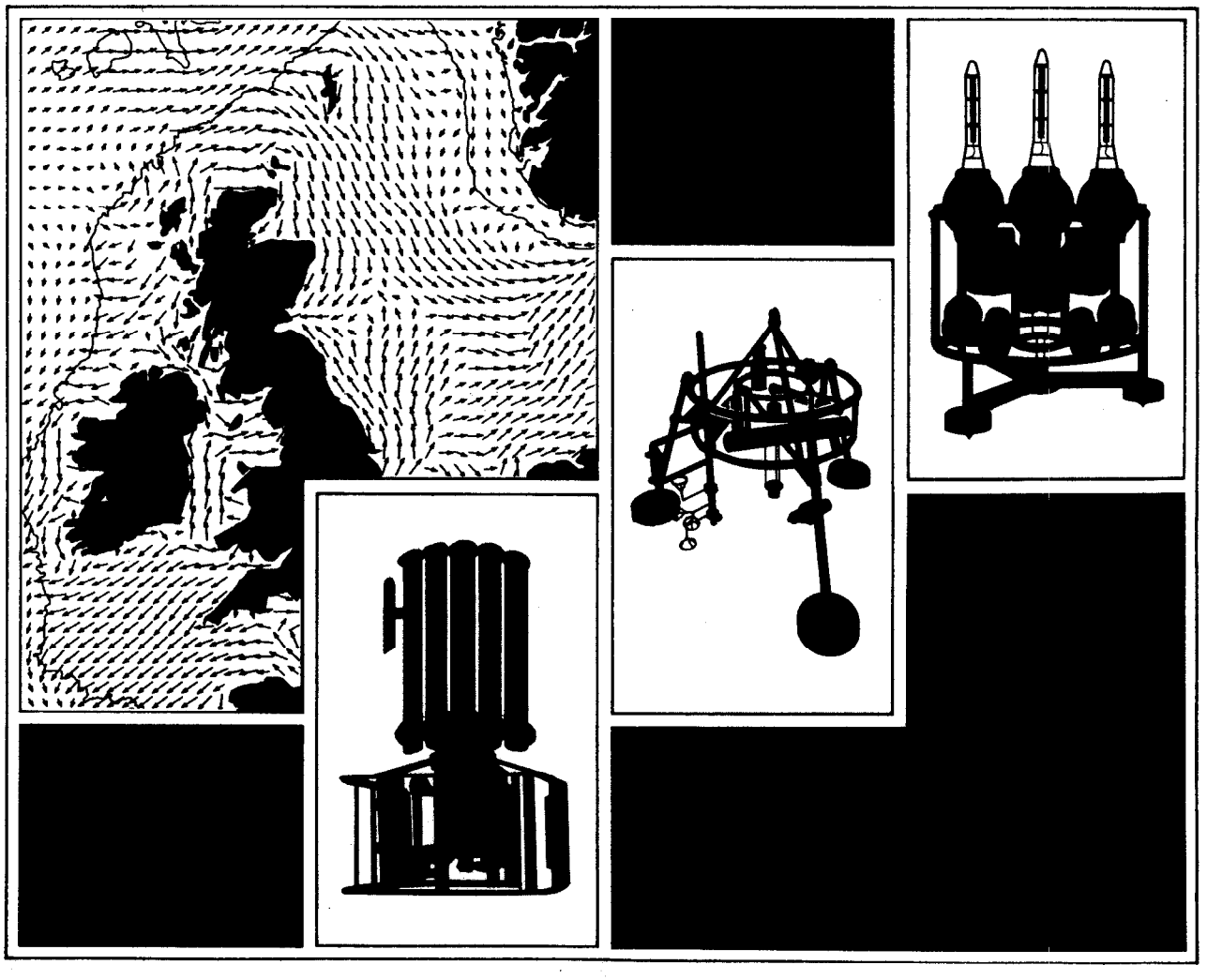
Proudman
Oceanographic
Laboratory

Class A Network Dataring gauges

1989 data processing and analysis

SM Shaw

Report No 18 1991



Natural Environment Research Council

PROUDMAN OCEANOGRAPHIC LABORATORY

Bidston Observatory,
Birkenhead, Merseyside, L43 7RA, U.K.

Telephone: 051 653 8633
Telex 628591 OCEANB G
Telefax 051 653 6269

Director: Dr. B.S. McCartney

Natural Environment Research Council

PROUDMAN OCEANOGRAPHIC LABORATORY
REPORT No.18

Class A Network Dataring gauges

1989 data processing and analysis

S.M.Shaw

1991

DOCUMENT DATA SHEET

AUTHOR

S M SHAW

PUBLICATION DATE

1991

TITLE

Class A Network Dataring gauges - 1989 data processing and analysis

REFERENCE

Proudman Oceanographic Laboratory, Report, No 18, 134pp

ABSTRACT

This report presents a summary of sea level data processing for 1989 from 20 modernised Dataring sites around the UK coast.

Details of processing, reference levels, statistics and analyses are included.

This work is funded by MAFF

ISSUING ORGANISATION

Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead, Merseyside L43 7RA
UK

Director: Dr B S McCartney

TELEPHONE
051 653 8633

TELEX
628591 OCEAN BG

TELEFAX
051 653 6269

KEYWORDS

SEA LEVEL MEASUREMENTS
SHORE BASED TIDE GAUGES
TIDAL RECORDS
DATA PROCESSING
NORTHWEST EUROPEAN WATERS
BRITISH WATERS

CONTRACT

PROJECT

PRICE £31

CONTENTS

1. INTRODUCTION

This report is the third in a series describing the data processing of Class-A tide gauge data obtained from modernised installations around the UK mainland and connected to the Dataring system. Twenty-one sites have now been incorporated and have also been operational in excess of one year.

The results for 1989 from 20 of these sites,each with percentage returns of data in excess of 86% (Figure 1 overleaf) are presented.

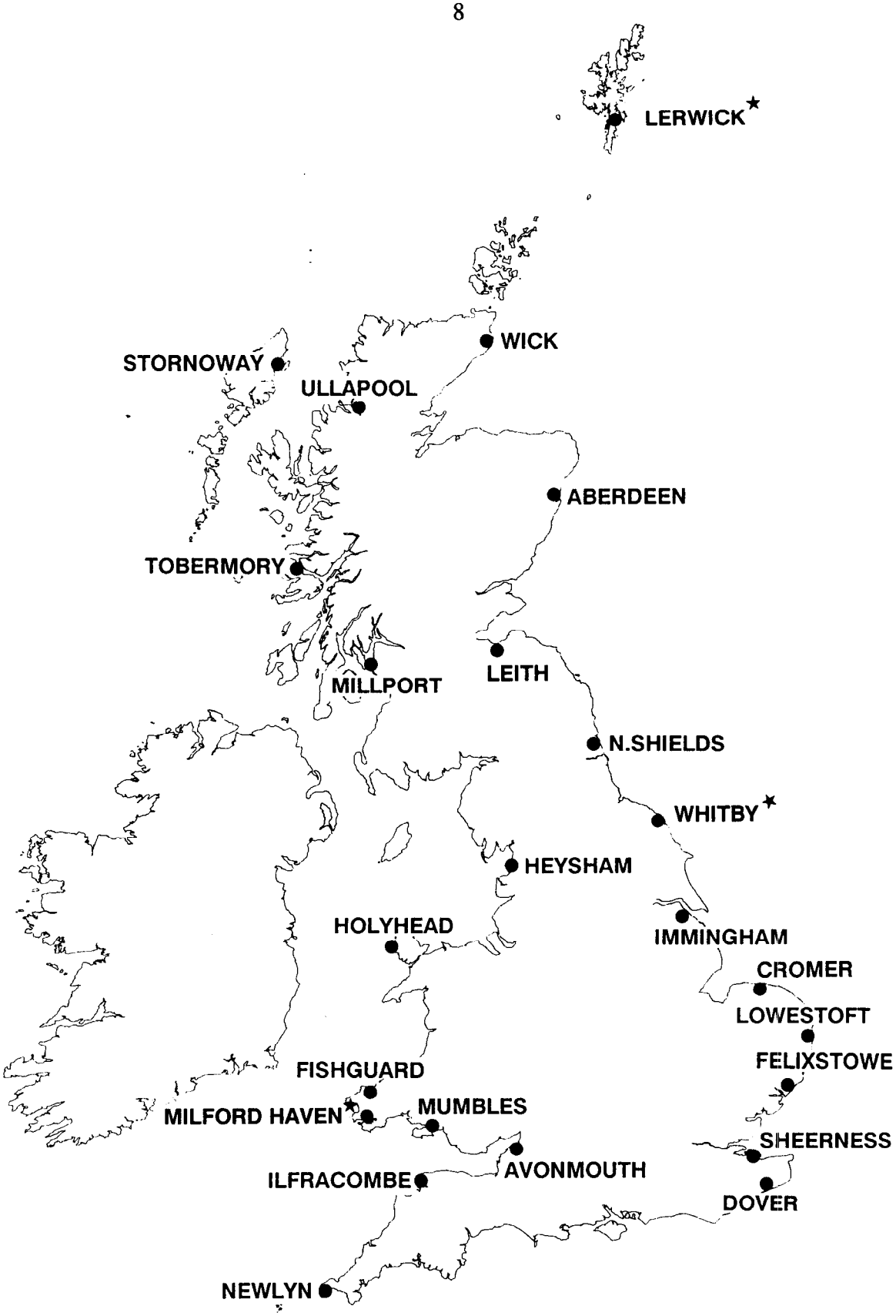
Nine sites returned complete year series , whilst 3 more had gaps of only one or less days.

However, in the case of Mumbles, less than 25% of the expected data has been retrieved, mainly due to communication and software faults. This was a new installation intended to take the place of Swansea on the Class-A network, which continues to be operated by Associated British Ports.

Section 2 contains a general description of the system configuration and methods of recording elevations at each site, clockwise from Newlyn. It includes details of site visits, processing details, harmonic constants from an independent analysis, frequency distribution curves and cumulative frequency curves.

Section 3 contains the 1989 statistics for extreme and mean sea levels, and surge residuals, for all twenty sites. It also includes a brief outline of the meteorological situation for some of the larger storm events during the year.

Section 4 contains introductory material to gauges operational in 1989 but not included in the main text.



★ Recent installations

Figure 1

2. GENERAL DESCRIPTION OF SITES AND PROCESSING

Raw values integrated over a 15 minute period from the modernised tide gauge installations are collected and rigorously checked each week.

On the basis of initial findings, isolated missing values and errors are ascertained and corrected before passing the values through a low-pass filter to produce hourly levels.

In addition, the gauge parameters at each site, ie. clocks and reference levels are checked from the central site at the Proudman Laboratory at least once a week, independent of data collections.

Hourly levels are then compared both with standard predicted levels, and at all but a few sites, with computer-modelled data during the winter months.This procedure provides a quality check on all three elements involved, (observed levels, predicted levels and computer model results).

Statistics and plots of the findings are retained for future comparisons and long-term studies.

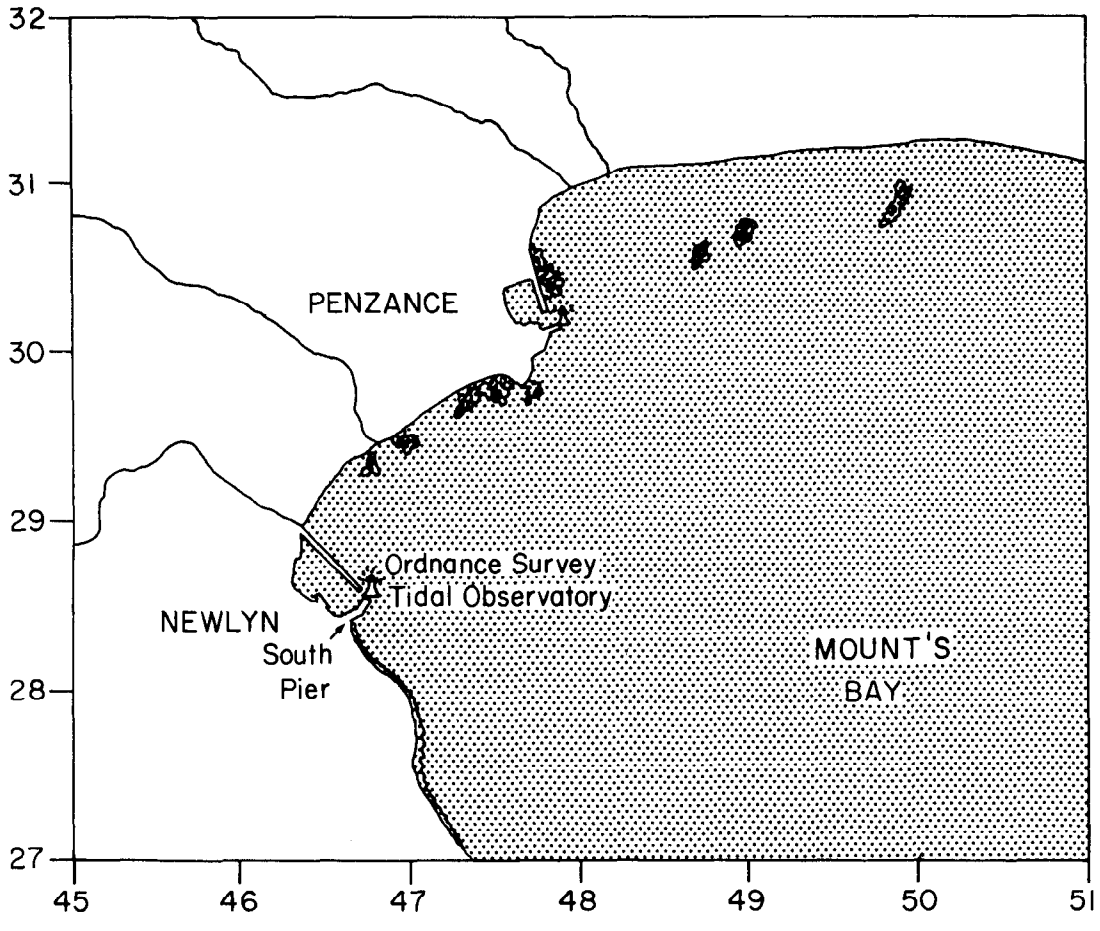
2.1 NEWLYN

Latitude 50 deg 6' 8.4"N Longitude 05 deg 32' 30.6"W

National Grid reference SW 4676 2855

Recording zero = Chart Datum = 3.05m below Ordnance Datum Newlyn

Recording zero = 7.8012m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	SW4676 2855	OSBM Bolt inside hut adjacent to well
Aux1	SW4673 2851	Flush Bracket 1565 on wall South Pier NW face 17.8m SW.
Aux2	SW4659 2841	Flush Bracket 1520 on wall SE side of S Pier Rd NW face.

Data processing

Hourly heights were processed from the digiquartz transducer connected to a pressure gauge outlet on Channel 2.

Missing values in the raw data in 1989 were interpolated for the following dates :12 Jan; 5, 13, 17 Feb; 1, 9, 21 Mar; 19, 28 Apr; 1, 8, 15, 20 May; 8 Jun; 19 Jul; 27 Sep; 21 Nov; 13,14 Dec.

Gaps in Channel 2 processed data for 1989

Nil gaps.

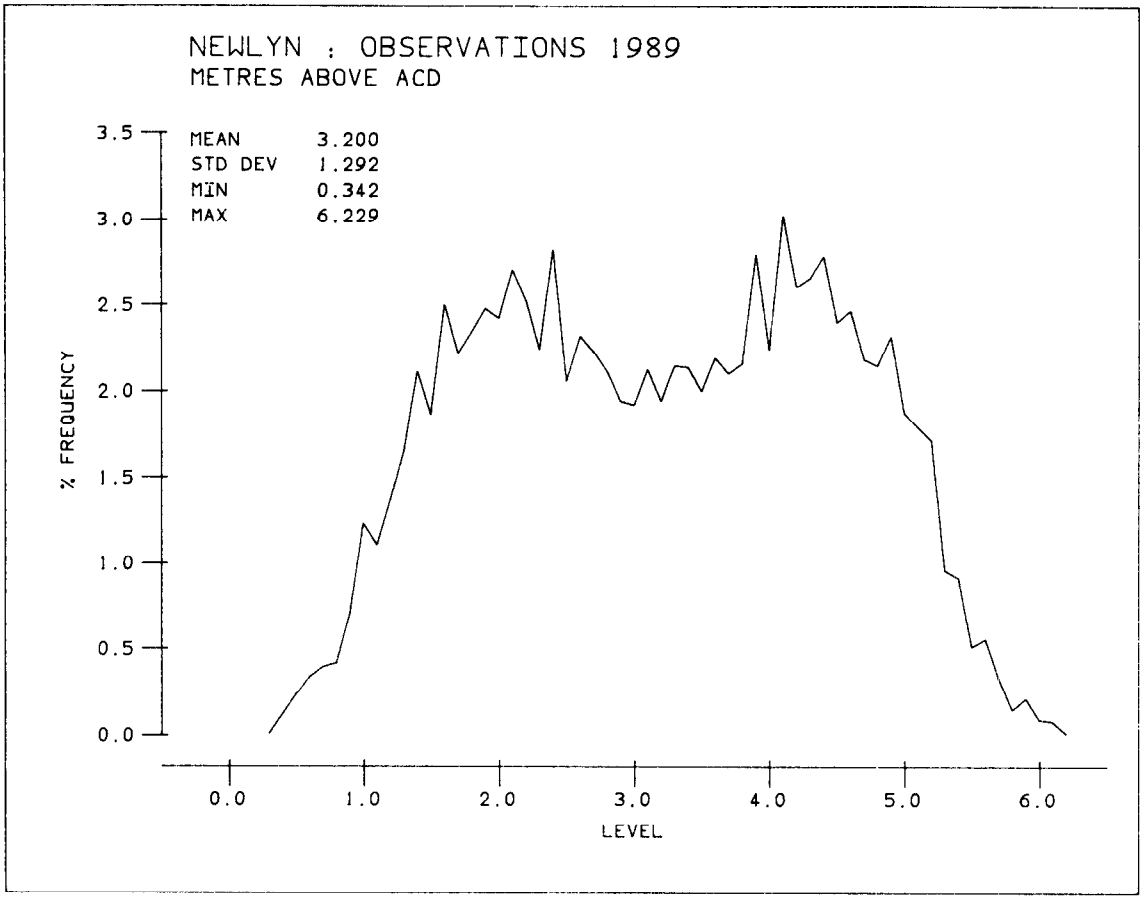
Site Diary

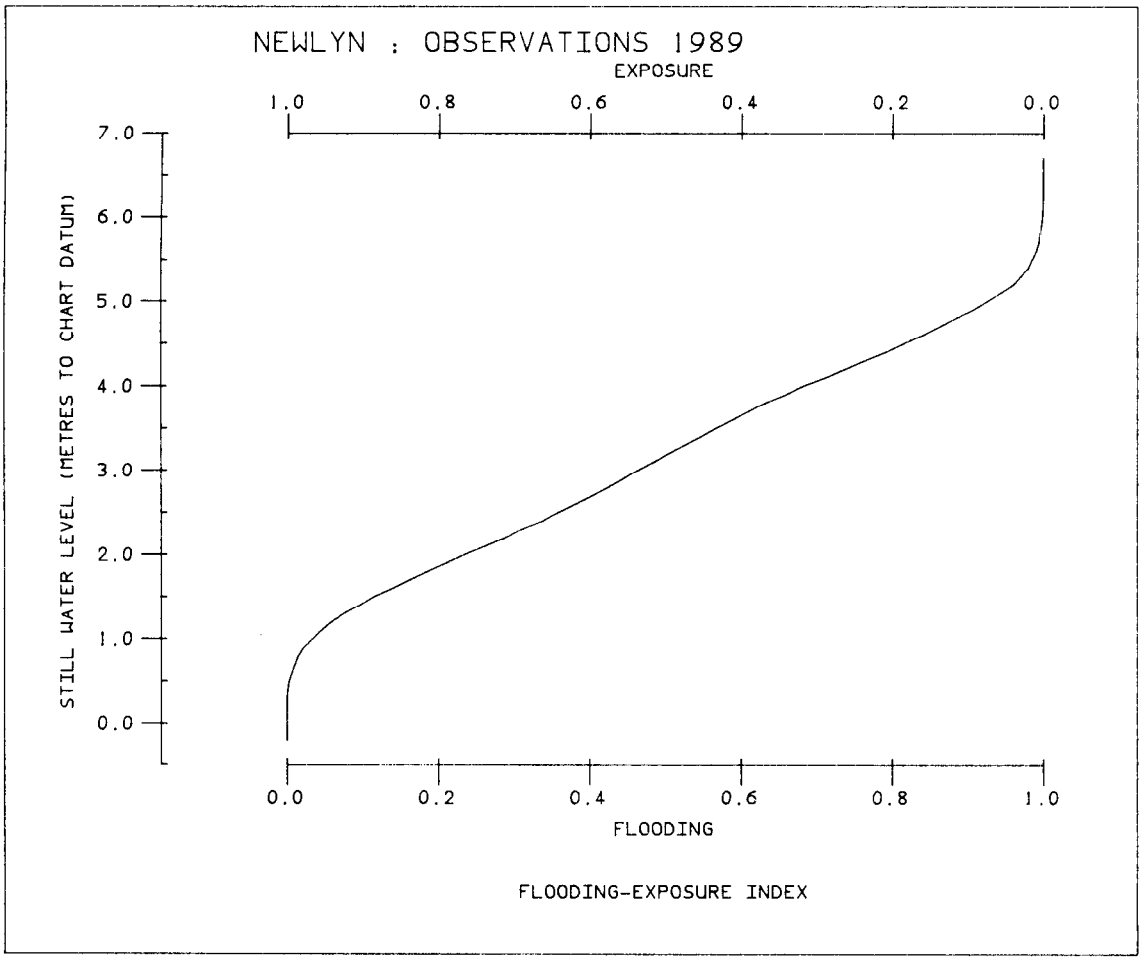
6 June	TGI visit. Calibration checks.
8 June	TGI visit. Compressor replaced by new unit.

Extreme Statistics

16 December (2100GMT) = Annual extreme level 6.229m above Chart Datum.

16 December (0700GMT) = Annual maximum surge 1.015m above predicted.


NEWLYN : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.200
STD DEV 1.292
MIN 0.342
MAX 6.229
% FREQUENCY
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


NEWLYN : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, South Coast - Newlyn

Latitude: 50 06' 08.4" N
Longitude: 5 32' 30.6" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 3.202

Hourly data from digiquartz sensor

Datum of observations = ACD: 3.05 Metres below Ordnance Datum (Newlyn)

Observation Mean= 0.3202D+01 Residual Mean = 0.6321D-06
Std Dev= 0.1294D+01 Std Dev = 0.1234D+00

Constituent	h	g
Q1	0.016	306.28
O1	0.057	341.77
P1	0.021	103.62
K1	0.064	109.41
J1	0.001	192.80
2N2	0.024	97.73
N2	0.333	113.28
M2	1.719	133.11
S2	0.578	177.33
K2	0.163	175.00
M3	0.010	20.10
M4	0.115	165.57
MS4	0.076	216.99
M6	0.009	327.36

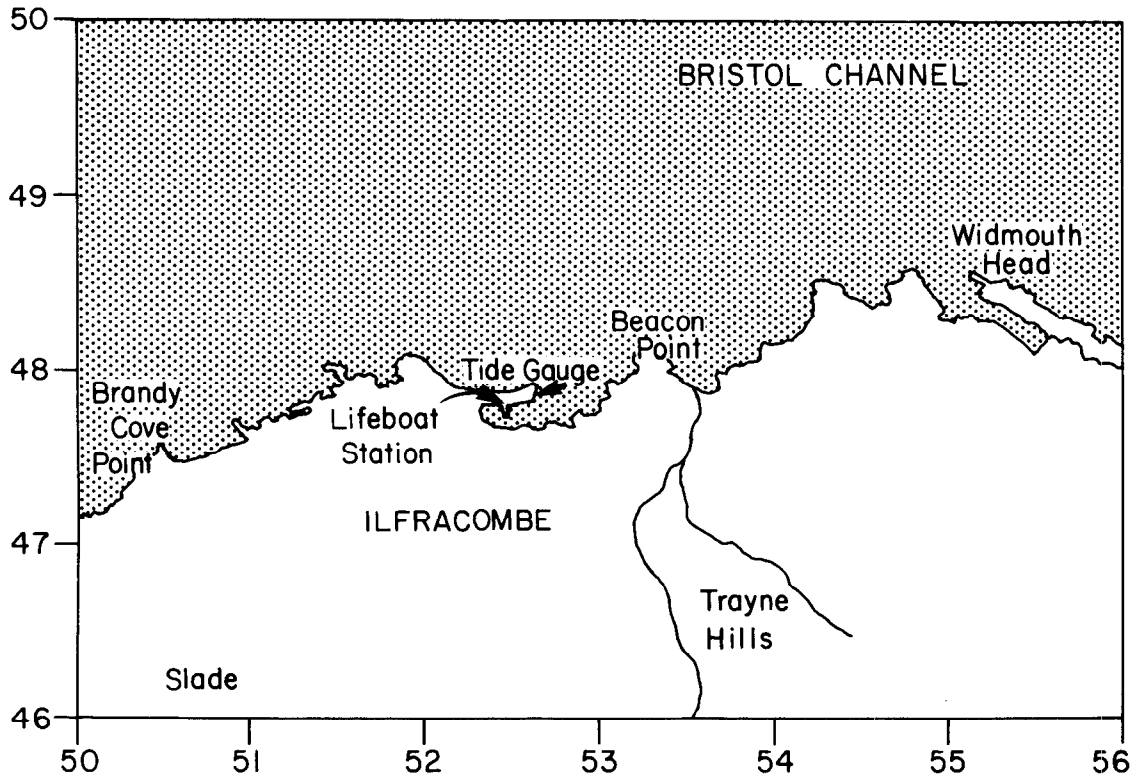
2.2 ILFRACOMBE

Latitude 51 deg 12' 39.0"N Longitude 04 deg 06' 36.3"W

National Grid reference SS 5263 4791

Recording zero = Chart Datum = 4.8m below Ordnance Datum Newlyn

Recording zero = 12.379m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	SS5263 4791	OSBM Bolt on concrete pier S angle of tide gauge hut.
Aux1	SS5245 4782	Pier Hotel, The Quay
Aux2	SS5251 4789	St.Nicholas Chapel, Lantern Hill.
Aux3	SS5249 4786	Flush Bracket G4851 on Lifeboat Station, E faceNE angle.

Data Processing

Hourly heights were filtered from Channel 2 Digiquartz on pressure gauge system. Missing scans in the raw elevations were interpolated on the following dates: 6, 8, 9 Mar; 21, 24 Apr; 18 Jul; 8 Aug; 15 Sep; 6, 31 Oct; 8 Nov and 16 Dec.

Scans recording at a higher frequency than 15 minutes during the TGI visits on 26 and 27 January were edited.

5 May Channel 1 (stilling well) reading 32cms higher.

Gaps in 1989 hourly heights

Nil gaps.

Site diary

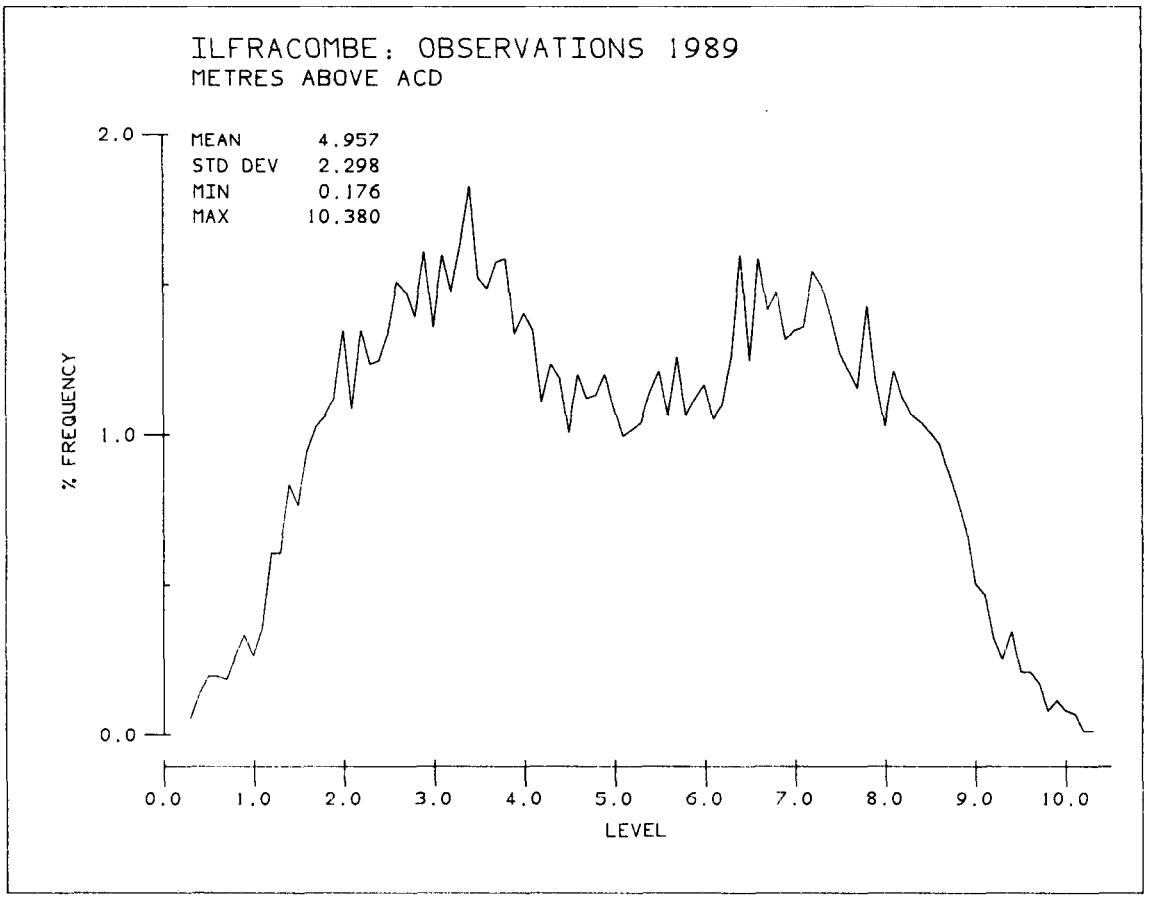
26 - 27 January TGI visit for test calibrations and general maintenance.

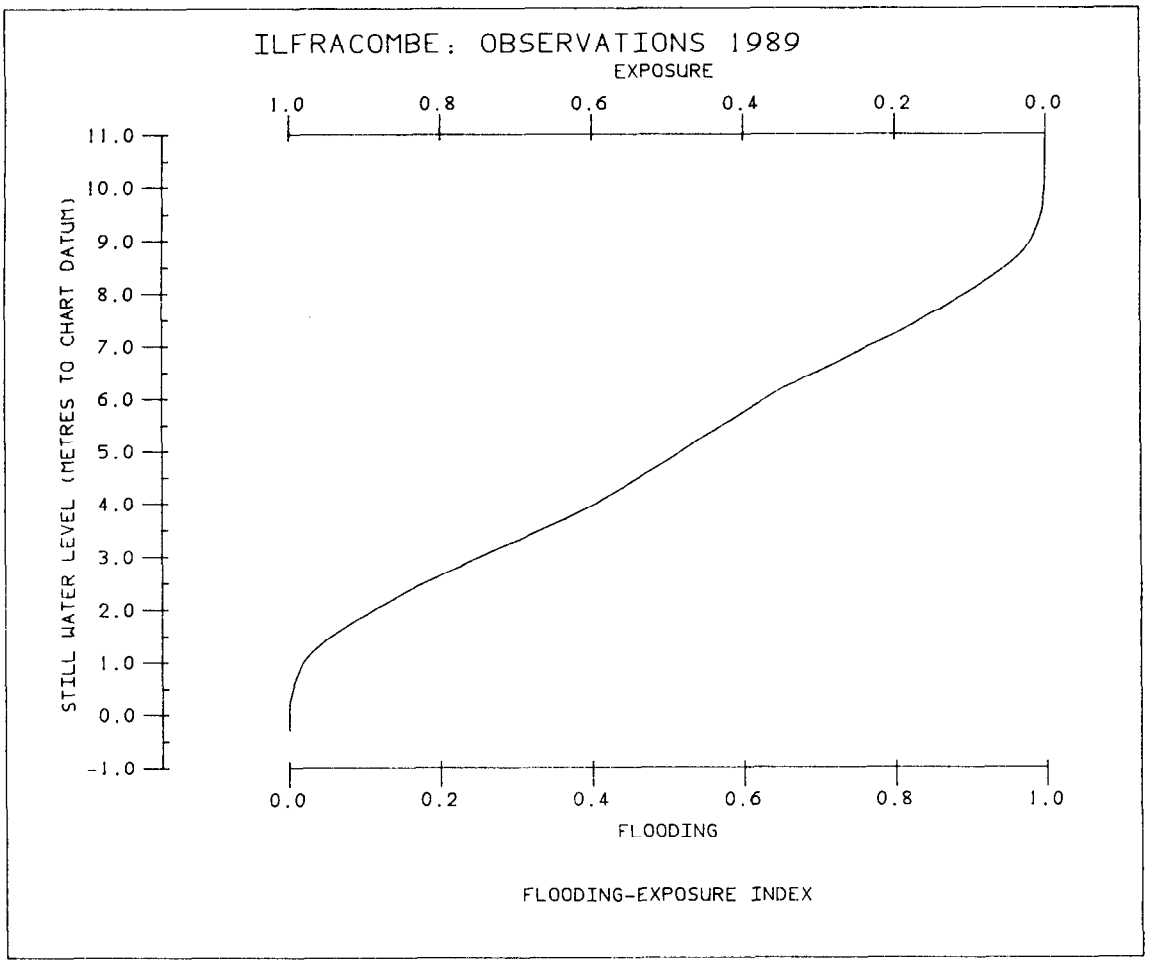
27 November TGI visit for routine servicing and datum check.

Extreme statistics

9 March Annual extreme level 10.380m above Chart Datum.

11 April Annual maximum surge 1.289m above predicted.


ILFRACOMBE: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 4.957
STD DEV 2.298
MIN 0.176
MAX 10.380
% FREQUENCY
2.0
1.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
LEVEL


ILFRACOMBE: OBSERVATIONS 1989
EXPOSURE
1.0 0.8 0.6 0.4 0.2 0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
0.0 0.2 0.4 0.6 0.8 1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, West Coast - Ilfracombe

Latitude: 51 12'39.0"N
Longitude: 4 06'36.3"W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 4.958

Hourly data from digiquartz sensor
Datum of Observations = ACD: 4.80 Metres below Ordnance Datum (Newlyn)

Observation Mean= 0.4958D+01 Residual Mean = 0.9591D-06
Std Dev= 0.2300D+01 Std Dev = 0.1505D+00

Constituent	h	g
Q1	0.021	319.79
O1	0.071	349.73
P1	0.022	123.15
K1	0.066	125.78
J1	0.002	204.13
2N2	0.083	129.66
N2	0.581	143.49
M2	3.046	161.91
S2	1.107	208.72
K2	0.315	206.82
M3	0.029	126.35
M4	0.109	350.60
MS4	0.061	51.5
M6	0.020	339.93

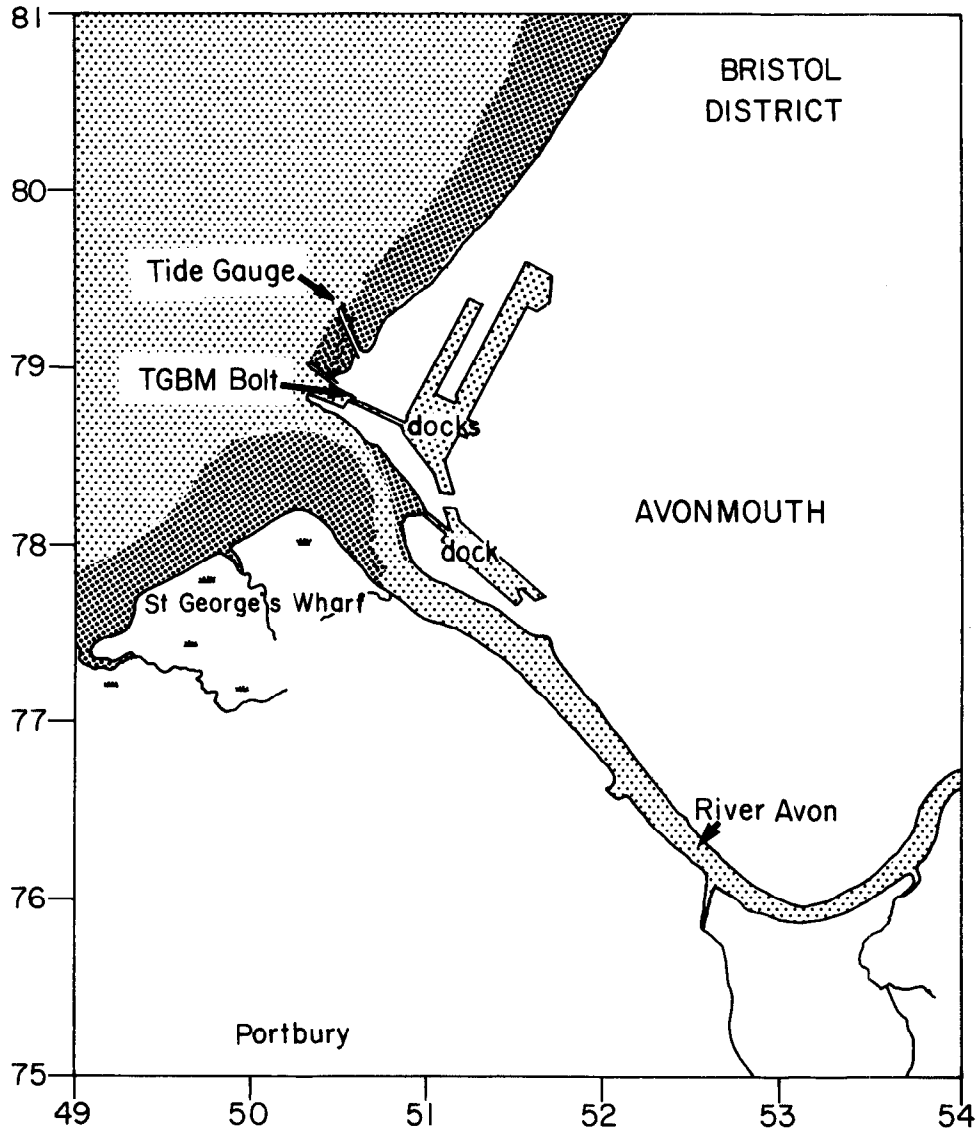
2.3 AVONMOUTH

Latitude 51 deg 30' 36.9"N Longitude 02 deg 42' 50.7"W

National Grid reference ST 5045 7933

Recording zero = Chart Datum = 6.5m below Ordnance Datum Newlyn

Recording zero = 15.711m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	ST5057 7881	OSBM Bolt at base of bollard.
Aux1	ST5072 7859	Rivet adjacent to transit shed NW face W angle.
Aux2	ST5063 7898	Rivet at base of building NW side S angle.
Aux3	ST5091 7927	Rivet on manhole cover surround on S side of road 1.8m N angle of building.

Data processing

Two digiquartz sensors on pressure systems continue to be interrogated.Channel 1, is treated as the Class-A channel.
1989 began as 1988 left off with the compressor awaiting repair or replacement and the general area still undergoing redevelopment, which continued throughout the year.

As a result of the visit by TGI in January, the back-up channel 2 was restored to normal working. Channel 1 pressure tube remained blocked despite efforts to purge the line. It was felt unwise to substitute the back-up channel data for Channel 1 as there are height differences as well as a timing difference between the two systems.

Channel 1 became operational again on 7 February but values were suspect until late on 8 February when the datum was corrected by TGI. The hourly levels were affected to the end of the day, and these have been deleted, and the statistics recomputed for the purposes of this report.

Missing scans were interpolated on the following dates : 28 Mar; 2 Apr; 22, 31 May (2); 14, 20, 28 Jun; 5, 6, 16, 18, 26 Jul; 7, 10, 12, 15, 23, 31 Aug; 12, 15, 21, 25, 27 Sep; 3, 11 Oct and 15 Nov.

Gaps in Channel 1 data

0000GMT 1 January - 1900GMT 7 February Gauge failure- see below.

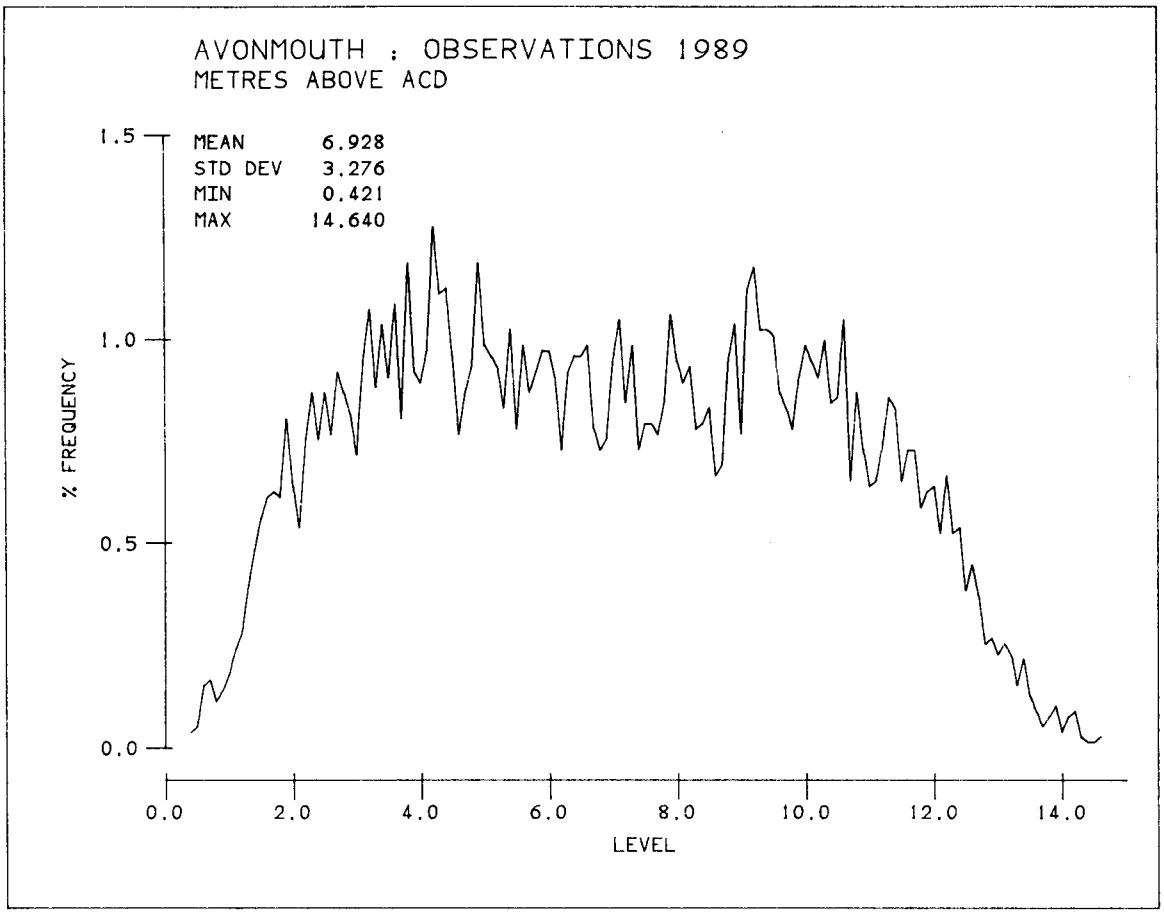
After examination of the data the gap was extended to end 2300GMT 8 February.

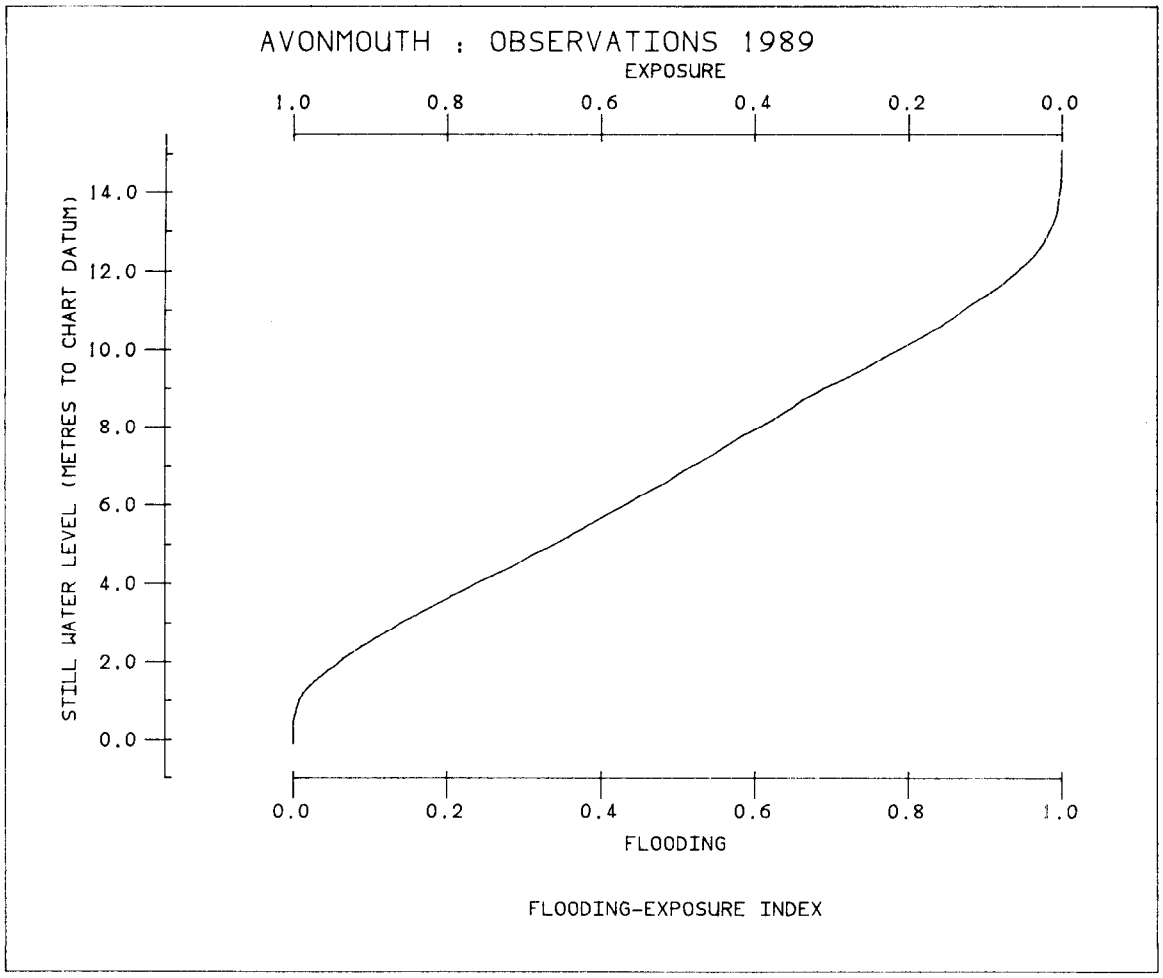
Site diary

24 January	TGI visit to check reason for gauge failure and ascertain effects of land reclamation on the instrument site.
7- 8 February	TGI visit.Pressure points found deeply embedded in mud on the sea bed. Blockage corrected and points refitted 1 metre higher, clear of mud. Site instrumentation reset for datum.
29 November	TGI visit for routine maintenance

Extreme statistics

9 March	Annual maximum level 14.64m above Chart Datum.
20 December	Annual maximum surge 2.026m above predicted.


AVONMOUTH : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 6.928
STD DEV 3.276
MIN 0.421
MAX 14.640
% FREQUENCY
1.5
1.0
0.5
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
LEVEL


AVONMOUTH : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, West Coast - Port of Bristol (Avonmouth)

Latitude: 51 30'36.9"N
Longitude: 2 42'50.7"W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 6.945

Hourly data from digiquartz sensor

Datum of Observations = ACD : 6.50 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.6945D+01 Residual Mean = 0.9018D-08
Std Dev = 0.3274D+01 Std Dev = 0.2381D+00

Constituent	h	g
Q1	0.023	325.26
O1	0.081	4.90
P1	0.029	134.98
K1	0.075	146.23
J1	0.003	232.42
2N2	0.105	165.43
N2	0.782	184.51
M2	4.298	200.18
S2	1.533	259.08
K2	0.433	255.87
M3	0.048	211.26
M4	0.261	346.75
MS4	0.236	19.99
M6	0.128	270.33

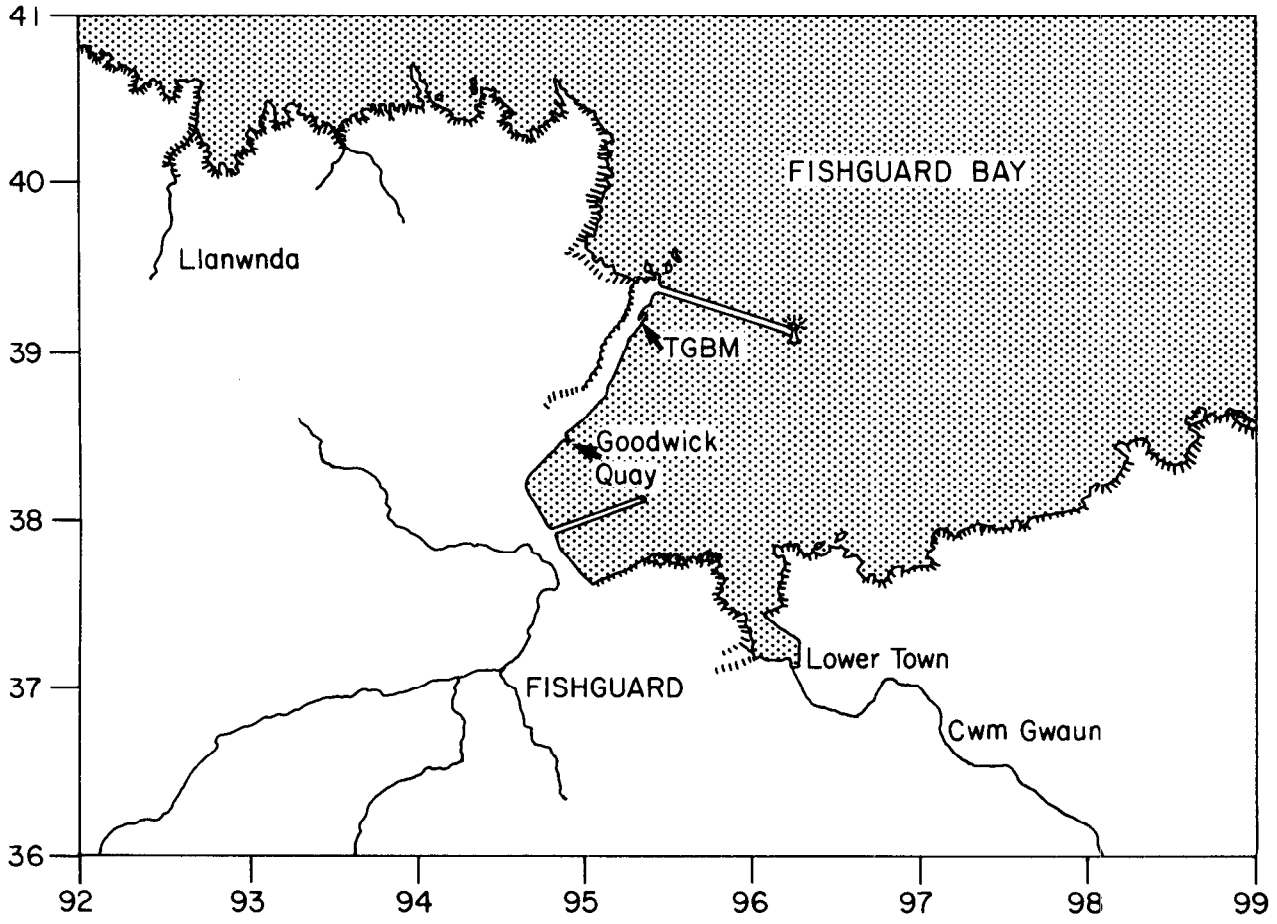
2.4 FISHGUARD

Latitude 52 deg 00' 46.2"N Longitude 04 deg 58' 57.5"W

National Grid Reference SM 9534 3918

Recording zero = Chart Datum = 2.44m below Ordnance Datum Newlyn

Recording zero = 7.880m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	SM9534 3918	OSBM Bolt on quay 3.6m NE of railings.
Aux1	SM9513 3874	OS Bolt in concrete base of railings, 6.4m from NW angle of tide gauge hut.
Aux2	SM9489 3849	Rivet in top step on Goodwick Quay.
Aux3	SM9455 3820	Flush bracket 11518 on building on SW side of railway bridge on SE face.

