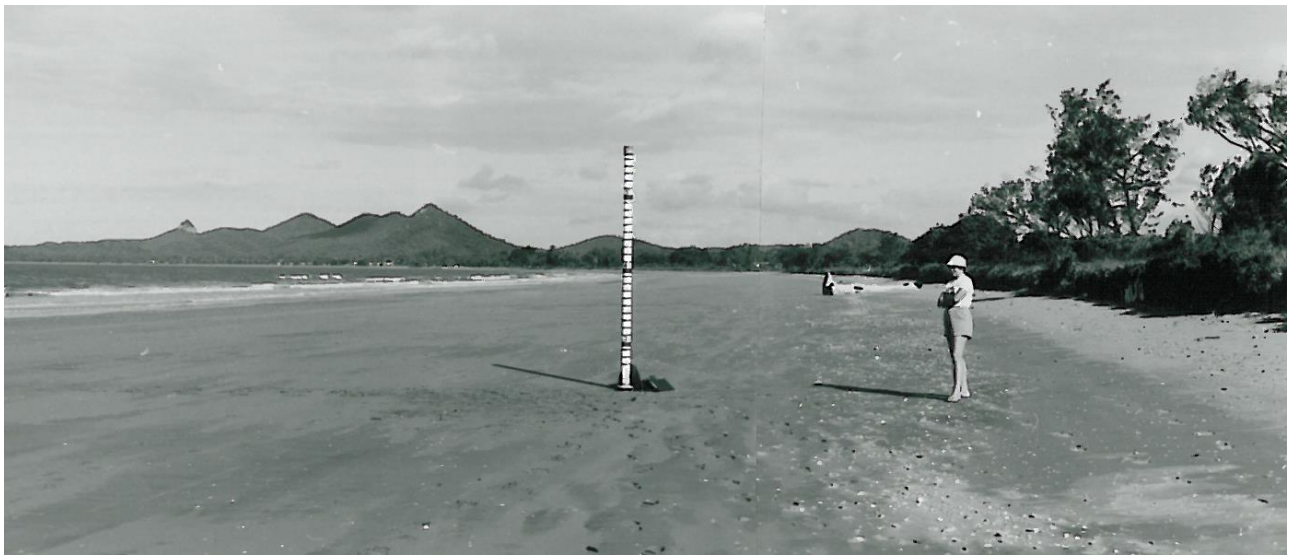

Figure 5 Seaforth Beach North, June 1977 – Looking south

Seaforth South

The beach at the Seaforth South COPE station exhibits the following characteristics:

- Typical beach slopes: Based on the original recording between 9 November 1977 and 28 February 1982 the beach slope oscillated between 1 and 5 degrees, with an average of 2.67 degrees; as shown on Figure 103.
- Beach width: Varied from 80 to 260 m measured from the seaward toe of the frontal dune to the Low Water Mark over the 17 year period (1979 - 1996) (by inspection of the monthly beach profiles in Figure 71 to Figure 87);
- D_{50} grain size: 0.30 mm averaged over 47 samples collected over the 18 years (November 1977 to March 1996)
- Adjoining landform: Low vegetated dune seaward of residential housing.

Images of the beach are provided in Figure 6 and Figure 7.

Figure 6 Seaforth South, December 1982 – Looking north

Figure 7 Seaforth South, December 1982 – Looking south

2.8 Meteorological Events

The following cyclones were recorded by the Brisbane Bureau of Meteorology as having tracks within 400 km of Seaforth Beach between January 1976 and January 1996. It is considered that these meteorological events may have had some effect on the condition of Seaforth Beach.

- Cyclone DAVID: 13 January – 21 January 1976
- Cyclone BETH: 13 February – 22 February 1976
- Cyclone COLIN: 25 February – 04 March 1976
- Cyclone HOPE: 24 February – 06 March 1976
- Cyclone DAWN: 03 March – 06 March 1976
- Cyclone WATOREA: 25 April – 28 April 1976
- Cyclone JUNE: 16 January – 19 January 1977
- Cyclone OTTO: 06 March – 10 March 1977
- Cyclone HAL: 06 April – 11 April 1978
- Cyclone GORDON: 08 January – 11 January 1979
- Cyclone KERRY: 12 February – 04 March 1979
- Cyclone PAUL: 02 January – 08 January 1980
- Cyclone RUTH: 11 February – 18 February 1980
- Cyclone SIMON: 21 February – 28 February 1980
- Cyclone FREDA: 24 February – 07 March 1981
- Cyclone ABIGAIL: 22 January – 05 February 1982
- Cyclone DOMINIC: 01 April – 14 April 1982
- Cyclone DES 14 January – 23 January 1983
- Cyclone ELINOR: 10 February – 03 March 1983
- Cyclone FRITZ: 09 December – 13 December 1983
- Cyclone GRACE: 11 January – 20 January 1984
- Cyclone HARVEY: 03 February – 09 February 1984
- Cyclone INGRID: 20 February – 25 February 1984
- Cyclone LANCE: 04 April – 07 April 1984
- Cyclone MONICA; 25 December – 28 December 1984
- Cyclone NIGEL: 14 January - 16 January 1985
- Cyclone PIERRE: 18 February – 24 February 1985

- Cyclone VERNON: 21 January – 24 January 1986
- Cyclone ALFRED: 02 March – 08 March 1986
- Cyclone BLANCH: 21 May – 27 May 1987
- Cyclone CHARLIE: 21 February – 01 March 1988
- Cyclone DELILAH: 28 December 1988 – 01 January 1989
- Cyclone AIVU: 01 April – 05 April 1989
- Cyclone FELICITY: 13 December – 20 December 1989
- Cyclone NANCY: 28 January – 04 February 1990
- Cyclone HILDA: 04 March – 07 March 1990
- Cyclone IVOR: 16 March – 26 March 1990
- Cyclone JOY: 18 December – 27 December 1990
- Cyclone KELVIN: 24 February – 05 March 1991
- Cyclone FRAN: 09 March – 17 March 1992
- Cyclone OLIVER: 05 February – 12 February 1993
- Cyclone ROGER: 12 March – 21 March 1993
- Cyclone REWA: 28 December 1993 – 21 January 1994
- Cyclone VIOLET: 03 March – 08 March 1995
- Cyclone CELESTE: 26 January – 29 January 1996
- Cyclone DENNIS: 15 February – 18 February 1996

See Figure 106 to Figure 111 for the cyclone tracks for a 400 km radius centred just east of Mackay over the recording period of 1975 – 1979, 1980 – 1982, 1983 – 1984, 1985 – 1988, 1989 – 1991 and 1992 - 1996.

2.9 Station Supervision

The observers were instructed in the recording program by the BPA COPE Field Officer and the initial instruction period was followed by regular visits to the station during the period of recordings presented in this report.

Installation of the reference pole for this station was carried out by the Pioneer Shire Council. Maintenance of the pole was carried out by the BPA COPE Field Officer.

3 Data

3.1 General

COPE data for the two combined stations recorded a total of sixteen years distributed between August 1976 and June 1994 is presented in the tables in Section 5 - Tabular Results and the figures in Section 6 - Data Presentation. 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 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 m above beach level. Initially, the wind direction was recorded as a cardinal direction, and the speed was recorded in knots (kn). From 30 July 1987 the wind direction was recorded in degrees by compass,

and the speed was recorded in miles per hour (mph). Wind speed data in this report is presented in metres per second (m/s).

A summary of annual wind speed direction percentage occurrences is shown as a wind rose in Figure 17 and Figure 18.

3.3 Waves

The average and maximum breaker height (trough to crest) was usually estimated to the nearest 0.1 metre. Previous studies (Patterson and Blair, 1983) have shown that the estimate of average breaker height is comparable with the equivalent deep water significant wave height. The wave height was measured using one of the methods described on page two of the recording sheet (Figure 16), the method chosen being dependent on the wave height.

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

Seaforth North

At Seaforth North, wave direction was recorded as a compass bearing (Refer Figure 16).

Wave direction is estimated as one of five direction sectors in relation to the shore normal direction from which the waves were approaching the beach. From aerial photography the shore normal direction (True North) was determined to be 51 degrees for the Seaforth North COPE site. The compass bearings (Adjusted for magnetic declination) for the sectors are displayed in Table 3 and in the diagram below:

Table 3 Seaforth North - Sector directions (Magnetic North)

Sector	Direction
1	329^{o} to 29^{o}
2	29^{o} to 54^{o}
3	54^{o} to 64^{o}
4	64^{o} to 89^{o}
5	89^{o} to 149^{o}

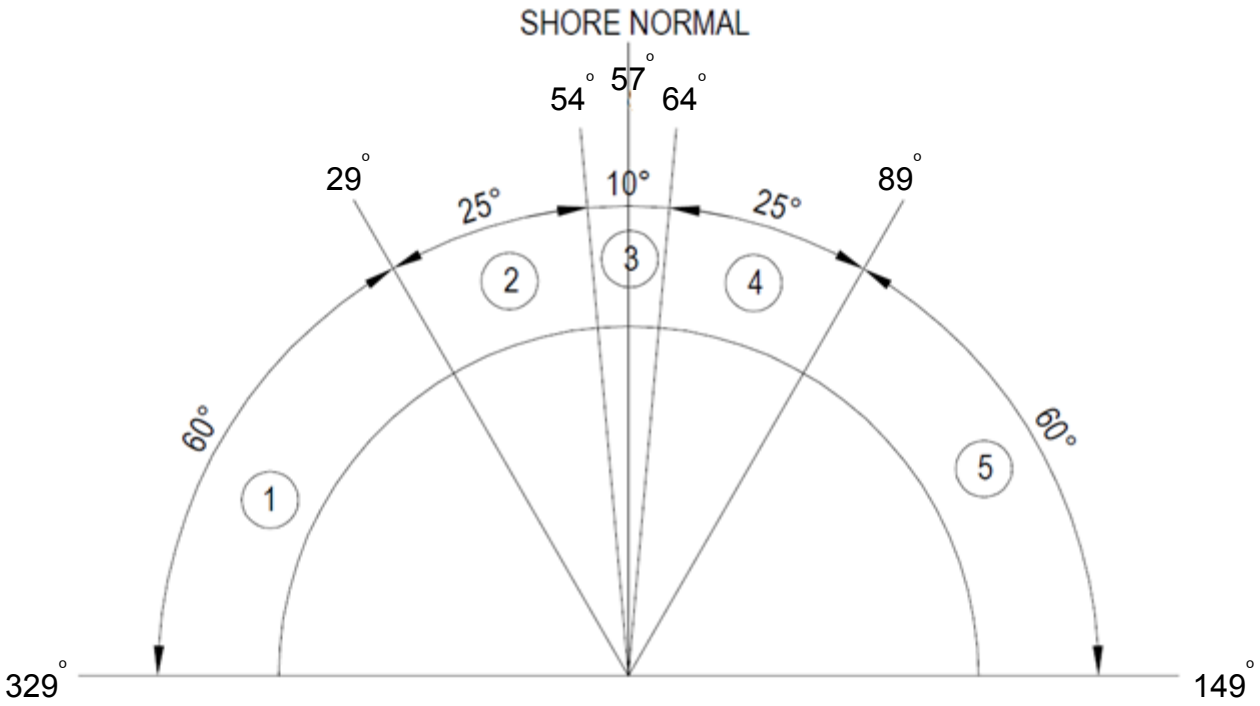

Figure 8 Seaforth Sector Distribution (Magnetic North)

Note: At the Seaforth North COPE station, the shore normal direction is approximately 57 degrees east of magnetic north.

Statistical representations of the observed wave data include:

- The percentage of wave height recordings which exceed any given wave height for all directions combined (Figure 19);
- The percentage occurrence of various combinations of wave heights, periods and directions (Figure 21 to Figure 30);
- Surf zone width with an indication of existence or otherwise of an offshore bar (Figure 31 to Figure 40); and
- Tabulation of the occurrence of various wave heights, periods, types and directions (Table 5 to Table 15).

Seaforth South

Prior to 21 October 1981, wave direction at Seaforth South was recorded as a compass bearing (refer Figure 16). The direction recorded was then converted to a sector, as shown in the following paragraph. After 21 October 1981 the wave direction at Seaforth South was recorded using the protractor in Figure 14 placed parallel to the shore.

Wave direction is estimated as one of five direction sectors in relation to the shore normal direction from which the waves were approaching the beach. From aerial photography the shore normal direction (True North) was determined to be 73 degrees for the Seaforth South COPE site. The compass bearings (Adjusted for magnetic declination) for the sectors are displayed in Table 4 and in the diagram below:

Table 4 Seaforth South - Sector directions (Magnetic North)

Sector	Direction
1	351° to 51°
2	51° to 76°
3	76° to 86°
4	86° to 111°
5	111° to 171°

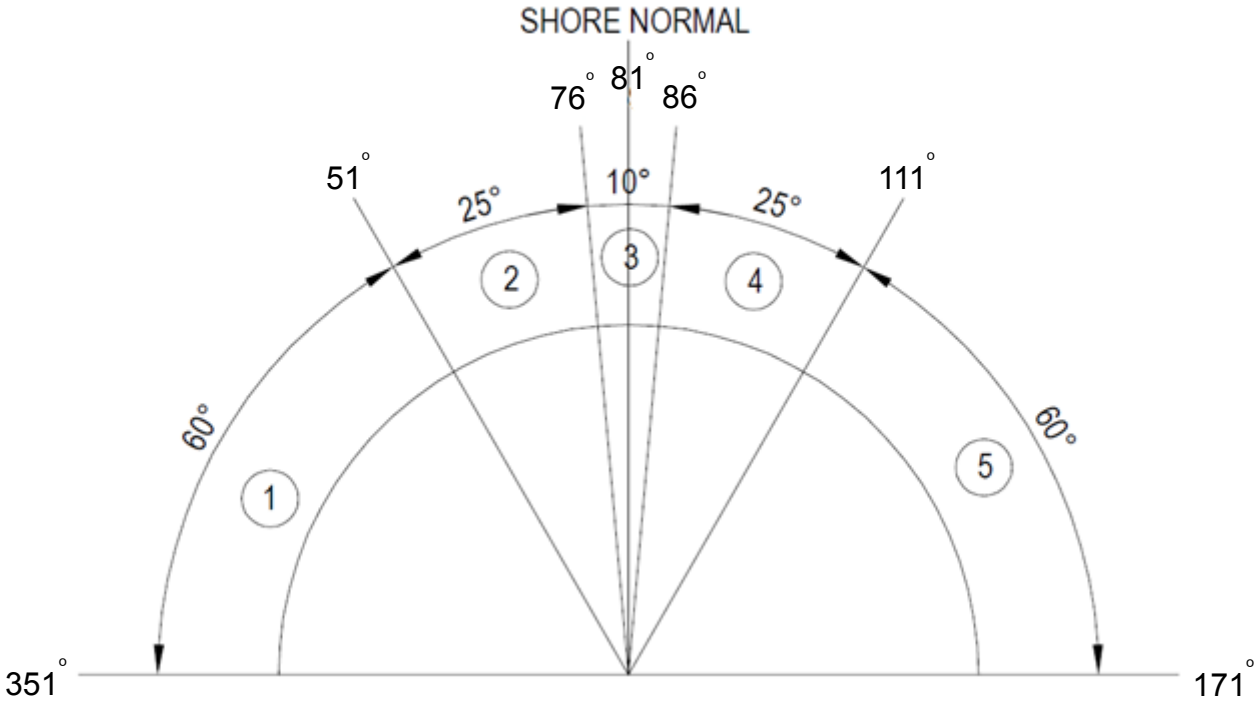

Figure 9 Seaforth South Sector Distribution (Magnetic North)

Note: At the Seaforth South COPE station, the shore normal direction is approximately 81 degrees east of magnetic north.

Statistical representations of the observed wave data include:

- The percentage of wave height recordings which exceed any given wave height for all directions combined (Figure 20);
- The percentage occurrence of various combinations of wave heights, periods and directions (Figure 23 to Figure 30);
- Surf zone width with an indication of existence or otherwise of an offshore bar (Figure 41 to Figure 45); and
- Tabulation of the occurrence of various wave heights, periods, types and directions (Table 15 to Table 19).

Wave direction data in this report is presented as per the sectors summarised in Table 4.

3.4 Longshore Currents

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

The readings were then converted to a velocity which was plotted on a monthly basis (Figure 46 to Figure 60). A summary table for the mean upcoast and downcoast components and overall annual averages are provided on each of these yearly figures.

3.5 Beach Profile Parameters

Fixed contour elevation was measured by using the supplied level and the 1.5 m support pole. The observer would stand the pole in the top of the berm, and by using the level, would site and record the elevation from the graduated COPE pole. The distance to the fixed contour was recorded using a tape measure. The fixed contour has been interpreted as being on top of a berm.

Sand level at the reference pole and the distance to the vegetation line were also recorded.

Changes in these parameters with time indicate how the beach moves in response to varying wave conditions. Plots of these parameters are shown in Figure 61 to Figure 68.

Based on the information provided, offshore slopes were recorded at the Seaforth Beach North site from 5 August 1976 to 19 April 1977. Offshore slopes at the Seaforth Beach South site were recorded from 9 November 1977 to 28 February 1982. Offshore slopes summaries are shown in Figure 102 and Figure 103.

Figure 69 and Figure 70 show summaries of monthly averages of the distance to berm and the distance to vegetation line for the full recording period.

3.6 Monthly Beach Profiles

Measurements of beach profiles at Seaforth were usually taken monthly. However, if the beach experienced appreciable erosion or accretion during the month, the observer was requested to take an additional beach profile. Monthly beach profiles at Seaforth South are shown in Figure 71 to Figure 87. It should be noted that the profile taken in January 1979 has been repeated in each graph so comparisons between profiles can be easily made. There was no beach profile data available for Seaforth North.

3.7 Sand Sample Particle Size Distribution

The data indicates that samples underwent a standard sieve analysis to determine the particle size distribution. The lower boundary (D_{16}), upper boundary (D_{84}) and the average D_{50} were derived from the data and are summarised in Figure 101. Particle Size Distribution D_{50} is the value of the particle diameter at 50% in the cumulative distribution, so that 50% of the particles in the sample are larger than D_{50}, and 50% smaller than D_{50} and the same concept is applied for D_{16} and D_{84}.

Seaforth North

A total of 5 sand samples over two years (1976 to 1977) were collected at the Seaforth North site. For Seaforth North, the average D_{50}=0.25 mm.

Seaforth South

A total of 47 samples over the 18 years (November 1977 to March 1996) were collected at the Seaforth South site. For Seaforth South, the average D_{50}=0.30 mm.

4 References

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5 Tabular Results

Table 5 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1976

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	0			0						
Apr	0			0						
May	0			0						
Jun	0			0						
Jul	0			0						
Aug	16	4.6	0.2	16	0	2	4	9	0	1
Sep	17	5.3	0.2	17	0	2	13	2	0	0
Oct	24	3.1	0.2	24	0	9	8	2	0	5
Nov	1	6.5	0.1	1	0	0	1	0	0	0
Dec	0			0						
Whole Year	**58**	**4.9**	**0.2**	**58**	**0**	**13**	**26**	**13**	**0**	**6**

Table 6 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1977

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	16	5.6	0.2	16	0	1	11	2	0	2
Apr	10	5.0	0.3	10	0	0	11	0	0	0
May	0			0						
Jun	0			0						
Jul	0			0						
Aug	0			0						
Sep	0			0						
Oct	0			0						
Nov	0			0						
Dec	0			0						
Whole Year	**26**	**5.3**	**0.2**	**26**	**0**	**1**	**22**	**2**	**0**	**2**

Table 7 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1987

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	0			0						
Apr	0			0						
May	0			0						
Jun	0			0						
Jul	2	5.4	0.2	2	0	0	2	0	0	0
Aug	24	4.9	0.3	24	2	9	8	4	0	0
Sep	21	4.3	0.3	21	2	7	7	5	0	0
Oct	19	4.8	0.3	19	12	4	2	1	0	0
Nov	18	4.6	0.3	18	7	9	1	1	0	0
Dec	13	3.9	0.3	13	2	11	0	0	0	0
Whole Year	**97**	**4.6**	**0.3**	**97**	**25**	**40**	**20**	**11**	**0**	**0**

Table 8 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1988

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	20	5.0	0.4	20	1	13	6	0	0	0
Feb	17	5.1	0.4	17	0	5	8	4	0	0
Mar	17	5.6	0.5	17	1	7	7	2	0	0
Apr	19	7.3	0.4	19	2	6	7	4	0	0
May	23	7.0	0.3	23	6	2	8	7	0	0
Jun	19	6.7	0.3	19	1	5	4	7	2	0
Jul	19	6.6	0.4	19	1	2	6	10	0	0
Aug	22	5.8	0.4	22	0	3	7	12	0	0
Sep	21	5.6	0.3	21	4	8	9	0	0	0
Oct	20	5.1	0.3	20	5	9	5	1	0	0
Nov	11	6.7	0.5	11	1	2	6	2	0	0
Dec	19	7.4	0.4	19	1	8	8	2	0	0
Whole Year	**227**	**6.2**	**0.4**	**227**	**23**	**70**	**81**	**51**	**2**	**0**

Table 9 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1989

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	24	7.0	0.4	24	5	6	11	2	0	0
Feb	20	6.1	0.5	20	2	6	11	1	0	0
Mar	24	5.8	0.4	24	2	8	11	3	0	0
Apr	21	6.3	0.5	21	0	4	15	2	0	0
May	23	5.9	0.5	23	0	3	8	12	0	0
Jun	21	6.0	0.3	21	0	4	3	14	0	0
Jul	22	5.3	0.3	22	0	6	5	9	2	0
Aug	21	6.2	0.3	21	0	12	6	3	0	0
Sep	22	5.2	0.3	22	1	13	8	0	0	0
Oct	22	4.4	0.3	22	4	14	3	1	0	0
Nov	20	4.9	0.4	20	2	14	4	0	0	0
Dec	20	5.6	0.4	20	1	11	7	1	0	0
Whole Year	**260**	**5.7**	**0.4**	**260**	**17**	**101**	**92**	**48**	**2**	**0**

Table 10 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1990

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	19	5.0	0.4	19	0	9	8	2	0	0
Feb	20	6.5	0.3	20	7	8	5	0	0	0
Mar	23	6.7	0.5	23	0	10	13	0	0	0
Apr	18	6.0	0.4	18	0	9	9	0	0	0
May	22	5.9	0.4	22	1	6	14	1	0	0
Jun	21	6.0	0.4	21	0	3	14	4	0	0
Jul	23	5.0	0.3	23	0	8	9	6	0	0
Aug	18	6.8	0.3	18	5	4	8	1	0	0
Sep	22	5.0	0.4	22	0	9	11	2	0	0
Oct	21	4.7	0.3	21	7	11	3	0	0	0
Nov	20	5.1	0.3	20	2	15	3	0	0	0
Dec	16	4.7	0.6	16	3	8	3	2	0	0
Whole Year	**243**	**5.6**	**0.4**	**243**	**25**	**100**	**100**	**18**	**0**	**0**

Table 11 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1991

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	20	6.1	0.4	20	1	14	5	0	0	0
Feb	19	5.8	0.5	19	0	11	7	1	0	0
Mar	20	5.5	0.5	20	1	11	8	0	0	0
Apr	16	5.0	0.5	16	1	6	8	1	0	0
May	23	5.2	0.5	23	0	5	13	5	0	0
Jun	21	6.4	0.3	21	1	12	5	3	0	0
Jul	21	5.4	0.3	21	3	5	8	5	0	0
Aug	17	5.2	0.3	17	4	5	5	3	0	0
Sep	16	4.6	0.3	16	3	12	1	0	0	0
Oct	0			0						
Nov	0			0						
Dec	0			0						
Whole Year	**173**	**5.5**	**0.4**	**173**	**14**	**81**	**60**	**18**	**0**	**0**

Table 12 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1992

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	0			0						
Apr	16	5.0	0.4	16	0	4	12	0	0	0
May	26	5.1	0.4	26	0	9	17	0	0	0
Jun	23	5.7	0.3	23	1	13	6	3	0	0
Jul	25	5.6	0.4	25	0	10	9	5	1	0
Aug	21	5.3	0.3	21	2	11	7	1	0	0
Sep	17	4.4	0.3	17	6	8	2	1	0	0
Oct	21	5.2	0.4	21	3	12	6	0	0	0
Nov	17	4.1	0.4	17	5	11	1	0	0	0
Dec	14	4.1	0.4	14	3	9	2	0	0	0
Whole Year	**180**	**5.0**	**0.4**	**180**	**20**	**87**	**62**	**10**	**1**	**0**

Table 13 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1993

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	17	5.4	0.4	17	3	11	3	0	0	0
Feb	19	5.7	0.4	19	1	11	6	1	0	0
Mar	24	6.0	0.4	24	3	13	5	3	0	0
Apr	20	5.4	0.5	20	0	10	9	1	0	0
May	20	5.1	0.4	20	0	13	7	0	0	0
Jun	21	5.5	0.3	21	1	8	12	0	0	0
Jul	20	6.0	0.3	20	1	11	6	2	0	0
Aug	20	5.2	0.4	20	1	7	12	0	0	0
Sep	17	4.8	0.4	17	5	8	2	2	0	0
Oct	20	4.4	0.3	20	7	12	1	0	0	0
Nov	19	4.6	0.3	19	3	15	1	0	0	0
Dec	18	4.7	0.4	18	3	11	3	0	1	0
Whole Year	**235**	**5.2**	**0.4**	**235**	**28**	**130**	**67**	**9**	**1**	**0**

Table 14 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth North. Year 1994

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	19	4.9	0.4	19	3	12	3	1	0	0
Feb	20	5.2	0.4	20	1	13	6	0	0	0
Mar	18	6.2	0.5	18	3	6	9	0	0	0
Apr	17	5.2	0.4	17	0	9	8	0	0	0
May	18	5.0	0.3	18	0	10	8	0	0	0
Jun	6	6.5	0.3	6	0	5	1	0	0	0
Jul	0			0						
Aug	0			0						
Sep	0			0						
Oct	0			0						
Nov	0			0						
Dec	0			0						
Whole Year	**98**	**5.5**	**0.4**	**98**	**7**	**55**	**35**	**1**	**0**	**0**

Table 15 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth South. Year 1977

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	0			0						
Apr	0			0						
May	0			0						
Jun	0			0						
Jul	0			0						
Aug	0			0						
Sep	0			0						
Oct	0			0						
Nov	22	3.6	0.3	22	0	1	21	0	0	0
Dec	31	3.2	0.3	31	0	6	18	0	0	7
Whole Year	**53**	**3.4**	**0.3**	**53**	**0**	**7**	**39**	**0**	**0**	**7**

Table 16 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth South. Year 1978

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	30	2.2	0.2	30	0	0	16	0	0	14
Feb	27	4.0	0.3	27	0	0	22	0	0	5
Mar	31	3.5	0.2	31	0	3	19	2	0	7
Apr	22	3.3	0.2	22	0	0	16	0	0	6
May	31	3.6	0.2	31	0	0	25	0	0	6
Jun	30	1.3	0.1	30	0	0	9	0	0	21
Jul	31	3.2	0.2	31	0	1	21	0	0	9
Aug	11	3.9	0.2	11	0	0	10	0	0	1
Sep	20	2.4	0.2	20	0	0	12	0	0	8
Oct	31	3.8	0.3	31	0	0	27	0	0	4
Nov	28	3.6	0.2	28	0	5	21	0	0	2
Dec	31	2.0	0.1	31	0	8	9	0	0	14
Whole Year	**323**	**3.1**	**0.2**	**323**	**0**	**17**	**207**	**2**	**0**	**97**

Table 17 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth South. Year 1979

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	27	3.4	0.3	27	0	0	16	2	0	9
Feb	28	4.4	0.4	28	0	0	23	0	0	5
Mar	30	3.2	0.2	30	0	0	21	0	0	9
Apr	7	4.5	0.2	7	0	0	7	0	0	0
May	0			0						
Jun	0			0						
Jul	0			0						
Aug	0			0						
Sep	0			0						
Oct	0			0						
Nov	0			0						
Dec	0			0						
Whole Year	**92**	**3.9**	**0.3**	**92**	**0**	**0**	**67**	**2**	**0**	**23**

Table 18 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth South. Year 1981

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	0			0						
Feb	0			0						
Mar	0			0						
Apr	0			0						
May	13	5.2	0.4	13	0	3	6	3	0	1
Jun	28	5.3	0.2	28	0	5	13	9	0	1
Jul	28	5.9	0.3	28	0	0	10	18	0	0
Aug	31	6.6	0.2	31	0	8	16	7	0	0
Sep	25	6.4	0.3	25	1	2	6	16	0	0
Oct	25	5.8	0.3	25	0	2	5	18	0	0
Nov	28	6.9	0.2	28	0	8	8	10	0	2
Dec	29	3.9	0.2	29	0	11	3	12	0	3
Whole Year	**207**	**5.8**	**0.3**	**207**	**1**	**39**	**67**	**93**	**0**	**7**

Table 19 Monthly and annual – mean wave height/mean wave period and wave direction occurrences. Seaforth South. Year 1982

Month	No. Observations	Mean Wave Period (s)	Mean Wave Height (m)	No of Obs.	Percentage occurences - wave direction (Sector)					
					1	2	3	4	5	Calm
Jan	27	4.2	0.3	27	0	8	2	17	0	0
Feb	19	4.1	0.3	19	0	1	8	10	0	0
Mar	0			0						
Apr	0			0						
May	0			0						
Jun	0			0						
Jul	0			0						
Aug	0			0						
Sep	0			0						
Oct	0			0						
Nov	0			0						
Dec	0			0						
Whole Year	**46**	**4.1**	**0.3**	**46**	**0**	**9**	**10**	**27**	**0**	**0**

6 Data Presentation

The data analysis for the Seaforth Beach COPE stations is presented in the following figures.

LEGEND

- COPE Station
- Rail
- Secondary Road
- Street/Local Road
- Private or Restricted Road
- Unconstructed Road
- Suburb

1:100,000 @ A4

0 750 1,500 2,250 3,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Department of Science, Innovation Technology and Innovation
Seaforth COPE sites

Job Number 41-28646
Revision A
Date 06 May 2015

Locality Plan

Figure 10 Seaforth Beach COPE Site Plan

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145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: GHD: Cope Station (2015); DNRM: Rail; Major Watercourse (2014) Baseline Roads (2015); ABS: Suburb Boundaries (2014); Google Earth Pro: Imagery (Extracted 01/04/15). Created by: CW

LEGEND

- COPE Station
- Major Watercourses
- Railway
- Suburb
- Street/Local Road
- Unconstructed Road

1:10,771 @ A4

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Department of Science, Innovation Technology and Innovation
Seaforth North COPE Site

Job Number 41-28646
Revision A
Date 05 May 2015

Site Plan

Figure 11 Seaforth Beach COPE Locality Plan

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145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: GHD: Cope Station (2015); DNRM: Rail; Major Watercourse (2014) Baseline Roads (2015); ABS: Suburb Boundaries (2014); Google Earth Pro: Imagery (Extracted 01/04/15). Created by: CW

LEGEND

- COPE Station
- Major Watercourses
- Secondary Road
- Street/Local Road
- Unconstructed Road
- Railway
- Suburb

1:10,000 @ A4

0 100 200 300 400

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Department of Science, Innovation Technology and Innovation
Seaforth South COPE site

Job Number 41-28646
Revision A
Date 06 May 2015

Site Plan

Figure 12 Seaforth Beach COPE Locality Plan 2

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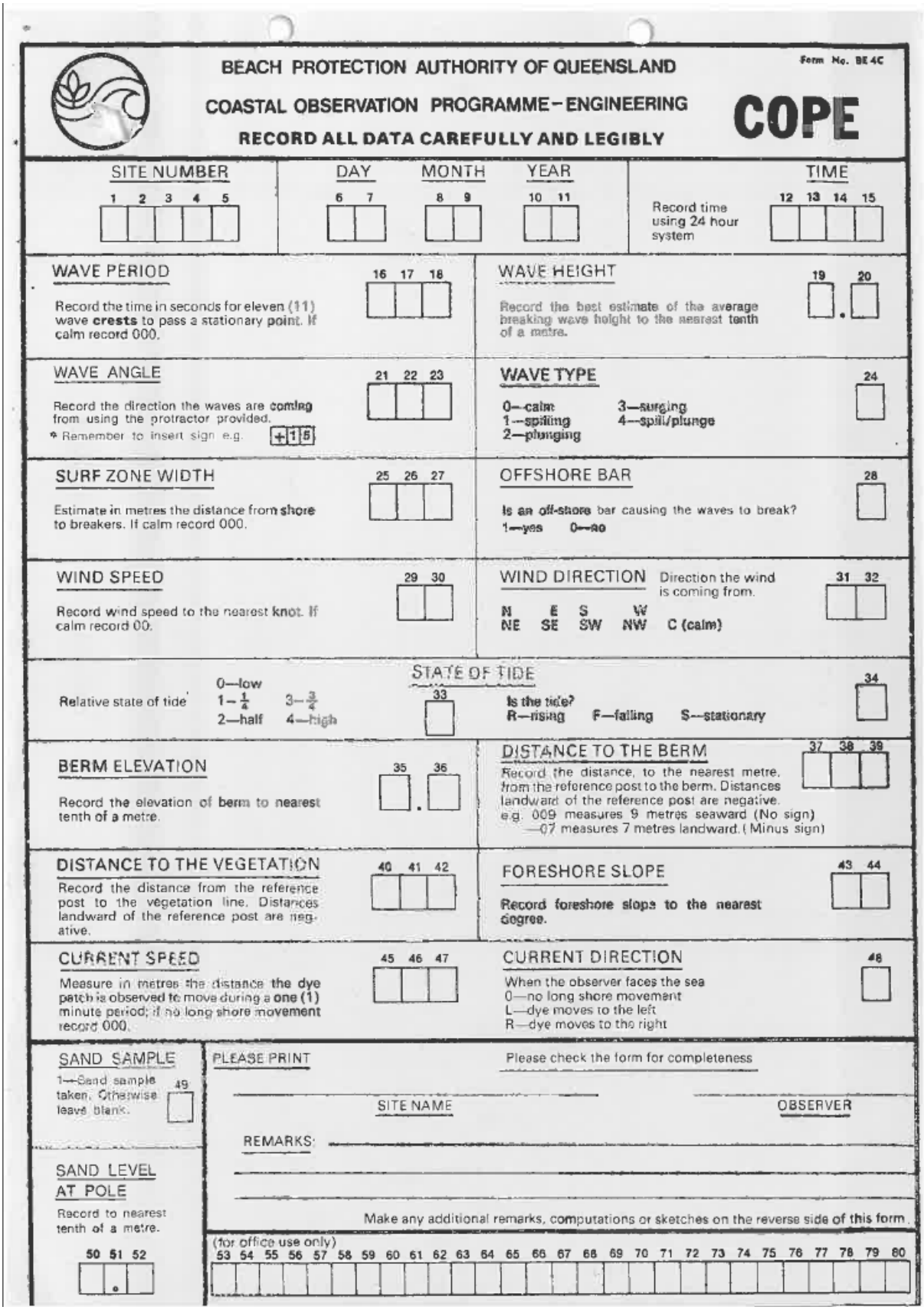
145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: GHD: Cope Station (2015); DNRM: Rail; Major Watercourse (2014) Baseline Roads (2015); ABS: Suburb Boundaries (2014); Google Earth Pro: Imagery (Extracted 01/04/15). Created by: CW



BEACH PROTECTION AUTHORITY OF QUEENSLAND

Form No. BE 4C

COASTAL OBSERVATION PROGRAMME – ENGINEERING

COPE

RECORD ALL DATA CAREFULLY AND LEGIBLY

SITE NUMBER (1 2 3 4 5) | DAY (6 7) | MONTH (8 9) | YEAR (10 11) | TIME (12 13 14 15) — Record time using 24 hour system

WAVE PERIOD (16 17 18) — Record the time in seconds for eleven (11) wave **crests** to pass a stationary point. If calm record 000.

WAVE HEIGHT (19 . 20) — Record the best estimate of the average breaking wave height to the nearest tenth of a metre.

WAVE ANGLE (21 22 23) — Record the direction the waves are **coming** from using the protractor provided.
* Remember to insert sign e.g. +15

WAVE TYPE (24)
0—calm
1—spilling
2—plunging
3—surging
4—spill/plunge

SURF ZONE WIDTH (25 26 27) — Estimate in metres the distance from **shore** to breakers. If calm record 000.

OFFSHORE BAR (28) — **Is an off-shore** bar causing the waves to break?
1—yes 0—no

WIND SPEED (29 30) — Record wind speed to the nearest knot. If calm record 00.

WIND DIRECTION (31 32) — Direction the wind is coming from.
N E S W
NE SE SW NW C (calm)

STATE OF TIDE

Relative state of tide (33)
0—low
1—¼
2—half
3—¾
4—high

Is the tide? (34)
R—rising F—falling S—stationary

BERM ELEVATION (35 . 36) — Record the elevation of berm to nearest tenth of a metre.

DISTANCE TO THE BERM (37 38 39) — Record the distance, to the nearest metre, from the reference post to the berm. Distances landward of the reference post are negative.
e.g. 009 measures 9 metres seaward (No sign)
—07 measures 7 metres landward. (Minus sign)

DISTANCE TO THE VEGETATION (40 41 42) — Record the distance from the reference post to the vegetation line. Distances landward of the reference post are negative.

FORESHORE SLOPE (43 44) — **Record foreshore slope to the nearest degree.**

CURRENT SPEED (45 46 47) — Measure in metres the distance **the dye** patch is observed to move during a **one (1)** minute period; if no long shore movement record 000.

CURRENT DIRECTION (48) — When the observer faces the sea
0—no long shore movement
L—dye moves to the left
R—dye moves to the right

SAND SAMPLE (49) — 1—Sand sample taken. Otherwise leave blank.

PLEASE PRINT

Please check the form for completeness

SITE NAME

OBSERVER

REMARKS:

SAND LEVEL AT POLE (50 51 52) — Record to nearest tenth of a metre.

Make any additional remarks, computations or sketches on the reverse side of this form.

(for office use only) (53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80)

Figure 13 COPE Recording Sheet – Old Format, Page 1

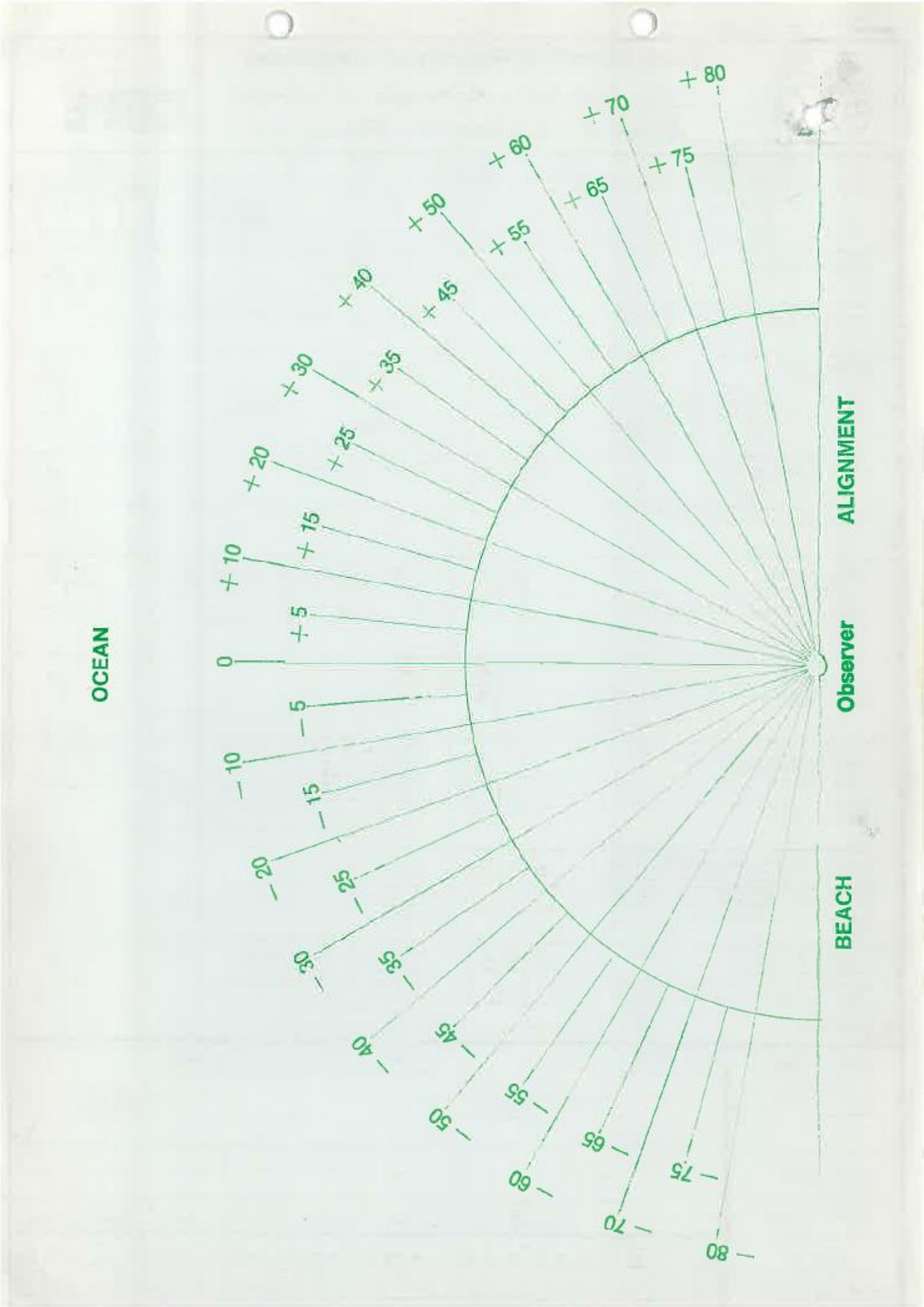
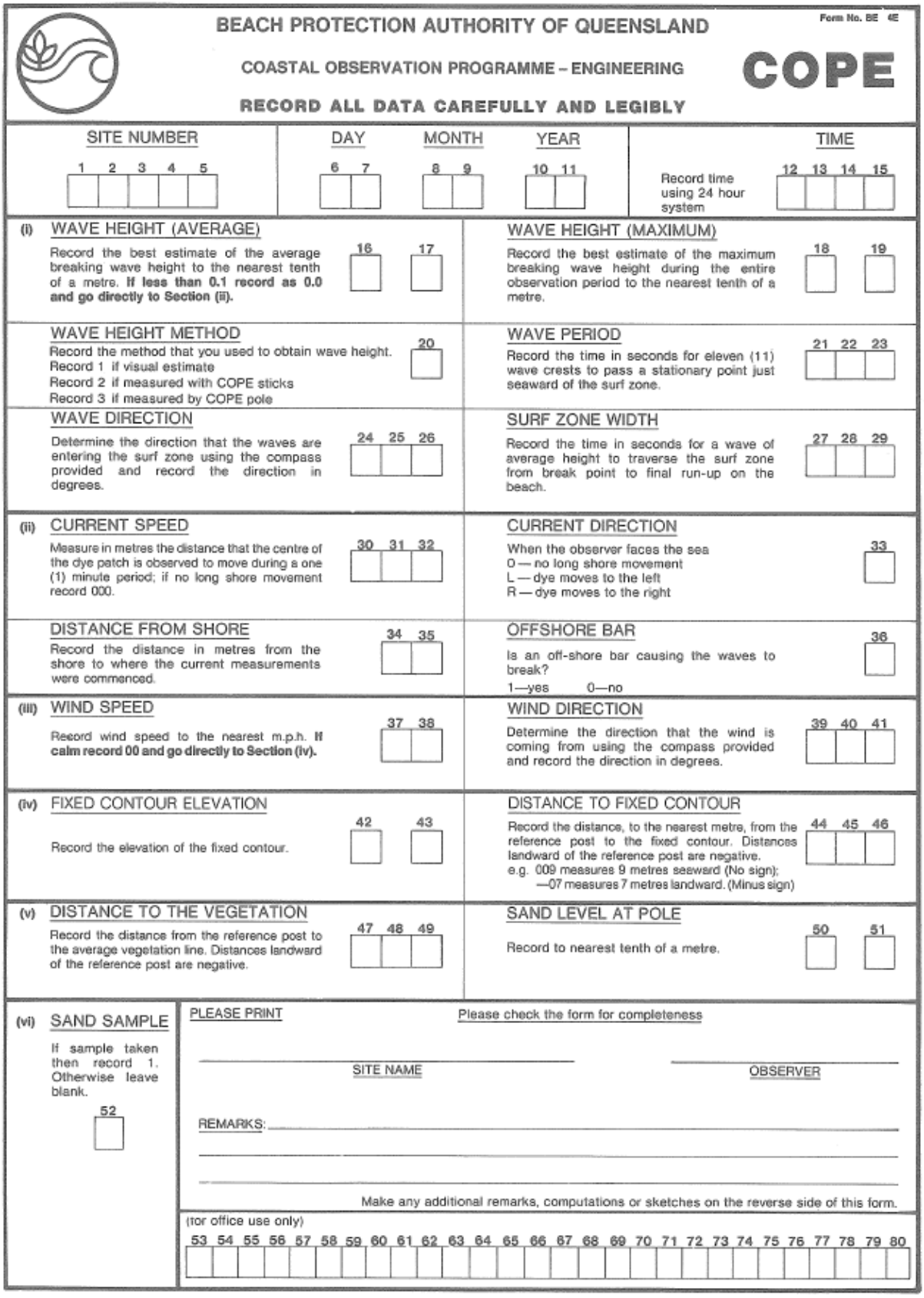


Figure 14 COPE Recording Sheet – Old Format, Page 2



BEACH PROTECTION AUTHORITY OF QUEENSLAND

Form No. BE 4E

COASTAL OBSERVATION PROGRAMME – ENGINEERING

COPE

RECORD ALL DATA CAREFULLY AND LEGIBLY

SITE NUMBER (1 2 3 4 5) | DAY (6 7) | MONTH (8 9) | YEAR (10 11) | TIME (Record time using 24 hour system) (12 13 14 15)

(i) WAVE HEIGHT (AVERAGE)
Record the best estimate of the average breaking wave height to the nearest tenth of a metre. **If less than 0.1 record as 0.0 and go directly to Section (ii).** (16 17)

WAVE HEIGHT (MAXIMUM)
Record the best estimate of the maximum breaking wave height during the entire observation period to the nearest tenth of a metre. (18 19)

WAVE HEIGHT METHOD
Record the method that you used to obtain wave height. (20)
Record 1 if visual estimate
Record 2 if measured with COPE sticks
Record 3 if measured by COPE pole

WAVE PERIOD
Record the time in seconds for eleven (11) wave crests to pass a stationary point just seaward of the surf zone. (21 22 23)

WAVE DIRECTION
Determine the direction that the waves are entering the surf zone using the compass provided and record the direction in degrees. (24 25 26)

SURF ZONE WIDTH
Record the time in seconds for a wave of average height to traverse the surf zone from break point to final run-up on the beach. (27 28 29)

(ii) CURRENT SPEED
Measure in metres the distance that the centre of the dye patch is observed to move during a one (1) minute period; if no long shore movement record 000. (30 31 32)

CURRENT DIRECTION
When the observer faces the sea (33)
O — no long shore movement
L — dye moves to the left
R — dye moves to the right

DISTANCE FROM SHORE
Record the distance in metres from the shore to where the current measurements were commenced. (34 35)

OFFSHORE BAR
Is an off-shore bar causing the waves to break? (36)
1—yes 0—no

(iii) WIND SPEED
Record wind speed to the nearest m.p.h. **If calm record 00 and go directly to Section (iv).** (37 38)

WIND DIRECTION
Determine the direction that the wind is coming from using the compass provided and record the direction in degrees. (39 40 41)

(iv) FIXED CONTOUR ELEVATION
Record the elevation of the fixed contour. (42 43)

DISTANCE TO FIXED CONTOUR
Record the distance, to the nearest metre, from the reference post to the fixed contour. Distances landward of the reference post are negative. (44 45 46)
e.g. 009 measures 9 metres seaward (No sign);
—07 measures 7 metres landward. (Minus sign)

(v) DISTANCE TO THE VEGETATION
Record the distance from the reference post to the average vegetation line. Distances landward of the reference post are negative. (47 48 49)

SAND LEVEL AT POLE
Record to nearest tenth of a metre. (50 51)

(vi) SAND SAMPLE
If sample taken then record 1. Otherwise leave blank. (52)

PLEASE PRINT — Please check the form for completeness

SITE NAME _____ OBSERVER _____

REMARKS: _____

Make any additional remarks, computations or sketches on the reverse side of this form.

