National Tidal and Sea Level Facility

2011 Annual Report for the UK National Tide Gauge Network and Related Sea Level Science

Edited by Paul McGarrigle

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Oceanographic Data Centre
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National Tidal and Sea Level Facility: Annual Report for 2011 for the UK National Tide Gauge Network and Related Sea Level Science

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Dave Smith, NOC	Leader Tide Gauge Inspectorate (retired)
Simon Williams, NOC	GPS and Absolute Gravity Networks

Thanks also to all those involved in maintenance of the network, data retrieval, processing, quality control and delivery.

Foreword

Based at the National Oceanography Centre in Liverpool, with research partners in UK universities and the Met Office, The National Tidal and Sea Level Facility (NTSLF) is the UK centre of excellence for sea level monitoring, coastal flood forecasting and the analysis of sea level extremes. It was established in 2002 to reflect the importance of national sea level monitoring to the public and government, as well as to the academic community. NTSLF is supported by the skills of the British Oceanographic Data Centre (BODC) in the processing, quality control and dissemination of sea level data.

NTSLF provides technical expertise to a wide community and supplies quality-controlled data with a range of practical and scientific applications including:

- Tidal prediction and sea level monitoring for the UK National Tide Gauge Network and at key sites in the South Atlantic Ocean and British Overseas Territories.
- Storm surge forecasting.
- Determination of extreme sea levels for coastal engineering design
- Studies into climate change, including contributions to the Intergovernmental Panel on Climate Change (IPCC).

This report contains a summary of NTSLF activity for 2011.

The NTSLF currently manages precision tide gauges at 43 sites around the UK. A 44th gauge at Felixstowe was decommissioned in February 2011, having been succeeded by the tide gauge at Harwich. Over the past year, we successfully upgraded 23 of the remaining 43 sites to a new telemetry system that offers improved resilience, fault identification and data quality. In addition, major refurbishment of the tide gauge building at Newport was undertaken. The Port Ellen tide gauge was temporarily decommissioned pending the redevelopment of the quayside and demolition of the ferry terminal building that housed the tide gauge; however, reinstallation is planned for 2012. Quality-controlled data from the UK National Tide Gauge Network are accessible free of charge via our web pages.

The tide-surge numerical models used for coastal flood forecasting were also upgraded during 2011. These models run four times a day at the Met Office, producing predictions up to two days ahead. The Met Office regional atmospheric model that forces the tide-surge models is to be retired during 2012; therefore, NTSLF scientists spent much of 2011 working to interface the surge models with an alternative Met Office global atmospheric model and to optimise performance.

NTSLF scientists are always seeking ways to improve tidal predictions, particularly in large estuaries where tidal distortion in shallow water can cause disparity between tidal predictions and observations. During 2011, we successfully tested a method of empirically correcting High Water predictions for such locations, to reflect differences between observations and predictions for a few preceding high water levels. The correction tool will be made available to coastal forecasters during 2012.

We would like to thank all those who contribute towards, and make use of, the NTSLF, as well as the Environment Agency, who own and fund the UK National Tide Gauge network.

Dr Angela Hibbert
Tidal and Sea Level Scientist
NTSLF

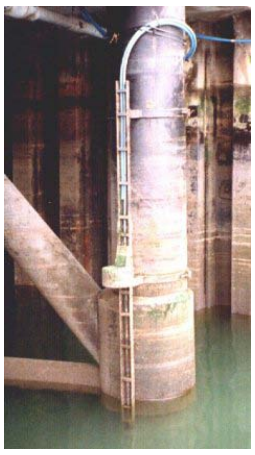
Tide Gauge Instruments

Full-tide Bubbler

The full tide bubbler system normally consists of two independent measuring systems. The pressure points are mounted approx 1m below Admiralty Chart Datum (ACD) so that negative surges can be recorded. The pressure points visible underwater in the photograph resemble an inverted bucket with a copper nozzle mounted on the side. This nozzle is the actual measuring point. A low flow of dry air (normally 7ml/min) is fed down an air tube to the top of the pressure point. When the air pressure in the tube equals the pressure exerted by the column of water above it, then the excess air is released as bubbles through the nozzle. This means the pressure in the air line is proportional to the weight of the water column.

Mid-tide Bubbler

The operation of the mid tide bubbler is similar to that of the full-tide system, except that the measuring point is mounted at the mid tide height. This means that the pressure point is only immersed for half of the tidal cycle. This is so that when the measuring point is exposed as in the photograph it can be levelled accurately into the geodetic network. Once this is accomplished the full tide pressure points can be fitted to match the tidal curve produced by the mid tide pressure point, thereby connecting them to the geodetic network.



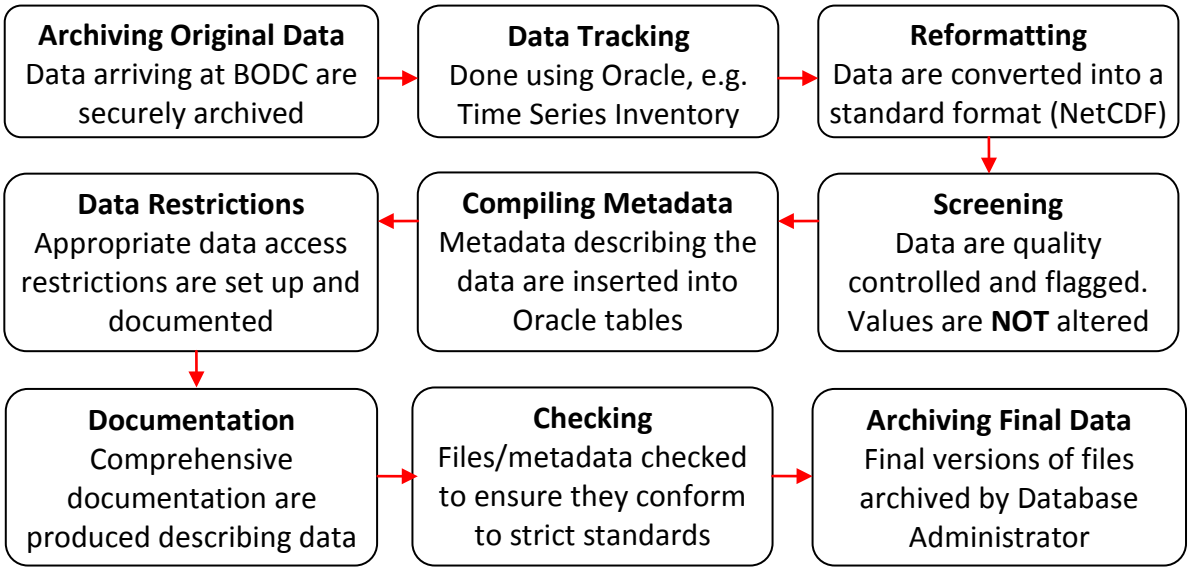
Pressure Transducer

These are differential transducers contained in a watertight housing. The reference port is vented to atmosphere via the power supply and signal cable tube, while the measuring port of the transducer is connected to a copper outlet nozzle on the top of the transducer housing. The nozzle, transducer measuring port and connecting tube are filled with oil. The pressure is transmitted to the crystal element via the oil, keeping the transducer components free from the effects of the saltwater.

Munro Float Gauge

The Munro gauge measures sea level using a float in a stilling well. The float is about 45cm in diameter - the large diameter reduces inevitable errors in buoyancy due to friction of the gearing and small changes in the length of float wire. This wire is coiled round a drum on the end of the gauge. Another drum contains a counterbalance wire. The drum is geared to a slotted tape attached to a pen carriage, which traces the tide curve on the chart. A precision potentiometer is attached to the gauge to provide an input to the data logger.

Data Processing



Flowchart summarising BODC data processing steps

Data arrive at BODC every week, where they are screened. The data are reviewed and then uploaded to the BODC website each month. They are reviewed annually before being banked (archived) in BODC's National Oceanographic Database. This process is described in more detail below.

Quality Control

All data arriving at BODC are converted to a common standard format. This makes storage and distribution much easier and ensures that parameter codes, flags, units, absent data values, etc, are consistent between different sources. We use a platform-independent binary format called QXF, a sub-set of NetCDF.

Data are quality-controlled weekly, monthly and annually using in-house software. This involves inspecting both recorded values and non-tidal residuals. Examining residuals is especially useful for detecting instrument faults (timing errors, datum shifts, spikes). Harmonic constants may be severely corrupted if the site has highly nonlinear tides, or is influenced by rivers/estuaries or particularly complex basin configuration. To produce more accurate predicted tides, we compute 'fresh' tidal constants from recent data, using Doodson harmonic analysis, rather than just relying upon historical values.

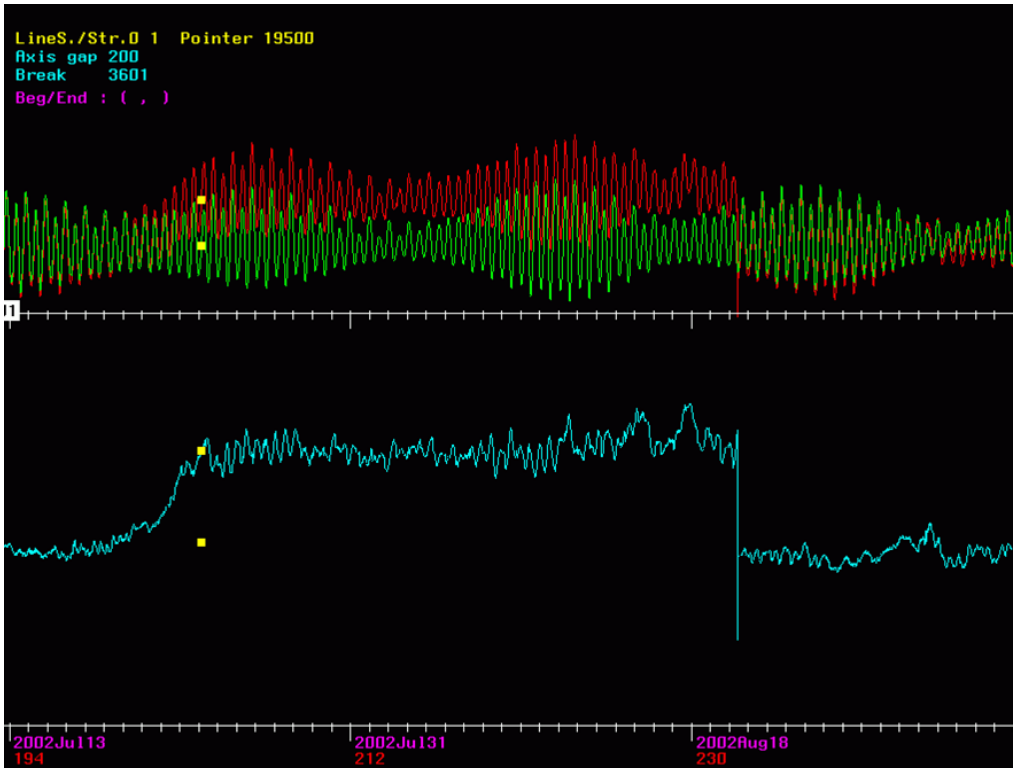
The standard procedure at BODC for the weekly quality control of sea level data includes, where possible:

- Screening the series, looking for spikes, gaps, timing errors and datum shifts
- Screening the series with previous series from the same site
- Screening the series with neighbouring stations covering the same period
- Displaying other parameters, such as sea temperature and atmospheric pressure, to aid quality control

Monthly processing includes checking the statistics produced, e.g., mean sea level, with those produced in previous years.