Data processing

Two pressure gauge systems installed with digiquartz sensors in June 1988.
Channel 2 is the designated Class-A channel, although elevations from both recording channels have been fully processed for 1989.

This is a completely new installation, taking the place of a Lea gauge with stilling well. The Tide Gauge Bench Mark replaces the one used for the Lea gauge which is now Auxiliary 1,as the new installation is some distance North.Lea gauge records ceased 22 October 1989.

Missing scans were interpolated on the following dates: 4 Jan; 22 Feb; 23 Mar; 22, 26 Apr; 10, 31 May; 2, 4, 26 Jul; 2, 12, 31 Aug; 1, 9, 15, 20 Sep; 2, 13, 31 Oct; 6 Nov; 10, 14, 27 Dec.

Gaps in 1989 filtered data for 1989

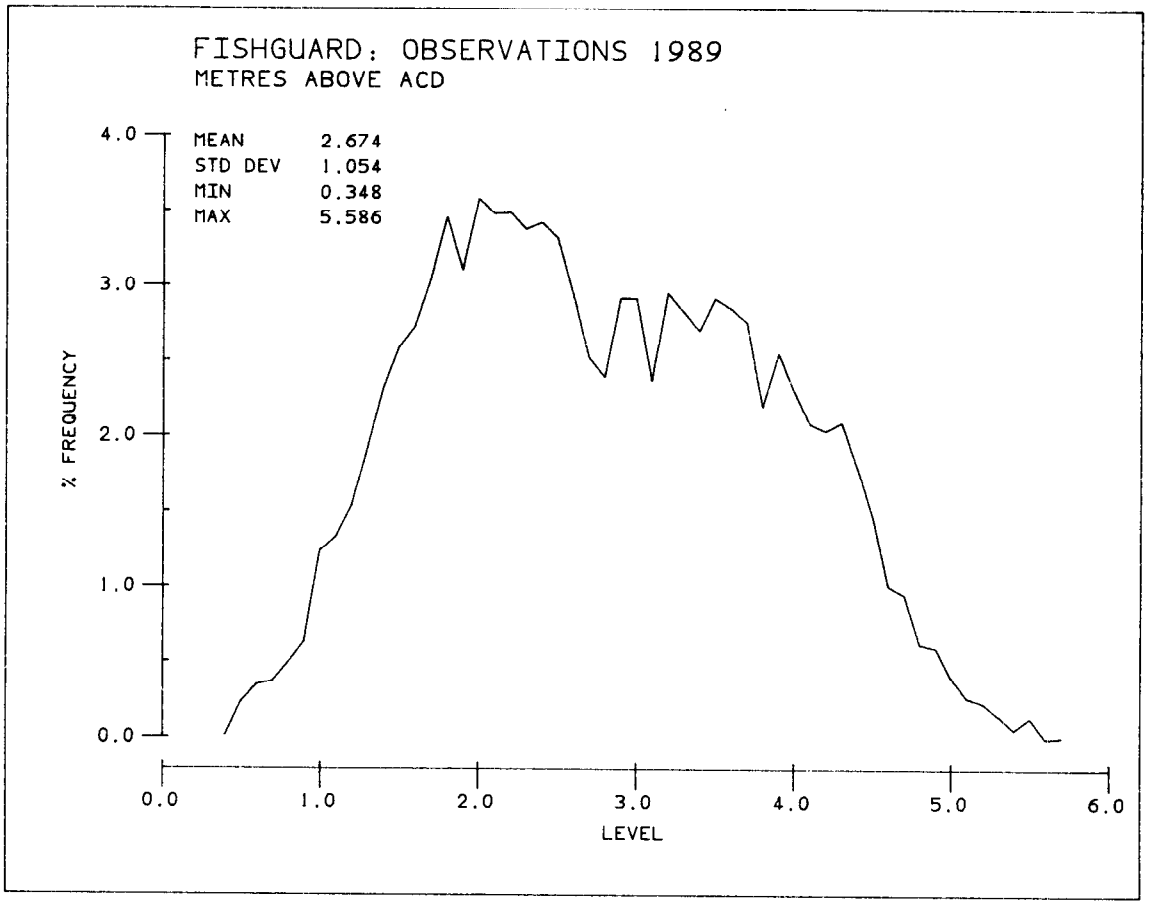
0500 GMT 12 December - 0400 GMT 13 December Data loss in store - reason not known.

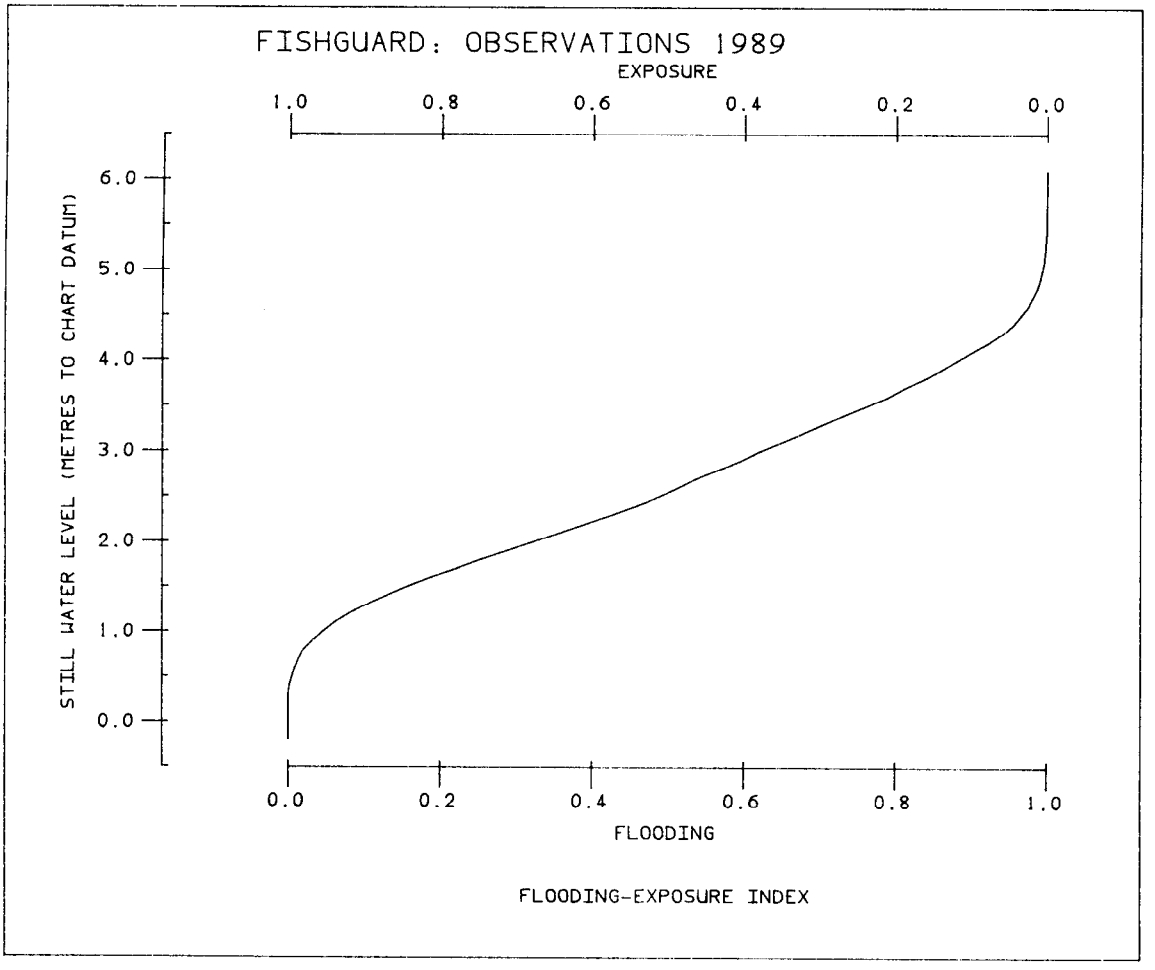
Site diary

1 November	Frequent errors on time channel, thought to be caused by an electrical storm.The elevation data was not affected.
14 December	TGI visit. Routine maintenance and new compressor installed.

Extreme Statistics

9 March	Annual extreme level of 5.586m above Chart Datum.
16 December	Annual maximum surge of 1.289m above predicted.


FISHGUARD: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.674
STD DEV 1.054
MIN 0.348
MAX 5.586
% FREQUENCY
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


FISHGUARD: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Wales - Fishguard

Latitude: 52 00' 46.2"N
Longitude: 4 58' 57.5"W

Time Zone: GMT

Length: 364 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.677

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 2.44 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2676D+01 Residual Mean = 0.7929D-06
Std Dev = 0.1053D+01 Std Dev = 0.1465D+00

Constituent	h	g
Q1	0.026	339.42
O1	0.083	10.28
P1	0.026	152.58
K1	0.079	153.27
J1	0.003	253.79
2N2	0.071	142.01
N2	0.278	188.37
M2	1.354	207.09
S2	0.531	248.01
K2	0.151	245.99
M3	0.012	194.05
M4	0.115	19.47
MS4	0.055	64.49
M6	0.001	30.81

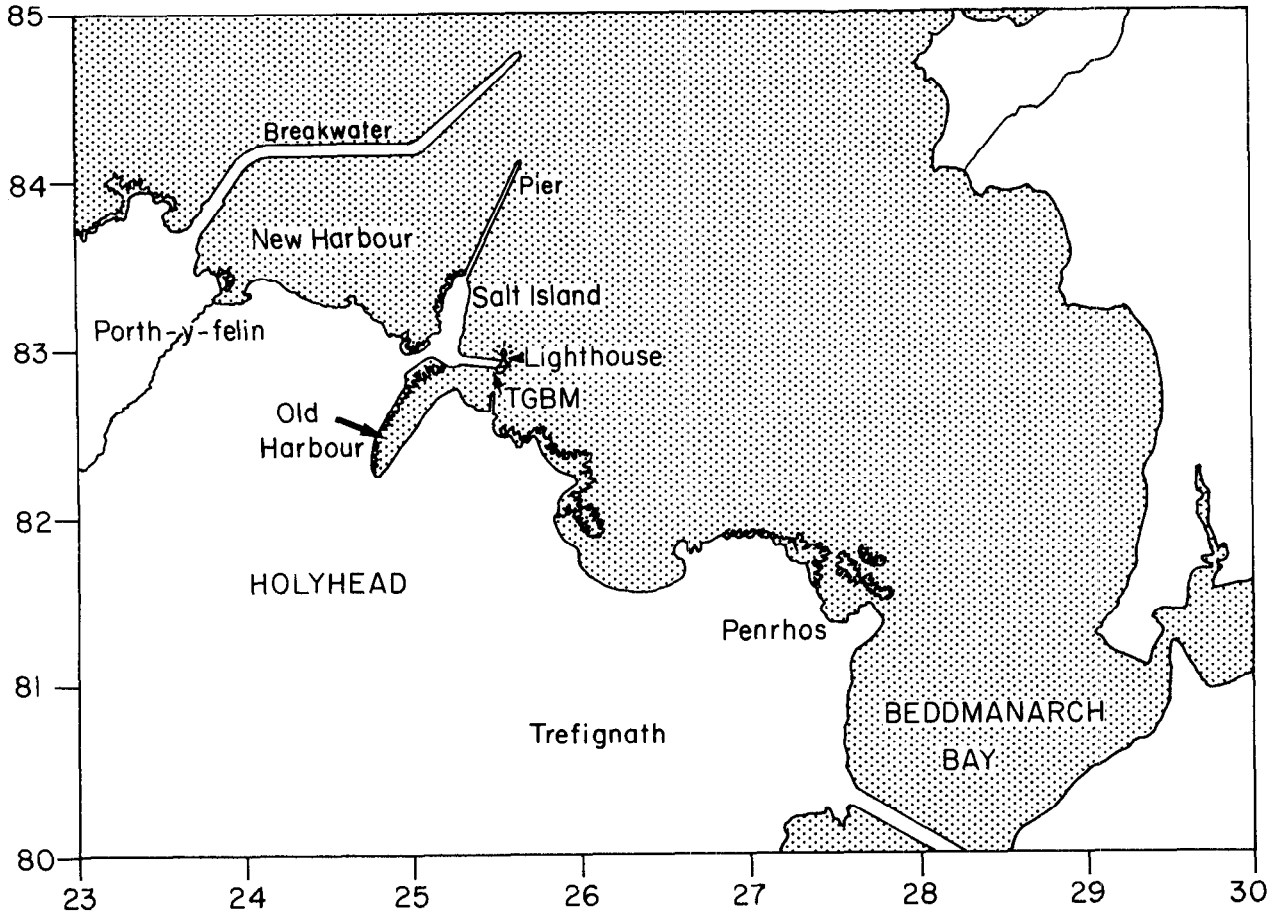
2.5 HOLYHEAD

Latitude 53 deg 18' 49.3"N Longitude 04 deg 37' 09.4"W

National Grid reference SH 2553 8287

Recording zero = Chart Datum = 3.05m below Ordnance Datum Newlyn

Recording zero = 7.447m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	SH2553 8287	Bolt concrete foundation N side of tide gauge building.
Aux1	SH2556 8289	PA bolt on harbour lighthouse S face.
Aux2	SH2553 8286	TG rivet on concrete foundation E side of entrance to tide gauge building.
Aux3	SH2506 8292	Bolt Salt Island bridge 2.2m S junction walls.

Data processing

Hourly levels were filtered from values on the digiquartz sensor (Channel 2).
Isolated missing scans were interpolated on the following dates : 11 Jul; 9 Aug; 7 Sep; 8 Oct; 19 Nov.

24 November to the end of the year: values were 0.8m low and corrected in reduction.

Gaps in filtered data from Class-A channel

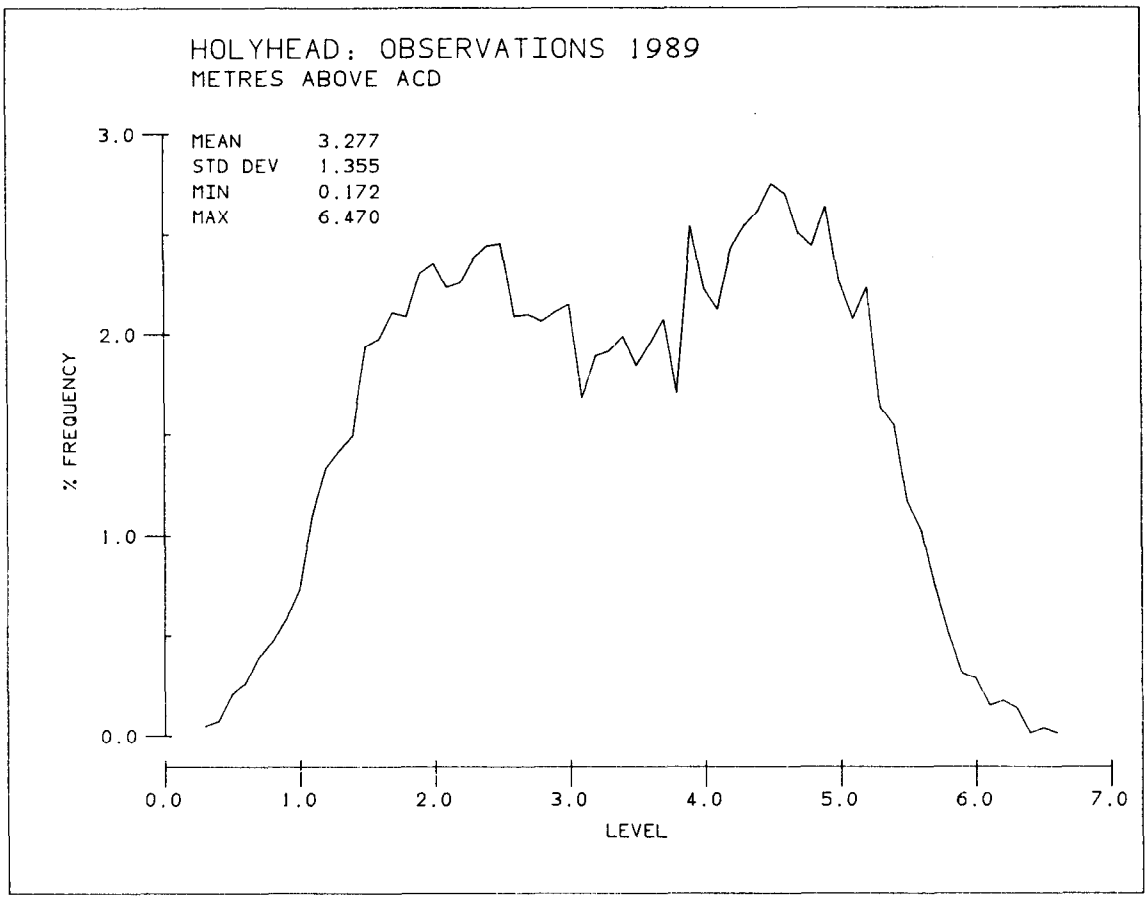
0900 GMT 31 March -	1400 GMT 24 April	Compressor fault: switched off.
1000 GMT 23 November -	1400 GMT 24 November	New pressure point awaiting calibration.
1000 GMT 6 December -	1800 GMT 7 December	Data lost in store.
1400 GMT 10 December -	0300 GMT 11 December	" " "

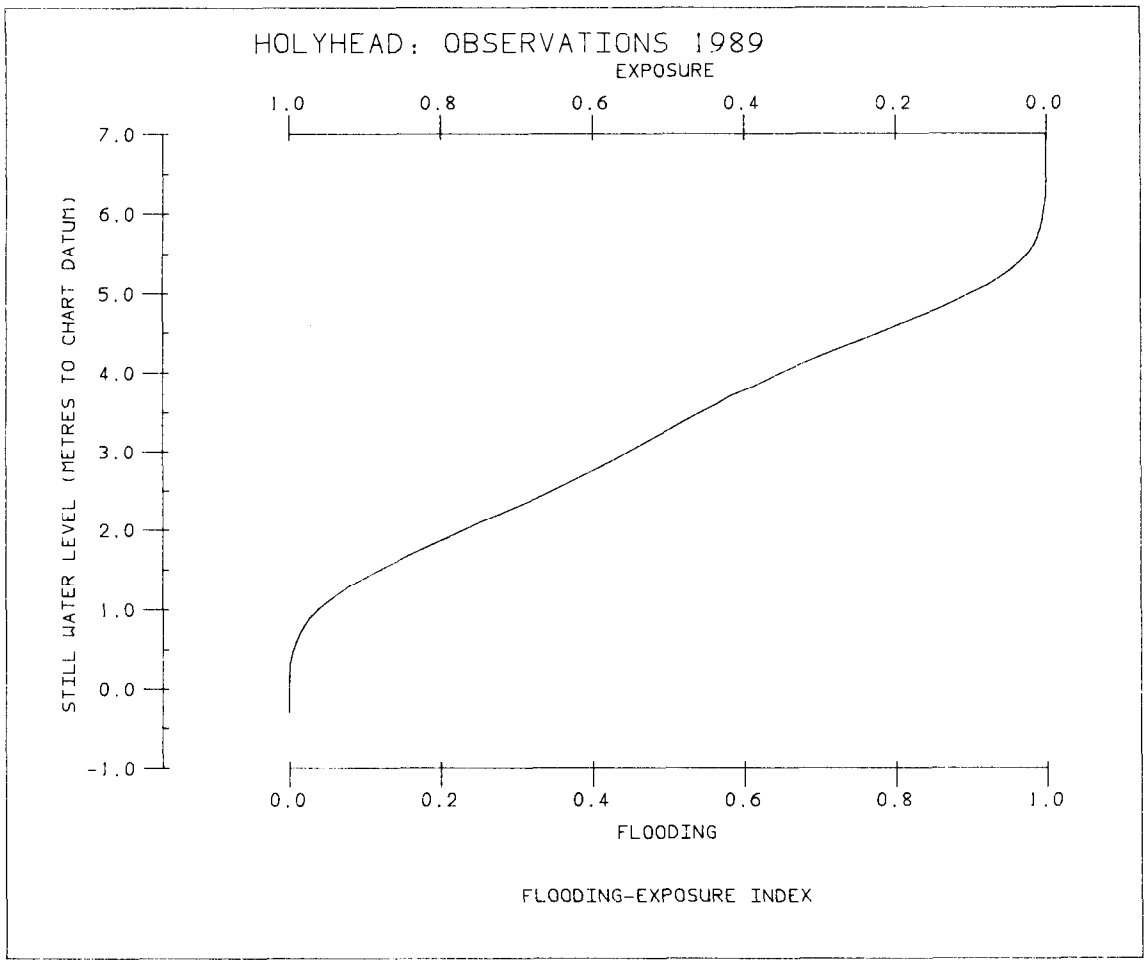
Site diary

24 April	TGI visit to replace compressor.
8 June	TGI visit. New compressor found to be leaking:removed for repairs.
19 June	TGI visit. Repaired compressor installed.
23 November	New pressure point installed by divers.

Extreme Statistics

9 March	Annual extreme level 6.47m. above Chart Datum.
16 December	Annual maximum surge 1.362m above predicted.


HOLYHEAD: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.277
STD DEV 1.355
MIN 0.172
MAX 6.470
% FREQUENCY
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
LEVEL


HOLYHEAD: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Wales - Holyhead

Latitude: 53 18'49.3" N
Longitude: 4 37'09.4" W

Time Zone: GMT

Length: 362 Days

From: 25th April, 1989 To: 24th April, 1990

Units: Metres A0: 3.285

Hourly data from digiquartz sensor

Datum of Observations = ACD : 3.05 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.3284D+01 Residual Mean = 0.8988D-06
Std Dev = 0.1366D+01 Std Dev = 0.1688D+00

Constituent	h	g
Q1	0.033	356.45
O1	0.103	29.32
P1	0.038	163.13
K1	0.115	177.84
J1	0.005	256.49
2N2	0.049	244.52
N2	0.360	267.57
M2	1.808	291.93
S2	0.594	328.78
K2	0.168	326.67
M3	0.016	246.59
M4	0.034	25.85
MS4	0.013	51.39
M6	0.021	222.77

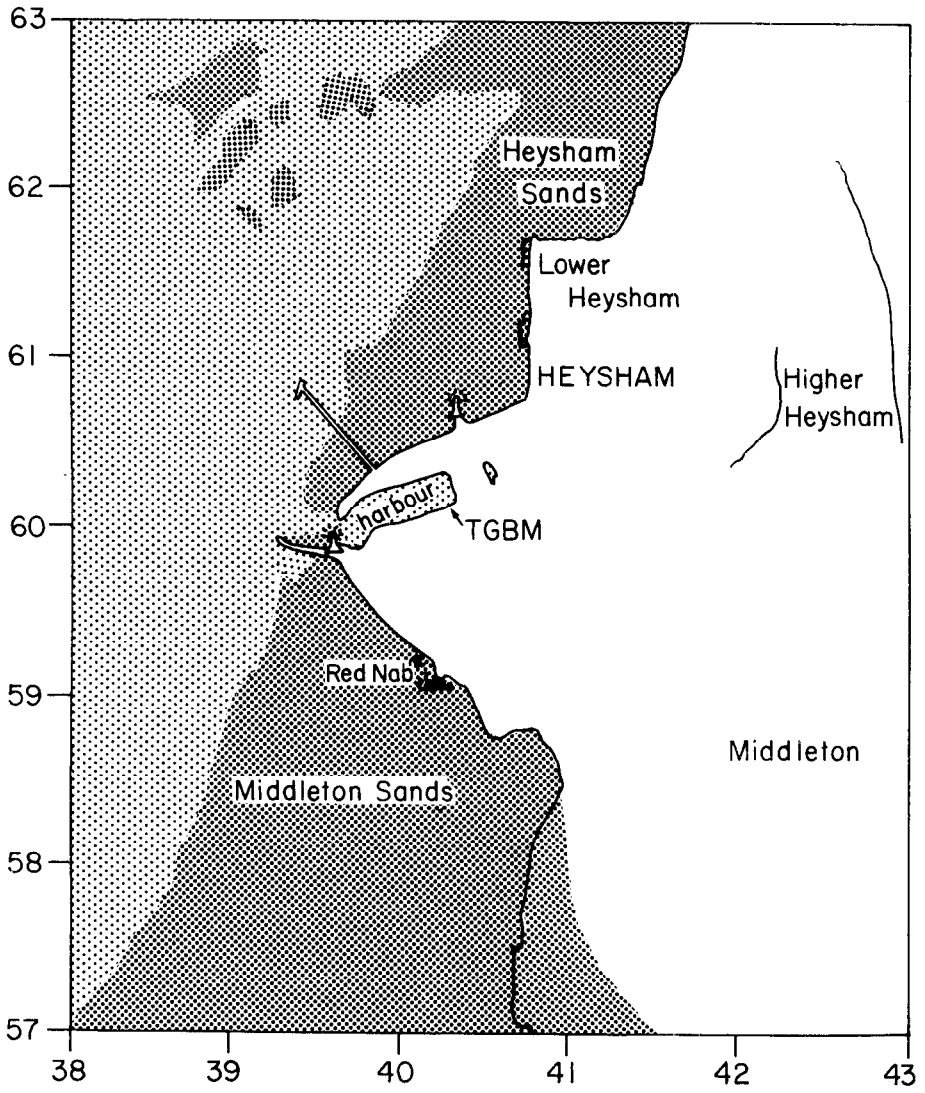
2.6 HEYSHAM

Latitude 54 deg 02' 0.3"N Longitude 02 deg 54' 41.7"W

National Grid reference SD 4030 6012

Recording zero = Chart Datum = 4.9m below Ordnance Datum Newlyn

Recording zero = 12.095m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	SD4030 6012	OSBM Bolt S quay 40.8m SW angle of dock.
Aux1	SD4141 6005	Bridge parapet 3.4m N fence, junction E side of road W face.
Aux2	SD4026 6033	Pivot pin on harbour wall 6.1m SW N angle of harbour.

Data processing

Hourly levels filtered from Channel 2 digiquartz.Missing scans were interpolated on the following dates : 8 Jan; 8 Mar; 7, 30 Apr; 21 Jul.

Gaps in filtered hourly levels

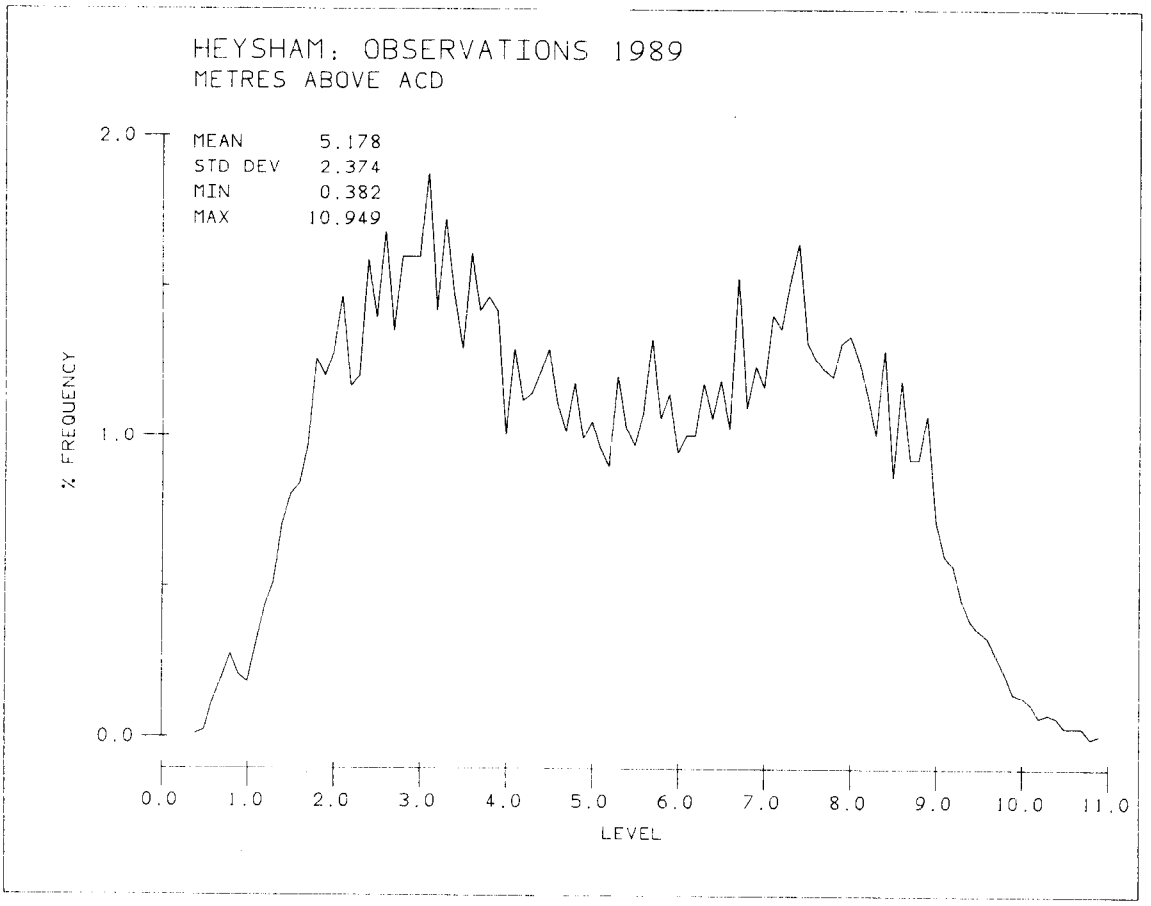
Nil gaps

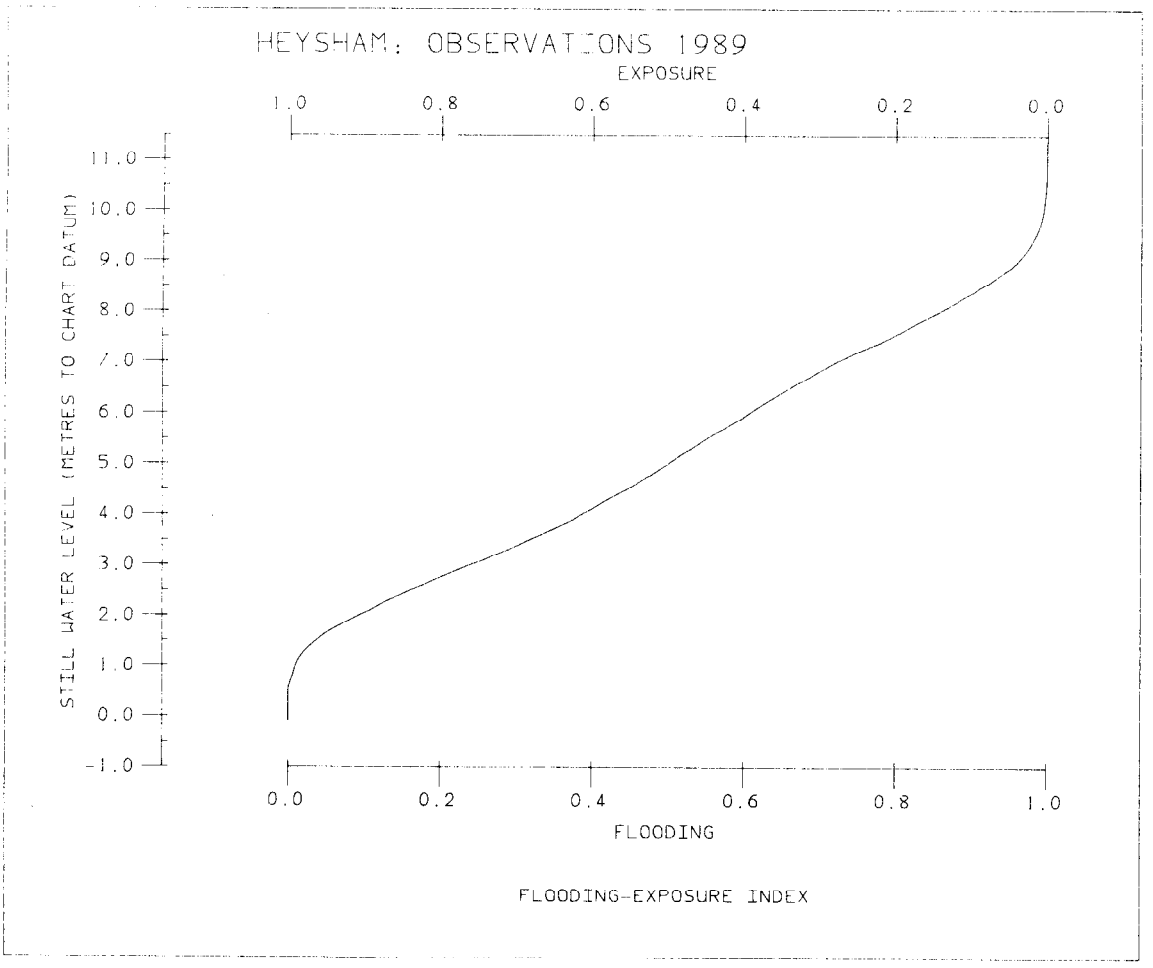
Site diary

17 March	TGI visit for routine checks.
13 October	TGI visit. Both channels purged.

Extreme Statistics

9 March	Annual extreme level 10.95m above Chart Datum.
11 April	Annual maximum surge 1.599m above predicted.


HEYSHAM: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 5.178
STD DEV 2.374
MIN 0.382
MAX 10.949
% FREQUENCY
2.0
1.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0
LEVEL


HEYSHAM: OBSERVATIONS 1989
EXPOSURE
1.0 0.8 0.6 0.4 0.2 0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
0.0 0.2 0.4 0.6 0.8 1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, West Coast - Heysham

Latitude: 54 02' 0.3" N
Longitude: 2 54'41.7" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 5.181

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 4.90 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.5179D+01 Residual Mean = 0.7264D-06
Std Dev = 0.2375D+01 Std Dev = 0.2065D+00

Constituent	h	g
Q1	0.039	14.03
O1	0.123	42.68
P1	0.045	191.77
K1	0.125	193.11
J1	0.007	310.07
2N2	0.075	279.24
N2	0.611	301.93
M2	3.176	325.68
S2	1.035	8.56
K2	0.290	6.86
M3	0.028	315.29
M4	0.203	245.90
MS4	0.118	297.95
M6	0.014	46.91

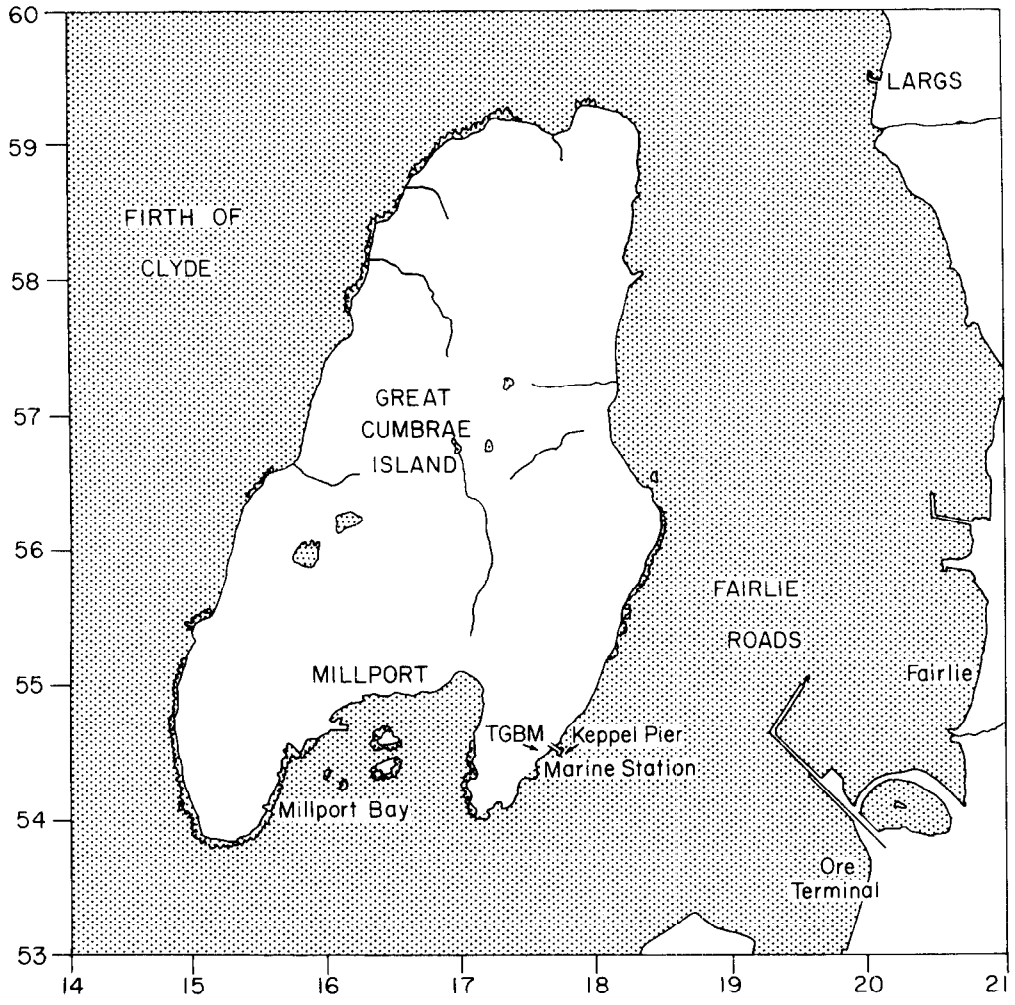
2.7 MILLPORT

Latitude 55 deg 44' 58.2"N Longitude 04 deg 54' 17.9"W

National Grid reference NS 1770 5450

Recording zero = Chart Datum = 1.62m below Ordnance Datum Newlyn

Recording zero = 7.825m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NS1757 5449	Flush bracket G4602 Marine Station.
Aux1	NS1771 5457	OSBM bolt on rock SE side of road 5m NE end of wall.
Aux2	NS1769 5454	Rivet on pier 0.8m production SE face of tide gauge building.
Aux3	NS1718 5451	45 Marine Parade NW angle N face.

Data processing

Hourly levels were filtered from Channel 2 with a digiquartz sensor. Missing scans were interpolated on the following dates: 7 Jan; 8 Feb; 7 Apr; 11 Aug; 2 Sep; 16, 26 Oct; 27, 30 Nov.
Scans recorded at 1 and 7/8 minute frequency during the TGI visit of 14 March were edited.

Gaps in filtered hourly data

2200 GMT 13 April - 1800 GMT 14 April Compressor failure.

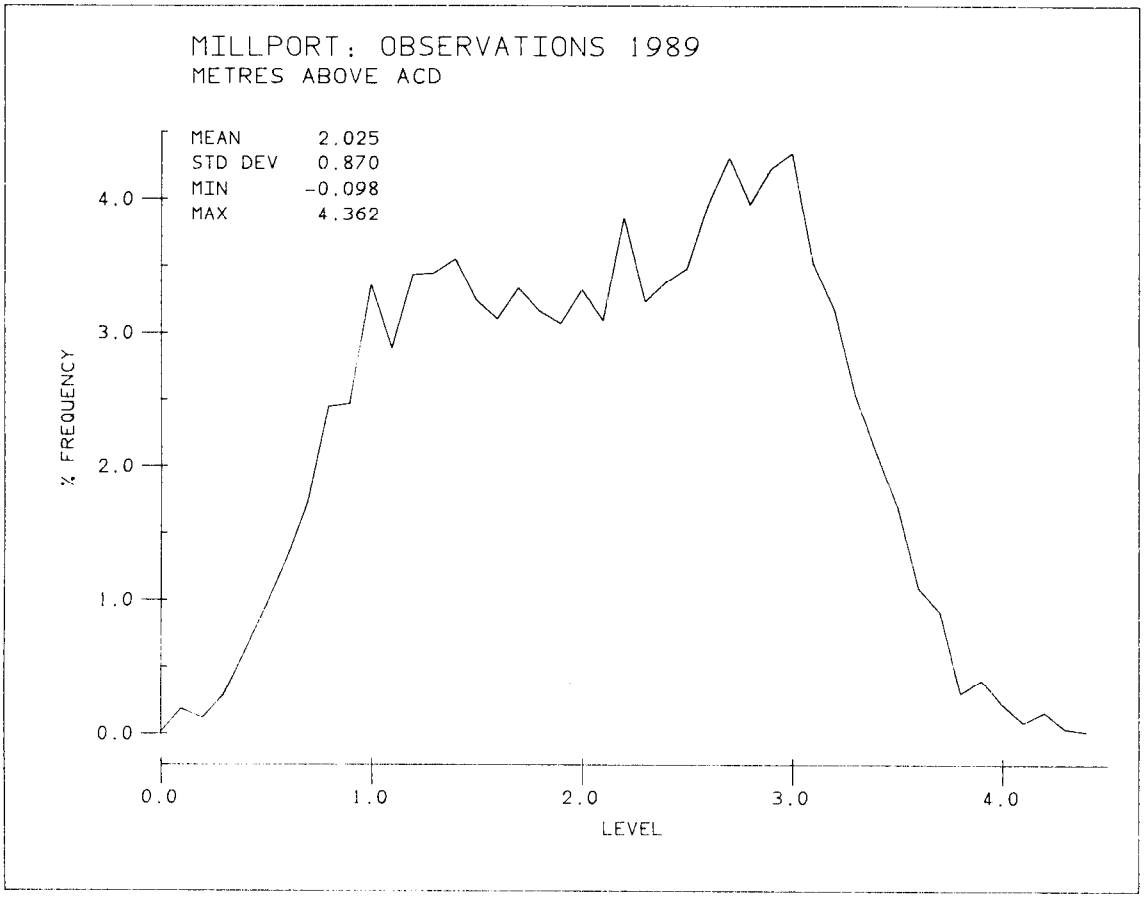
Site diary

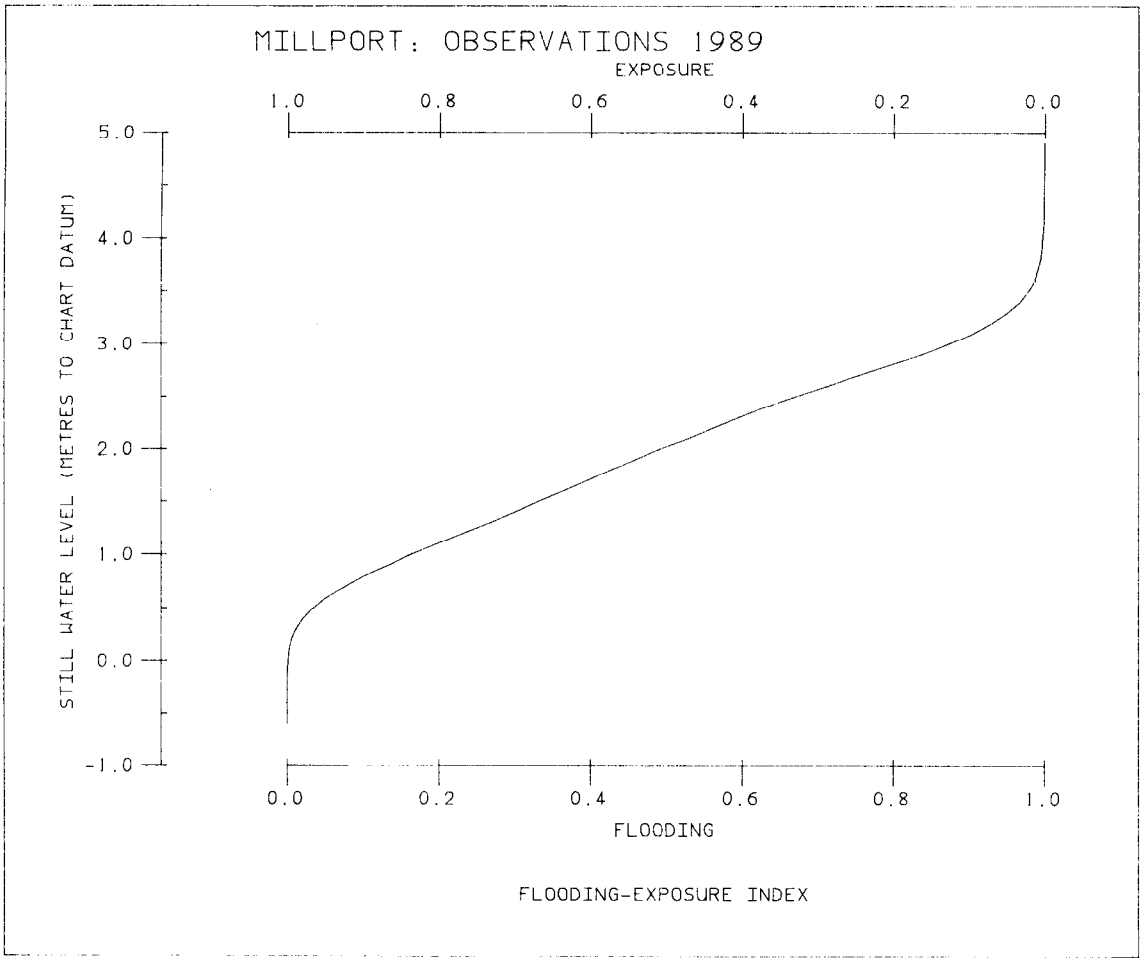
14-15 March TGI visit for calibration checks.New fitting put on pressure point: original eroded.(Channel 1)

Extreme Statistics

December 17 (1500GMT) Annual maximum level 4.363m above Chart Datum.

December 17 (0100GMT) Annual maximum surge 1.483m above predicted.