(for office use only) (53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80)

Figure 15 COPE Recording Sheet – New Format, Page 1

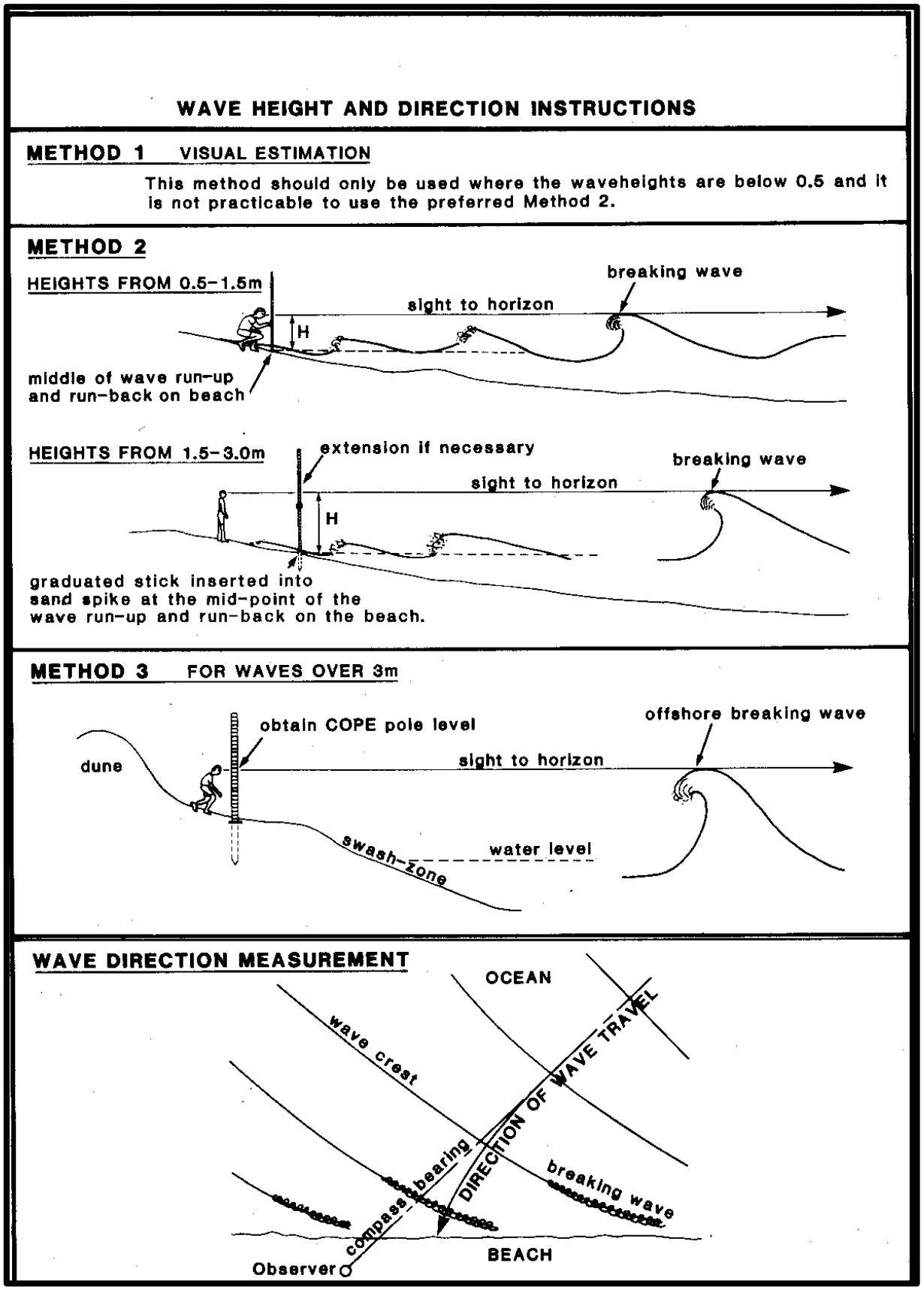


Figure 16 COPE Recording Sheet – New Format, Page 2

Wind Rose – Seaforth North

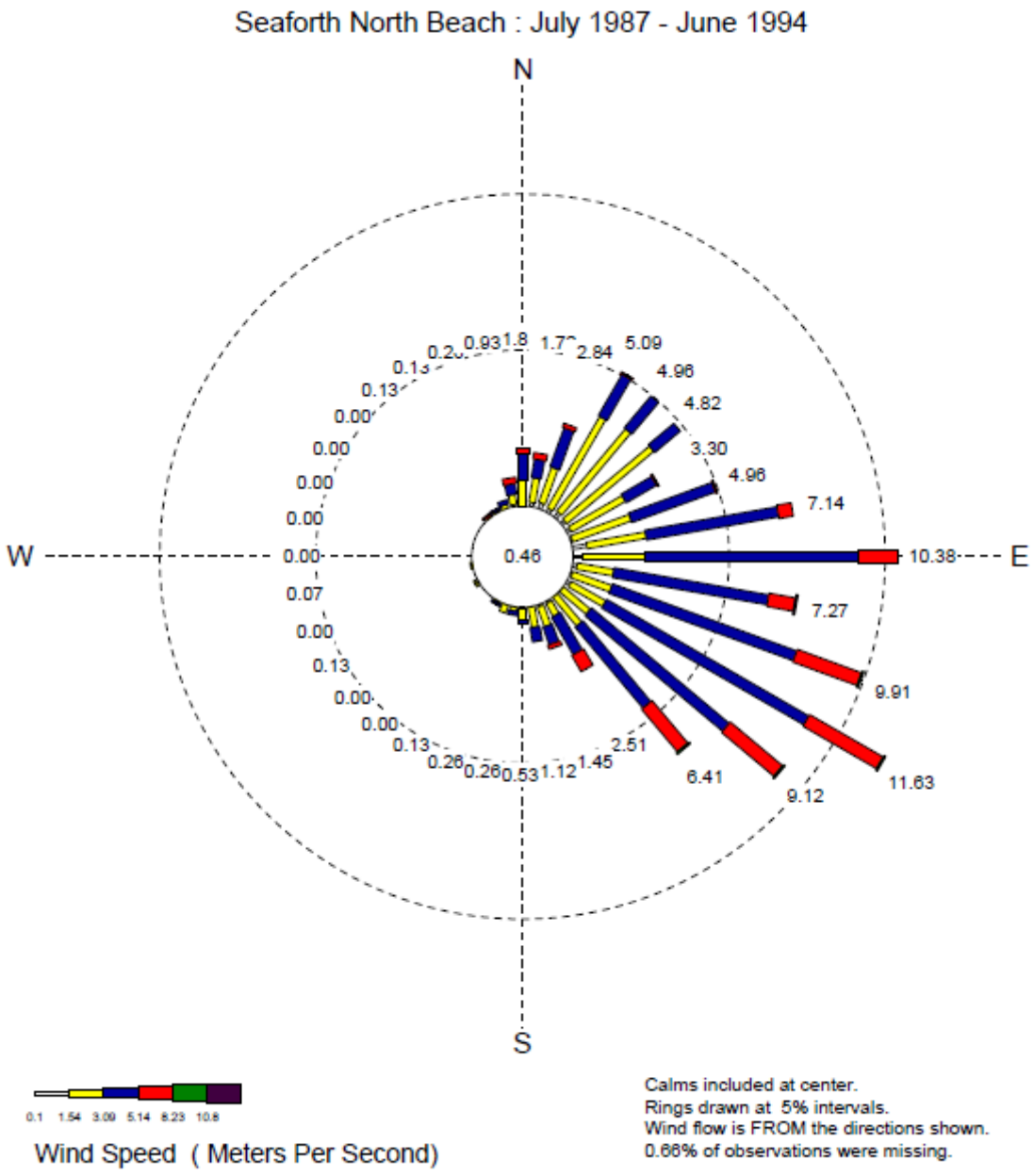


Figure 17 Wind Rose Diagram – Seaforth North

Wind Rose – Seaforth South

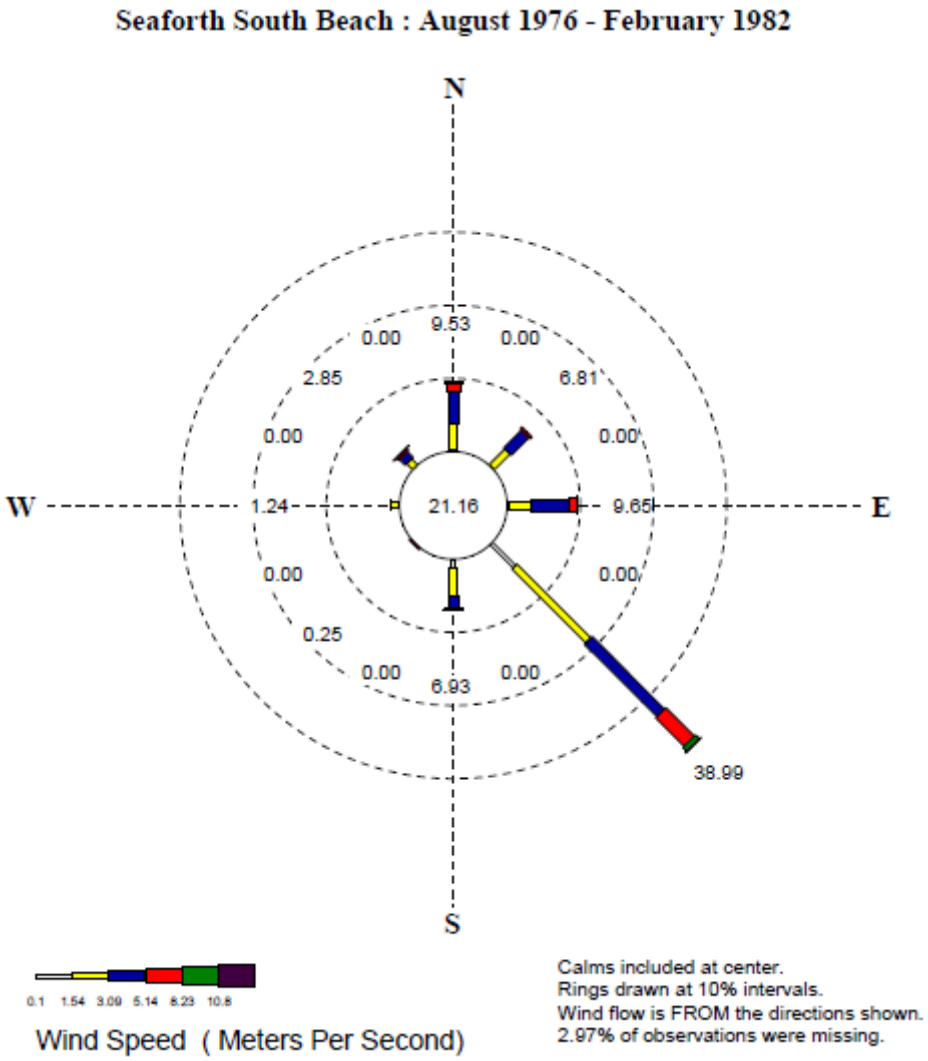


Figure 18 Wind Rose Diagram – Seaforth Beach South

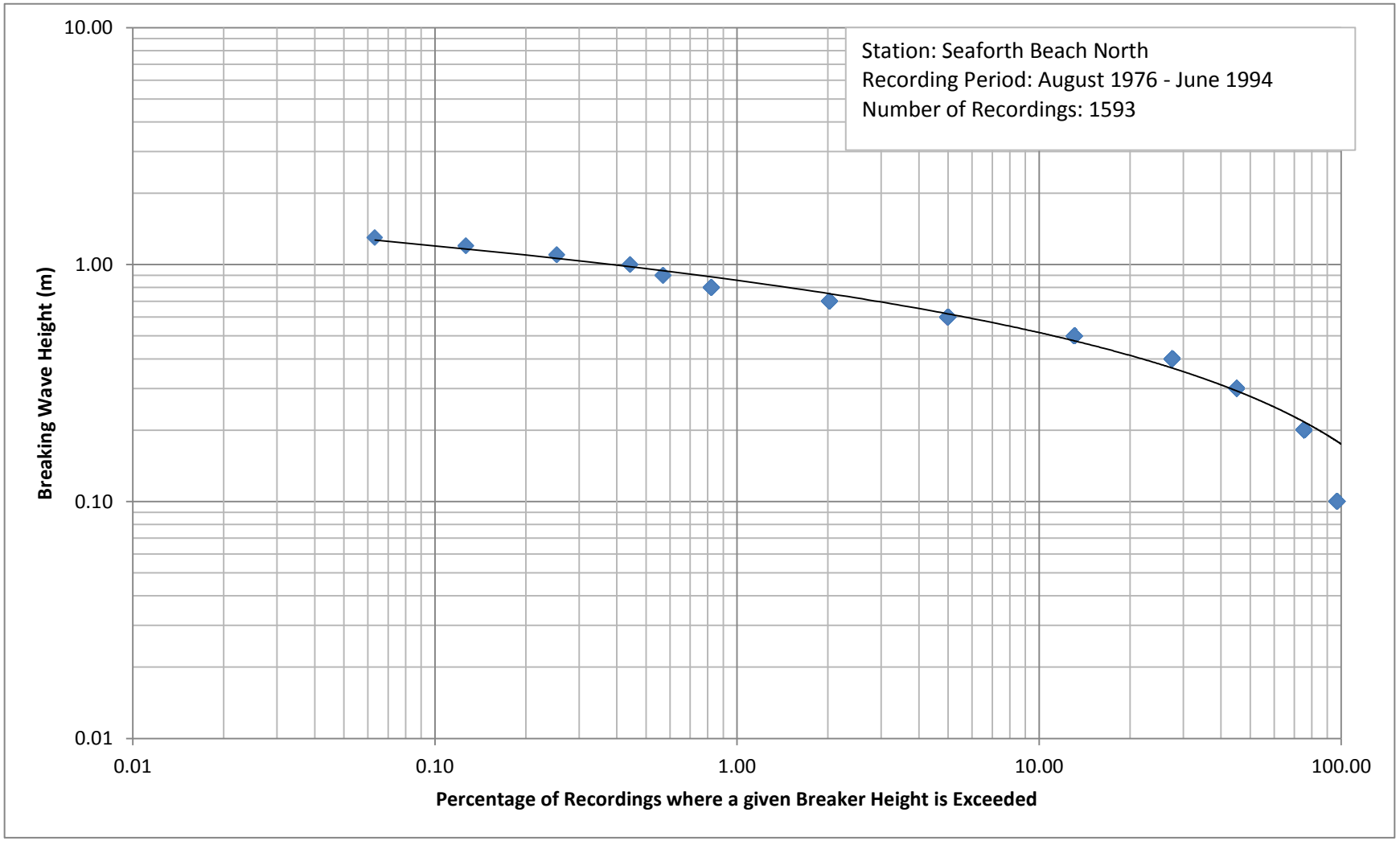


Figure 19 Wave height percentage exceedance – Seaforth North

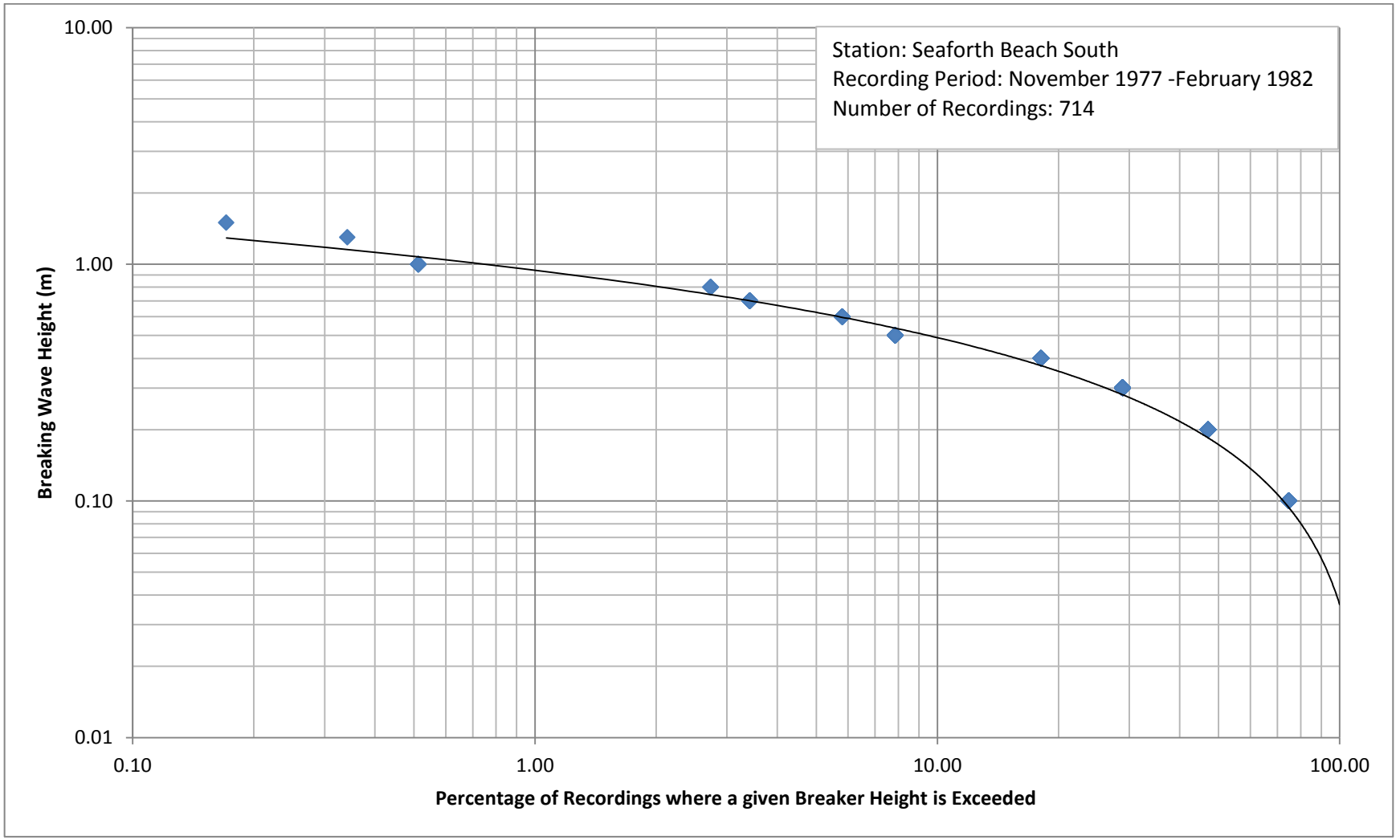


Figure 20 Wave height percentage exceedance – Seaforth South

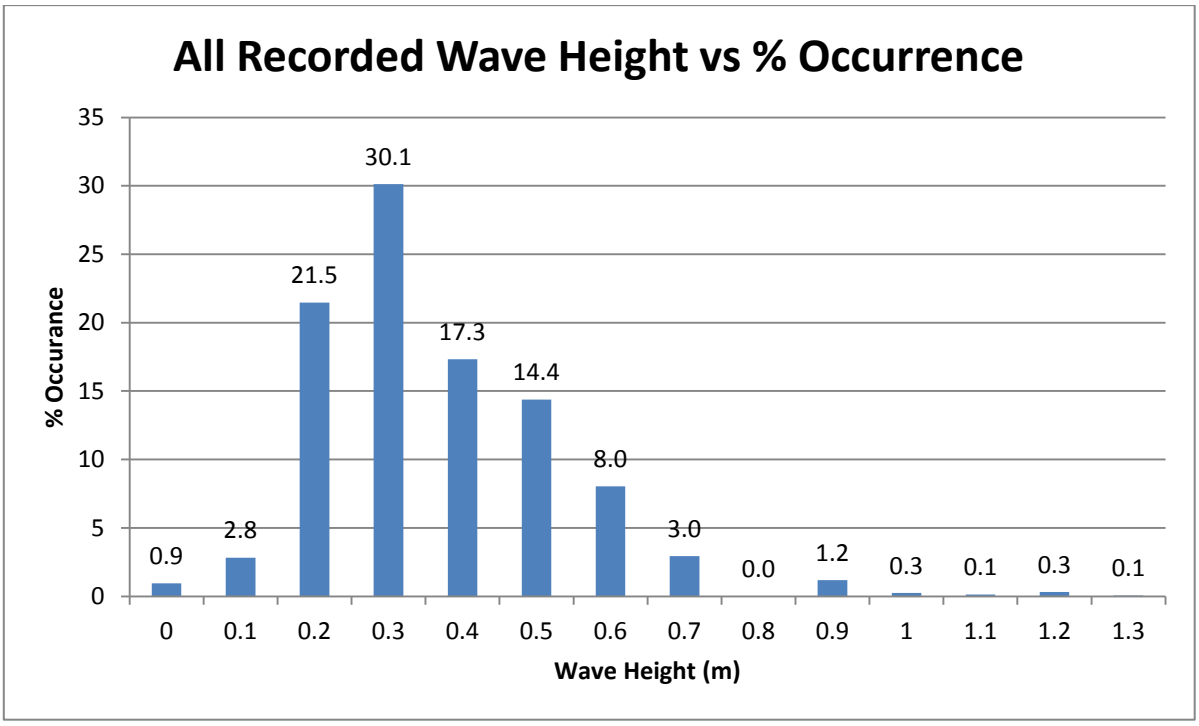


Figure 21 North Site - Wave Height Occurrence Aug 76 – June 94

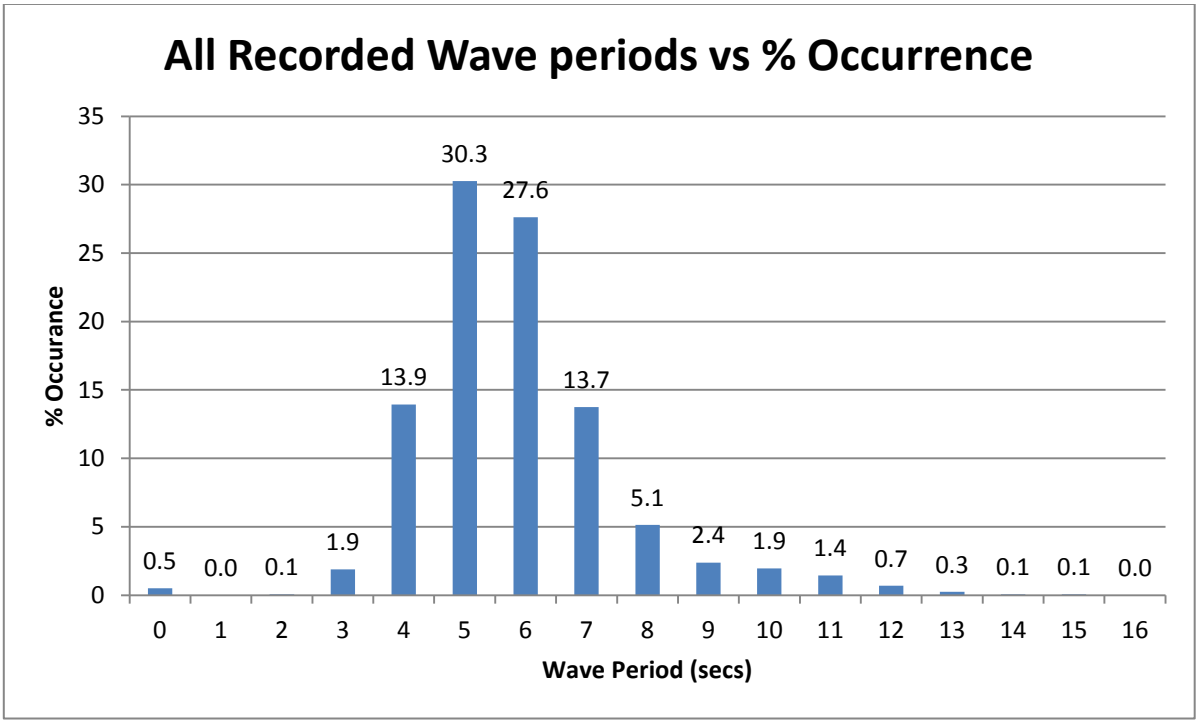


Figure 22 North Site - Wave Period Occurrence Aug 76 – June 94

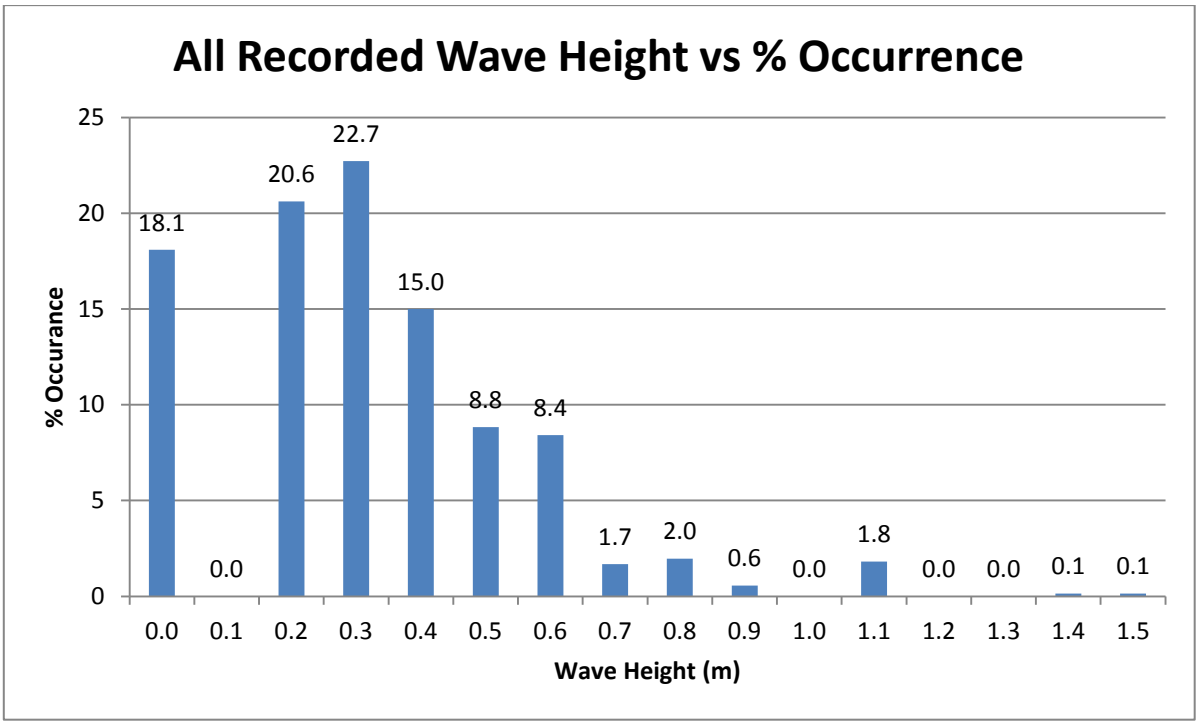


Figure 23 South Site - Wave Height Occurrence Nov 77 – Feb 82

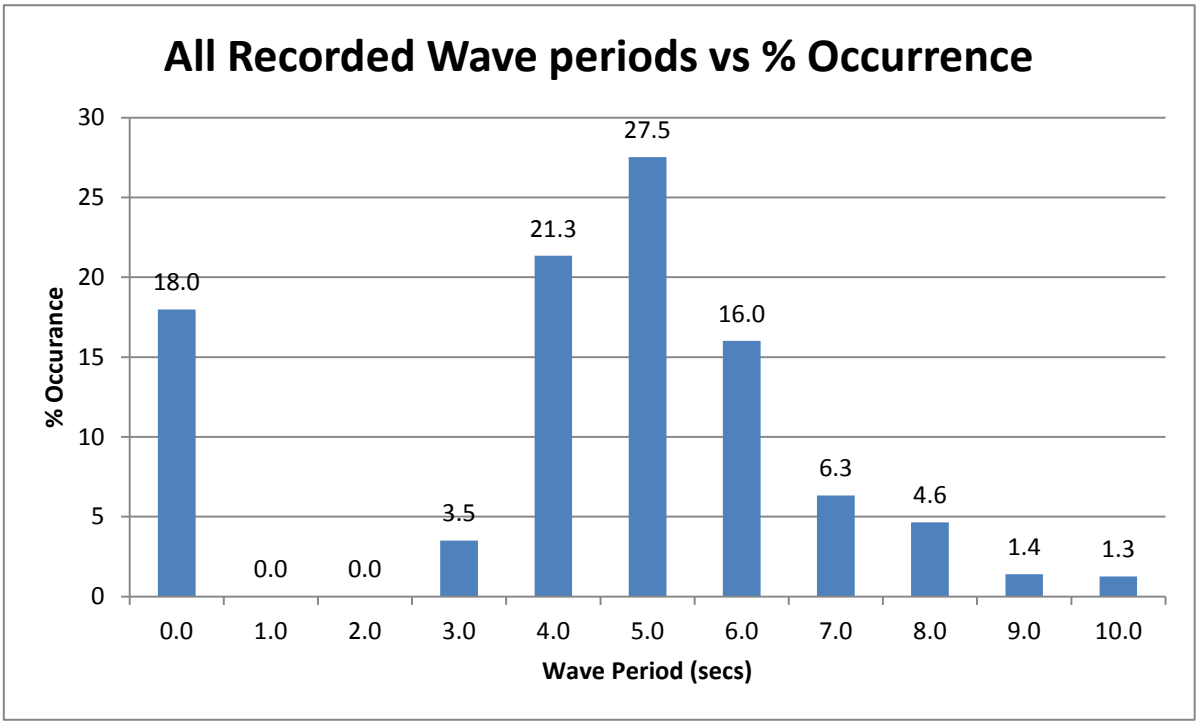


Figure 24 South Site - Wave Period Occurrence Nov 77 – Feb 82

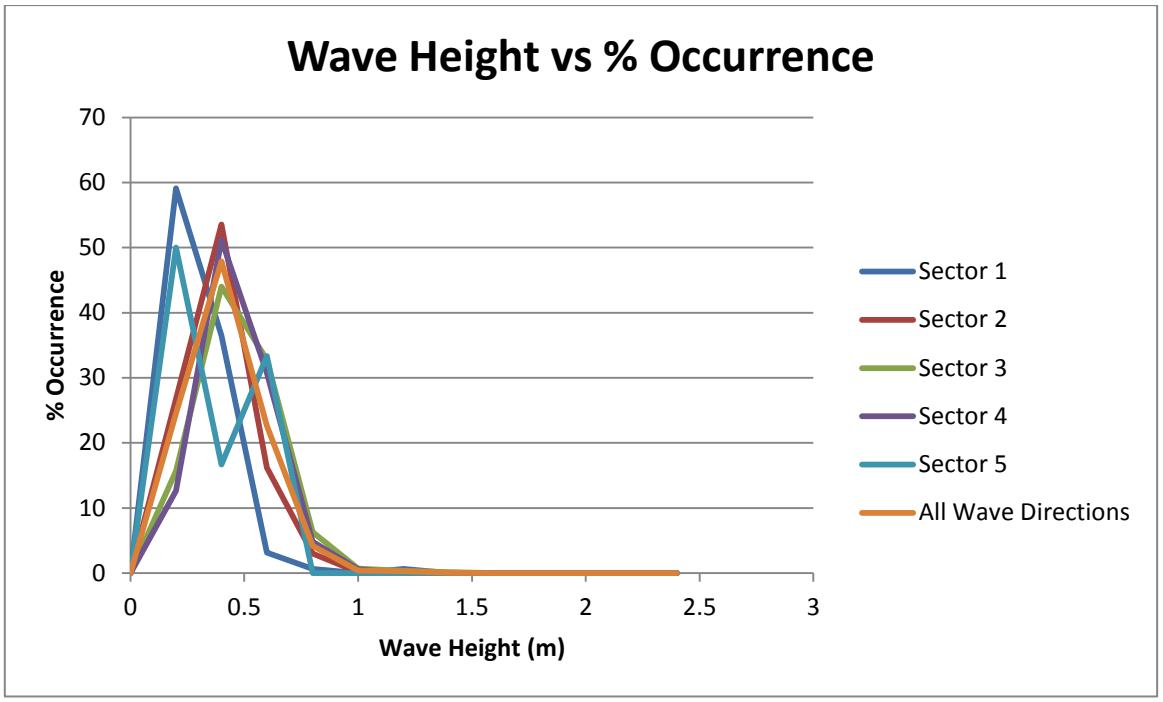


Figure 25 **North Site - Wave Height by Direction Aug 76 – Jun 94**

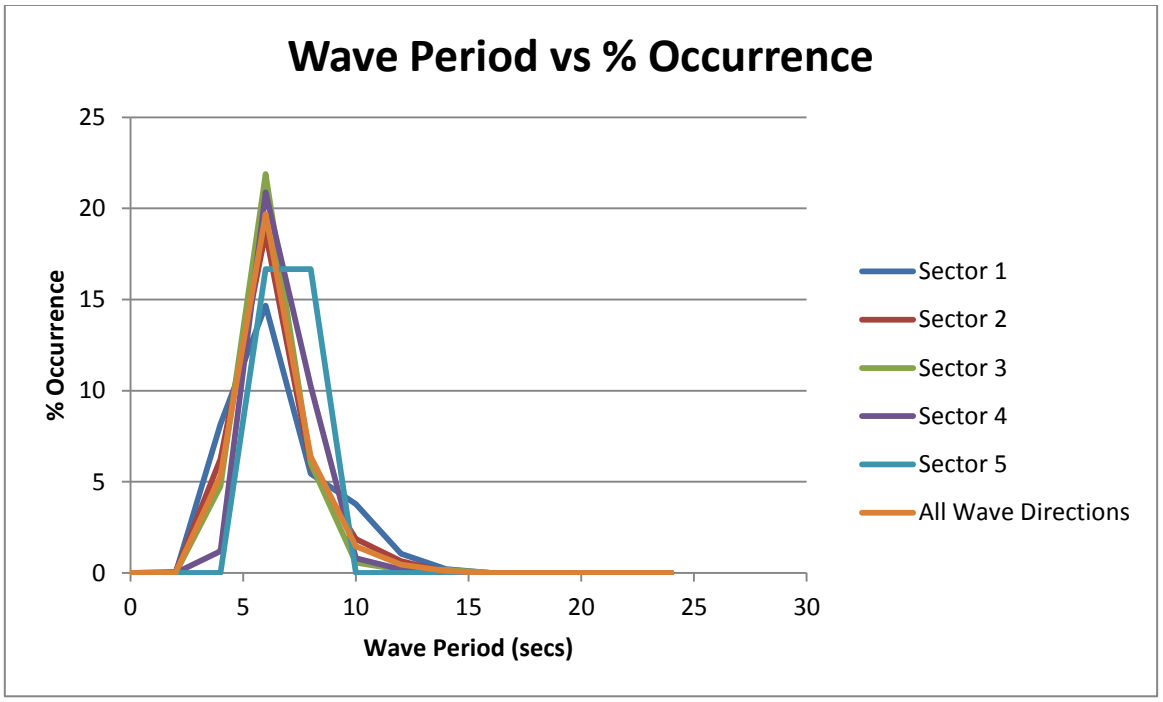


Figure 26 **North Site - Wave Period by Direction Aug 76 – Jun 94**

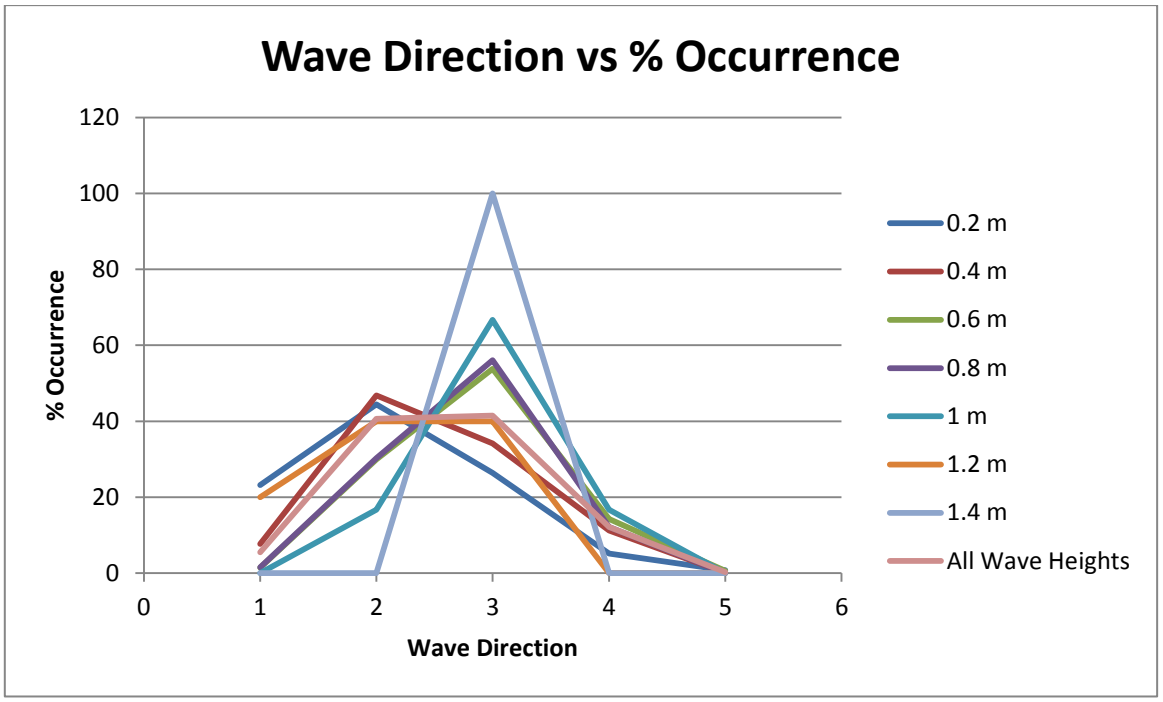


Figure 27 North Site - Wave Direction Occurrence Aug 76 – Jun 94

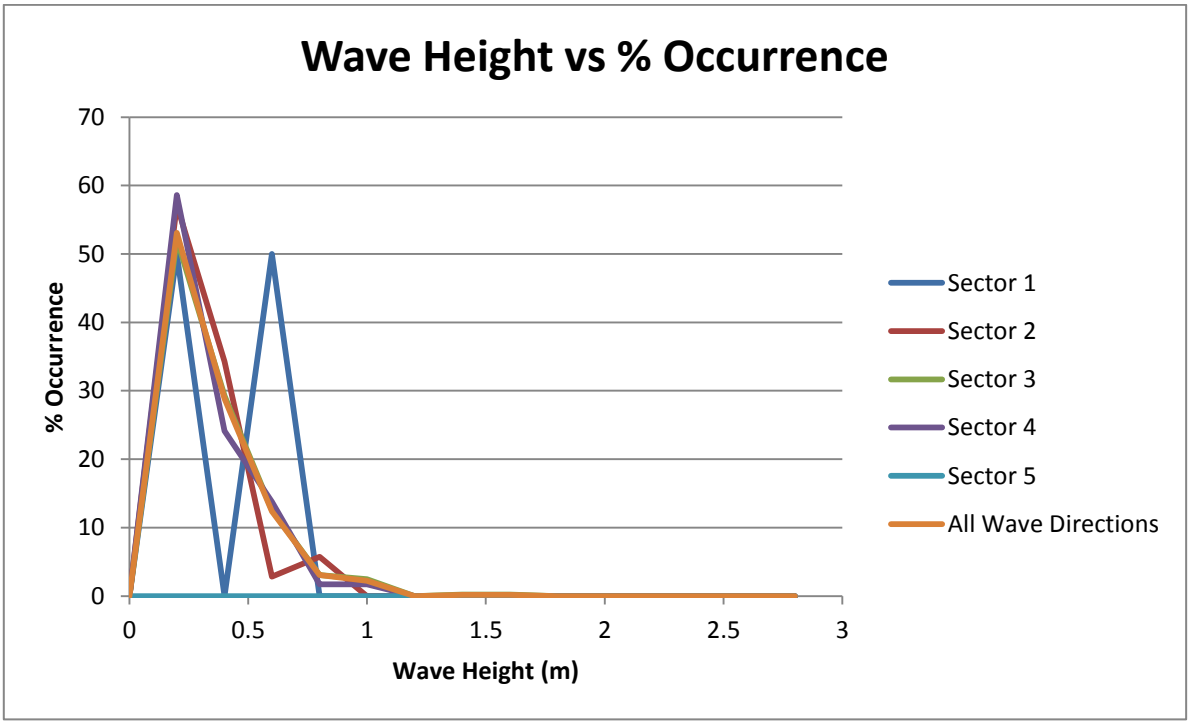


Figure 28 South Site - Wave Height by Direction Nov 77 – Feb 82

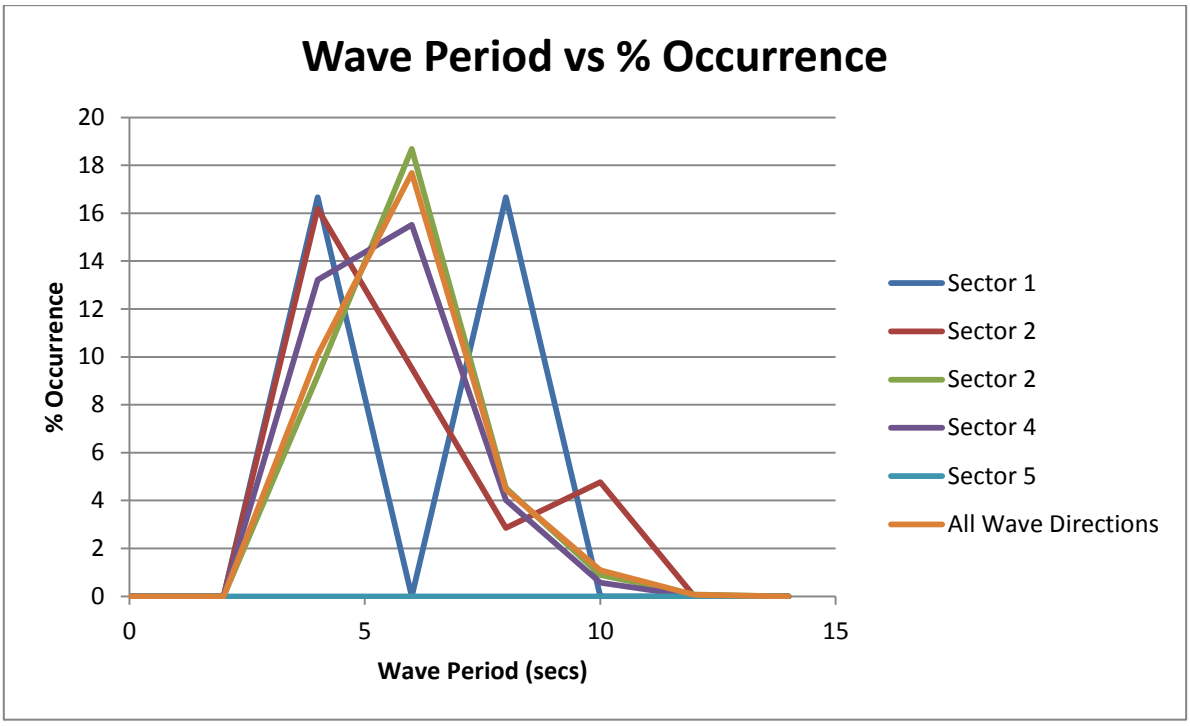


Figure 29 **South Site - Wave Period by Direction Nov 77 – Feb 82**

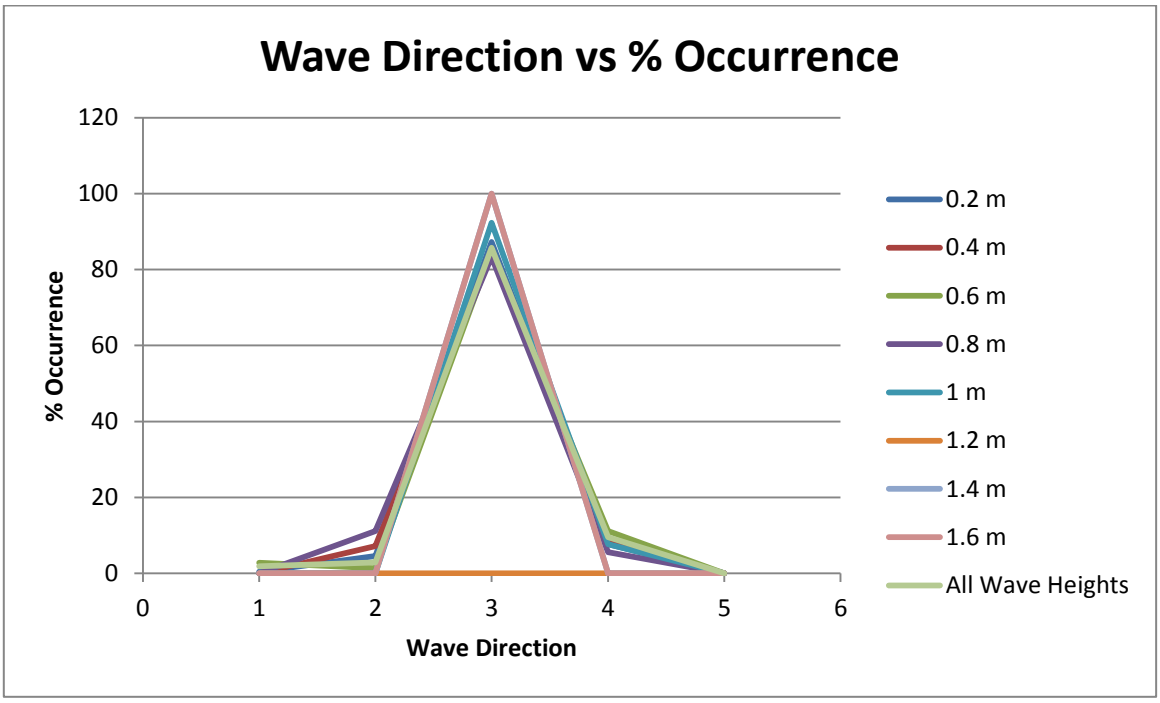


Figure 30 **South Site - Wave Direction Occurrence Nov 77 – Feb 82**

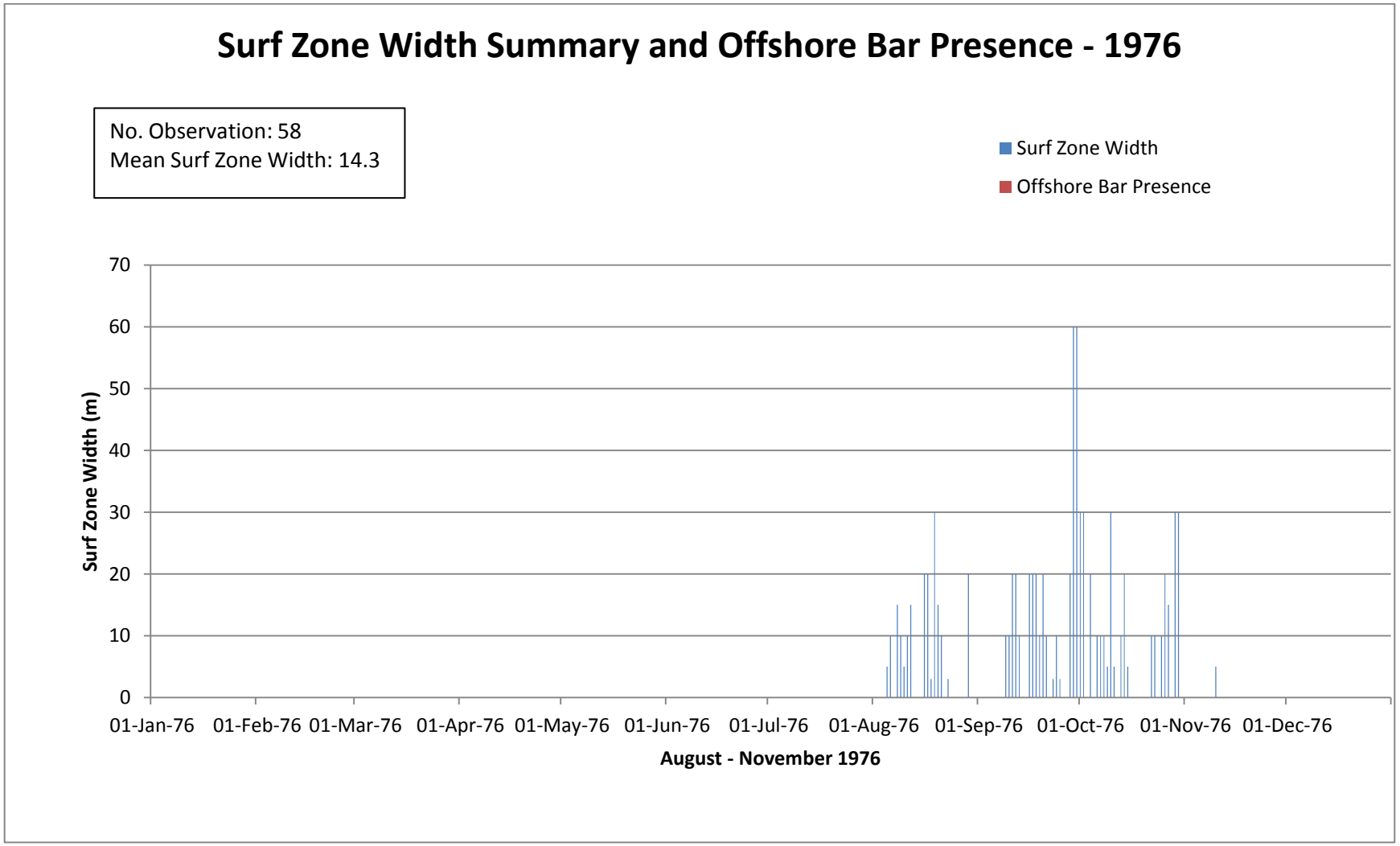


Figure 31 North Site - Surf Zone Width - 1976

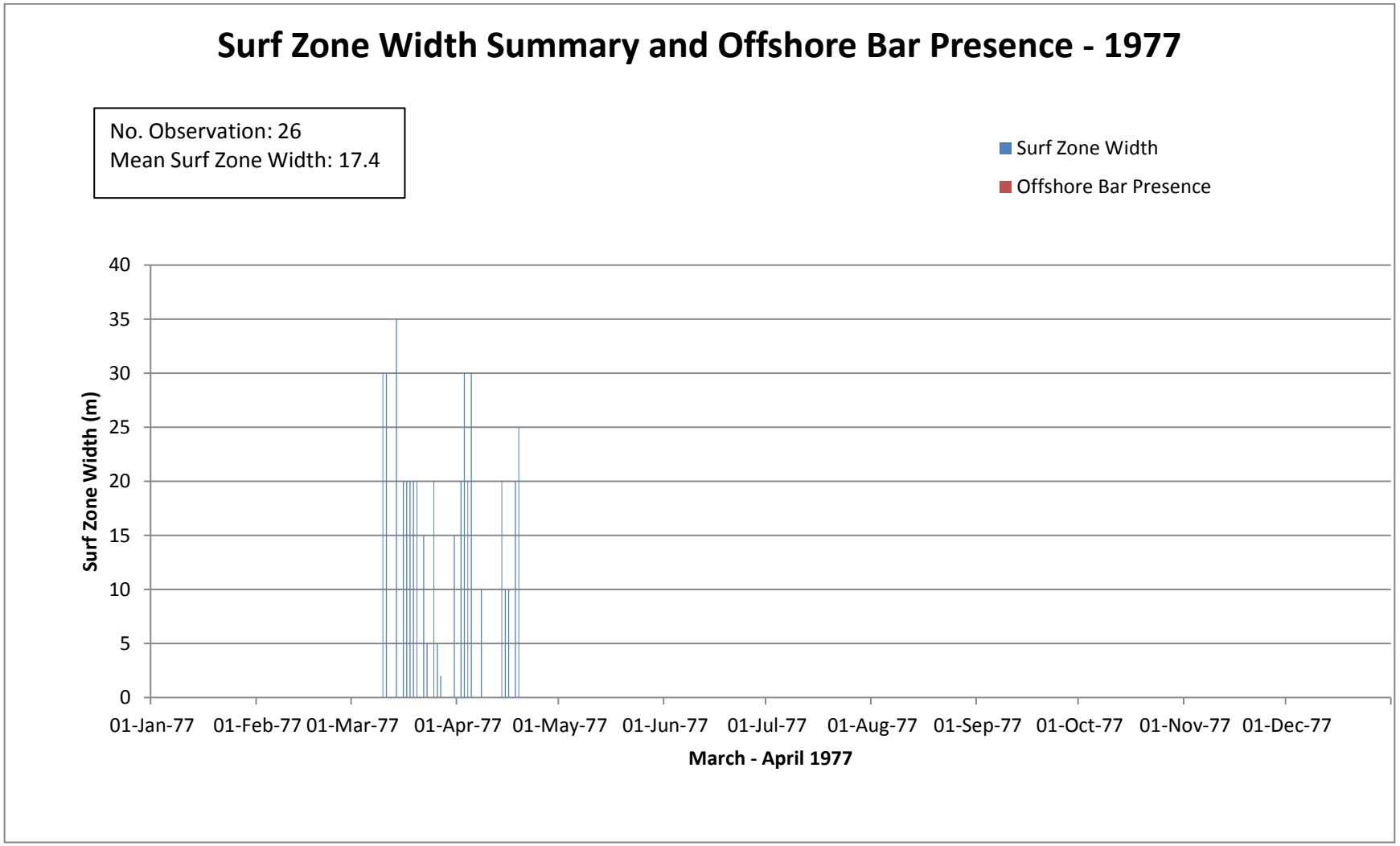


Figure 32 North Site - Surf Zone Width - 1977

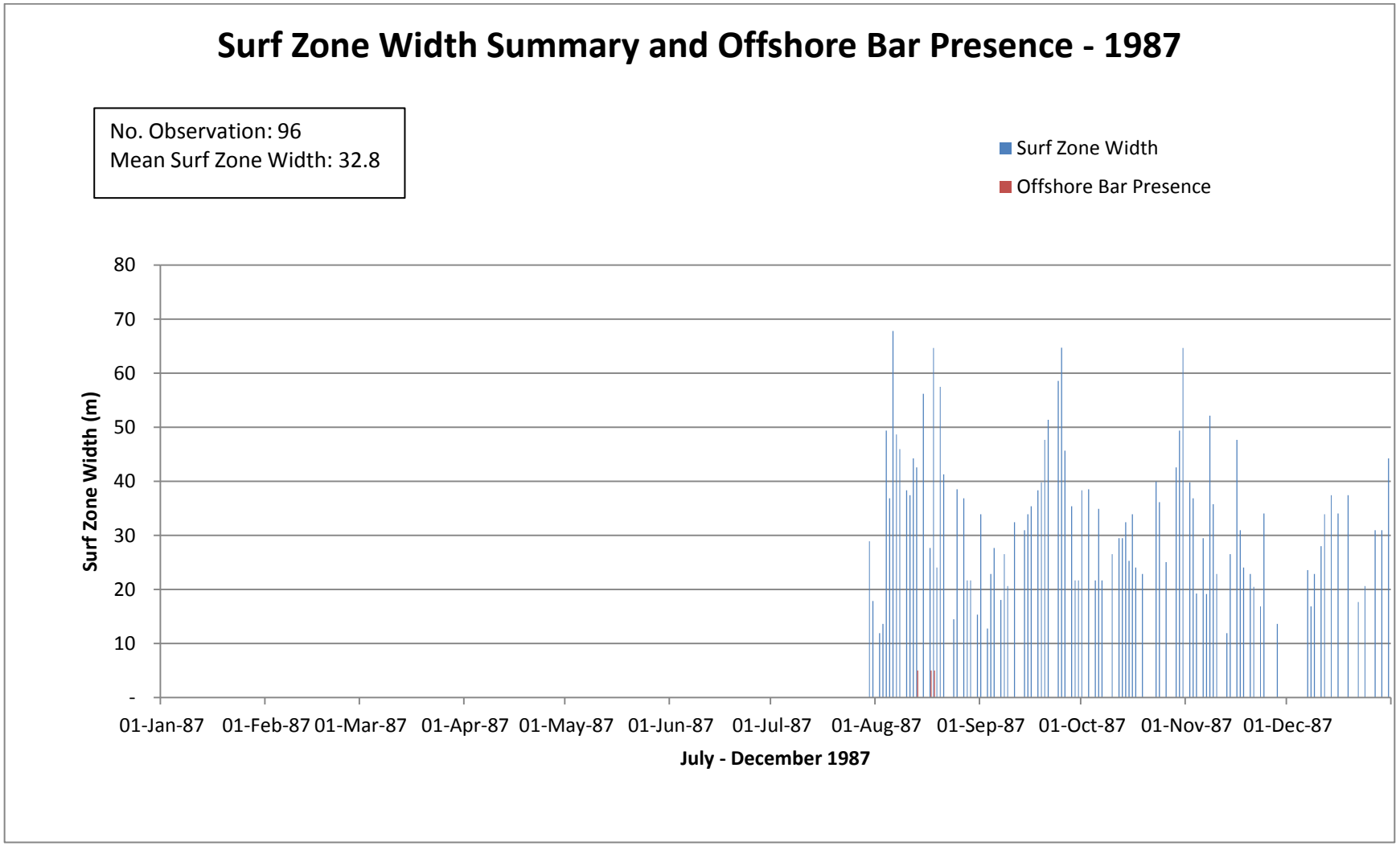


Figure 33 North Site - Surf Zone Width - 1987

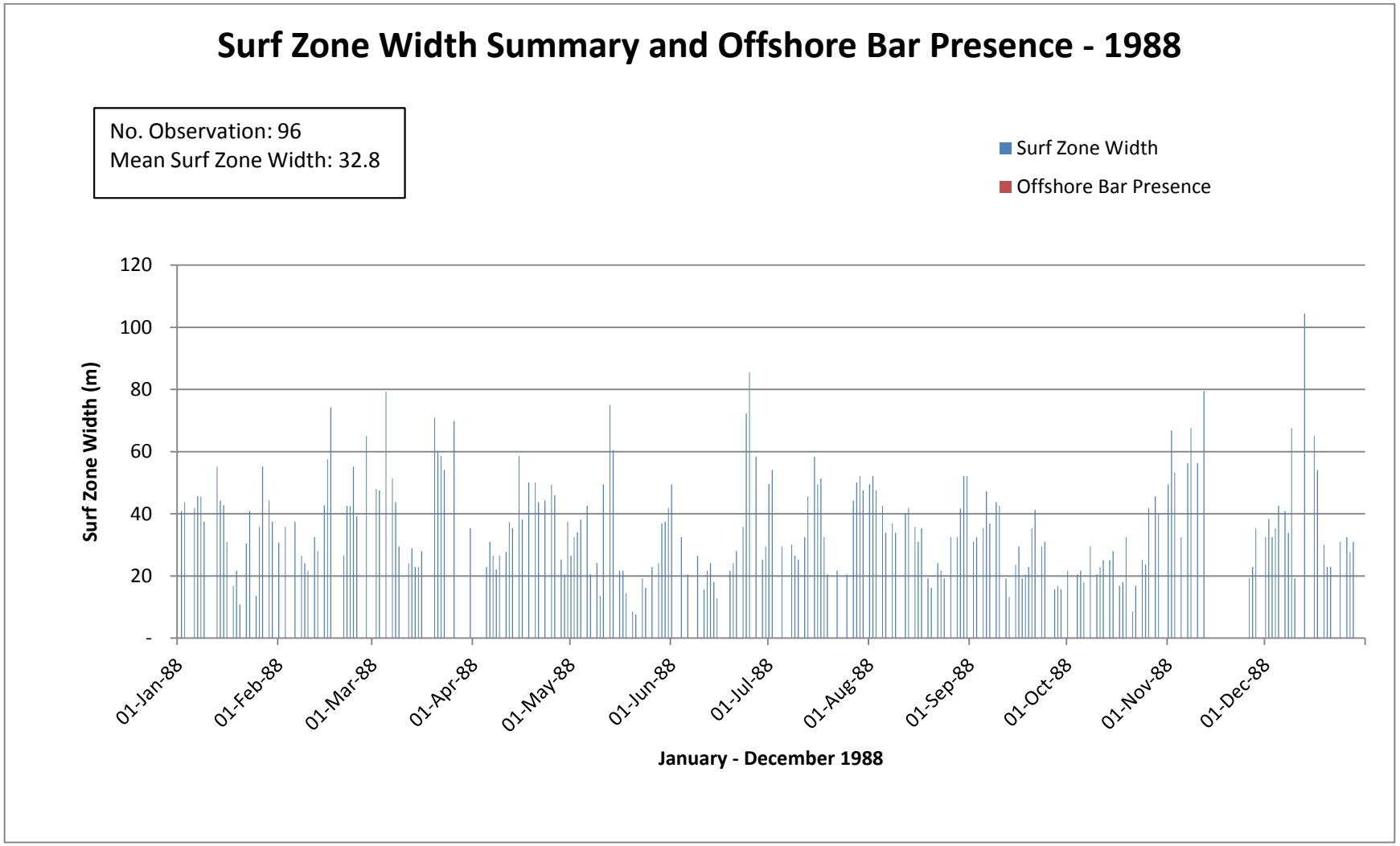


Figure 34 North Site - Surf Zone Width - 1988

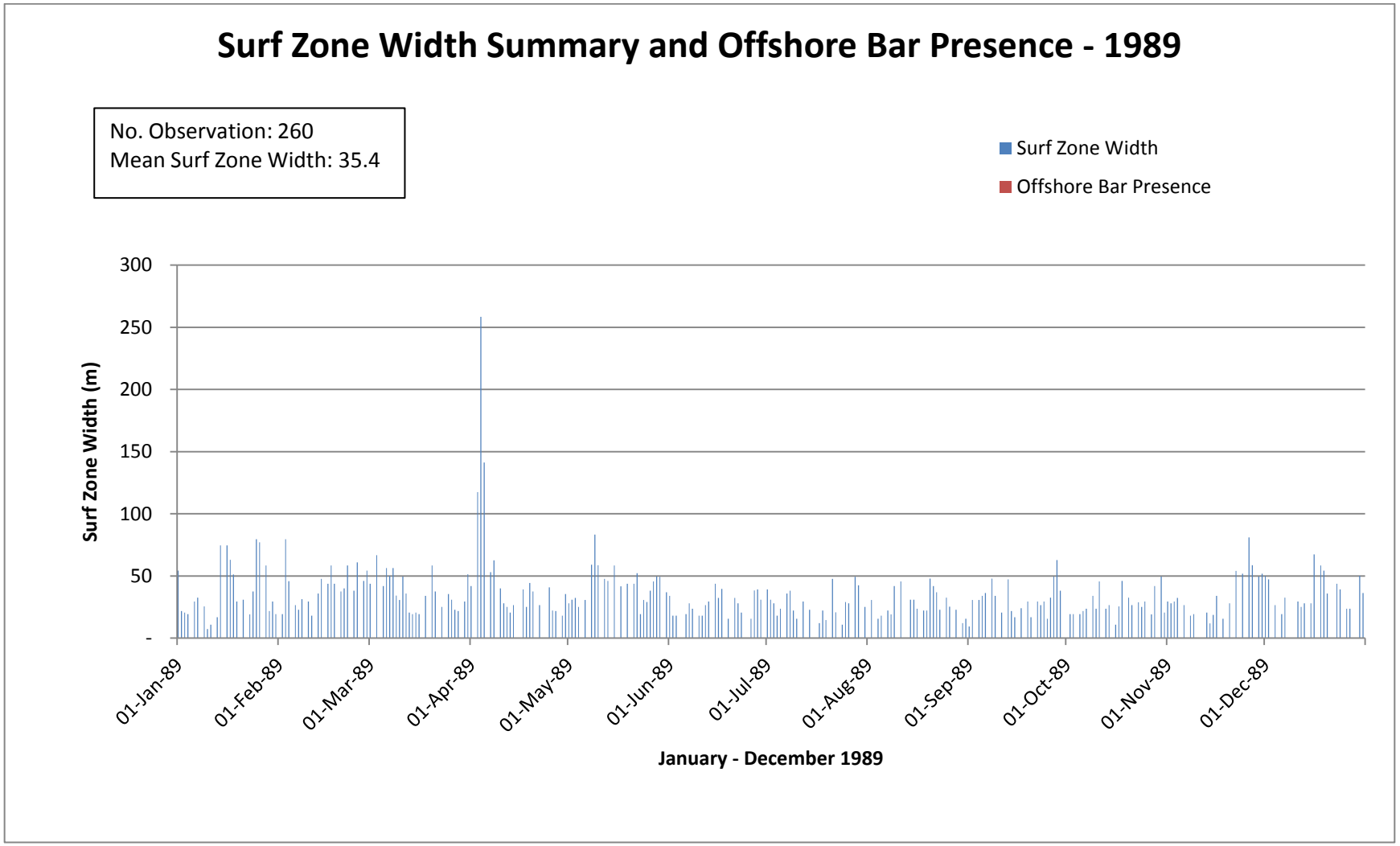


Figure 35 North Site - Surf Zone Width - 1989

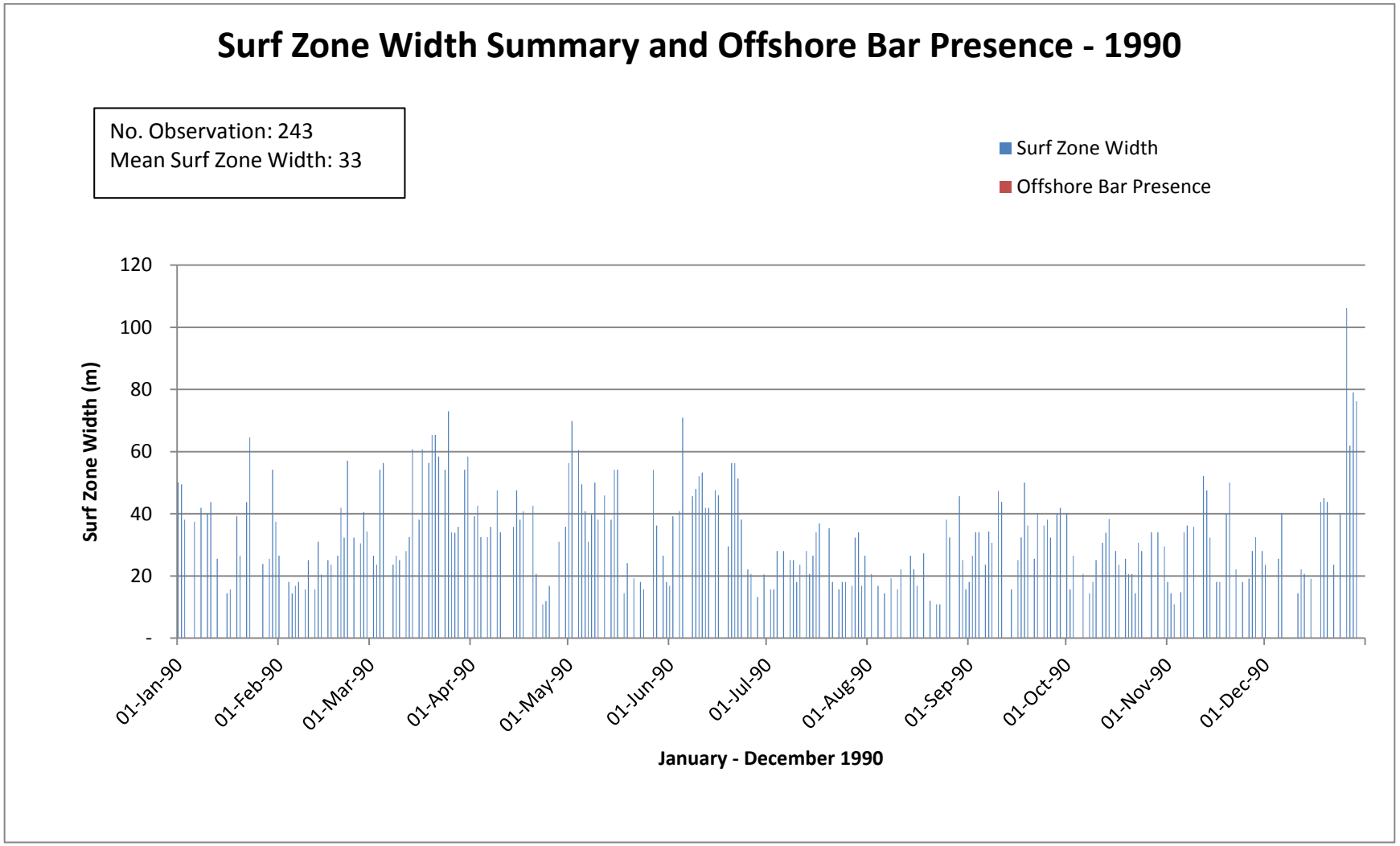


Figure 36 North Site - Surf Zone Width - 1990

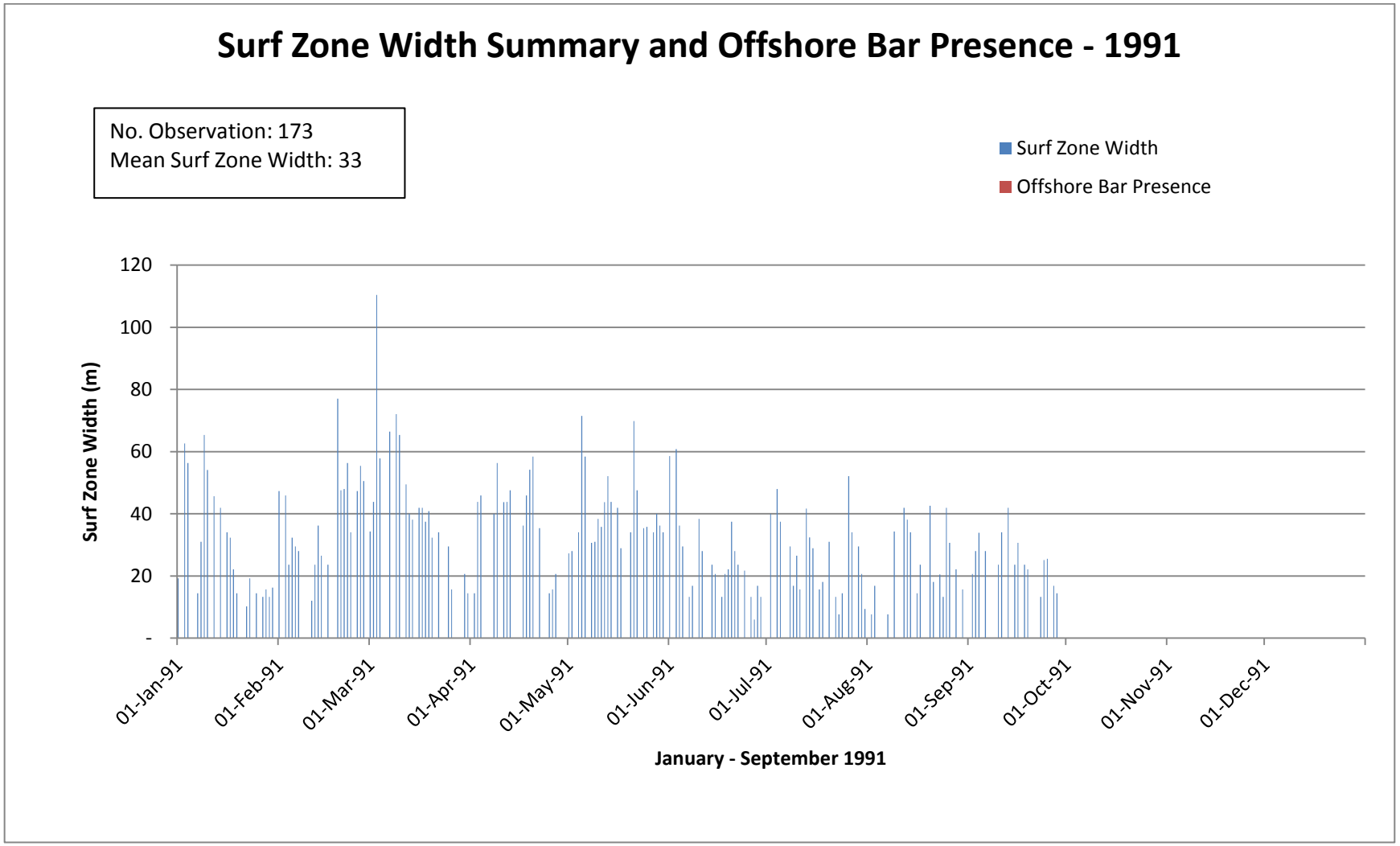


Figure 37 North Site - Surf Zone Width - 1991

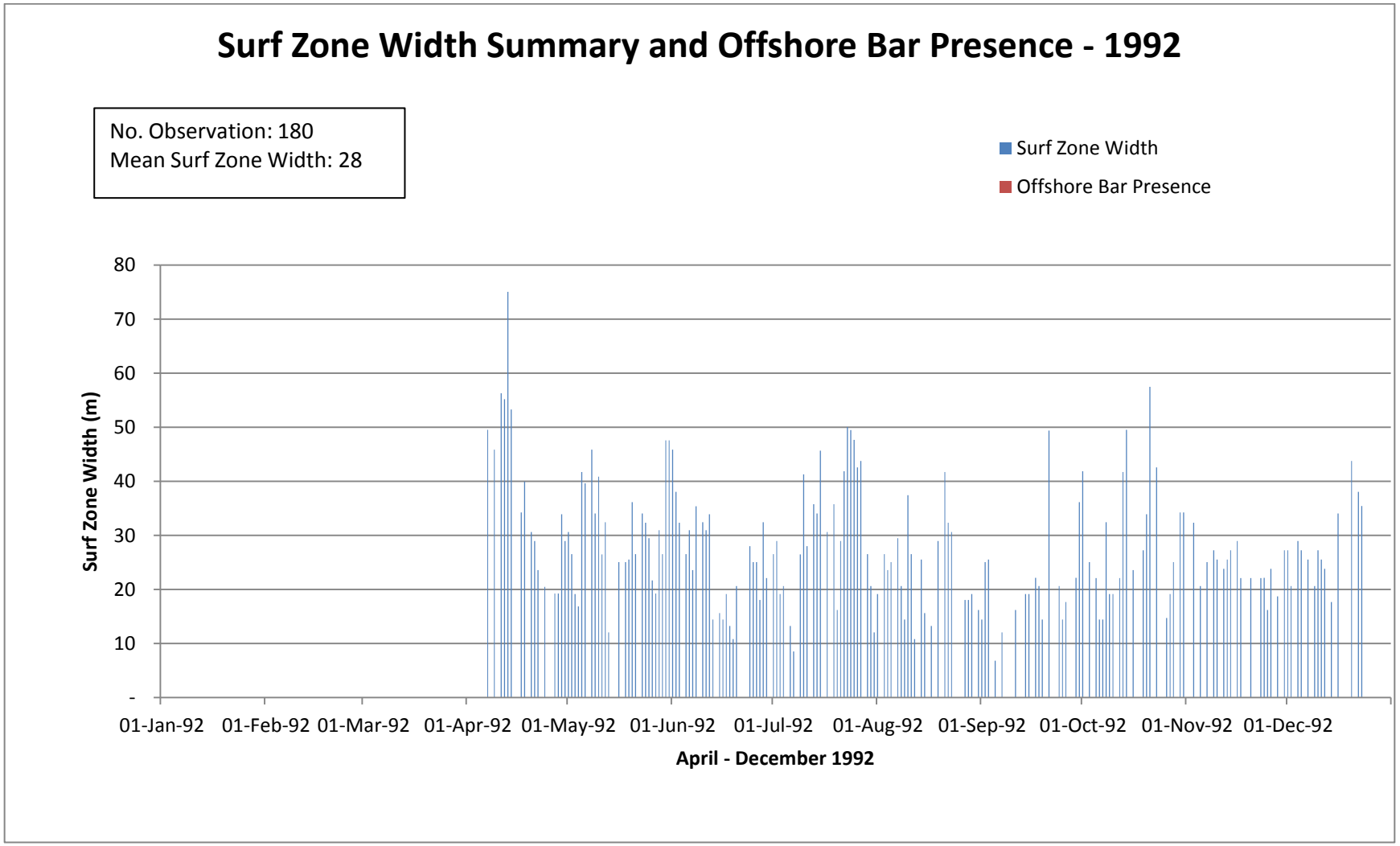


Figure 38 North Site - Surf Zone Width - 1992

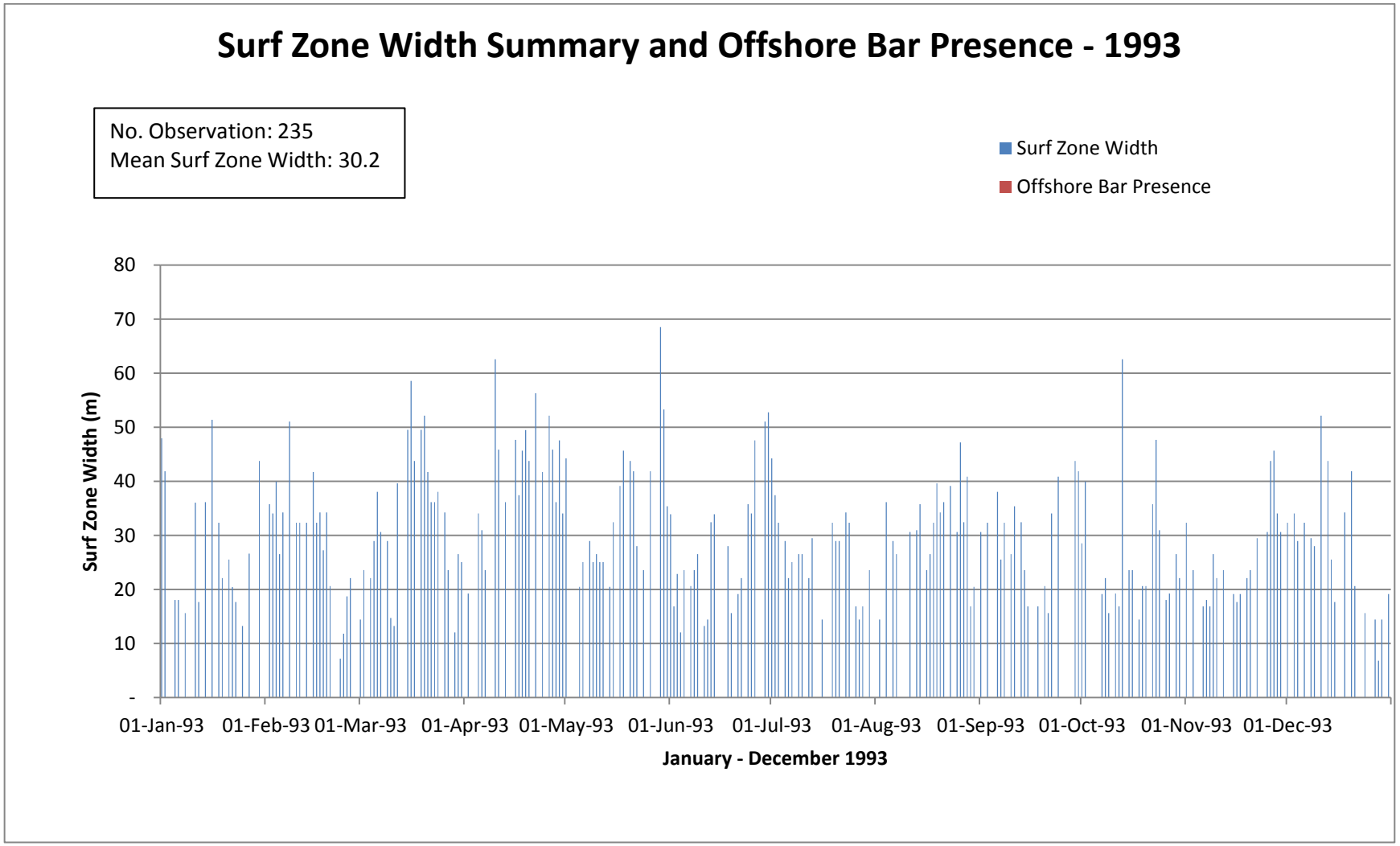


Figure 39 North Site - Surf Zone Width - 1993

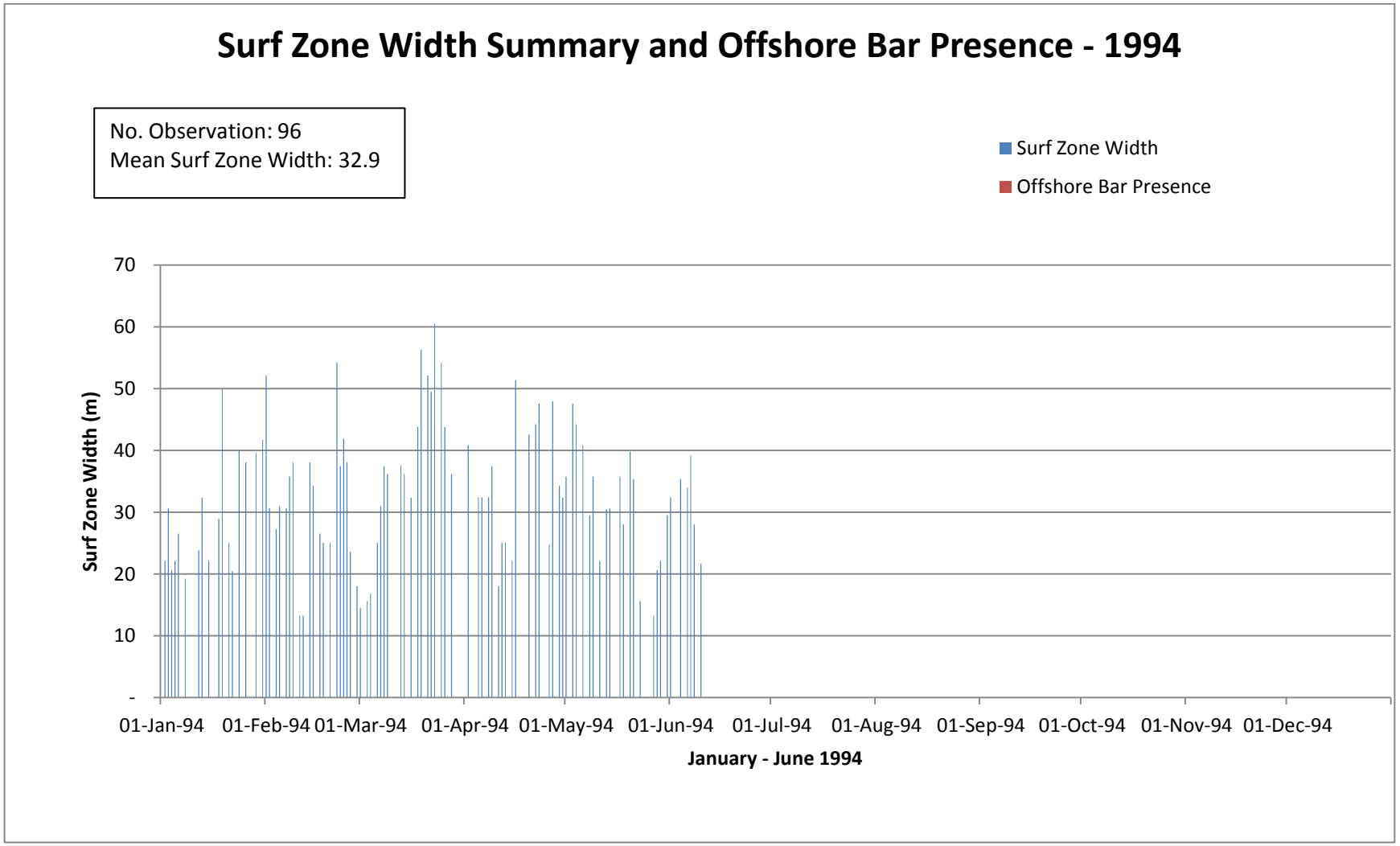


Figure 40 North Site - Surf Zone Width - 1994

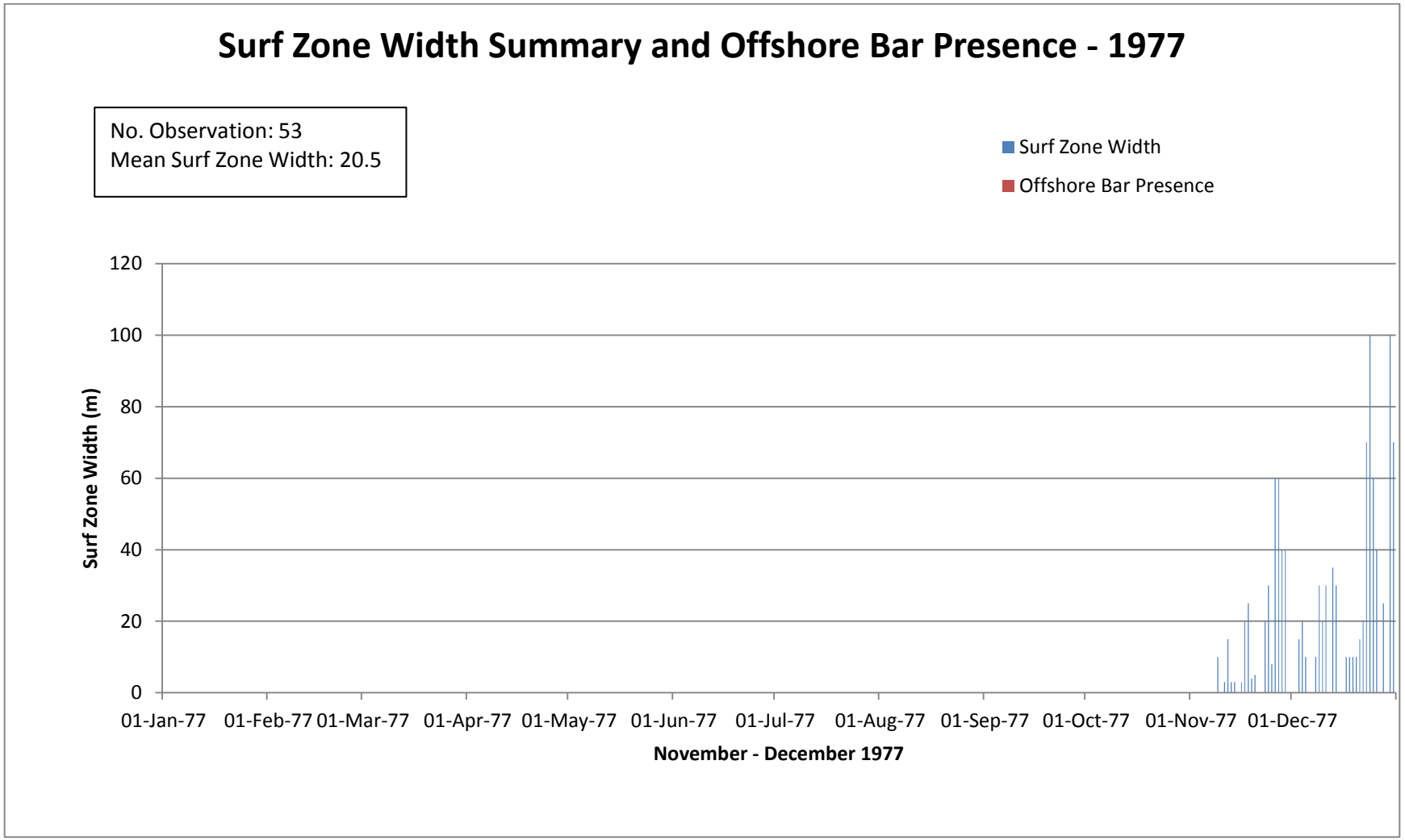


Figure 41 South Site - Surf Zone Width - 1977

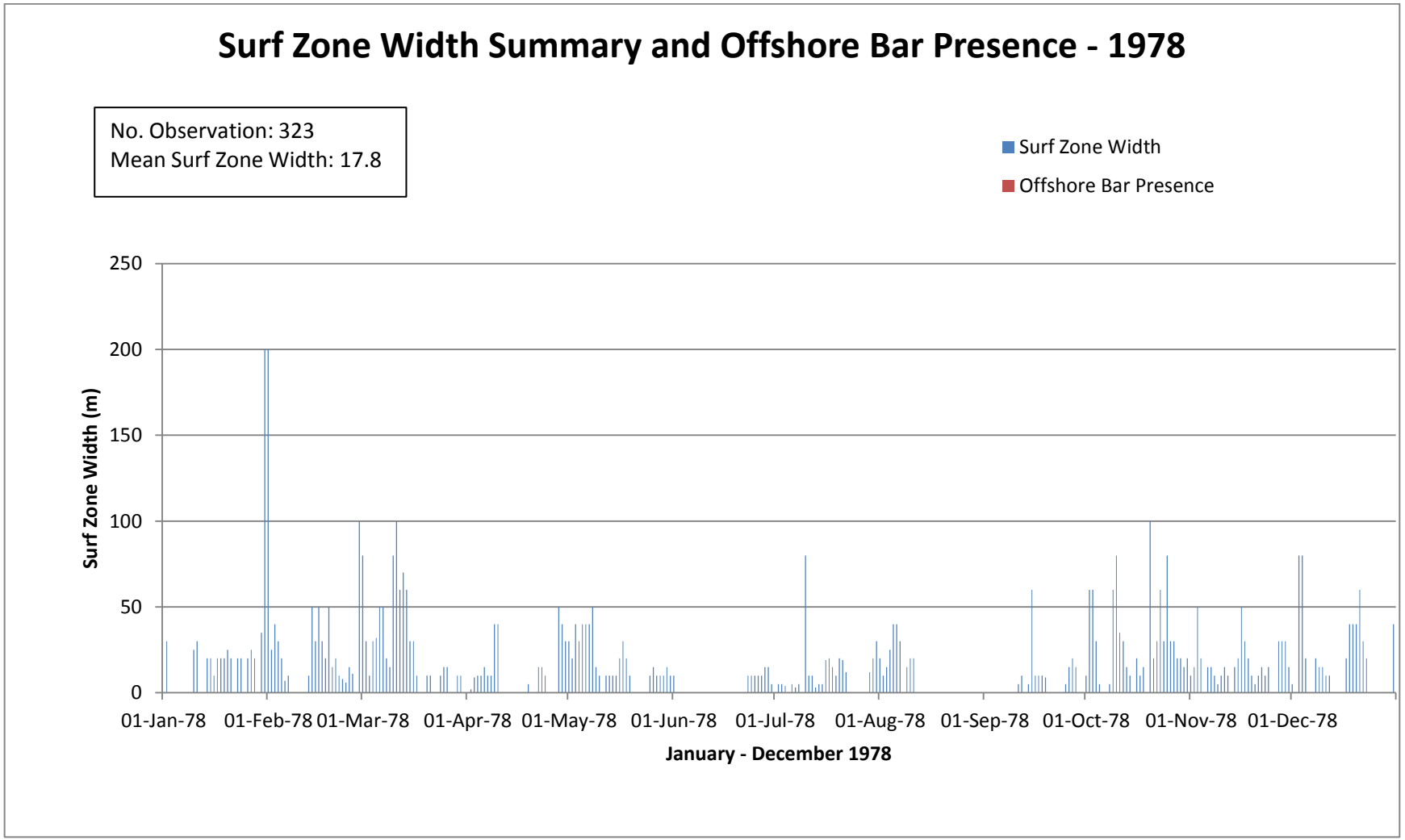


Figure 42 South Site - Surf Zone Width - 1978

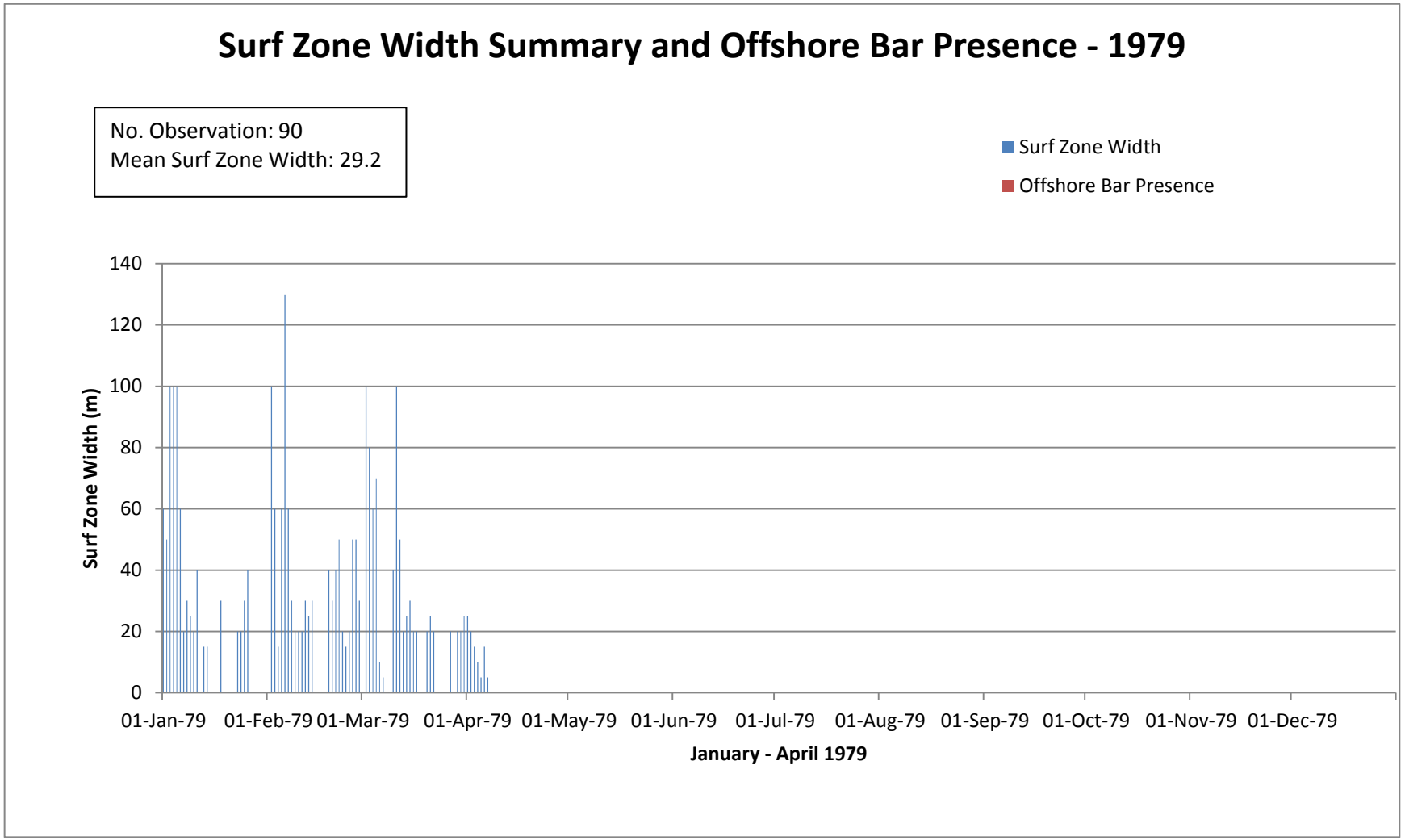


Figure 43 South Site - Surf Zone Width – 1979

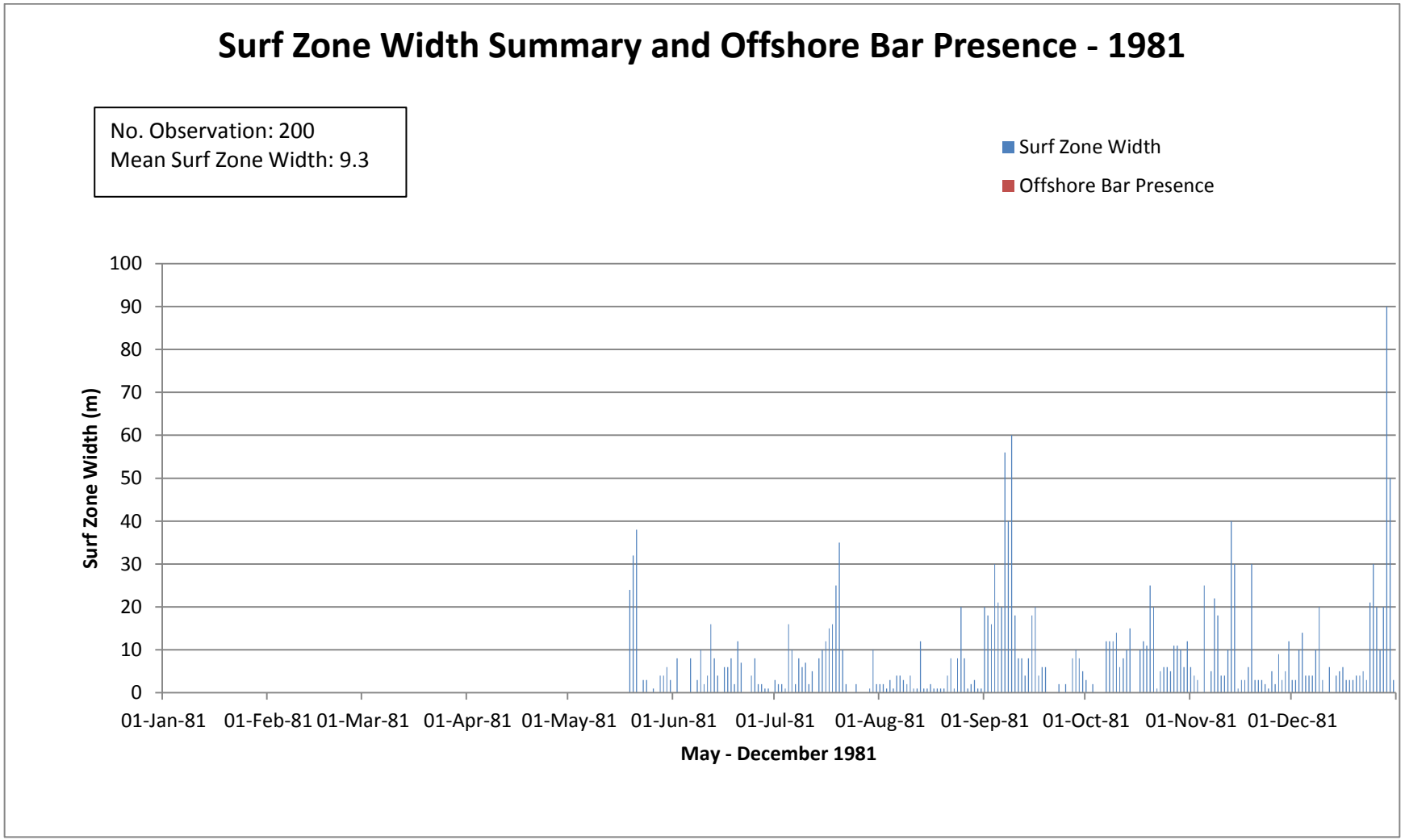


Figure 44 South Site - Surf Zone Width – 1981

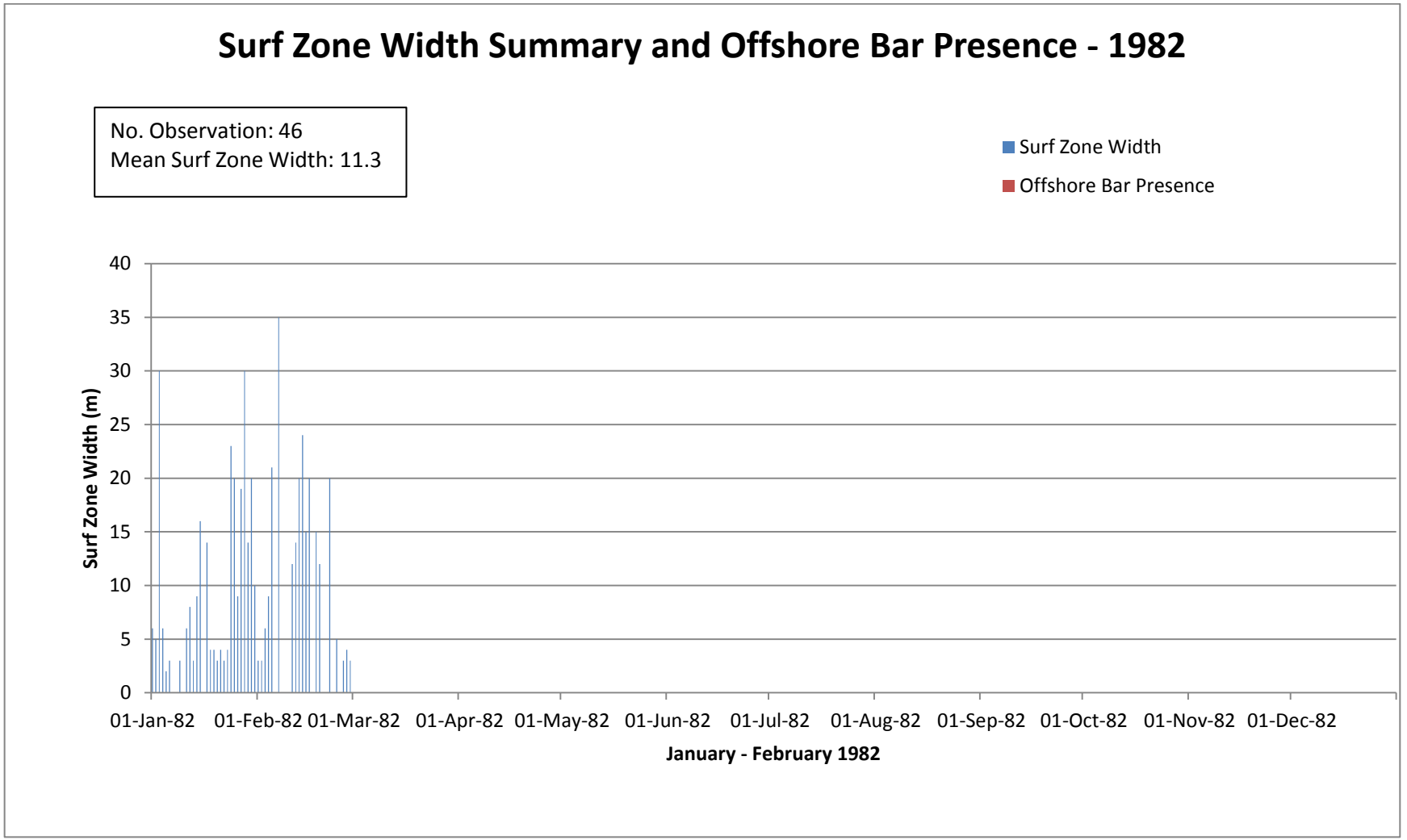


Figure 45 South Site - Surf Zone Width – 1982

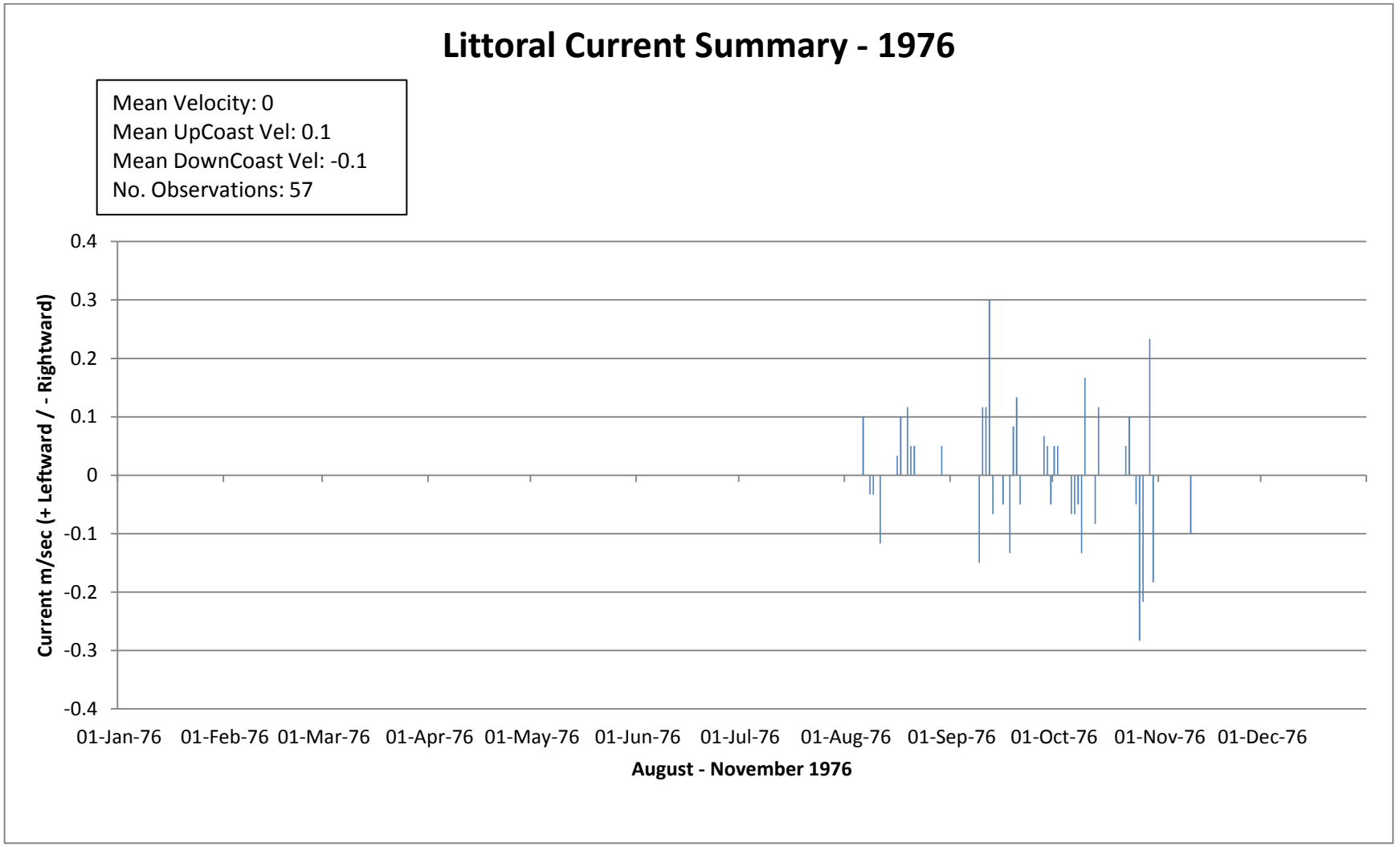


Figure 46 North Site - Littoral Current Summary 1976

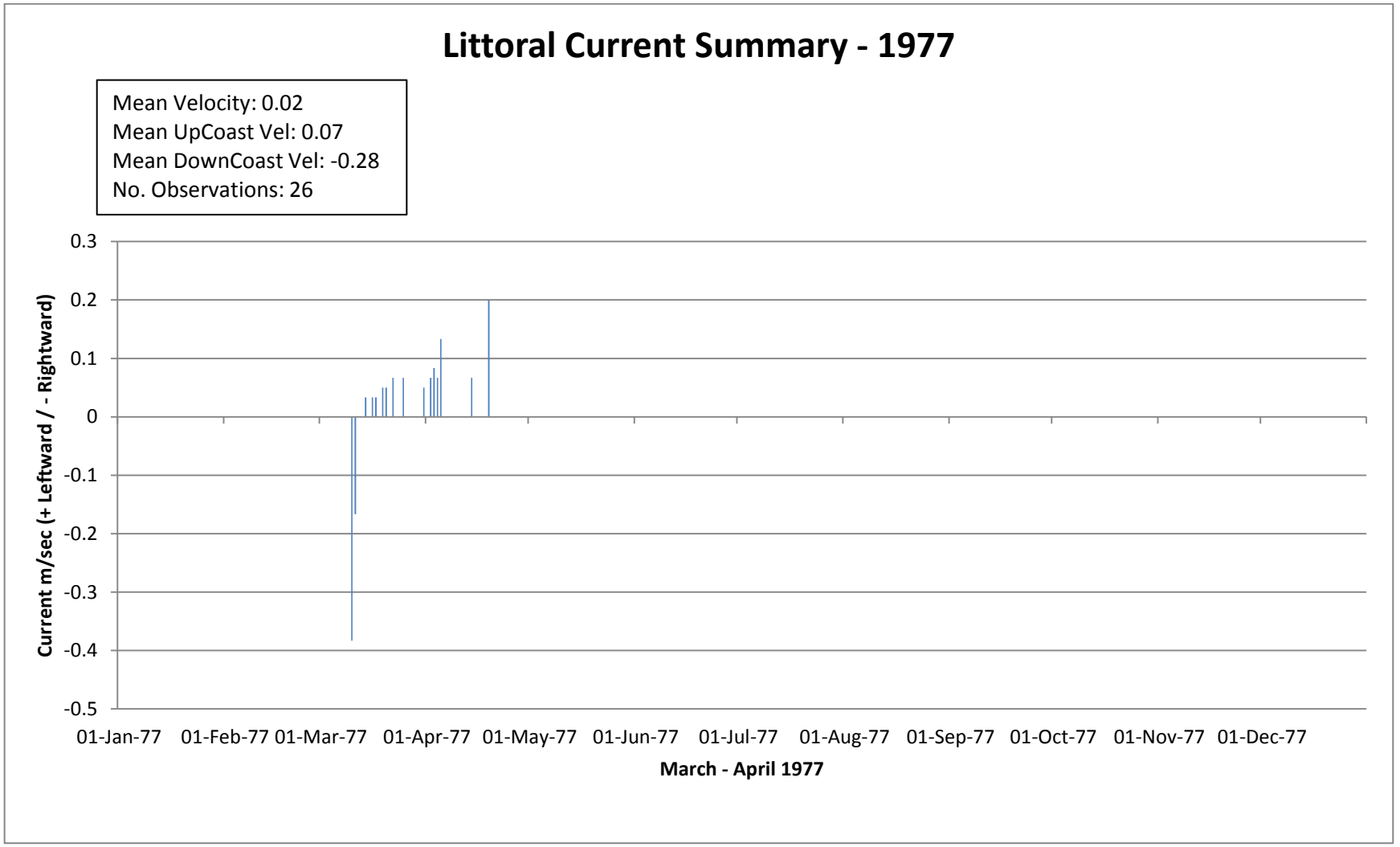


Figure 47 North Site - Littoral Current Summary 1977

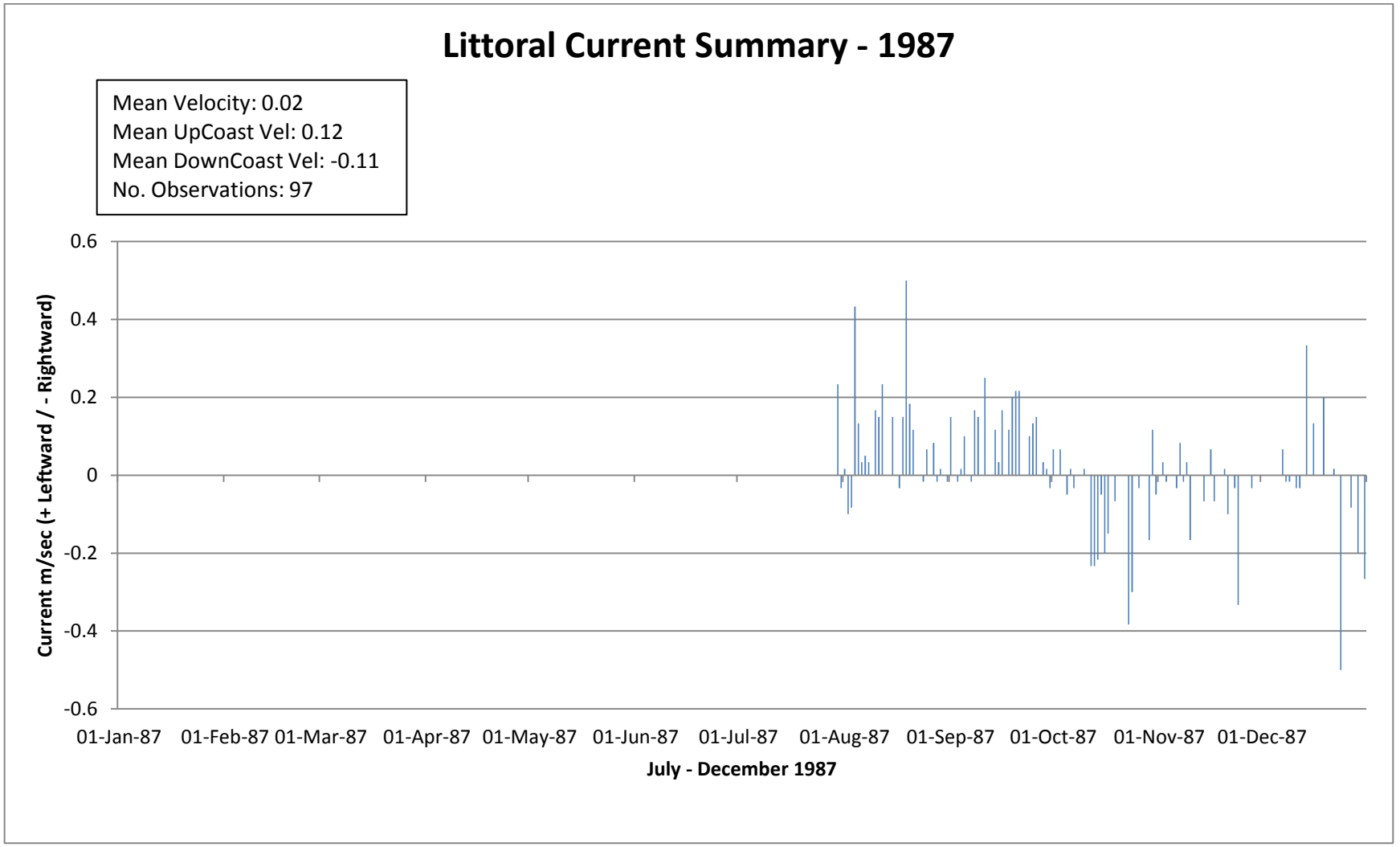


Figure 48 North Site - Littoral Current Summary 1987

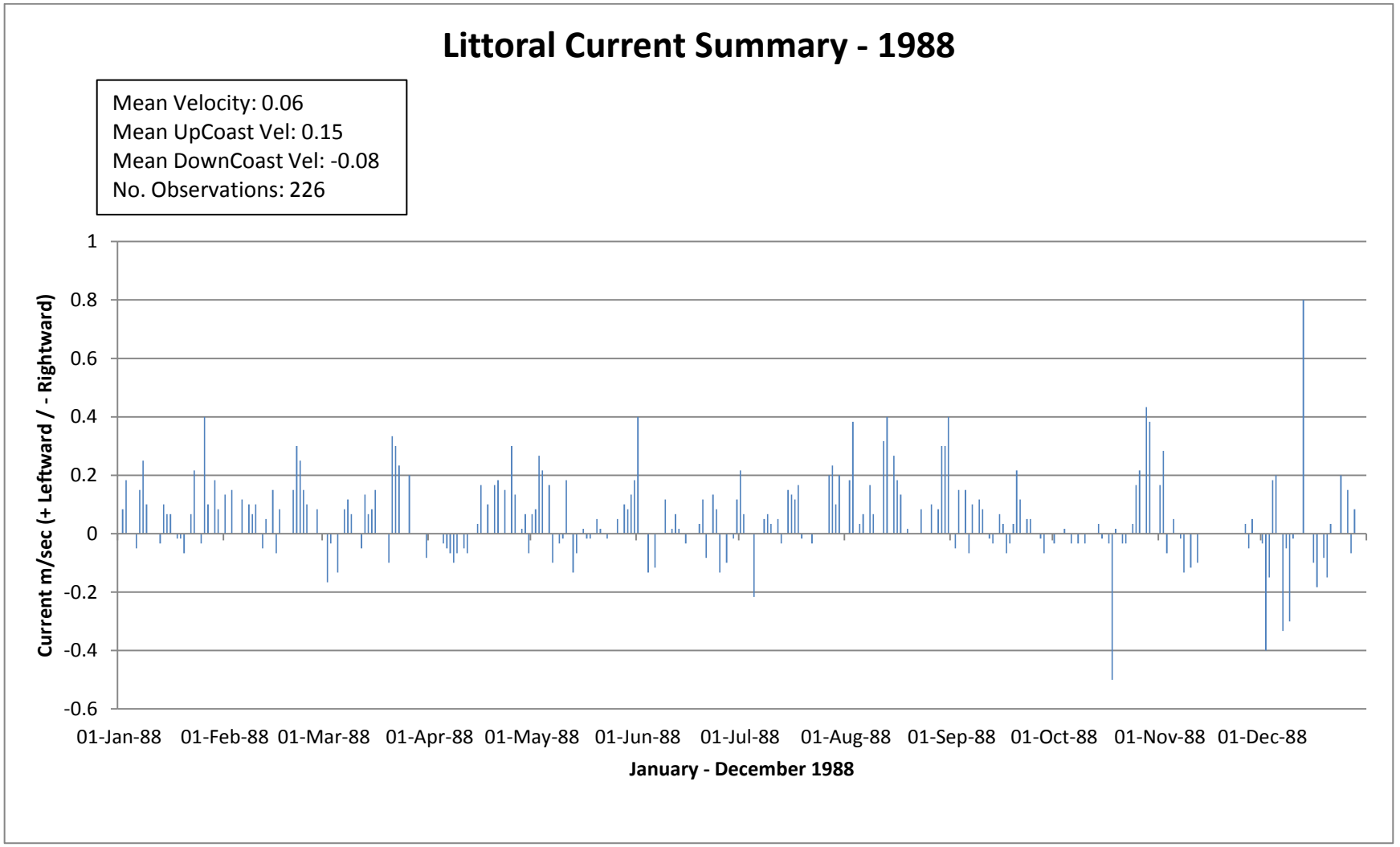


Figure 49 North Site - Littoral Current Summary 1988

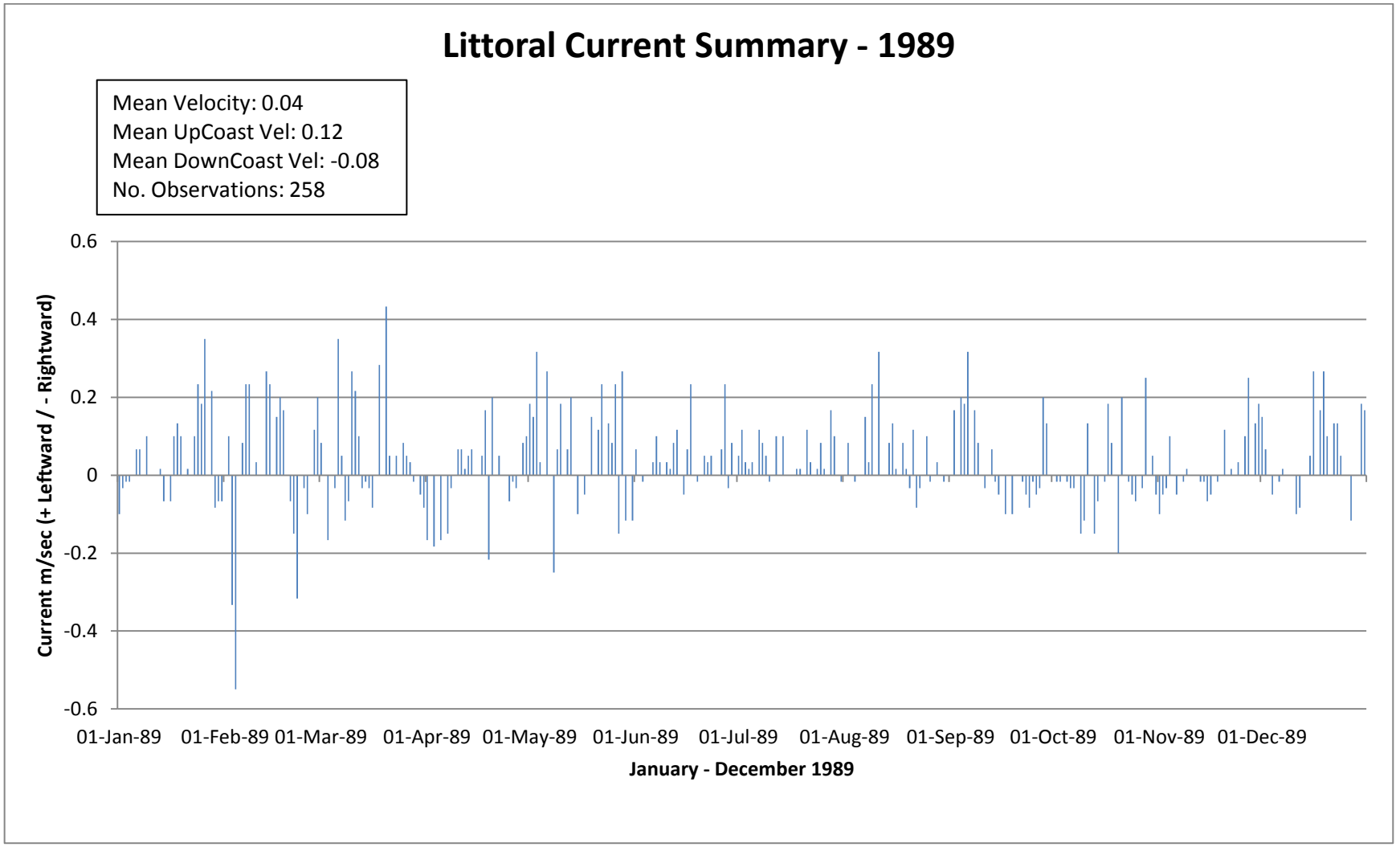


Figure 50 North Site - Littoral Current Summary 1989