The annual quality-control process involves producing a tidal analysis and comparing M2, S2, N2, K1, O1, and Z0 constituents with previous data series, adjacent sites and the Admiralty Tide Tables for the closest site.

Data values are considered suspicious if the measured value differs by more than approximately 20mm (for a site of average tidal range) from either the mid-tide channel (if one exists at the site) or the predicted value. The person screening the data will often have to use their own judgement. Suspicious data points are flagged 'M' and any timing errors or datum shifts are noted. An 'N' flag is assigned to those values that are null. No data values are changed. The data quality is noted in accompanying documentation.



Screenshot of BODC visualisation software showing data, analysis and residual
(Legend: Tidal observations (m), Tidal predictions (m) and Residual (m))

Metadata and Documentation

Additional information (metadata) is needed not only for quality control and archiving, but also for exchanging data or integrating them into a regional or global data set. Basic metadata quality control includes checking that, for example, latitude and longitude or start/end dates of records are reasonable.

Sufficient documentation should accompany each data series to ensure that the data can be used with confidence by a secondary user. This documentation should be stored alongside the data, and where applicable, should cover:

Site information

- Brief description of location of tide gauge peculiar characteristics of the tide gauge site (for example, complex local geography, seiching, silting of the harbour, river mouths) (including maps, photos)
- Description of tide gauge benchmarks, their history and method of determination (including maps, photos)
- Datum relationships - Measurements must be relative to a fixed and permanent local tide gauge bench mark (TGBM). This should be connected to auxiliary marks to guard against its movement or destruction. Connections between the TGBM and the gauge zero should be made to an accuracy of a few millimetres regularly (e.g. annually)

Data sampling and processing details

- Sampling scheme e.g. continuous recording, instantaneous, averaged
- Interval between samples and duration of individual samples (raw data)
- Nominal interval of processed data
- Gaps in the data record
- Timing and/or datum corrections applied
- De-spiking/smoothing/interpolating methods and editing procedures

Instrument information

- Instrument description, manufacturer, model, principle of measurement, method of recording - refer to publication or briefly describe
- Instrument modifications and their effect on the data
- Method and times of calibration, calibration factors
- Frequency of cleaning, control of biological fouling
- Operational history
- Pertinent instrument characteristics; for example, for a conventional stilling well, information should include well diameter, orifice depth below mean water level and orifice height above sea bed; for a bubbler gauge - tube length, tube diameter, orifice diameter, density value used to convert to elevation, acceleration due to gravity and the formula used to compensate for tube length.

Auditing and Banking

The metadata and documentation are checked before banking. A Matlab script cross-references the data header files against the metadata to ensure no data-entry errors have been made. Another script checks the data files to make sure timing errors, out-of-range values and nulls have been dealt with.

Datasets that have been completely processed are audited. A second data scientist completes a series of final checks. Any differences of opinion are highlighted and re-examined. Files are then archived and marked as 'banked'. Finally, monthly files are concatenated into yearly files and the yearly file metadata are banked in a database.

Calculating Statistics

Edserplo calculates four types of summary information

- a history of when the tide gauge has been in operation (“history”)
- monthly extremes (“extremes”)
- monthly extreme surges (“surges”)
- monthly and daily mean sea level (“MSL”)

Gaps greater than 4.1 hours in the primary channel are registered as gaps in the history.

Extremes are the maximum and minimum calculated over all sampled data during the month. This excludes any interpolated data but may include rapidly sampled data. Extreme surges (residuals) are calculated in the same way from tidal residuals. Tidal residuals are defined to be the measured water level minus the predicted tide. The predictions derive from the database of tidal constants maintained by NOC’s Applications Group (as defined at the time of the calculation) for the ports of the UK and elsewhere.

Mean Sea Level is calculated from a filter working on quarter-hourly values derived from one or more cubic splines applied to the raw data. The filter is a convolution of Vassie’s 03B filter which converts 15-minute data to hourly values and Doodson’s X0 filter. Splines are not applied across gaps as defined above. Short gaps can therefore lead to the loss of a day of output data (the half length of the filter is 91 and a day is 96 samples). Provided there are some daily (@12:00Z) values these are then averaged to provide the monthly value.

The Permanent Service for Mean Sea Level (PSMSL) recommend refraining from computing a mean sea level value there isn't sufficient data available. Consequently, the monthly statistics given in this report do not feature a mean sea level value for any month where more than 15 days of data are missing (the values given for extremes and surges for these months should be treated with caution). Similarly, there is no yearly mean sea level figure given if more than two monthly mean values are missing. If there are 11 monthly means available, the annual mean is calculated from a weighted average of these (the weight for each month being the number of days for which readings exist).

Issues with Migration

The migration of a number of the sites to the EA's Swantel system and the installation of the S500 datalogger affected the data quality and completeness figures for the year.

On migration, some data was lost when essential tests were carried out to ensure the logger was functioning correctly.

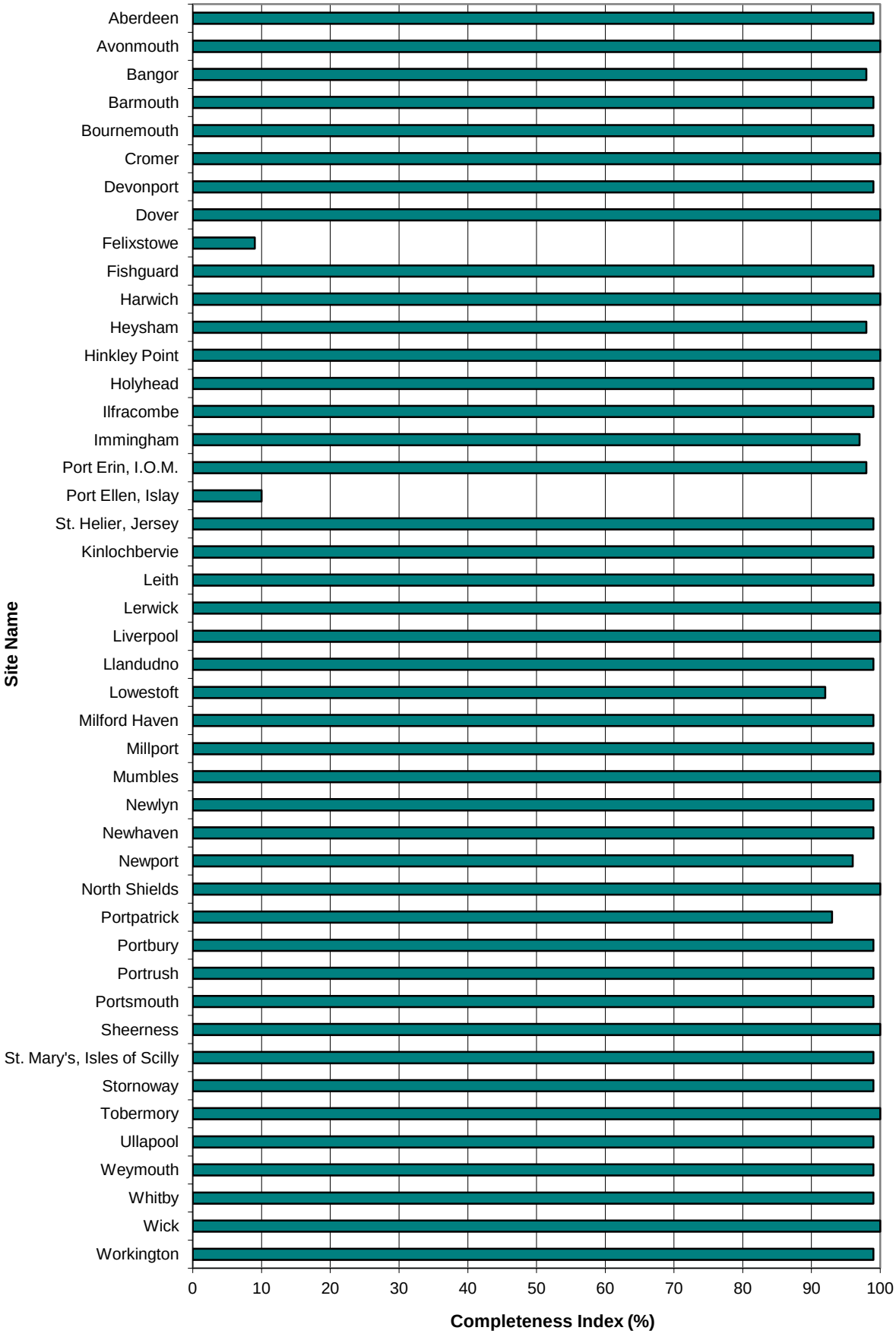
A software issue caused spikes in the data at some sites. The problem is believed to be the result of incorrect handling of invalid readings. In some cases, these values, rendered as '-9999' in the logger software, were included in calculations of averages, giving erroneous values for the 15-minute average sea level height. These data were either flagged or replaced with data from the Dataring system.

Many Swantel-equipped sites reported bad data values on 24 August and 8 September, when both Swantel servers were offline simultaneously, thus affecting the data quality indices for these sites.