MILLPORT: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.025
STD DEV 0.870
MIN -0.098
MAX 4.362
% FREQUENCY
0.0
1.0
2.0
3.0
4.0
LEVEL


MILLPORT: OBSERVATIONS 1989
EXPOSURE
1.0 0.8 0.6 0.4 0.2 0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0 0.2 0.4 0.6 0.8 1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, West Coast - Millport

Latitude: 55 44'58.2" N
Longitude: 4 54'17.9" W

Time Zone: GMT

Length: 364 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.031

Hourly data from digiquartz sensor

Datum of Observations = ACD : 1.62 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2030D+01 Residual Mean = 0.7301D-06
Std Dev = 0.8658D+01 Std Dev = 0.1943D+00

Constituent	h	g
Q1	0.037	7.77
O1	0.103	43.30
P1	0.039	187.40
K1	0.109	192.81
J1	0.005	284.49
2N2	0.025	295.09
N2	0.212	315.50
M2	1.122	342.59
S2	0.301	34.77
K2	0.084	34.69
M3	0.045	112.99
M4	0.088	89.02
MS4	0.086	117.23
M6	0.025	303.37

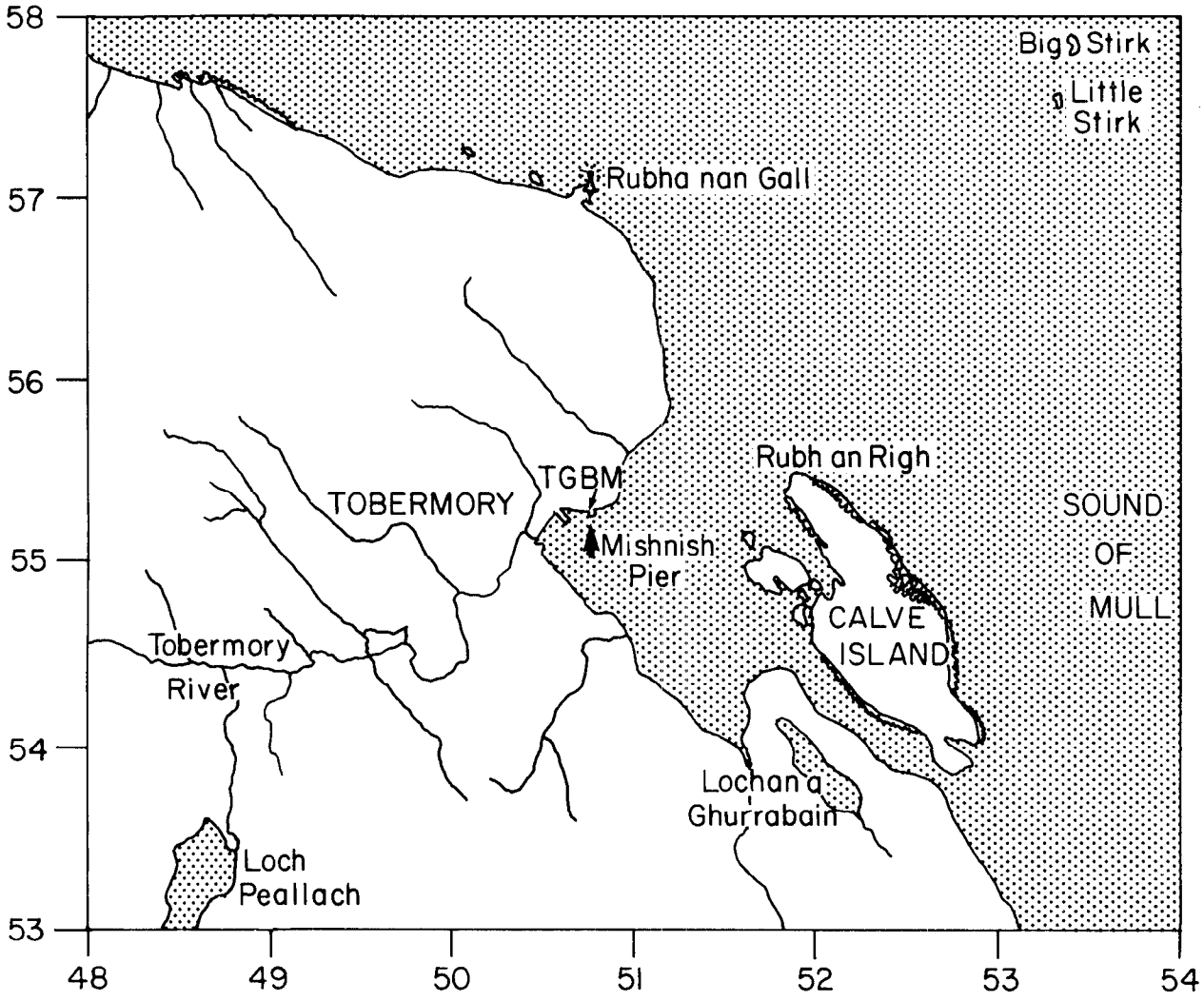
2.8 TOBERMORY

Latitude 56 deg 37' 23.3"N Longitude 06 deg 03' 46.1"W

National Grid reference NM 5081 5529

Recording zero = Chart Datum = 2.39m below Ordnance Datum Newlyn

Recording zero = 6.856m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NM5069 5530	Flush bracket G5186 on SW angle of Royal Buildings.
Aux2	NM5077 5529	NBM rivet in sea wall of Mishnish Pier.

Data processing

This tide gauge site was modernised to accommodate Dataring in August 1987 with two digiquartz sensors on pressure gauge systems. Channel 2 is the designated Class-A channel.

Missing scans were interpolated on the following dates: 14 Jan; 13, 27 Feb; 20 Apr; 8, 23, 31 May; 4, 21 Jul; 17 Aug; 3 Sep; 3 Oct; 1 Nov.

7 - 15 February Suspect high water recordings were interpolated.

17 July scans recording at 1 7/8 minute frequency over period of TGI visit edited.

According to the Ordnance Survey, the new permanent tide staff at this site was set 3cm in error.Unfortunately, this level was used for relationships for the new installation in August 1987. Consequently, the gauge datum was 3cm low from that date until the TGI adjusted the level on their visit of 17 July 1989.

At the time of writing, no adjustment has been made to the hourly levels and statistics since modernisation. Results are therefore likely to be in error. For the early section of 1988, a back-up Aanderaa record was reduced so the datum references for this instrument will also have to be reviewed.

Gaps in hourly filtered levels from channel 2

Nil gaps in 1989.

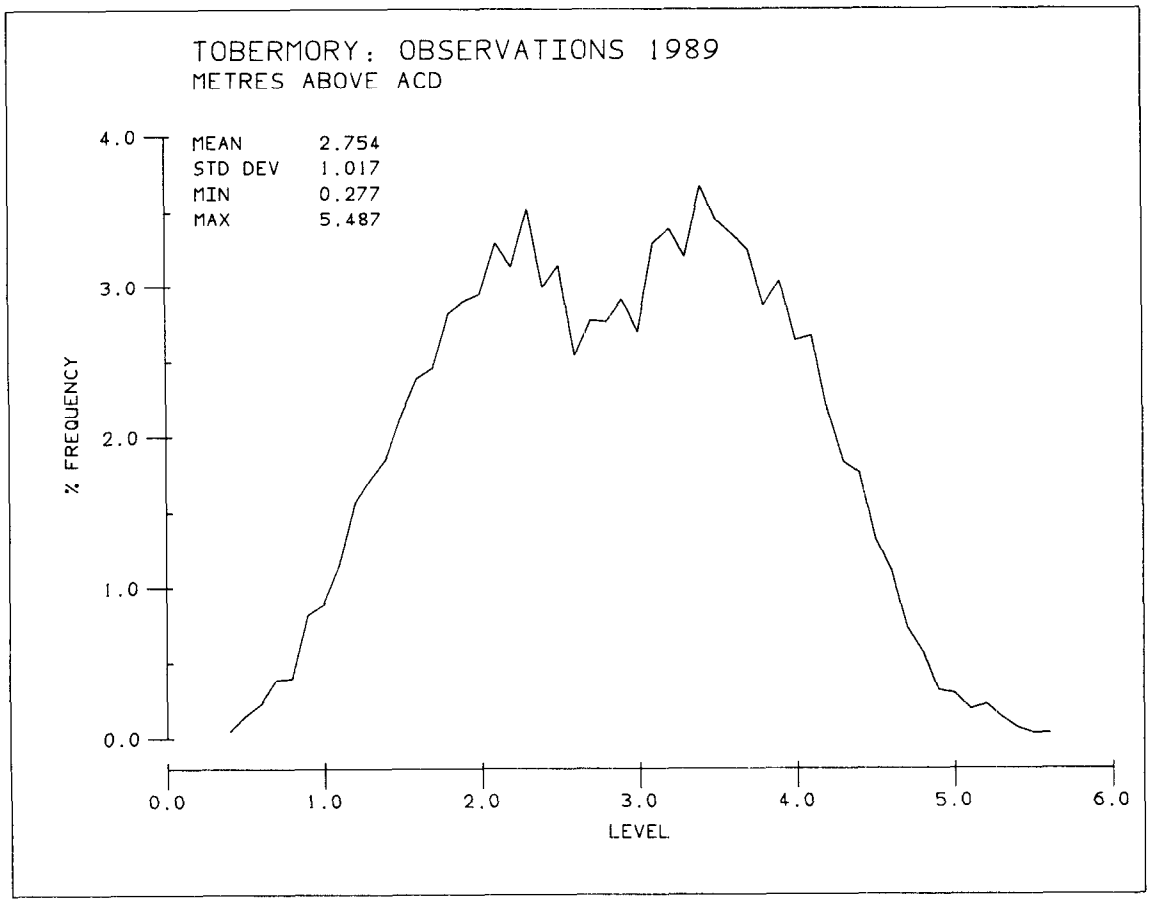
Site diary

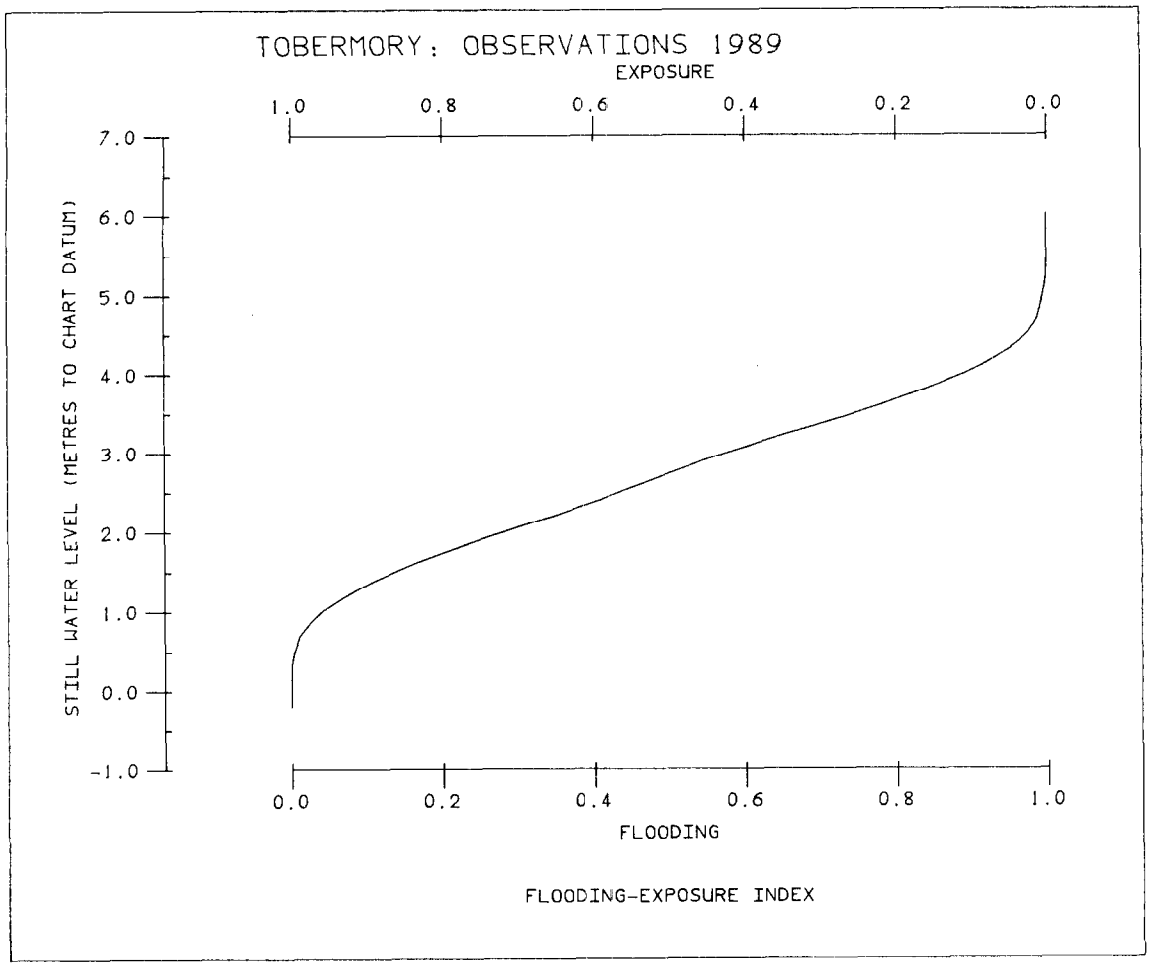
17 July	TGI visit. Compressor changed.Back-up Aanderaa recorder fitted with new tape and battery.

Extreme Statistics

18 September Annual maximum level 5.487m above Chart Datum.

13 February Annual maximum surge 1.246m above predicted.


TOBERMORY: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.754
STD DEV 1.017
MIN 0.277
MAX 5.487
% FREQUENCY
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


TOBERMORY: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, West Coast - Tobermory

Latitude: 56 37'23.3" N
Longitude: 6 03'46.1" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.756

Hourly data from digiquartz sensor

Datum of Observations = ACD : 2.39 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2755D+01 Residual Mean = 0.4118D-06
Std Dev = 0.1016D+01 Std Dev = 0.1717D+00

Constituent	h	g
Q1	0.028	342.23
O1	0.066	22.38
P1	0.018	161.26
K1	0.065	168.90
J1	0.004	194.54
2N2	0.037	131.78
N2	0.263	148.52
M2	1.295	168.51
S2	0.525	204.63
K2	0.150	202.67
M3	0.034	117.07
M4	0.044	178.78
MS4	0.036	288.39
M6	0.013	8.10

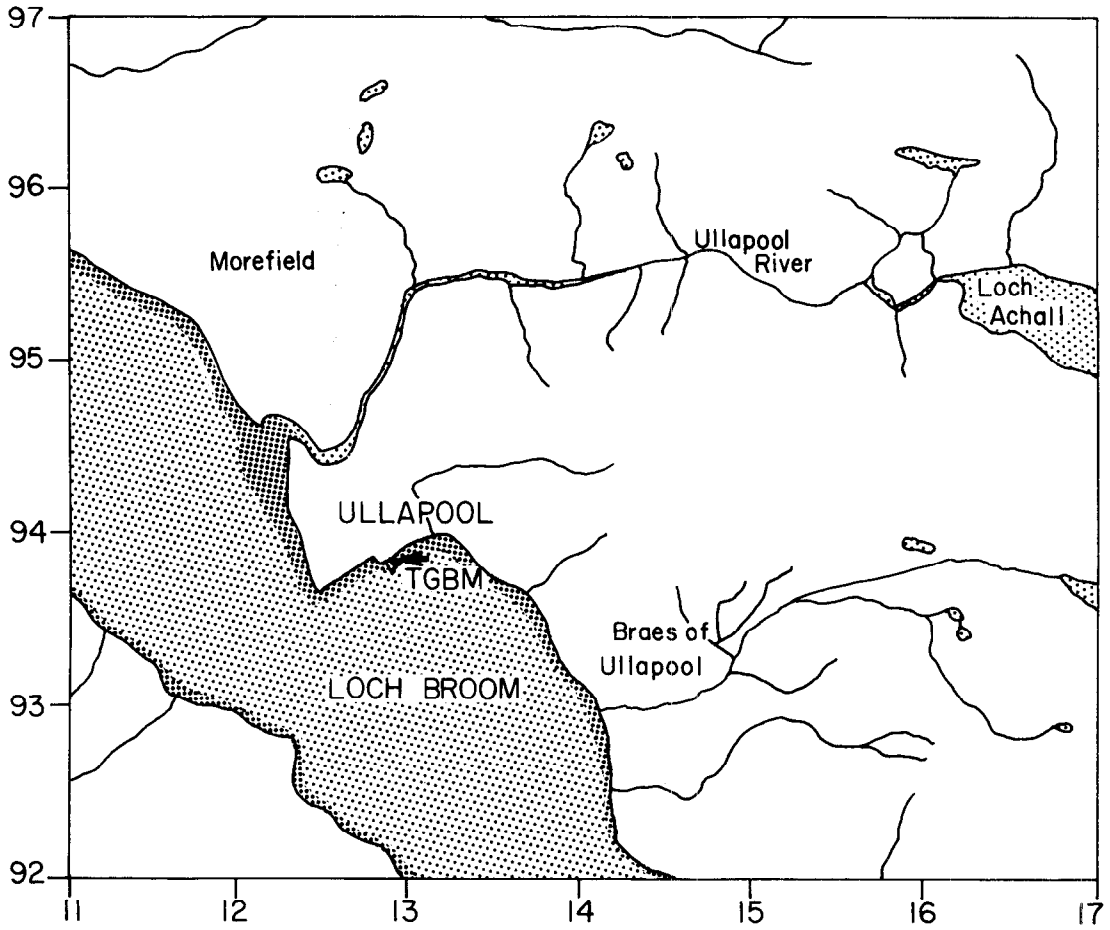
2.9 ULLAPOOL

Latitude 57 deg 53' 44.0"N Longitude 05 deg 09' 26.9"W

National Grid reference NH 1288 9391

Recording zero = Chart Datum = 2.75m below Ordnance Datum Newlyn

Recording zero = 7.155m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NH1288 9391	OSBM pier NW parapet 8.2m NE of steps.
Aux1	NH1303 9425	PA bolt on church SW side of road NE face N angle.
Aux2	NH1288 9398	8 Shore St. SE face 0.3m S angle.
Aux3	NH1253 9376	Rivet foundation of 21 West Shore St. S. angle.

Data processing

Hourly heights filtered from digiquartz transducer on pressure gauge (Channel 2).

Missing scans were interpolated on the following dates: 13, 27 Jan; 15 May; 5 Jun; 13, 18 Sep; 9 Oct(3); 21 Nov.

Gaps in 1989 filtered data

0800 GMT - 2200 GMT 15 March Memory fault

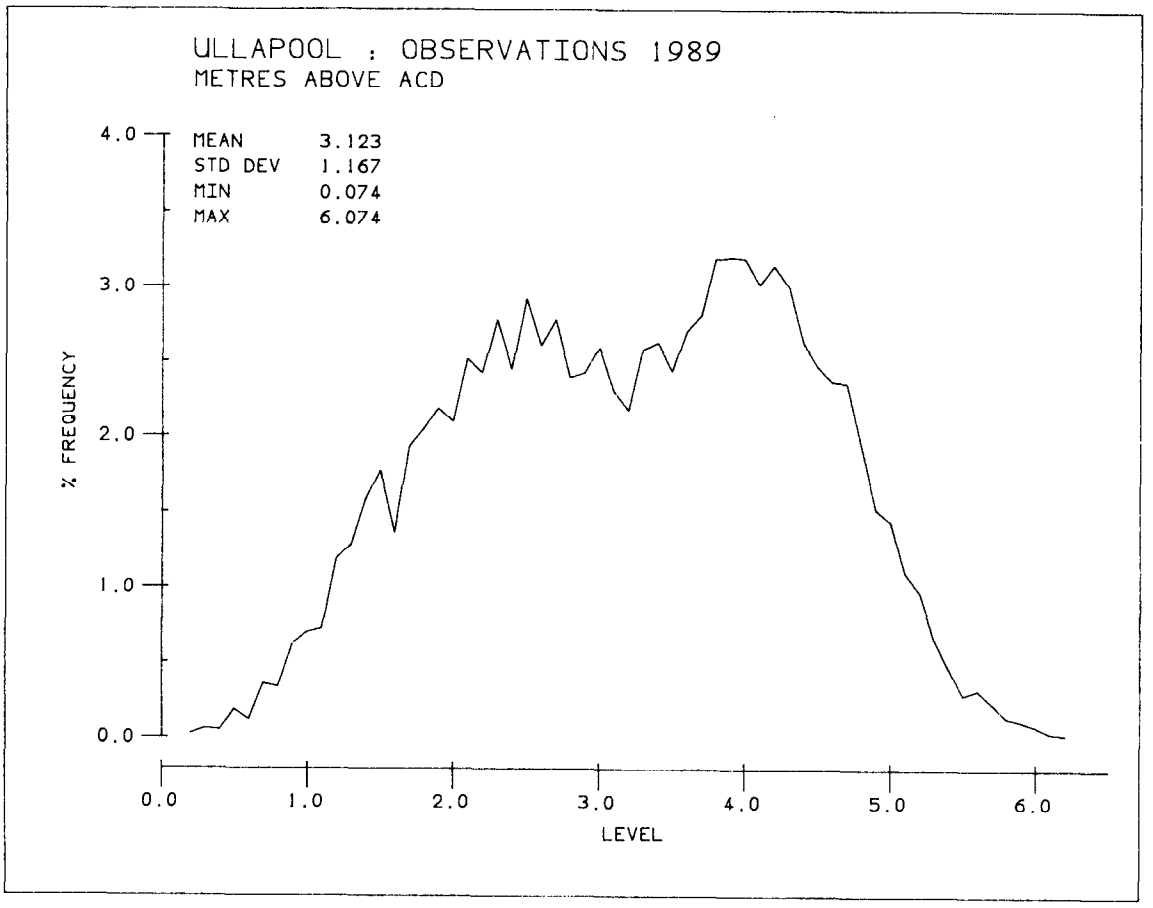
Site diary

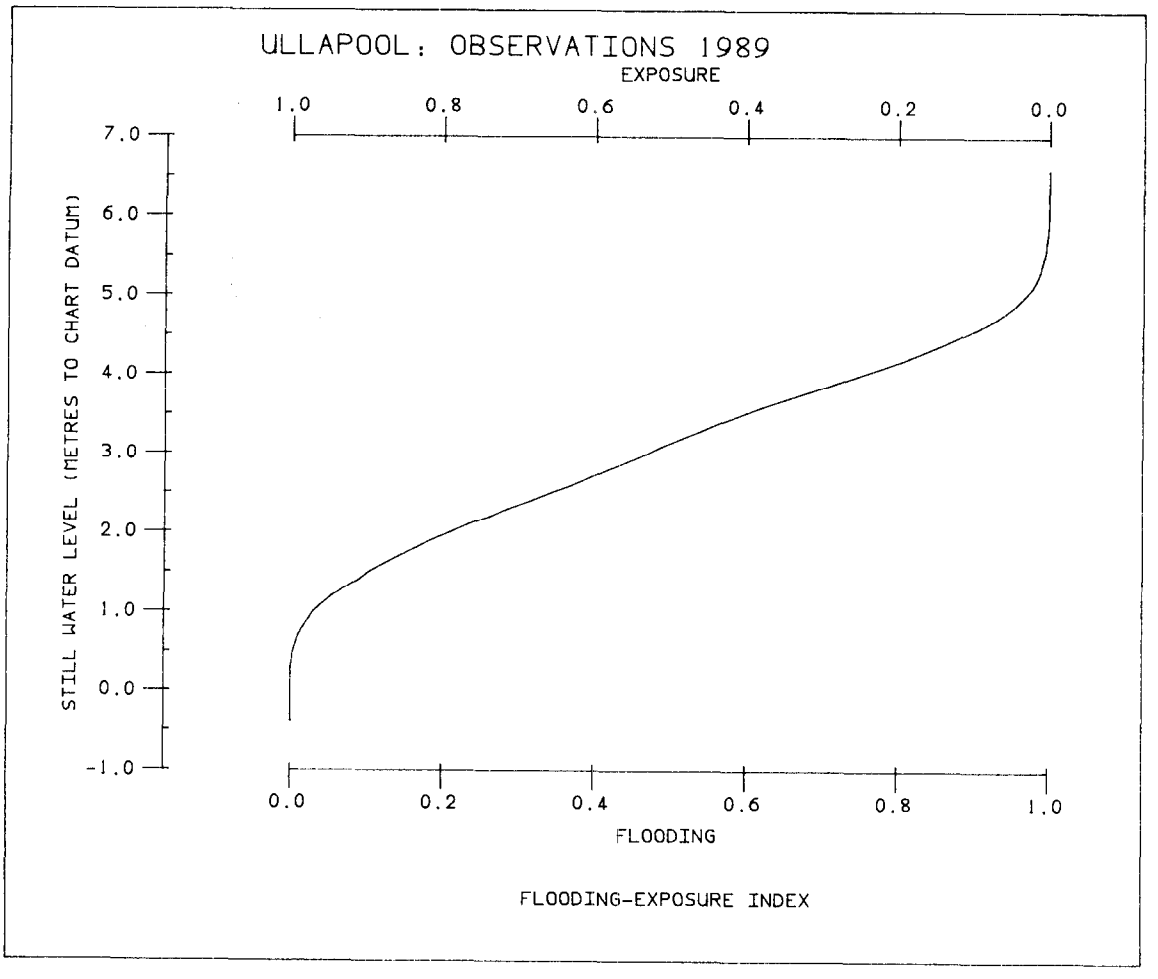
19 July TGI visit for routine maintenance.

Extreme Statistics

9 February Annual maximum level 6.074m above Chart Datum.

13 February Annual maximum surge 1.083m above predicted.


ULLAPOOL : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.123
STD DEV 1.167
MIN 0.074
MAX 6.074
% FREQUENCY
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


ULLAPOOL: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, West Coast - Ullapool

Latitude: 57 53'44.0" N
Longitude: 5 09'26.9" W

Time Zone: GMT

Length: 364 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 3.125

Hourly data from digiquartz sensor

Datum of Observations = ACD : 2.75 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.3125D+01 Residual Mean = 0.1010D-05
Std Dev = 0.1168D+01 Std Dev = 0.1701D+00

Constituent	h	g
Q1	0.027	311.10
O1	0.082	345.96
P1	0.034	119.48
K1	0.106	129.39
J1	0.006	203.61
2N2	0.045	153.43
N2	0.304	179.16
M2	1.500	200.70
S2	0.583	234.76
K2	0.166	232.48
M3	0.028	128.18
M4	0.066	229.15
MS4	0.074	302.16
M6	0.007	199.23

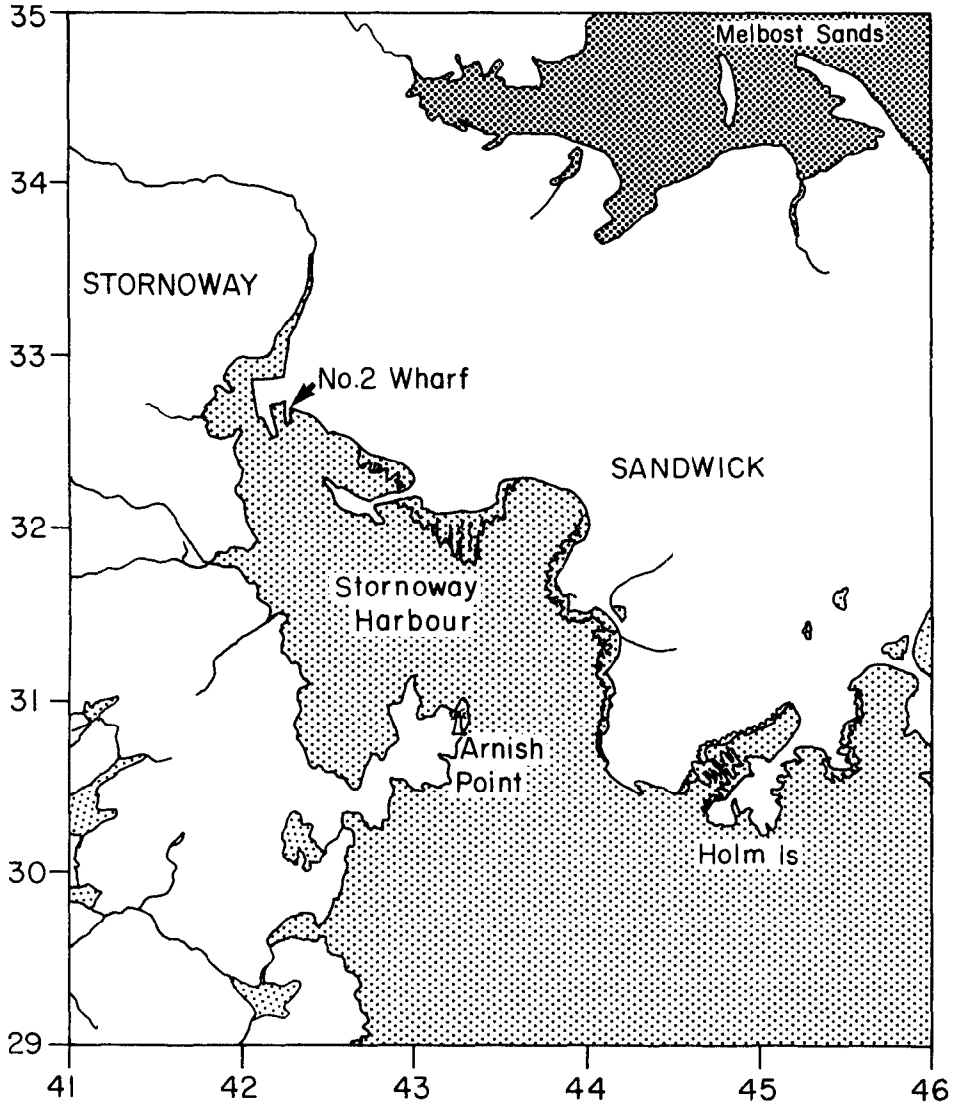
2.10 STORNOWAY

Latitude 58 deg 12' 28.6"N Longitude 06 deg 23' 17.5"W

National Grid reference NB 4226 3271

Recording zero = Chart Datum = 2.71m below Ordnance Datum Local

Recording zero = 6.368m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NB4228 3264	OSBM bolt E side No.2 Wharf.
Aux1	NB4215 3271	OSBM bolt steps NE angle King Edward Wharf.
Aux2	NB4212 3275	Amity House, E side of Esplanade Rd. N face NW angle.
Aux3	NB4223 3280	Bank, S side Worth Beach NW angle N face.

Data processing

Hourly heights filtered from digiquartz transducer on pressure gauge (Channel 2).

Missing scans were interpolated in the raw values on the following dates: 12 Jan; 14 Apr; 17, 29 May; 27 Jun; 7 Aug; 15, 16 Sep; 2 Oct; 3 Nov.

Scans recorded at 1 7/8 min frequency over the period of the TGI visit were edited.

Gaps in 1989 filtered data from Channel 2

2000 GMT 2 April - 1900 GMT 3 April Data lost at source.Reason not known.

0600 GMT 2 June - 1300 GMT 5 June Data lost at source.Reason not known.

0500 GMT 12 September - 1900 GMT 12 September Data lost at source.Reason not known.

Site diary

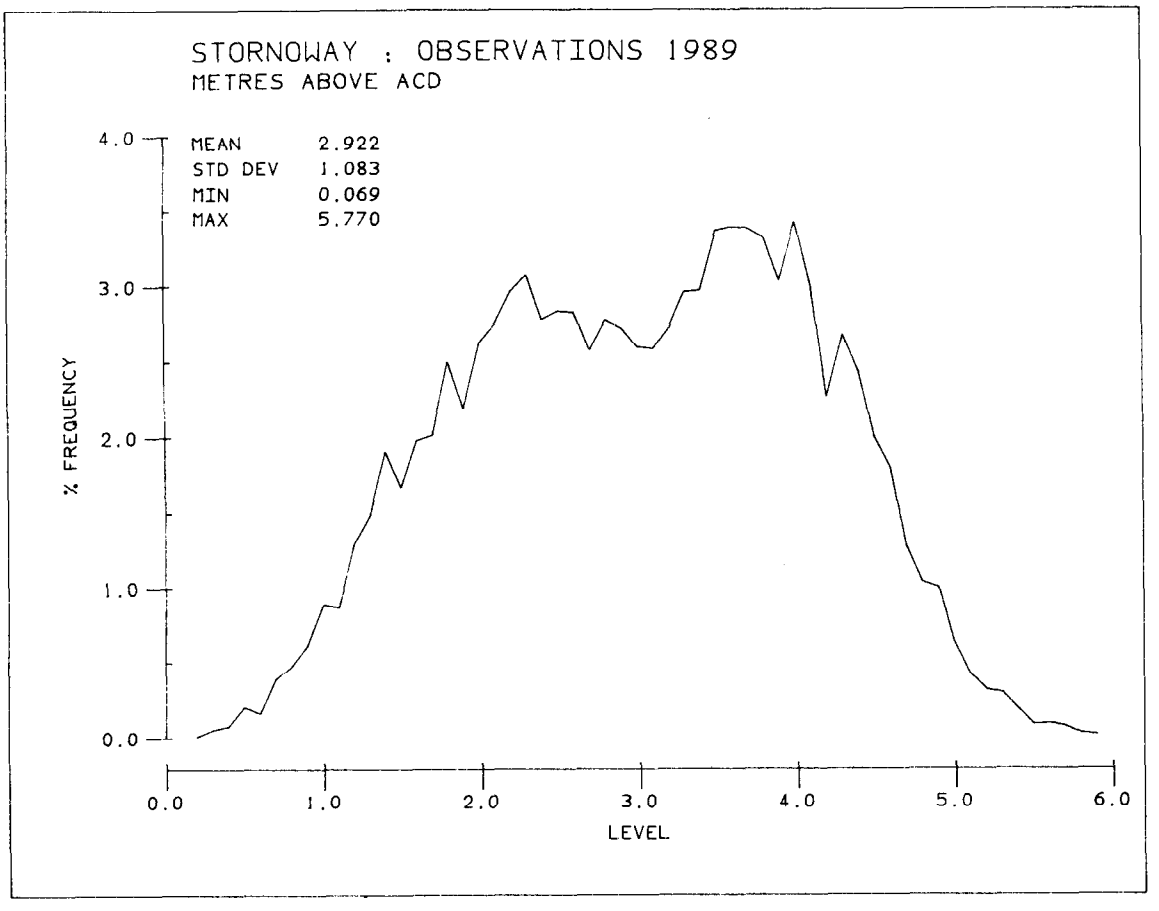
18-19 July TGI visit. Compressor replaced.

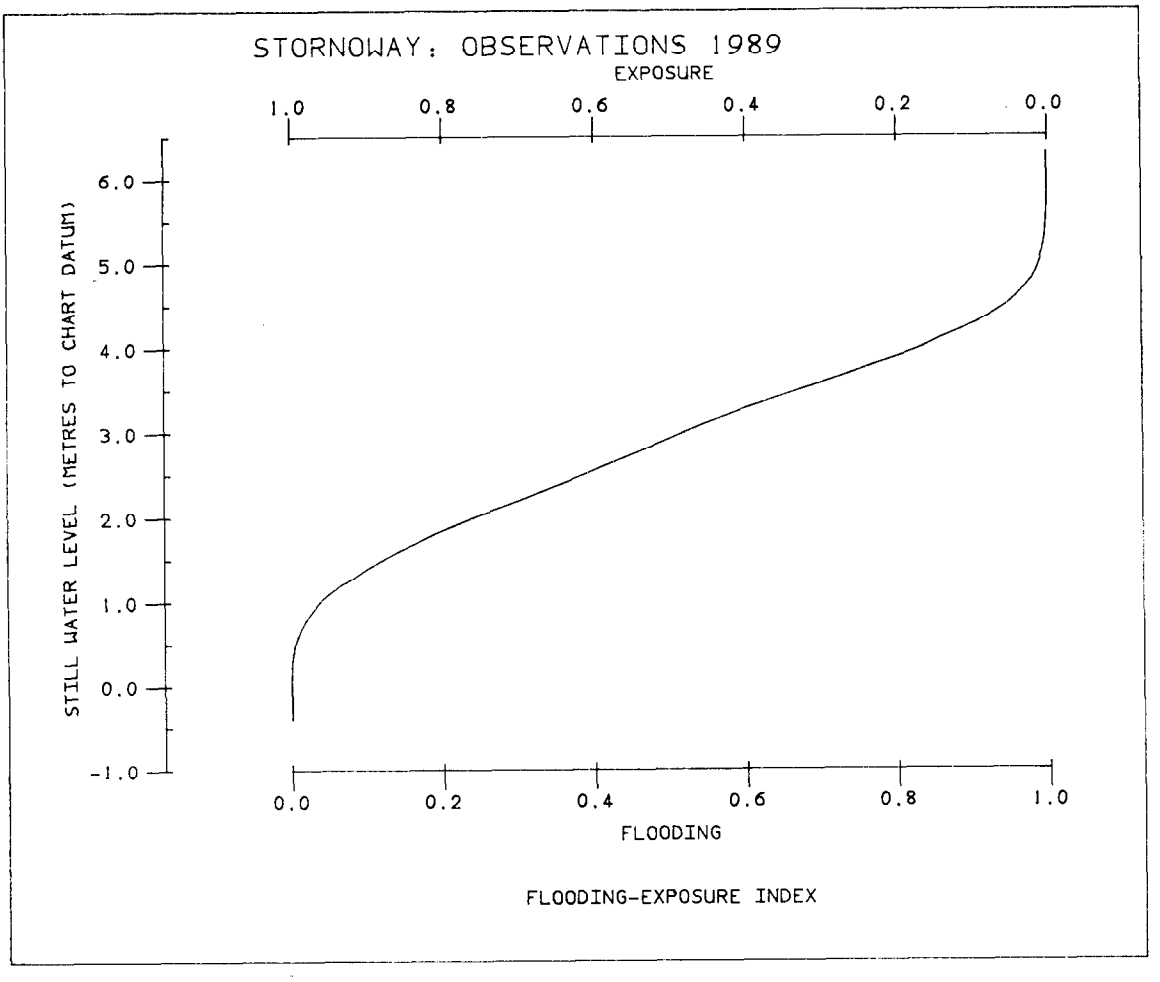
28 November - 6 December Channel 1 (back-up) failure.

Extreme Statistics

9 March Annual maximum level 5.771m above Chart Datum.

18 February Annual maximum surge 0.806m above predicted.


STORNOWAY : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.922
STD DEV 1.083
MIN 0.069
MAX 5.770
% FREQUENCY
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


STORNOWAY: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, West Coast - Stornoway

Latitude: 58 12'28.6" N
Longitude: 6 23'17.5" W

Time Zone: GMT

Length: 360 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.922

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 2.71 Metres below Ordnance Datum (Local)

Observation Mean = 0.2924D+01 Residual Mean = 0.5339D-06
Std Dev = 0.1082D+01 Std Dev = 0.1555D+00

Constituent	h	g
Q1	0.033	309.20
O1	0.097	349.70
P1	0.040	128.04
K1	0.129	135.88
J1	0.007	205.21
2N2	0.043	151.32
N2	0.282	176.23
M2	1.388	197.56
S2	0.544	231.18
K2	0.155	229.10
M3	0.028	120.31
M4	0.061	219.50
MS4	0.071	295.08
M6	0.007	188.59

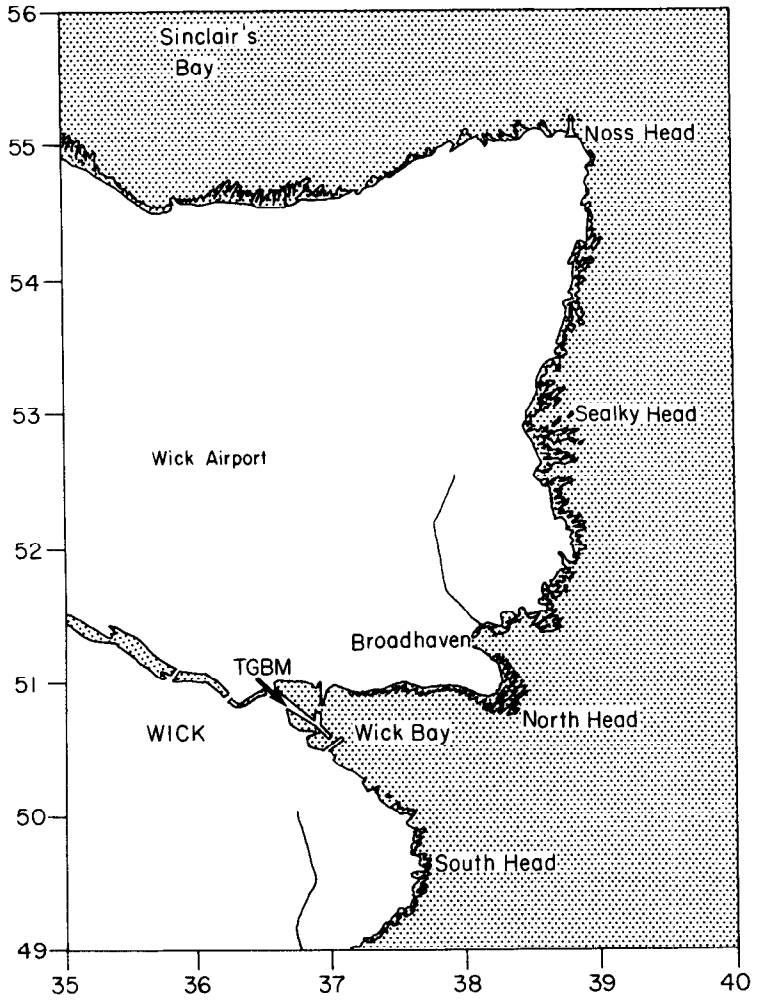
2.11 WICK

Latitude 58 deg 26' 28.5"N Longitude 03 deg 05' 5.7"W

National Grid reference ND 3667 5080

Recording zero = Chart Datum = 1.71m below Ordnance Datum Newlyn

Recording zero = 5.077m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	ND3667 5081	OSBM bolt on quay, E angle of tide gauge building.
Aux1	ND3662 5083	6 Harbour Quay E face SE angle.
Aux2	ND3670 5083	NBM Rivet at base SE end of wall NE side North Pier.
Aux3	ND3705 5055	Wall base of steps SE side of pier.

Data processing

Hourly levels are filtered from Channel 2 digiquartz.

Missing scans in the raw values were interpolated on the following dates: 12, 25 Jan; 13 Feb; 12, 29 Mar; 10, 13 Apr; 15 May; 7, 21 Jun; 17 Aug; 6(2), 13 Oct; 10 Nov; 4 Dec.

Scans integrated at 1 7/8min during the visit of TGI, 21 July, were edited.

Gaps in 1989 filtered data

0600 GMT 28 September - 1400 GMT 2 October Local storage fault.

Site diary

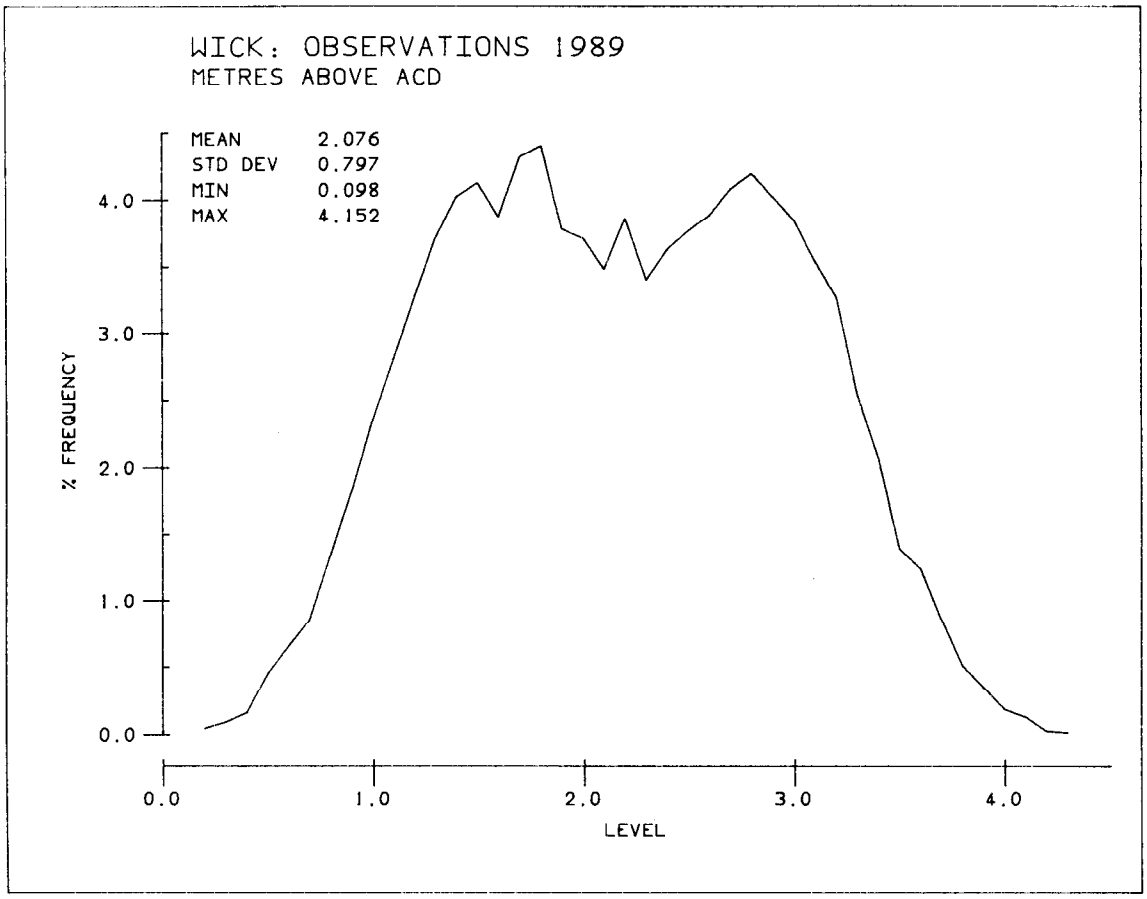
21 July TGI visit to replace compressor.

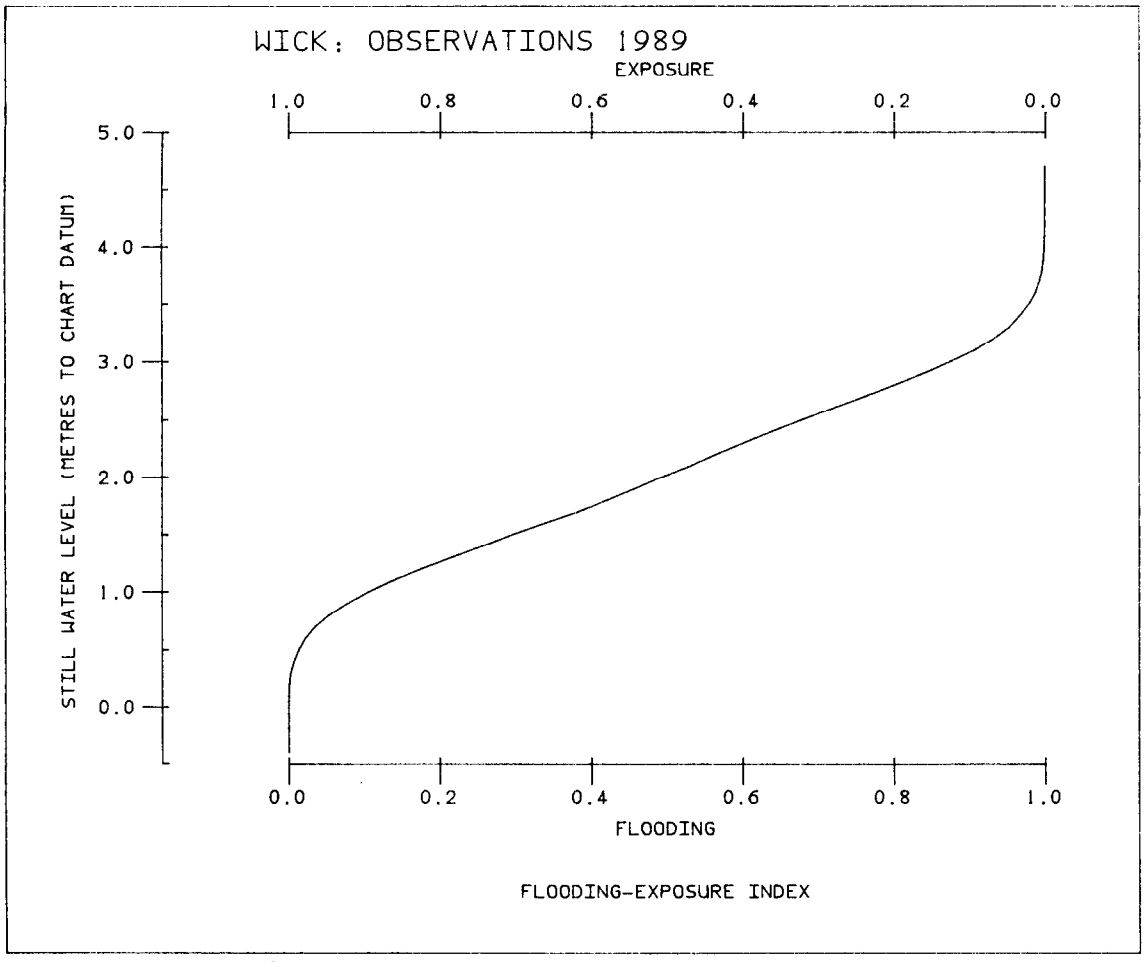
21 November TGI visit. General maintenance.

Extreme Statistics

9 March Annual maximum level 4.153m above Chart Datum.

18 February Annual maximum surge 0.944m above predicted.


WICK: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.076
STD DEV 0.797
MIN 0.098
MAX 4.152
% FREQUENCY
0.0
1.0
2.0
3.0
4.0
LEVEL


WICK: OBSERVATIONS 1989
EXPOSURE
1.0 0.8 0.6 0.4 0.2 0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
0.0 1.0 2.0 3.0 4.0 5.0
0.0 0.2 0.4 0.6 0.8 1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, East Coast - Wick

Latitude: 58 26'28.5" N
Longitude: 3 05' 5.7" W

Time Zone: GMT

Length: 360 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.080

Hourly data from digiquartz sensor

Datum of Observations = ACD : 1.71 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2078D+01 Residual Mean = 0.9262D-06
Std Dev = 0.7951D+00 Std Dev = 0.1483D+00

Constituent	h	g
Q1	0.040	344.85
O1	0.116	29.19
P1	0.031	163.74
K1	0.108	175.35
J1	0.007	234.92
2N2	0.022	271.10
N2	0.207	301.95
M2	1.018	321.85
S2	0.349	359.96
K2	0.099	357.23
M3	0.011	225.35
M4	0.038	315.78
MS4	0.021	51.61
M6	0.006	227.05

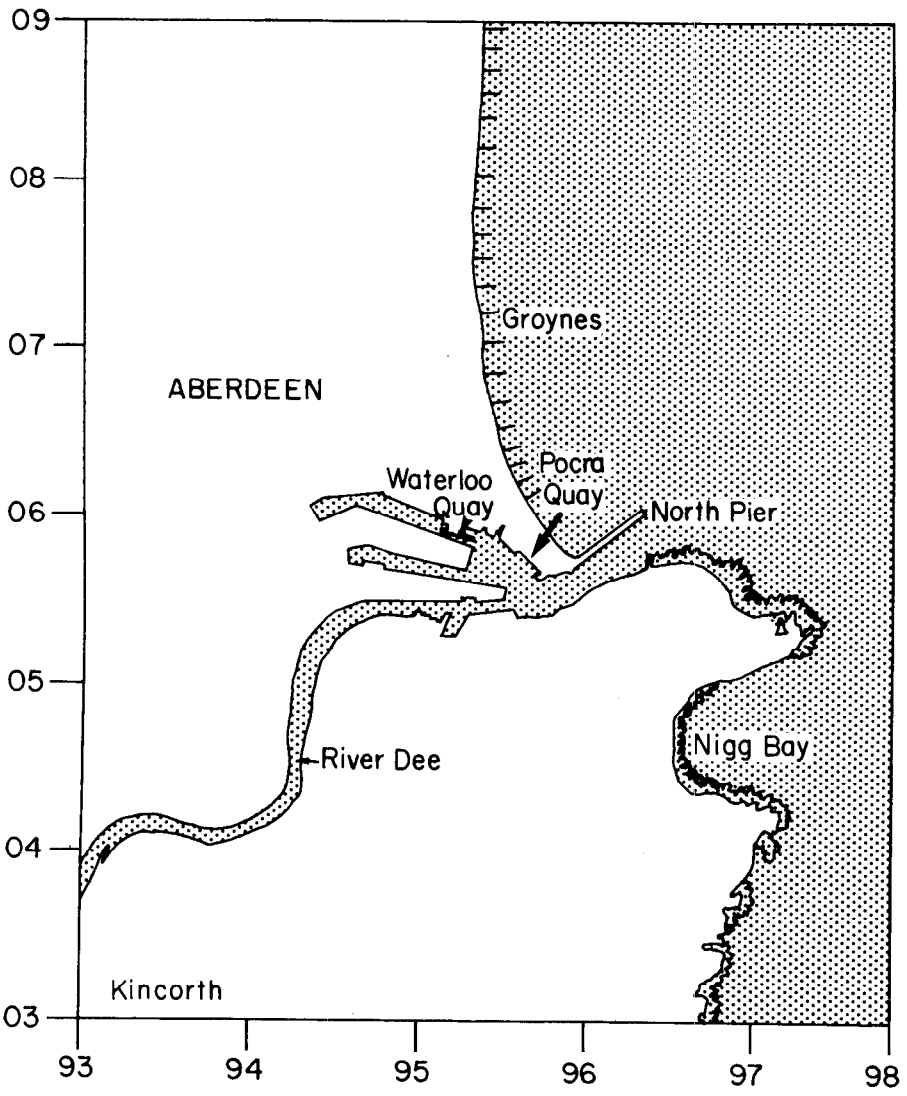
2.12 ABERDEEN

Latitude 57 deg 08' 38.9"N Longitude 02 deg 04' 43.2"W

National Grid reference NJ 9524 0590

Recording zero = Chart Datum = 2.25m below Ordnance Datum Newlyn

Recording zero = 6.091m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NJ9524 0590	NBM OSBM bolt SE face of tide gauge housing, Waterloo Quay.
Aux1	NJ9572 0593	Public Convenience E side of esplanade, W face SW angle.
Aux2	NJ9586 0571	Observatory, Pocra Quay N face NW angle.
Aux3	NJ9524 0600	Building, NE side of Waterloo Quay, SW face S angle.