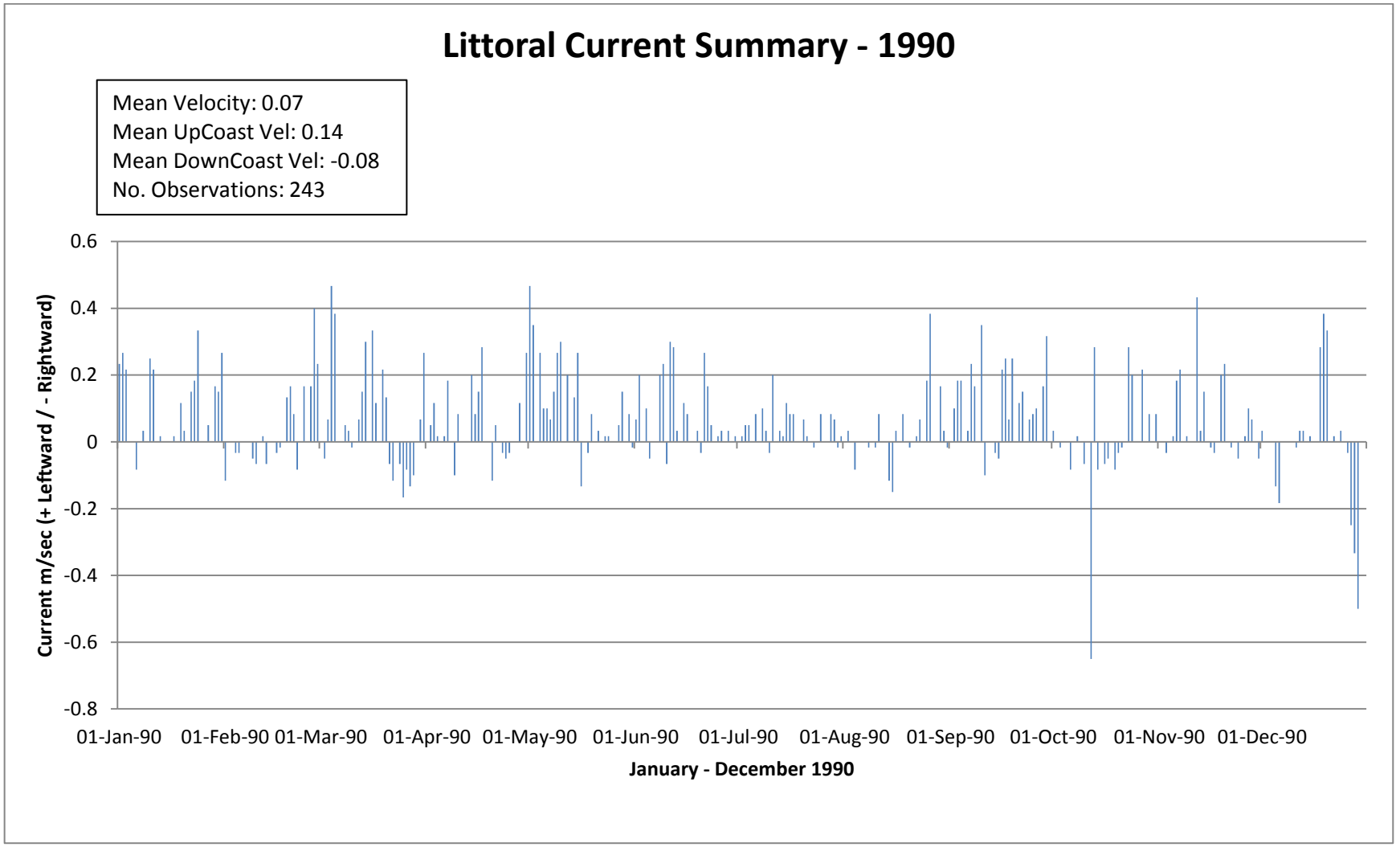


Figure 51 North Site - Littoral Current Summary 1990

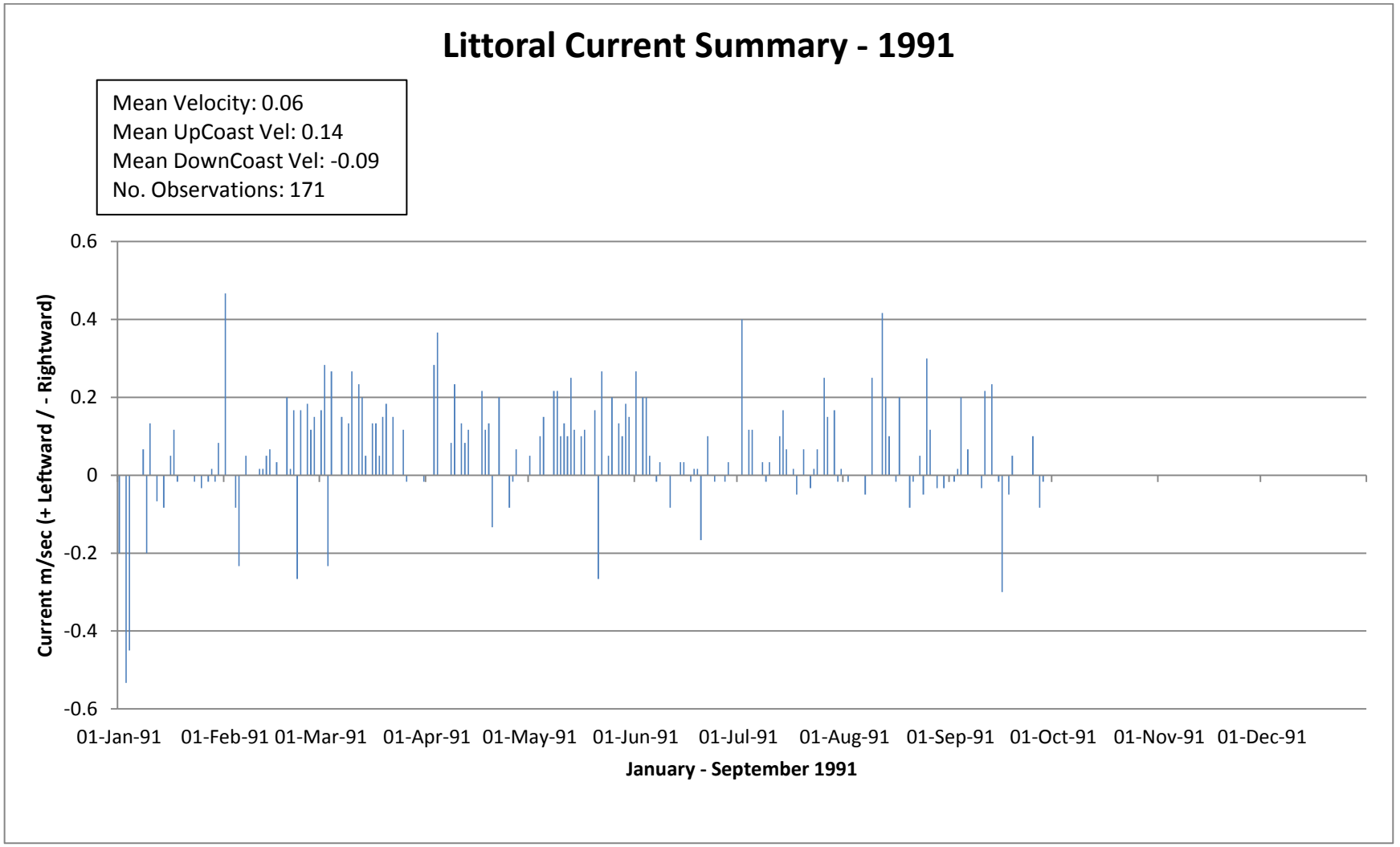


Figure 52 North Site - Littoral Current Summary 1991

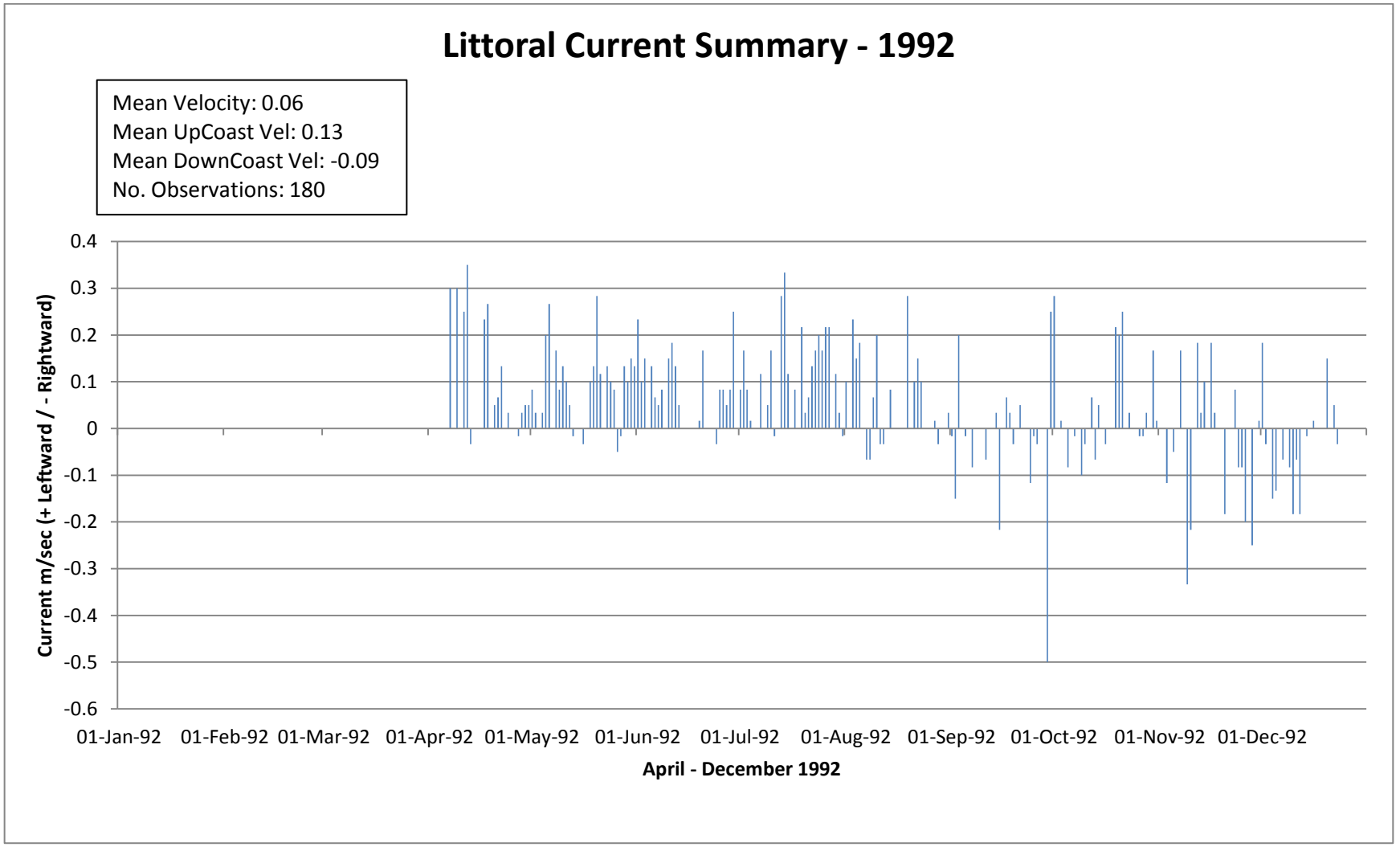


Figure 53 North Site - Littoral Current Summary 1992

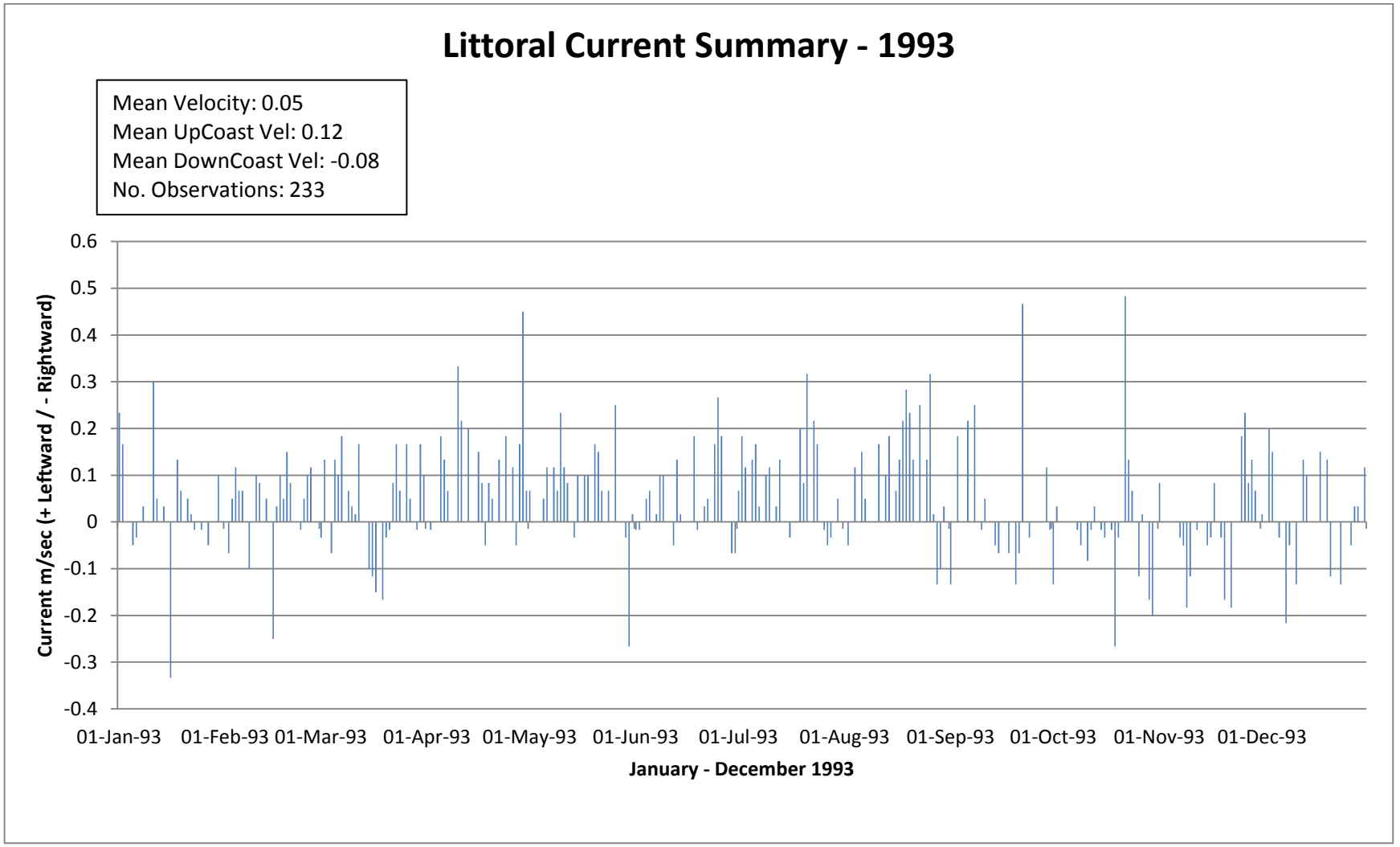


Figure 54 North Site - Littoral Current Summary 1993

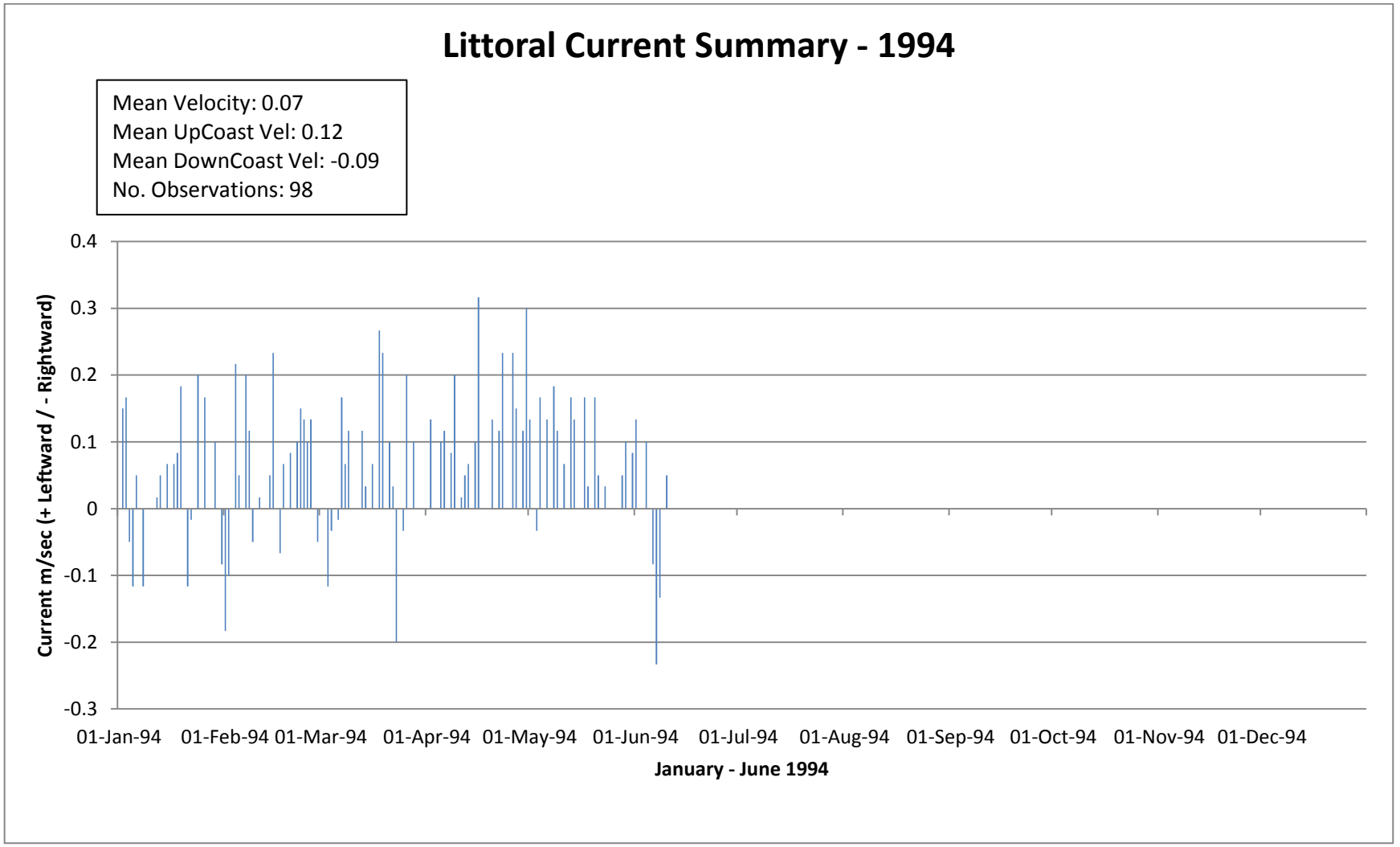


Figure 55 North Site - Littoral Current Summary 1994

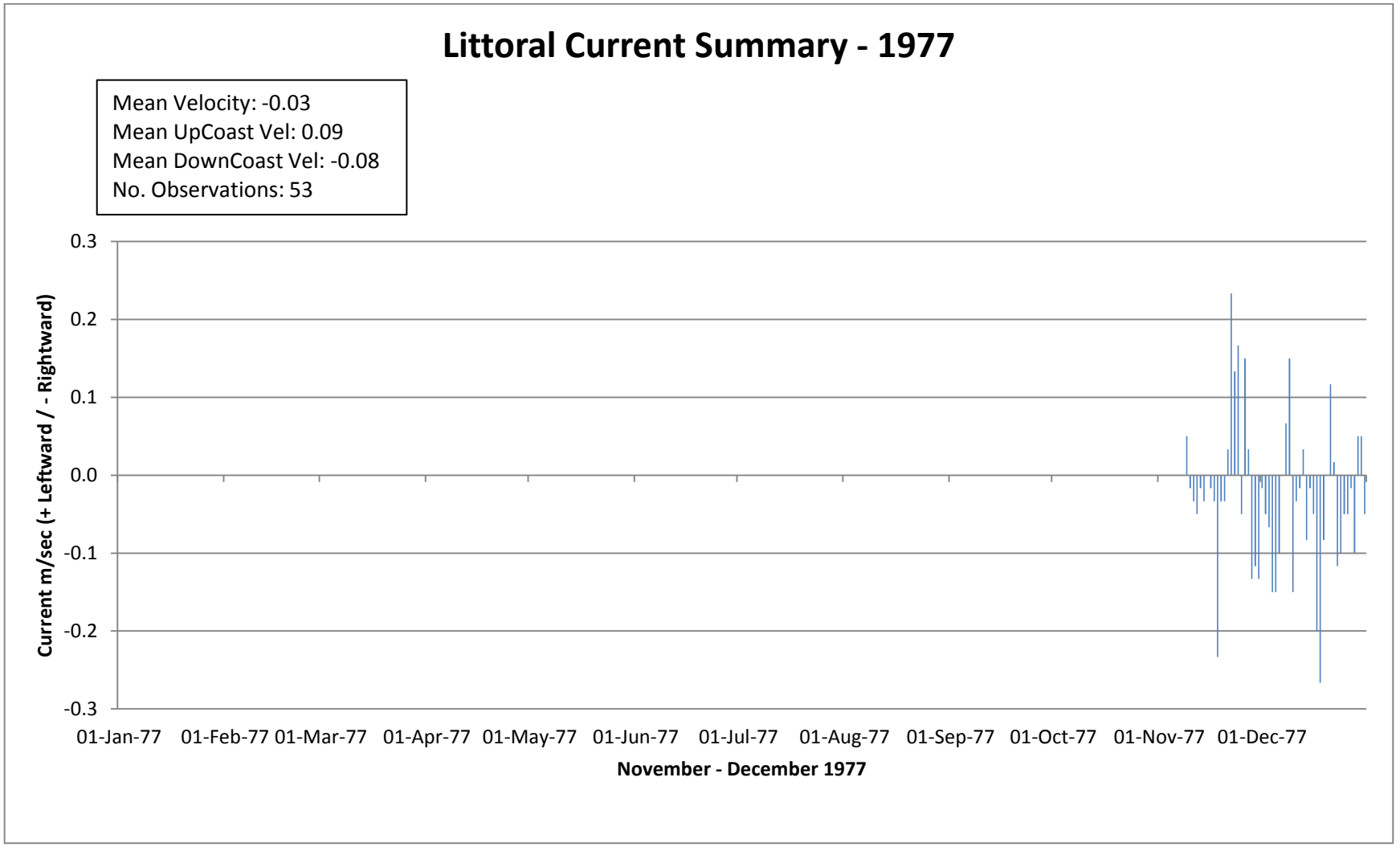


Figure 56 South Site - Littoral Current Summary 1977

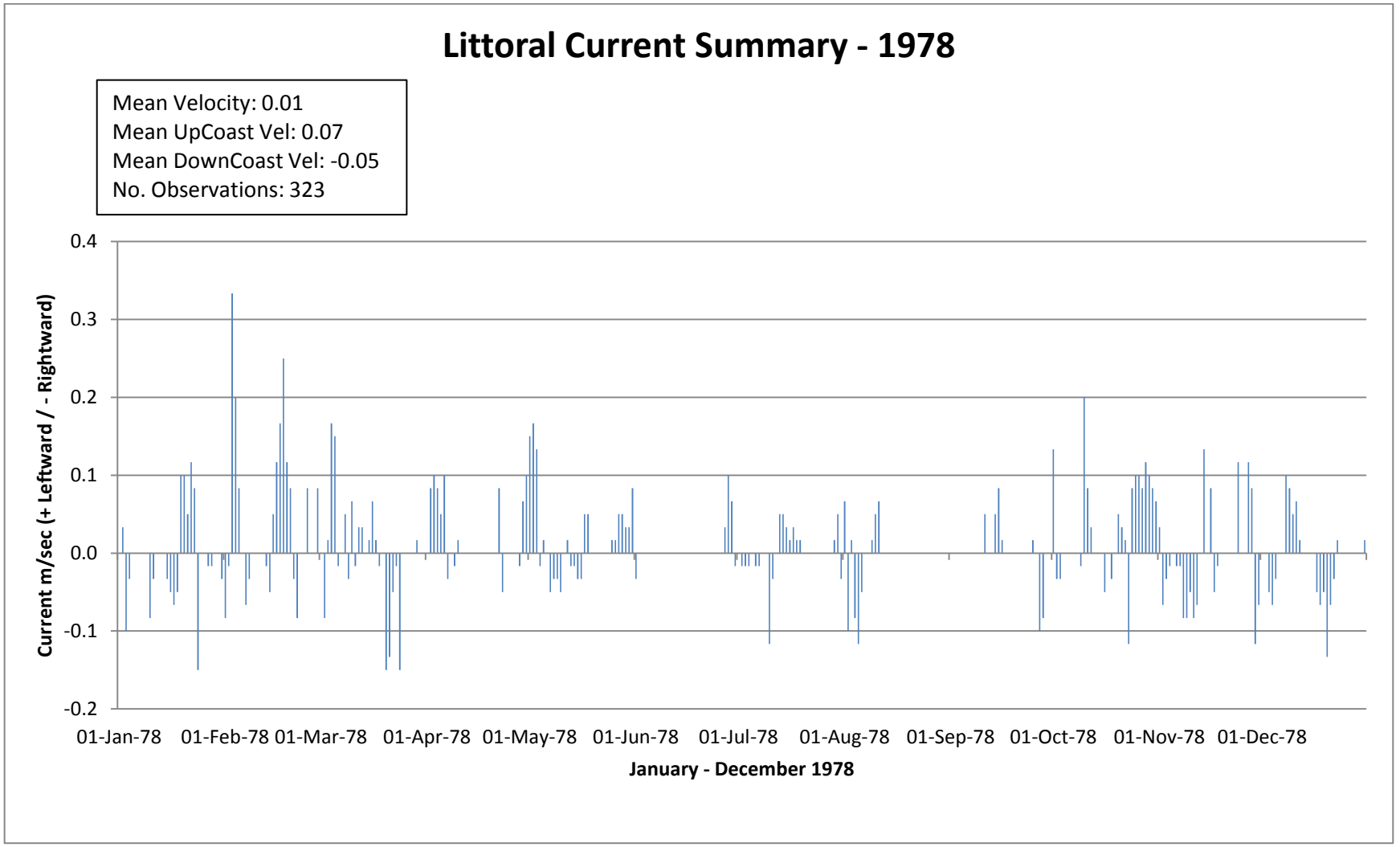


Figure 57 South Site - Littoral Current Summary 1978

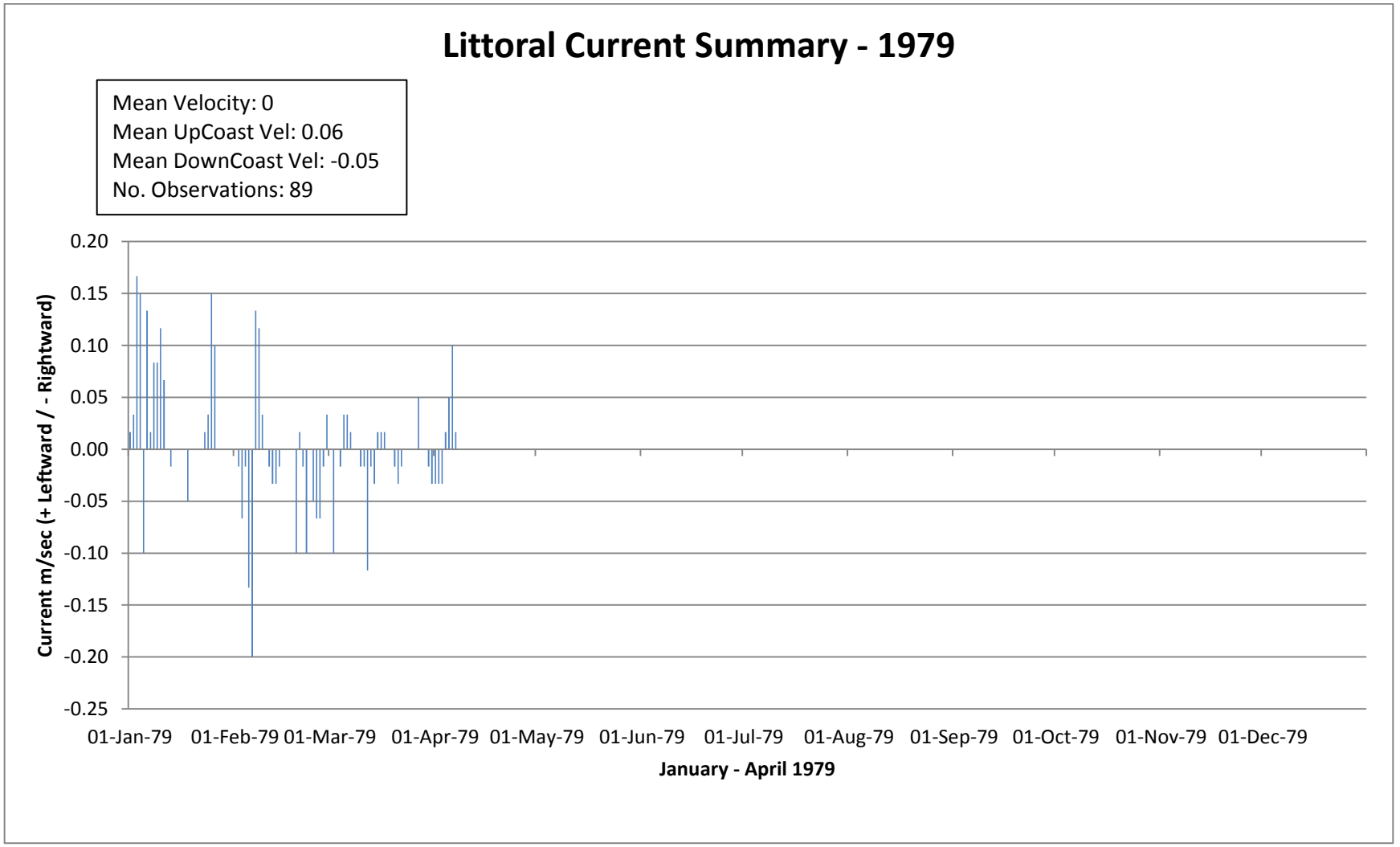


Figure 58 South Site - Littoral Current Summary 1979

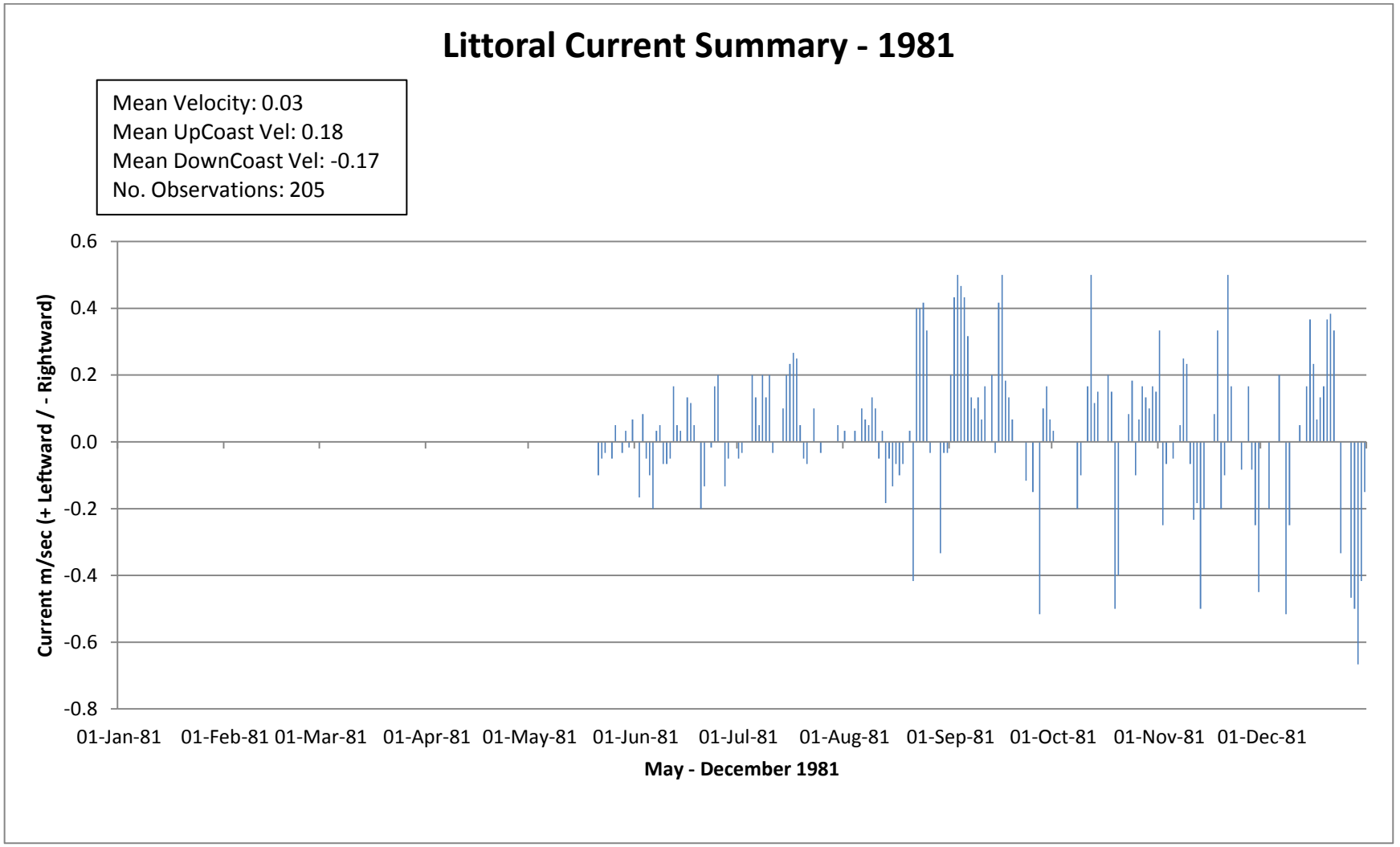


Figure 59 South Site - Littoral Current Summary 1981

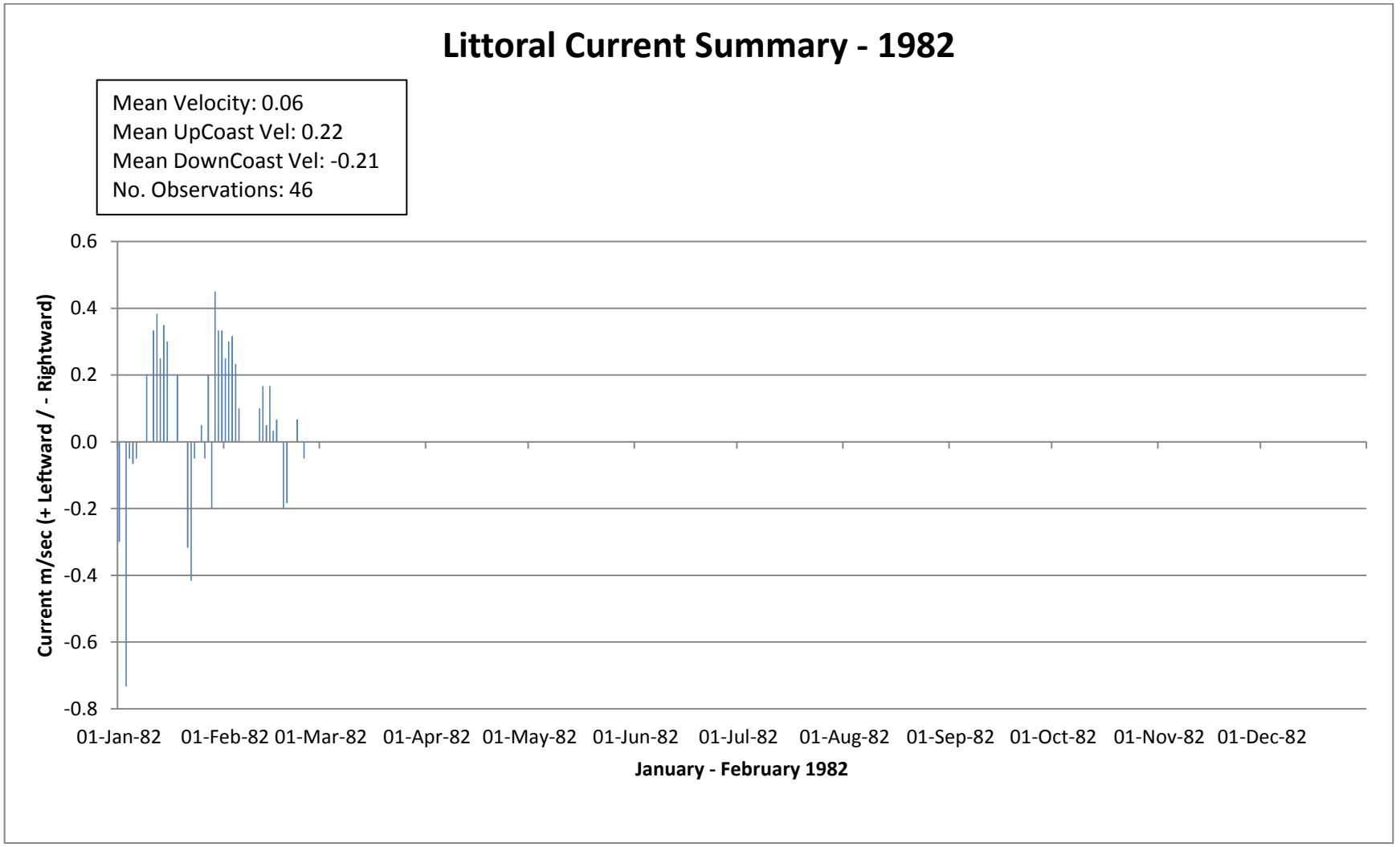


Figure 60 South Site - Littoral Current Summary 1982

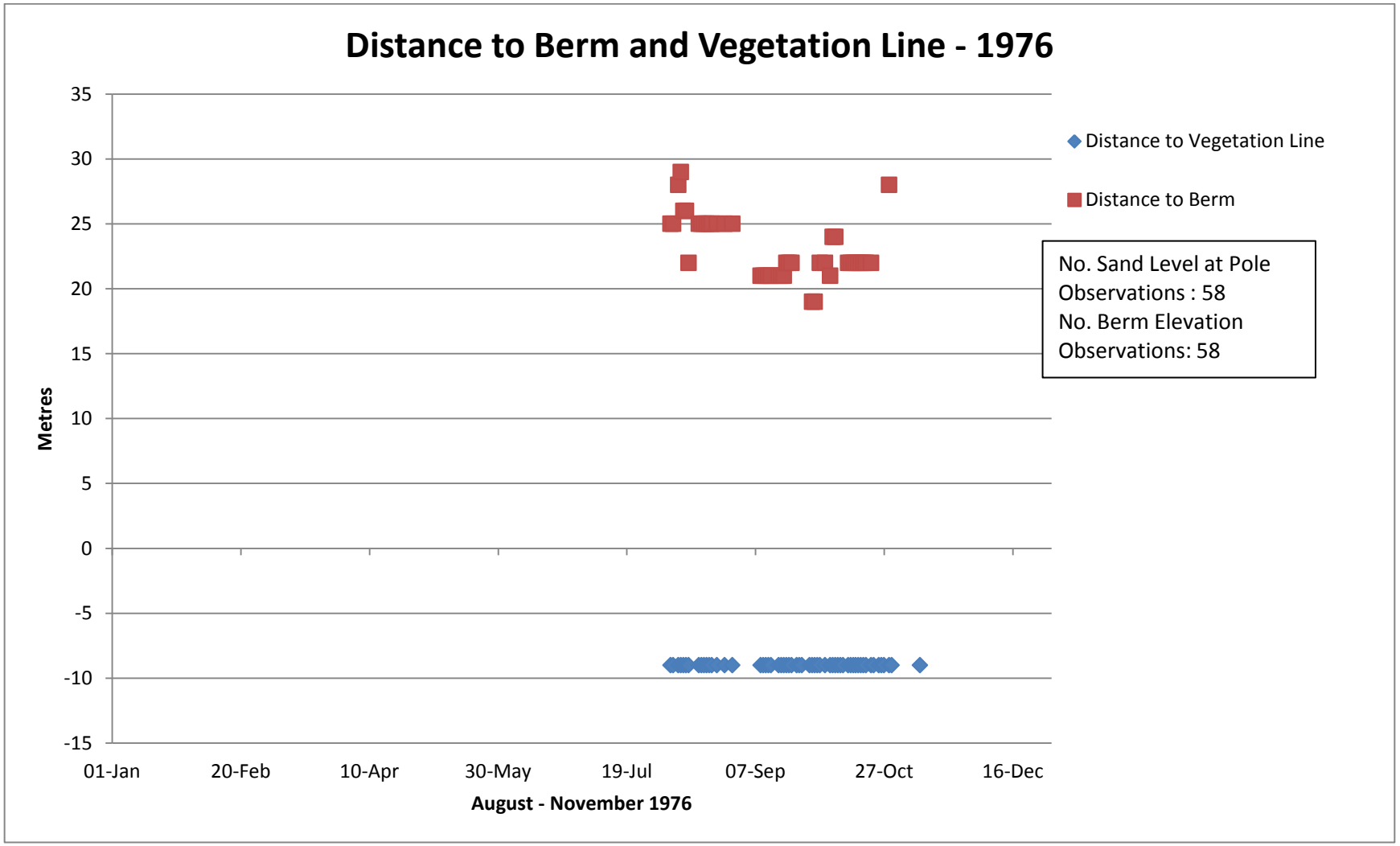


Figure 61 North site - Distance to berm and vegetation line - 76

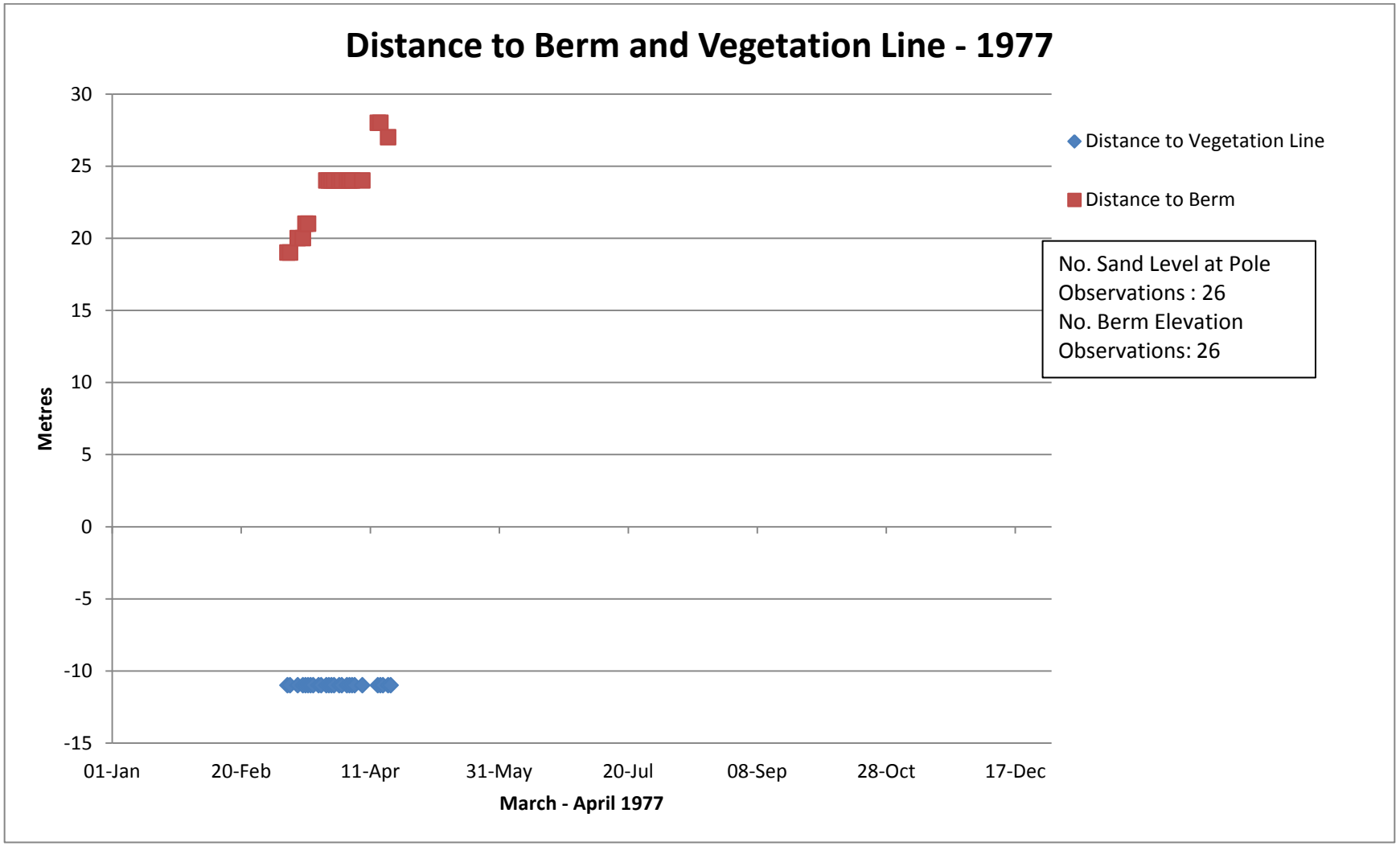


Figure 62 North site - Distance to berm and vegetation line - 77

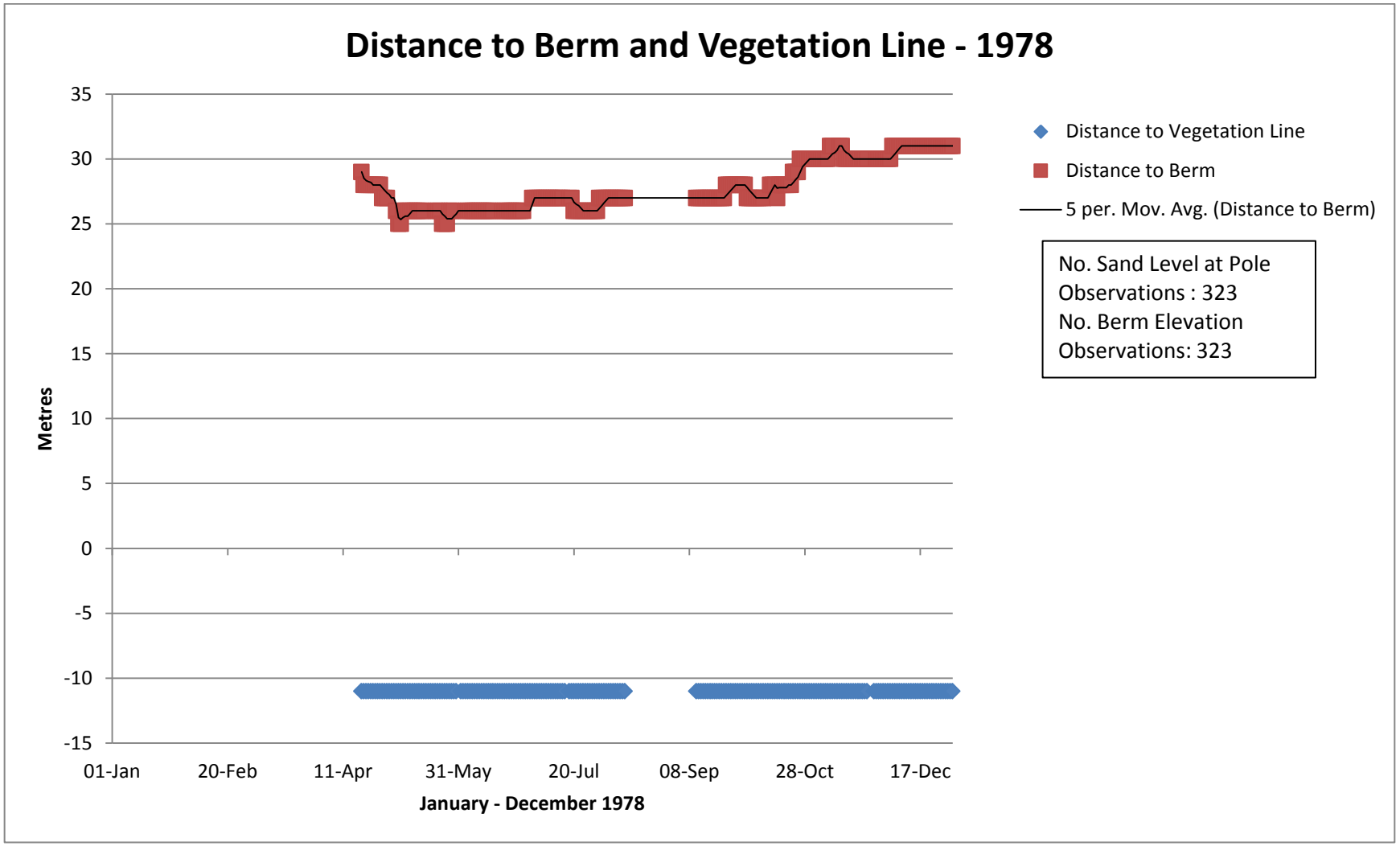


Figure 63 South site - Distance to berm and vegetation line - 78

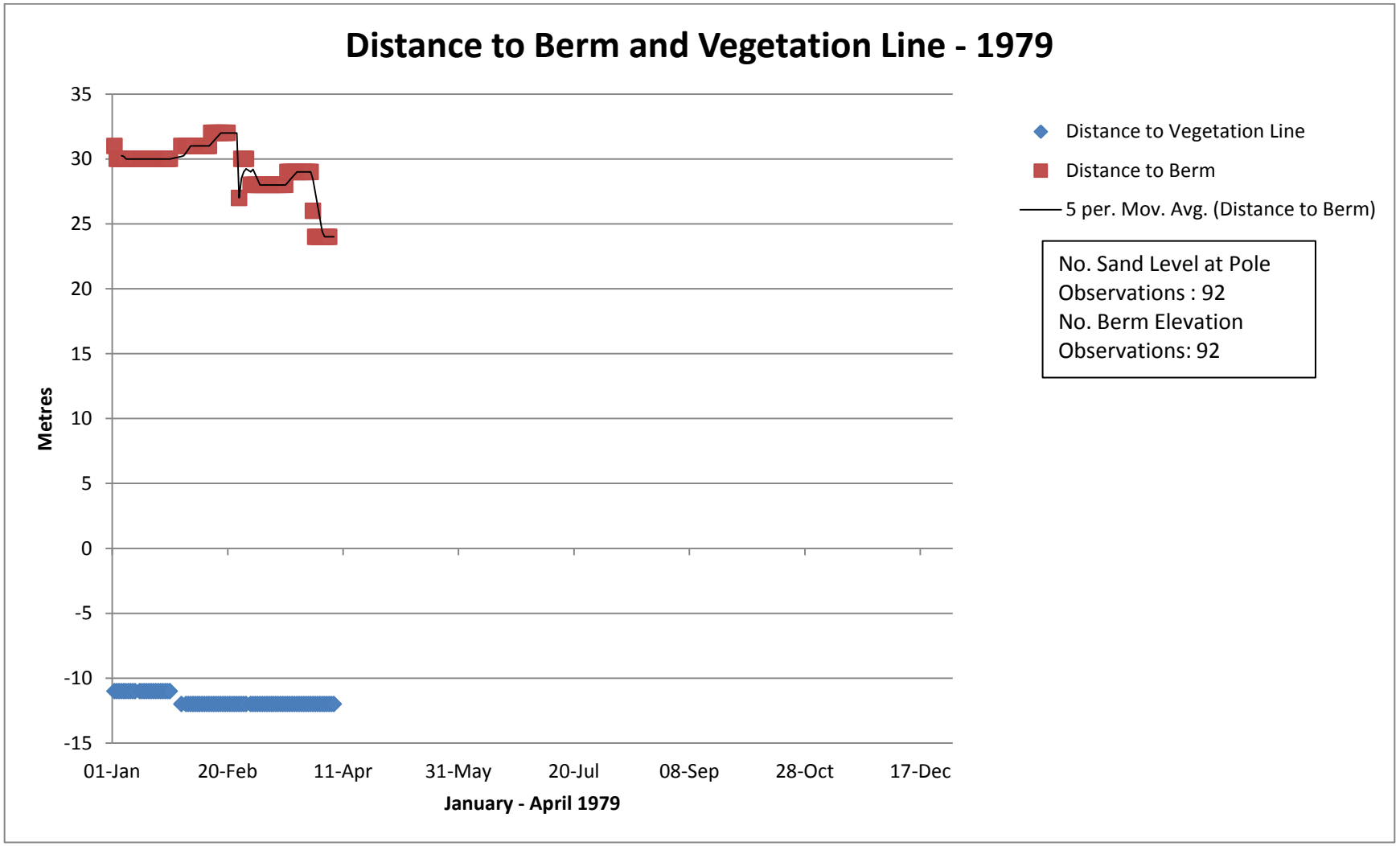


Figure 64 South site - Distance to berm and vegetation line - 79

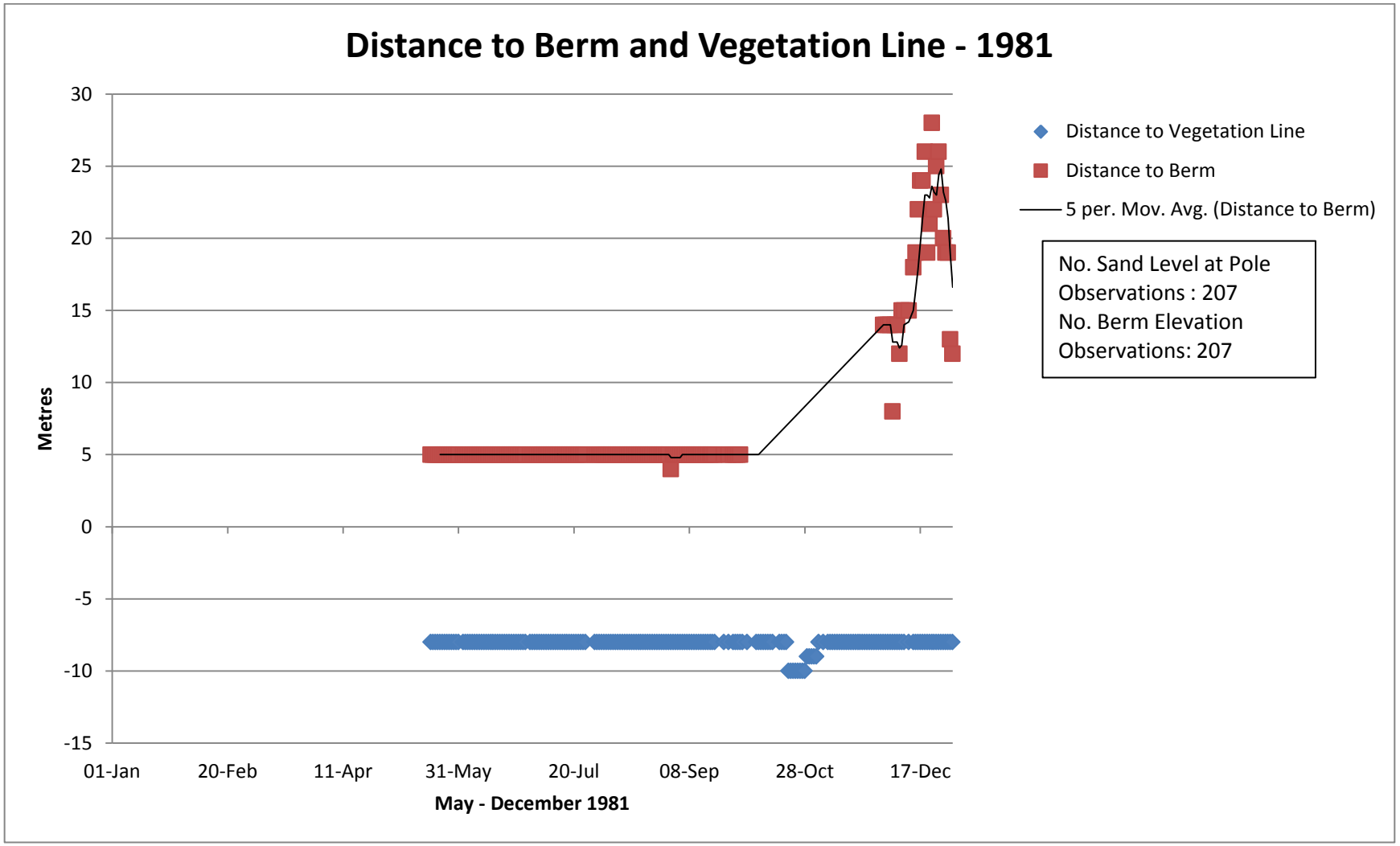


Figure 65 South site - Distance to berm and vegetation line - 81

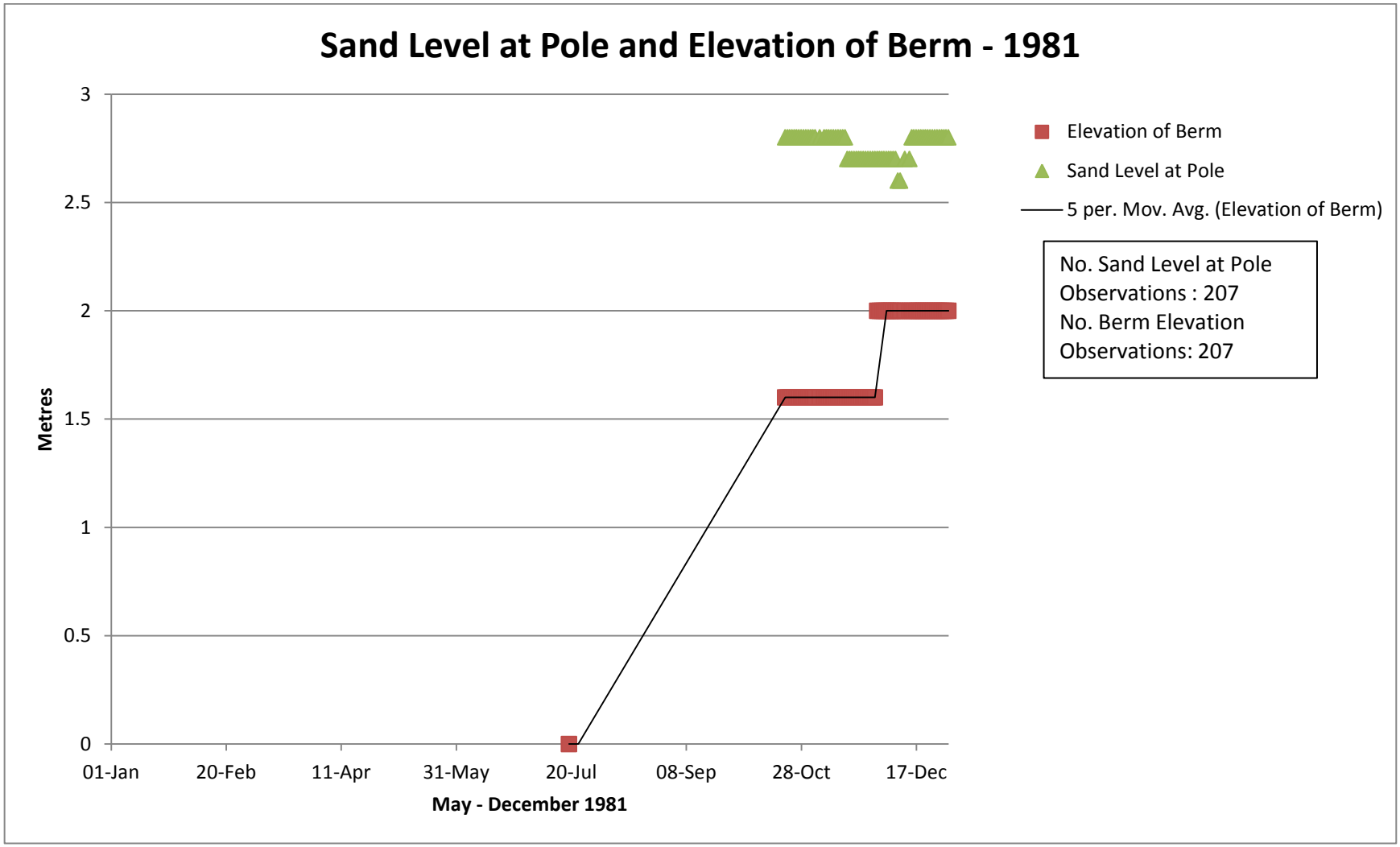


Figure 66 South site - Sand level at pole and elevation of berm - 81

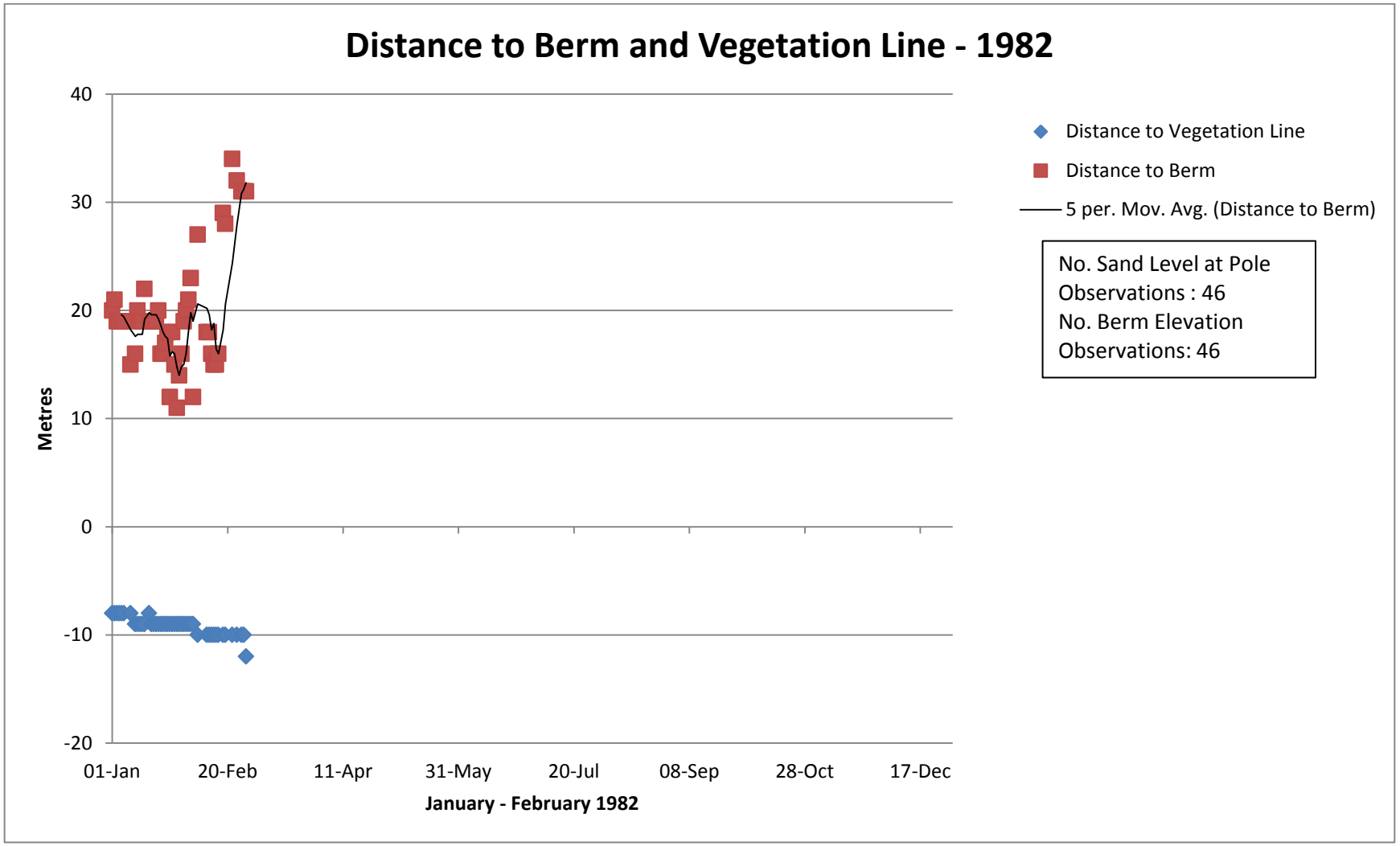


Figure 67 South site - Distance to berm and vegetation line - 82

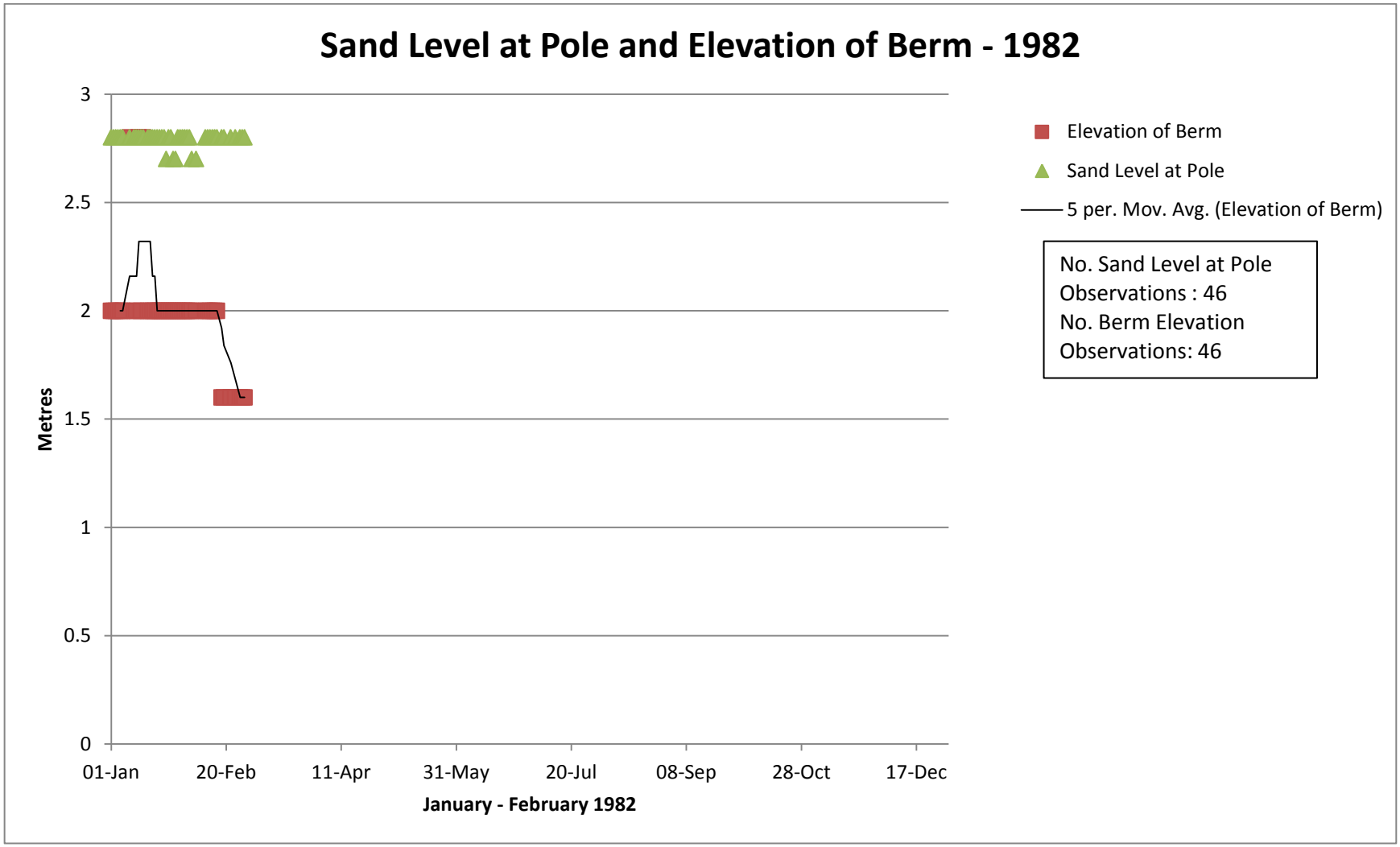


Figure 68 South site - Sand level at pole and elevation of berm - 82

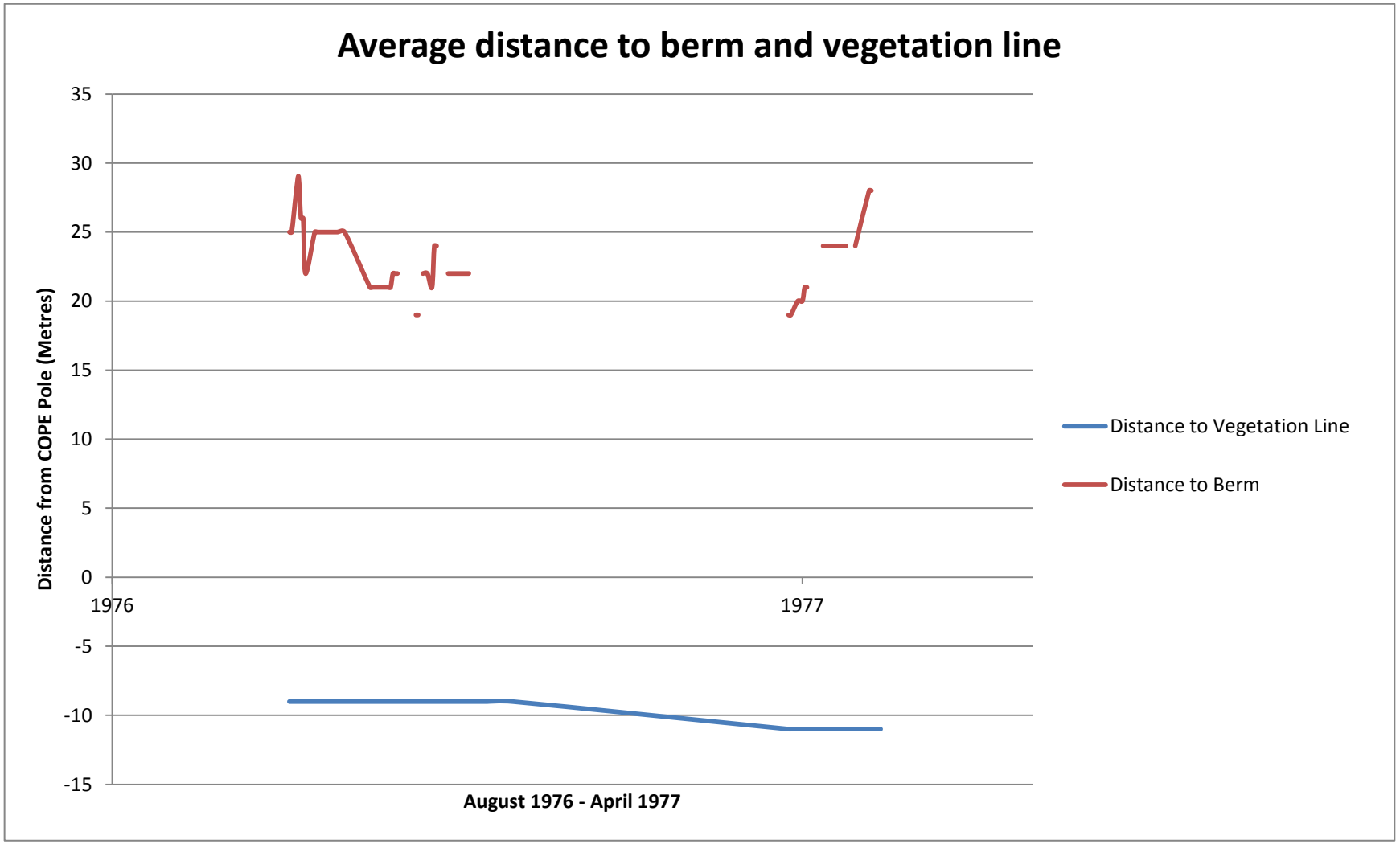


Figure 69 North site - Average distance to berm and vegetation line

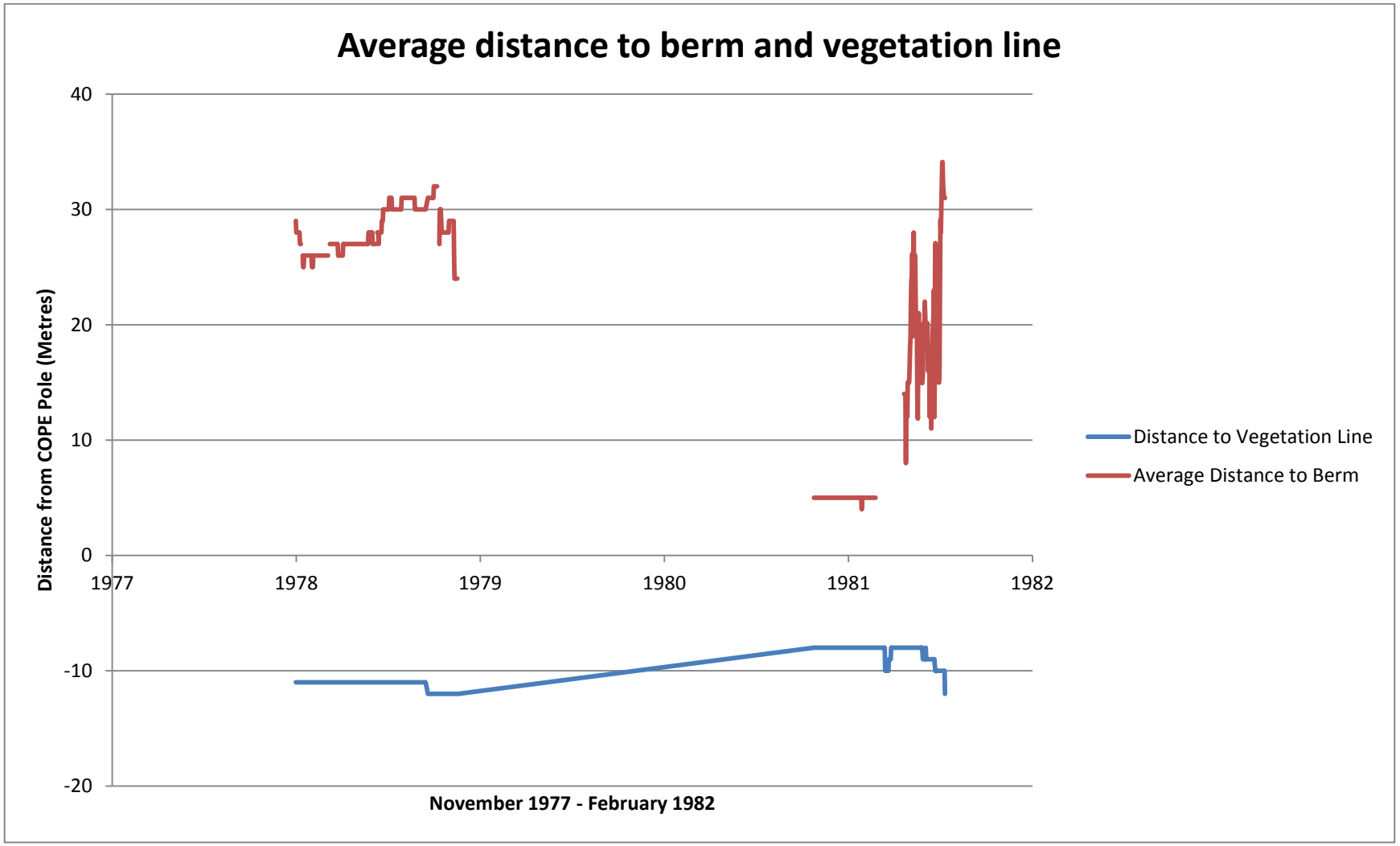


Figure 70 South site - Average distance to berm and vegetation line

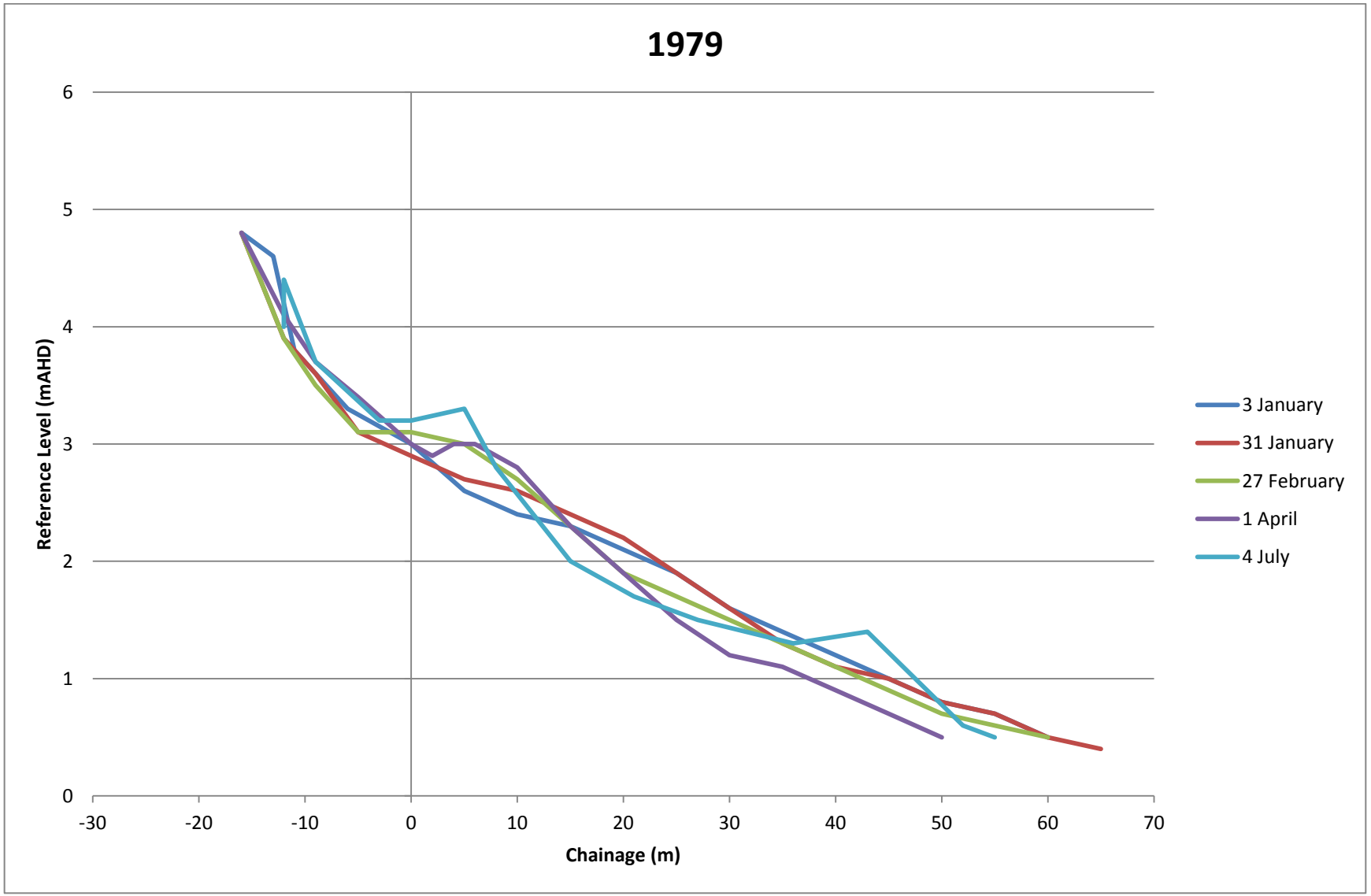


Figure 71 Seaforth South - Monthly beach profile – 1979

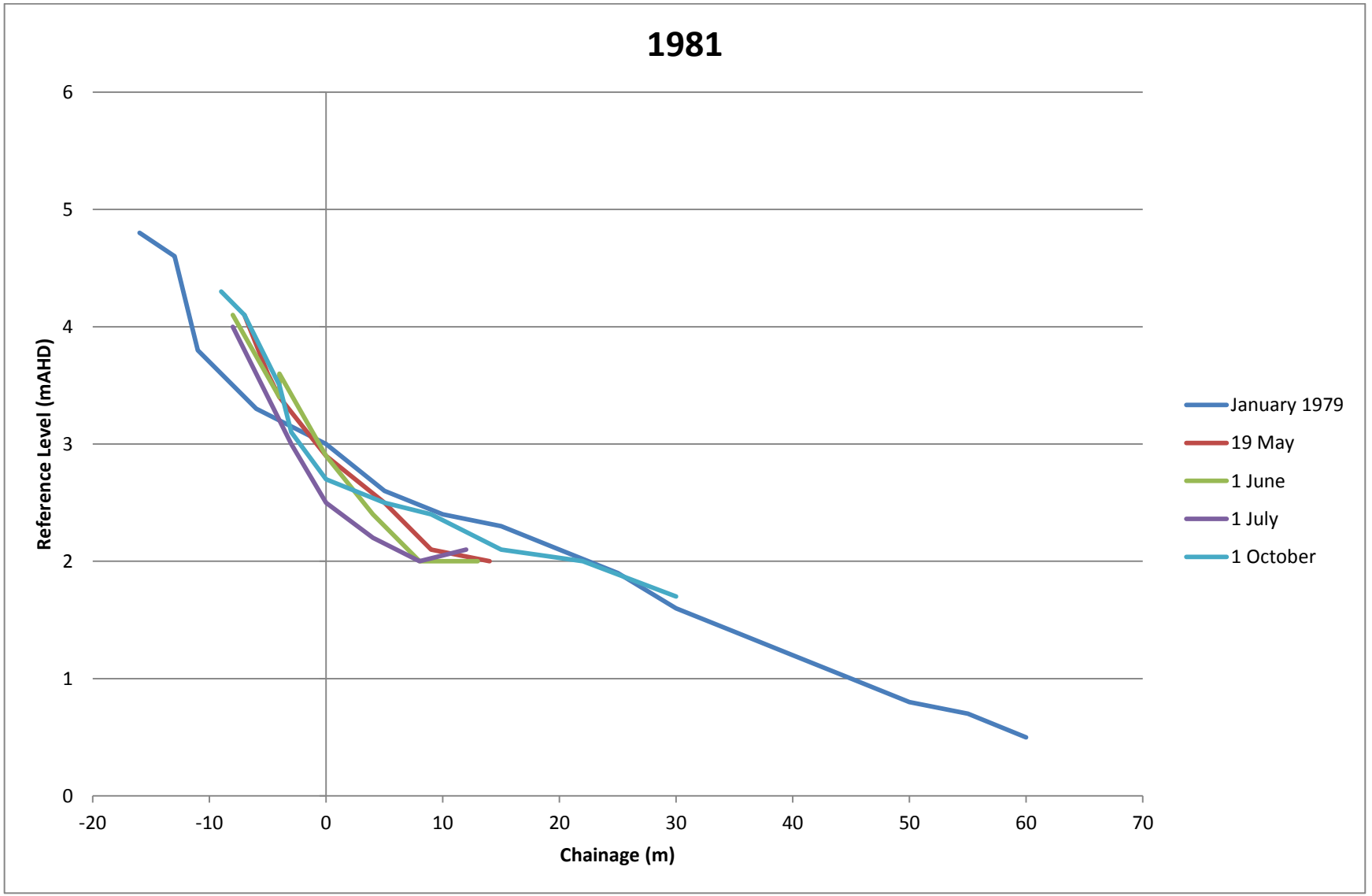


Figure 72 Seaforth South - Monthly beach profile - 1981

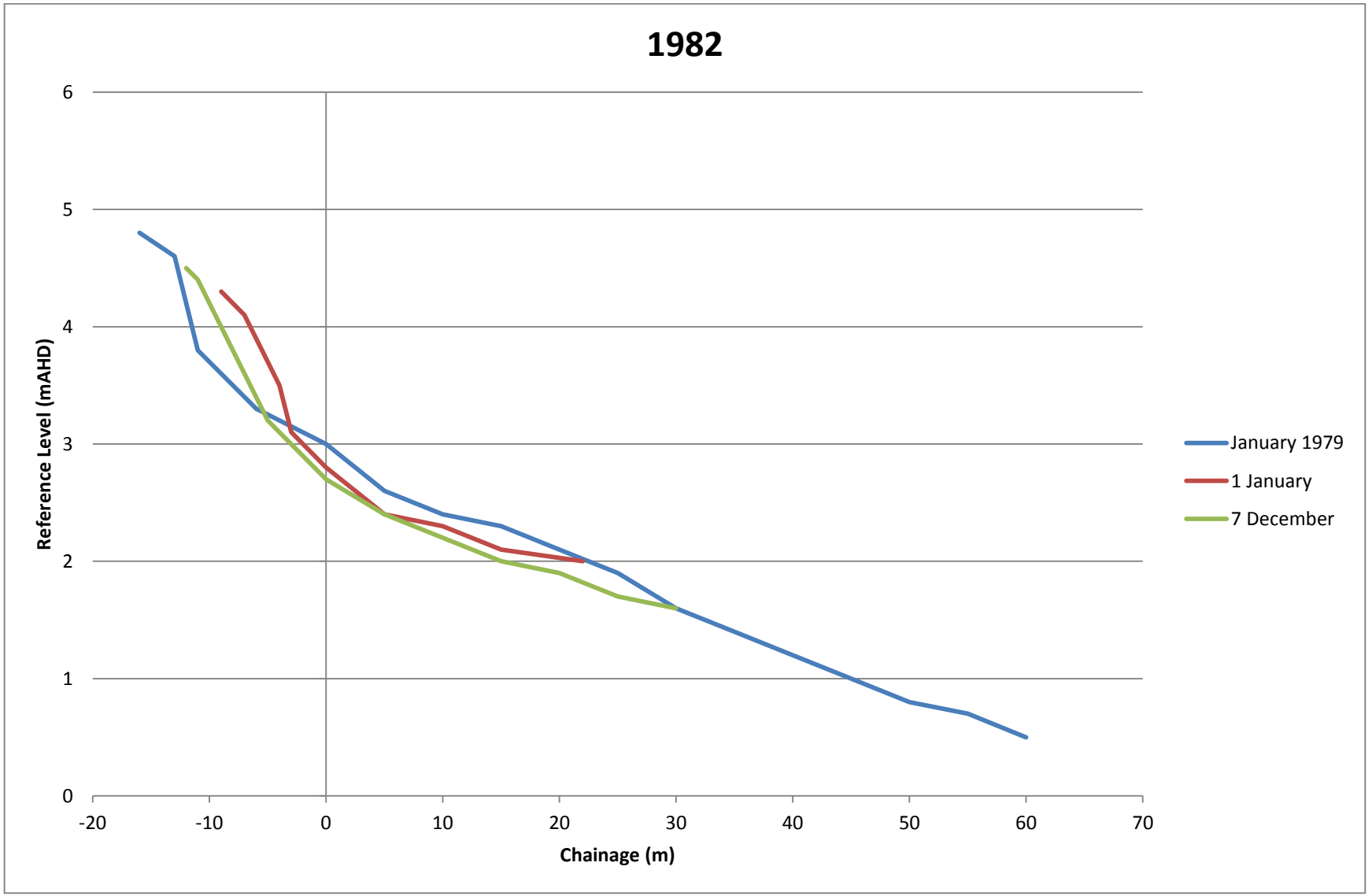


Figure 73 Seaforth South - Monthly beach profile - 1982

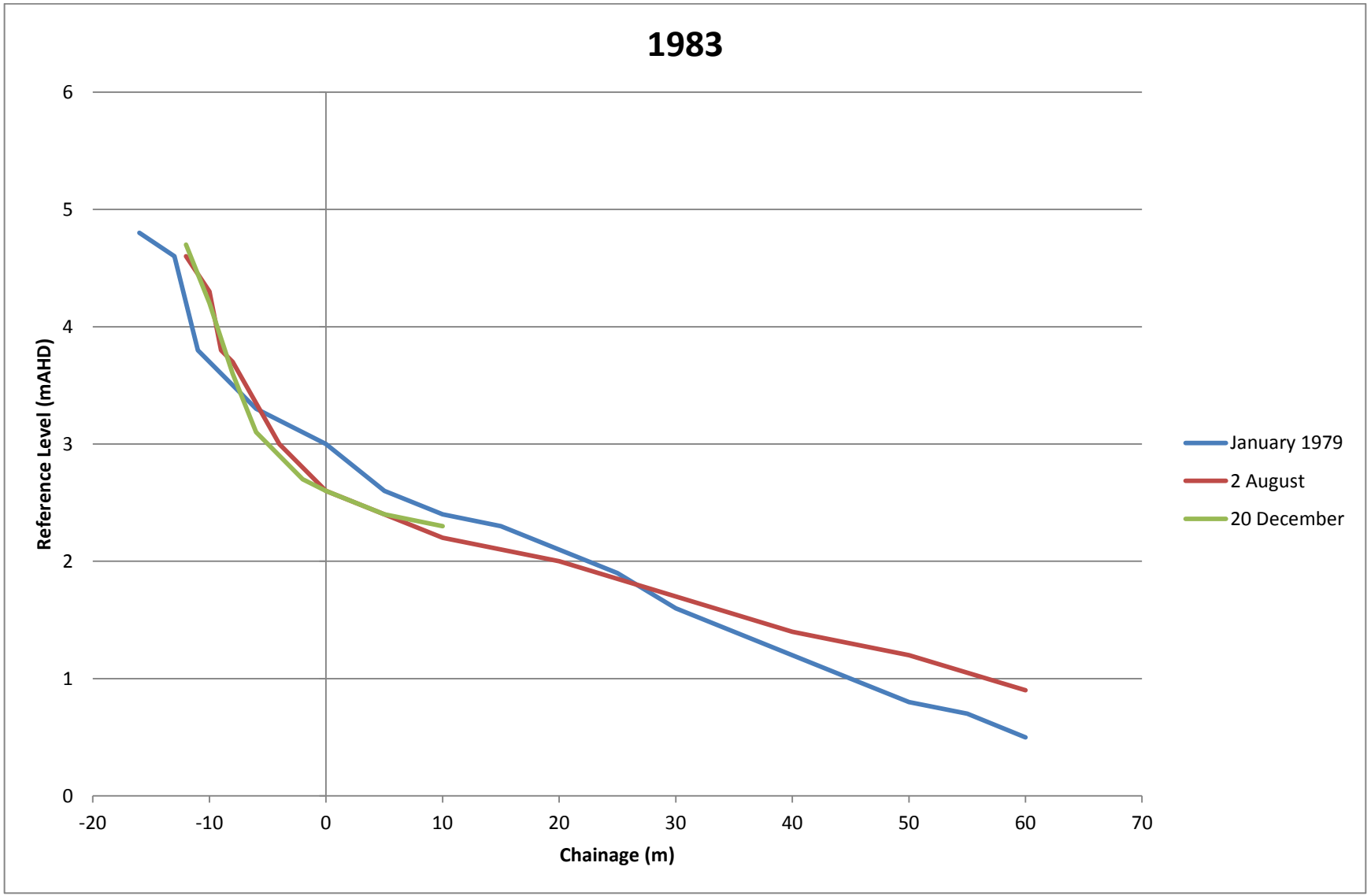


Figure 74 Seaforth South - Monthly beach profile – 1983

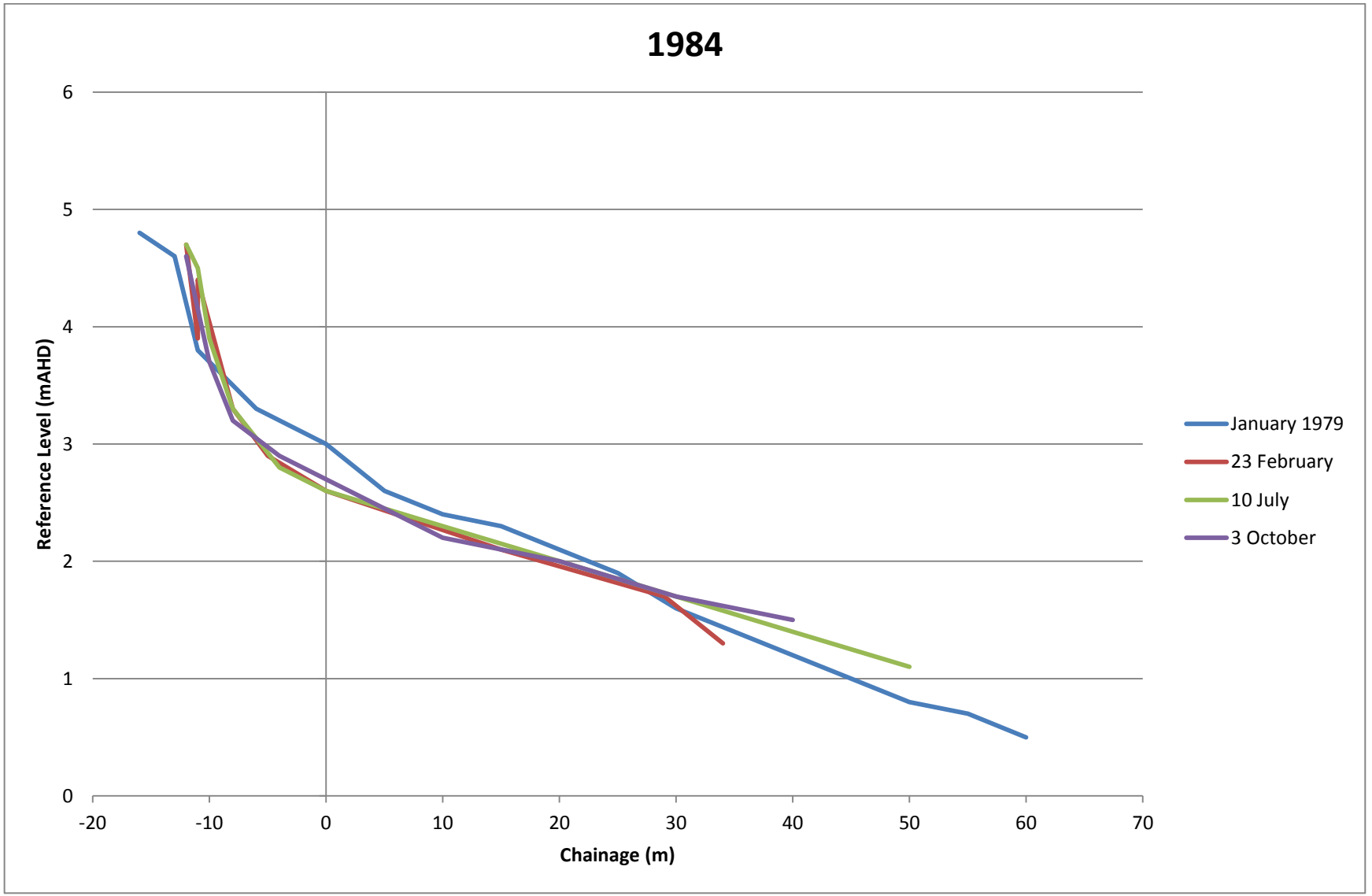


Figure 75 Seaforth South - Monthly beach profile – 1984

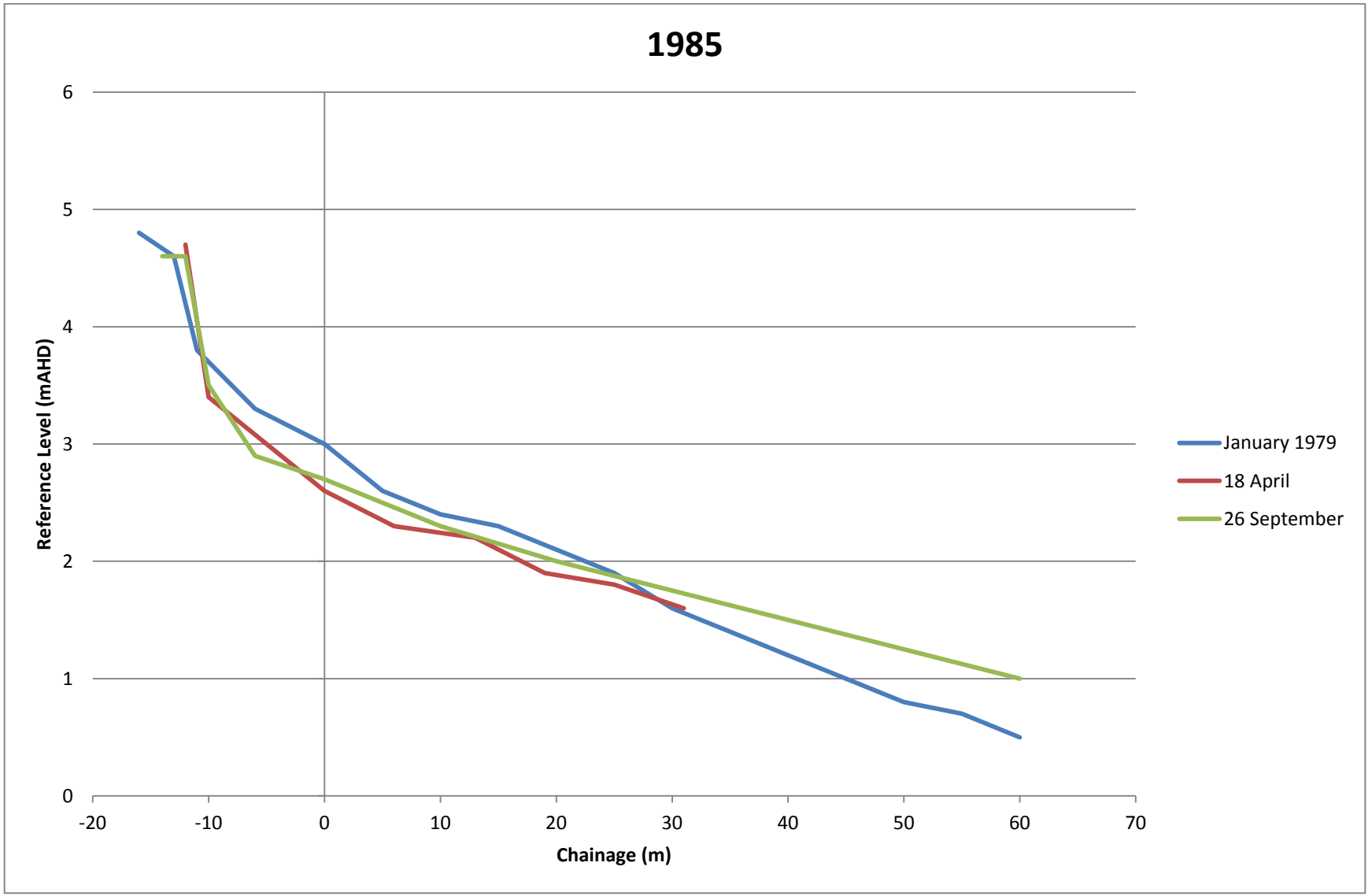


Figure 76 Seaforth South - Monthly beach profile – 1985

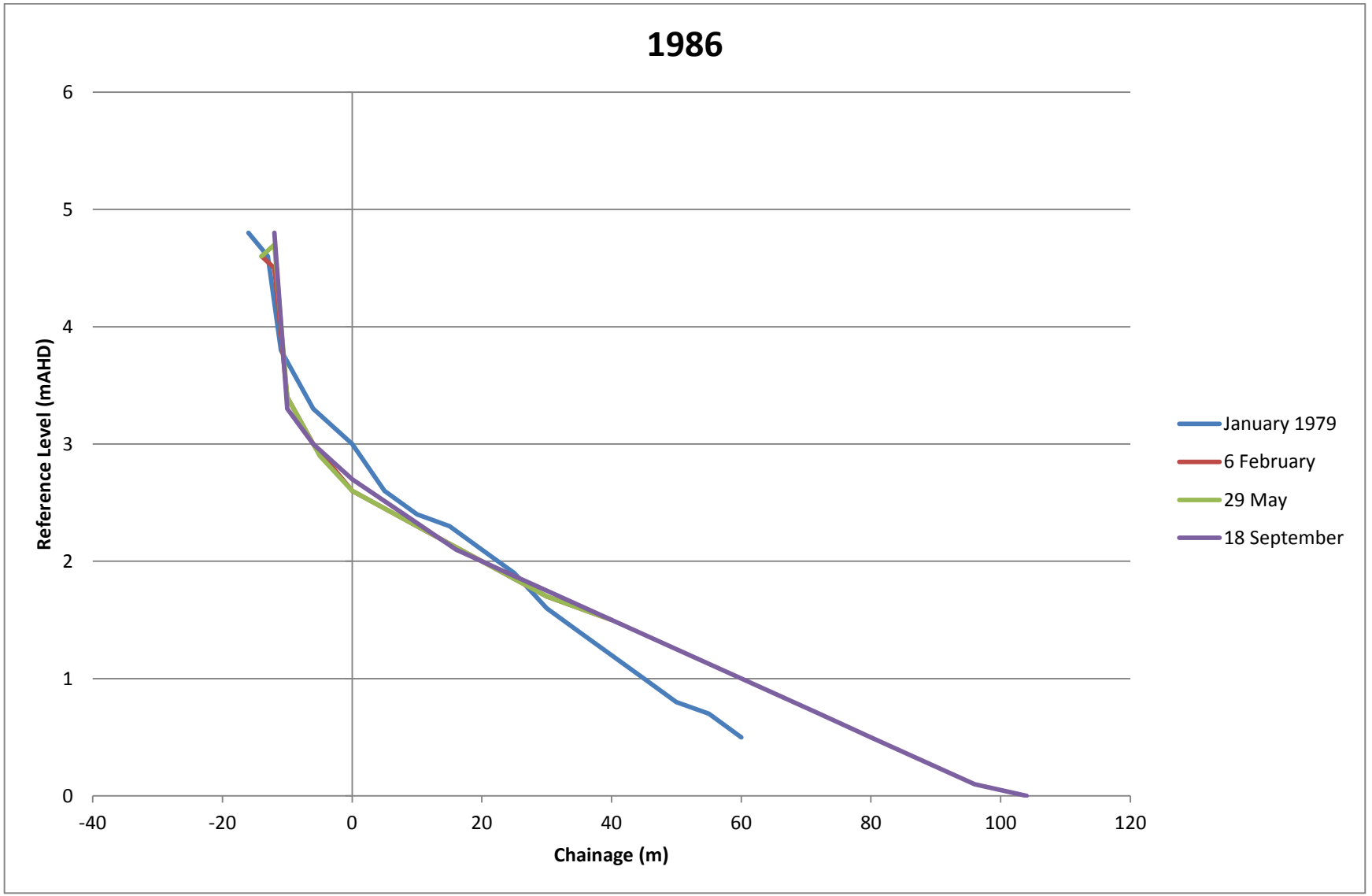


Figure 77 Seaforth South - Monthly beach profile – 1986

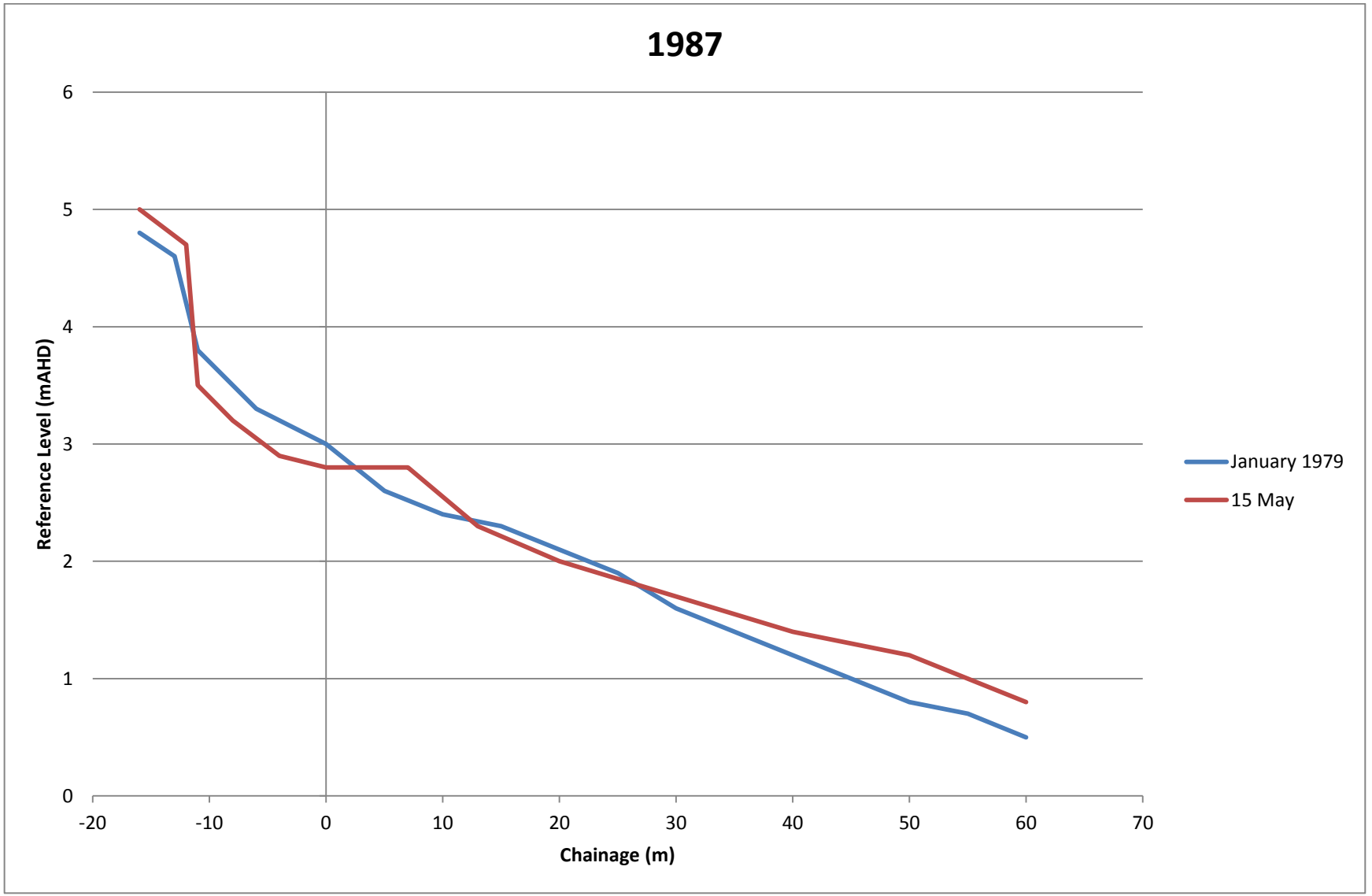


Figure 78 Seaforth South - Monthly beach profile – 1987

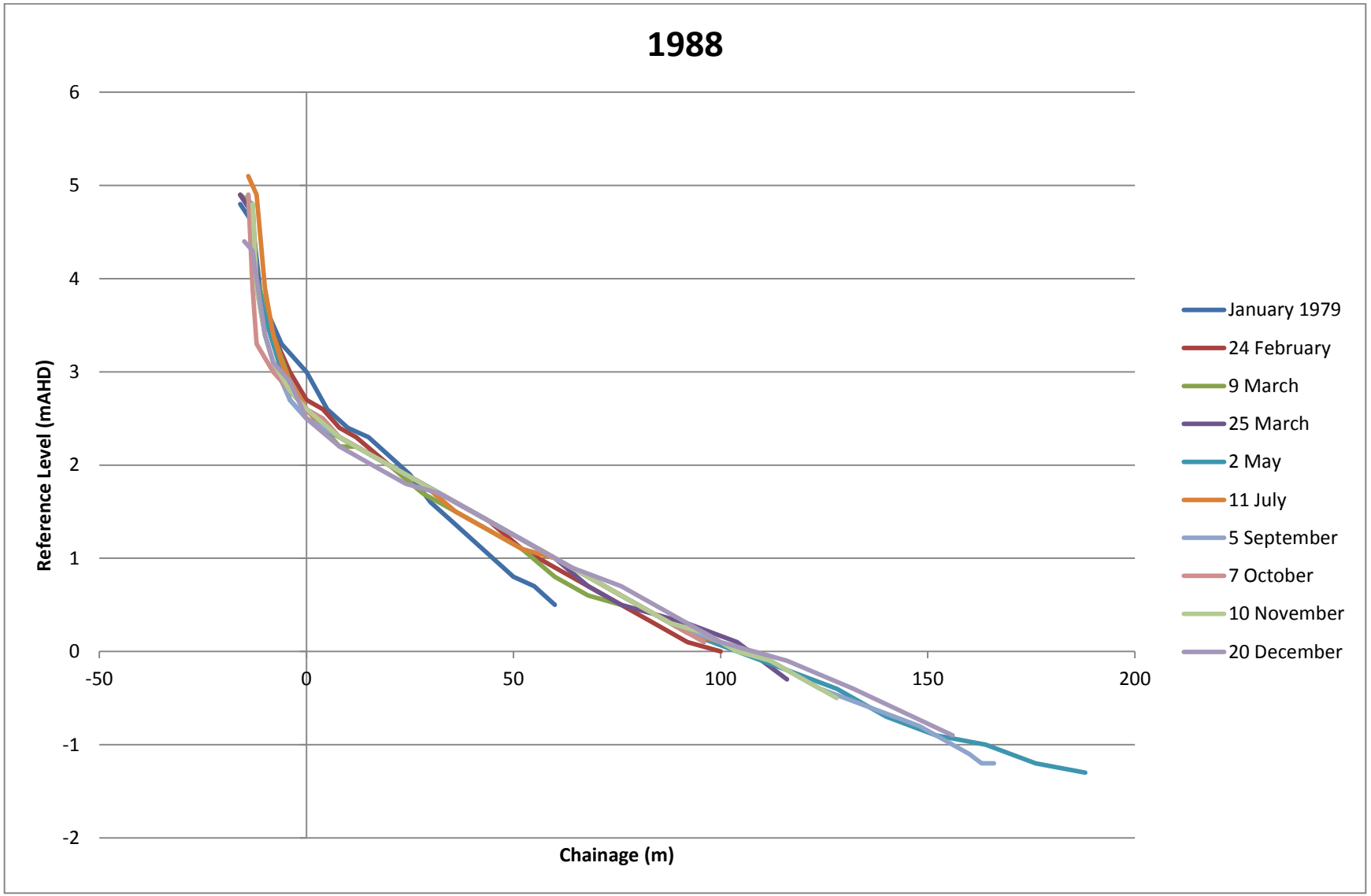


Figure 79 Seaforth South - Monthly beach profile – 1988

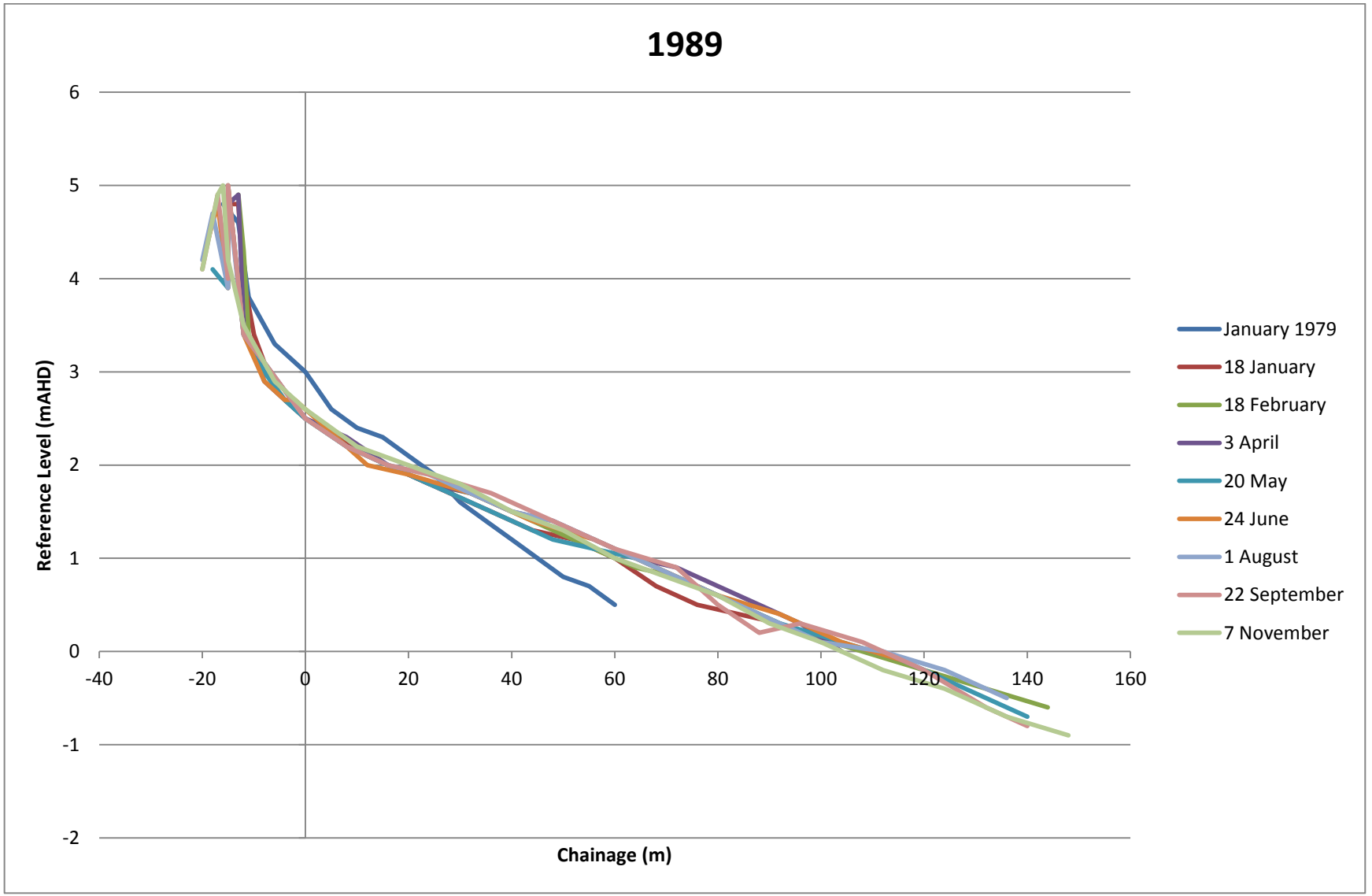


Figure 80 Seaforth South - Monthly beach profile – 1989

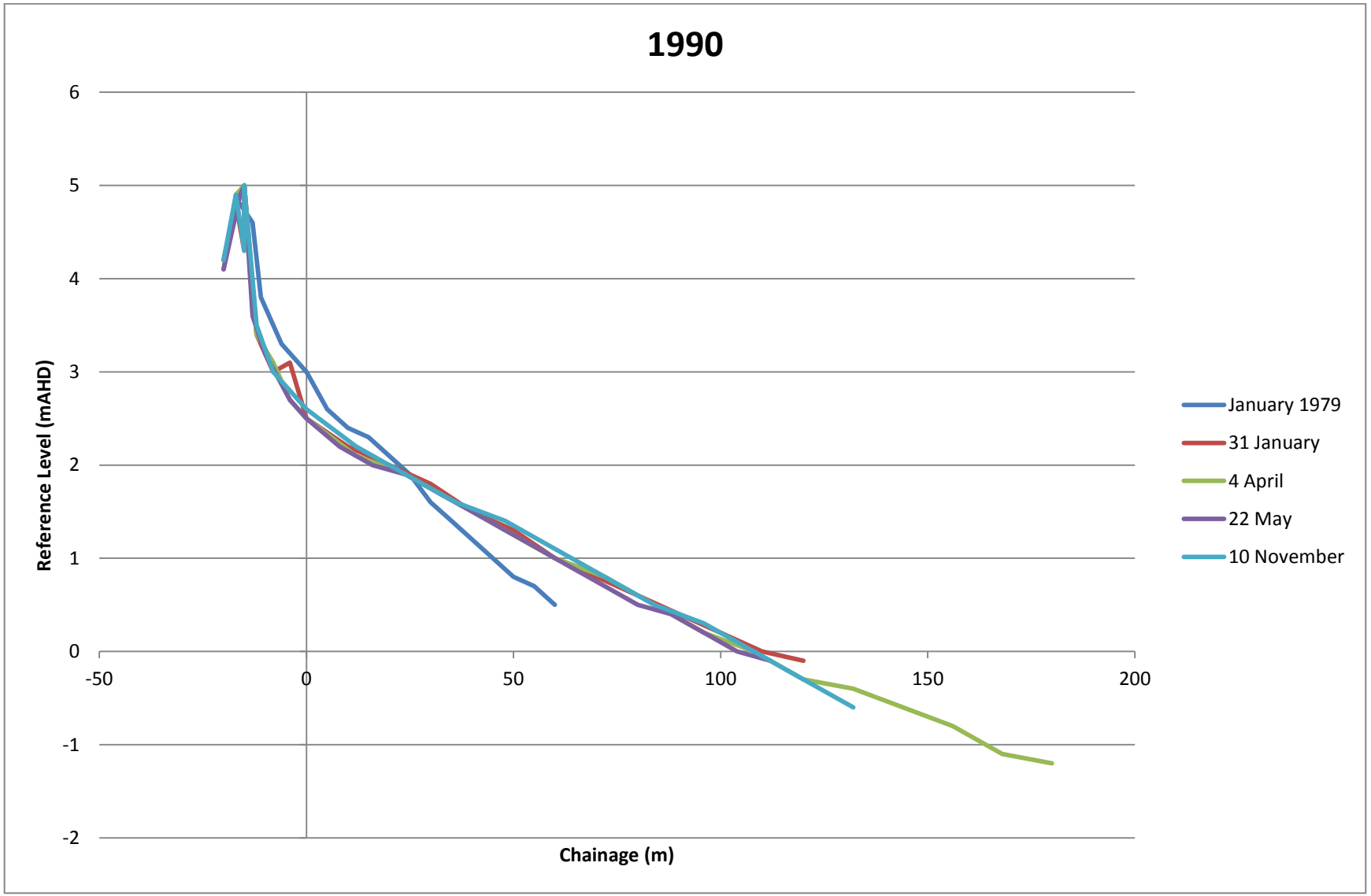


Figure 81 Seaforth South - Monthly beach profile – 1990

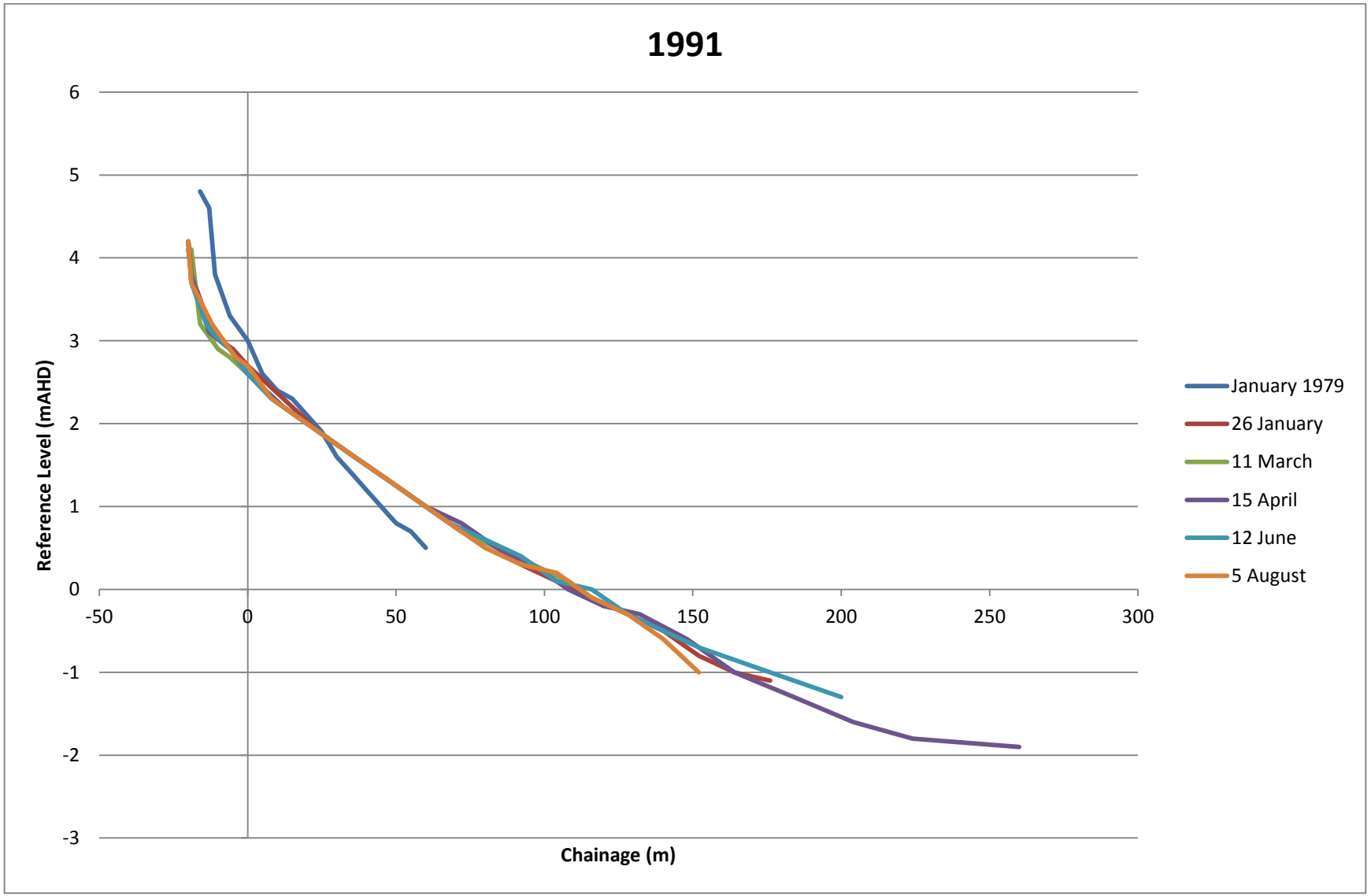


Figure 82 Seaforth South - Monthly beach profile – 1991

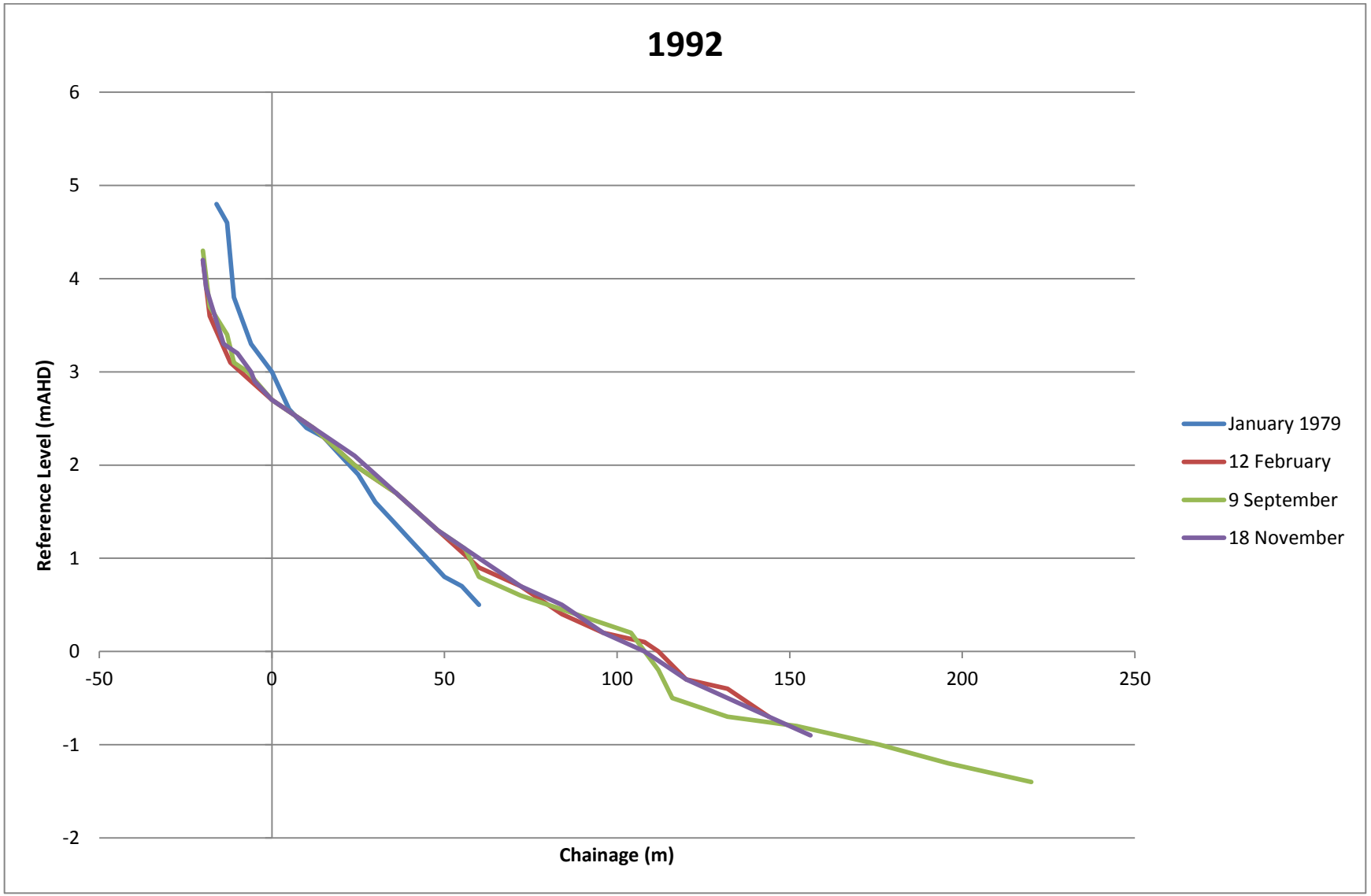


Figure 83 Seaforth South - Monthly beach profile – 1992

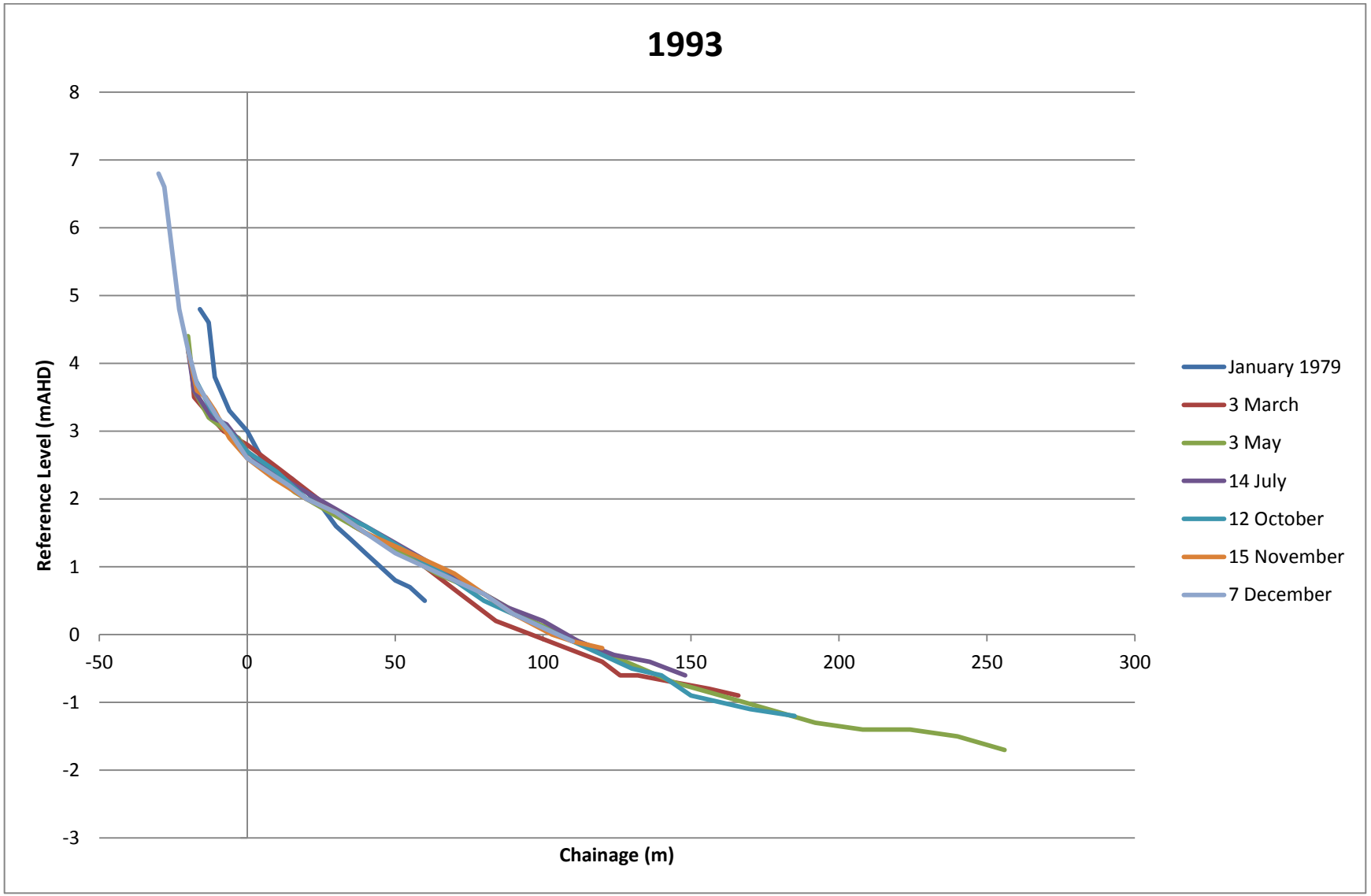


Figure 84 Seaforth South - Monthly beach profile – 1993

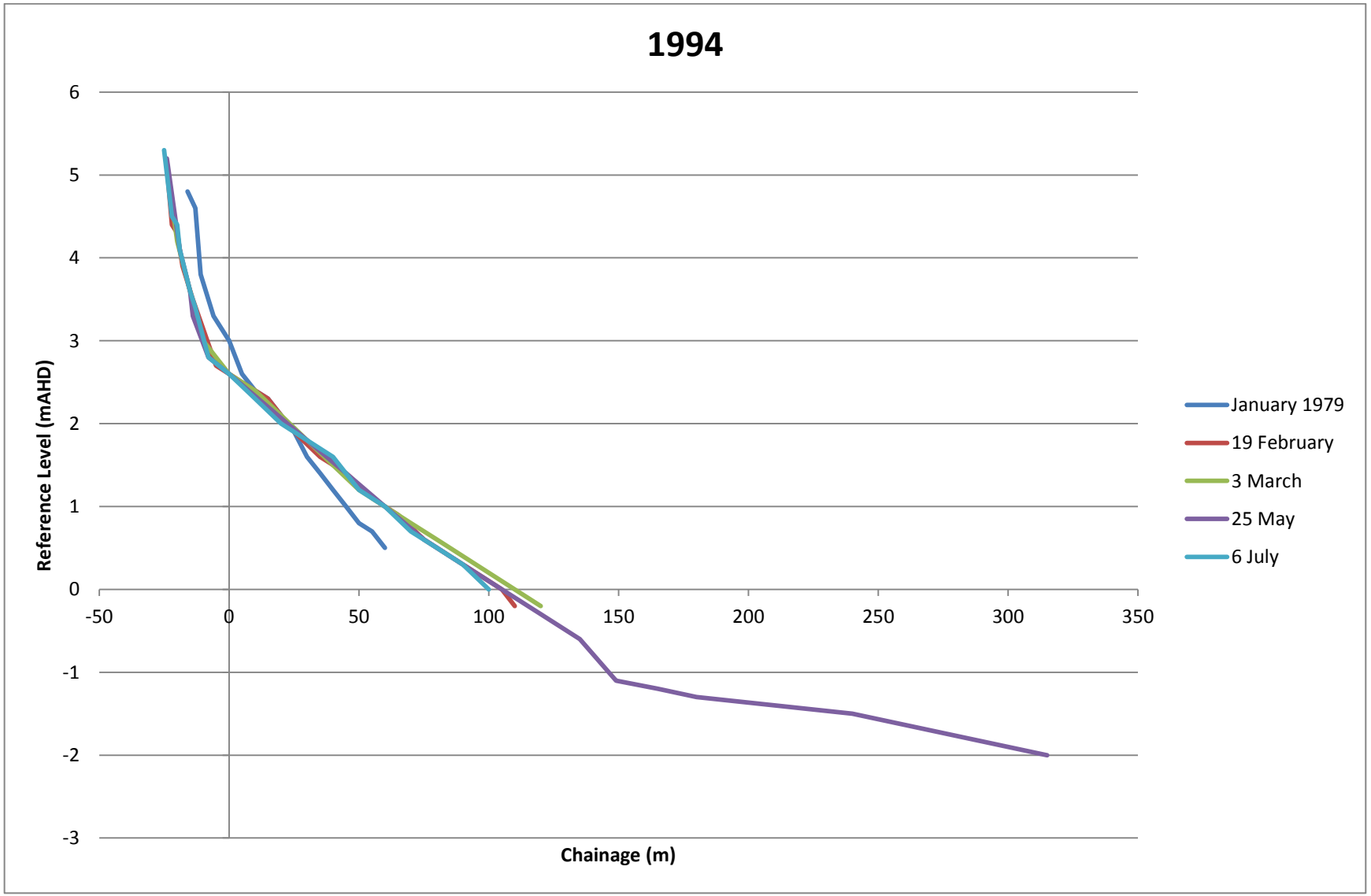


Figure 85 Seaforth South - Monthly beach profile – 1994

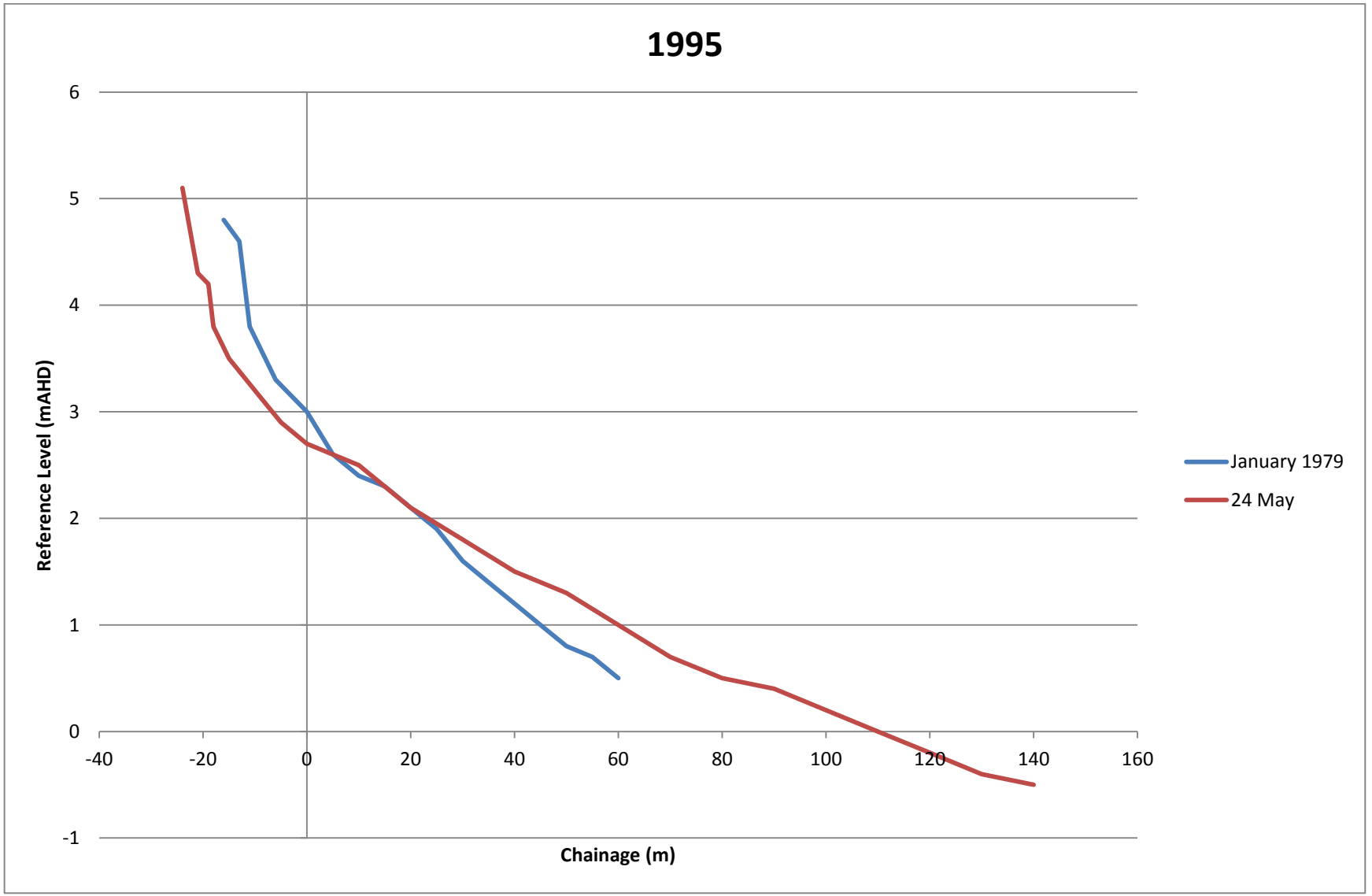