UK Tide Gauge Network Map

Image ©2012 Aerodata International Surveys
Image ©2012 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2012 Cnes/Spot Image

Completeness Index (CI%) for UK Tide Gauge sites



Aberdeen – Tide Gauge Information

Latitude 57° 08' 38.5" N **Longitude** 02° 04' 38.5" W **Grid Ref** NJ 9525 0591

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Waterloo Quay
Measuring Points The South West corner of Telford Dock

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NJ 9525 0590	New bolt N side jetty Waterloo Quay
Aux1	NJ 9572 0593	Building NW side York Place SE face E angle
Aux2	NJ 9586 0571	Observatory Pocra Quay N face NW angle
Aux3	NJ 9524 0600	Building NE side Waterloo Quay SW face S angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.25m below Ordnance Datum Newlyn (ODN)
TGZ = 6.318m below TGBM

Levelling No levelling was carried out in 2011

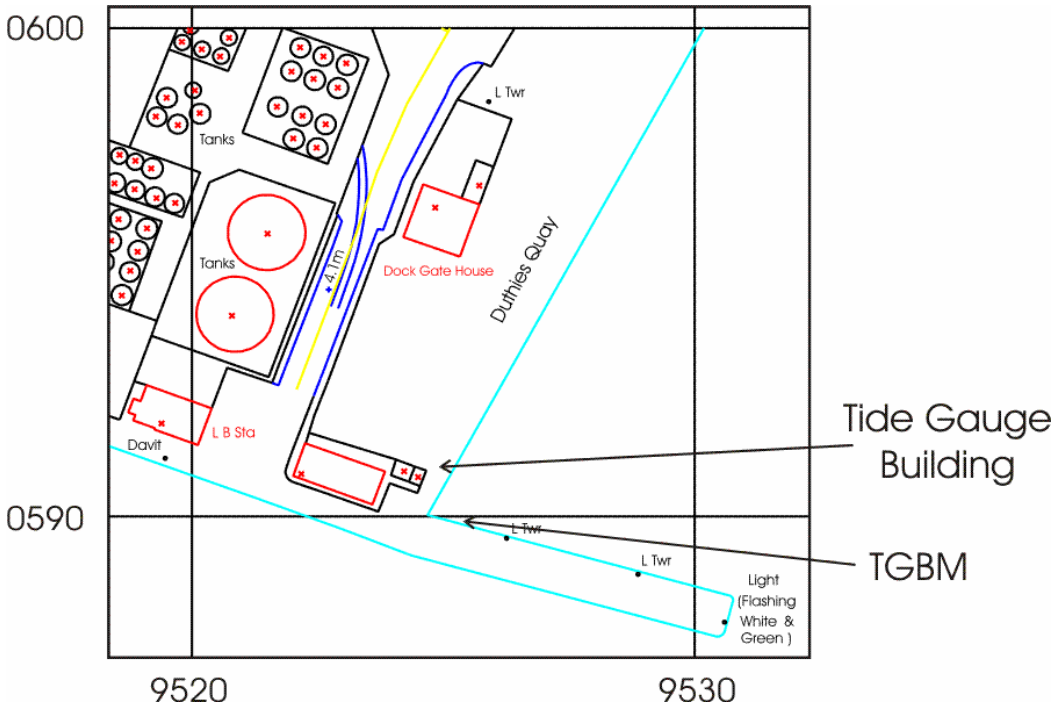
Site visits

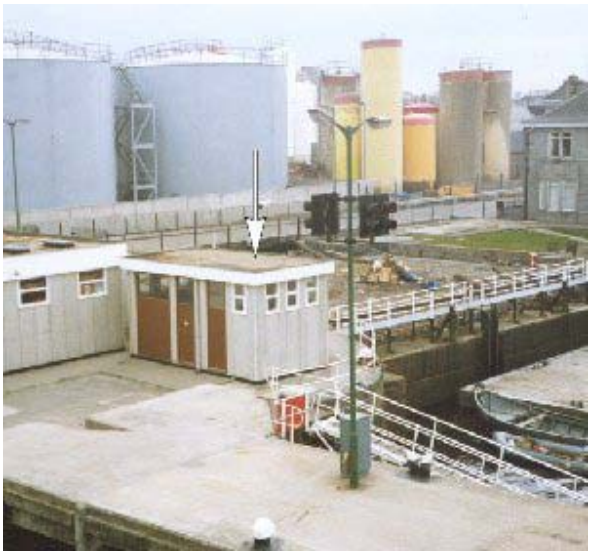
Day 041	Visit with electrical contractor to survey site for electrical works in advance of the installation of new telemetry system. General maintenance also undertaken.
Day 188	Delivered new telemetry outstation for installation
Day 313	Installed S500 telemetry outstation and repaired pneumatic line damaged by electrical contractors

Data quality

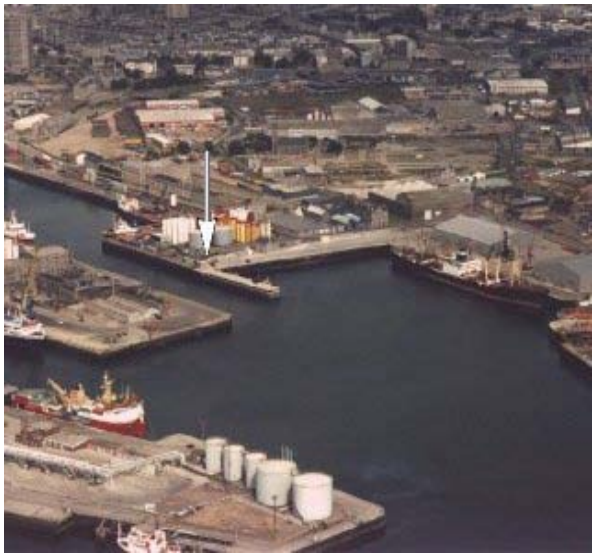
CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	313	003-004,007,015-017,055-057,214-313,313-314,315,329,361

Aberdeen – Map & Images of Site





Tide gauge location



Aerial view of site

Aberdeen – Statistics

Surge maxima	Value	Day	Time
January	0.227	15	04:15:00
February	1.276	4	08:45:00
March	0.423	8	20:00:00
April	0.368	5	18:00:00
May	0.545	24	03:15:00
June	0.245	22	05:00:00
July	0.275	16	21:30:00
August	0.066	1	05:30:00
September			
October			
November	0.845	25	08:45:00
December	1.016	25	22:00:00

Surge minima	Value	Day	Time
January	-0.366	23	12:15:00
February	-0.371	28	06:45:00
March	-0.395	3	09:00:00
April	-0.192	26	17:30:00
May	-0.301	23	17:45:00
June	-0.176	3	09:45:00
July	-0.191	29	09:45:00
August	-0.11	2	05:15:00
September			
October			
November	-0.246	11	21:30:00
December	-0.664	8	15:00:00

Extreme maxima	Value	Day	Time
January	4.417	8	15:30:00
February	4.949	4	13:45:00
March	4.782	21	14:15:00
April	4.549	19	14:00:00
May	4.551	18	13:45:00
June	4.471	18	02:30:00
July	4.518	17	02:00:00
August	4.456	1	01:45:00
September			
October			
November	5.14	27	14:15:00
December	5.016	26	01:30:00

Extreme minima	Value	Day	Time
January	0.004	22	21:15:00
February	0.016	19	20:00:00
March	0.082	19	19:00:00
April	0.093	18	19:15:00
May	0.583	15	17:30:00
June	0.656	5	09:30:00
July	0.448	31	07:30:00
August	0.226	2	09:00:00
September			
October			
November	0.727	26	07:30:00
December	0.449	27	21:15:00

Mean sea level	No days	MSL
January	23	2.497
February	23	2.574
March	31	2.438
April	30	2.491
May	31	2.546
June	30	2.543
July	31	2.518
August	1	*
September	0	
October	0	
November	20	2.711
December	31	2.753
	Sum	Avg
	251	**

* No mean sea level value as more than 15 days of data missing

** No yearly average value as more than one month's MSL missing

Avonmouth – Tide Gauge Information

Latitude 51° 30' 27.6" N **Longitude** 02° 42' 45.9" W **Grid Ref** ST 5063 7899

Instrument Data acquisition system with dual underwater pressure transducers
Location **Tide Gauge Building** Between disused oil jetty and fuel storage depot
Measuring Points The seaward end of the oil jetty

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 5057 7881	OSBM bolt at base of bollard
Aux1	ST 5072 7859	Rivet adjacent to transit shed NW face W angle
Aux2	ST 5063 7898	Rivet base building NW side S angle
Ref M	ST 5047 7934	Ref mark on seaward end of jetty

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 6.50 m below Ordnance Datum Newlyn (ODN)
TGZ = 15.711 m below TGBM

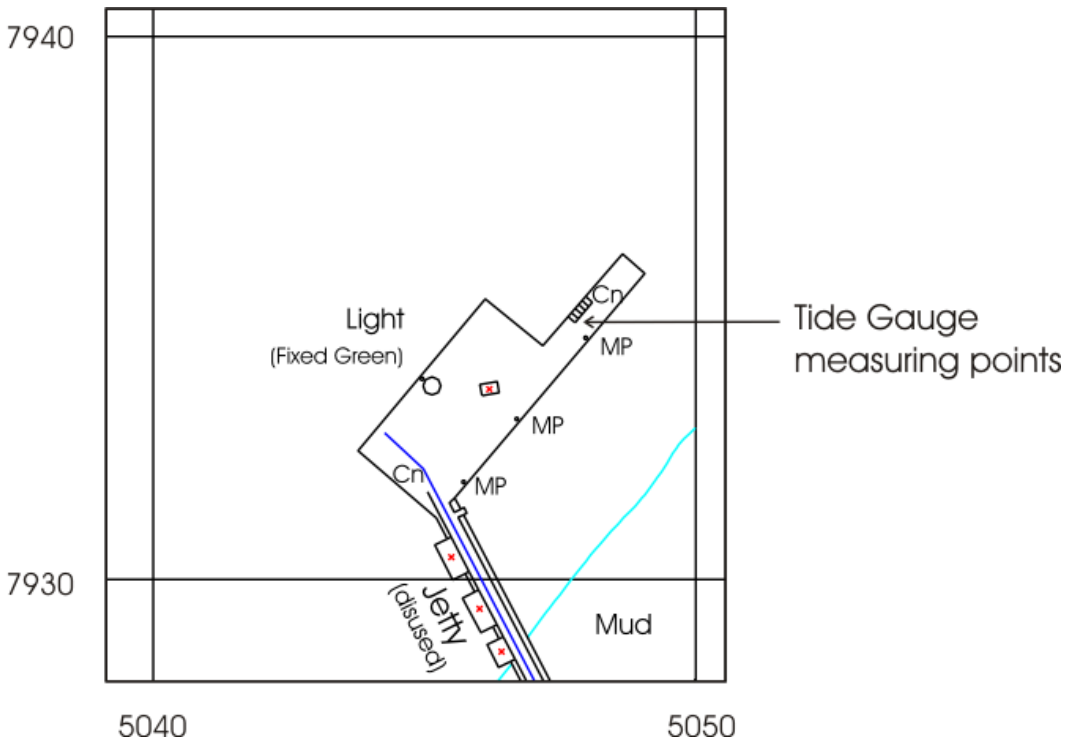
Levelling No levelling was carried out in 2011