Data processing

Hourly heights filtered from pressure gauge with digiquartz transducer,Channel 2.

Isolated missing scans were edited on the following dates: 4, 29 Jan; 13, 27 Feb; 28 Mar(3), 11 May; 12 Jun; 5, 26 Jul; 23 Aug; 20, 24 Sep; 9 Oct; 15 Nov.

Gaps in filtered 1989 data

Nil gaps

Site diary

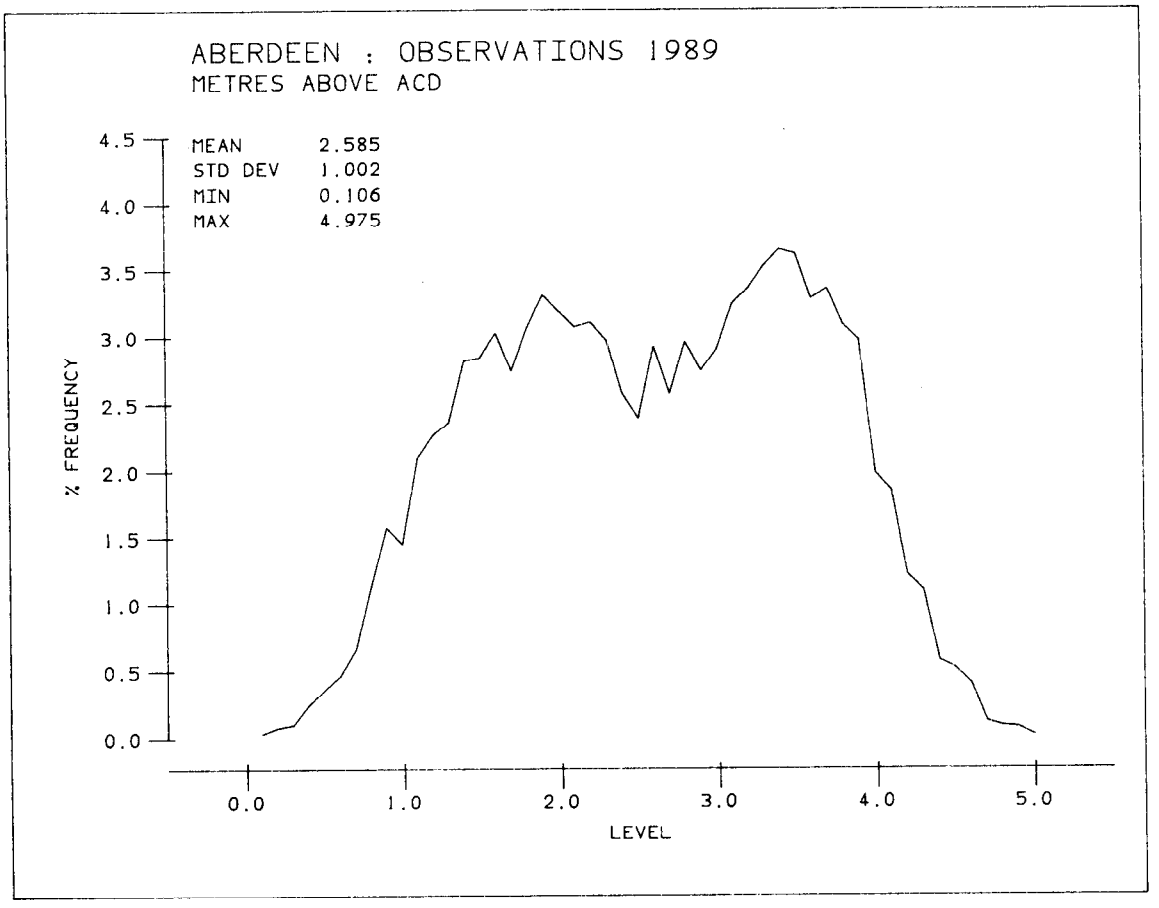
15 May TGI visit. Routine maintenance and compressor replaced.

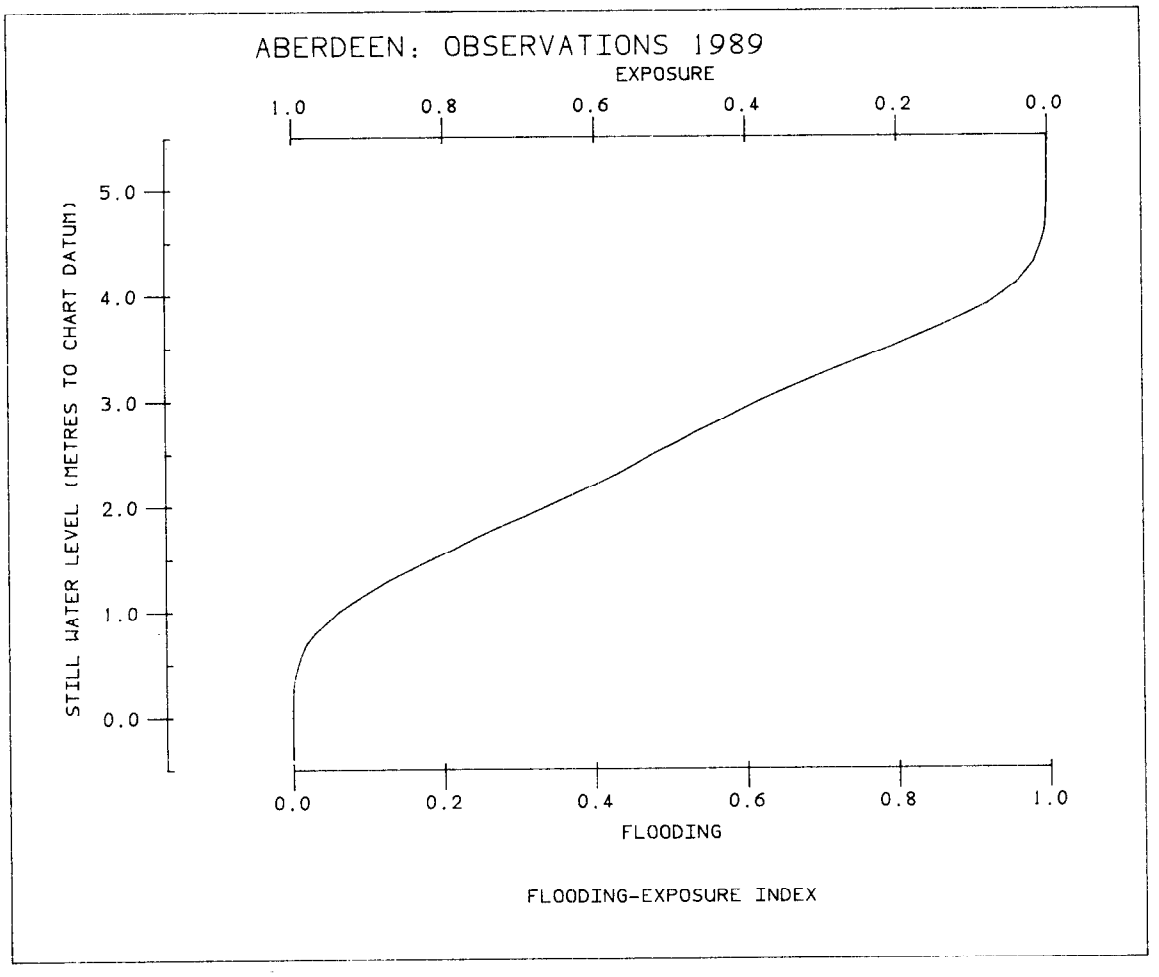
14 November Well cleaned by Harbour Authority (Channel 1 -back-up)

Extreme Statistics

17 September Annual maximum level 4.976m above Chart Datum.

14 February Annual maximum surge 1.177m above predicted.


ABERDEEN : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.585
STD DEV 1.002
MIN 0.106
MAX 4.975
% FREQUENCY
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
1.0
2.0
3.0
4.0
5.0
LEVEL


ABERDEEN: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, East Coast - Aberdeen

Latitude: 57 08'38.9" N
Longitude: 2 04'43.2" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.588

Hourly data from digiquartz sensor

Datum of Observations = ACD : 2.25 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2587D+01 Residual Mean = 0.1815D-06
Std Dev = 0.9996D+00 Std Dev = 0.1414D+00

Constituent	h	g
Q1	0.044	8.54
O1	0.129	53.40
P1	0.029	193.61
K1	0.114	203.94
J1	0.007	259.66
2N2	0.032	320.13
N2	0.262	1.18
M2	1.305	24.10
S2	0.445	62.57
K2	0.126	59.60
M3	0.009	307.94
M4	0.033	167.07
MS4	0.031	241.89
M6	0.007	108.98

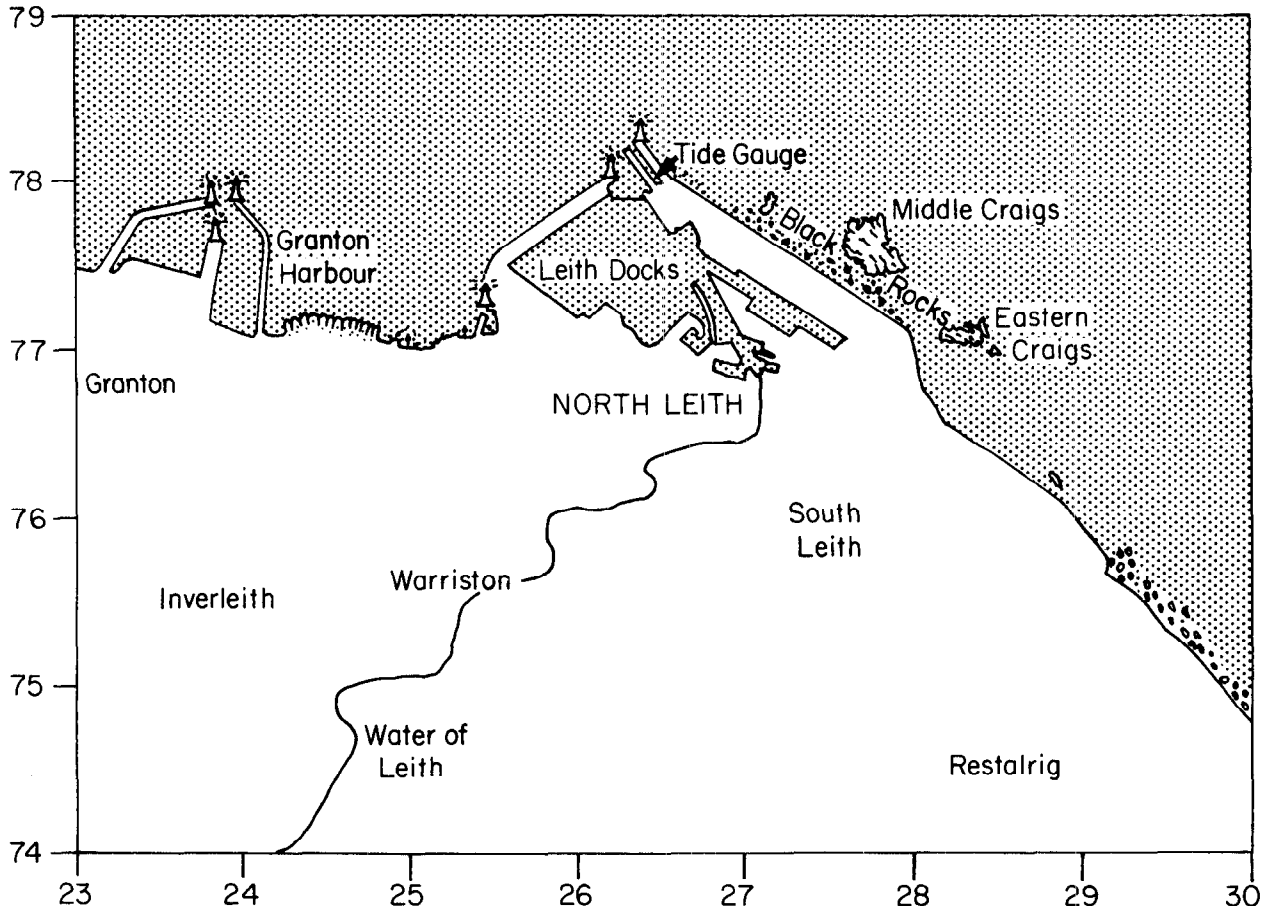
2.13 LEITH

Latitude 55 deg 59' 23.3"N Longitude 03 deg 10' 48.9"W

National Grid reference NT 2638 7805

Recording zero = Chart Datum = 2.9m below Ordnance Datum Newlyn

Recording zero = 7.84m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NT2643 7797	OSBM bolt SE end of tide gauge pier 0.9m from N angle of pier.
Aux1	NT2648 7797	Rivet in top step SW side of road 1.6m from S angle of building.
Aux2	NT2653 7789	Rivet in top step SW side of road 11.9m from W angle of building.
Aux3	NT2722 7646	Bolt 25 Bernard St. in NE face of SE side porch.

Data processing

This site was converted to the Dataring system in November 1988 with sensors as follows:

a) Potentiometer attached to Munro gauge (Channel 1 back-up)
b) Potentiometer attached to well head unit (Channel 2 Class-A) on Ott gauge well.

Missing scans were interpolated on the following dates: 25 Jan; 10, 13, 22 Feb; 14, 21, 28 Mar; 11 Apr; 5 May; 4 Jun; 27 Jul; 1, 20, 30 Sep; 26 Oct; 13, 14, 29 Nov; 13 Dec.

13 March Scans integrated at 1 7/8min during TGI visit were edited.

Gaps in 1989 filtered data from Channel 2

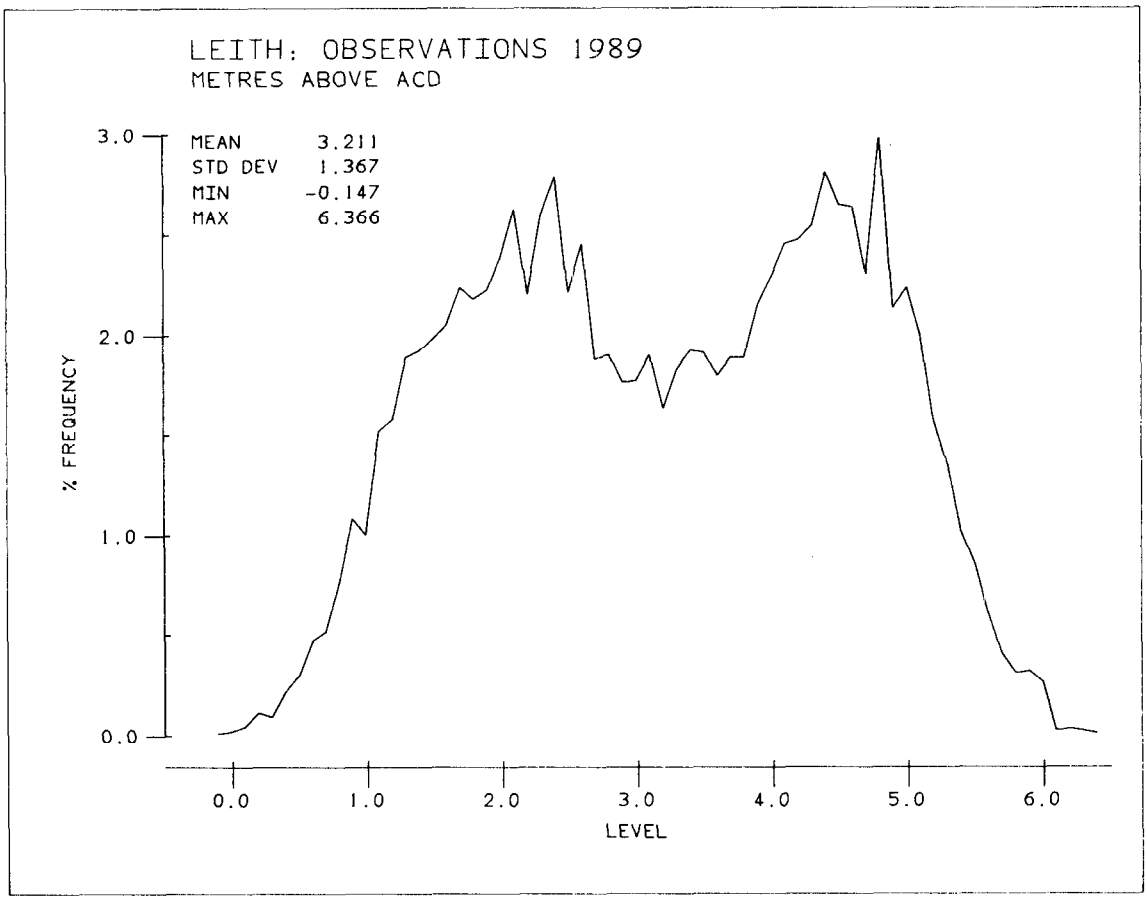
0001 GMT 1 January	- 0400 GMT	2 January	Local processor and clock problems.
1700 GMT 3 July	- 0400 GMT	4 July	Steps on rising tide
1700 GMT 4 July	- 1500 GMT	5 July	" " " "

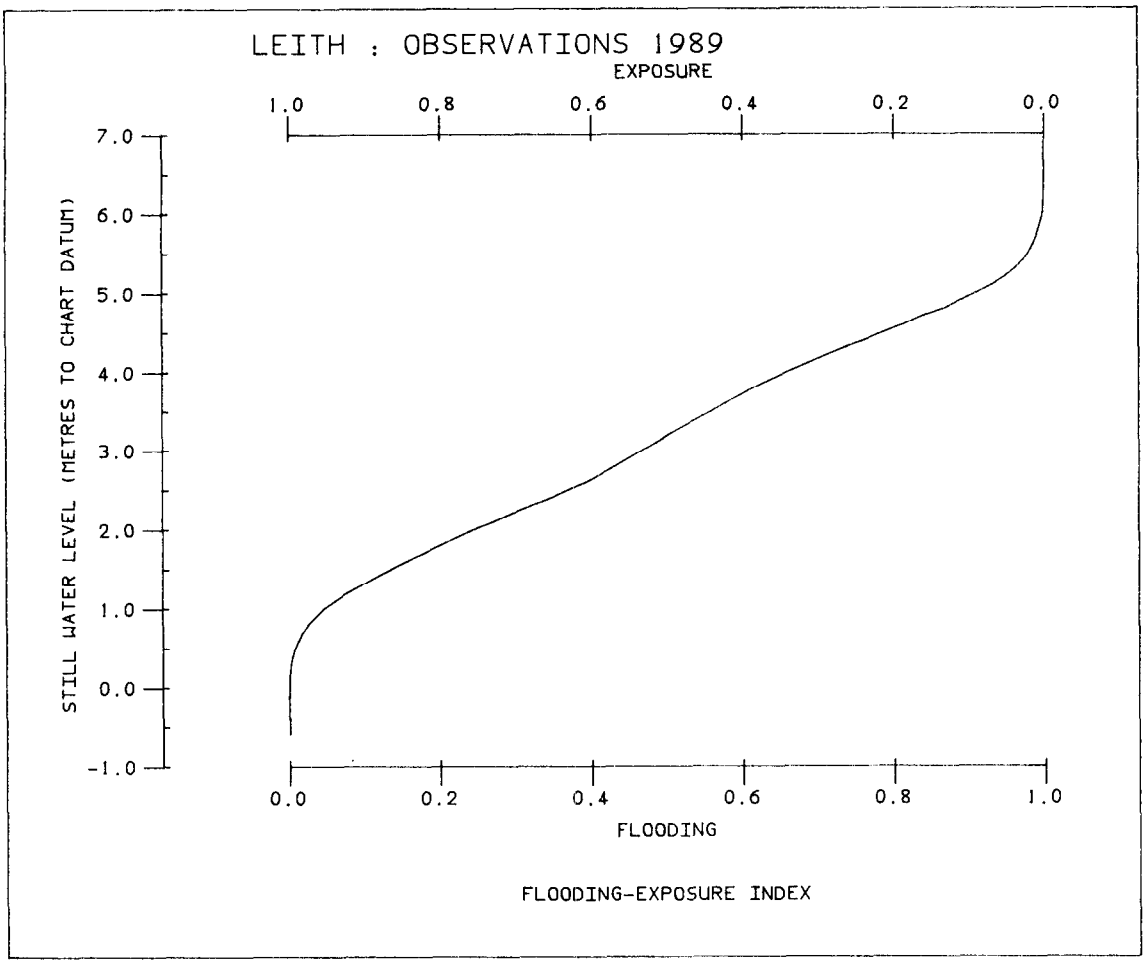
Site diary

27 January	Munro stilling well damaged in storm.
3 February	Munro gauge well reported to be loose; float system disengaged.
4 February	Munro gauge well washed away and float wire broken.
13 March	TGI visit. Munro gauge undamaged but potentiometer was broken.
22 July	TGI visit to investigate fault on well-head unit (Channel 2). Pigeons were found to have nested under the bench since the loss of of the Munro gauge well. Feathers and guano were removed.A heavier counterweight and new wires were fitted to the well-head unit.

Extreme Statistics

18 September	Annual maximum level 6.366m above Chart Datum.
14 February	Annual maximum surge 1.353m above predicted.


LEITH: OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.211
STD DEV 1.367
MIN -0.147
MAX 6.366
% FREQUENCY
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


LEITH : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: Scotland, East Coast - Leith

Latitude: 55 59'23.3" N
Longitude: 3 10'48.9" W

Time Zone: GMT

Length: 362 Days

From: 2nd January, 1989 To: 31st December, 1989

Units: Metres A0: 3.212

Hourly data from digiquartz sensor

Datum of Observations = ACD : 2.90 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.3212D+01 Residual Mean = 0.2885D-06
Std Dev = 0.1369D+01 Std Dev= 0.1509D+00

Constituent	h	g
Q1	0.048	22.98
O1	0.144	68.15
P1	0.032	210.15
K1	0.124	220.21
J1	0.009	276.07
2N2	0.039	352.17
N2	0.356	32.23
M2	1.802	55.09
S2	0.621	95.50
K2	0.175	92.87
M3	0.015	358.66
M4	0.080	185.02
MS4	0.072	297.25
M6	0.046	285.06

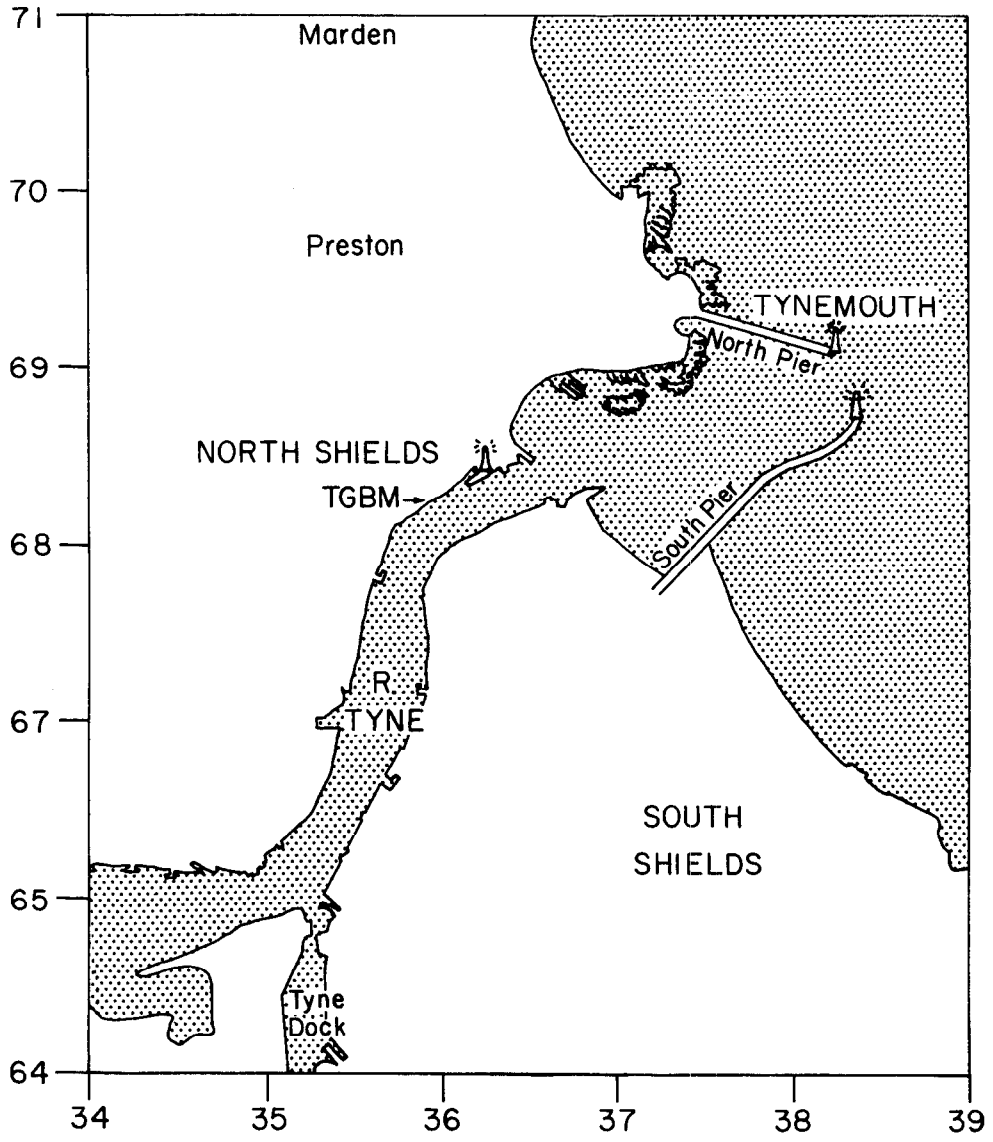
2.14 NORTH SHIELDS

Latitude 55 deg 00' 26.1"N Longitude 01 deg 26' 17.9"W

National Grid reference NZ 3592 6823

Recording zero = Chart Datum = 2.6m below Ordnance Datum Newlyn

Recording zero = 6.515m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	NZ3592 6823	OSBM bolt on tide gauge building.
Aux1	NZ3626 6842	PA bolt on low lighthouse W face SW angle.
Aux2	NZ3630 6895	PA bolt on buttress N side of railway.
Aux3	NZ3589 6823	Building Western Quay E angle NE face.

Data processing

Hourly heights filtered from 15 minute integrated values from Channel 2, the Ott gauge well.

Missing scans in the raw values were interpolated on the following dates:- 12 Jan; 2, 22 Feb; 5 Apr; 3, 16, 22 May; 7, 28 Jun; 19, 21, 27(22), 28 Jul; 12, 25, 27 Sep; 13 Nov.

Gaps in 1989 filtered data

0300 GMT 22 March - 1200 GMT 29 March

1900 GMT 14 August - 1900 GMT 12 September Potentiometer fault.

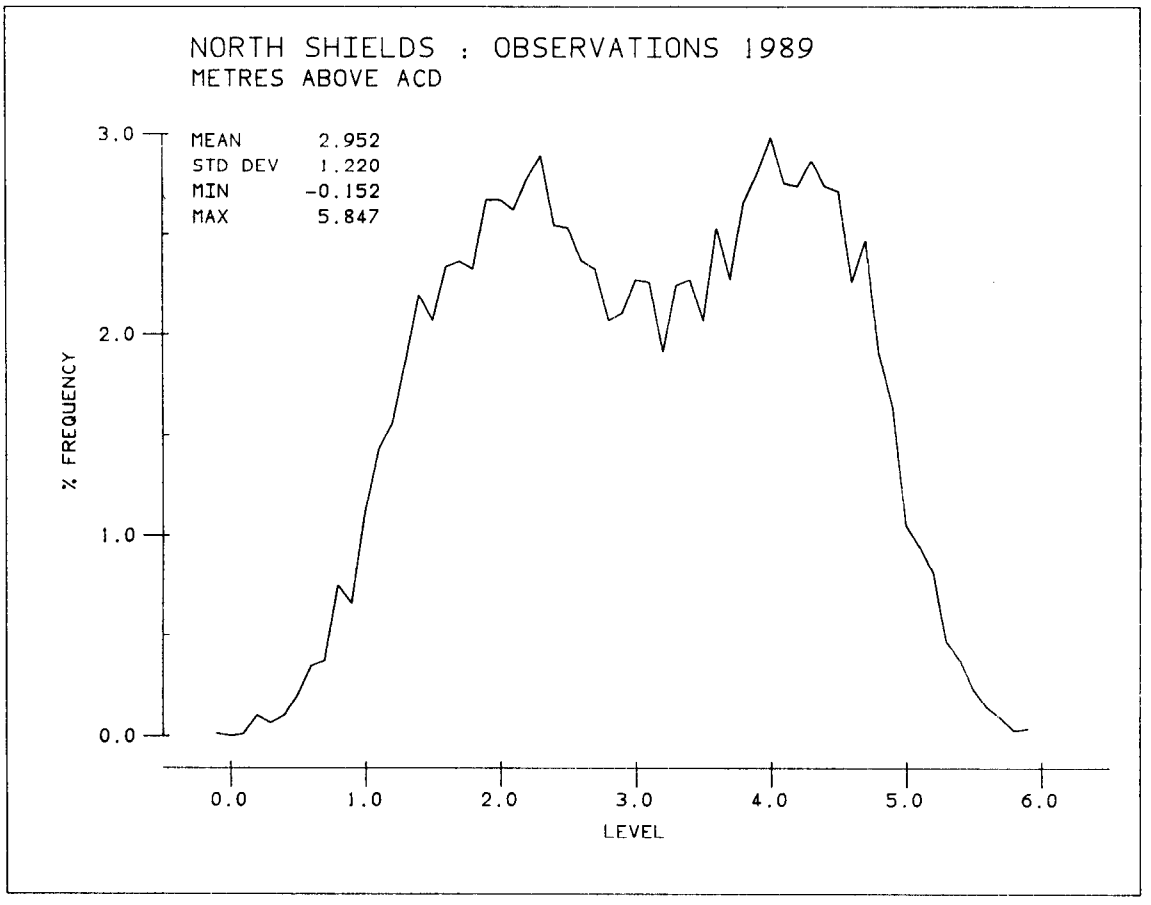
0100 GMT 23 November - 2100 GMT 28 November Gauge jammed.

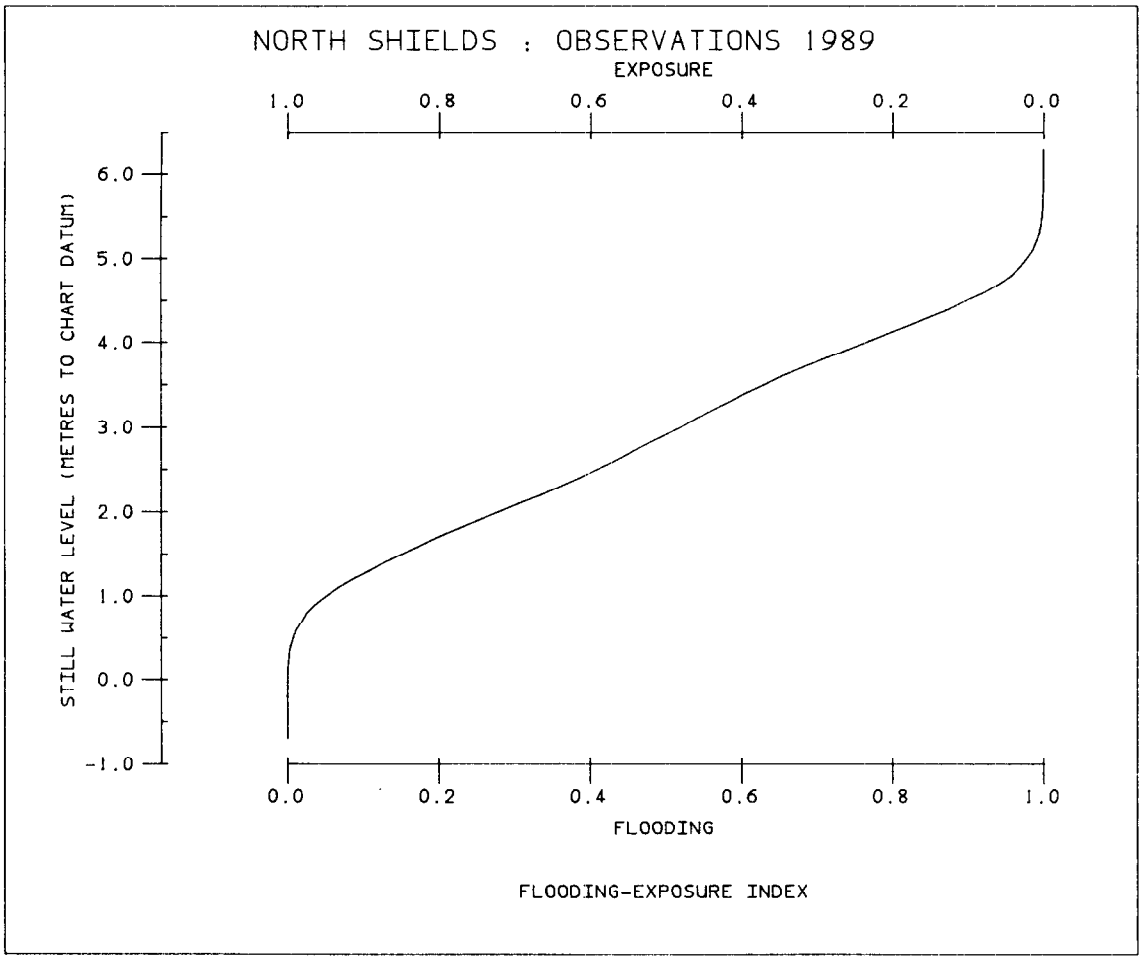
Site diary

10 April	TGI visit for calibration checks and to replace modem.
10-11 September	TGI visit.Potentiometer repaired.
28 November	TGI visit to reinstate gauge.

Extreme statistics

17 September	Annual maximum level 5.847m above Chart Datum
14 February	Annual maximum surge 1.607m above predicted.


NORTH SHIELDS : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.952
STD DEV 1.220
MIN -0.152
MAX 5.847
% FREQUENCY
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


NORTH SHIELDS : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - North Shields

Latitude: 55 00'26.1" N
Longitude: 1 26'17.9" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 4th February, 1990

Units: Metres A0: 2.958

Hourly Data From Potentiometer Gauge 2

Datum of Observations = ACD : 2.60 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2966D+01 Residual Mean = 0.2018D-06
Std Dev = 0.1219D+01 Std Dev = 0.1615D+00

Constituent	h	g
Q1	0.049	39.15
O1	0.143	83.71
P1	0.030	232.01
K1	0.126	242.53
J1	0.006	289.87
2N2	0.036	21.67
N2	0.317	65.66
M2	1.609	88.54
S2	0.545	130.71
K2	0.155	128.16
M3	0.011	53.34
M4	0.023	108.51
MS4	0.018	87.46
M6	0.007	13.08

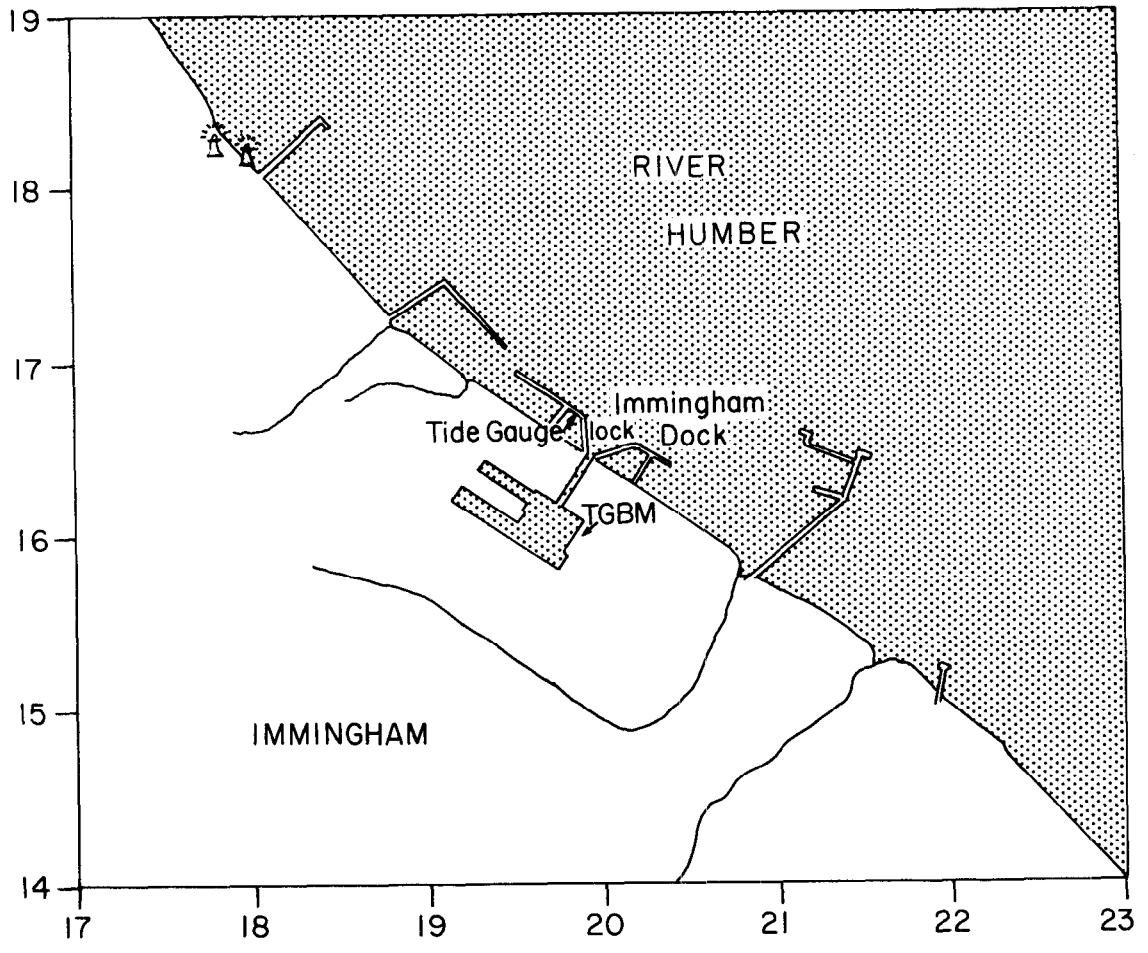
2.15 IMMINGHAM

Latitude 53 deg 37' 58.9"N Longitude 00 deg 11' 13.0"W

National Grid reference TA 1987 1672

Recording zero = Chart Datum = 3.9m below Ordnance Datum Newlyn

Recording zero = 9.131m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TA1989 1630	Flush Bracket G4658 on Office building NE face N angle.
Aux1	TA2005 1631	Building SW side of road NE face E angle.
Aux2	TA2068 1535	Flush Bracket G4483 on bridge, SW parapet, SE angle NE face.
Aux3	TA1982 1676	Rivet on concrete pier 0.4m SW of production on SE side of jetty.

Data processing

Hourly heights filtered from Channel 2 digiquartz transducer on pressure gauge.

Missing scans were interpolated in the raw data on the following dates:- 14 Jan; 11 Mar, 20 Jun (2); 27 Jul; 15 Aug; 5 Sep; 3, 18 Oct; 6(3), 23 Nov.

Other interpolations were :-

1) Over a gap of 1 hour (0830-0915) on 11 April
2) Scans integrated at 1 7/8min caused by a telephone fault on 12-13 July edited
3) Scans integrated at 1 7/8mins during the TGI visit of 12 September edited.

Gaps in 1989 filtered hourly heights

Nil gaps.

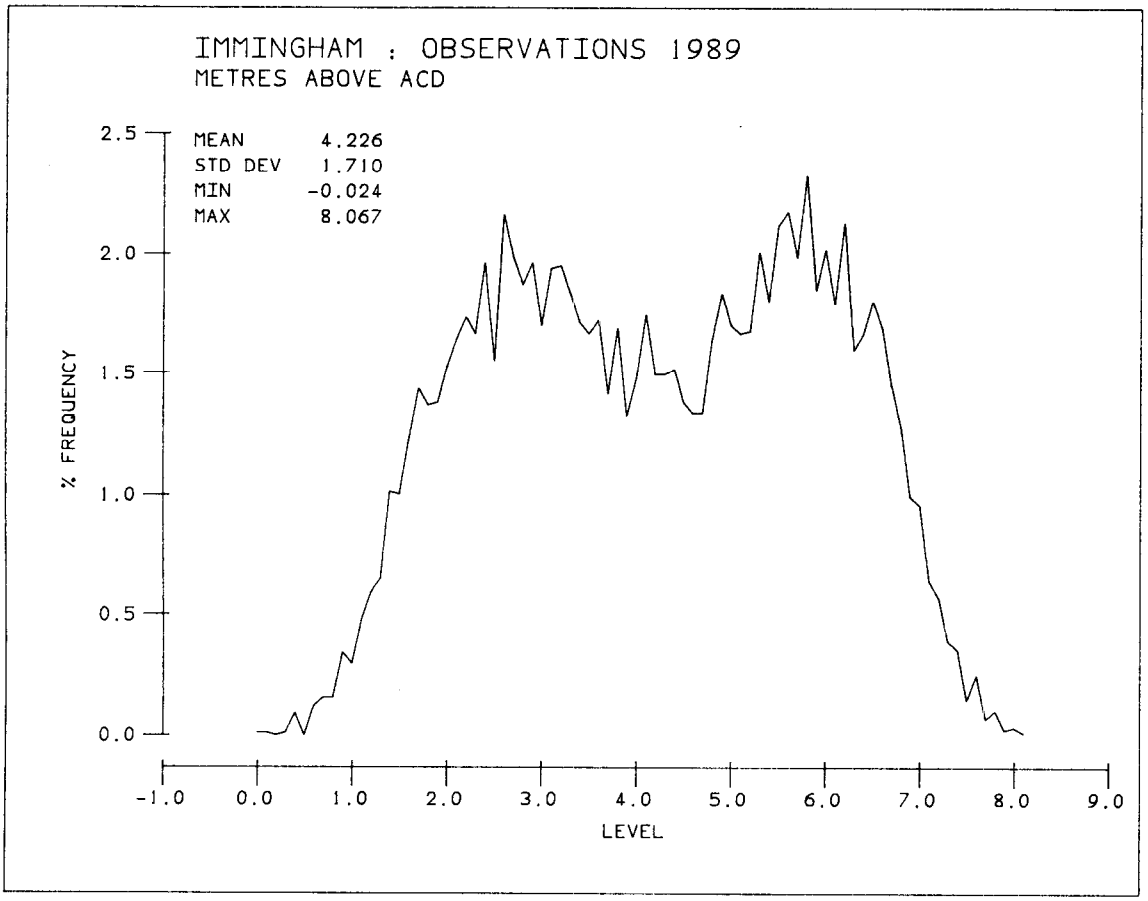
Site diary

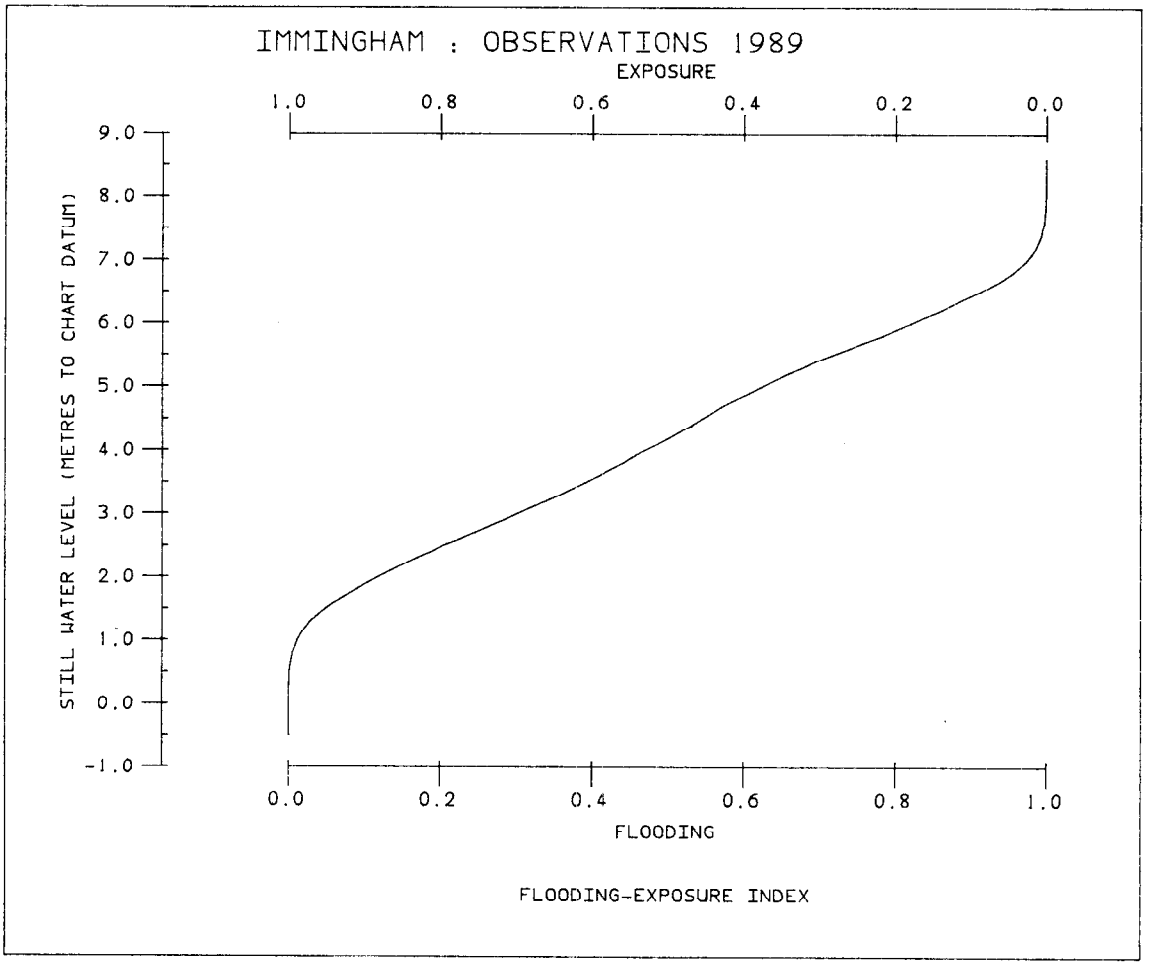
12 September TGI visit. New compressor fitted.