Figure 86 Seaforth South - Monthly beach profile – 1995

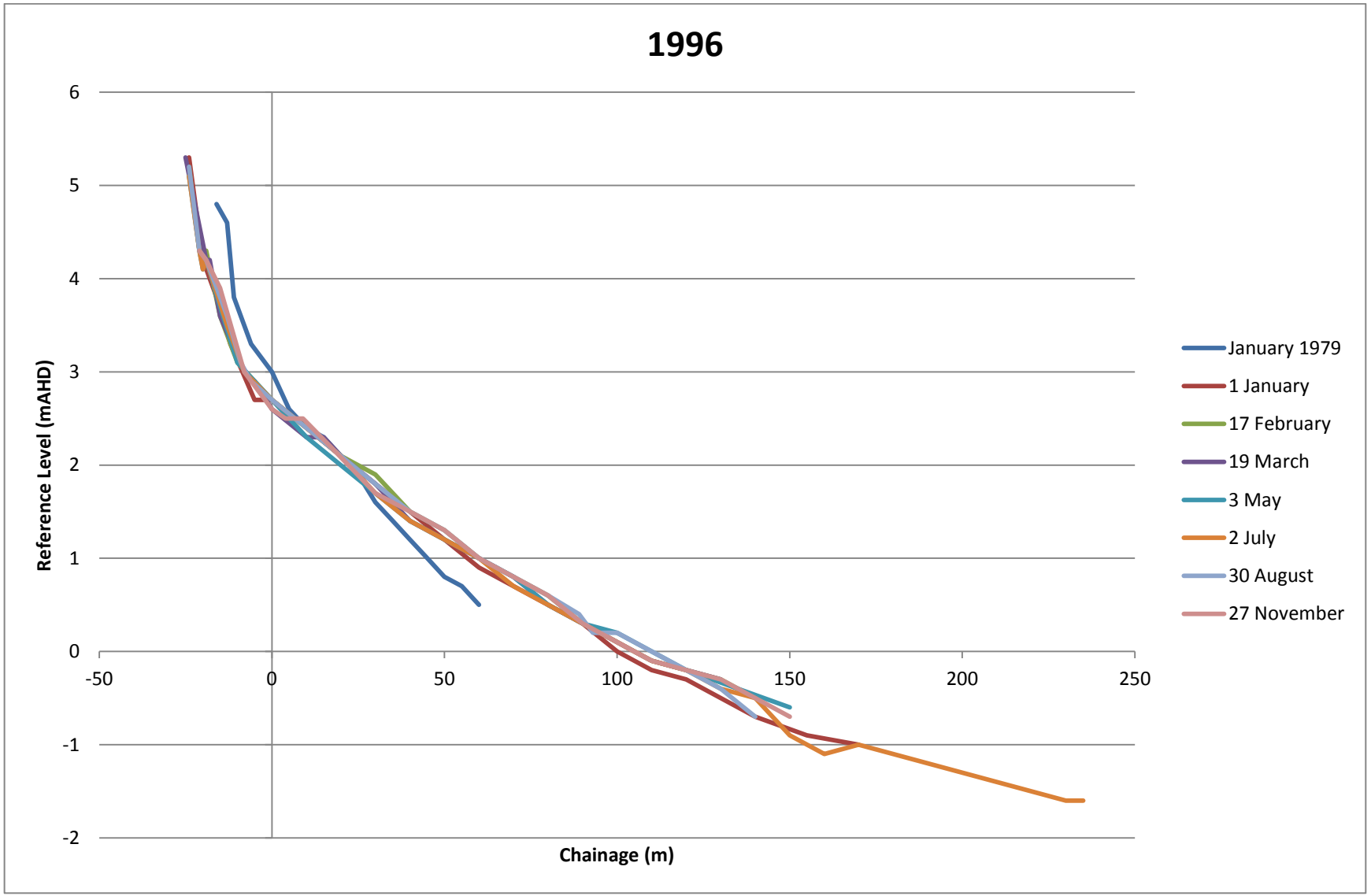


Figure 87 Seaforth South– Monthly beach profile – 1996

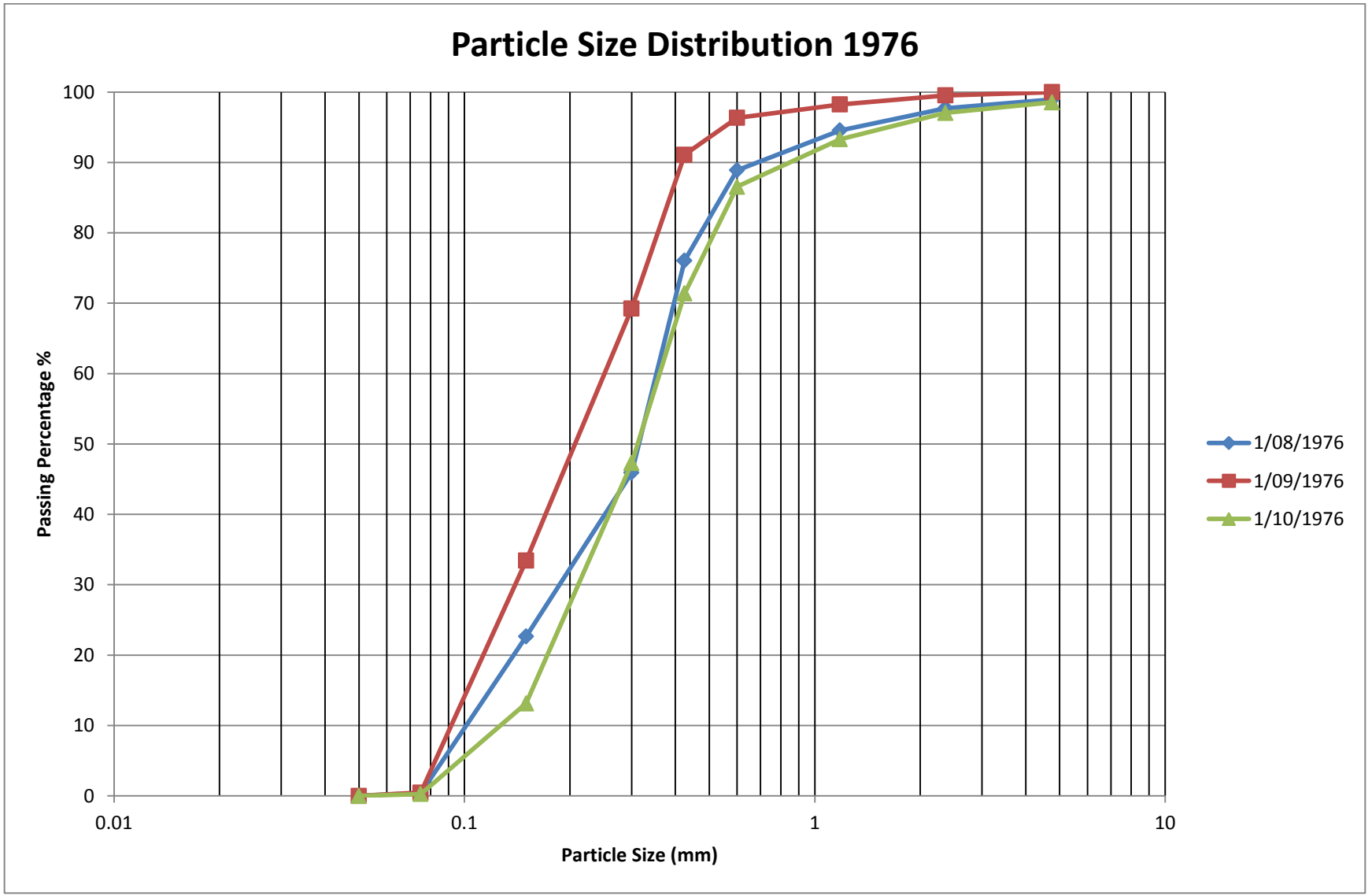


Figure 88 Particle size distribution 1976

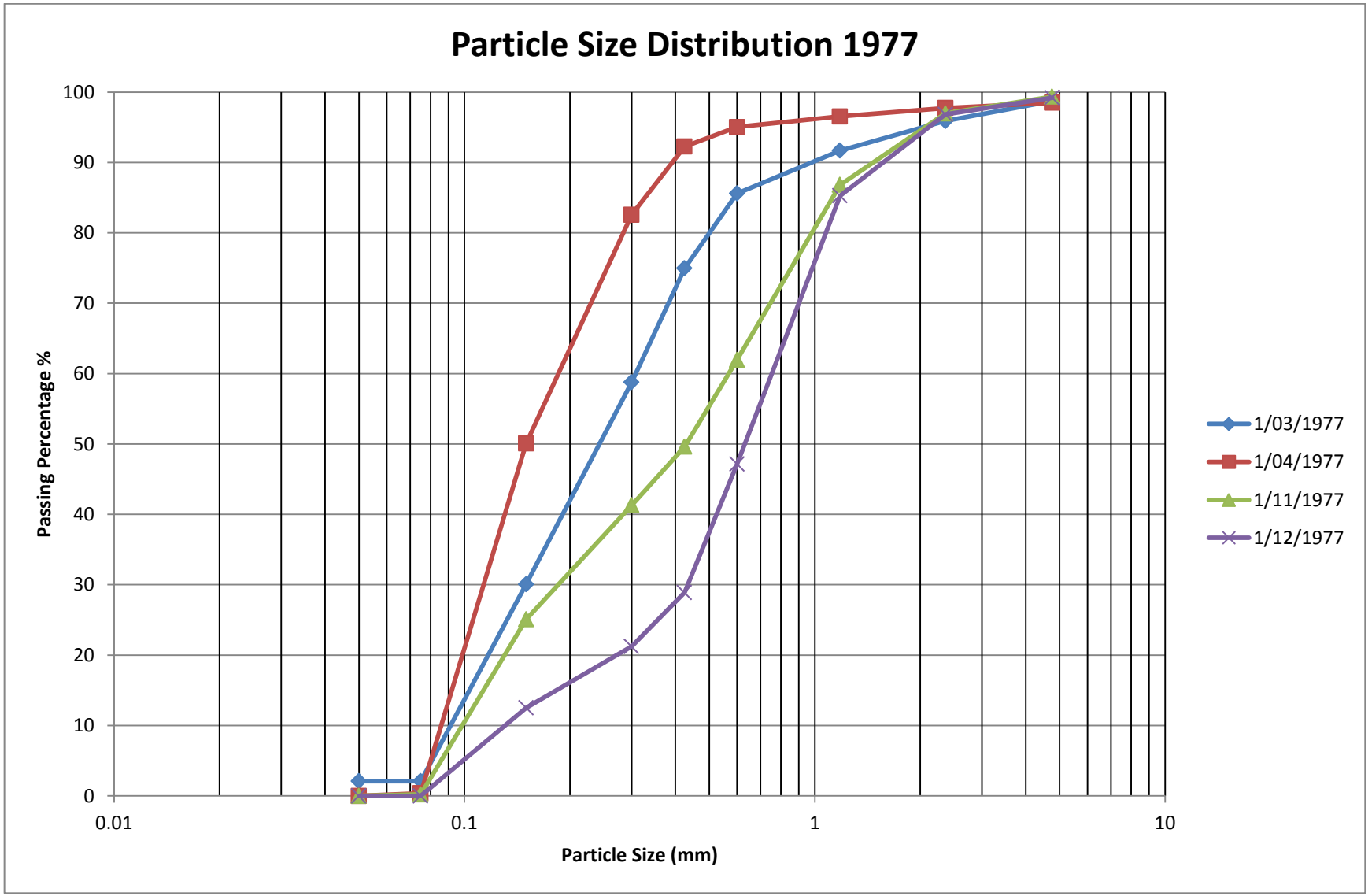


Figure 89 Particle size distribution 1977

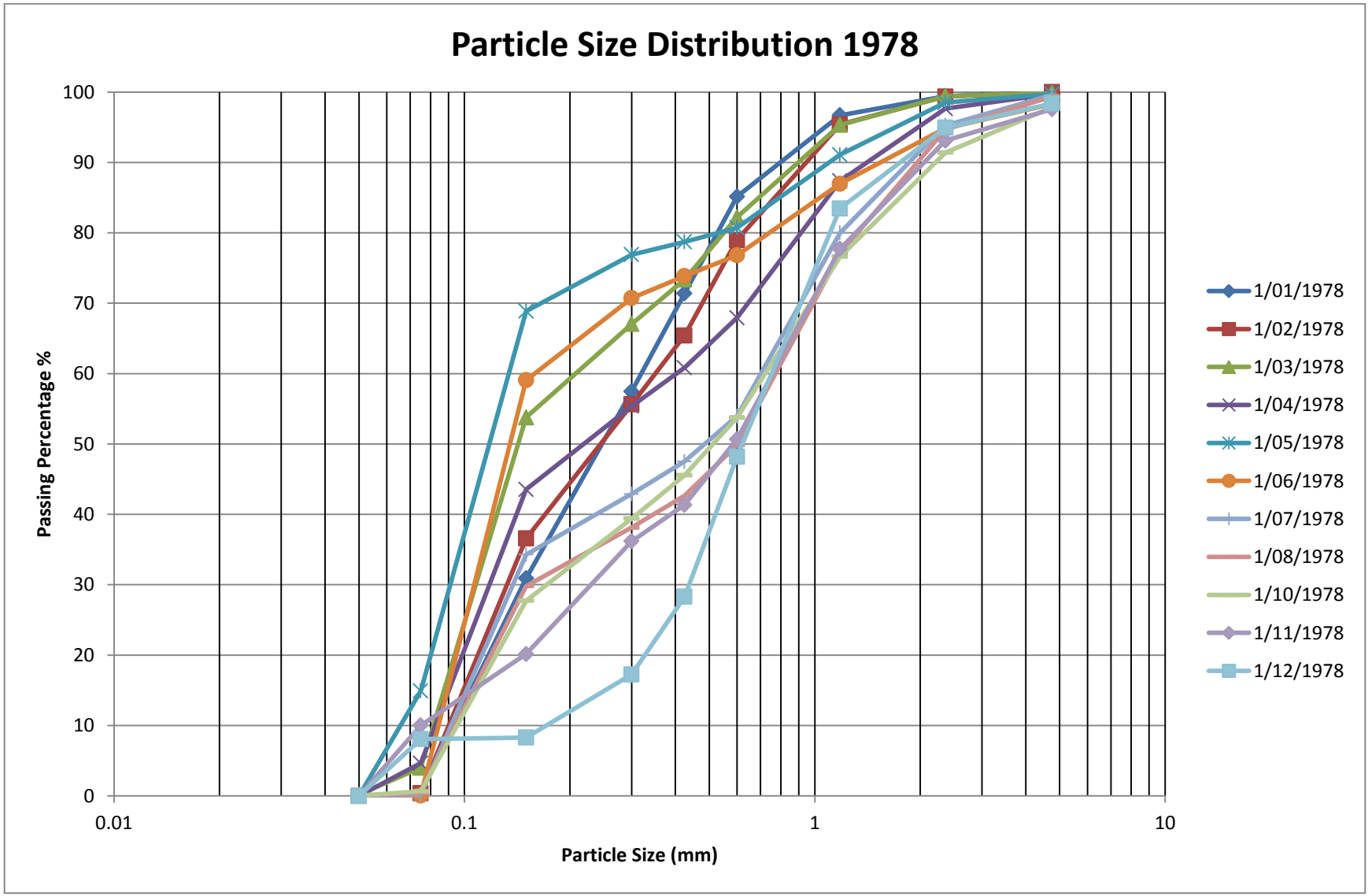


Figure 90 Particle size distribution 1978

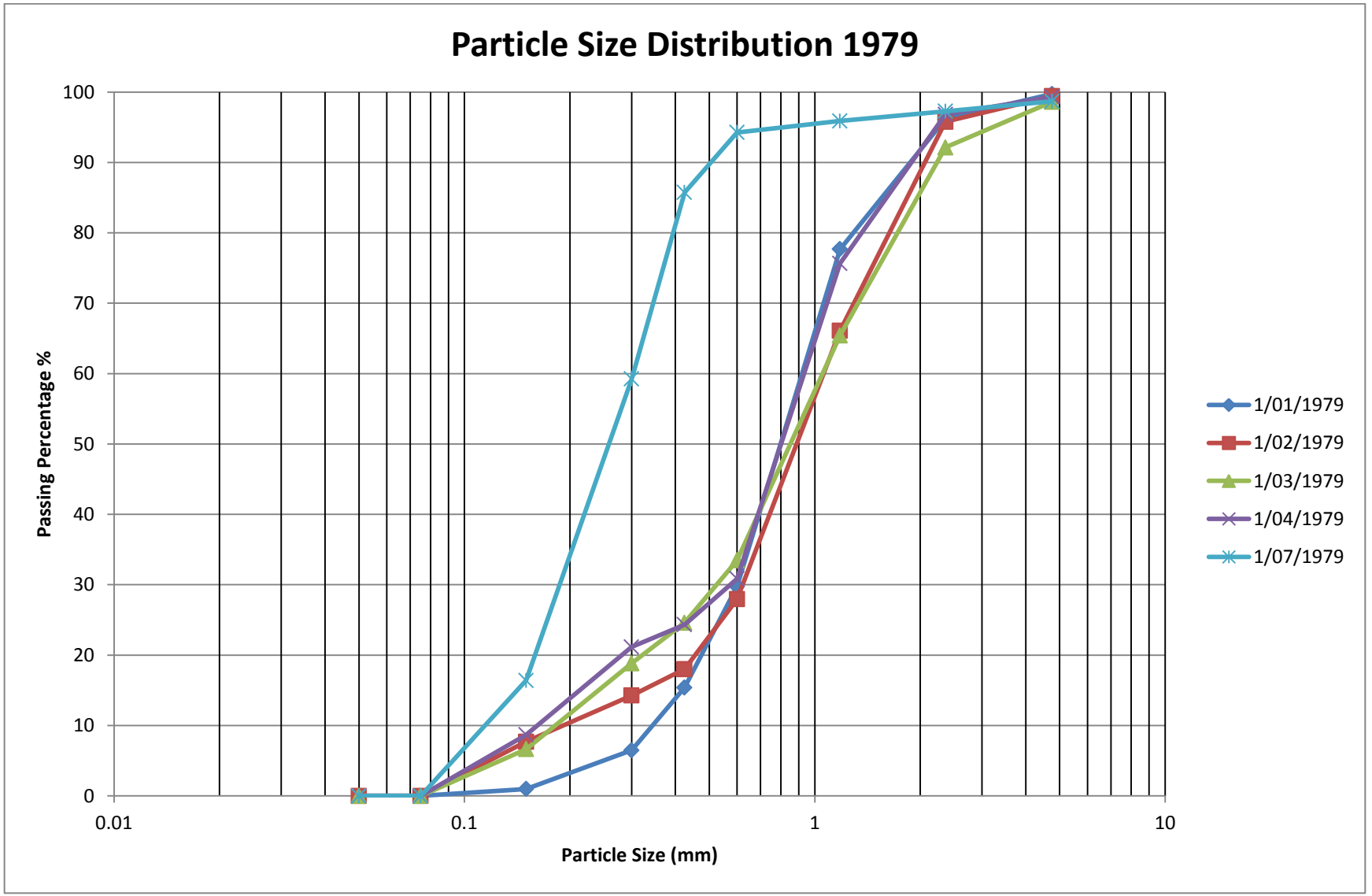


Figure 91 Particle size distribution 1979

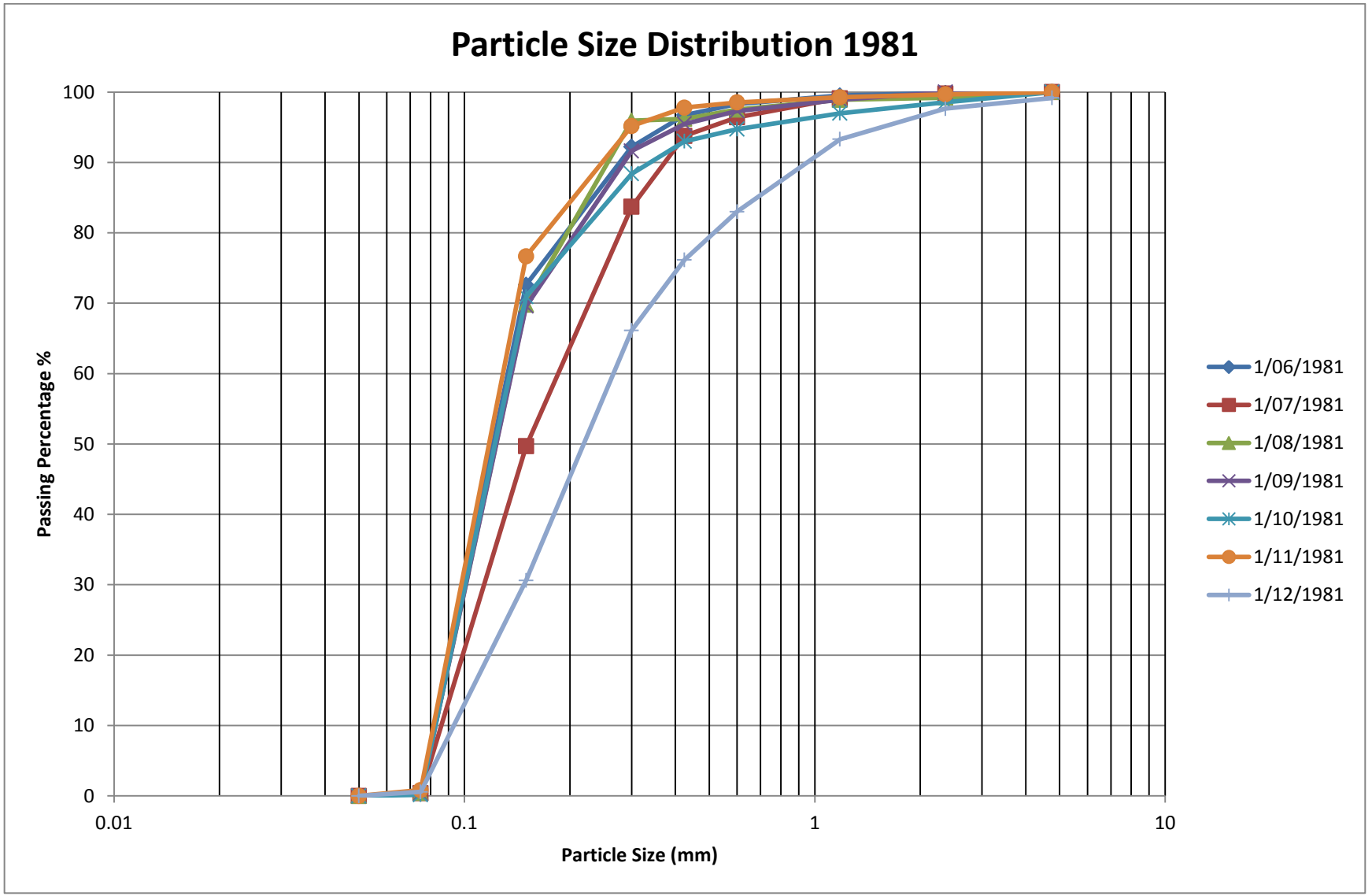


Figure 92 Particle size distribution 1981

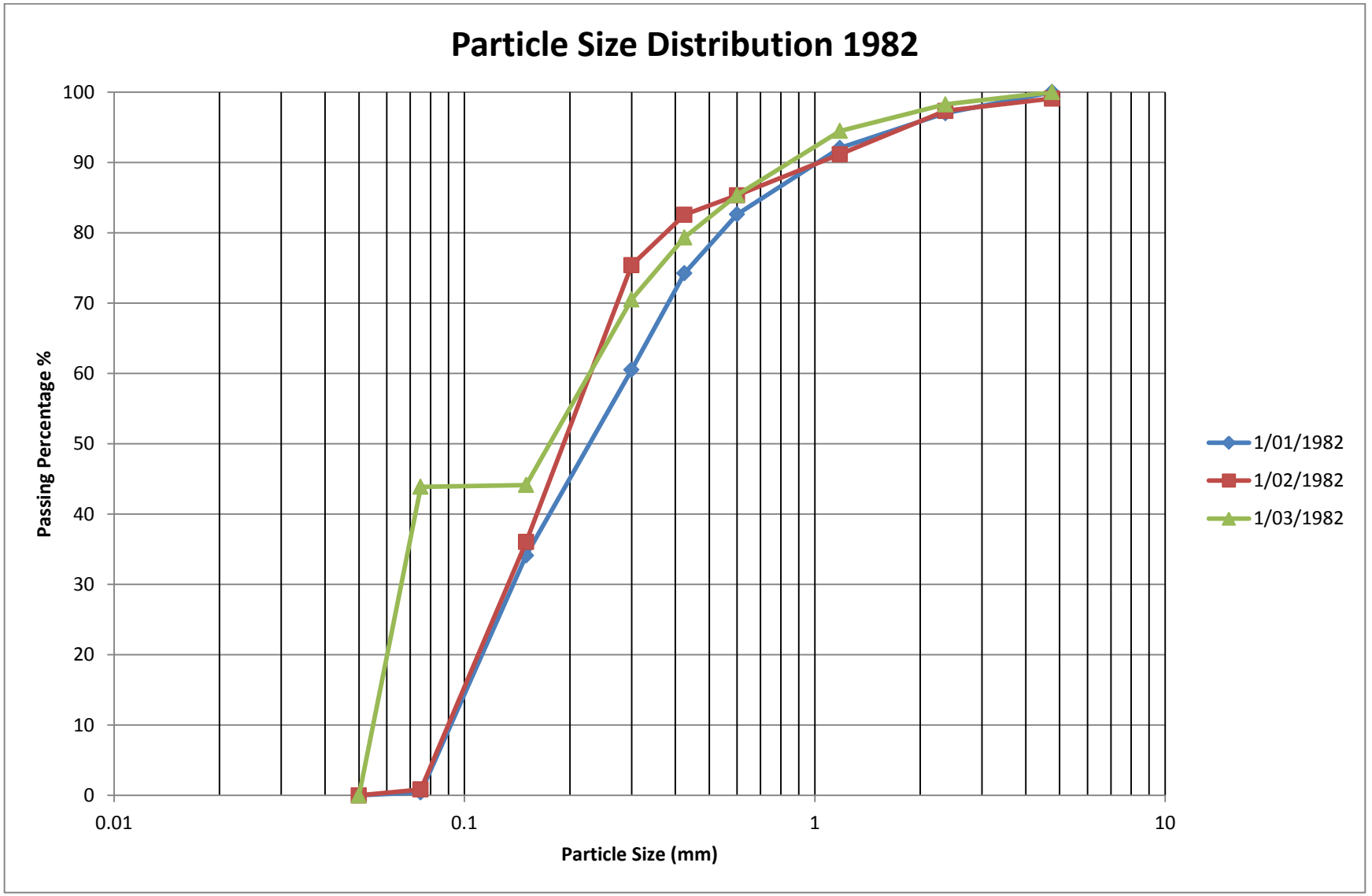


Figure 93 Particle size distribution 1982

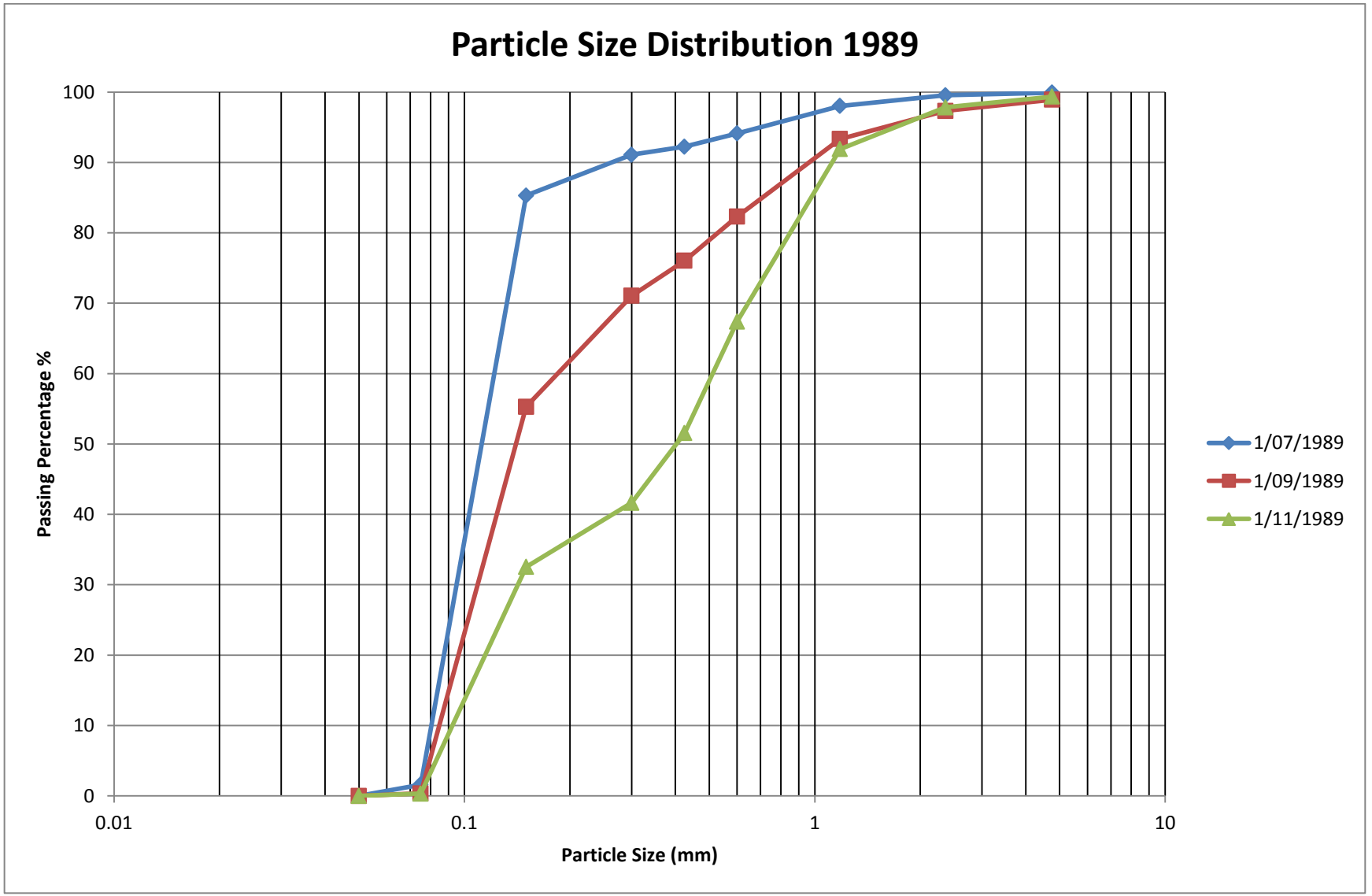


Figure 94 Particle size distribution 1989

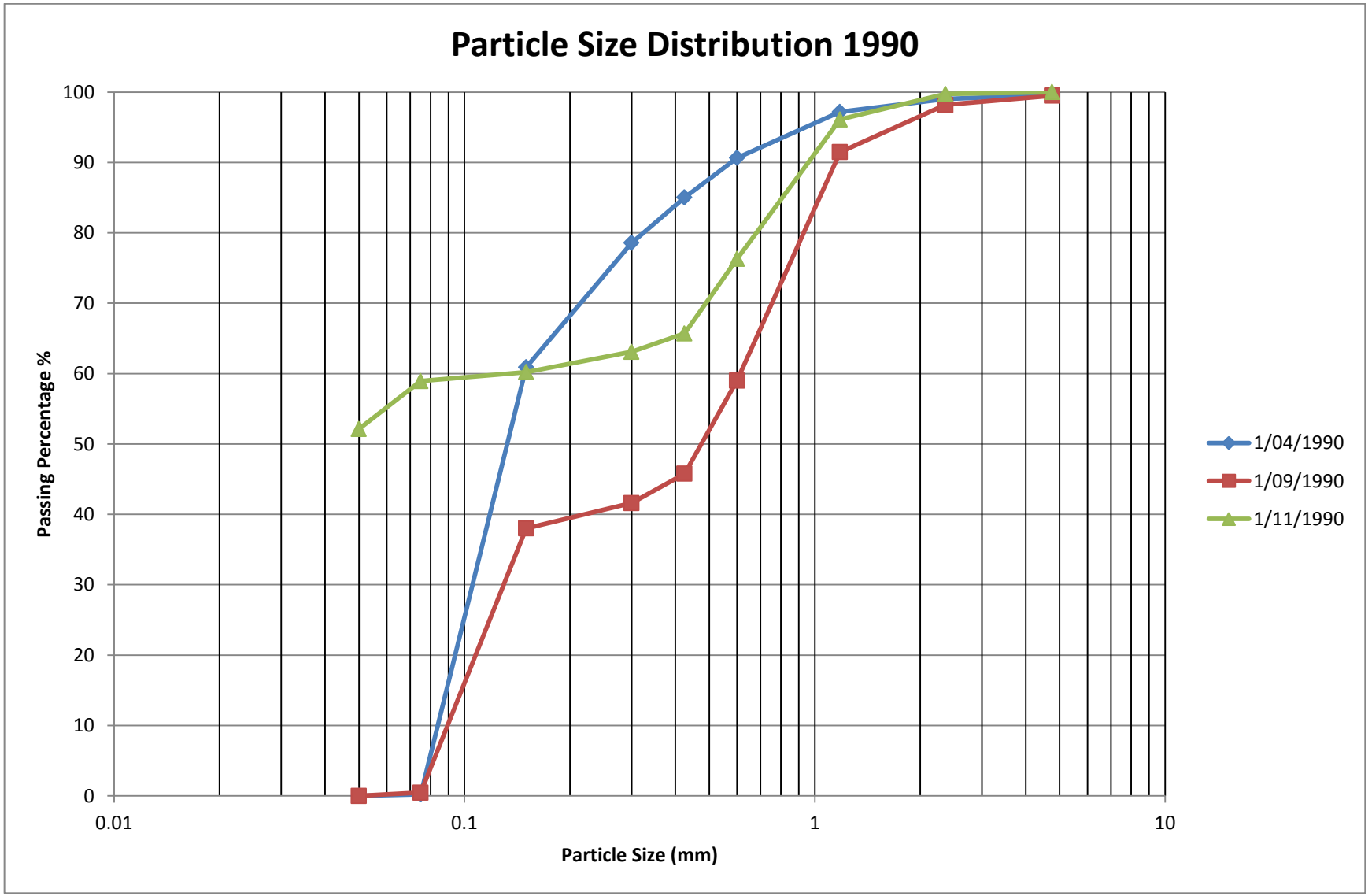


Figure 95 Particle size distribution 1990

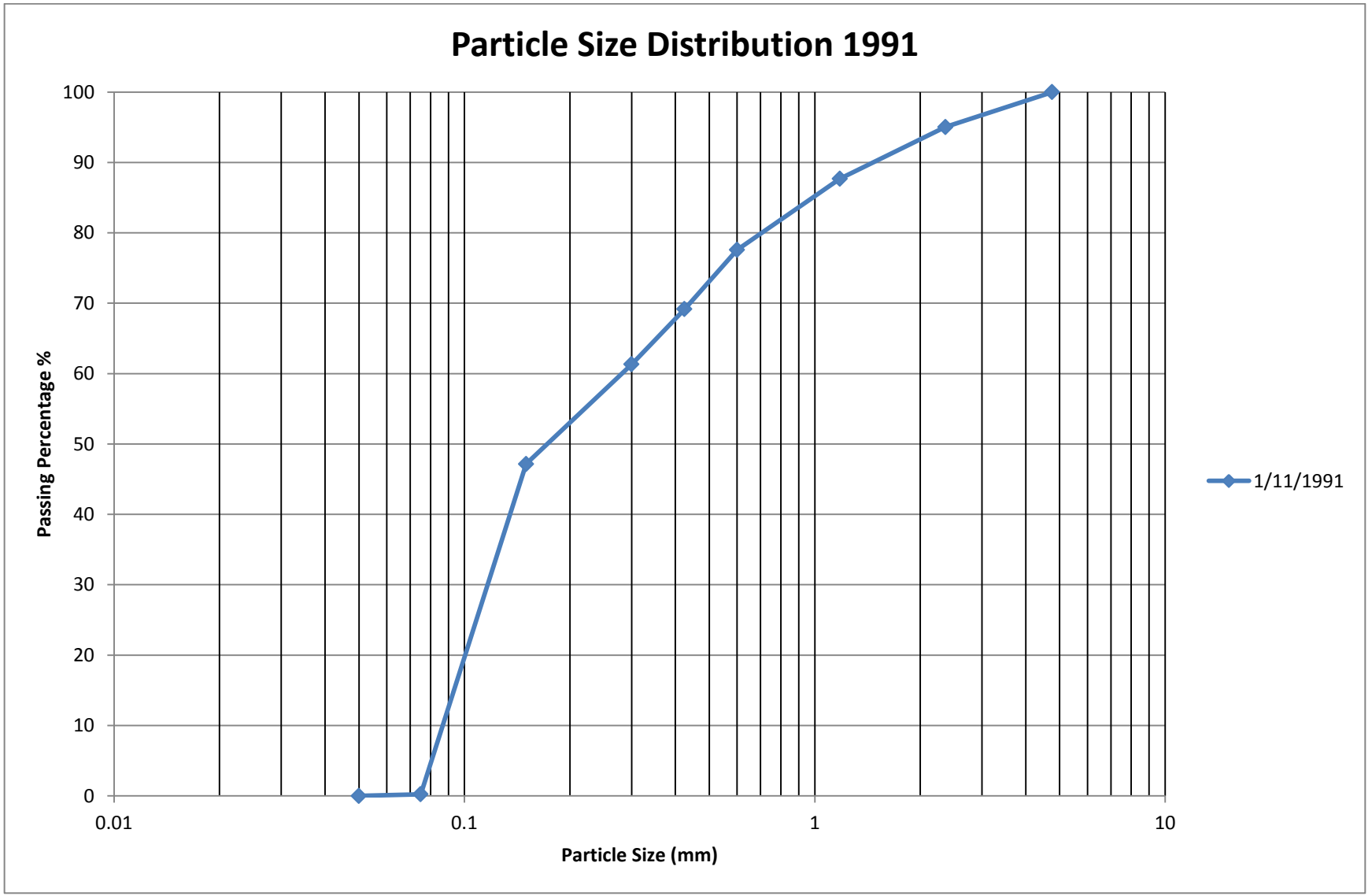


Figure 96 Particle size distribution 1991

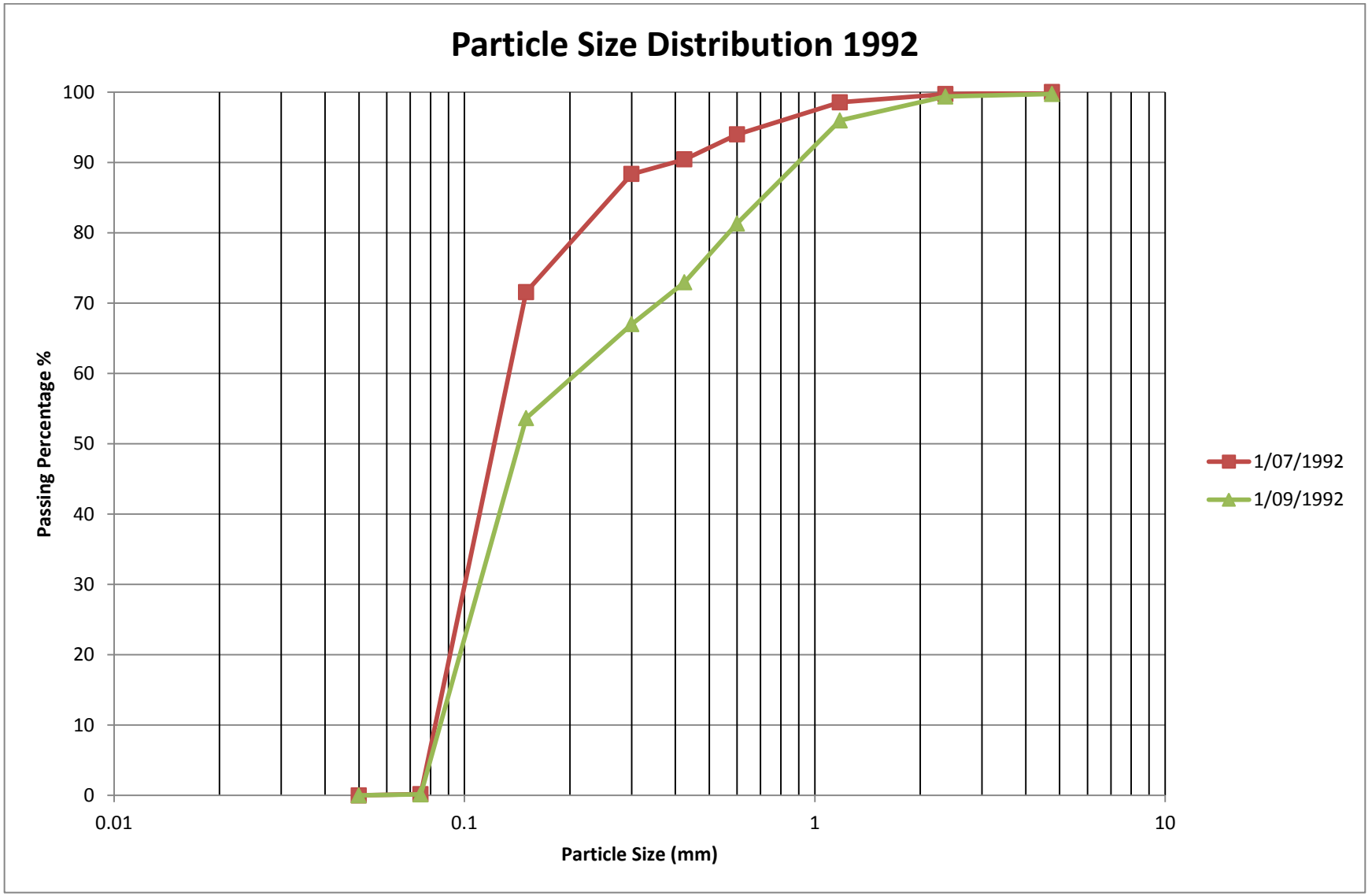


Figure 97 Particle size distribution 1992

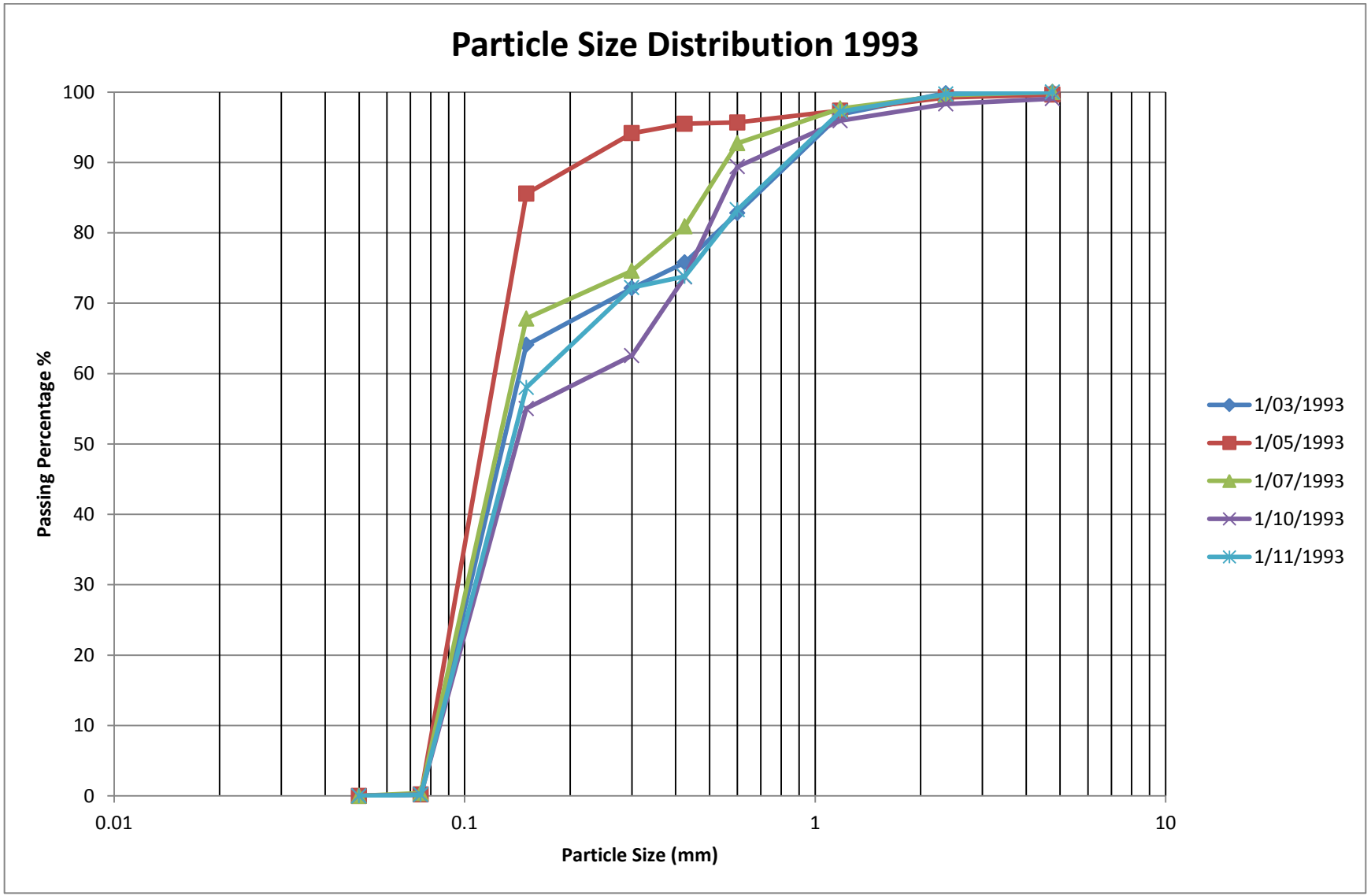


Figure 98 Particle size distribution 1993

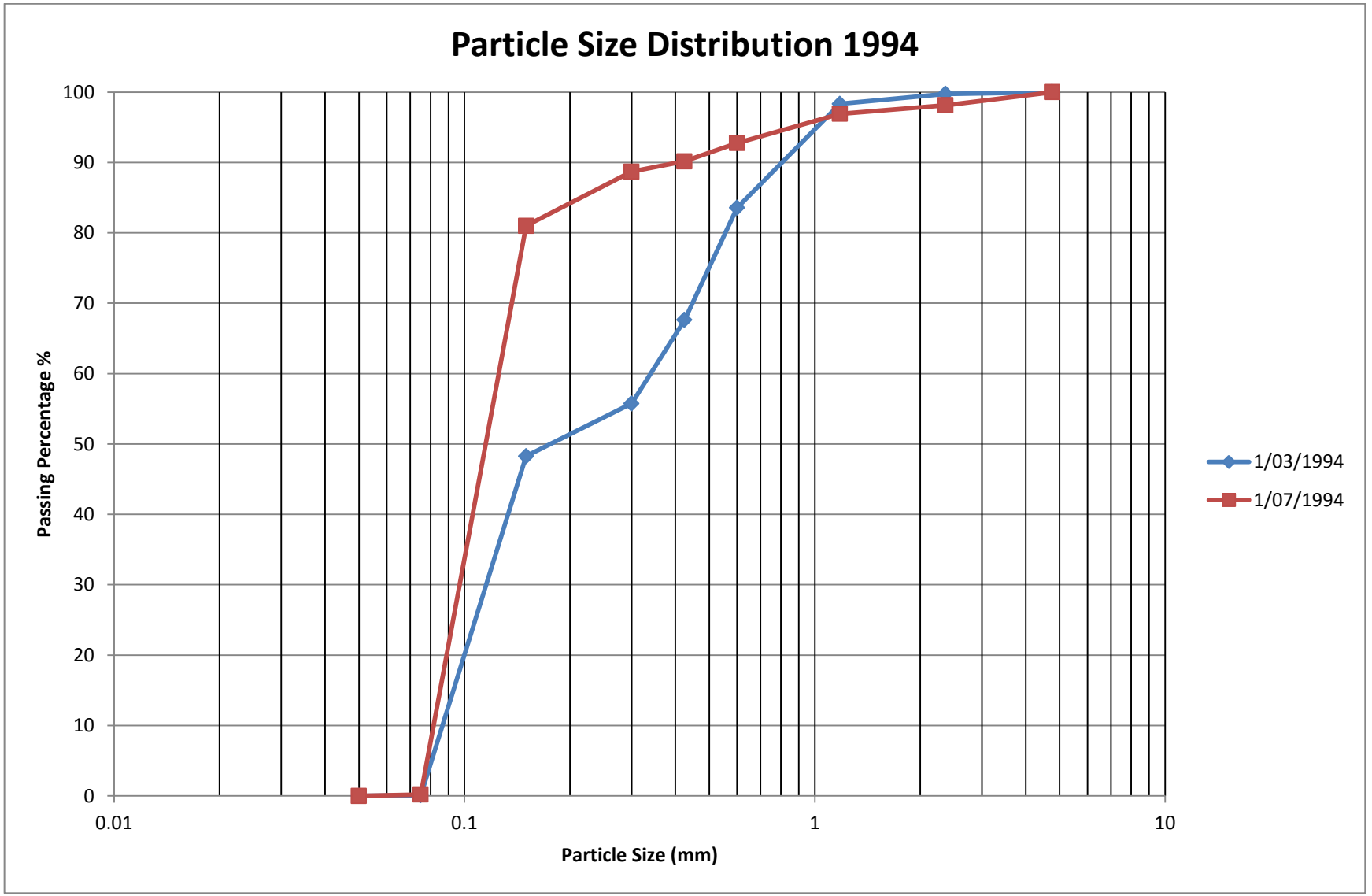


Figure 99 Particle size distribution 1994

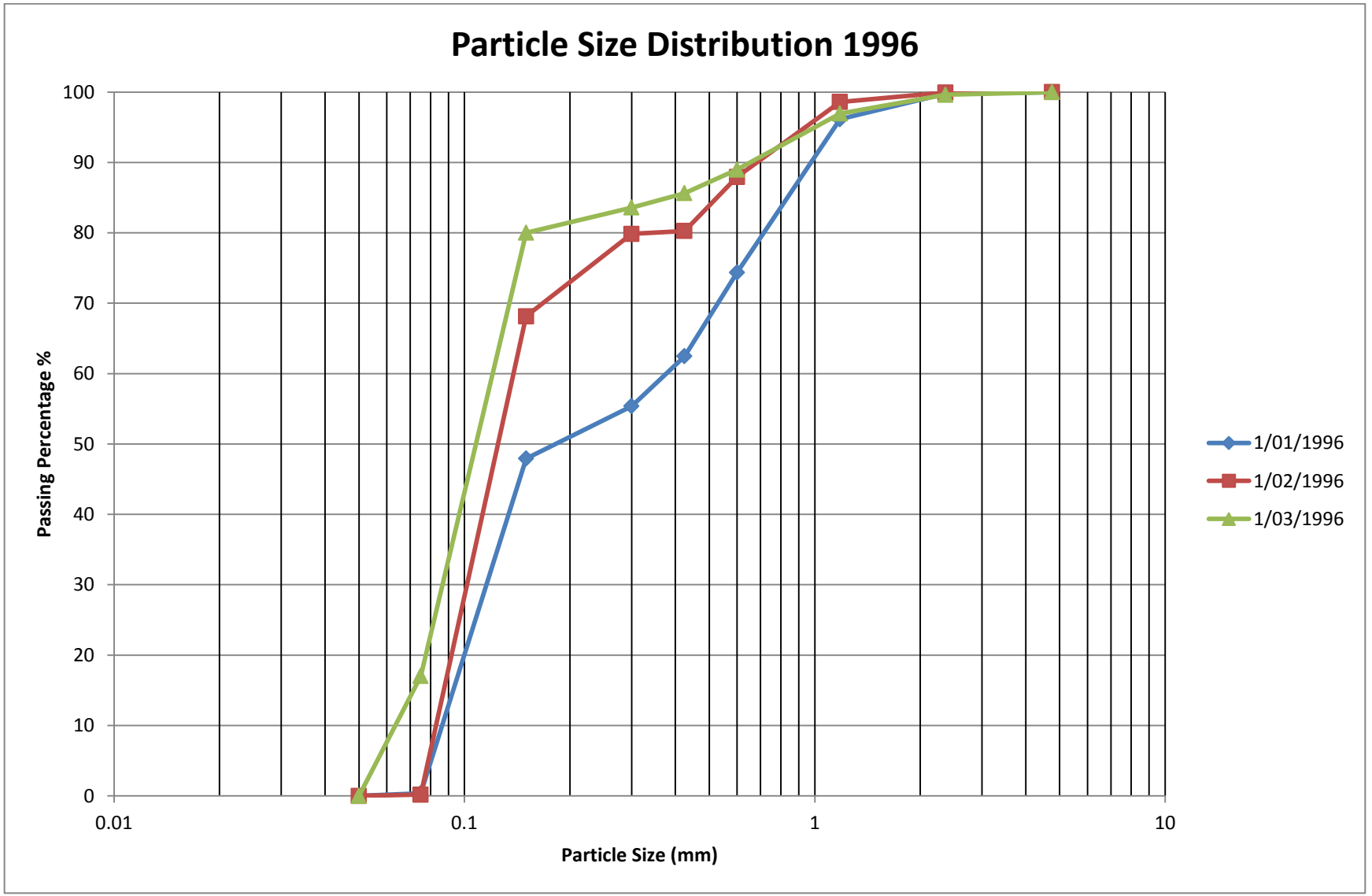


Figure 100 Particle size distribution 1996

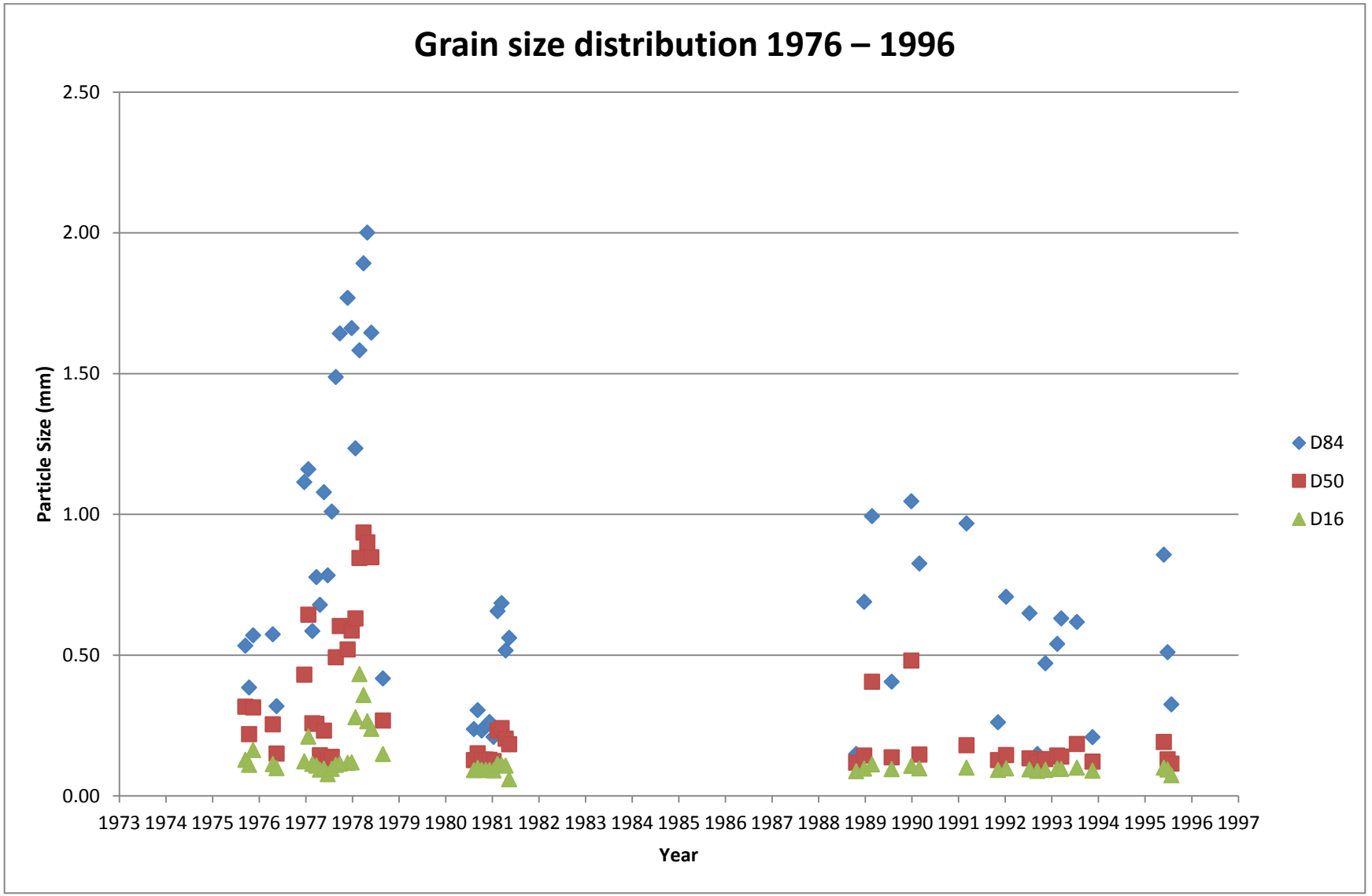


Figure 101 Grain size distribution 1976 – 1996

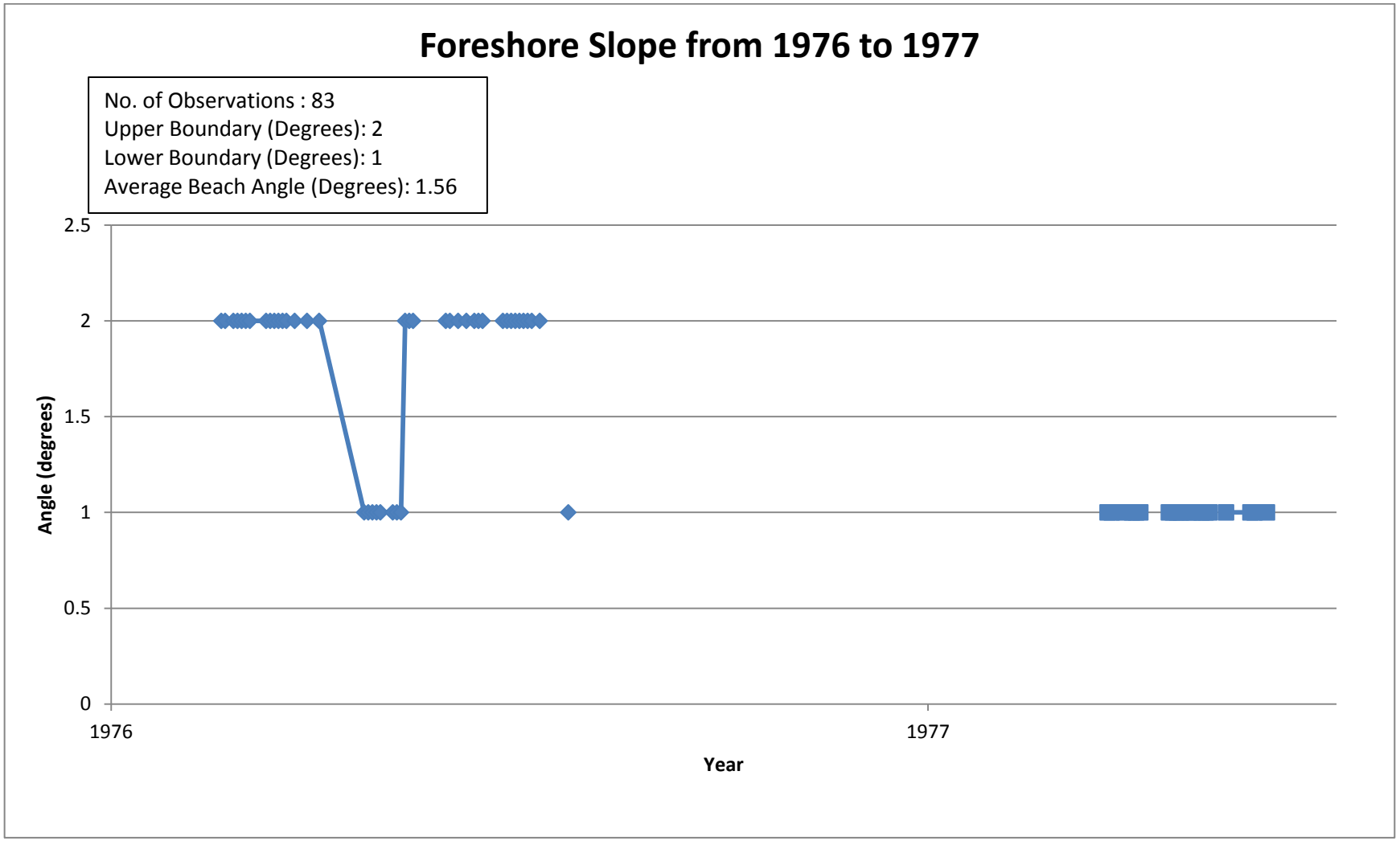


Figure 102 Seaforth North – Foreshore slope summary

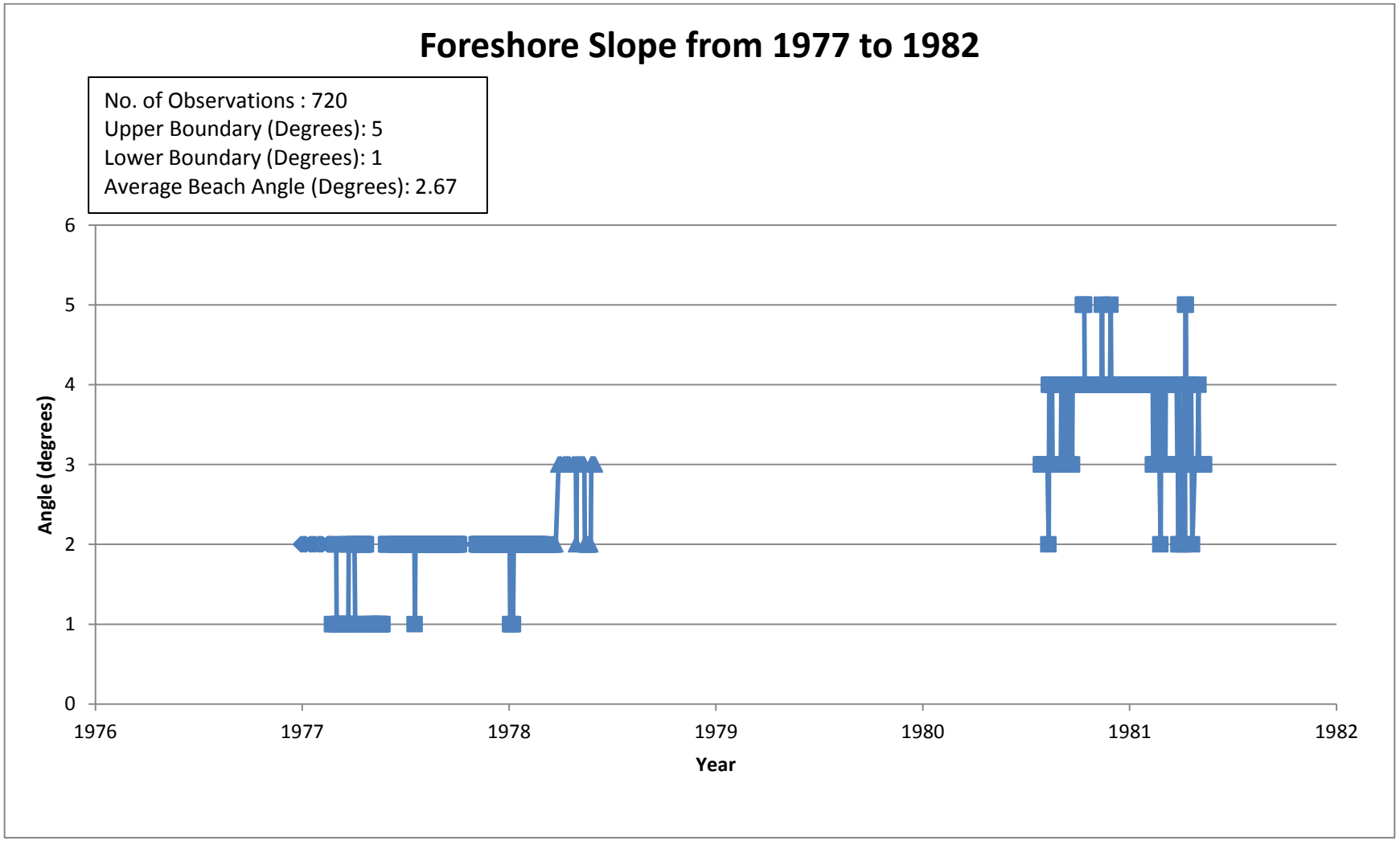


Figure 103 Seaforth South - Foreshore slope summary

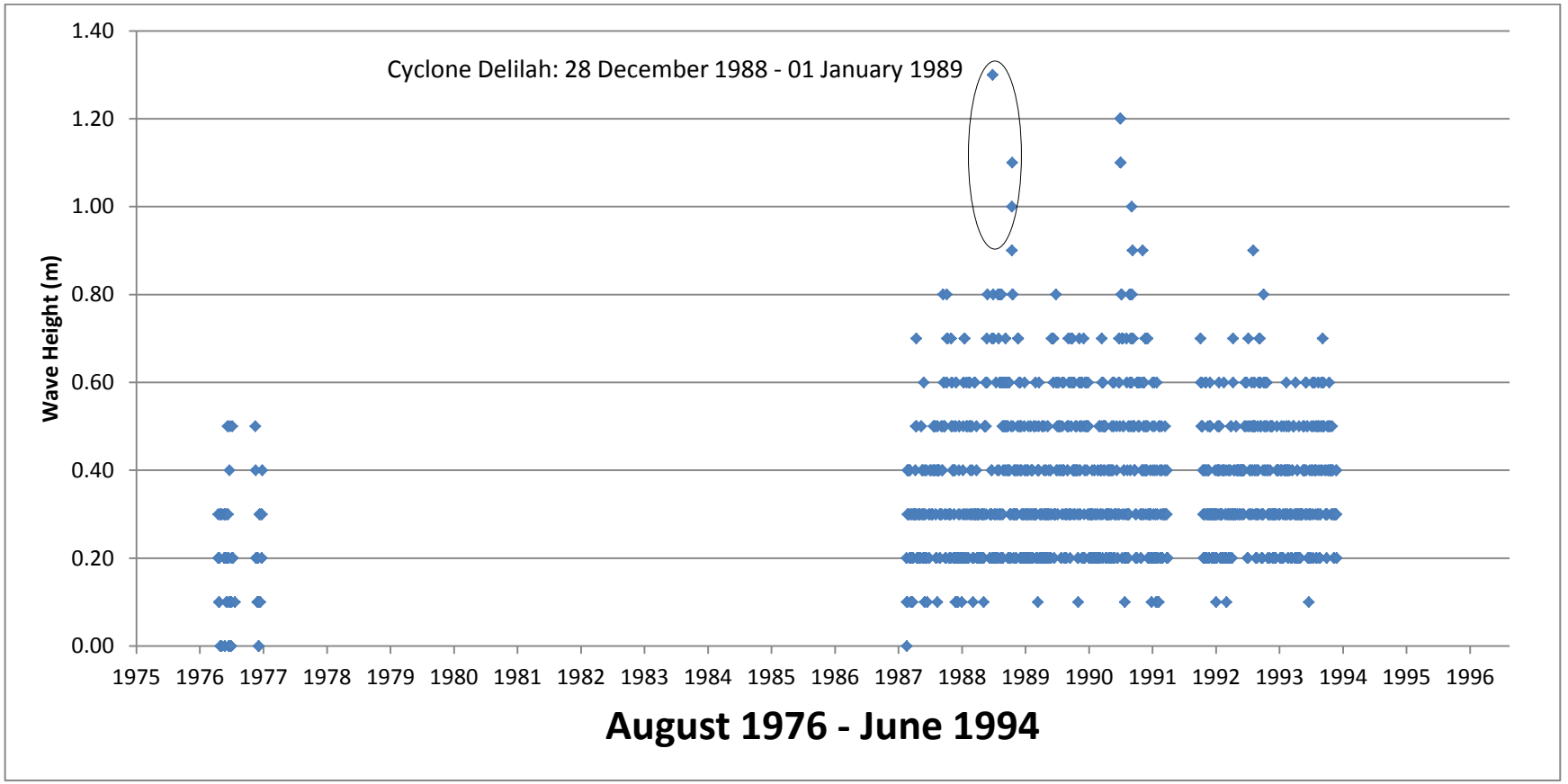


Figure 104 North site – Wave height and cyclone influence

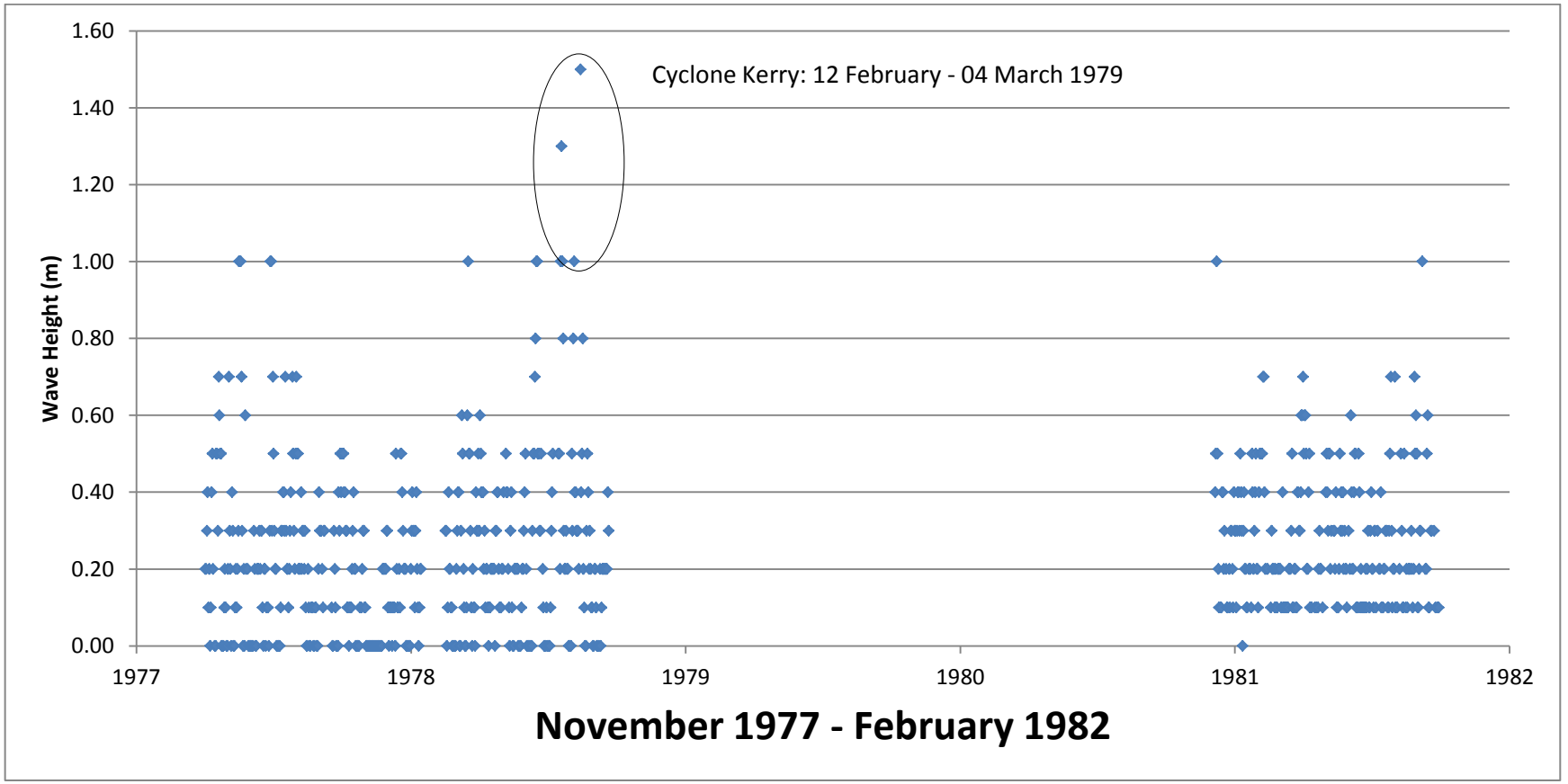


Figure 105 South site - Wave height and cyclone influence

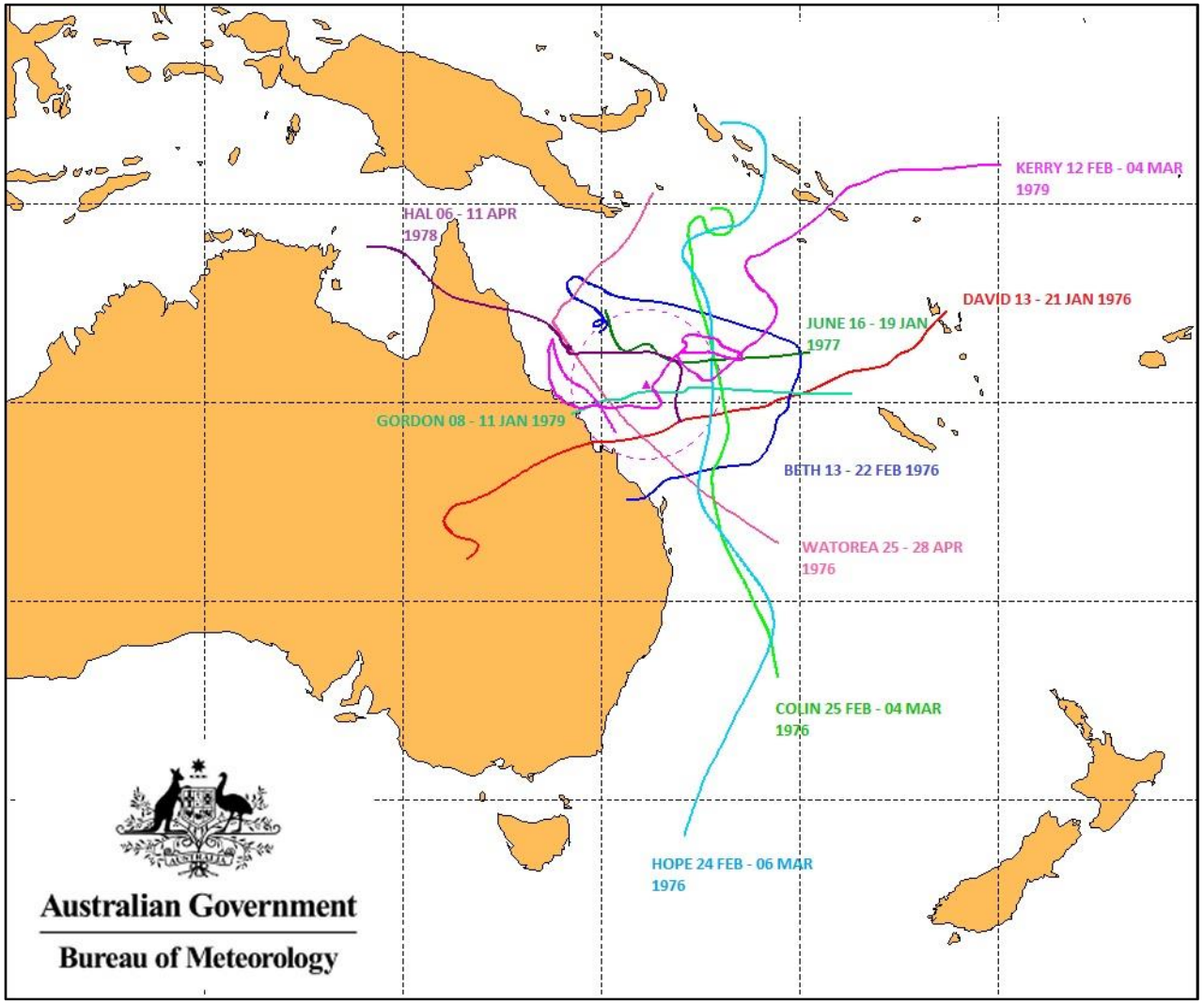


Figure 106 Cyclone tracks 1975 to 1979

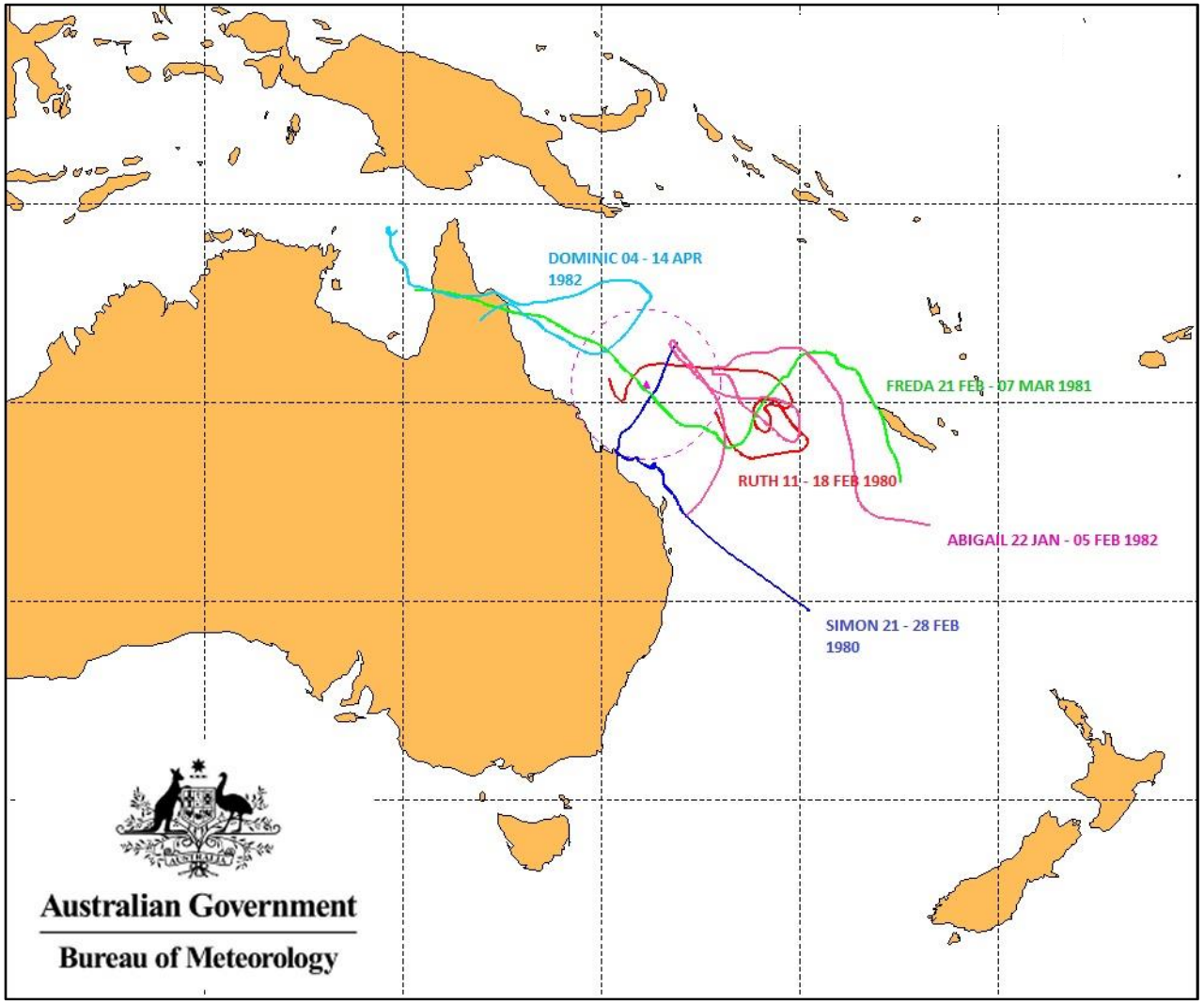


Figure 107 Cyclone tracks 1980 to 1982

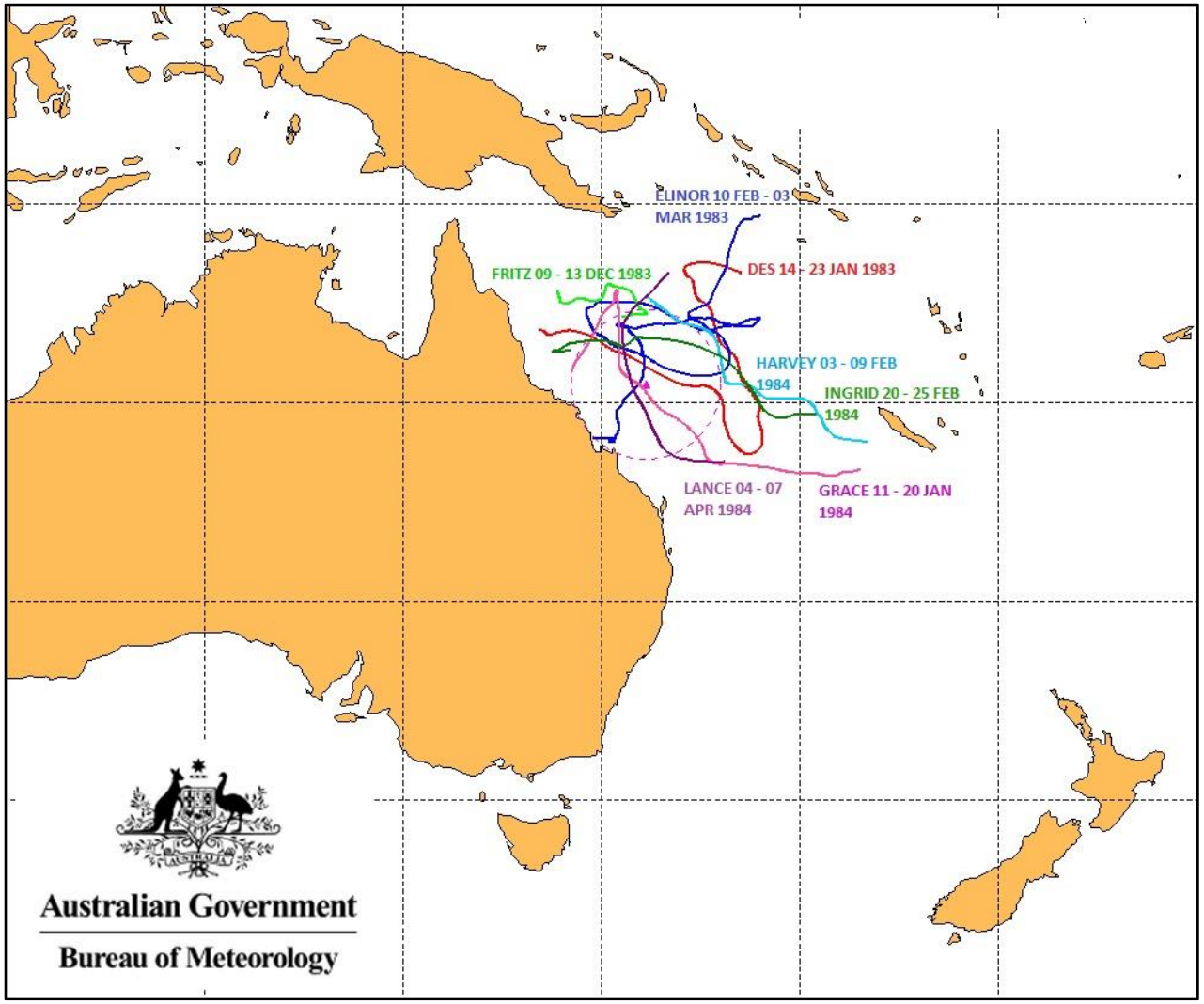


Figure 108 Cyclone tracks 1983 to 1984

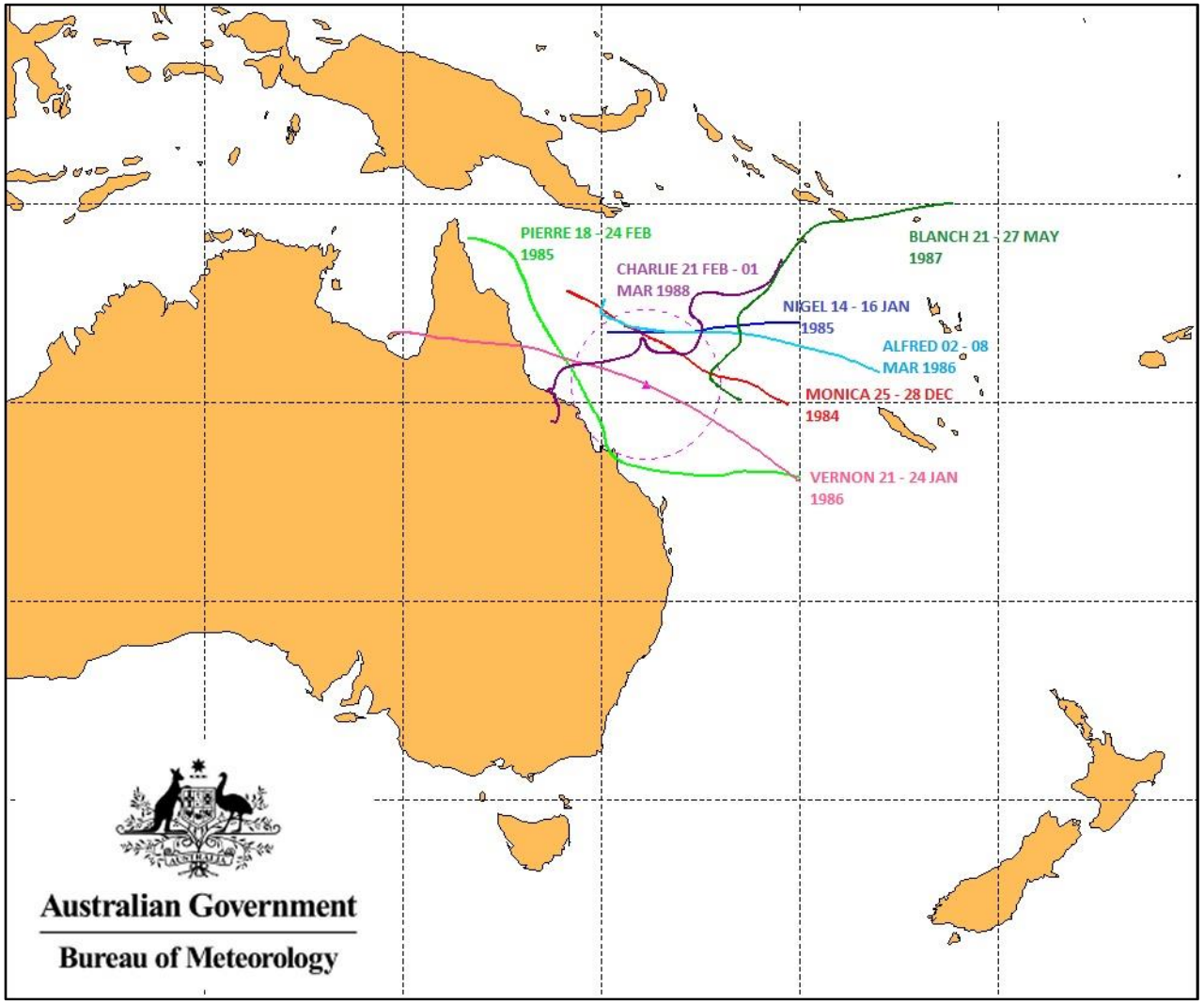


Figure 109 Cyclone tracks 1985 to 1988

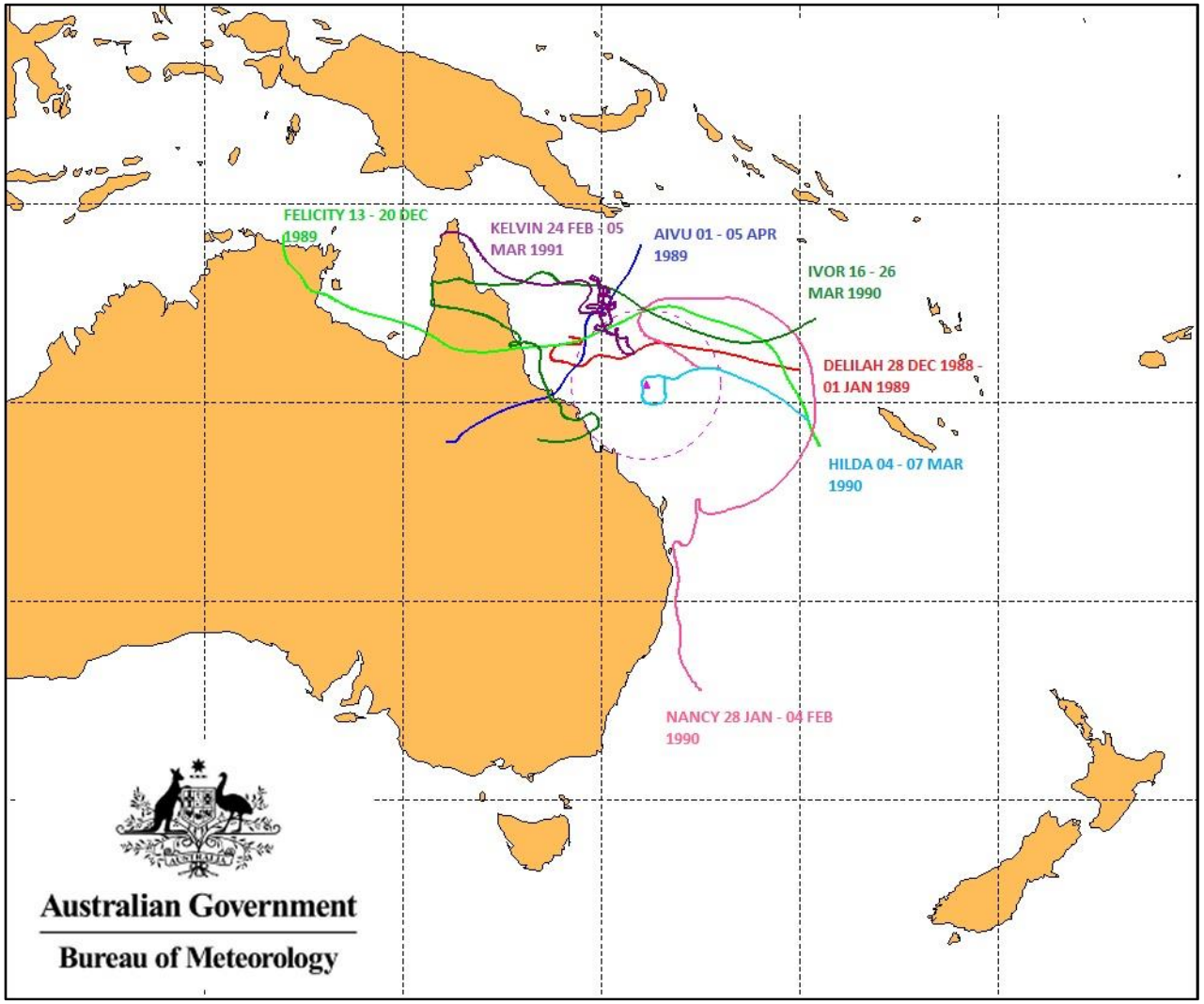


Figure 110 Cyclone tracks 1989 to 1991

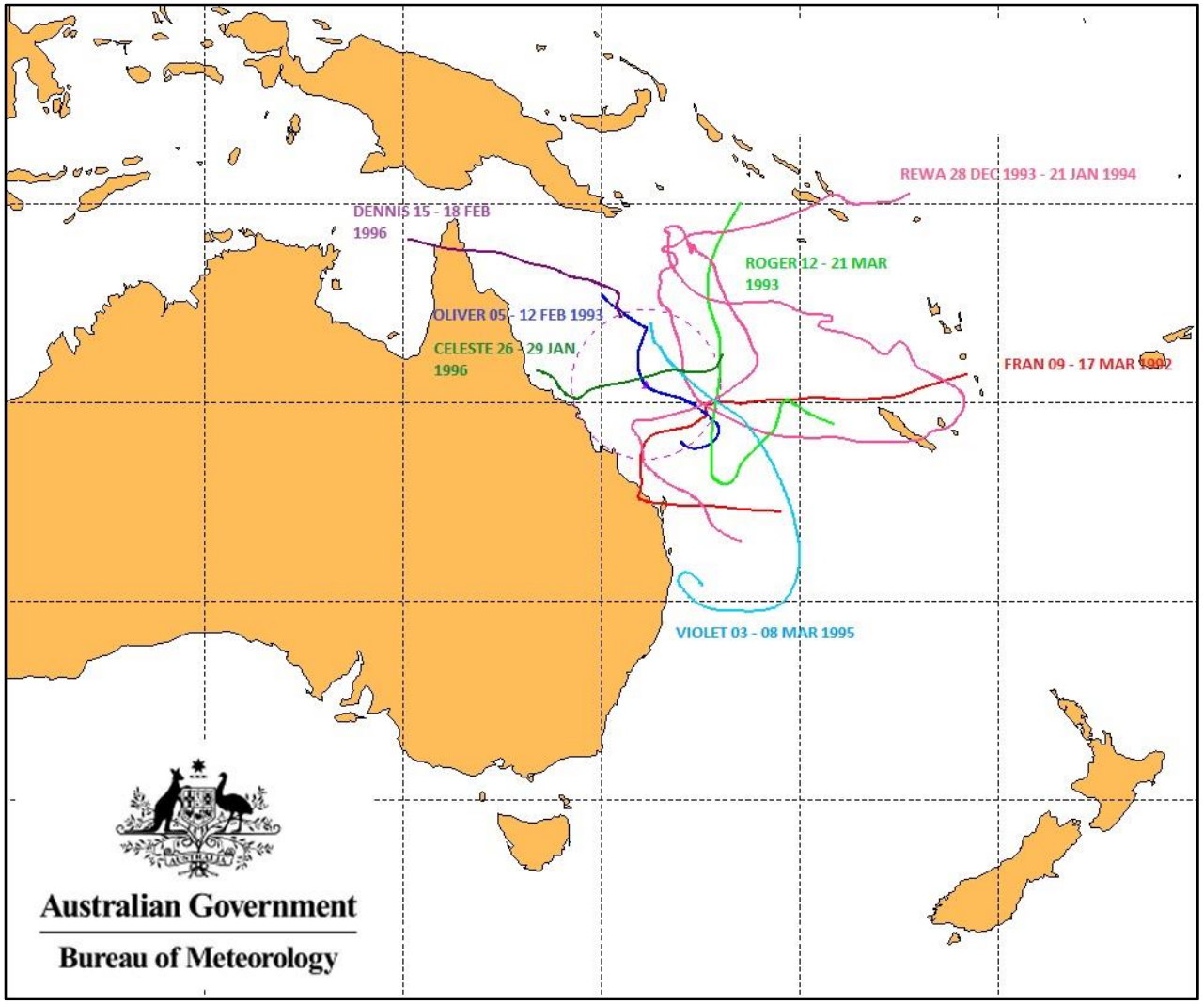


Figure 111 Cyclone tracks 1992 to 1996

Table 20 Amendments to Data

Date	Parameter	Changed From	Changed To	Justification
13/09/76	Wave period	11	7	Change period from 11 to 7 on the basis that it was recorded as 1 mins 10 sec
11/03/77	Wave period	12.2	8.2	Change period from 12.2 to 8.2 on the basis that it was recorded as 1 mins 22 sec
27/04/89	Wave period	16.5	4.5	Change period for consistency by using the average of the adjacent values for the same conditions
31/05/89	Wave period	11.6	4.8	Change period for consistency by using the average of the adjacent values for the same conditions
10/06/89	Wave period	10.6	4.9	Change period for consistency by using the average of the adjacent values for the same conditions
28/01/91	Wave period	10.9	5.7	Change period for consistency by using the average of the adjacent values for the same conditions
29/01/91	Wave period	15	5.7	Change period for consistency by using the average of the adjacent values for the same conditions
01/03/93	Wave period	10	6.1	Change period for consistency by using the average of the adjacent values for the same conditions
02/08/93	Wave period	10.3	5.3	Change period for consistency by using the average of the adjacent values for the same conditions
06/03/94	Wave period	11.2	5.4	Change period for consistency by using the average of the adjacent values for the same conditions