Site visits
Day 061 Carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	None

Avonmouth – Map & Images of Site



Avonmouth – Statistics

Surge maxima	Value	Day	Time
January	1.059	13	07:15:00
February	1.086	13	08:45:00
March	1.103	24	15:45:00
April	1.168	1	11:30:00
May	0.845	8	05:15:00
June	0.776	27	11:30:00
July	0.847	17	16:45:00
August	0.63	22	19:00:00
September	1.123	12	02:30:00
October	1.077	17	17:00:00
November	0.801	29	16:00:00
December	1.509	13	04:15:00

Surge minima	Value	Day	Time
January	-0.961	27	10:15:00
February	-0.757	28	22:15:00
March	-1.2	23	17:15:00
April	-0.741	8	18:30:00
May	-0.569	14	23:30:00
June	-0.447	14	00:00:00
July	-0.578	12	10:45:00
August	-0.404	31	16:15:00
September	-0.597	28	15:00:00
October	-0.512	1	17:00:00
November	-0.558	27	15:45:00
December	-0.623	17	01:00:00

Extreme maxima	Value	Day	Time
January	13.588	23	09:45:00
February	14.424	20	08:45:00
March	14.329	21	08:30:00
April	14.213	19	20:15:00
May	13.683	18	20:00:00
June	13.4	17	20:15:00
July	13.419	31	19:45:00
August	14.33	31	21:00:00
September	14.513	28	19:45:00
October	14.345	27	07:00:00
November	14.006	26	07:30:00
December	13.584	26	08:00:00

Extreme minima	Value	Day	Time
January	0.283	22	03:45:00
February	0.302	20	16:00:00
March	0.068	22	04:00:00
April	0.401	18	14:30:00
May	0.84	19	03:00:00
June	1.253	3	14:45:00
July	1.176	31	14:30:00
August	0.467	31	16:00:00
September	0.316	29	15:30:00
October	0.558	28	15:00:00
November	0.813	27	15:30:00
December	0.981	26	15:15:00

Mean sea level	No days	MSL
January	31	6.978
February	28	7.062
March	31	6.874
April	30	6.922
May	31	6.996
June	30	7.02
July	31	7.017
August	31	7.068
September	30	7.137
October	31	7.121
November	30	7.105
December	31	7.139
	Sum	Avg
	365	7.037

Bangor – Tide Gauge Information

Latitude 54° 39' 53.1" N **Longitude** 05° 40' 10.1" W **Grid Ref** NW 6340 3620

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Central Pier at Bangor Marina
Measuring Points The seaward side of the open pier, directly beneath the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	5043 8212 (Sheet 115)	S S Pin Tide gauge building Central Pier
Aux1	5038 8200 (Sheet 115)	Cut mark Clock tower

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.01m below Ordnance Datum Belfast (ODB)
TGZ = 5.592m below TGBM

Levelling No levelling was carried out in 2011

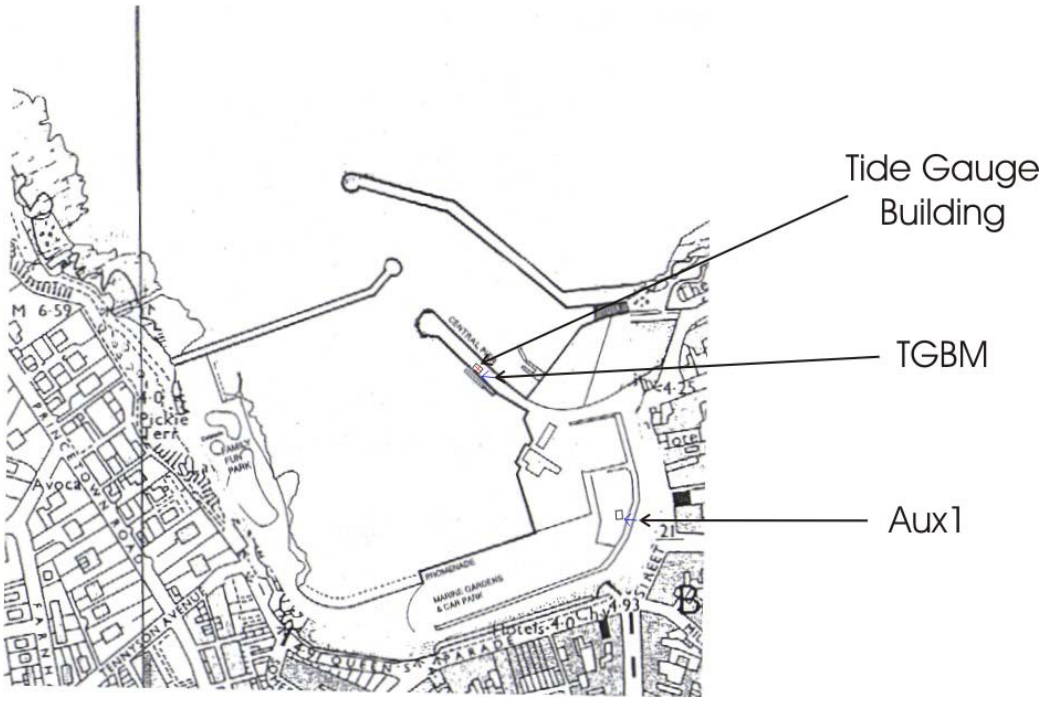
Site visits

Day 031	Visit with EA electrical contractor to carry out a site survey for enabling works to install a new telemetry outstation and to carry out general maintenance
Day 088	Delivered new telemetry outstation to site and undertook diving work to clear pressure points and clean nozzles
Day 228	Installed S500 telemetry outstation and migrated the gauge to Swantel
Day 266	Visit to carry out maintenance and investigate a pneumatic fault on the mid-tide sensor

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
98	15 minutes	228-234	001-007,015,026-028,041-045,048,053-061,067-083,087-088,209,236,244,250,261,275,279,285,289,294-295,304,314,340,342,345-346,354-355,363-365

Bangor – Map & Images of Site



Bangor – Statistics

Surge maxima	Value	Day	Time
January	0.455	15	06:45:00
February	0.771	4	02:30:00
March	0.475	31	10:00:00
April	0.391	1	16:15:00
May	0.842	23	15:00:00
June	0.255	17	11:45:00
July	0.255	16	04:15:00
August	0.26	10	11:45:00
September	0.759	12	14:00:00
October	0.363	17	20:15:00
November	0.677	30	23:45:00
December	0.995	8	13:15:00

Surge minima	Value	Day	Time
January	-0.458	23	13:15:00
February	-0.4	28	04:30:00
March	-0.362	3	20:45:00
April	-0.27	12	07:15:00
May	-0.294	27	06:45:00
June	-0.299	2	23:00:00
July	-0.26	28	23:15:00
August	-0.21	9	06:45:00
September	-0.24	18	13:15:00
October	-0.265	7	08:00:00
November	-0.272	12	23:15:00
December	-0.407	17	19:45:00

Extreme maxima	Value	Day	Time
January	3.726	7	12:45:00
February	3.904	19	11:30:00
March	3.598	31	09:15:00
April	3.614	19	11:45:00
May	3.76	23	15:00:00
June	3.716	18	00:15:00
July	3.712	7	02:45:00
August	3.752	4	01:45:00
September	3.913	10	22:00:00
October	3.917	26	22:15:00
November	4.169	29	13:30:00
December	4.182	13	12:30:00

Extreme minima	Value	Day	Time
January	-0.048	22	18:45:00
February	0.263	19	17:30:00
March	0.219	24	08:00:00
April	0.109	17	16:00:00
May	0.292	19	06:00:00
June	0.356	3	05:45:00
July	0.316	4	06:45:00
August	0.186	31	06:00:00
September	0.218	28	04:45:00
October	0.348	1	07:00:00
November	0.24	27	18:30:00
December	0.368	17	21:45:00

Mean sea level	No days	MSL
January	18	1.987
February	18	2.162
March	7	*
April	30	1.961
May	31	2.035
June	30	2.002
July	31	1.985
August	23	2.044
September	30	2.163
October	31	2.155
November	30	2.221
December	24	2.181
	Sum	Avg
	303	2.081

* No mean sea level value as more than 15 days of data missing

Barmouth – Tide Gauge Information

Latitude 52° 43' 09.6" N **Longitude** 04° 02' 42.1" W **Grid Ref** SH 6197 1548

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Toll booth on the north end of Barmouth railway bridge
Measuring Points Attached to the first leg of the railway bridge in the deep channel

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 6197 1548	NBM rivet concrete 2.9M NE wall junction
Aux 1	SH 6173 1558	Rivet step NE side of road NW entrance path
Aux 2	SH 6186 1556	Rivet wall SE side road 17.6M E steps
Aux 3	SH 6196 1550	Rivet step E side lifeboat station

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.44m below ODN
TGZ = 10.363m below TGBM