Extreme Statistics

18 September Annual maximum level 8.067m above Chart Datum.

14 February Annual maximum surge 2.439m above predicted.


IMMINGHAM : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 4.226
STD DEV 1.710
MIN -0.024
MAX 8.067
% FREQUENCY
2.5
2.0
1.5
1.0
0.5
0.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
LEVEL


IMMINGHAM : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - Immingham

Latitude: 53 37'58.9" N
Longitude: 0 11'13.0" W

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 4.228

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 3.90 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.4228D+01 Residual Mean = 0.8276D-07
Std Dev = 0.1712D+01 Std Dev = 0.1901D+00

Constituent	h	g
Q1	0.056	68.81
O1	0.171	118.51
P1	0.043	276.20
K1	0.157	280.28
J1	0.008	327.92
2N2	0.052	120.16
N2	0.434	140.60
M2	2.270	161.73
S2	0.753	212.18
K2	0.214	209.76
M3	0.011	166.89
M4	0.023	186.54
MS4	0.034	248.86
M6	0.017	156.58

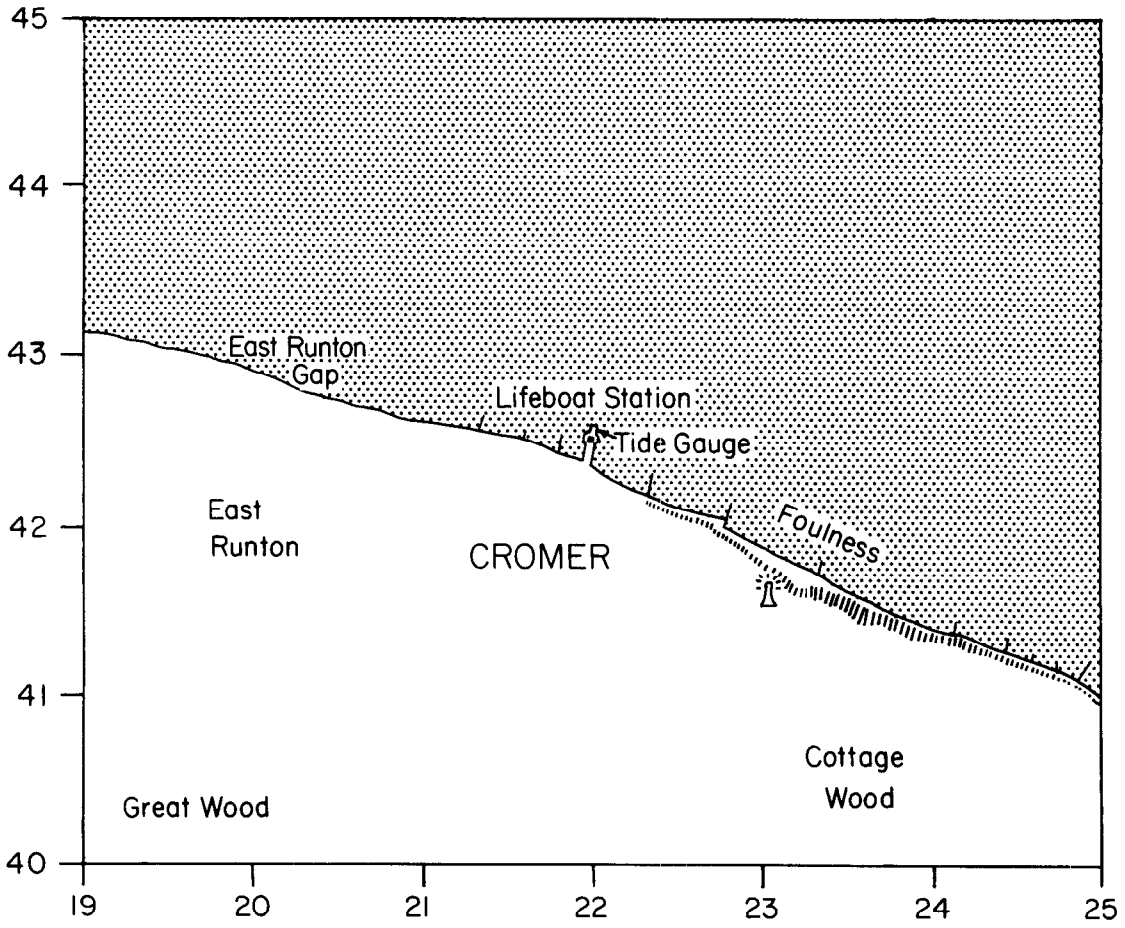
2.16 CROMER

Latitude 52 deg 56' 01.9"N Longitude 01 deg 18' 12.5"E

National Grid reference TG 2198 4253

Recording zero = Chart Datum = 2.75m below Ordnance Datum Newlyn

Recording zero = 10.117m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TG2193 4233	SS bolt on top of wall opposite E side of pier.
Aux1	TG2198 4253	Rivet at bottom of steps at centre of catwalk at NE angle of lifeboat station.
Aux2	TG2195 4233	SS bolt at bottom of ramp on S side at W corner.
Aux3	Destroyed.	

Data processing

Originally a temporary tide-gauge site with an Aanderaa pressure gauge, Cromer was upgraded to accommodate Dataring in March 1988 with two pressure gauges and digiquartz transducers.Both channels were processed until the end of 1989, although only the statistics for Channel 2 are presented in this report.

For the first half of the year, the quality of data retrieved was very poor and considerable processing effort was made to interpolate off-scale and missing values to minimise the number of gaps. TGI considered they were caused by a poor connection in the power supply to the Digiquartz transducers.

Missing scans in the raw values were interpolated on the following dates:4(2), 12, 18, 24 Jan; 2, 12, 13, 17, 27 Feb; 10, 17, 28 Mar; 11, 13, 20, 26 Apr; 12, 15 May; 12, 25 Jun; 10 Jul; 23 Nov.

Gaps in 1989 filtered hourly heights

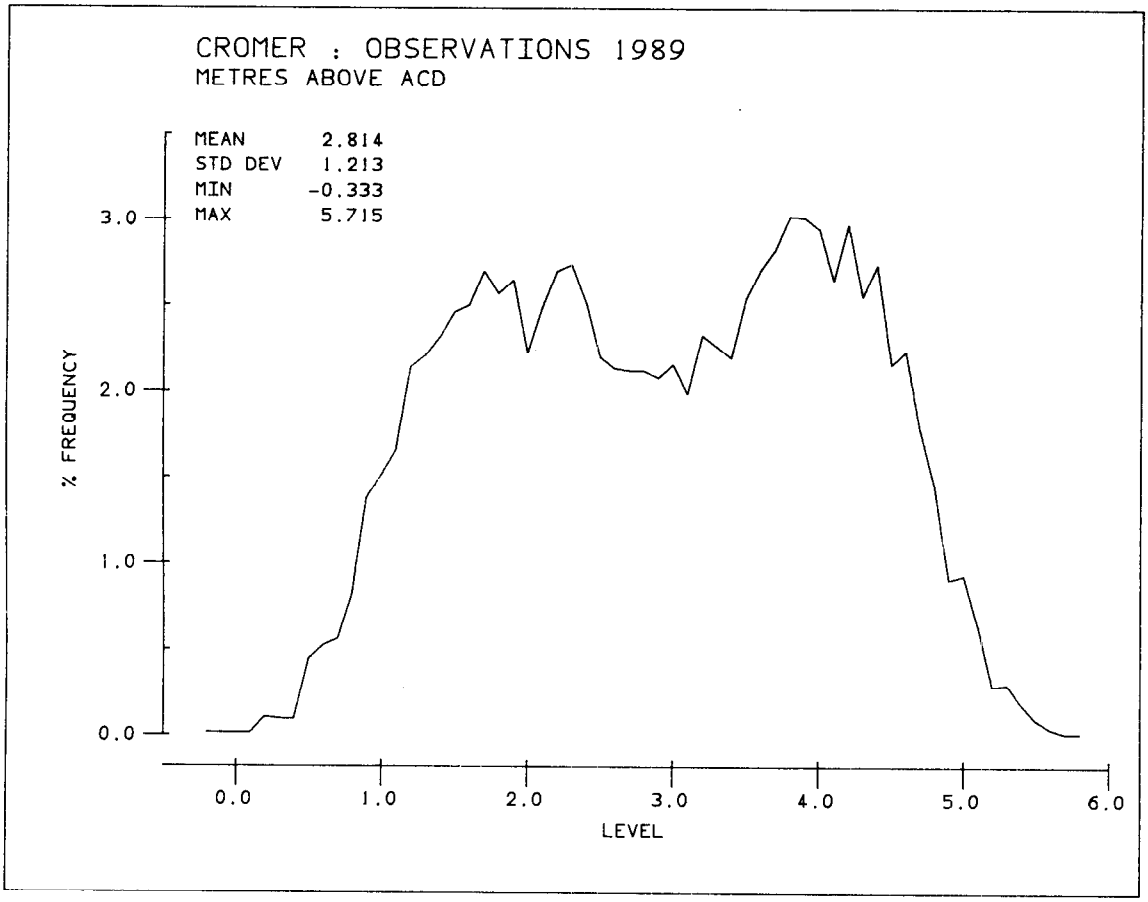
2300 GMT 17 March	-	0900 GMT 23 March	Readings jammed at top of scale.
0800 GMT 30 March	-	2100 GMT 7 April	" " " " "
0400 GMT 28 April	-	2100 GMT 1 May	" " " " "
1000 GMT 8 May	-	1500 GMT 14 May	" " " " "
1100 GMT 27 May	-	1400 GMT 11 June	" " " " "
1700 GMT 27 June	-	1400 GMT 6 July	" " " " "

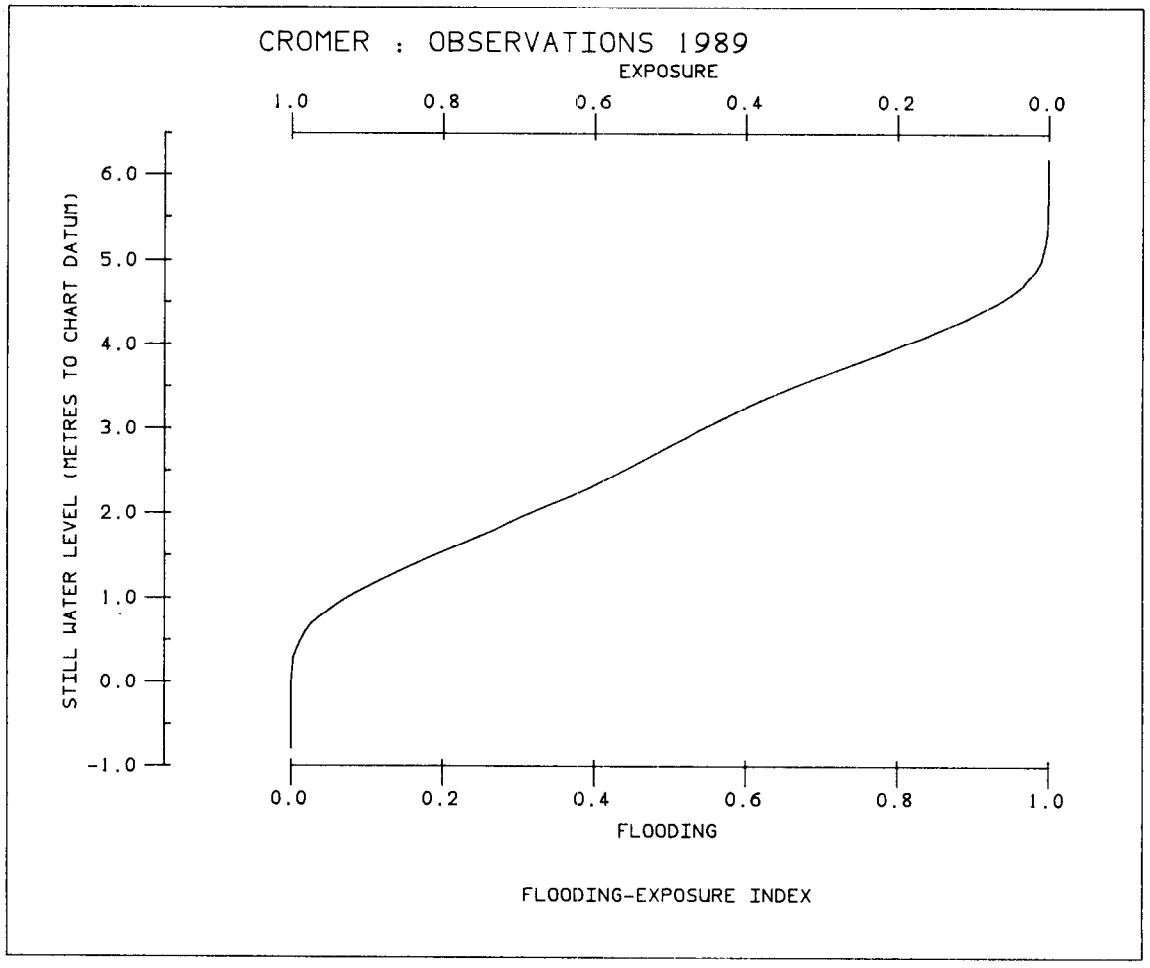
Site diary

2 - 3 May	TGI visit to investigate off-scale fault and recalibrate sensors. Fault not found, although still occurring.
6 July	New clock and processor board fitted by local operator.
August	Isolated off-scale spikes still occuring in raw values, which were interpolated before filtering to hourly levels.

Extreme Statistics

17 September	Annual maximum level 5.715m above Chart Datum.
14 February	Annual maximum surge 2.233m above predicted.


CROMER : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.814
STD DEV 1.213
MIN -0.333
MAX 5.715
% FREQUENCY
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
LEVEL


CROMER : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - Cromer

Latitude: 52 56'01.9" N
Longitude: 1 18'12.5" E

Time Zone: GMT

Length: 353 Days

From: 1st January, 1989 To: 4th February, 1990

Units: Metres A0: 2.804

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 2.75 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2814D+01 Residual Mean = 0.6007D-06
Std Dev = 0.1212D+01 Std Dev = 0.2274D+00

Constituent	h	g
Q1	0.055	90.18
O1	0.161	137.30
P1	0.047	297.53
K1	0.154	301.96
J1	0.004	38.78
2N2	0.030	121.01
N2	0.309	164.66
M2	1.571	187.93
S2	0.537	234.28
K2	0.151	232.05
M3	0.008	185.70
M4	0.087	282.35
MS4	0.072	326.96
M6	0.026	34.62

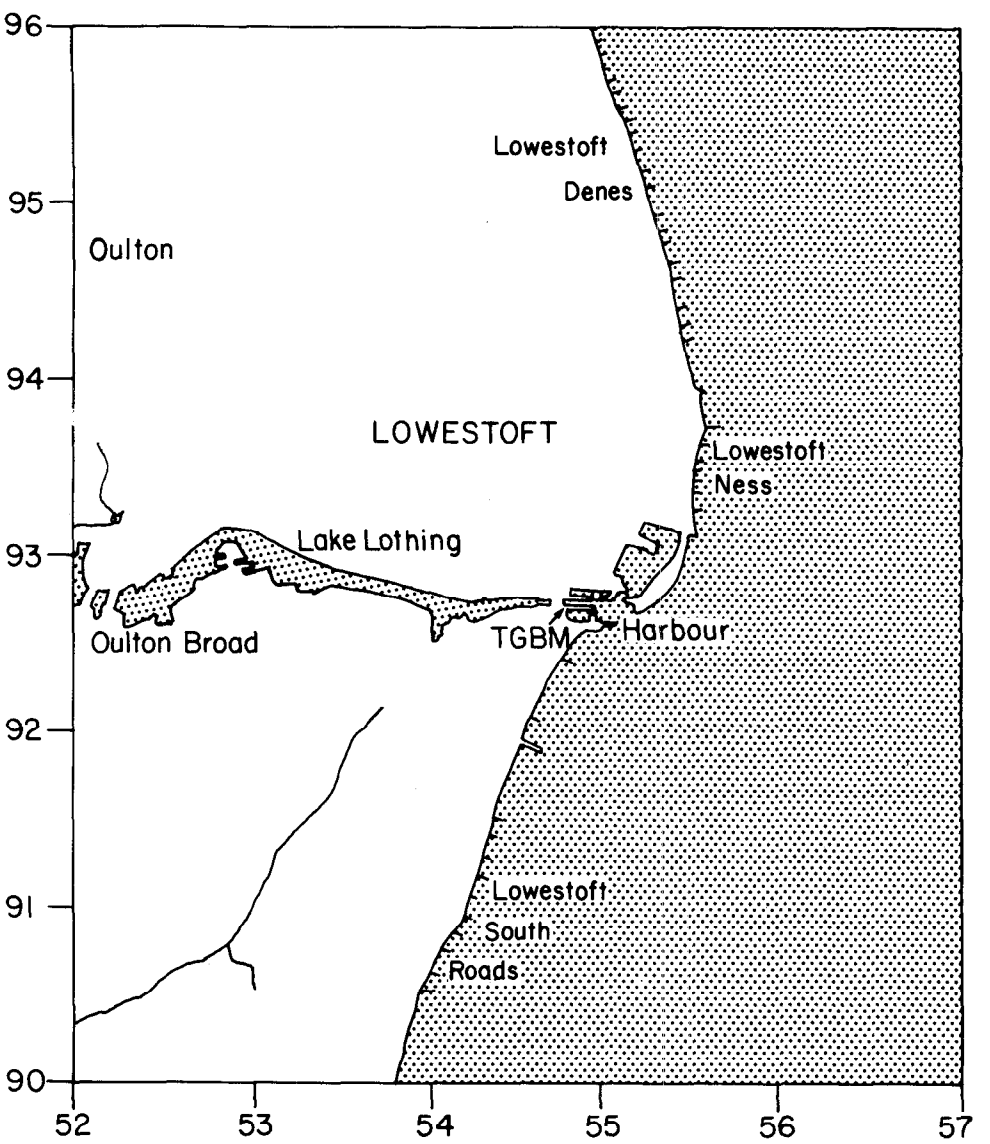
2.17 LOWESTOFT

Latitude 52 deg 28' 20.9"N Longitude 01 deg 45' 06.4"E

National Grid reference TM 5477 9272

Recording zero = Chart Datum = 1.5m below Ordnance Datum Newlyn

Recording zero = 4.483m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TM5482 9273	Bolt on quay wall S side of pier.
Aux1	TM5477 9272	Bolt on concrete jetty SW corner of automatic TG recorder building.
Aux2	TM5478 9274	Harbourmaster's Office SE angle S face.
Aux3	TM5472 9261	Building SW side of Royal Thoroughfare.

Data processing

Hourly heights filtered from Channel 2 potentiometer attached to Munro gauge.

Missing scans in the raw data were interpolated on the following dates:- 12, 15 Jan, 28 Mar; 4, 10, 15 Apr; 15, 19 May; 9, 12, 14, 18 Jun; 4, 11, 14, 16, 17, 24, 30 Jul; 7, 13, 15, 28(2) Aug; 12(3), 23, 25 Sep; 3 Oct; 10 Nov.

Gaps in 1989 filtered values

Nil gaps.

Site diary

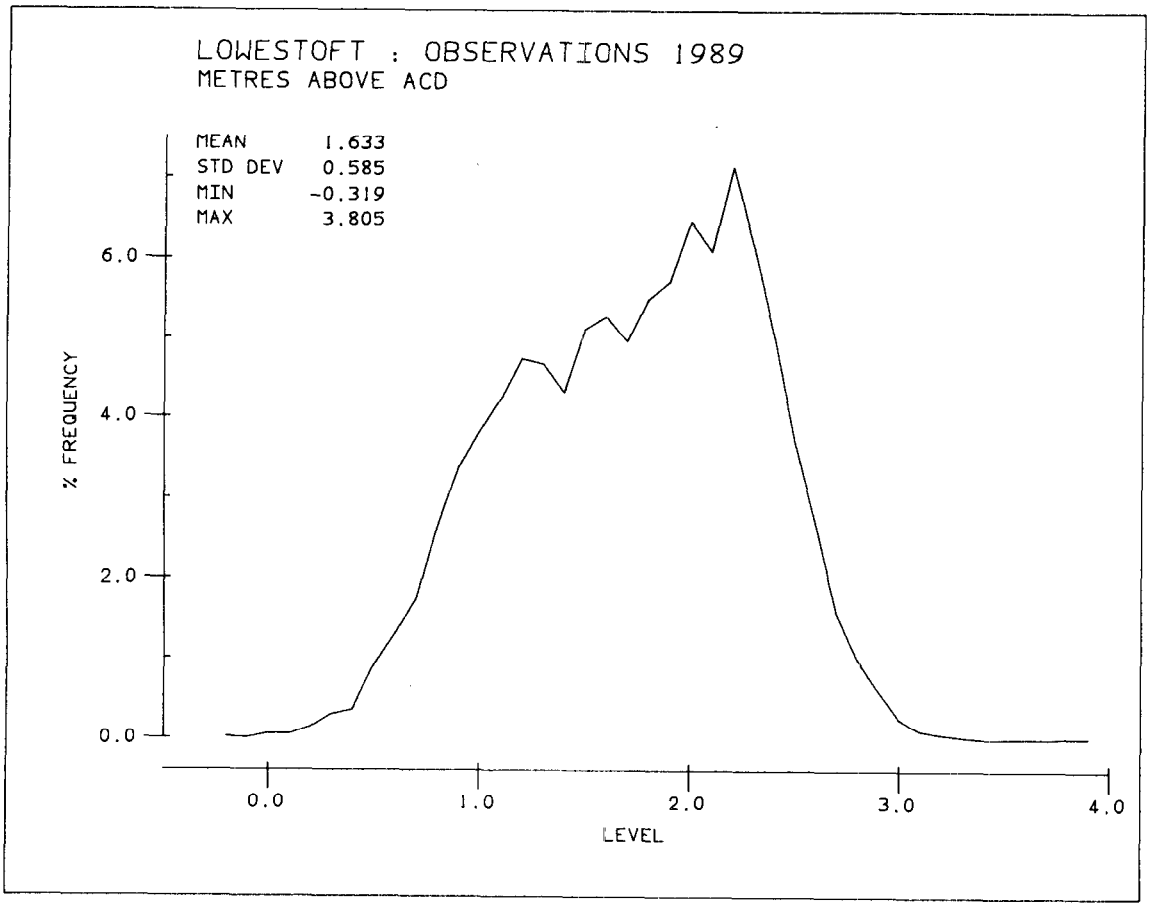
4 May	TGI visit for routine maintenance.
13-14 September	TGI visit. Well head unit replaced on Channel 1.
	Both Dataring channels recalibrated.

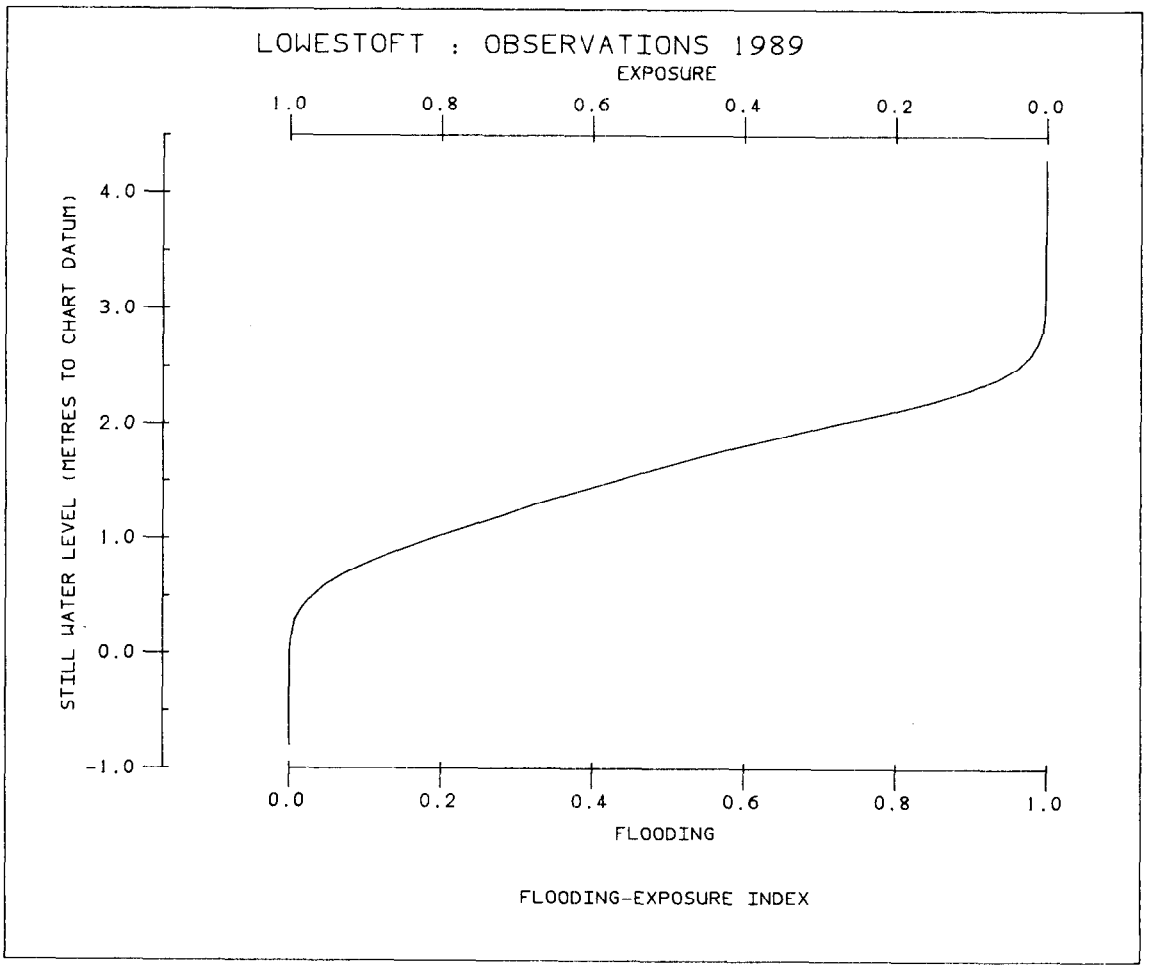
Extreme Statistics

14 February (0600GMT) Annual maximum level 3.805m above Chart Datum.

14 February (0800GMT) Annual maximum surge 2.541m above predicted.

(Figure 2 on Page 106)


LOWESTOFT : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 1.633
STD DEV 0.585
MIN -0.319
MAX 3.805
% FREQUENCY
6.0
4.0
2.0
0.0
0.0
1.0
2.0
3.0
4.0
LEVEL


LOWESTOFT : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - Lowestoft

Latitude: 52 28'20.9" N
Longitude: 1 45'06.4" E

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 1.634

Hourly Data From Potentiometer Gauge 2

Datum of Observations = ACD : 1.50 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.1634D+01 Residual Mean = 0.9013D-06
Std Dev = 0.5835D+00 Std Dev = 0.2025D+00

Constituent	h	g
Q1	0.045	113.50
O1	0.138	165.08
P1	0.036	326.78
K1	0.122	330.41
J1	0.004	17.31
2N2	0.021	162.20
N2	0.138	230.58
M2	0.699	259.03
S2	0.214	298.68
K2	0.060	297.25
M3	0.006	243.31
M4	0.047	333.77
MS4	0.041	25.34
M6	0.040	113.92

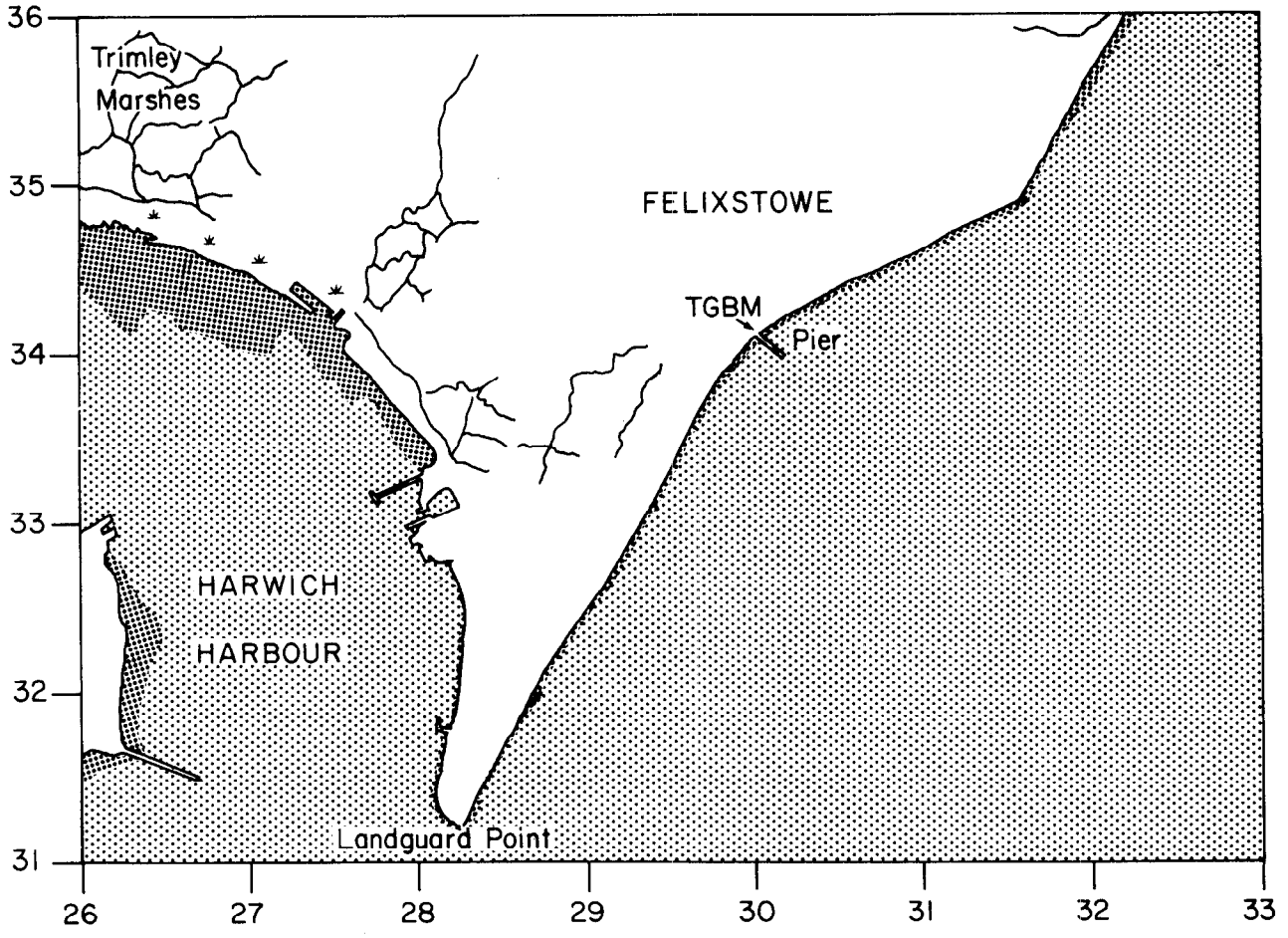
2.18 FELIXSTOWE

Latitude 51 deg 57' 22.8"N Longitude 01 deg 21' 00.0"E

National Grid reference TM 3015 3400

Recording zero = Chart Datum = 1.95m below Ordnance Datum Newlyn

Recording zero = 5.69m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TM3001 3414	Bolt on SE side of promenade, production on NE face of arcade.
Aux1	TM2956 3393	Flush bracket 2071 on 25 Langer Road, W angle, NW face.
Aux2	TM3015 3427	NE face of Town Hall, at E angle.

Data processing

Furnished with two pressure points with digiquartz transducers in September 1988, Channel 2 is the designated Class-A channel.

Missing scans in the raw data were interpolated on the following dates:- 12, 14(2), 25, 28 Jan; 5, 7, 8, 22(2) Feb; 14(2), 16, 17 Mar; 3, 6, 22, 26 Apr; 17, 20 May; 17, 21 Jun; 2 Jul; 10, 17 Aug; 3(2) Sep; 9, 13, 31 Oct; 8 Nov.

Gaps in 1989 filtered data

Nil gaps.

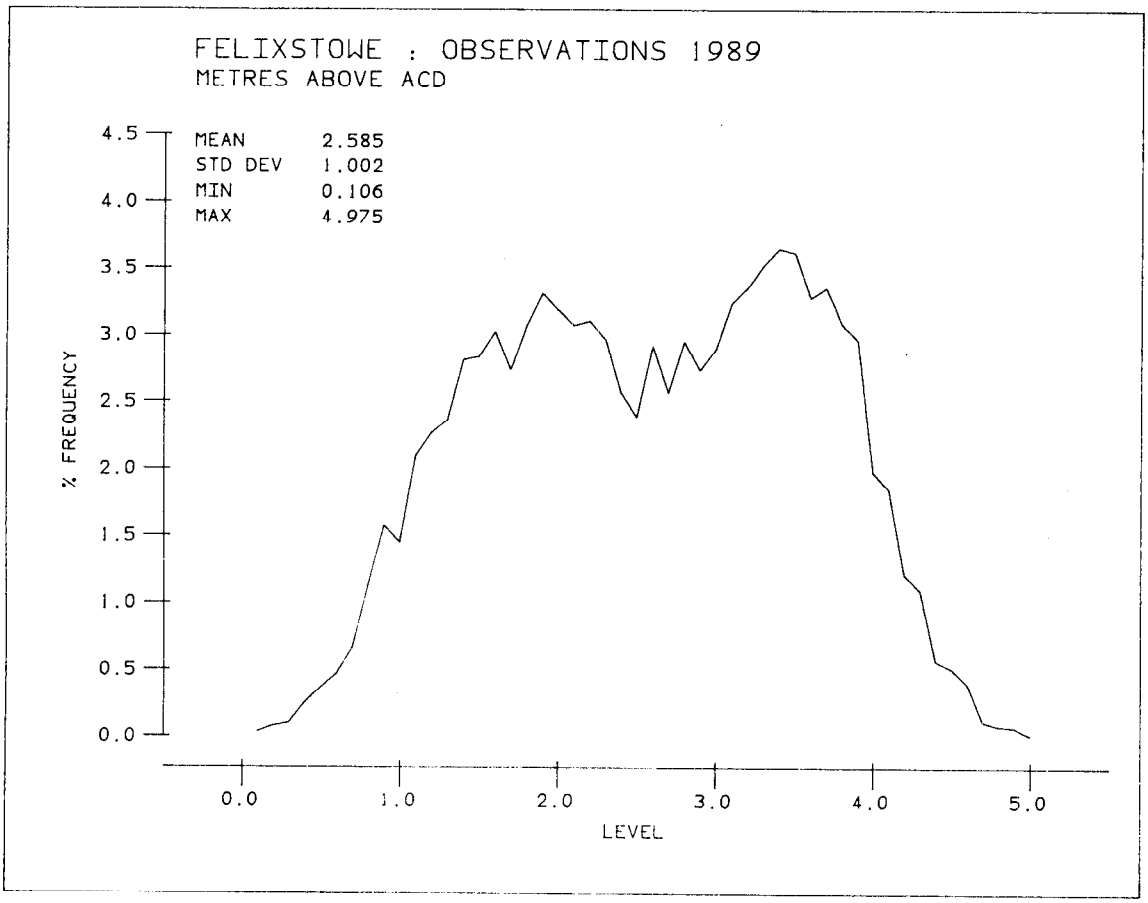
Site diary

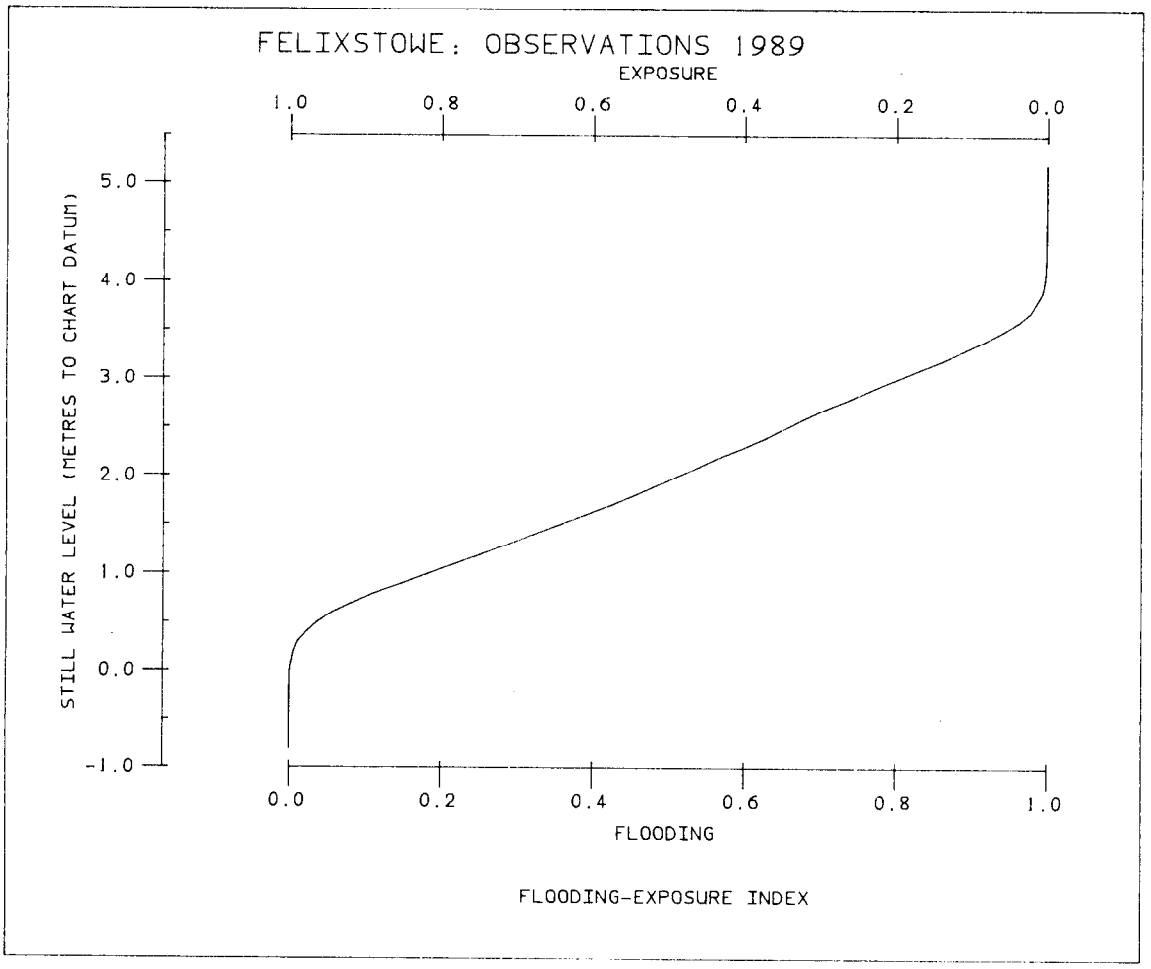
4 May	TGI visit.Sensors recalibrated.Leaks found and repaired in both systems.

Extreme Statistics

14 February (0600GMT) Annual maximum level 4.749m above Chart Datum.

14 February (0900GMT) Annual maximum surge 2.258m above predicted.


FELIXSTOWE : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 2.585
STD DEV 1.002
MIN 0.106
MAX 4.975
% FREQUENCY
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
1.0
2.0
3.0
4.0
5.0
LEVEL


FELIXSTOWE: OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - Felixstowe

Latitude: 51 57'22.8" N
Longitude: 1 21'00.0" E

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 2.059

Hourly data from digiquartz sensor 2

Datum of Observations = ACD : 1.95 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.2058D+01 Residual Mean = 0.8006D-06
Std Dev = 0.9621D+00 Std Dev = 0.2042D+00

Constituent	h	g
Q1	0.043	126.18
O1	0.130	178.78
P1	0.034	345.21
K1	0.110	349.70
J1	0.003	31.40
2N2	0.020	172.51
N2	0.219	294.54
M2	1.260	321.01
S2	0.353	13.40
K2	0.101	12.90
M3	0.005	287.86
M4	0.077	320.65
MS4	0.053	31.39
M6	0.054	268.37

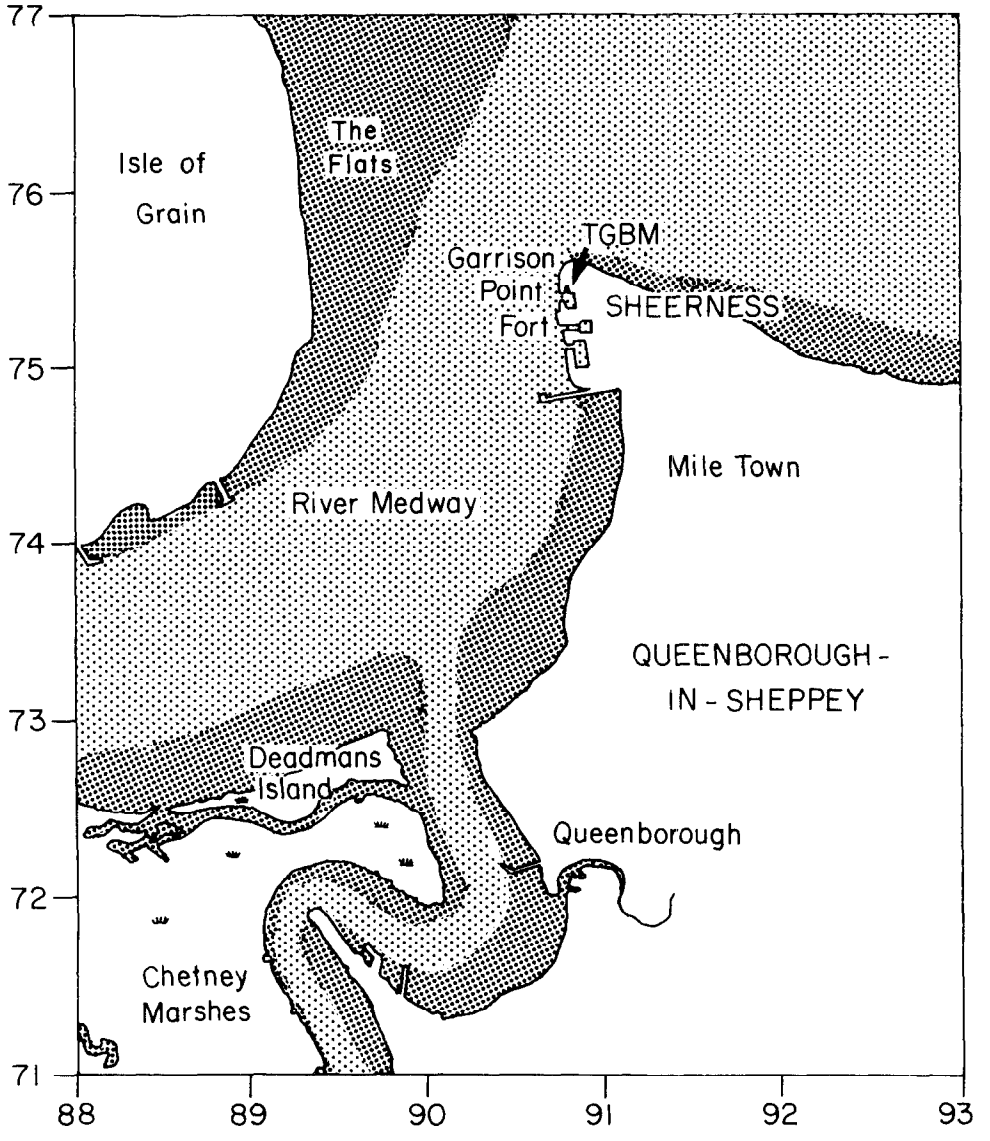
2.19 SHEERNESS

Latitude 51 deg 26' 42.4"N Longitude 00 deg 44' 41.9"E

National Grid reference TQ 9073 7542

Recording zero = Chart Datum = 2.9m below Ordnance Datum Newlyn

Recording zero = 7.532m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TQ9080 7549	Flush Bracket 11859 Garrison Point Fort E junction of flood gate.
Aux1	TQ9133 7523	Flush Bracket G4790 Dockyard Cottages.
Aux2	TQ9115 7533	Wall SW side of road NE angle.
Aux3	TQ9147 7516	PA bolt on disused church.

Data processing

Modernised with two pressure sensors in 1986, with digiquartz transducers,this site has continued to operate with little or no problem from the data processing point of view.

Missing scans in the raw data were interpolated for the following dates: 26 Jan; 13 Feb; 6 Mar; 20, 26 Apr; 7, 25 Jun; 5 Jul; 17 Aug; 16, 25 Sep; 31 Oct; 8 Dec.

Gaps in 1989 filtered hourly data

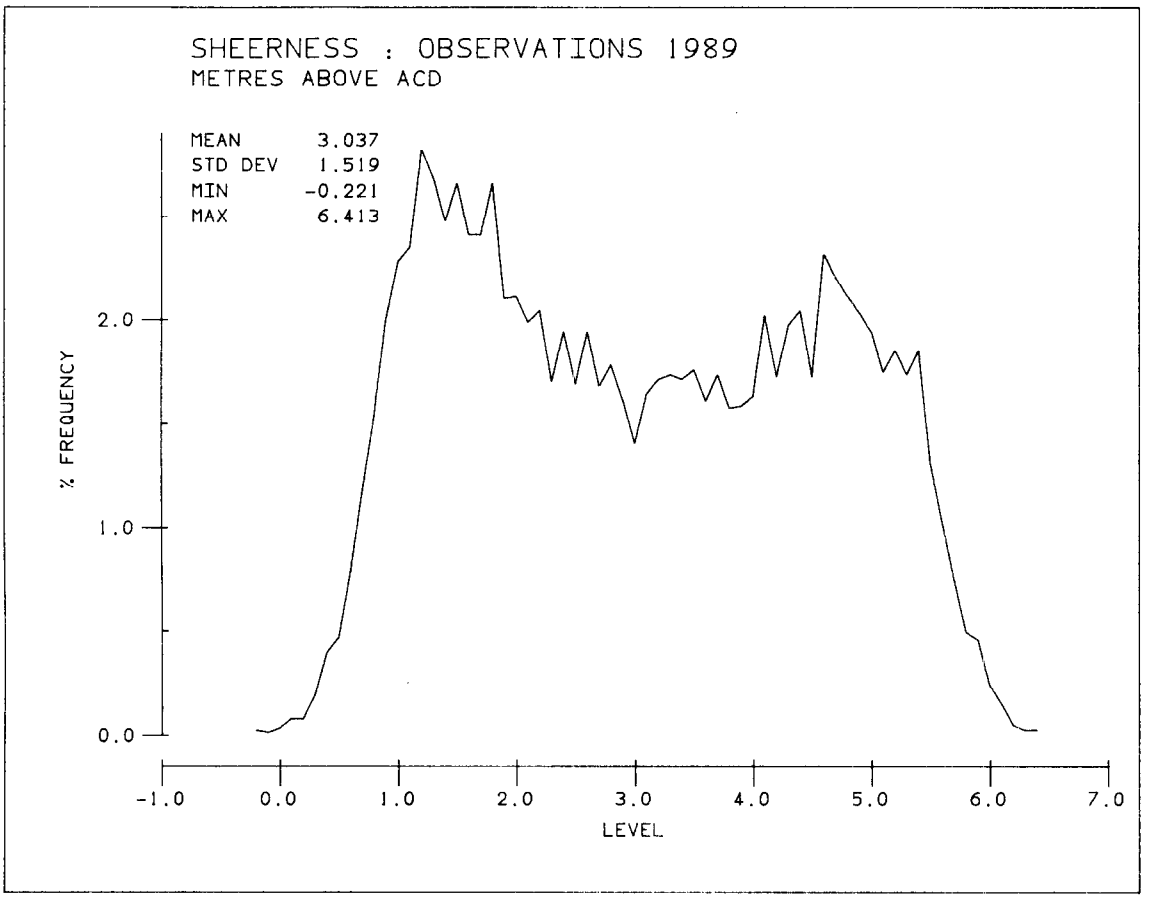
Nil gaps.

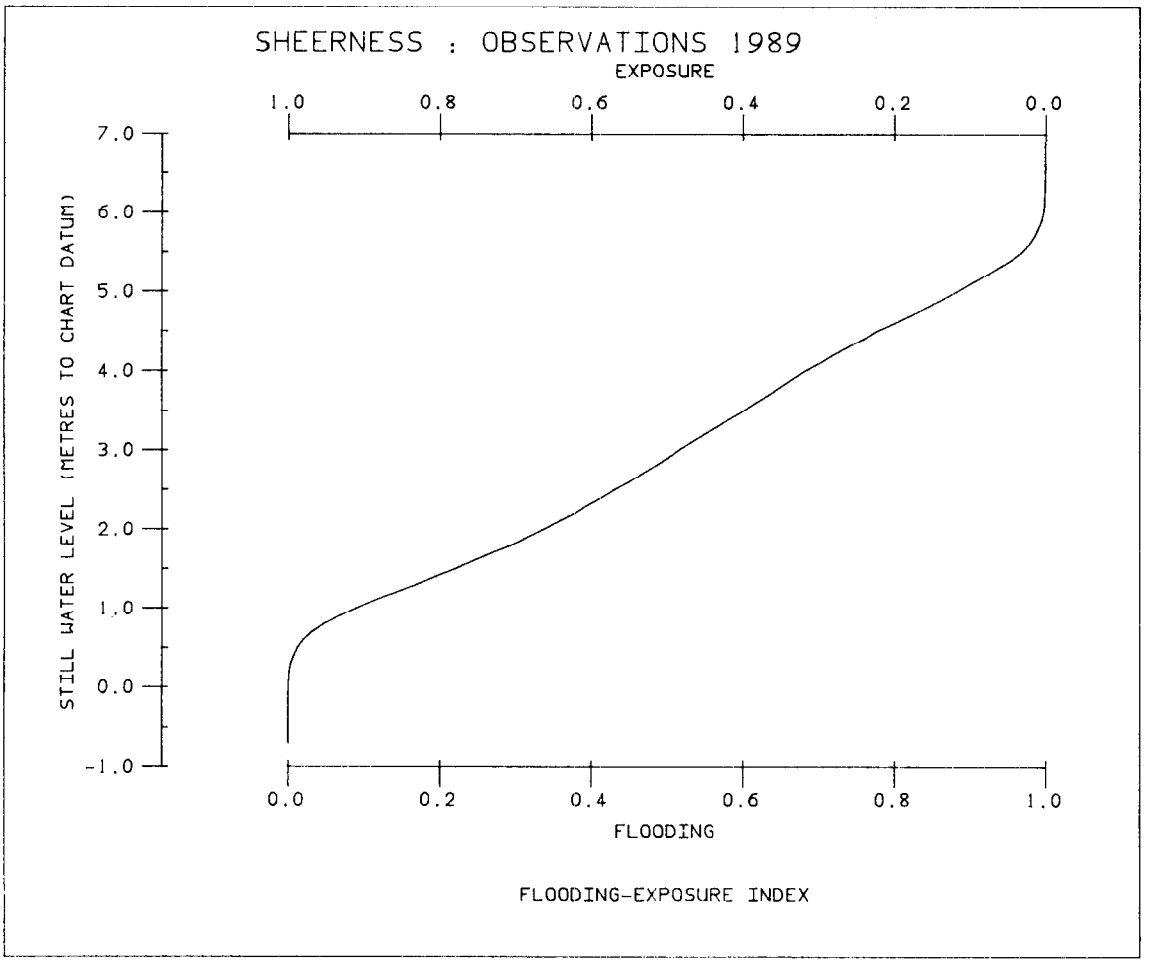
Site diary

9-10 January	TGI visit for calibration checks.