20/05/81	Wave period	11.5	7.5	Change period from 11.5 to 7.5 on the basis that it was recorded as 1 mins 15 sec
23/05/81	Wave period	12	4.1	Change period for consistency by using the average of the adjacent values for the same conditions

26/05/81	Wave period	12	4.1	Change period for consistency by using the average of the adjacent values for the same conditions
23/06/81	Wave period	13	6.3	Change period for consistency by using the average of the adjacent values for the same conditions
27/06/81	Wave period	11	6.3	Change period for consistency by using the average of the adjacent values for the same conditions
11/08/81	Wave period	11.2	7.1	Change period for consistency by using the average of the adjacent values for the same conditions
31/08/81	Wave period	12.5	6.6	Change period for consistency by using the average of the adjacent values for the same conditions
17/09/81	Wave period	11.3	6.5	Change period for consistency by using the average of the adjacent values for the same conditions
20/10/81	Surf zone width	125	25	Surrounding data is consistent with 25, assume transcription error in the original recording of the surf zone width
12/12/81	Berm elevation	0.2	2	Surrounding data is consistent with 2, assume transcription error
22/12/81	Distance to fixed contour	38	28	Surrounding data is consistent with 28, assume transcription error in the original recording of the surf zone width

Note: On the new recording sheet, surf zone widths (m) were recorded as the time (s) it takes for an average wave to traverse the surf zone. Using the following equation from Patterson & Blair 1983, the value was converted into metres:

$$Surf\ Zone\ Width\ (metres) = 0.86 \times g^{\frac{1}{2}} \times H_{obs}^{\frac{1}{2}} \times t_w$$

where:

$g = acceleration\ due\ to\ gravity = 9.81 m/s^2$

$H_{obs} = observed\ wave\ height\ (m)$

$t_w = elapsed\ time\ for\ a\ wave\ of\ average\ height\ to\ transgress\ the\ surf\ zone\ from\ the\ break\ point\ to\ the\ final\ runup\ position\ on\ the\ beach\ (s)$

Where a correction to the surf zone width was required, a value was estimated by using a surf zone parameter for a wave with a similar height and period. This value was then converted from seconds to metres using the above formula.

Appendix A – Cope Instructions

The following text is an extract from BPA newsletter – Beach Conservation No. 69 in which the COPE program was the feature article. The extract describes how the recordings were performed for the **new format** recording sheet, which was introduced in March 1986.

OBSERVATIONS

The data is recorded on special forms which are suitable for computer processing. An example is shown in Figure 2. The wave parameters recorded are:

(i) estimate of wave heights (average and maximum):

(ii) wave period (average time interval between waves);

(iii) wave direction (as a compass bearing);

(iv) surf zone width (traverse time of surf zone by average wave).

The beach parameters recorded, using the installed reference pole are:

(i) elevation of the fixed contour or beach berm;

(ii) distance to the fixed contour or beach berm;

(iii) distance to the average vegetation line;

(iv) sand level at the pole.

Wind speed and compass direction are determined by the use of a hand held wind meter.

The longshore current in the surf zone causes the transportation of sand along the beach, and it is important that this current is measured. This is done by introducing a harmless dye into the water and measuring the distance that the dye patch travels along the beach in one minute. Wave action soon dissipates the dye.