Levelling No levelling was carried out in 2011

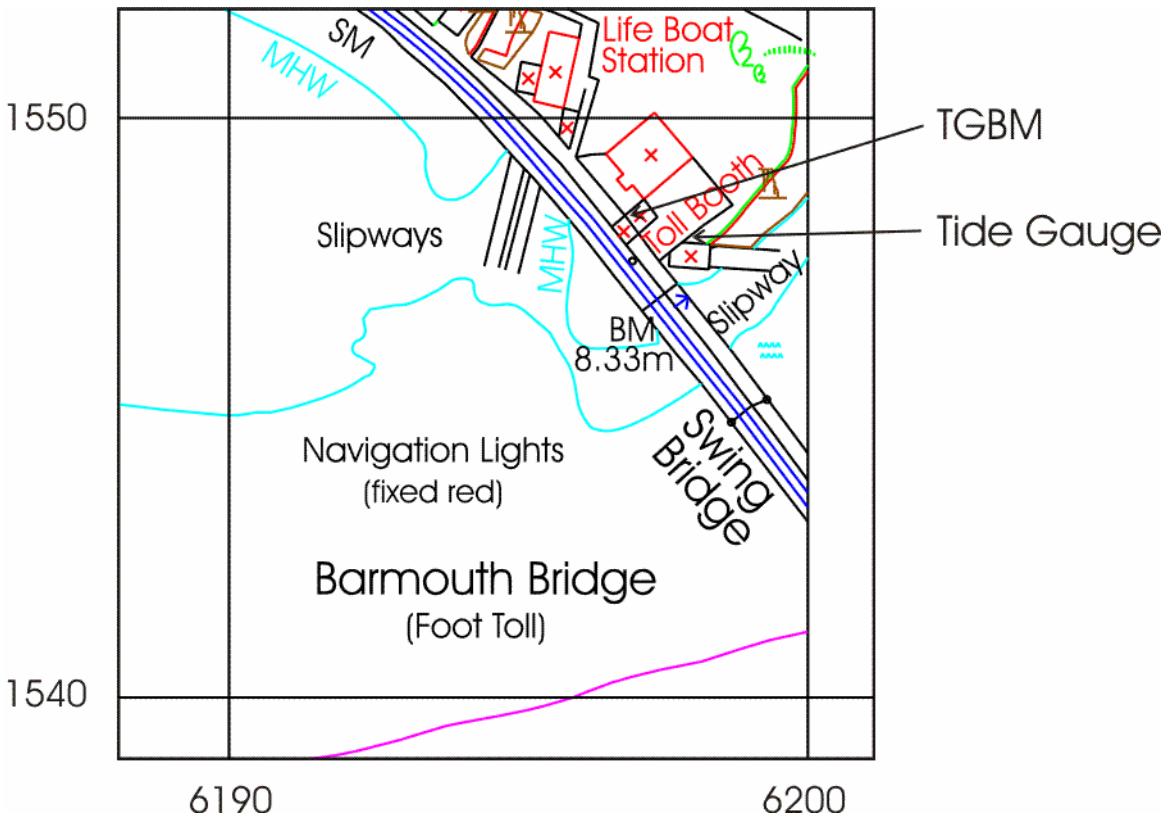
Site visits
Day 320 Installed S500 telemetry outstation, migrated to Swantel and carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	321,322	001-107,143-146,148,152-154,186-198,201-202,214-241,243-244,246-256,259-270,276-281,300-316,322,323-365

Notes on Completeness/Quality
From January to April, from August to September and from November to December the primary channel was reading up to ~45 mm high, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring.

Barmouth – Map & Images of Site



Barmouth – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April	0.2	20	04:15:00
May	0.601	23	14:30:00
June	0.456	25	08:15:00
July	0.372	8	16:45:00
August	0.219	31	14:45:00
September	0.905	6	05:45:00
October	0.928	17	18:00:00
November	0.514	3	09:15:00
December			

Surge minima	Value	Day	Time
January			
February			
March			
April	-0.252	17	15:45:00
May	-0.285	15	00:45:00
June	-0.278	3	12:15:00
July	-0.23	28	15:30:00
August	-0.199	30	05:00:00
September	-0.262	18	16:45:00
October	-0.306	13	18:00:00
November	-0.336	12	18:15:00
December			

Extreme maxima	Value	Day	Time
January			
February			
March			
April	5.475	19	08:45:00
May	5.222	18	20:45:00
June	5.303	17	21:30:00
July	5.232	31	20:45:00
August	5.596	31	21:45:00
September	5.73	28	20:45:00
October	5.669	27	08:00:00
November	4.887	12	08:45:00
December			

Extreme minima	Value	Day	Time
January			
February			
March			
April	0.592	17	15:30:00
May	0.708	19	05:00:00
June	0.758	4	04:45:00
July	0.821	4	05:30:00
August	0.744	30	04:45:00
September	0.734	28	04:15:00
October	0.797	1	18:15:00
November	1.051	12	16:00:00
December			

Mean sea level	No days	MSL
January	0	
February	0	
March	0	
April	13	*
May	23	2.692
June	27	2.72
July	16	2.642
August	0	
September	6	*
October	24	2.805
November	5	*
December	0	
	Sum	Avg
	114	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Bournemouth – Tide Gauge Information

Latitude 50° 42' 51.6" N **Longitude** 01° 52' 29.5" W **Grid Ref** SZ 0893 9053

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Electrical room at the west side of the South Pier
Measuring Points Directly below the electrical room, on a pier leg

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
Aux1	SZ 0869 9066	Cut mark Wall
Aux2	SZ 0893 9083	Cut mark Pillar
REF A	SZ 0893 9052	Steelwork clamp
REF B	SZ 0893 9052	Mid-tide pressure point nozzle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.40m below ODN
TGZ = 5.96m below Aux1

Levelling No levelling was carried out in 2011

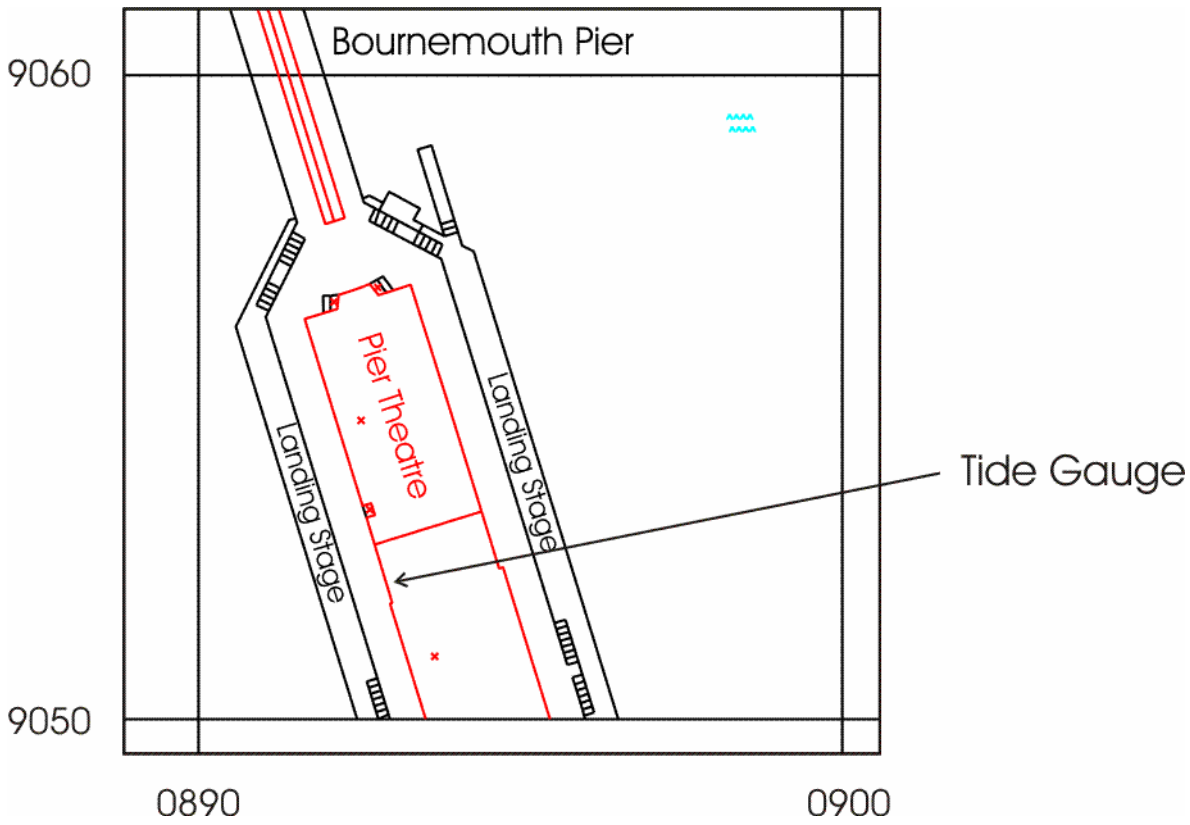
Site visits

Day 026	Visit with EA electrical contractor to carry out electrical survey for enabling works required for new telemetry outstation. General maintenance also undertaken.
Day 164	Delivered new outstation to site
Day 214	Replaced compressor
Day 273	Installed new S500 outstation, migrated system to Swantel and performed general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	273	217,274,281,295-298

Bournemouth – Map & Images of Site



Bournemouth – Statistics

Surge maxima	Value	Day	Time
January	0.522	8	05:00:00
February	0.364	15	08:15:00
March	0.276	13	03:45:00
April	0.172	29	22:30:00
May	0.224	8	06:15:00
June	0.335	17	16:30:00
July	0.275	17	05:00:00
August	0.222	8	00:15:00
September	0.325	12	03:30:00
October	0.357	24	00:45:00
November	0.384	3	09:00:00
December	0.593	12	23:15:00

Surge minima	Value	Day	Time
January	-0.434	23	06:15:00
February	-0.314	28	21:45:00
March	-0.431	2	16:00:00
April	-0.219	8	03:00:00
May	-0.323	24	06:15:00
June	-0.282	1	12:00:00
July	-0.164	1	12:30:00
August	-0.193	10	21:45:00
September	-0.377	6	19:30:00
October	-0.245	14	13:45:00
November	-0.268	25	10:15:00
December	-0.572	8	23:30:00

Extreme maxima	Value	Day	Time
January	2.457	7	10:00:00
February	2.566	19	09:15:00
March	2.38	21	09:30:00
April	2.43	19	21:45:00
May	2.266	17	20:30:00
June	2.419	17	21:30:00
July	2.319	16	21:45:00
August	2.499	31	22:15:00
September	2.534	28	21:15:00
October	2.721	27	08:45:00
November	2.443	26	09:00:00
December	2.587	12	22:00:00

Extreme minima	Value	Day	Time
January	-0.082	22	17:30:00
February	0.069	19	16:15:00
March	-0.086	20	16:00:00
April	0.124	18	15:45:00
May	0.28	18	03:45:00
June	0.429	3	04:15:00
July	0.37	4	05:15:00
August	0.115	31	04:45:00
September	0.057	28	03:30:00
October	0.263	28	04:00:00
November	0.244	26	16:00:00
December	0.294	28	18:00:00

Mean sea level	No days	MSL
January	31	1.564
February	28	1.584
March	31	1.462
April	30	1.525
May	31	1.536
June	30	1.59
July	31	1.604
August	31	1.621
September	29	1.639
October	25	1.629
November	30	1.683
December	31	1.667
	Sum	Avg
	358	1.592

Cromer – Tide Gauge Information

Latitude 52° 56' 03.7" N **Longitude** 01° 18' 05.9" E **Grid Ref** TG 2198 4254

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Within Cromer lifeboat station
Measuring Points Attached to a leg of the lifeboat slipway