Extreme Statistics

15 December	Annual maximum level 6.414m above Chart Datum.
14 February	Annual maximum surge 2.329m above predicted.


SHEERNESS : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.037
STD DEV 1.519
MIN -0.221
MAX 6.413
% FREQUENCY
2.0
1.0
0.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
LEVEL


SHEERNESS : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, East Coast - Sheerness

Latitude: 51 26'42.4" N
Longitude: 0 44'41.9" E

Time Zone: GMT

Length: 365 Days

From: 1st January, 1989 To: 31st December, 1989

Units: Metres A0: 3.039

Hourly data from digiquartz sensor 2

Datum of observations = ACD : 2.90 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.3038D+01 Residual Mean = 0.1057D-05
Std Dev = 0.1520D+01 Std Dev = 0.2262D+00

Constituent	h	g
Q1	0.042	141.70
O1	0.133	195.08
P1	0.035	6.21
K1	0.118	11.40
J1	0.003	78.11
2N2	0.020	181.53
N2	0.353	328.74
M2	2.030	353.16
S2	0.585	50.24
K2	0.171	48.77
M3	0.006	12.87
M4	0.119	9.32
MS4	0.052	80.09
M6	0.052	34.64

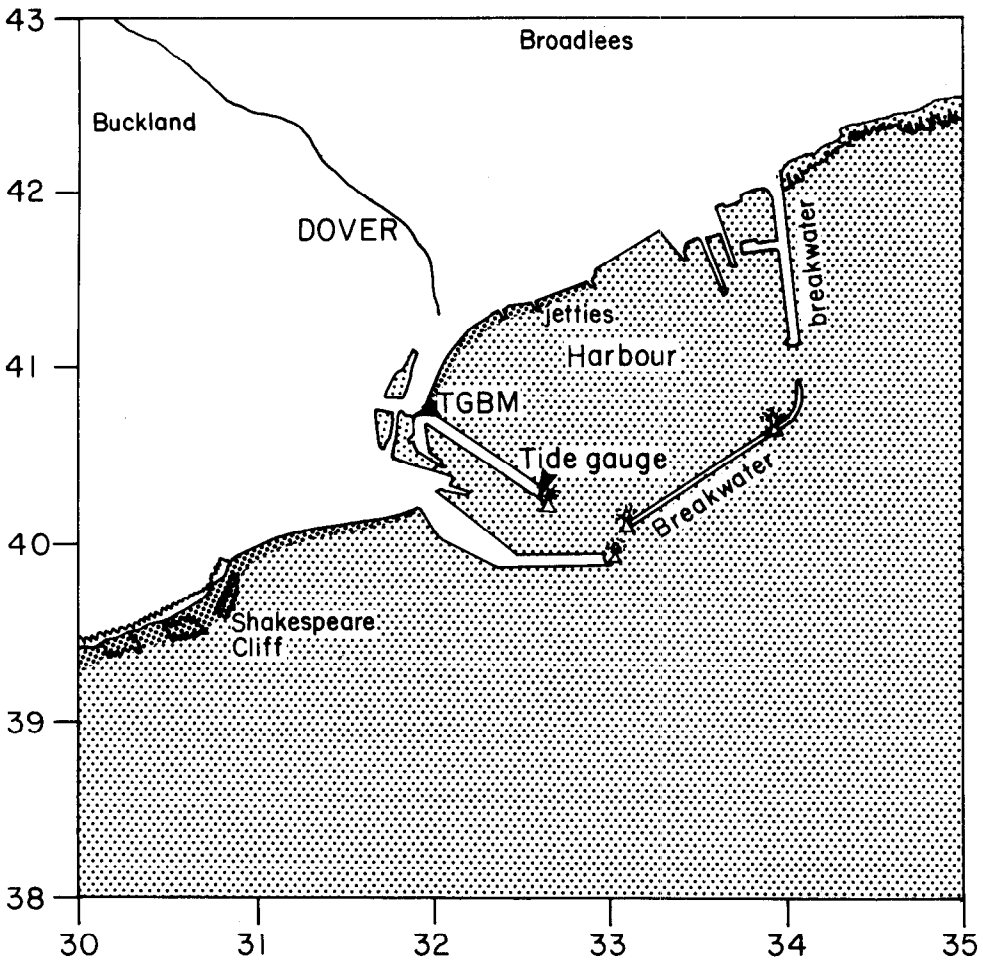
2.20 DOVER

Latitude 51 deg 06' 59.7"N Longitude 01 deg 19' 05.4"E

National Grid Reference TR 3220 4055

Recording zero = Chart Datum = 3.67m below Ordnance Datum Newlyn

Recording zero = 10.491m below Tide Gauge Bench Mark



Bench Marks	NG co-ords	Description
TGBM	TR3193 4074	Flush Bracket G4868 on building E side entrance to works.
Aux1	TR3195 4095	29 Waterloo Crescent SW face S angle.
Aux2	TR3228 4053	Rivet on pier wall Ne side of pier facing junction.
Aux3	TR3265 4026	Rivet on steps NE side of production of W pier 1.0m SE of W angle.

Data processing

The Class-A sensor (Channel 2) is connected to the Munro gauge. Gaps in the data during the year were caused by losses of data from the memory of the on-site microprocessor.The filtering process extended each gap from about 6 hours to 14 hours.

Isolated missing values in the raw data were interpolated for the following dates:- 5(2), 6, 14 Feb; 15 Mar; 21, 26 Apr; 22, 28, 29 May; 12, 14, 21, 23 Jun; 4, 6, 17, 19 Jul; 3, 7, 15, 23(2) Aug; 1(2), 13 Sep; 2, 29, 31 Oct; 15 Nov.
In addition, on the 17 Feb (1745-1830 GMT) and 7 March (1730-1815 GMT) complete hours were lost and subsequently interpolated by hand. (Reasons for missing data not known).

Gaps in 1989 filtered hourly data

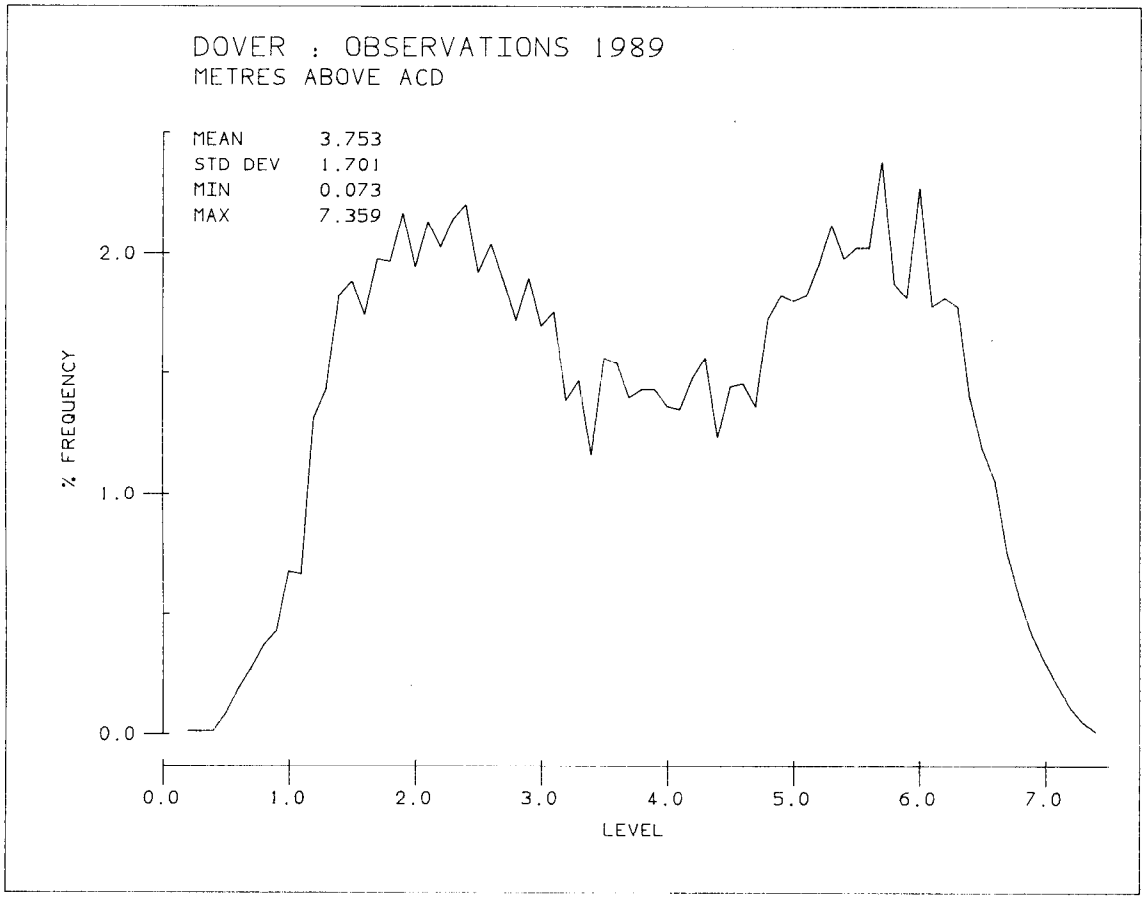
0000 GMT 1 January - 2000 GMT 11 January		Damaged unit repaired. Support brackets for both wells repaired.
0400 GMT - 1800 GMT	31 January	Data lost from store; reason not known.
1400 GMT 7 February - 0200 GMT	8 February	" " " " "
1400 GMT 10 February - 0300 GMT	11 February	" " " " "
0600 GMT 6 September - 1900 GMT	6 September	" " " " "

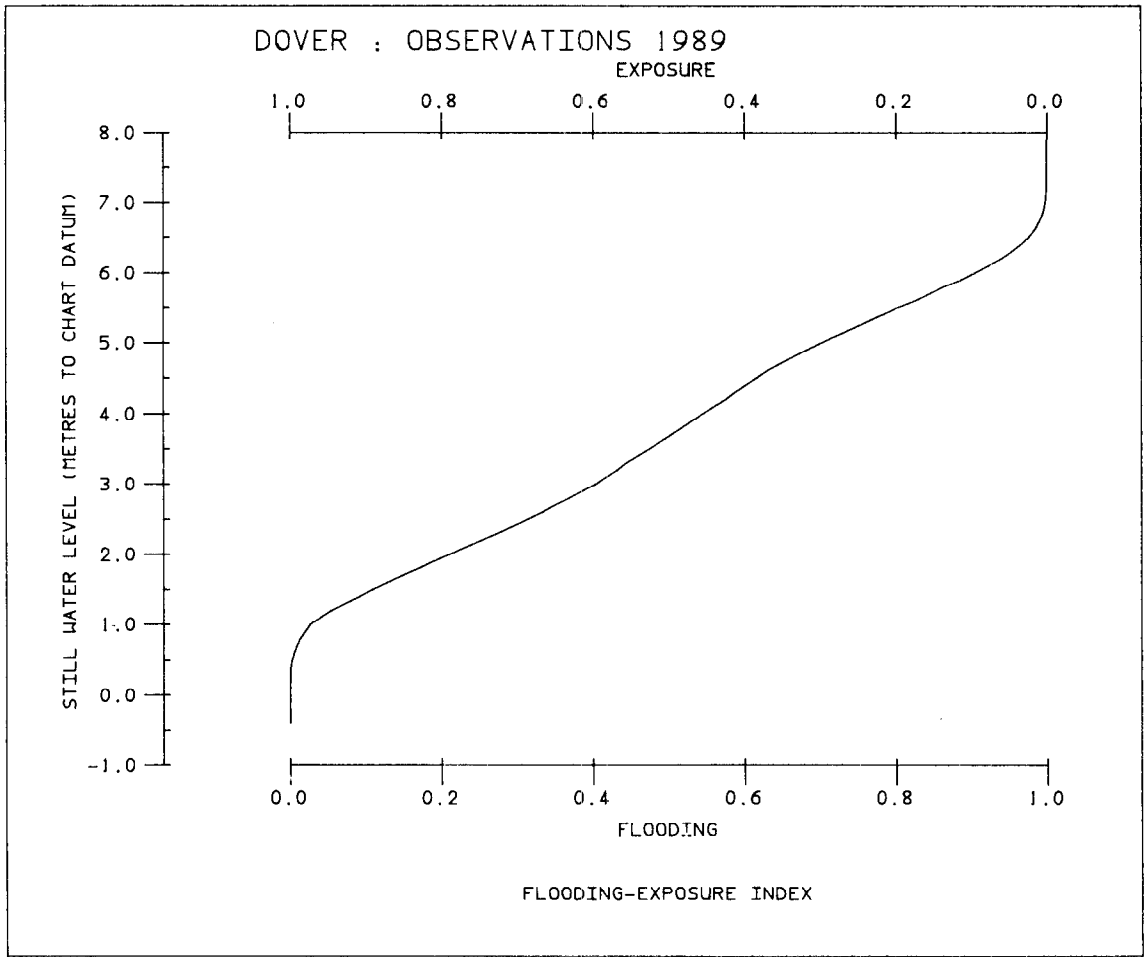
Site diary

11 January	TGI visit to repair both systems and reset to datum. Potentiometer on Munro gauge replaced.

Extreme Statistics

17 September	Annual maximum level 7.36m above Chart Datum.
14 February	Annual maximum surge 1.844m above predicted.


DOVER : OBSERVATIONS 1989
METRES ABOVE ACD
MEAN 3.753
STD DEV 1.701
MIN 0.073
MAX 7.359
% FREQUENCY
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
LEVEL


DOVER : OBSERVATIONS 1989
EXPOSURE
1.0
0.8
0.6
0.4
0.2
0.0
STILL WATER LEVEL (METRES TO CHART DATUM)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
0.0
0.2
0.4
0.6
0.8
1.0
FLOODING
FLOODING-EXPOSURE INDEX

Harmonic Tidal Analysis.

Port: England, South Coast - Dover

Latitude: 51 06'59.7" N
Longitude: 1 19'05.4" E

Time Zone: GMT

Length: 350 Days

From: 11th January, 1989 To: 31st December, 1989

Units: Metres A0: 3.758

Hourly data from Potentiometer sensor 2

Datum of observations = ACD : 3.67 Metres below Ordnance Datum (Newlyn)

Observation Mean = 0.3755D+01 Residual Mean = 0.2649D-06
Std Dev = 0.1703D+01 Std Dev = 0.1720D+00

Constituent	h	g
Q1	0.023	125.50
O1	0.057	190.36
P1	0.016	55.94
K1	0.052	40.17
J1	0.005	226.77
2N2	0.051	285.71
N2	0.415	310.06
M2	2.262	332.00
S2	0.719	23.69
K2	0.204	22.77
M3	0.012	33.46
M4	0.264	221.50
MS4	0.175	273.63
M6	0.069	103.07

3. ANALYSED DATA STATISTICS

3.1 EXTREME LEVEL VALUES

As in the previous section, monthly extreme values are presented for all twenty ports in clock-wise order from Newlyn around the coast.

It should be noted that these values are derived from hourly still water levels. All effects due to waves are filtered out, and the results generally may be lower than the levels reported elsewhere eg. from higher frequency recordings.

Notable levels recorded in 1989 were 3.805m above Chart Datum recorded at Lowestoft on 14 February, which was the highest level at this site since February 1983, 10.95m recorded at Heysham also the highest since February 1983 and 5.586m recorded at Fishguard the highest since January 1977 at this site. Both the Heysham and Fishguard extreme levels were recorded on 9 March.
The Lowestoft extreme maximum level closely coincided with predicted low water, as can be seen in Figure 2 on page 106.

NEWLYN

DATUM = CHART DATUM

ORDNANCE DATUM - 3.05m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR
JANUARY	0.675	10	13	5.631	11	7
FEBRUARY	0.482	8	13	6.069	9	7
MARCH	0.342	10	13	6.126	9	6
APRIL	0.364	7	12	6.034	7	5
MAY	0.474	7	0	5.621	6	5
JUNE	0.861	3	23	5.497	4	17
JULY	0.810	22	1	5.614	20	18
AUGUST	0.516	19	0	5.873	19	18
SEPTEMBER	0.508	17	0	6.140	17	18
OCTOBER	0.378	16	12	5.887	15	17
NOVEMBER	0.557	13	23	5.693	12	16
DECEMBER	1.178	12	10	6.229	16	7
ANNUAL	0.342	10	13	6.229	16	7

ILFRACOMBE

DATUM = CHART DATUM

ORDNANCE DATUM - 4.8m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR
JANUARY	0.911	10	14	9.315	9	7
FEBRUARY	0.370	8	13	10.010	9	8
MARCH	0.177	10	14	10.380	9	7
APRIL	0.202	6	12	10.030	7	7
MAY	0.404	6	0	9.414	6	6
JUNE	1.057	4	12	9.062	5	19
JULY	0.814	22	2	9.276	21	20
AUGUST	0.372	19	1	9.742	19	20
SEPTEMBER	0.262	17	1	10.157	17	19
OCTOBER	0.221	16	0	9.985	15	18
NOVEMBER	0.497	14	0	9.584	12	17
DECEMBER	1.411	30	13	9.801	14	7
ANNUAL	0.177	10	14	10.380	9	7

AVONMOUTH

DATUM = CHART DATUM

ORDNANCE DATUM - 6.5m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
FEBRUARY	0.702	9	4	14.090	9	9
MARCH	0.421	10	16	14.640	9	8
APRIL	0.438	7	15	14.579	7	8
MAY	0.457	6	2	13.513	6	20
JUNE	1.168	4	14	12.951	5	20
JULY	1.116	22	4	13.182	21	21
AUGUST	0.685	20	4	14.055	19	21
SEPTEMBER	0.444	17	3	14.383	16	20
OCTOBER	0.568	15	2	14.123	16	20
NOVEMBER	0.639	14	2	13.748	13	19
DECEMBER	1.447	30	15	13.805	14	8
ANNUAL	0.421	10	16	14.640	9	8

FISHGUARD

DATUM = CHART DATUM

ORDNANCE DATUM - 2.44m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR
JANUARY	0.668	10	16	5.017	11	10
FEBRUARY	0.400	8	15	5.421	9	9
MARCH	0.400	10	16	5.586	9	8
APRIL	0.359	6	14	5.381	7	8
MAY	0.382	6	2	4.813	5	7
JUNE	0.879	5	2	4.692	5	20
JULY	0.722	22	4	4.854	21	21
AUGUST	0.420	19	3	5.248	19	21
SEPTEMBER	0.424	17	2	5.383	16	20
OCTOBER	0.349	15	1	5.289	15	19
NOVEMBER	0.516	14	2	5.058	12	18
DECEMBER	1.090	30	15	5.412	16	10
ANNUAL	0.349	15	1	5.586	9	8

HOLYHEAD

DATUM = CHART DATUM

ORDNANCE DATUM - 3.05m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.568	10	18	6.158	11	13
FEBRUARY	0.250	8	18	6.352	9	12
MARCH	0.248	7	16	6.470	9	11
APRIL	1.186	25	6	5.118	25	0
MAY	0.173	5	16	5.643	5	10
JUNE	0.684	4	4	5.550	5	23
JULY	0.631	21	6	5.789	22	0
AUGUST	0.408	20	6	6.147	20	0
SEPTEMBER	0.262	17	5	6.427	15	22
OCTOBER	0.208	15	4	6.208	15	22
NOVEMBER	0.382	14	4	5.881	12	21
DECEMBER	0.987	30	18	6.228	16	13
ANNUAL	0.173	5	16	6.470	9	11

HEYSHAM

DATUM = CHART DATUM

ORDNANCE DATUM - 4.9m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	1.070	10	20	10.250	11	14
FEBRUARY	0.549	8	19	10.440	9	13
MARCH	0.584	10	7	10.950	9	12
APRIL	0.382	6	18	10.570	7	12
MAY	0.583	6	6	9.723	5	11
JUNE	1.149	3	17	9.362	5	0
JULY	0.988	22	8	9.714	22	1
AUGUST	0.686	19	7	10.359	20	1
SEPTEMBER	0.612	17	7	10.685	15	23
OCTOBER	0.596	15	5	10.653	15	23
NOVEMBER	0.690	14	6	9.993	13	23
DECEMBER	1.199	14	19	10.014	17	14
ANNUAL	0.382	6	18	10.950	9	12

MILLPORT

DATUM = CHART DATUM

ORDNANCE DATUM - 1.62m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.365	10	20	4.262	13	16
FEBRUARY	0.126	10	21	4.139	13	17
MARCH	0.095	7	18	4.172	9	13
APRIL	-0.099	5	17	3.829	11	16
MAY	-0.043	5	17	3.523	11	4
JUNE	0.193	6	7	3.530	25	4
JULY	0.168	5	7	3.505	22	2
AUGUST	0.246	18	6	3.791	20	2
SEPTEMBER	0.255	29	5	4.119	19	2
OCTOBER	0.086	15	5	3.846	19	15
NOVEMBER	0.145	13	5	3.884	10	22
DECEMBER	0.457	30	19	4.363	17	15
ANNUAL	-0.099	5	17	4.363	17	15

TOBERMORY

DATUM = CHART DATUM

ORDNANCE DATUM - 2.39m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.869	10	14	5.270	11	8
FEBRUARY	0.469	8	14	5.365	9	8
MARCH	0.426	8	0	5.337	9	7
APRIL	0.285	6	12	5.060	7	6
MAY	0.277	6	0	4.572	5	5
JUNE	0.731	4	0	4.463	5	19
JULY	0.616	21	14	4.625	21	20
AUGUST	0.557	18	13	5.208	20	20
SEPTEMBER	0.470	17	1	5.487	18	20
OCTOBER	0.379	15	0	5.197	15	18
NOVEMBER	0.522	14	0	4.778	13	18
DECEMBER	0.933	13	0	5.066	17	9
ANNUAL	0.277	6	0	5.487	18	20

ULLAPOOL

DATUM = CHART DATUM

ORDNANCE DATUM - 2.75m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.693	10	15	5.906	11	9
FEBRUARY	0.247	8	15	6.074	9	9
MARCH	0.405	10	15	6.070	9	8
APRIL	0.074	6	13	5.656	7	7
MAY	0.247	5	13	5.194	5	6
JUNE	0.731	4	1	4.998	5	20
JULY	0.629	23	4	5.218	21	21
AUGUST	0.498	19	2	5.799	19	20
SEPTEMBER	0.311	17	2	6.017	15	19
OCTOBER	0.214	15	1	5.862	15	19
NOVEMBER	0.502	13	0	5.450	13	19
DECEMBER	0.984	13	13	5.466	14	8
ANNUAL	0.074	6	13	6.074	9	9

STORNOWAY

DATUM = CHART DATUM

ORDNANCE DATUM - 2.71m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.654	10	15	5.513	11	9
FEBRUARY	0.285	8	15	5.717	9	9
MARCH	0.410	9	14	5.771	9	8
APRIL	0.070	6	13	5.347	7	7
MAY	0.220	5	13	4.892	5	6
JUNE	0.804	6	2	4.692	5	20
JULY	0.593	22	3	4.926	21	21
AUGUST	0.444	19	2	5.492	19	20
SEPTEMBER	0.336	17	2	5.679	16	19
OCTOBER	0.215	15	1	5.497	15	19
NOVEMBER	0.441	13	0	5.065	13	19
DECEMBER	0.968	13	13	5.130	14	8
ANNUAL	0.070	6	13	5.771	9	8

WICK

DATUM = CHART DATUM

ORDNANCE DATUM - 1.71m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.444	10	19	3.992	11	14
FEBRUARY	0.162	8	19	3.969	6	11
MARCH	0.210	9	18	4.153	9	12
APRIL	0.099	4	16	3.768	7	12
MAY	0.219	4	16	3.468	5	11
JUNE	0.482	4	5	3.420	26	4
JULY	0.314	21	7	3.510	22	1
AUGUST	0.322	19	6	3.946	20	1
SEPTEMBER	0.384	17	6	4.117	17	0
OCTOBER	0.138	15	5	4.026	17	0
NOVEMBER	0.381	15	18	3.821	13	23
DECEMBER	0.722	15	19	3.811	14	12
ANNUAL	0.099	4	16	4.153	9	12

ABERDEEN

DATUM = CHART DATUM

ORDNANCE DATUM - 2.25m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.489	22	20	4.638	9	14
FEBRUARY	0.144	8	21	4.766	7	14
MARCH	0.106	8	20	4.889	10	15
APRIL	0.179	7	20	4.691	7	14
MAY	0.332	4	18	4.382	5	13
JUNE	0.604	4	7	4.193	5	2
JULY	0.350	21	9	4.315	22	3
AUGUST	0.296	19	9	4.743	20	3
SEPTEMBER	0.298	17	8	4.976	17	2
OCTOBER	0.140	15	7	4.831	17	2
NOVEMBER	0.406	13	7	4.691	14	1
DECEMBER	0.794	13	20	4.644	14	14
ANNUAL	0.106	8	20	4.976	17	2

LEITH

DATUM = CHART DATUM

ORDNANCE DATUM - 2.9m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.508	10	23	5.857	9	16
FEBRUARY	0.152	8	22	6.028	7	15
MARCH	-0.147	9	22	6.240	10	16
APRIL	0.086	6	21	6.043	7	15
MAY	0.325	6	9	5.723	7	16
JUNE	0.700	5	9	5.560	3	14
JULY	0.398	21	10	5.585	22	5
AUGUST	0.180	19	10	6.001	20	4
SEPTEMBER	0.178	18	10	6.366	18	4
OCTOBER	0.142	15	8	6.180	16	3
NOVEMBER	0.386	13	8	5.963	14	15
DECEMBER	0.856	18	0	6.033	14	15
ANNUAL	-0.147	9	22	6.366	18	4

NORTH SHIELDS

DATUM = CHART DATUM

ORDNANCE DATUM - 2.6m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.472	22	22	5.404	9	16
FEBRUARY	0.132	9	0	5.545	7	16
MARCH	-0.153	9	23	5.711	10	17
APRIL	0.120	6	22	5.517	7	16
MAY	0.291	4	21	5.244	5	15
JUNE	0.694	6	11	5.038	3	15
JULY	0.319	22	12	5.119	23	6
AUGUST	0.625	2	10	5.116	4	5
SEPTEMBER	0.162	18	11	5.847	17	4
OCTOBER	0.129	15	10	5.621	16	4
NOVEMBER	0.356	13	9	5.515	14	3
DECEMBER	0.851	18	1	5.548	14	16
ANNUAL	-0.153	9	23	5.847	17	4

IMMINGHAM

DATUM = CHART DATUM

ORDNANCE DATUM - 3.9m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.719	23	1	7.676	9	19
FEBRUARY	0.390	9	2	7.740	7	19
MARCH	-0.025	10	2	7.930	10	20
APRIL	0.417	6	0	7.771	6	18
MAY	0.611	7	1	7.425	5	18
JUNE	1.060	5	13	7.188	3	17
JULY	0.761	22	15	7.357	22	8
AUGUST	0.425	19	14	7.768	21	8
SEPTEMBER	0.357	18	14	8.067	18	7
OCTOBER	0.371	15	12	7.854	16	6
NOVEMBER	0.705	13	12	7.772	14	6
DECEMBER	1.171	18	4	7.733	14	19
ANNUAL	-0.025	10	2	8.067	18	7

CROMER

DATUM = CHART DATUM

ORDNANCE DATUM - 2.75m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.280	23	2	5.257	12	22
FEBRUARY	0.086	9	3	5.333	7	19
MARCH	-0.333	10	3	5.462	10	20
APRIL	0.106	8	2	5.241	8	20
MAY	0.294	7	2	5.167	5	18
JUNE	0.717	22	15	4.819	23	9
JULY	0.367	21	15	5.000	23	9
AUGUST	0.211	19	15	5.446	21	9
SEPTEMBER	0.164	18	15	5.715	17	7
OCTOBER	0.143	15	13	5.390	16	7
NOVEMBER	0.319	16	3	5.295	14	19
DECEMBER	0.692	18	5	5.213	13	19
ANNUAL	-0.333	10	3	5.715	17	7

LOWESTOFT

DATUM = CHART DATUM

ORDNANCE DATUM - 1.5m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.073	23	5	3.054	13	0
FEBRUARY	0.015	9	6	3.805	14	6
MARCH	-0.319	10	5	3.089	24	23
APRIL	-0.054	6	3	2.734	8	23
MAY	0.181	5	3	2.694	30	17
JUNE	0.412	24	19	2.616	1	19
JULY	0.222	22	18	2.688	31	8
AUGUST	0.122	19	17	3.009	21	12
SEPTEMBER	0.120	18	18	2.995	17	10
OCTOBER	0.081	15	16	2.827	7	1
NOVEMBER	0.229	11	14	2.829	14	22
DECEMBER	0.355	17	7	2.947	19	1
ANNUAL	-0.319	10	5	3.805	14	6

FELIXSTOWE

DATUM = CHART DATUM

ORDNANCE DATUM - 1.95m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.067	23	6	4.125	14	16
FEBRUARY	0.037	9	8	4.749	14	6
MARCH	-0.279	10	7	4.283	25	1
APRIL	-0.129	6	5	3.979	9	1
MAY	0.103	7	6	3.900	6	12
JUNE	0.347	20	18	3.914	5	0
JULY	0.164	22	20	3.818	30	22
AUGUST	0.073	19	19	4.049	21	14
SEPTEMBER	0.086	18	19	4.342	17	0
OCTOBER	0.010	29	5	4.152	14	23
NOVEMBER	0.148	13	17	4.083	14	12
DECEMBER	0.328	17	9	4.366	15	13
ANNUAL	-0.279	10	7	4.749	14	6

SHEERNESS

DATUM = CHART DATUM

ORDNANCE DATUM - 2.9m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.227	23	8	5.934	10	2
FEBRUARY	0.140	9	9	6.332	14	7
MARCH	-0.221	24	8	6.175	25	2
APRIL	0.048	6	7	6.049	9	2
MAY	0.297	7	8	5.933	6	13
JUNE	0.552	5	20	5.877	5	1
JULY	0.430	22	22	5.714	5	2
AUGUST	0.250	20	21	6.073	21	15
SEPTEMBER	0.190	18	21	6.383	17	1
OCTOBER	0.097	29	6	6.131	15	0
NOVEMBER	0.381	13	19	6.096	15	1
DECEMBER	0.395	17	10	6.414	15	14
ANNUAL	-0.221	24	8	6.414	15	14

DOVER

DATUM = CHART DATUM

ORDNANCE DATUM - 3.67m

	MINIMA			MAXIMA		
MONTH	HEIGHT	DAY	HR.	HEIGHT	DAY	HR.
JANUARY	0.683	11	21	6.818	13	3
FEBRUARY	0.466	9	9	6.975	9	1
MARCH	0.073	10	8	7.241	11	1
APRIL	0.355	7	7	7.119	6	23
MAY	0.502	7	7	6.961	5	23
JUNE	0.942	4	6	6.721	4	23
JULY	0.749	21	20	6.756	23	14
AUGUST	0.467	19	20	7.095	20	13
SEPTEMBER	0.459	17	20	7.360	17	12
OCTOBER	0.410	15	19	7.110	17	12
NOVEMBER	0.502	13	18	7.057	14	11
DECEMBER	1.150	30	7	7.183	13	11
ANNUAL	0.073	10	8	7.360	17	12

3.2 MEAN SEA LEVEL VALUES

Mean sea level (MSL) statistics are presented on the following pages as:

i: Doodson's x0 filtered monthly values to Chart Datum

ii: Tables and graphs of MSL anomalies (monthly mean - annual mean)

As in the report for 1988, the latter are depicted relative to West and East coasts of U.K.

MONTHLY MEAN SEA LEVEL VALUES TO CHART DATUM

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
NEWLYN	3.134	3.187	3.176	3.167	3.132	3.141	3.113	3.176	3.169	3.229	3.353	3.446	3.202
ILFRACOMBE	4.940	4.979	4.962	4.898	4.858	4.876	4.848	4.945	4.912	5.008	5.079	5.193	4.958
AVONMOUTH	xxx 31	7.033 09	6.940	6.820	6.791	6.847	6.829	6.967	6.898	7.032	6.990	7.109	6.929
FISHGUARD	2.639	2.702	2.684	2.617	2.578	2.598	2.565	2.664	2.628	2.724	2.805	2.911	2.674
HOLYHEAD	3.281	3.344	3.308	3.112 24	3.150	3.175	3.147	3.273	3.219	3.332	3.389	3.516 04	3.278
HEYSHAM	5.228	5.336	5.256	5.049	5.037	5.066	5.042	5.207	5.105	5.252	5.245	5.351	5.181
MILLPORT	2.133	2.193	2.107	1.886 02	1.880	1.899	1.855	2.046	1.963	2.078	2.105	2.212	2.030
TOBERMORY	2.882	2.931	2.822	2.621	2.623	2.641	2.592	2.770	2.695	2.786	2.812	2.903	2.756
ULLAPOOL	3.293	3.323	3.186 02	2.944	2.968	2.979	2.954	3.151	3.093	3.174	3.182	3.263	3.125
STORNOWAY	3.066	3.098	2.968	2.752 02	2.771	2.788 05	2.759	2.951	2.905 03	2.972	2.983	3.062	2.925
WICK	2.237	2.264	2.118	1.898	1.925	1.934	1.920	2.102	2.083 04	2.144 02	2.116	2.224	2.079
ABERDEEN	2.705	2.736	2.619	2.439	2.461	2.470	2.460	2.615	2.578	2.643	2.631	2.705	2.588
LEITH	3.261 02	3.280	3.213	3.098	3.102	3.119	3.111 03	3.241	3.218	3.269	3.284	3.354	3.213
NORTH SHIELDS	3.013	3.044	2.970 09	2.832	2.844	2.862	2.848	2.989 18	3.012 13	3.002	2.994 07	3.087	2.952
IMMINGHAM	4.234	4.266	4.187	4.123	4.129	4.155	4.156	4.260	4.270	4.279	4.316	4.364	4.228
CROMER	2.802	2.838	2.770 09	2.705 11	2.698 13	2.708 15	2.769 06	2.862	2.857	2.853	2.866	2.910	2.817
LOWESTOFT	1.626	1.676	1.617	1.527	1.549	1.573	1.594	1.689	1.675	1.676	1.680	1.729	1.634
FELIXSTOWE	2.038	2.089	2.035	1.939	1.978	2.001	2.021	2.108	2.106	2.105	2.119	2.168	2.059
SHEERNESS	3.003	3.037	2.994	2.984	2.982	2.993	3.017	3.074	3.099	3.055	3.105	3.128	3.039
DOVER	3.676 13	3.808 05	3.749	3.680	3.669	3.700	3.709	3.790	3.787 03	3.808	3.822	3.883	3.759

MONTHLY MEAN SEA LEVEL ANOMALIES

(MONTHLY MEAN - ANNUAL MEAN)

(millimetres)

West Coast (N - S)

1.1 STORNOWAY	141	173	043	-173	-154	-137	-166	026	-020	047	058	137
1.2 ULLAPOOL	168	198	061	-181	-157	-146	-171	026	-032	049	057	138
1.3 TOBERMORY	126	175	066	-135	-133	-115	-164	014	-061	030	056	147
1.4 MILLPORT	103	163	077	-144	-150	-131	-175	016	-067	048	075	182
1.5 HEYSHAM	047	155	075	-132	-144	-115	-139	026	-076	071	064	170
1.6 HOLYHEAD	003	066	030	-166	-128	-103	-131	-005	-059	054	111	238
1.7 FISHGUARD	-035	028	010	-057	-096	-076	-109	-010	-046	050	131	237
1.8 AVONMOUTH	000	104	011	-109	-138	-082	-100	038	-031	103	061	180
1.9 ILFRACOMBE	-018	021	004	-060	-100	-082	-110	-013	-046	050	121	235
1.10 NEWLYN	-068	-015	-026	-035	-070	-061	-089	-026	-033	027	151	244

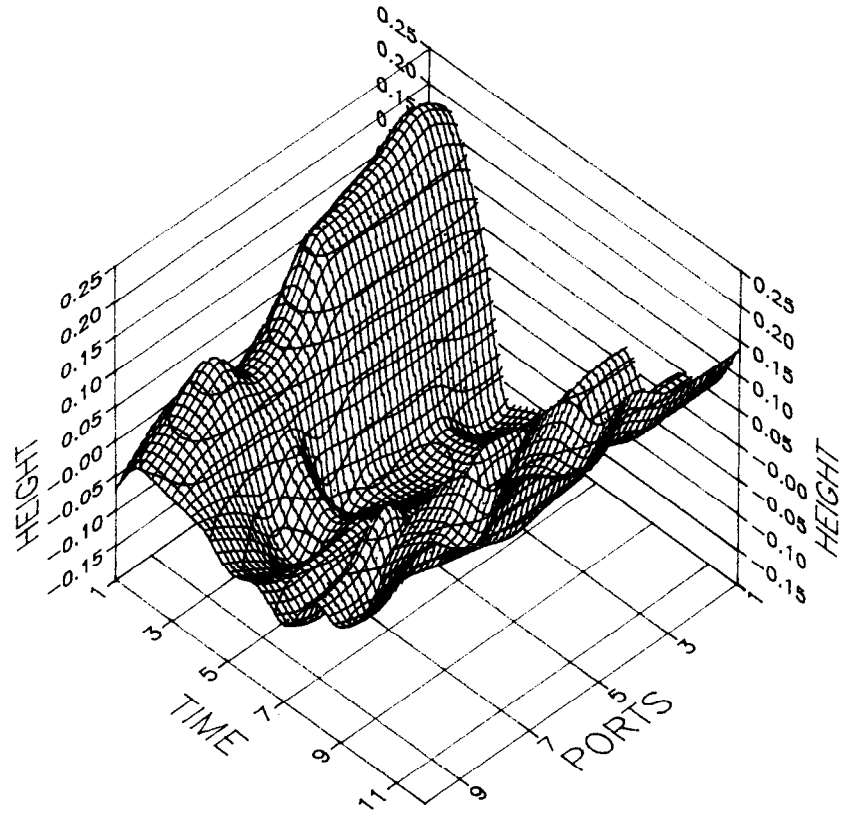
East Coast (N - S)

2.1 WICK	158	185	039	-181	-154	-145	-159	023	004	065	037	145
2.2 ABERDEEN	117	148	031	-149	-127	-118	-128	027	-010	055	043	117
2.3 LEITH	048	067	000	-115	-111	-094	-102	028	005	056	071	141
2.4 N.SHIELDS	061	092	018	-120	-108	-090	-104	037	060	050	042	135
2.5 IMMINGHAM	006	038	-041	-105	-099	-073	-072	032	042	051	088	136
2.6 CROMER	-015	021	-047	-112	-119	-109	-048	045	040	036	049	093
2.7 LOWESTOFT	-008	042	-017	-107	-085	-061	-040	055	041	042	046	095
2.8 FELIXSTOWE	-021	030	-024	-120	-081	-058	-038	049	047	046	060	109
2.9 SHEERNESS	-036	-002	-045	-055	-057	-046	-022	035	060	016	066	089
2.10 DOVER	-083	049	-010	-079	-090	-059	-050	031	028	049	063	124

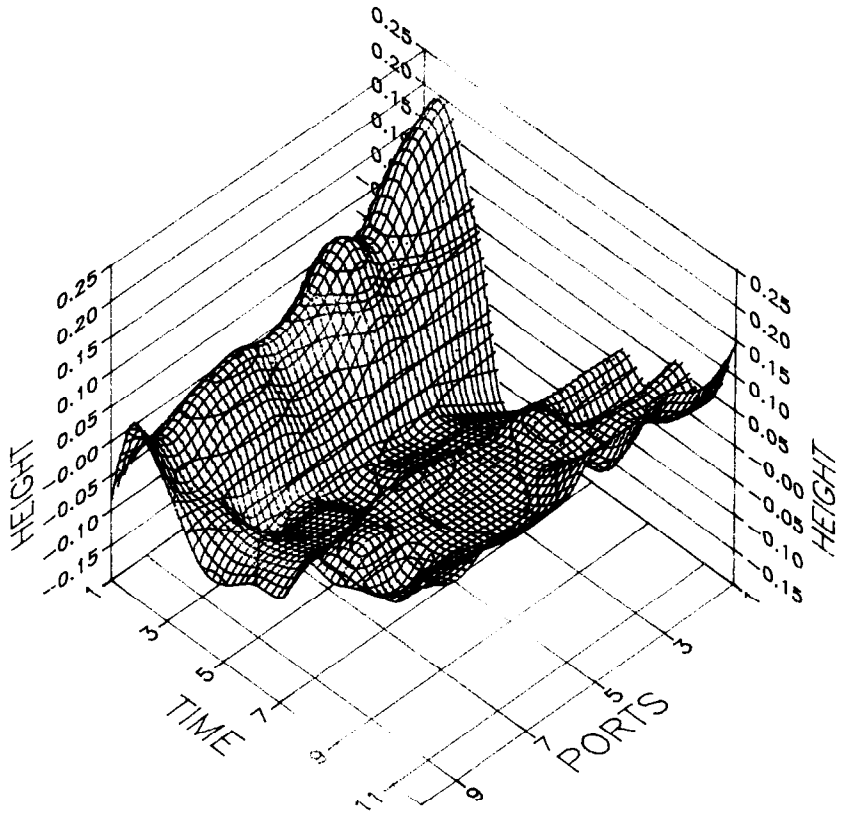
The values are depicted in graphical form overleaf

(Port numbers relate to those on the diagrams)

Mean Sea Level Anomalies 1989 – West Coast



Mean Sea Level Anomalies 1989 – East Coast



3.3 STORM SURGE RESIDUALS

The difference between gauge recordings and predicted levels, depending on the quality of the predictions leave a 'residual' tide which reflects the meteorological influence with some local effects due to the topography and/or instrument errors.

These are positive or negative anomalies termed storm surges as they are generally associated with storms and inclement weather. It is emphasised that the values are from hourly still water levels ie. not including wave effects.

The following pages show these differences whereby the effects on coastal sea levels may be tracked from port to port with the storm's progress. Results are graphically presented monthly for each coast, West and East.

Tables of the residual statistics for the year follow the December plots.

Predominant surges in excess of 1m observed in 1989 were :

a) 13/14 January

Positive surges of less than 1 metre were recorded at most West coast gauges on the 13th.Gusts of 76kts were reported at Stornoway.
A negative surge of 1.510m below the predicted level at Sheerness was caused by a deep depression slowly moving North-Eastward just to the East of Iceland. Strong SSWly winds associated with a warm front created the surge peak just after high water.

b) 13/14 February

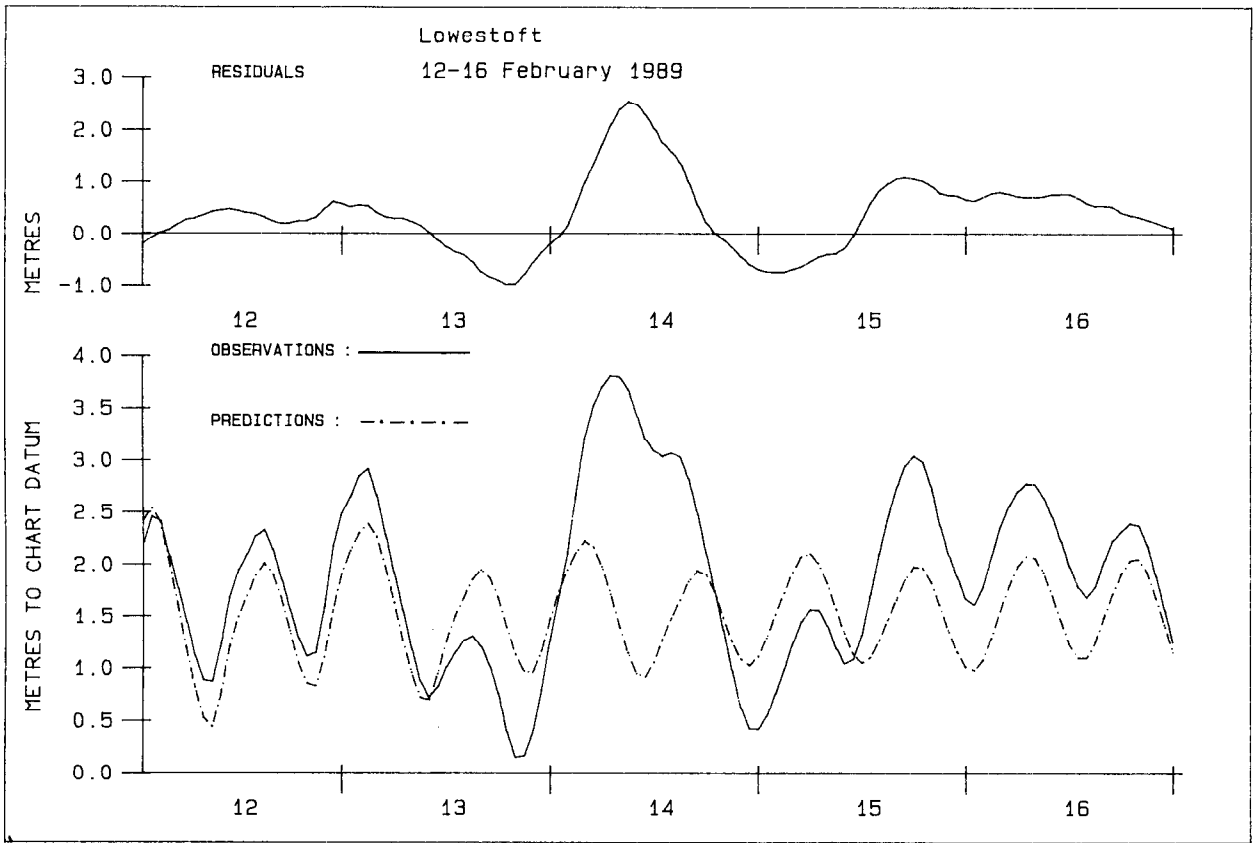
Positive surges in excess of 1m were recorded on West coast gauges from Heysham north to Ullapool on pm. 13.
The very large surge on the morning of the 14th (maximum 2.541m at Lowestoft) affecting the East coast was predicted well in advance.Fortunately,it also coincided with predicted low water (Figure 2) preventing a major catastrophe.
A deep depression moved NE between Shetland and Faeroes with an occlusion moving SE across Britain. The strong SW'ly gradient veered NW and intensified for a time.

c) 26 February

A positive surge of 1.532m was recorded at Avonmouth - with little effect at other Dataring gauge sites, caused by a deep depression tracking Eastward through the English Channel

d) 1/2 March

1.175m at Avonmouth- lesser effects elsewhere.



e) 11 April

Maximum positive surge of 1.599m at Heysham.
A deep depression moved up the Irish Sea and across Scotland.Gusts of 84kts were reported at Milford Haven.

f) 16 September

A maximum surge level of 1.021m was recorded at Cromer (1600GMT)
A very intense depression moved NEwards close to north-western parts of Britain. A slow moving associated cold front from Bristol Channel to the Wash. Active waves running along it affected parts of Wales and western areas with heavy rain in the south west.

g) 20 October

Positive surges of over a metre were recorded at both Heysham and Avonmouth.
Gusts of more than 50kts over southern counties and Wales including 63kts at Sheerness and 69kts at Portland Bill.

h) 28/29 October

A large positive surge at Avonmouth (maximum 1.973m at 1400GMT) with a negative surge occuring on southern East coast ports.
Levels at Avonmouth remained over or close to 1m above predicted from 1200GMT 28 to 0400GMT 29 October.

i) 4 November

1.031m at Avonmouth (0500GMT)
A complex low crossed northern parts of Britain from 1 to 5 November, with associated fronts crossing the SW in the early morning of the 4th.

j) 16 December

1.81m at Avonmouth
This storm caused much damage and flooding across southern Britain. The Class A gauge at St.Mary's Isles of Scilly was destroyed.

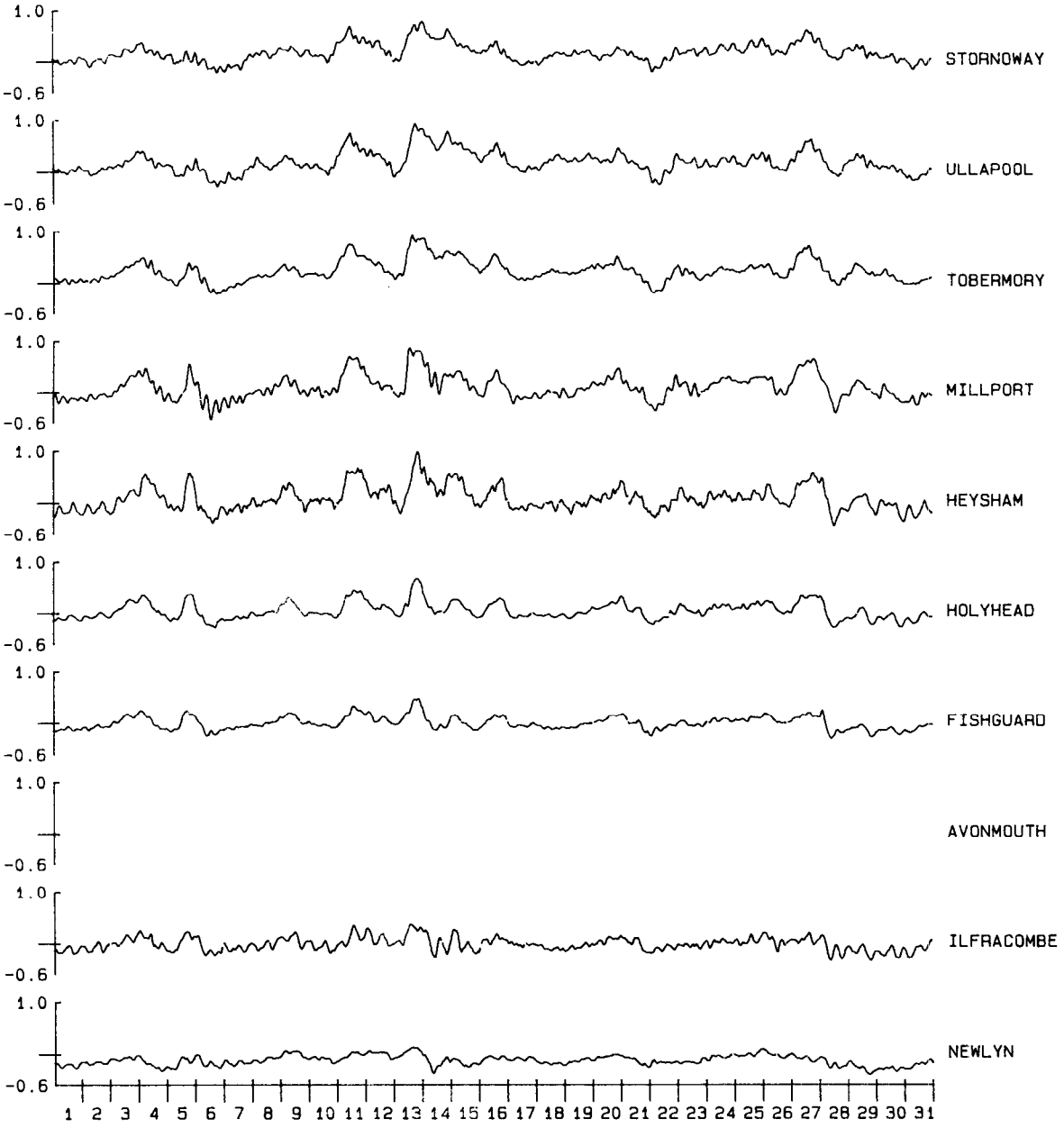
k) 21 December

2.026m at Avonmouth.
A deep depression (965mbs) tracked NE across Ireland and N.Scotland.Strong SWly winds affected the south west.
Gusts up to 64kts were reported at Mumbles.