The survey of a monthly beach profile, using the installed reference pole, provides information on beach movements. During periods of change, such as cyclonic wave attack, profiles are usually taken before and after the event. All reference poles are surveyed at the time of installation to allow replacement in the same position if they are destroyed or are washed out by erosion.

The average sand grain size is an element to be considered in the assessment of longshore sand transport rates. Therefore, a monthly sample is taken from a specified beach level and analysed to reveal any seasonal or long term changes.

The following document details the instructions on how to fill out the **old format** recording sheet which was discontinued in March 1986.

FORM No. BE3

BEACH PROTECTION AUTHORITY - QUEENSLAND

Instructions for filling out COPE recording form

COASTAL OBSERVATION PROGRAMME - ENGINEERING

(COPE)

STATION IDENTIFICATION:

Each site for COPE has been assigned a numerical code consisting of five digits. The first two digits define the Shire or City in which the site is located, and the remaining three digits define the particular beach and reference mark position within a particular Local Authority area. A space is provided to write in the name of the beach at which the observation is made.

DATE:

Record the year, month and day in the spaces provided on each page of the recording sheet.

TIME: (Column 2)

Record the time to the nearest quarter-hour **in Eastern Standard Time** (E.S.T.) at which the observation is made. (e.g. 10.00 a.m. Daylight Saving Time is 0900 E.S.T.). The 24-hour clock system of recording time is used to avoid any confusion between a.m. and p.m. (e.g. 0900 is 9.00 a.m. and 1500 is 3.00 p.m.).

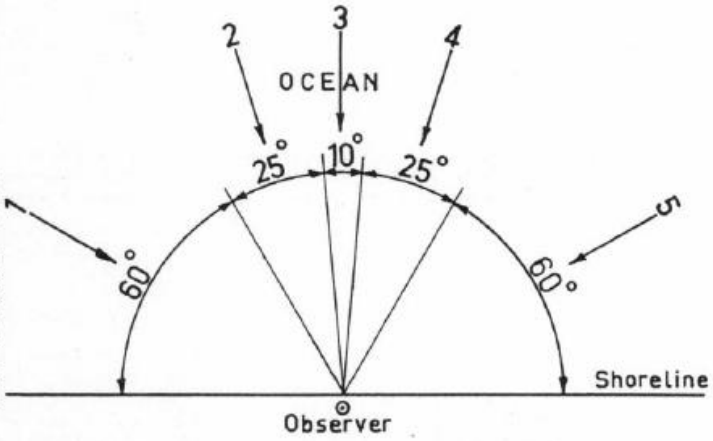
Daily observations should be made as close as possible to 0900 hours, and twice-daily observations should be made once in the morning and once in the afternoon and as close as possible to 0900 and 1500 hours. Observations should be made at the **same** time every day.

WAVE OBSERVATIONS:
(These observations are to be made twice daily.)

(a) **Wave Period:** (Column 3). Record the time in seconds for eleven wave "crests" to pass a stationary point. Eleven "crests" will include ten complete waves (crests and trough). Crest 1 is zero-time, crest 11 is cut time.

(b) **Wave Height:** (Column 4). This observation is based solely on the judgement of the observer. The observer's best estimate will be sufficient. Record the breaking wave height to the nearest one-fifth metre. If wave height is less than one-fifth metre (0.2), the wave height is "O". If no waves exist at all, mark "O" for **both** WAVE HEIGHT and WAVE PERIOD columns.

Fig. 1 WAVE DIRECTION CODE



(c) **Wave Direction:** (Column 5). Darken the space which best describes the direction of the approaching waves according to Fig. 1 above. If no waves exist at all, write the direction as "O".

(d) **Type of Breaking Waves:** (Column 6). If no waves exist, leave the item blank, otherwise choose only **ONE** of the following four types of waves:

Spilling – Spilling occurs when the wave crest becomes unstable at the top and the crest flows down the front face of the wave, producing an irregular, foamy water surface. This wave is sometimes referred to as a "roller" (see Fig. 2 below). Mark "SP" for spilling.

Plunging – Plunging occurs when the wave crest curls over the front face of the wave and falls into the base of the wave, producing a high splash and much foam. This wave is sometimes referred to as a "dumper" (see Fig. 3 below). Mark "PL" for plunging.