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TG 2193 4233	S Steel bolt on top of wall opposite E side of pier
Aux1	TG 2198 4253	Rivet on steps of catwalk NE angle of LB station
Aux2	TG 2195 4233	S Steel bolt bottom ramp S side at W corner

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Newlyn
TGZ = 10.117m below TGBM

Levelling No levelling was carried out in 2011

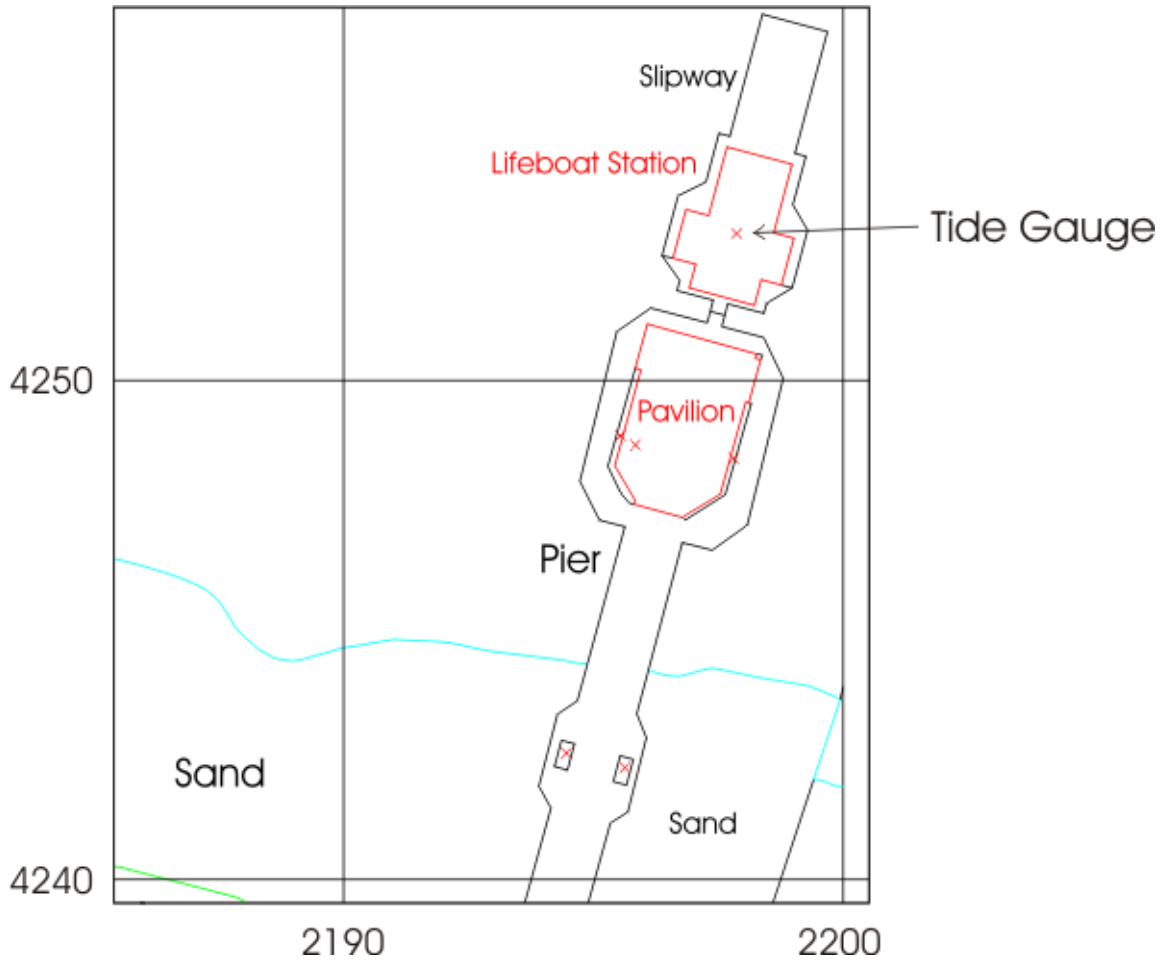
Site visits

Day 069	Delivered new outstation equipment to site and assessed electrical installation
Day 144	EA attended site to test electrical installation

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	001-002,022,026-027,050-051,059,066-074,144-145,158

Cromer – Map & Images of Site



Cromer – Statistics

Surge maxima	Value	Day	Time
January	0.77	11	18:45:00
February	1.463	4	16:00:00
March	0.218	8	23:45:00
April	0.338	8	16:45:00
May	0.833	24	08:15:00
June	0.32	19	05:15:00
July	0.659	23	21:15:00
August	0.493	9	07:45:00
September	0.55	7	07:15:00
October	0.743	4	07:30:00
November	1.706	27	16:30:00
December	1.471	9	09:45:00

Surge minima	Value	Day	Time
January	-0.506	10	14:45:00
February	-0.932	4	01:45:00
March	-0.481	23	05:45:00
April	-0.274	4	22:30:00
May	-0.687	23	21:00:00
June	-0.264	13	00:00:00
July	-0.266	31	15:30:00
August	-0.343	10	12:15:00
September	-0.725	6	10:30:00
October	-0.657	25	00:15:00
November	-0.777	25	02:15:00
December	-1.425	8	14:45:00

Extreme maxima	Value	Day	Time
January	5.395	6	19:30:00
February	5.446	4	19:00:00
March	5.549	21	19:45:00
April	5.356	19	19:15:00
May	5.275	19	07:15:00
June	5.195	19	08:30:00
July	5.213	17	07:30:00
August	5.562	31	07:30:00
September	5.562	29	07:15:00
October	5.578	28	06:45:00
November	6.17	27	19:30:00
December	5.529	26	07:00:00

Extreme minima	Value	Day	Time
January	0.412	23	03:15:00
February	-0.011	4	01:45:00
March	0.179	20	01:15:00
April	0.308	19	01:30:00
May	0.641	18	01:15:00
June	0.835	17	14:15:00
July	0.574	31	13:30:00
August	0.393	2	15:00:00
September	0.337	27	13:00:00
October	0.424	26	12:30:00
November	0.378	25	00:30:00
December	0.301	28	03:30:00

Mean sea level	No days	MSL
January	25	2.953
February	24	2.88
March	21	2.803
April	30	2.9
May	29	2.9
June	30	2.944
July	31	2.973
August	31	2.999
September	30	2.984
October	31	2.98
November	30	3
December	31	3.076
	Sum	Avg
	343	2.949

Devonport – Tide Gauge Information

Latitude 50° 22' 06.2" N **Longitude** 04° 11' 06.9" W **Grid Ref** SX 4469 5434

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** No. 1 Jetty in Devonport Royal Naval base
Measuring Points Attached to the stilling well beneath the building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SX 4468 5434	Bolt on jetty wall. 6.6m NW angle T G building
Aux1	SX 4471 5433	Building N face NE angle
Aux2	SX 4487 5425	Bldg NW face W angle
Aux3	SX 4501 5454	Fl Br 11818 bldg W face NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.22m below ODN
TGZ = 7.631m below TGBM

Levelling No levelling was carried out in 2011

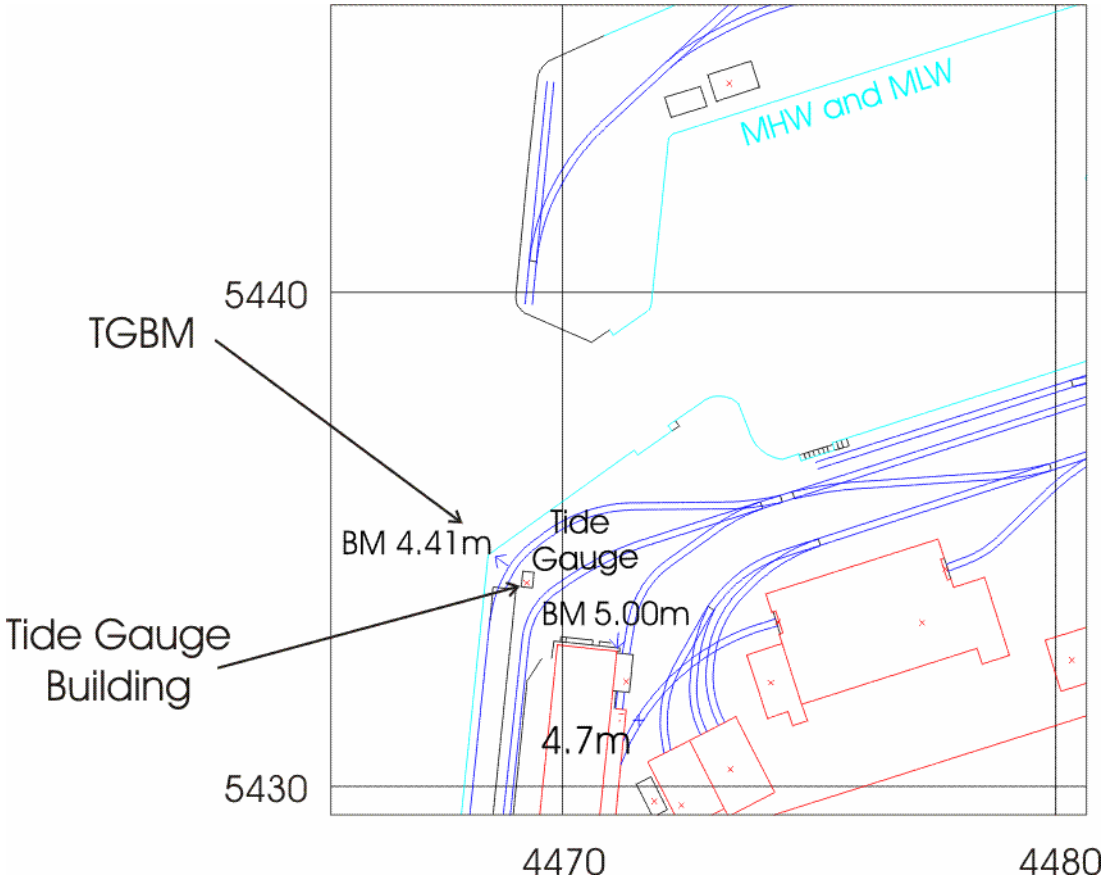
Site visits

Day 082	Visit with EA contractor to conduct electrical survey for new telemetry outstation enabling works and to carry out general maintenance
Day 164	Delivered new outstation equipment to site
Day 284	Installed S500 telemetry outstation, changed compressor and carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	272,284,305	001-068,179-185,257-258,272-273,284,286,296,324,338,354,359