HOURLY RESIDUALS JANUARY 1989

WEST COAST PORTS

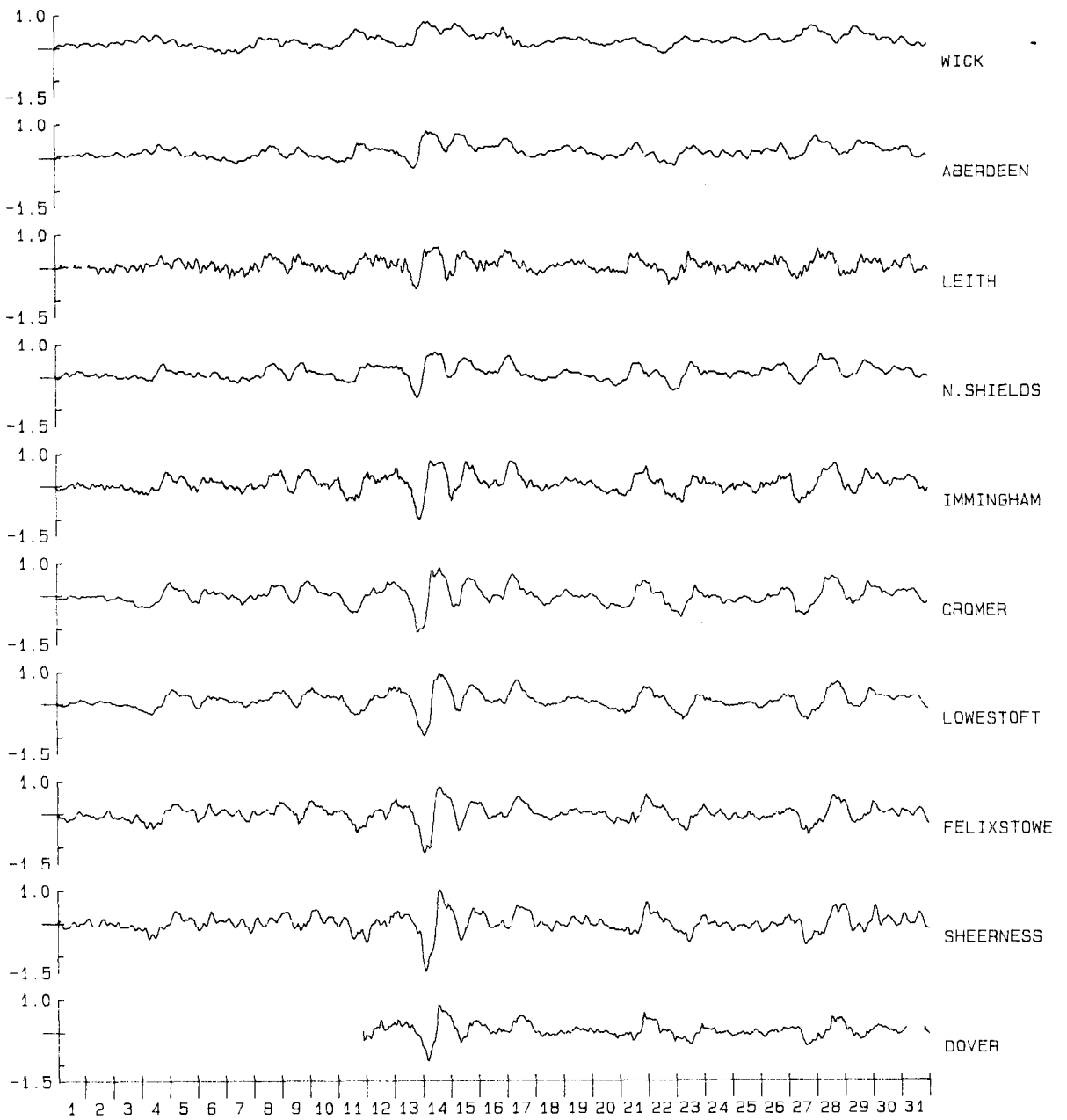
(METRES)



HOURLY RESIDUALS JANUARY 1989

EAST COAST PORTS

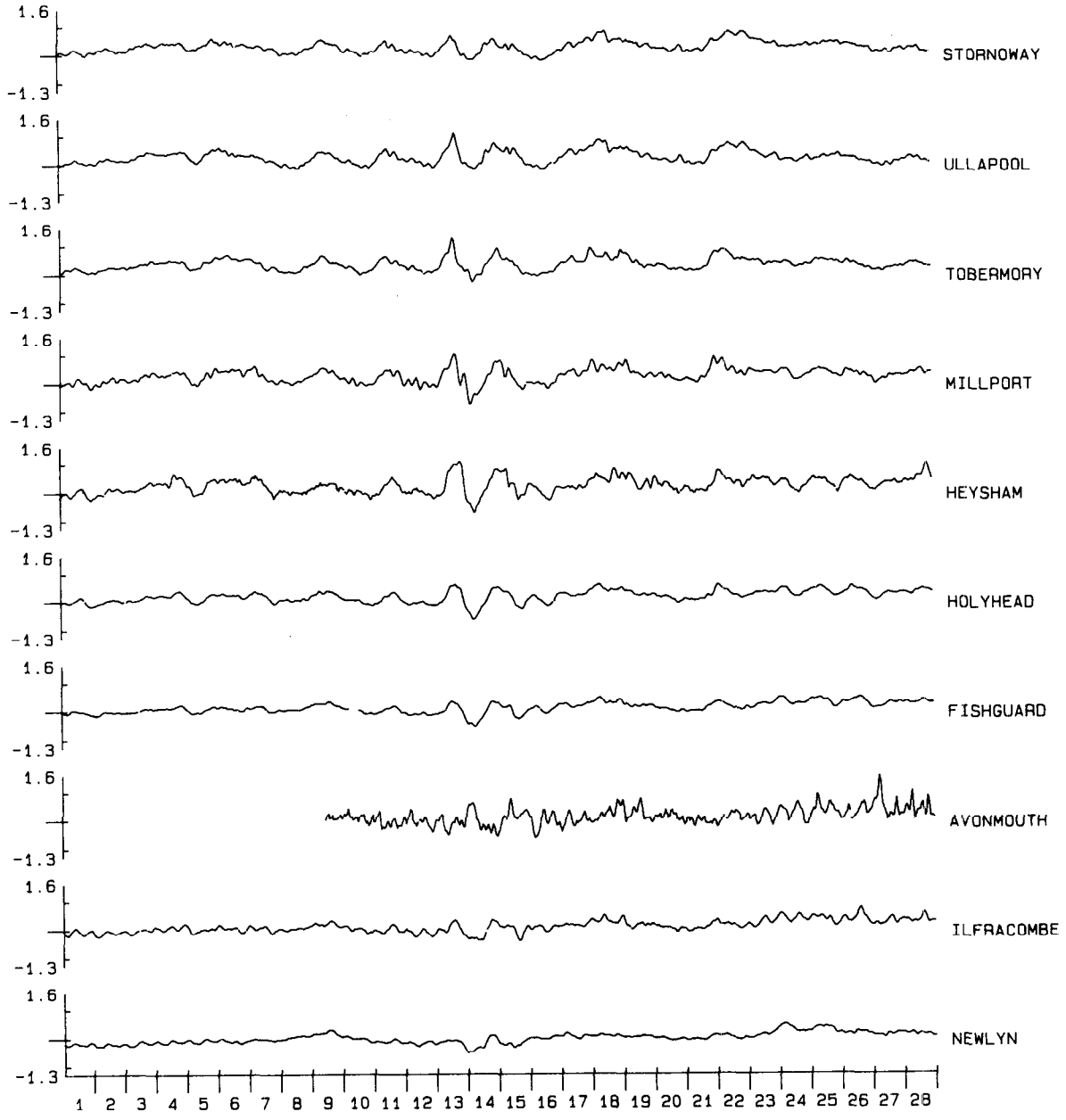
(METRES)



HOURLY RESIDUALS FEBRUARY 1989

WEST COAST PORTS

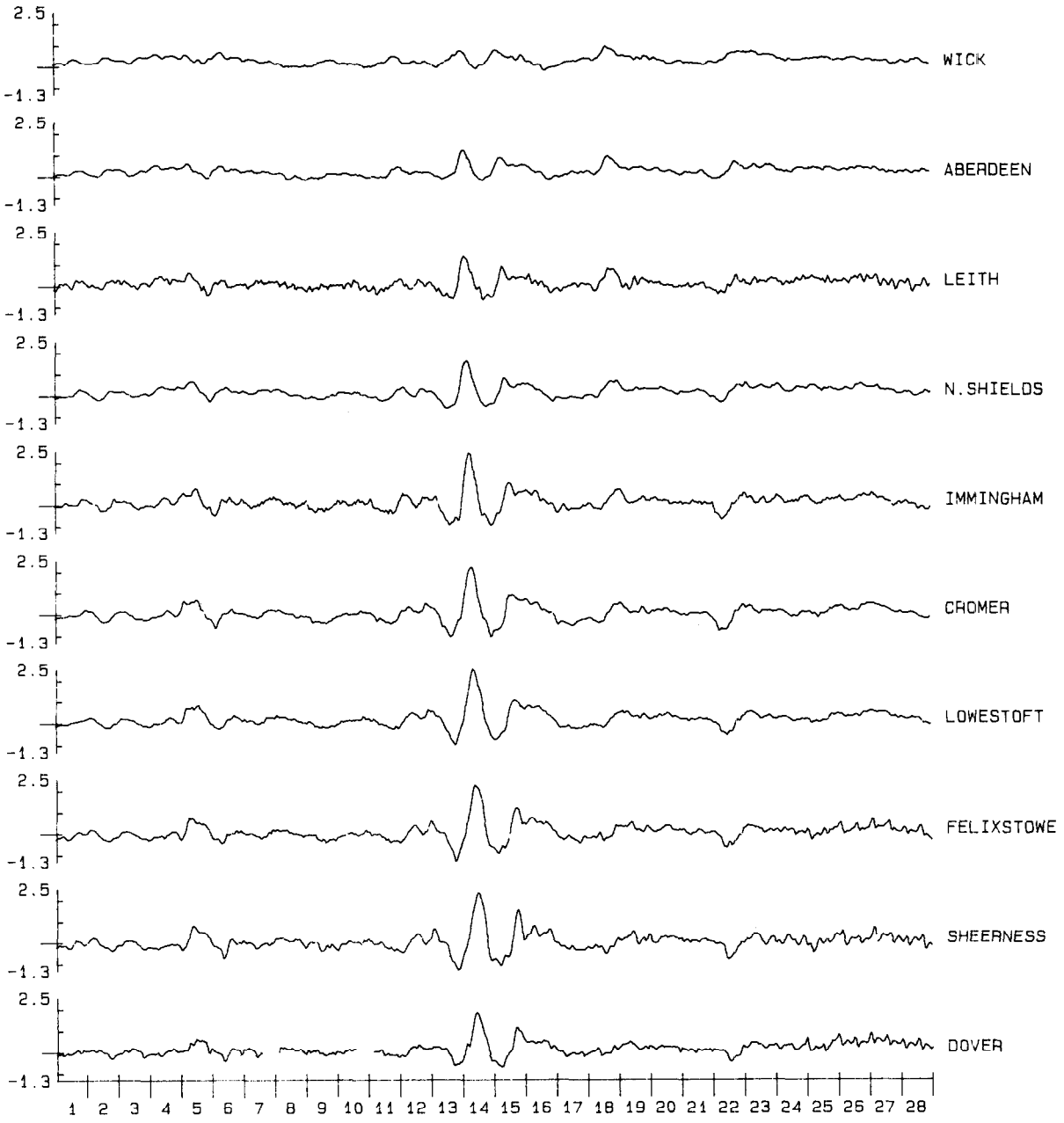
(METRES)



HOURLY RESIDUALS FEBRUARY 1989

EAST COAST PORTS

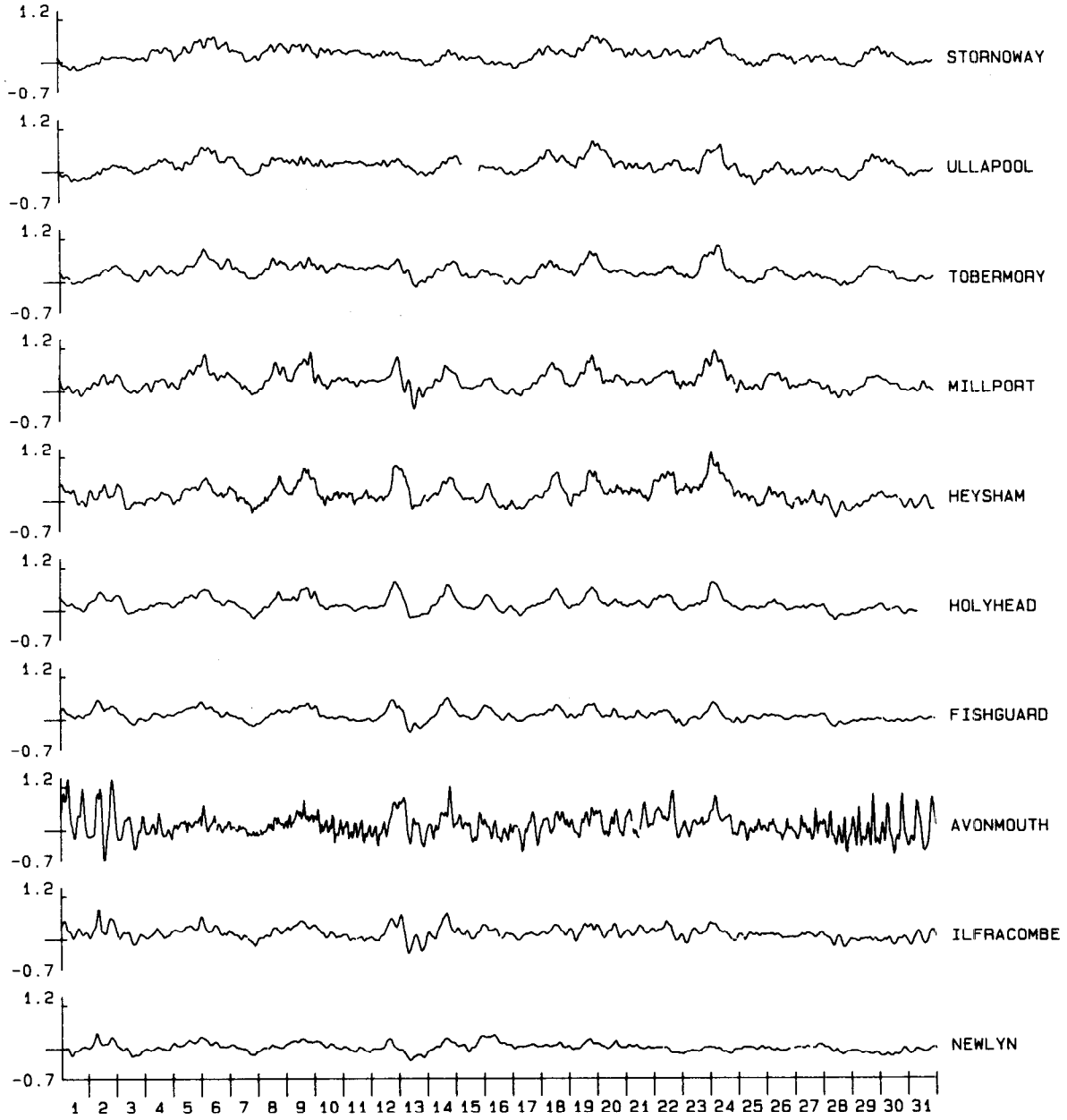
(METRES)



HOURLY RESIDUALS MARCH 1989

WEST COAST PORTS

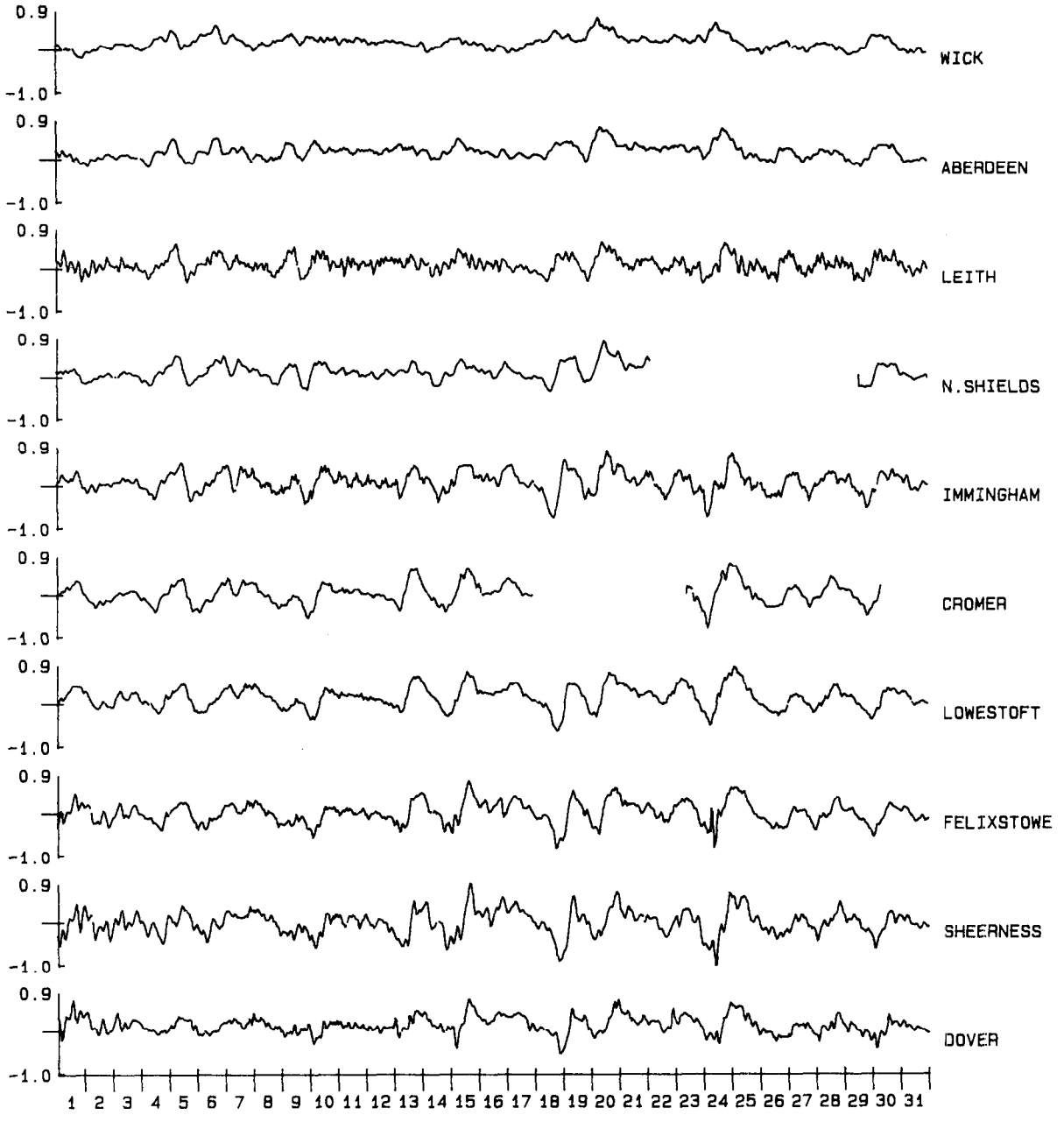
(METRES)



HOURLY RESIDUALS MARCH 1989

EAST COAST PORTS

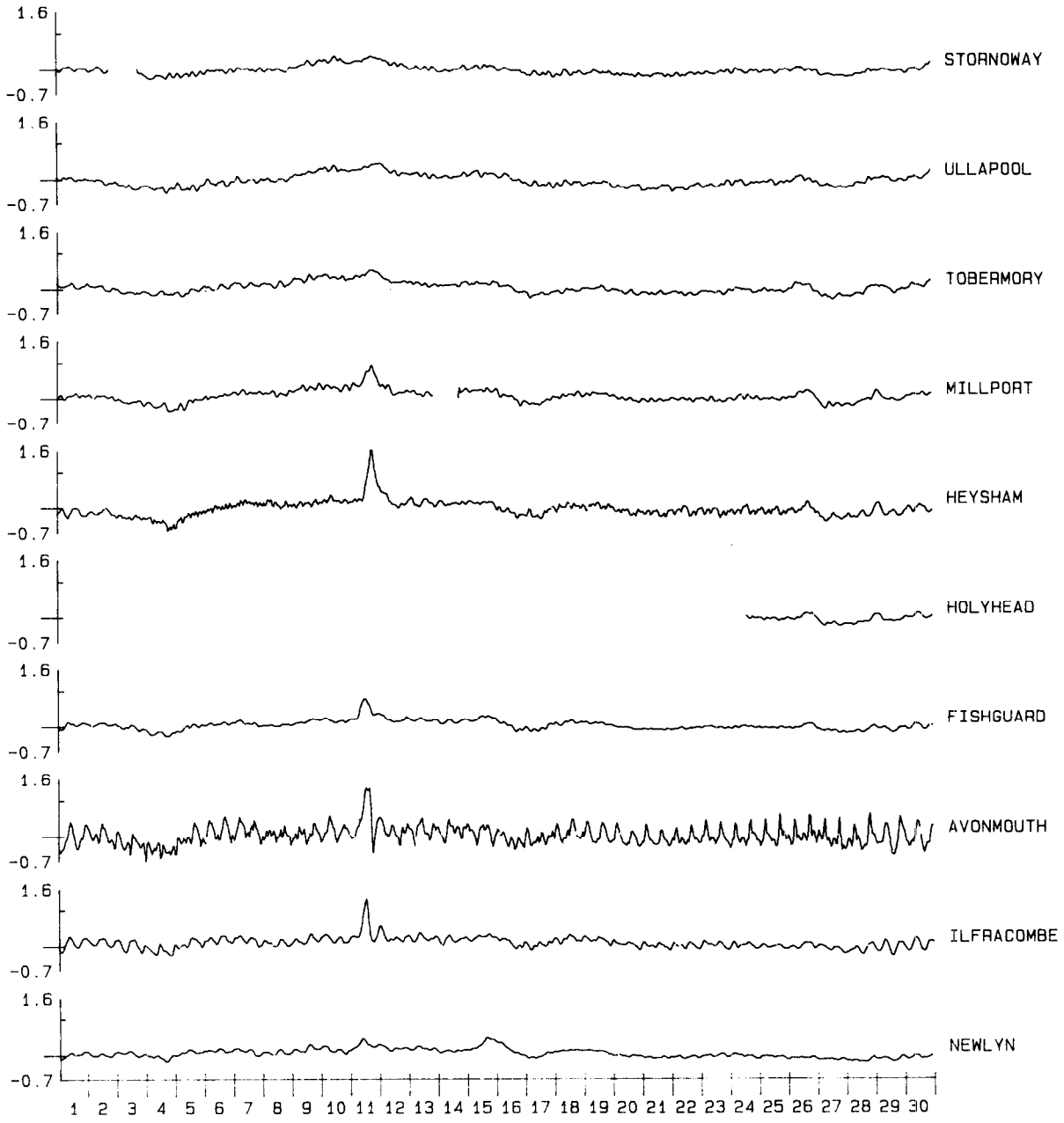
(METRES)



HOURLY RESIDUALS APRIL 1989

WEST COAST PORTS

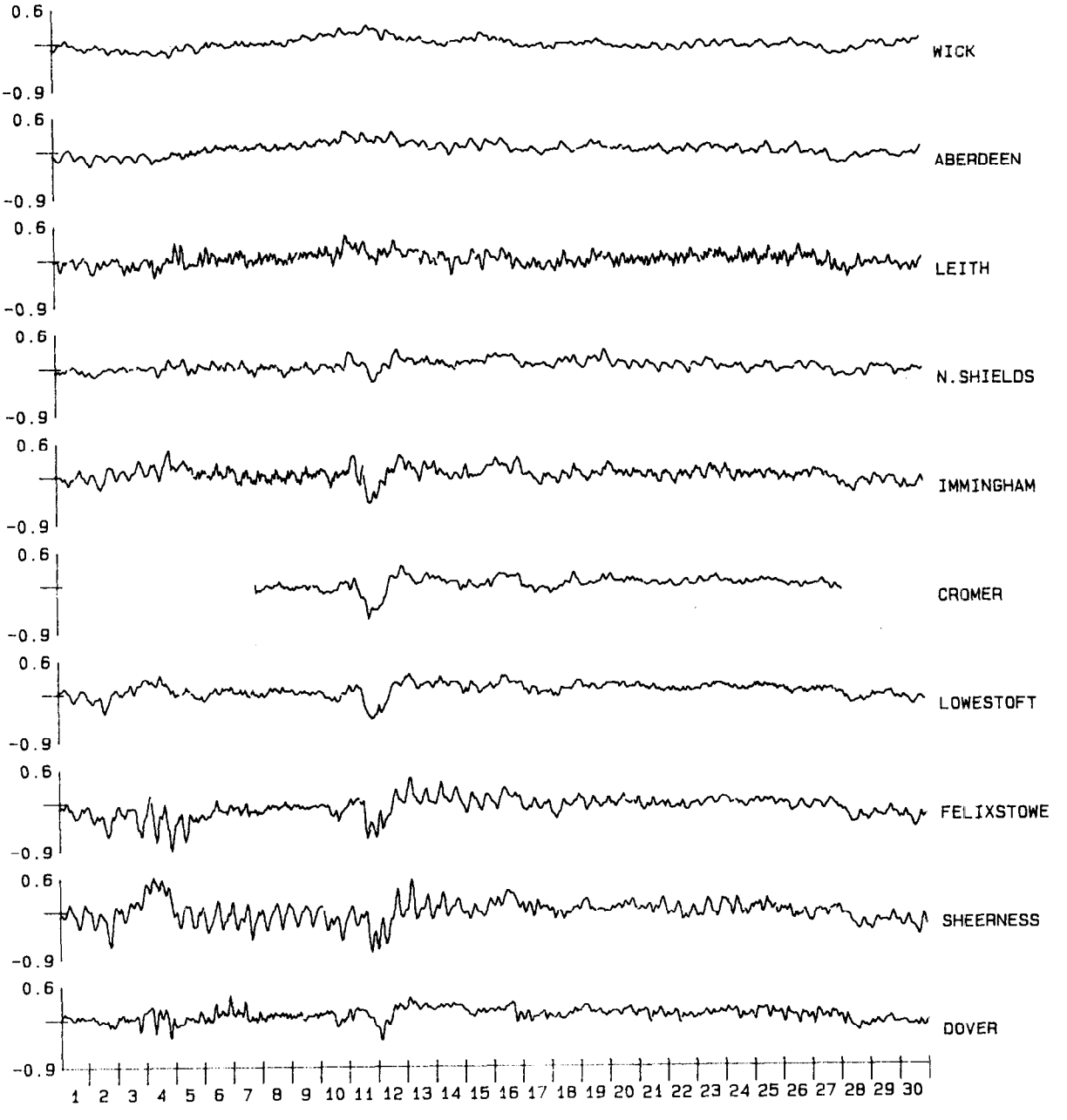
(METRES)



HOURLY RESIDUALS APRIL 1989

EAST COAST PORTS

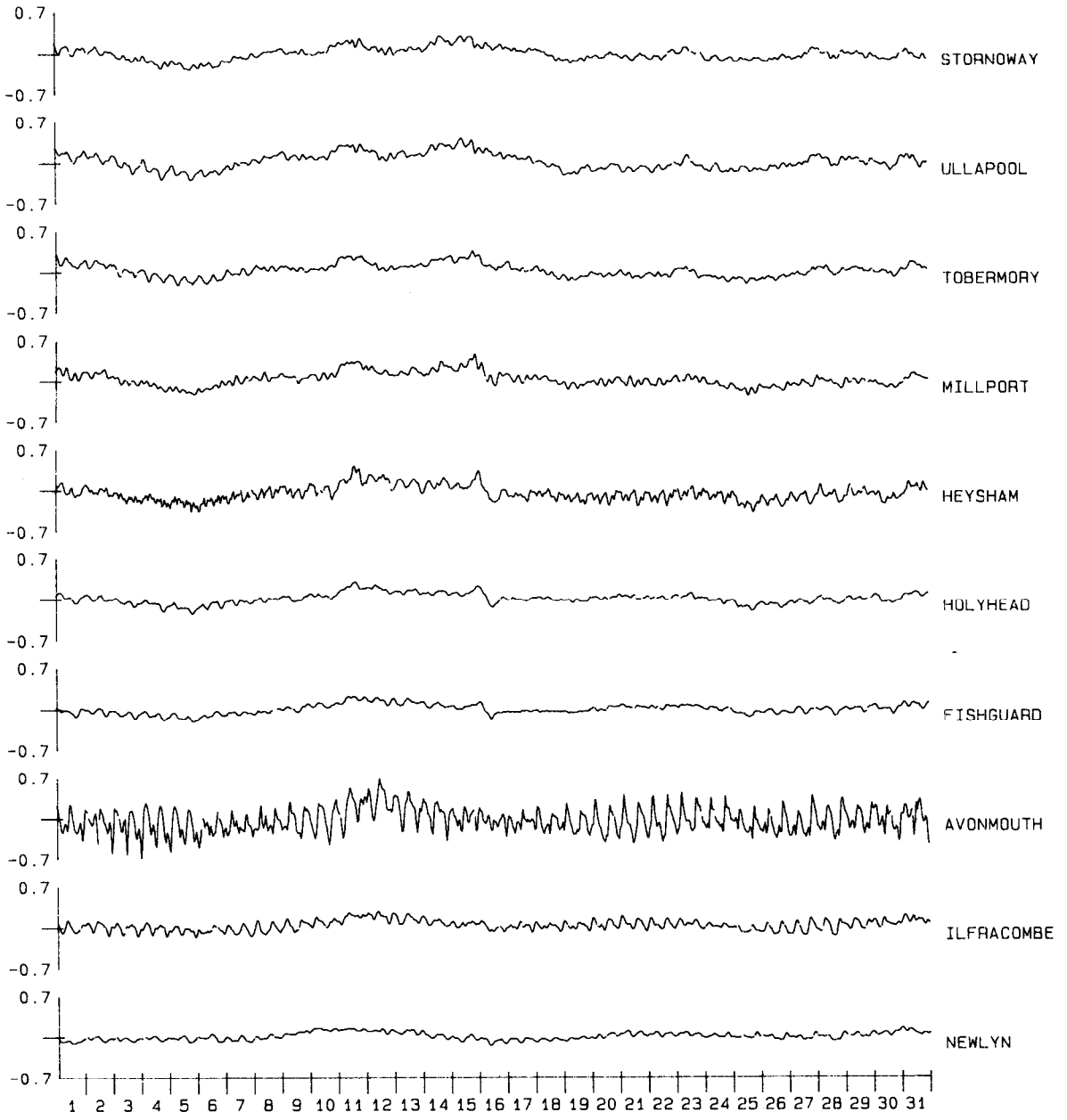
(METRES)



HOURLY RESIDUALS MAY 1989

WEST COAST PORTS

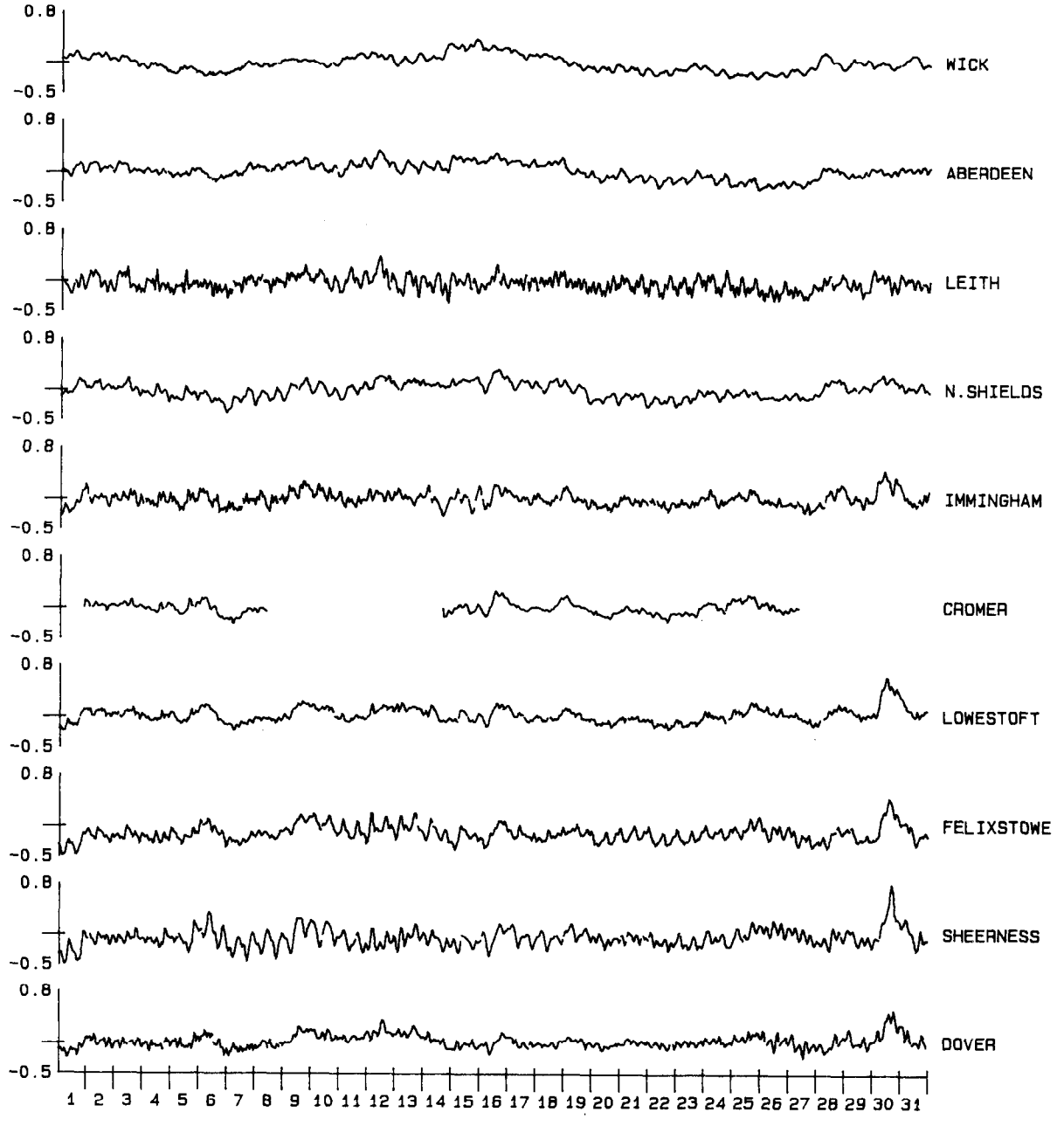
(METRES)



HOURLY RESIDUALS MAY 1989

EAST COAST PORTS

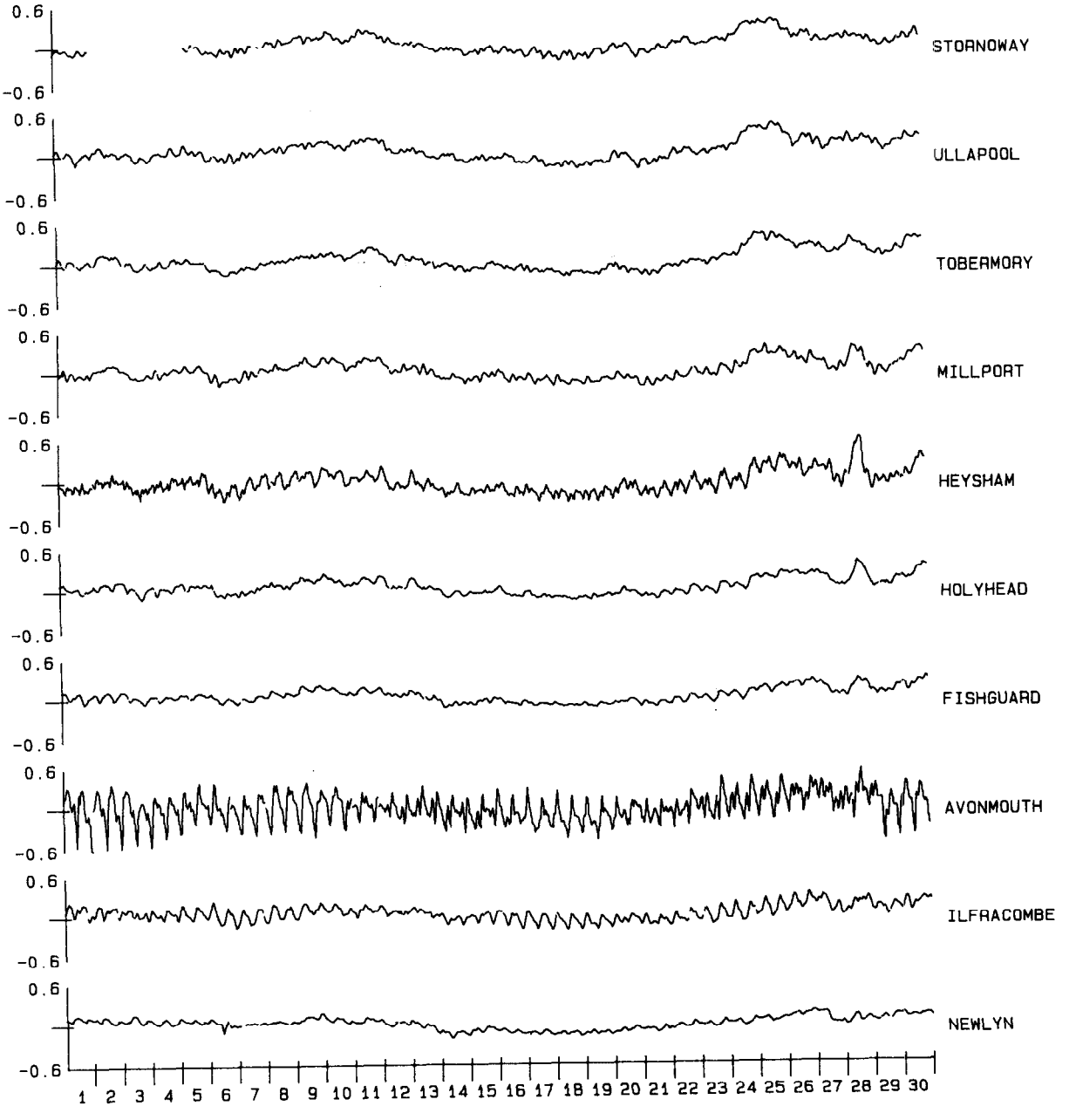
(METRES)



HOURLY RESIDUALS JUNE 1989

WEST COAST PORTS

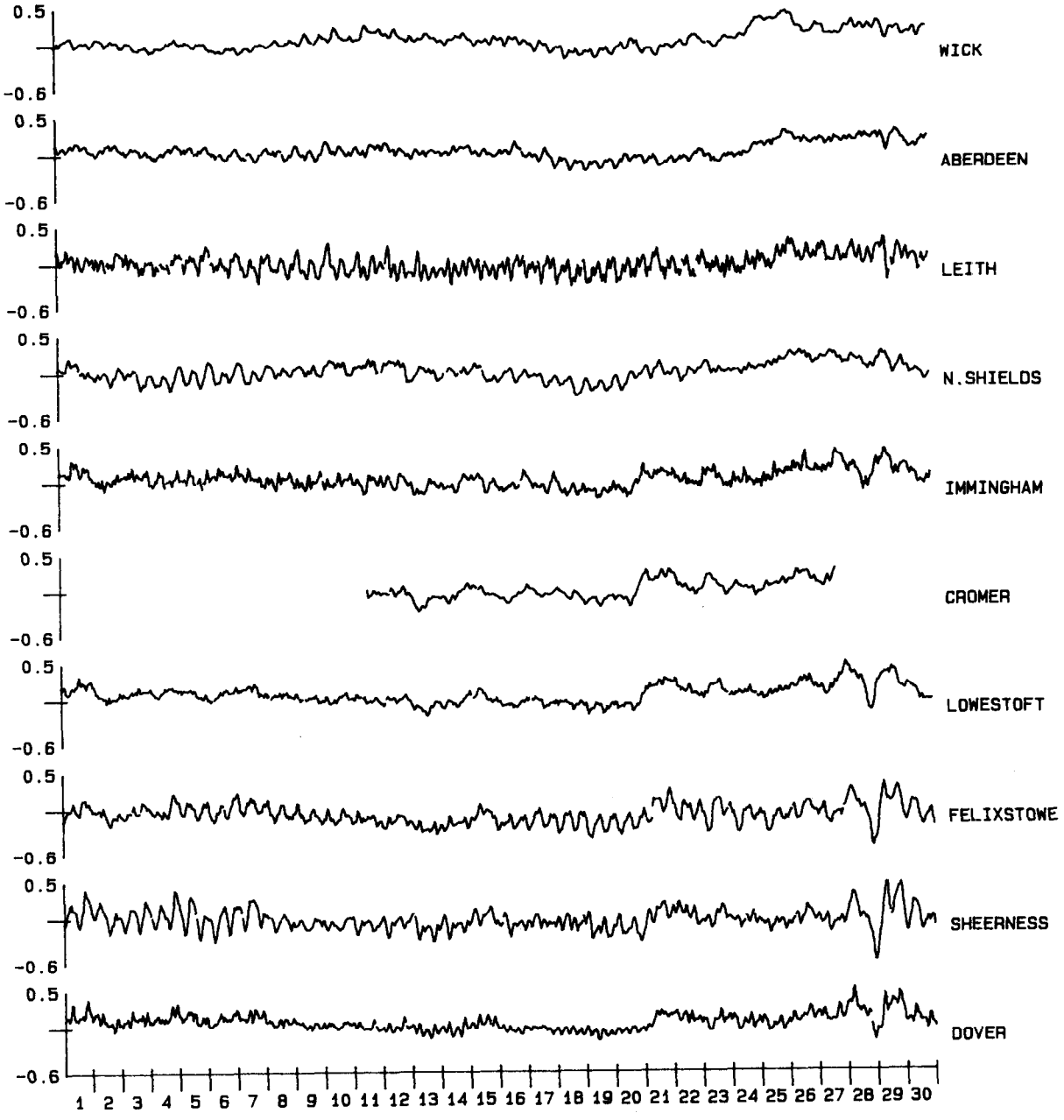
(METRES)



HOURLY RESIDUALS JUNE 1989

EAST COAST PORTS

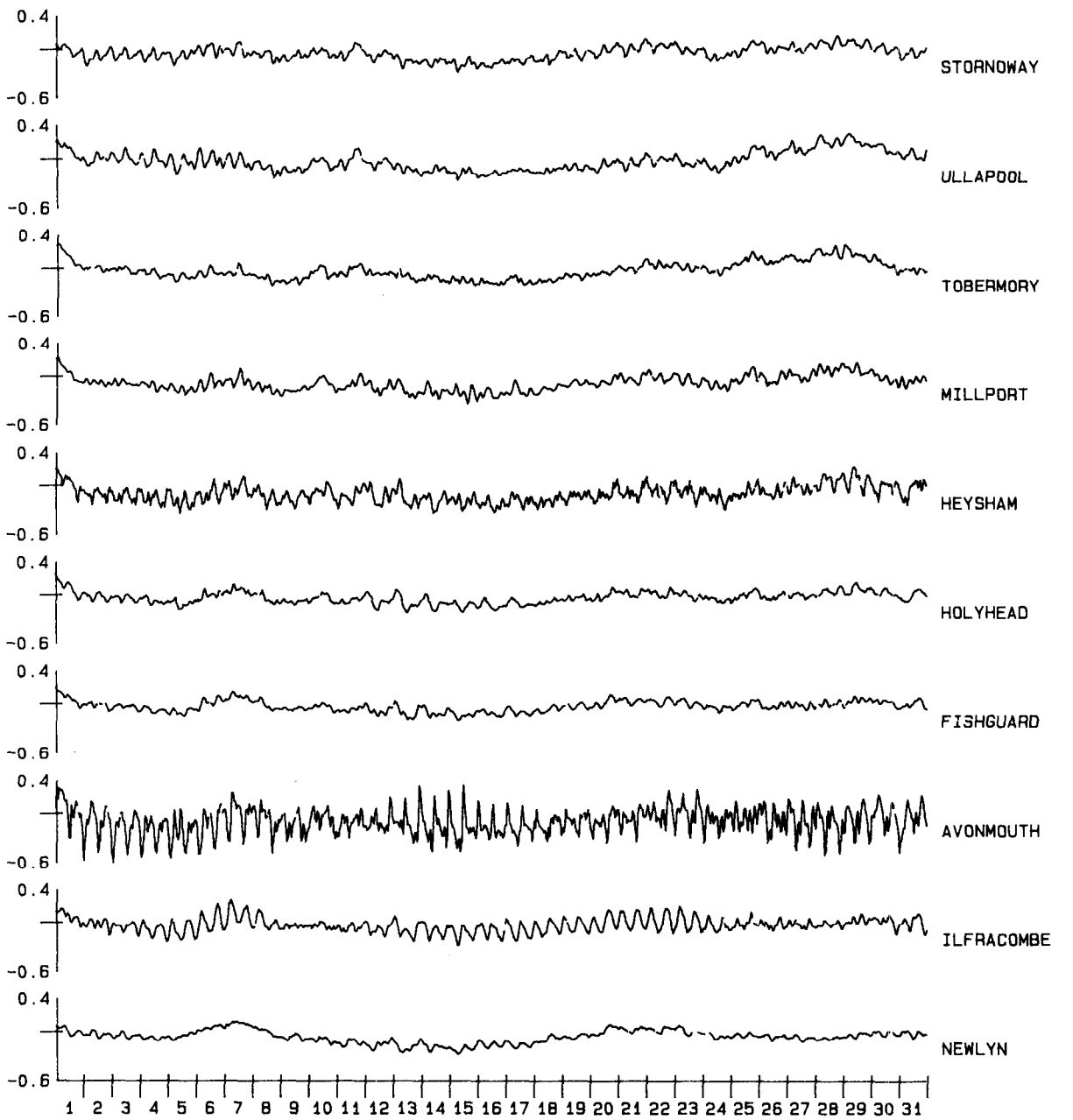
(METRES)



HOURLY RESIDUALS JULY 1989

WEST COAST PORTS

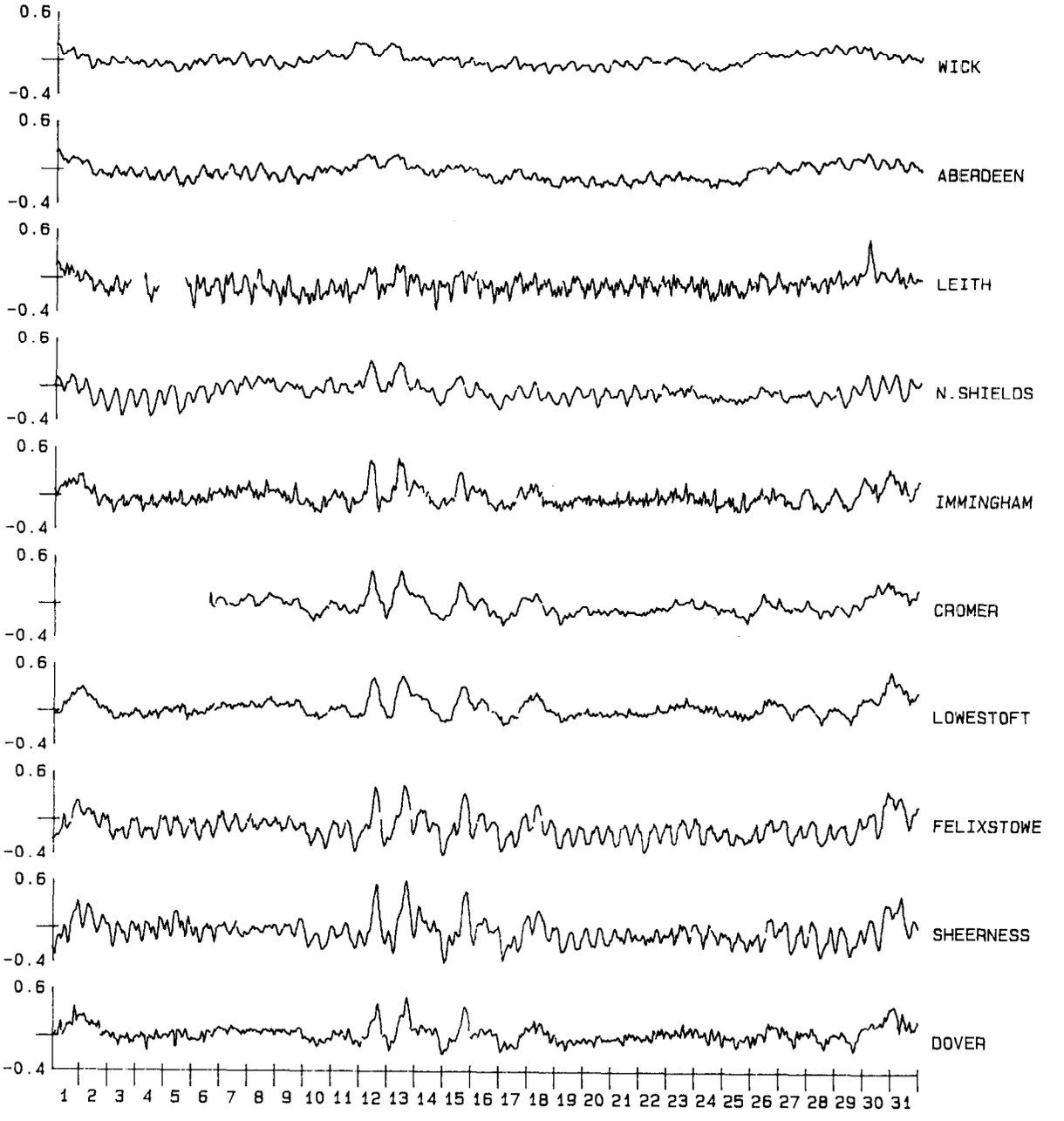
(METRES)