Plunging/Spilling – Darken this space only when there is a combination of spilling and plunging waves. Mark "PS" for plunging/spilling.

Surging – Surging occurs when the wave crest remains unbroken while the base of the front of the wave advances up the beach (see Fig. 4 below). Mark "S" for surging.

(e) **Surf Zone Width:** (Column 7). This observation is based on the judgement of the observer. The observer's best estimate is sufficient. Record the distance, to the nearest whole metre, from the water line at the time of observation to the line of the most seaward row of breakers, at the time of observation. If no waves exist at all, mark "O". If two or more breaker zones exist, record the distance to the most seaward row of breakers of the most seaward breaker zone.

(f) **Offshore Bar:** (Column 8). Record whether or not a significant offshore bar exists. This may be determined as "yes" if there is a distinct gutter between the initial breakpoint and the beach, allowing the wave to reform; and "no" if the wave continues in a broken state from the initial breakpoint to the beach (see Fig. 5).

Fig. 2

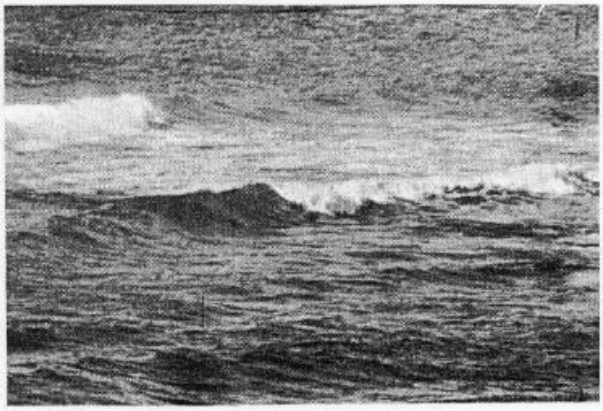


Fig. 3

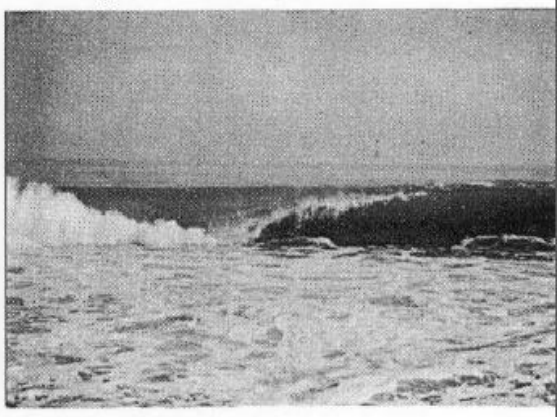


Fig. 4

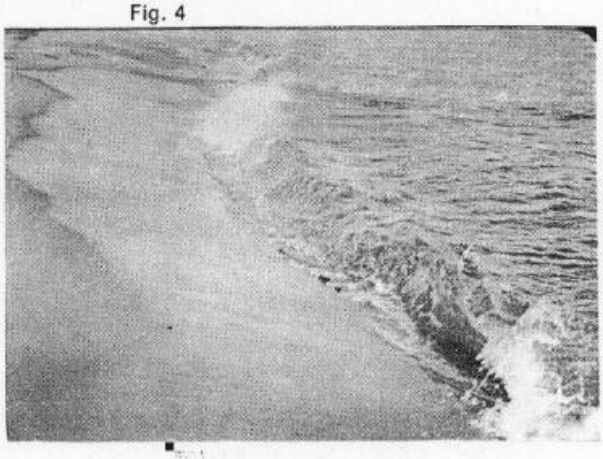
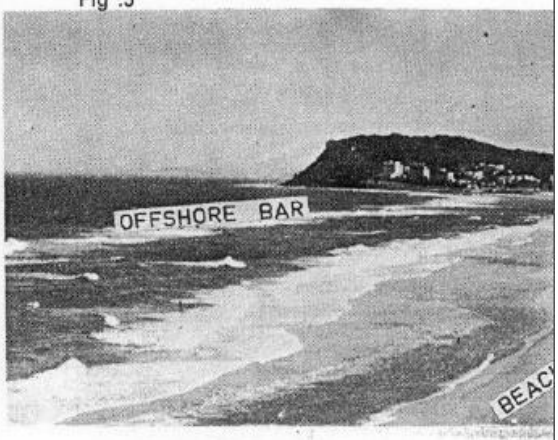


Fig .5



WIND OBSERVATIONS: (These observations are to be made twice daily).

(a) **Wind Velocity:** (Column 9). A wind meter is provided for each observer. The instructions provided with the meter should be followed to obtain wind velocity measurements.

(b) **Wind Direction:** (Column 10). Determine the orientation of the beach with respect to the compass directions, and record the direction **from which** the wind is coming. The direction of true north should be indicated on the reference mark or nearby.

STATE OF TIDE: (Column 11). (This observation is to be made twice daily).

Indicate the relative state of tide by marking one of the ranges: low tide "O/4", quarter tide "1/4", half tide "2/4", three-quarter tide "3/4", full tide "4/4", and mark whether the tide is rising "R", falling "F", or stationary "S" at the time of observation.

BEACH OBSERVATIONS: (These observations are to be made once daily.)

(a) **Elevation of the most seaward beach berm crest:** (Column 12). To obtain this, a graduated reference pole has been installed on the beach and the observer has been provided with a hand level. The observer should also have a 1.5 m-long support for the level. To use the Clinometer as a level, set the bubble lever to zero and sight through the instrument to the reference pole so that the bubble is centred on the cross hair. To obtain this measurement, the observer must place himself on the most seaward berm crest and take a reading of the reference pole (see Fig. 6 below). This reading minus 1.5 metres (length of support) is recorded on the form. If no berm can be easily recognised mark "NB" for no berm.

(b) **Distance to the most seaward berm crest from the reference pole:** (Column 13). Record the distance (to the nearest whole metre) between where the level reading is taken and the reference pole (see Fig. 6 below). If no berm exists, leave the distance **blank: DO NOT** mark the "O". If the distance is measured landward from the reference pole, the distance is a minus value. After erosion the berm may be at the erosion scarp.

(c) **Distance to the vegetation line from the reference pole:** (Column 14). Record the distance to the nearest whole metre between the reference pole and a line along the average seaward extent of the existing perennial vegetation. If the distance is measured landward from the reference pole, the distance is a minus value.