Devonport – Map & Images of Site



Devonport – Statistics

Surge maxima	Value	Day	Time
January	-0.024	1	05:15:00
February			
March	0.25	12	17:00:00
April	0.201	30	10:45:00
May	0.296	8	02:30:00
June	0.279	17	14:30:00
July	0.252	6	16:45:00
August	0.2	7	15:15:00
September	0.344	12	00:15:00
October	0.389	23	19:45:00
November	0.427	3	10:15:00
December	0.457	12	22:30:00

Surge minima	Value	Day	Time
January	-0.067	1	06:15:00
February			
March	-0.341	23	16:00:00
April	-0.321	12	00:30:00
May	-0.273	15	22:30:00
June	-0.247	1	18:45:00
July	-0.176	11	21:00:00
August	-0.177	10	09:15:00
September	-0.252	6	21:15:00
October	-0.265	9	05:00:00
November	-0.267	25	12:00:00
December	-0.384	29	01:30:00

Extreme maxima	Value	Day	Time
January	4.805	1	02:45:00
February			
March	5.844	21	06:45:00
April	5.834	19	06:15:00
May	5.582	18	18:30:00
June	5.718	17	18:45:00
July	5.675	31	18:15:00
August	5.931	31	19:30:00
September	5.968	28	18:15:00
October	6.125	27	05:30:00
November	5.745	29	08:15:00
December	5.665	13	07:15:00

Extreme minima	Value	Day	Time
January	2.949	1	06:30:00
February			
March	0.01	21	13:15:00
April	0.293	18	12:00:00
May	0.519	19	00:45:00
June	0.903	17	00:30:00
July	0.897	5	02:15:00
August	0.312	31	01:00:00
September	0.229	29	00:45:00
October	0.424	28	12:45:00
November	0.549	26	12:15:00
December	0.662	25	12:15:00

Mean sea level	No days	MSL
January	0	
February	0	
March	21	3.314
April	30	3.322
May	31	3.331
June	26	3.384
July	27	3.394
August	31	3.404
September	27	3.418
October	30	3.437
November	28	3.509
December	31	3.446
	Sum	Avg
	282	**

** No yearly average value as more than one month's MSL missing

Dover – Tide Gauge Information

Latitude 51° 06' 51.8" N **Longitude** 01° 19' 21.6" E **Grid Ref** TR 3265 4026

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Prince of Wales Pier, Western Dock (just before the lighthouse)
Measuring Points Attached to the stilling well

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TR 3193 4074	Fl Br G4868 building. East side of works entrance
Aux 1	TR 3195 4095	No 29 Waterloo Crescent SW face S angle
Aux 2	TR 3228 4053	Rivet pier wall NE side of pier F junction
Aux 3	TR 3265 4026	Rivet steps NE side P of W pier 1.0M SE W angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.67m below Ordnance Datum Newlyn (ODN)
TGZ = 10.491m below TGBM

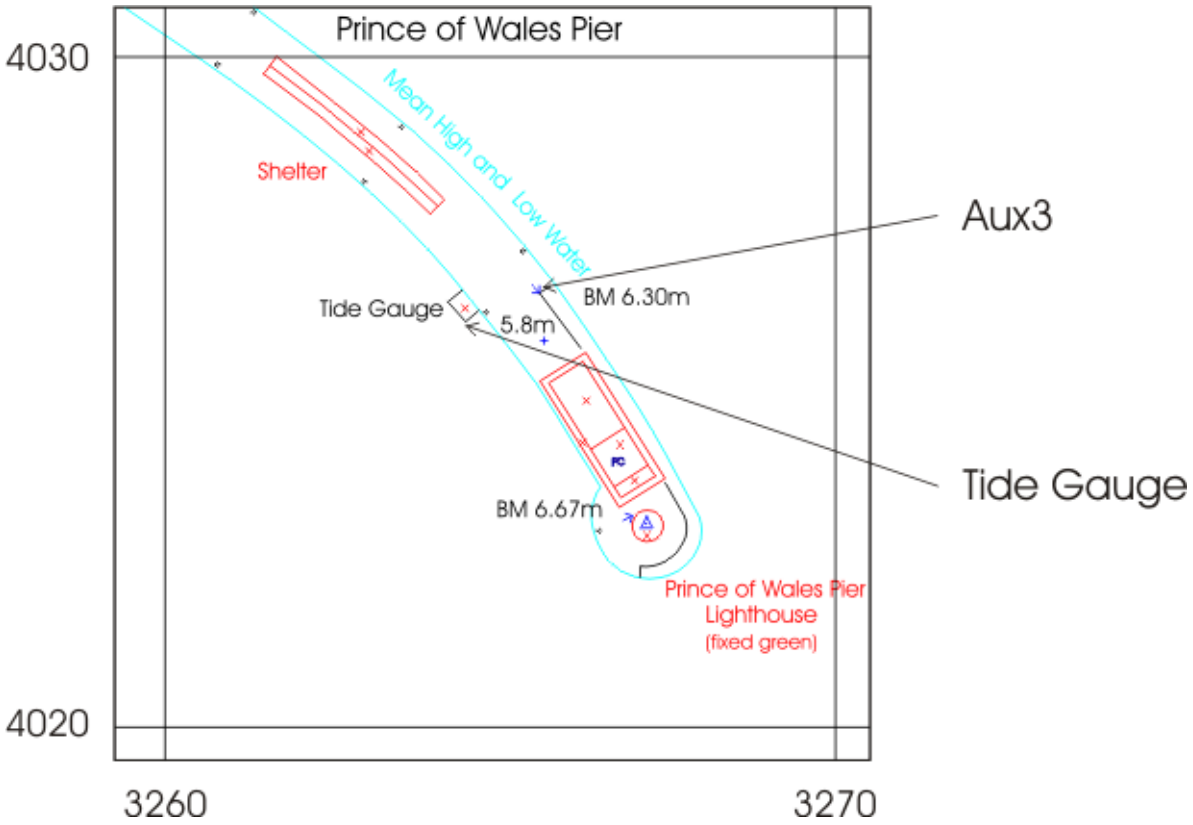
Levelling No levelling was carried out in 2011

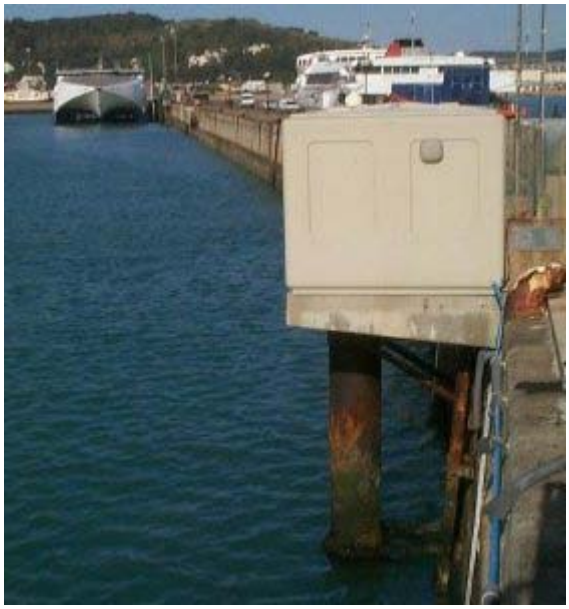
Site visits
Day 214 Changed compressor and delivered new outstation

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	214,300,302-309,311-346,348-361

Dover – Map & Images of Site





Dover – Statistics

Surge maxima	Value	Day	Time
January	0.504	6	10:30:00
February	0.812	4	20:45:00
March	0.405	11	03:30:00
April	0.295	7	13:30:00
May	0.525	24	12:30:00
June	0.436	18	22:30:00
July	0.638	24	03:30:00
August	0.387	9	08:00:00
September	0.463	7	10:00:00
October	0.571	18	11:30:00
November	0.239	5	14:30:00
December	0.715	29	10:45:00

Surge minima	Value	Day	Time
January	-0.449	27	14:00:00
February	-0.585	4	06:30:00
March	-0.611	3	20:30:00
April	-0.265	10	01:30:00
May	-0.505	24	03:30:00
June	-0.36	3	09:30:00
July	-0.211	31	23:00:00
August	-0.302	10	16:15:00
September	-0.72	6	16:45:00
October	-0.493	22	19:00:00
November	-0.128	6	17:45:00
December	-1.09	8	20:45:00

Extreme maxima	Value	Day	Time
January	6.935	24	01:45:00
February	7.022	21	00:30:00
March	7.215	22	00:15:00
April	7.102	20	00:00:00
May	6.883	19	12:00:00
June	6.758	19	13:15:00
July	6.742	17	12:15:00
August	7.202	31	12:15:00
September	7.212	29	12:00:00
October	7.218	28	11:30:00
November	5.877	6	08:00:00
December	6.87	29	14:00:00

Extreme minima	Value	Day	Time
January	0.467	23	08:45:00
February	0.257	21	08:30:00
March	0.254	21	07:30:00
April	0.391	19	07:00:00
May	0.632	18	06:30:00
June	0.979	15	17:45:00
July	0.718	31	18:45:00
August	0.5	31	20:00:00
September	0.383	29	19:45:00
October	0.611	29	07:30:00
November	1.404	1	09:30:00
December	0.592	28	08:30:00

Mean sea level	No days	MSL
January	31	3.75
February	28	3.704
March	31	3.627
April	30	3.704
May	31	3.712
June	30	3.761
July	31	3.789
August	31	3.804
September	30	3.801
October	25	3.807
November	0	
December	3	*
	Sum	Avg
	300	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Felixstowe – Tide Gauge Information

Latitude 51° 57' 27.7" N **Longitude** 01° 20' 47.6" E **Grid Ref** TM 3003 3409

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge. Decommissioned May 2011.