HOURLY RESIDUALS JULY 1989

EAST COAST PORTS

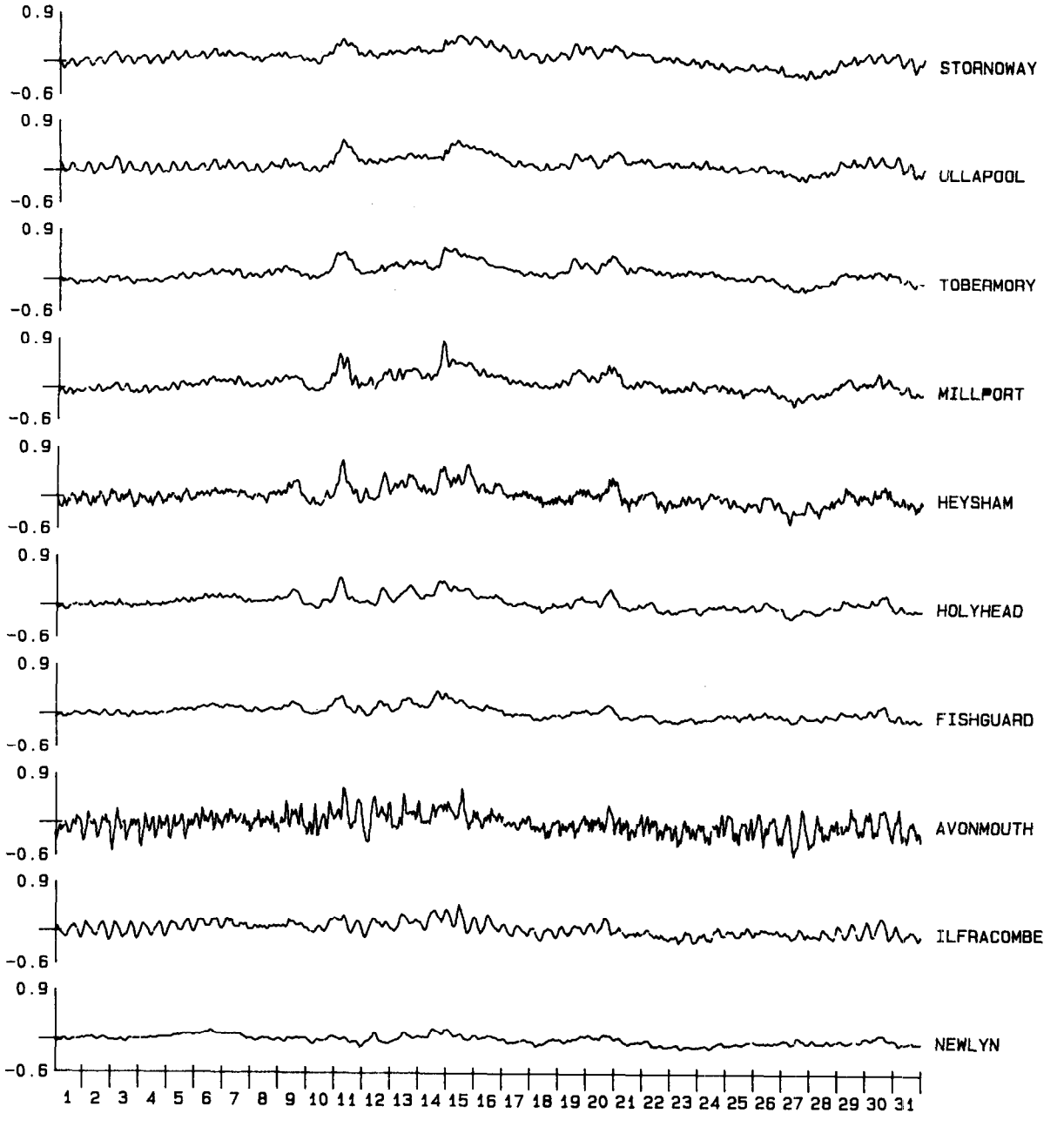
(METRES)



HOURLY RESIDUALS AUGUST 1989

WEST COAST PORTS

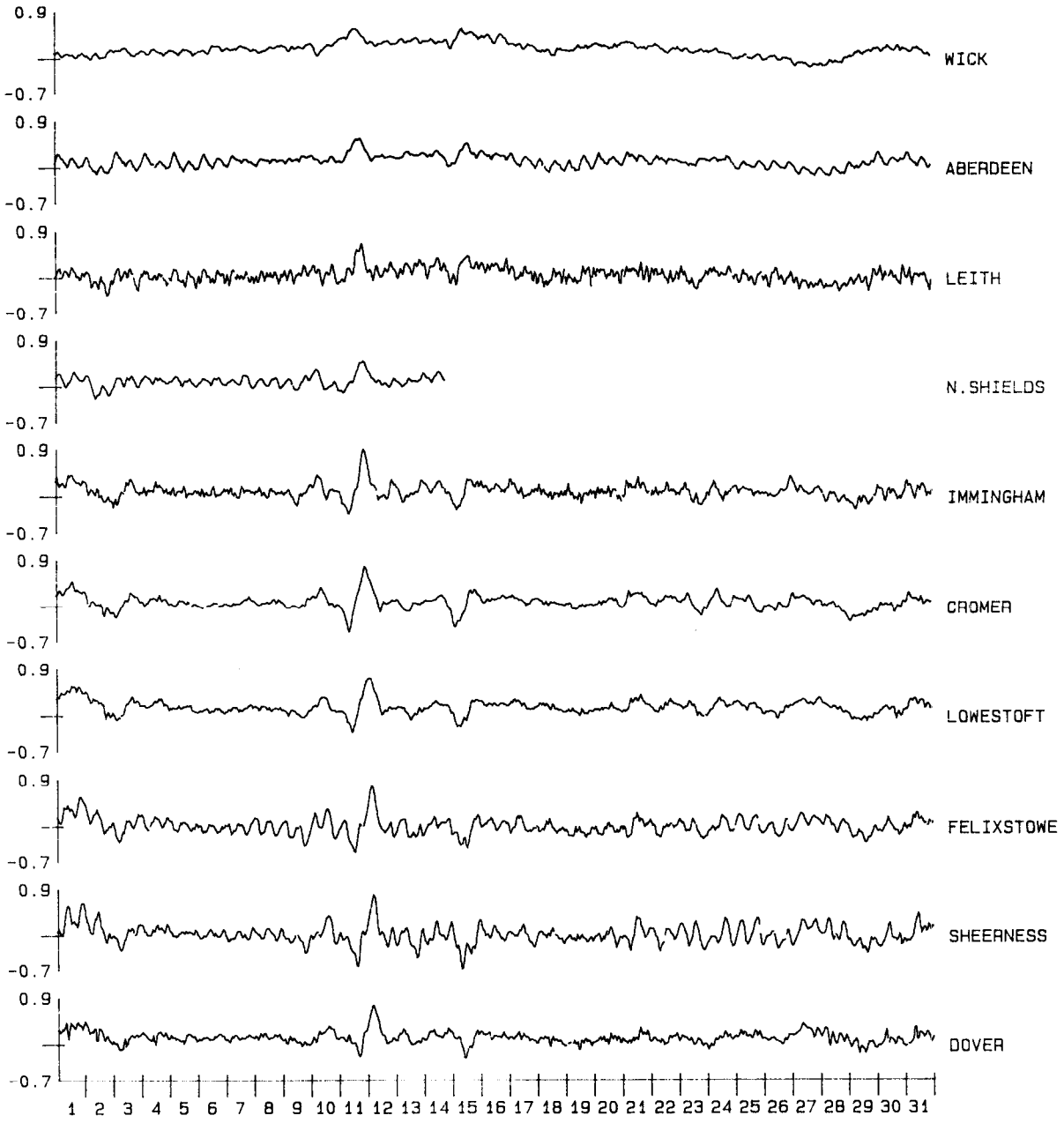
(METRES)



HOURLY RESIDUALS AUGUST 1989

EAST COAST PORTS

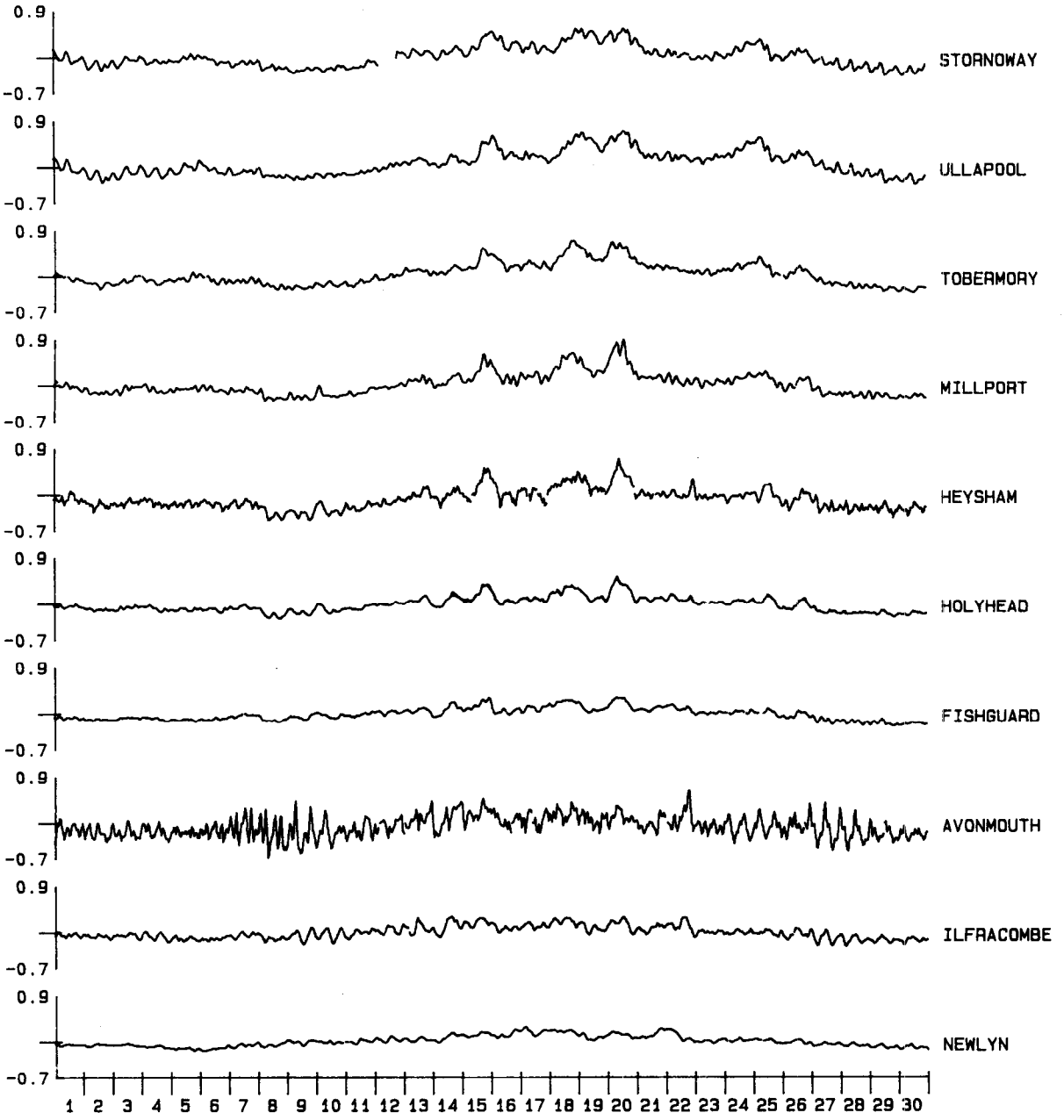
(METRES)



HOURLY RESIDUALS SEPTEMBER 1989

WEST COAST PORTS

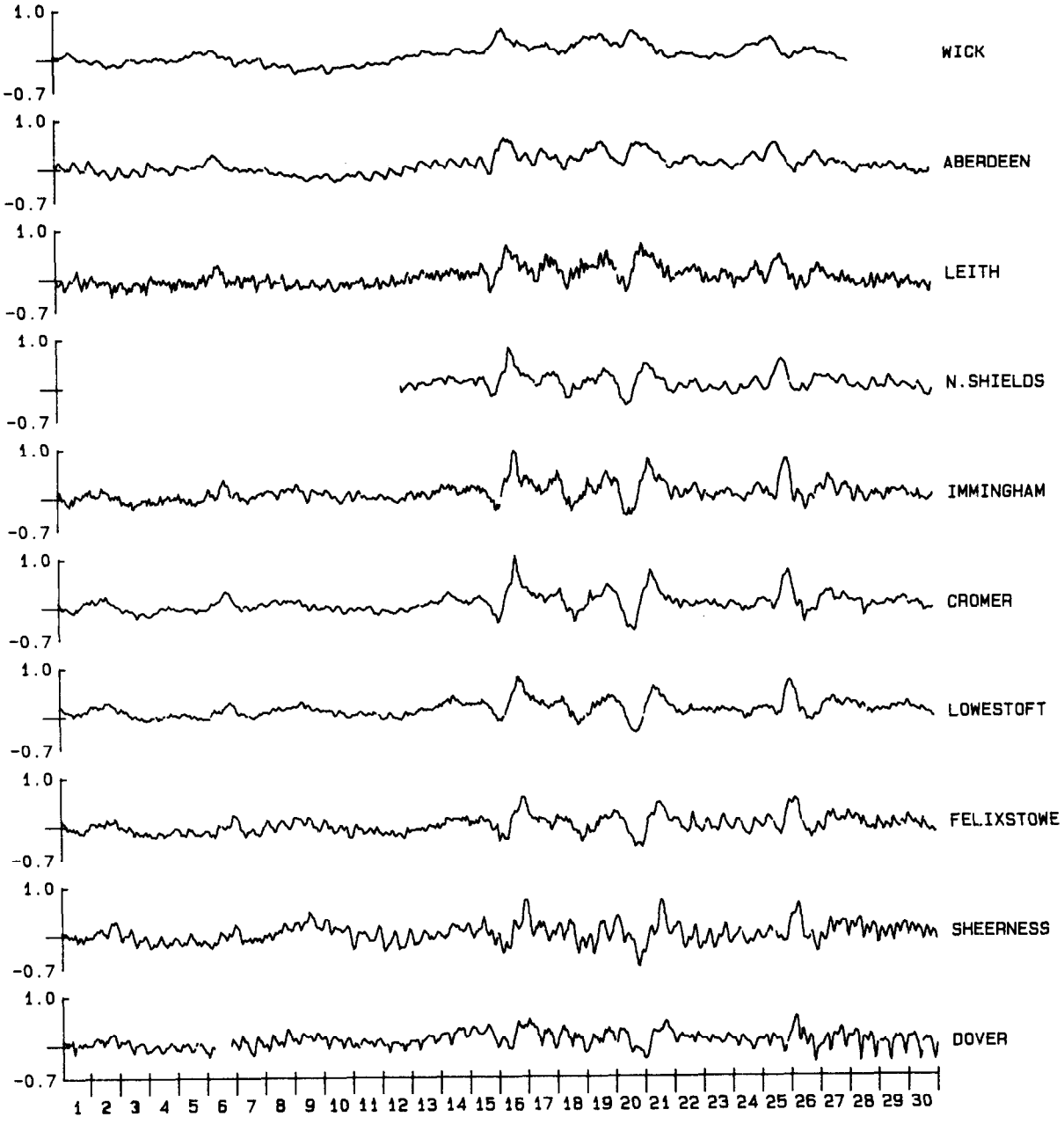
(METRES)



HOURLY RESIDUALS SEPTEMBER 1989

EAST COAST PORTS

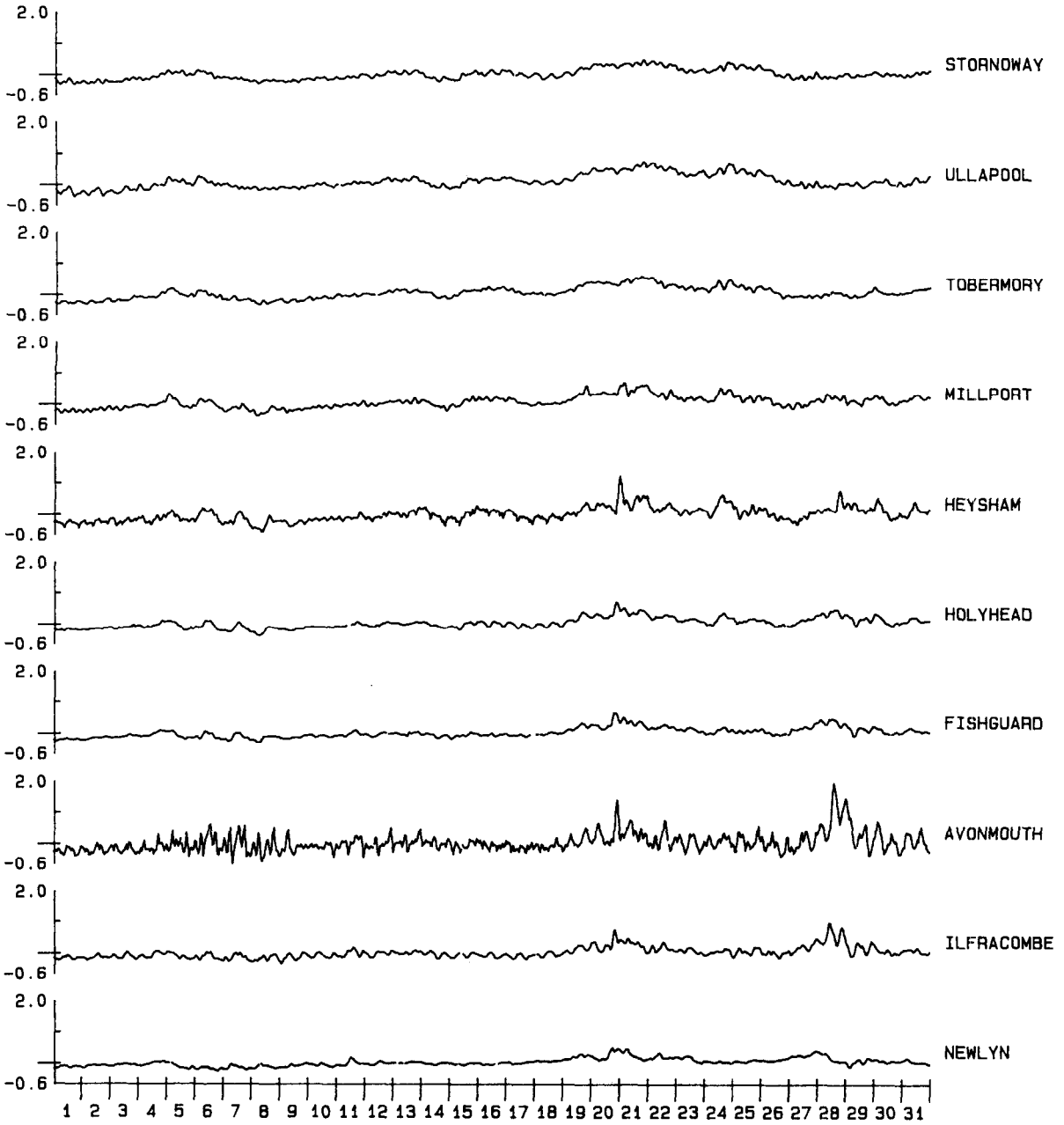
(METRES)



HOURLY RESIDUALS OCTOBER 1989

WEST COAST PORTS

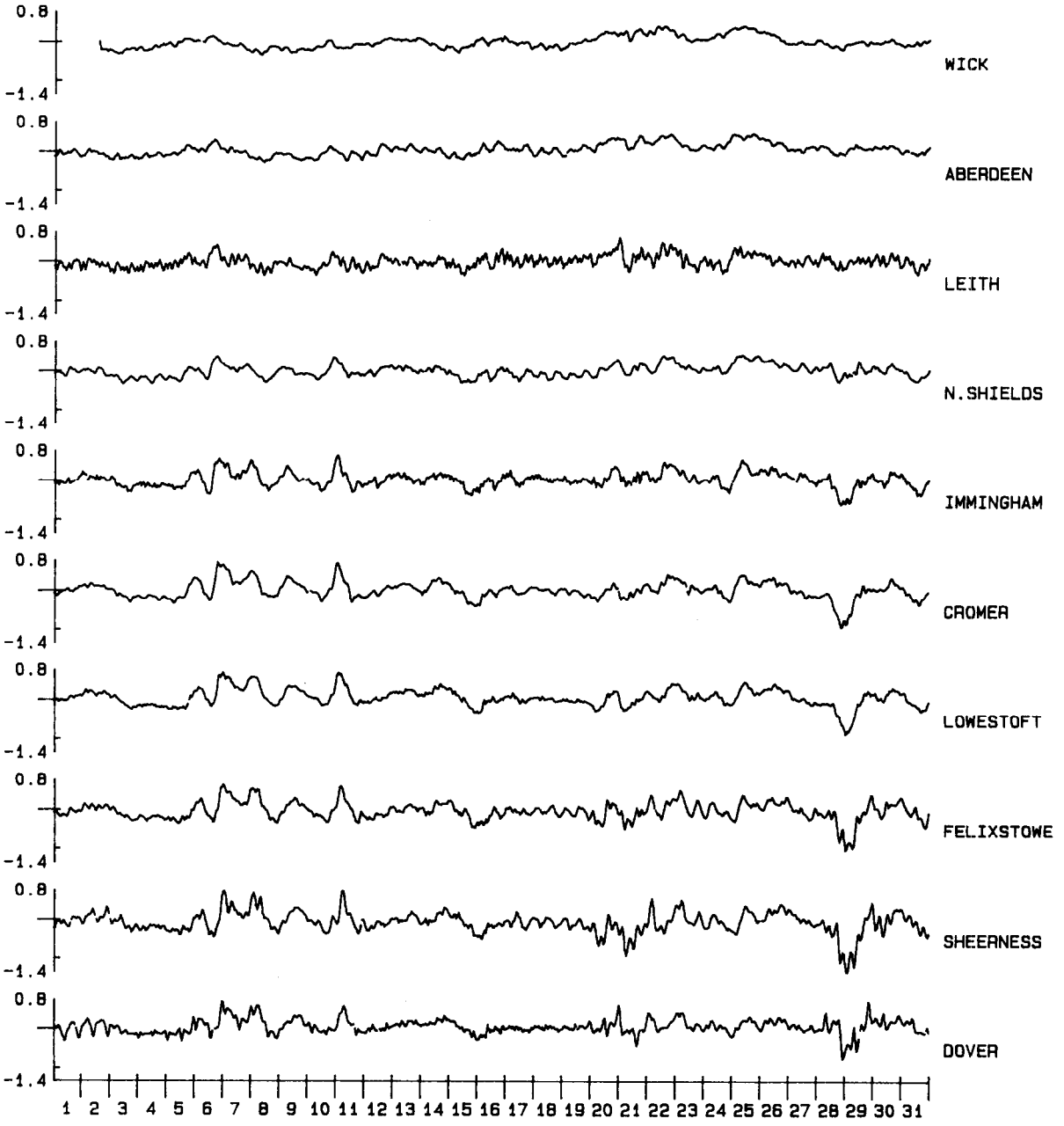
(METRES)



HOURLY RESIDUALS OCTOBER 1989

EAST COAST PORTS

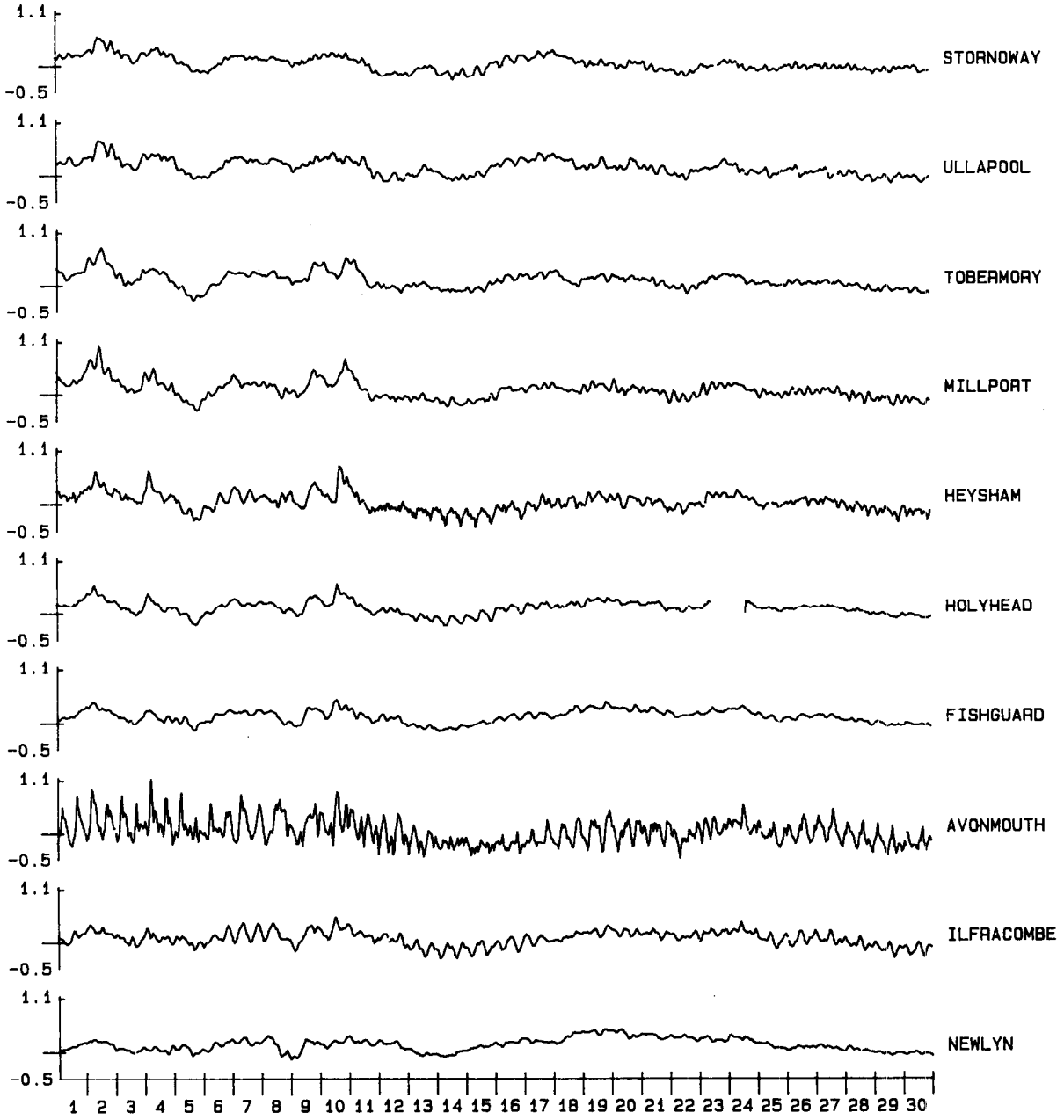
(METRES)



HOURLY RESIDUALS NOVEMBER 1989

WEST COAST PORTS

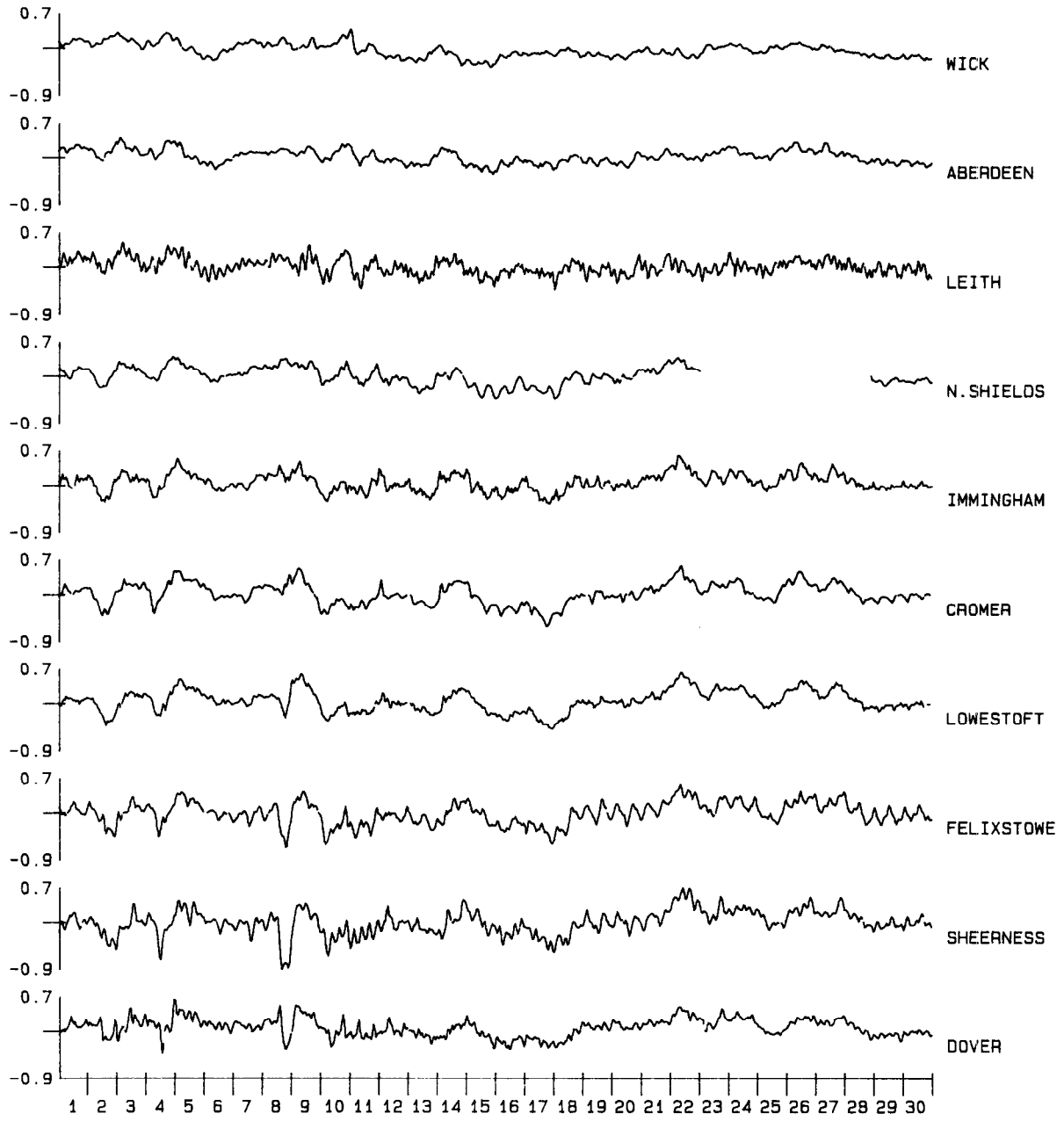
(METRES)



HOURLY RESIDUALS NOVEMBER 1989

EAST COAST PORTS

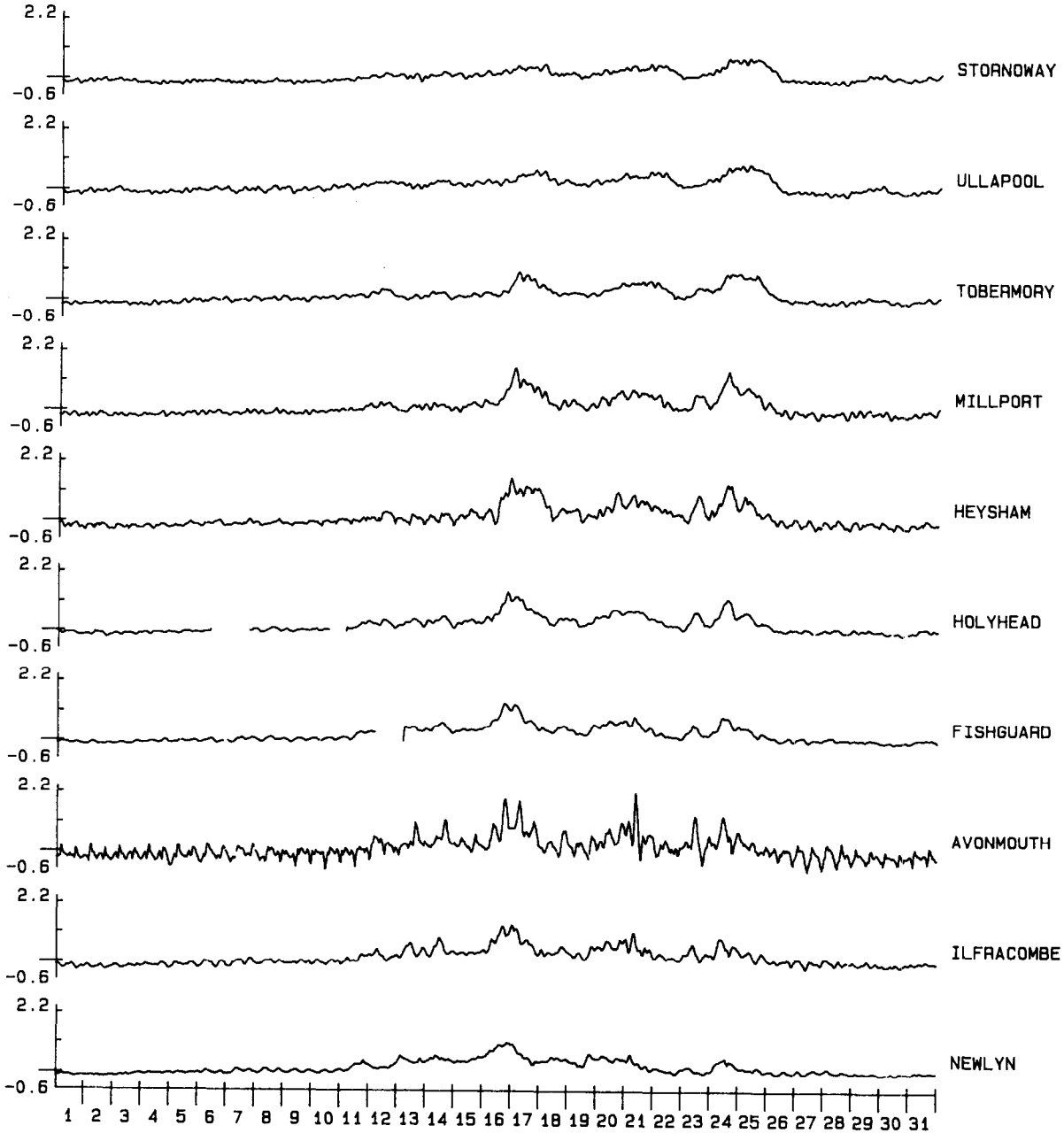
(METRES)



HOURLY RESIDUALS DECEMBER 1989

WEST COAST PORTS

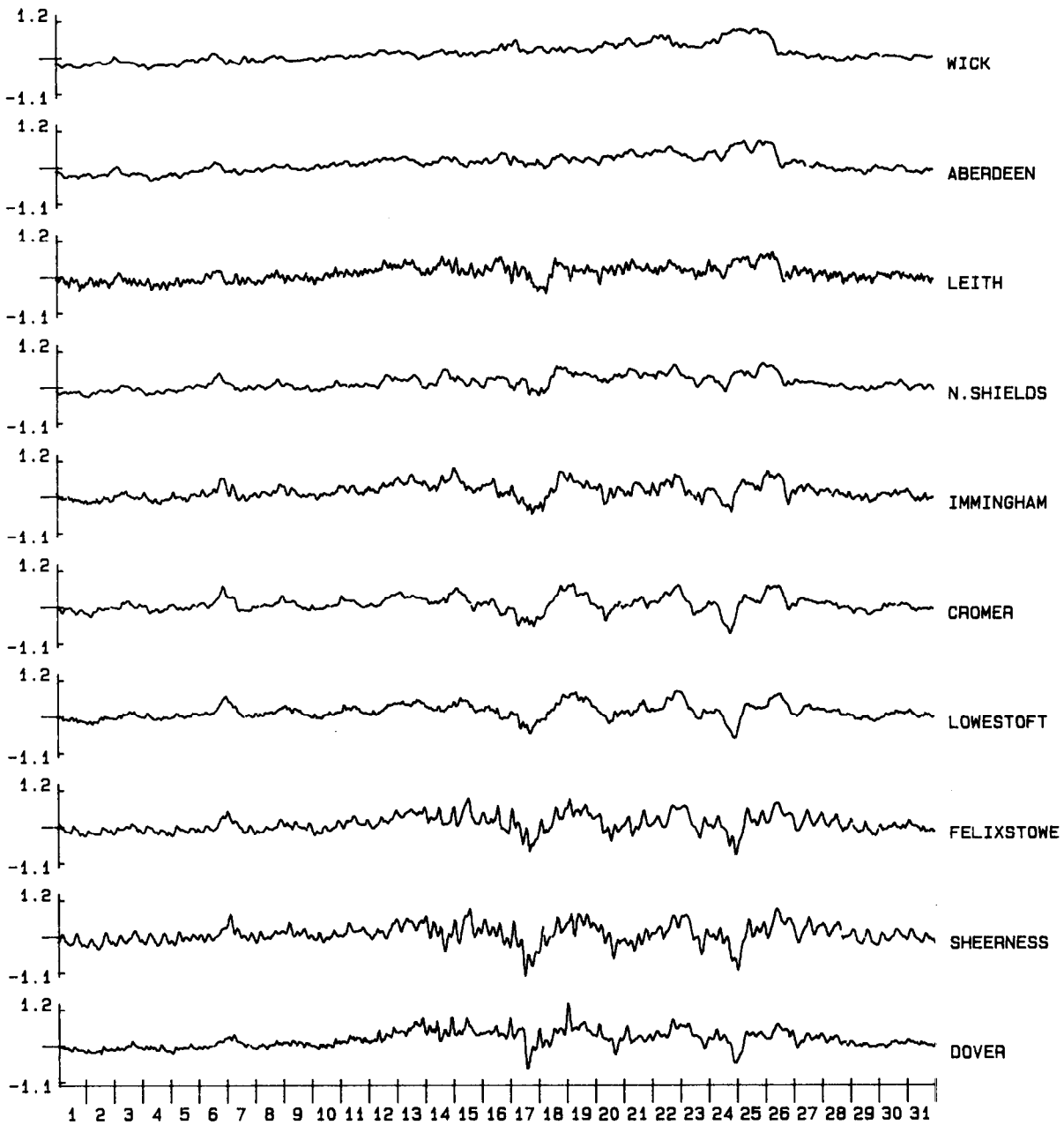
(METRES)



HOURLY RESIDUALS DECEMBER 1989

EAST COAST PORTS

(METRES)



RESIDUAL STATISTICS 1989

WEST COAST PORTS
(metres)

PORT	STAT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
STORNOWAY	MEAN	.168	.243	.136	-.045	-.020	.001	-.043	.120	.015	.035	.029	.130	.064
	MAX	.783	.806	.589	.363	.294	.335	.187	.532	.571	.496	.530	.765	.806
	MIN	-.221	-.242	-.186	-.272	-.295	-.259	-.280	-.252	-.381	-.324	-.278	-.231	-.381
	S.D.	.180	.198	.163	.134	.113	.121	.086	.147	.213	.181	.144	.226	.164
ULLAPOOL	MEAN	.182	.218	.113	-.057	.012	.027	-.021	.148	.071	.137	.135	.187	.095
	MAX	.928	1.083	.692	.432	.408	.401	.323	.583	.733	.775	.643	.920	1.083
	MIN	-.287	-.207	-.342	-.390	-.306	-.258	-.256	-.142	-.358	-.378	-.167	-.218	-.390
	S.D.	.208	.223	.174	.172	.140	.132	.116	.136	.237	.236	.155	.246	.186
TOBERMORY	MEAN	.224	.319	.225	.018	.012	.025	-.021	.146	.037	.080	.085	.196	.112
	MAX	.930	1.246	.823	.516	.347	.384	.300	.601	.727	.632	.719	.992	1.246
	MIN	-.228	-.295	-.139	-.329	-.227	-.231	-.210	-.179	-.340	-.320	-.282	-.231	-.340
	S.D.	.204	.207	.176	.160	.115	.136	.109	.148	.226	.208	.155	.272	.182
MILLPORT	MEAN	.088	.227	.217	.043	.017	-.007	-.078	.111	.017	.091	.062	.139	.077
	MAX	.868	1.013	.914	.906	.471	.332	.228	.884	.930	.729	.913	1.483	1.483
	MIN	-.552	-.775	-.444	-.369	-.264	-.264	-.333	-.292	-.315	-.380	-.304	-.280	-.775
	S.D.	.230	.236	.209	.176	.125	.127	.095	.160	.225	.208	.177	.321	.199
HEYSHAM	MEAN	.071	.218	.144	-.054	-.067	-.053	-.100	.035	-.102	.018	.013	.152	.022
	MAX	.988	1.083	1.088	1.599	.417	.581	.244	.672	.724	1.236	.697	1.461	1.599
	MIN	-.447	-.741	-.433	-.641	-.399	-.351	-.340	-.456	-.519	-.571	-.440	-.349	-.741
	S.D.	.227	.264	.235	.226	.131	.144	.103	.158	.204	.244	.170	.357	.216
HOLYHEAD	MEAN	.039	.147	.132	-.086	-.001	.014	-.033	.068	-.022	.055	.095	.235	.062
	MAX	.680	.571	.650	.097	.289	.355	.263	.510	.545	.726	.547	1.362	1.362
	MIN	-.289	-.656	-.252	-.268	-.257	-.191	-.220	-.198	-.309	.381	-.241	-.231	-.656
	S.D.	.164	.192	.166	.092	.092	.109	.073	.119	.153	.187	.133	.306	.163
FISHGUARD	MEAN	-.011	.080	.079	.022	-.011	.010	-.030	.051	-.019	.041	.110	.236	.046
	MAX	.473	.457	.493	.772	.210	.263	.196	.428	.317	.679	.434	1.289	1.289
	MIN	-.312	-.590	-.304	-.284	-.222	-.171	-.202	-.132	-.261	-.299	-.169	-.164	-.590
	S.D.	.128	.170	.136	.142	.080	.096	.067	.102	.127	.170	.122	.287	.146
AVONMOUTH	MEAN		.122	.092	-.005	-.043	-.034	-.098	.004	-.078	.048	.013	.136	.011
	MAX		1.531	1.175	1.321	.685	.498	.352	.659	.650	1.973	1.032	2.026	2.025
	MIN		-.655	-.694	-.687	-.692	-.617	-.600	-.557	-.721	-.646	-.495	-.584	-.722
	S.D.		.297	.277	.259	.206	.196	.164	.177	.211	.311	.239	.382	.254
ILFRACOMBE	MEAN	-.021	.090	.122	.076	.023	.016	-.029	.059	-.006	.036	.061	.177	.050
	MAX	.366	.755	.691	1.289	.264	.291	.280	.505	.323	1.002	.460	1.264	1.289
	MIN	-.349	-.434	-.341	-.295	-.168	-.254	-.283	-.192	-.281	-.327	-.312	-.297	-.434
	S.D.	.128	.189	.150	.162	.085	.110	.091	.117	.128	.188	.139	.302	.159
NEWLYN	MEAN	-.120	-.022	.013	.039	-.001	-.020	-.062	.011	.009	.045	.126	.188	.017
	MAX	.125	.470	.359	.479	.144	.157	.122	.219	.298	.505	.413	1.015	1.015
	MIN	-.395	-.539	-.288	-.209	-.165	-.227	-.279	-.150	-.188	-.246	-.131	-.159	-.539
	S.D.	.097	.162	.107	.131	.061	.093	.080	.065	.107	.138	.120	.241	.126

RESIDUAL STATISTICS 1989

EAST COAST PORTS
(metres)

PORT	STAT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
WICK	MEAN	.198	.274	.148	-.054	.007	.044	.028	.160	.043	.012	-.038	.111	.078
	MAX	.775	.944	.730	.302	.378	.395	.255	.554	.576	.438	.360	.778	.944
	MIN	-.204	-.219	-.193	-.296	-.219	-.220	-.152	-.187	-.332	-.325	-.366	-.318	-.366
	S.D.	.179	.194	.157	.108	.122	.114	.091	.136	.175	.166	.132	.236	.156
ABERDEEN	MEAN	.140	.222	.150	-.003	.026	.019	-.019	.107	.034	.061	.019	.093	.070
	MAX	.759	1.177	.718	.350	.337	.274	.263	.537	.571	.488	.384	.710	1.177
	MIN	-.339	-.242	-.229	-.309	-.254	-.257	-.225	-.176	-.300	-.267	-.335	-.381	-.381
	S.D.	.185	.220	.165	.121	.114	.102	.108	.114	.174	.161	.130	.223	.157
LEITH	MEAN	.024	.094	.070	-.026	-.026	-.029	-.069	.037	-.018	.003	-.001	.079	.011
	MAX	.593	1.353	.589	.435	.375	.287	.536	.637	.647	.642	.480	.663	1.353
	MIN	-.673	-.697	-.393	-.380	-.333	-.330	-.397	-.335	-.380	-.347	-.430	-.450	-.697
	S.D.	.203	.259	.180	.121	.105	.116	.119	.133	.183	.157	.148	.202	.166
N.SHIELDS	MEAN	.082	.160	.110	-.001	.004	-.008	-.055	.095	.048	.014	-.003	.108	.043
	MAX	.724	1.607	.829	.324	.320	.238	.338	.478	.766	.445	.375	.638	1.607
	MIN	-.668	-.606	-.349	-.284	-.370	-.339	-.405	-.221	-.423	-.338	-.453	-.275	-.668
	S.D.	.209	.274	.190	.099	.116	.108	.114	.107	.176	.163	.177	.188	.169
IMMINGHAM	MEAN	.035	.110	.062	.008	.008	.019	.003	.084	.060	.033	.057	.123	.050
	MAX	.745	2.439	.795	.496	.452	.392	.477	.879	.932	.664	.591	.787	2.439
	MIN	-1.048	-.945	-.779	-.513	-.251	-.240	-.232	-.335	-.428	-.596	-.372	-.481	-1.048
	S.D.	.261	.366	.241	.136	.103	.109	.116	.137	.178	.194	.171	.213	.198
CROMER	MEAN	-.046	.028	.009	-.004	.003	-.012	.001	.064	.042	.021	.018	.054	.017
	MAX	.832	2.233	.732	.362	.261	.263	.441	.754	1.021	.713	.571	.625	2.233
	MIN	-1.131	-1.061	-.820	-.619	-.240	-.280	-.261	-.490	-.525	-.933	-.632	-.753	-1.131
	S.D.	.279	.382	.249	.121	.087	.112	.116	.141	.177	.221	.208	.215	.216
LOWESTOFT	MEAN	.069	.166	.127	.032	.034	.044	.059	.146	.104	.063	.049	.122	.084
	MAX	.912	2.541	.858	.372	.629	.457	.560	.699	.790	.690	.608	.686	2.541
	MIN	-.976	-.999	-.653	-.483	-.225	-.231	-.172	-.331	-.375	-.874	-.500	-.621	-.999
	S.D.	.262	.385	.258	.127	.115	.117	.121	.133	.156	.222	.209	.207	.206
FELIXSTOWE	MEAN	-.041	.035	-.011	-.118	-.102	-.097	-.087	-.005	-.021	-.032	-.010	.059	-.036
	MAX	.820	2.258	.760	.455	.449	.308	.451	.746	.574	.631	.546	.772	2.258
	MIN	-1.224	-1.314	-.823	-.885	-.449	-.516	-.442	-.496	-.468	-1.032	-.666	-.777	-1.314
	S.D.	.260	.390	.255	.174	.121	.128	.151	.154	.157	.228	.214	.235	.216
SHEERNESS	MEAN	-.039	.012	-.025	-.035	-.042	-.040	-.034	.001	-.002	-.064	-.003	.048	-.019
	MAX	.992	2.329	.903	.625	.787	.426	.615	.758	.713	.762	.676	.755	2.329
	MIN	-1.510	-1.309	-1.033	-.770	-.461	-.602	-.443	-.664	-.674	-1.355	-.927	-1.101	-1.510
	S.D.	.277	.410	.291	.204	.144	.137	.155	.176	.186	.270	.241	.258	.240
DOVER	MEAN	.011	.144	.128	.060	.034	.051	.047	.112	.070	.064	.066	.154	.080
	MAX	.796	1.844	.750	.439	.507	.484	.508	.739	.541	.727	.619	1.166	1.844
	MIN	-.914	-.722	-.547	-.401	-.218	-.208	-.220	-.256	-.388	-.752	-.429	-.625	-.914
	S.D.	.221	.312	.205	.117	.102	.107	.110	.113	.147	.188	.178	.224	.177

4. OTHER INSTALLATIONS

4.1 WHITBY

Furnished with a pressure gauge system in 1980, this site was upgraded to the Dataring system by the addition of another pressure point and was fully operational by April 1989.

4.2 LERWICK

Hourly data commences 17 May 1989.
This station has been upgraded from a chart-recording Lea gauge with stilling well to a system with a potentiometer linked to the Lea gauge and a digiquartz sensor connected to a pressure point.

4.3 MILFORD HAVEN

This Port Authority site was incorporated into the Class A network with the installation of two pressure points with digiquartz sensors, to replace the original 'Newton Noyes' site. A Munro gauge with stilling well is also operational, and records from this gauge are being used to fill the gap between the Newton Noyes gauge failure and commencement of Dataring.(December 1989)

5. ACKNOWLEDGEMENTS

The author gratefully acknowledges the efforts of the Tide Gauge Inspectorate of the Proudman Laboratory who work so hard to maintain all the gauges on the Class-A Network, all in Tidal Computations Section involved with the collection and reduction of the data,the Ordnance Survey Levelling Section and Ian Pratt of Storm Tide Warning.My thanks also to Joyce Richards for much of the drawing work and Joyce Scoffield who analysed the data series.