(d) **Angle of Foreshore Slope:** (Column 15). This observation can be made by placing the support pole for the level on the foreshore slope and laying the level on the support, as shown in Fig. 7 below. The foreshore is the uniform sloped section of the beach between H.W.M. and L.W.M. Next, adjust the bubble level so as to centre the bubble in the bubble tube, and then note reading on the DEGREE scale.

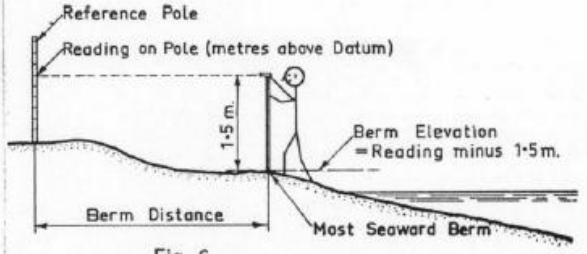


Fig. 6

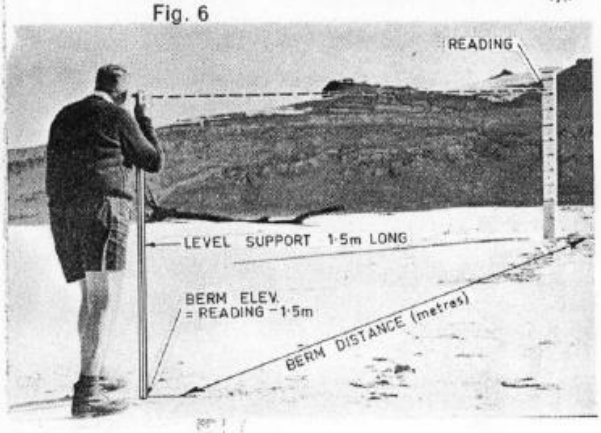


Fig. 7

Continued overleaf

LITTORAL CURRENT OBSERVATIONS: (These observations are to be made once daily.)

(a) **Current Velocity:** (Column 16). For this measurement the observer is provided with dye. The dye is **very** powerful, and care must be observed when handling it so as not to allow any dye to accidentally spill. The dye should be thrown as near as possible to the midpoint of the surf zone. The observer will note the position of the dye at entry to the breaker zone and the position of the dye after an elapsed time of one minute. The distance between these two positions is entered in the spaces provided on the form. If no current is evident, darken the "O" marks.

(b) **Current Direction:** (Column 17). If no current is evident, mark "C" for "calm". Otherwise indicate whether the dye patch moves downcoast or upcoast. In general, current that flows to the north is considered upcoast, and that which flows to the south is considered downcoast.

SAND SAMPLES:

Sand samples should be collected once a month in the special plastic bags provided. The sample should be obtained from the foreshore slope of the beach at about half tide level. Identify the sample with the name and code number of the beach, and record the date and time the sample was collected. Write this information directly on the outside of the specially provided padded envelope.

PHOTOGRAPHS: (Optional)

Photographs are to be taken once a month, preferably early each month and at low tide. General panoramic views of the beach in the up and down coast directions are desired. Photographs should be taken from the same location each time and view the same area with a recognisable landmark in the background. Each photo must be identified with the name and code number of the beach, and the date and time and tide level when it was taken.

COMMENTS:

Note any remarks or sketches or unusual events (e.g. erosion scarps, cyclone damage, surge etc.) in the comments column of the recording form.

Remember: There are about 50 COPE stations in Queensland.

Remember: To mark **all** recording sheets, sand samples and photographs with your code number, and time and date.

Issued by

BEACH PROTECTION AUTHORITY
OF QUEENSLAND

Department of Harbours and Marine
Edward Street, Brisbane 4000
(G.P.O. Box 2195, Brisbane 4001)

Appendix B – Historical Photographs

Figure 112 Seaforth Beach North June 1977 (Looking North)

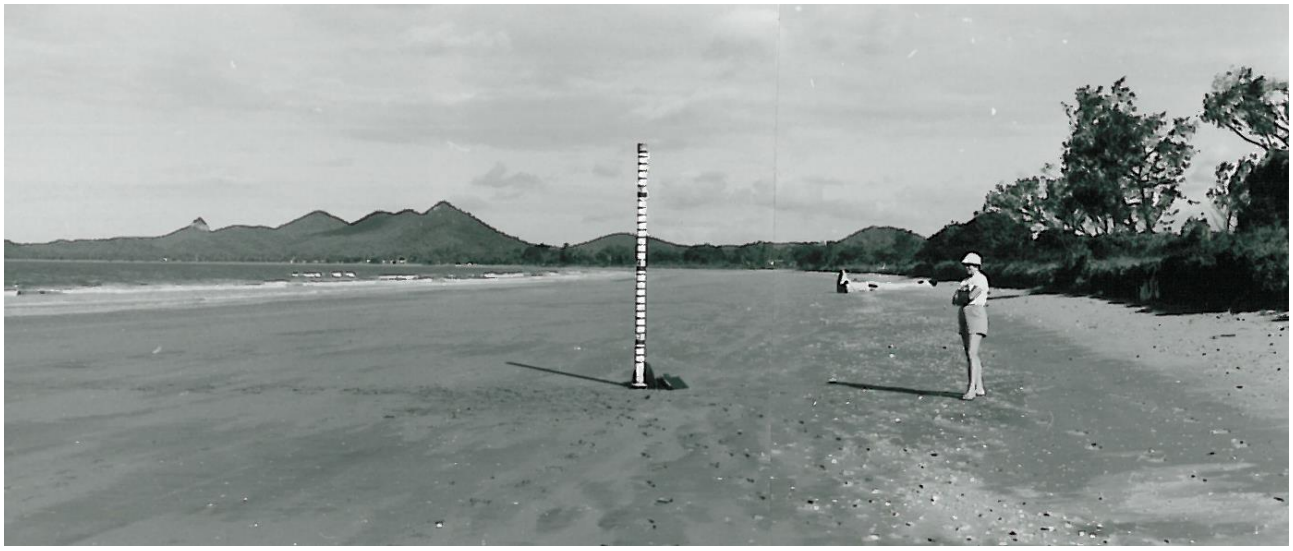


Figure 113 Seaforth Beach North June 1977 (Looking South)

Figure 114 Seaforth Beach South April 1978 (Looking North)

Figure 115 Seaforth Beach South April 1978 (Looking South)

Figure 116 Seaforth Beach South August 1983 (Looking North)

Figure 117 Seaforth Beach South August 1983 (Looking South)

Figure 118 Seaforth Beach South February 1984 (Looking North)

Figure 119 Seaforth Beach South February 1984 (Looking South)

Figure 120 Seaforth Beach South December 1993 (Looking North)

Figure 121 Seaforth Beach South December 1993 (Looking South)