Location **Tide Gauge Building** Landward end of Felixstowe pier
Measuring Points Seaward end of Felixstowe pier

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TM 3001 3414	Bolt on the SE side of prom NE face of arcade
Aux1	TM 2956 3393	Flush Bracket 2071 on No. 25 Langer Road W angle NW face
Aux3	TM 3003 3409	Rivet outside TG building

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.95m below ODN
TGZ = 5.69m below TGBM

Levelling No levelling was carried out in 2011

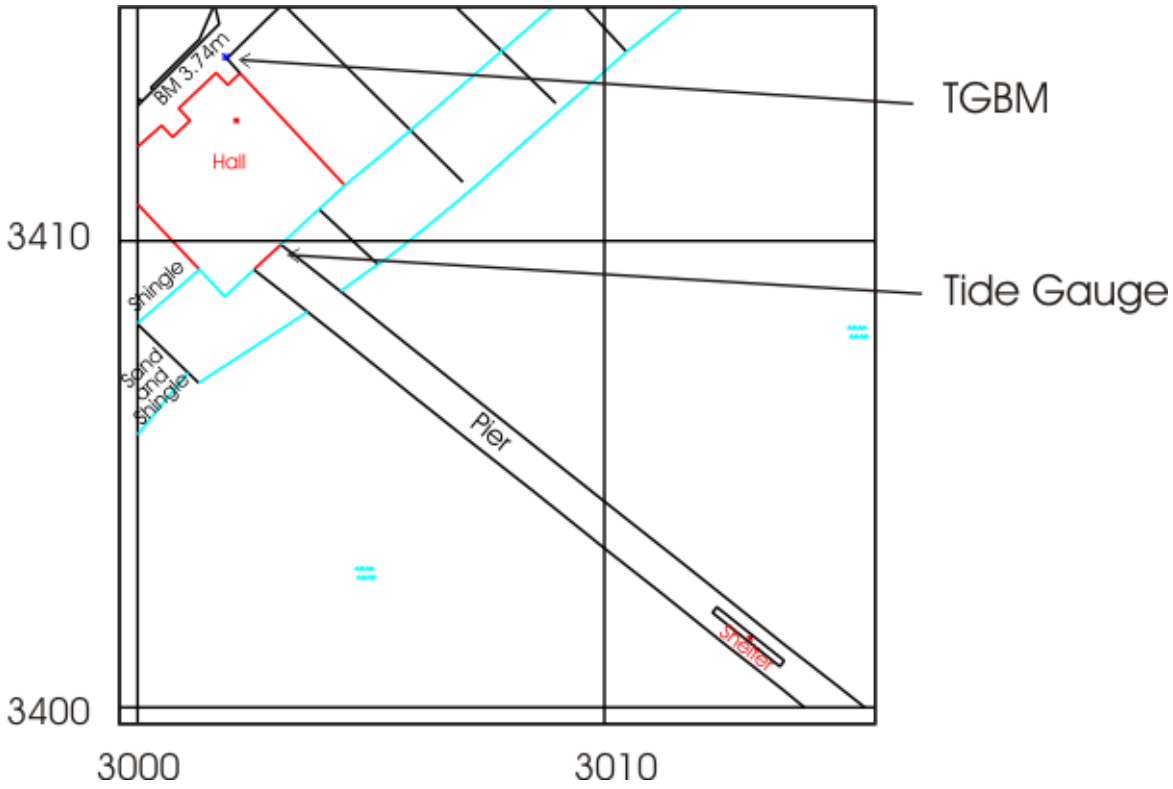
Site visits
Day 034 Started decommissioning
Day 124 Onsite to decommission the gauge

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
9	15 minutes	033-365	None

Notes on Completeness/Quality
Gauge was removed from the network on 03 February 2011

Felixstowe – Map & Images of Site



Felixstowe – Statistics

Surge maxima	Value	Day	Time
January	0.713	11	22:00:00
February	0.4	1	20:00:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Surge minima	Value	Day	Time
January	-0.541	11	04:00:00
February	-0.249	1	08:15:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme maxima	Value	Day	Time
January	4.16	6	12:45:00
February	3.694	1	23:00:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme minima	Value	Day	Time
January	0.115	23	07:30:00
February	0.52	1	04:15:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Mean sea level	No days	MSL
January	31	2.083
February	0	
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
	Sum	Avg
	31	**

** No yearly average value as more than one month's MSL missing

Fishguard – Tide Gauge Information

Latitude 52° 00' 47.6" N **Longitude** 04° 59' 01.5" W **Grid Ref** SM 9534 3918

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** On Fishguard Quay, adjacent to the RNLI station
Measuring Points Approximately 10m from the end of the quay

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SM 9534 3918	OSBM bolt on quay 3.6M NE end of railings (1987)
Aux1	SM 9513 3874	OS bolt con base railings 6.4M NW angle TG hut
Aux2	SM 9489 3849	Rivet step top of Goodwick Quay
Aux3	SM 9455 3820	Fl Br 11518 blding SW side railway bridge SE Face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.44m below ODN
TGZ = 7.88m below TGBM

Levelling No levelling was carried out in 2011

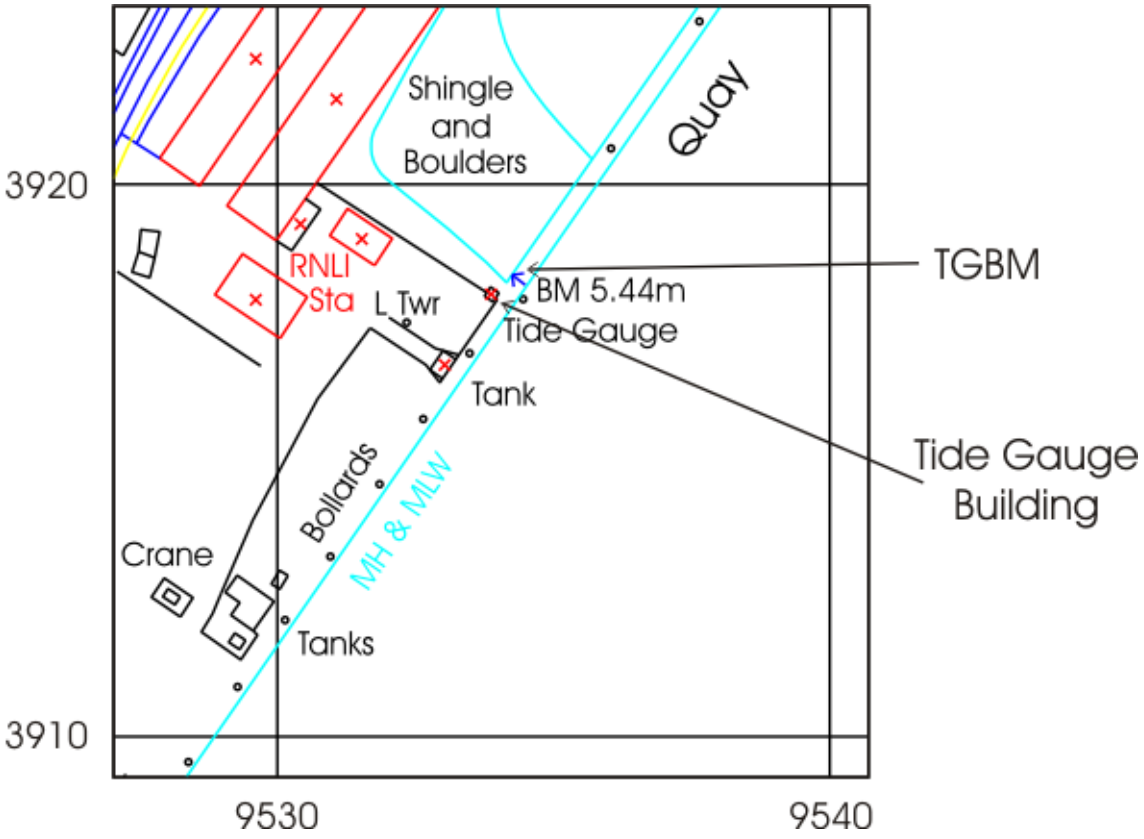
Site visits

Day 012	Visit with EA electrician to conduct electrical survey for telemetry outstation enabling works and to carry out routine maintenance
Day 139	Changed compressor and delivered new outstation equipment
Day 160	Began installing new telemetry outstation, but electrical works not completed to standard so work abandoned
Day 262	Began installing new telemetry outstation, but electrical works not completed to standard so work abandoned
Day 306	Installed new logger, migrated site to Swantel and carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	306	013-014,306-307,321,324,329,337

Fishguard – Map & Images of Site



Fishguard – Statistics

Surge maxima	Value	Day	Time
January	0.431	10	15:00:00
February	0.506	3	23:15:00
March	0.273	31	13:30:00
April	0.281	5	04:30:00
May	0.362	23	10:00:00
June	0.311	17	15:30:00
July	0.292	6	18:00:00
August	0.224	7	18:30:00
September	0.402	12	02:45:00
October	0.463	23	23:45:00
November	0.514	29	12:45:00
December	0.6	13	02:30:00

Surge minima	Value	Day	Time
January	-0.39	23	18:15:00
February	-0.326	28	01:30:00
March	-0.351	3	05:30:00
April	-0.331	12	01:00:00
May	-0.353	24	05:30:00
June	-0.244	2	11:15:00
July	-0.166	1	05:45:00
August	-0.135	8	23:15:00
September	-0.203	18	15:30:00
October	-0.286	7	08:30:00
November	-0.398	27	14:30:00
December	-0.509	29	02:45:00

Extreme maxima	Value	Day	Time
January	4.984	5	07:45:00
February	5.421	20	08:30:00
March	5.238	21	08:15:00
April	5.201	19	07:45:00
May	4.93	18	19:45:00
June	5.013	17	20:15:00
July	4.967	31	19:45:00
August	5.306	31	20:45:00
September	5.407	28	19:45:00
October	5.392	27	07:00:00
November	5.153	26	07:30:00
December	4.918	26	08:15:00

Extreme minima	Value	Day	Time
January	0.257	22	15:30:00
February	0.406	20	15:15:00
March	0.145	22	03:00:00
April	0.39	18	13:45:00
May	0.595	19	02:45:00
June	0.947	3	02:15:00
July	0.877	4	03:30:00
August	0.403	31	02:45:00
September	0.363	28	01:45:00
October	0.515	28	14:15:00
November	0.448	27	15:00:00
December	0.734	26	15:00:00

Mean sea level	No days	MSL
January	27	2.676
February	28	2.758
March	31	2.599
April	30	2.651
May	31	2.69
June	30	2.713
July	31	2.707
August	31	2.733
September	30	2.775
October	31	2.776
November	27	2.838
December	31	2.767
	Sum	Avg
	358	2.724

Harwich – Tide Gauge Information

Latitude 51° 56' 52.8" N **Longitude** 01° 17' 31.7" E **Grid Ref** TM 2634 3284

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Seaward end of Harwich Haven Authority jetty
Measuring Points On the jetty, directly below the tide gauge cabinet

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TM 2634 3284	Bolt at base of flag staff
Aux1	TM 2617 3277	Cut mark quay edge
Aux2	TM 2608 3271	Cut mark NW face of Bank building
Aux3	TM 2610 3258	Cut mark N side of ent St Nicholas's church

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.02m below ODN
TGZ = 6.17m below TGBM

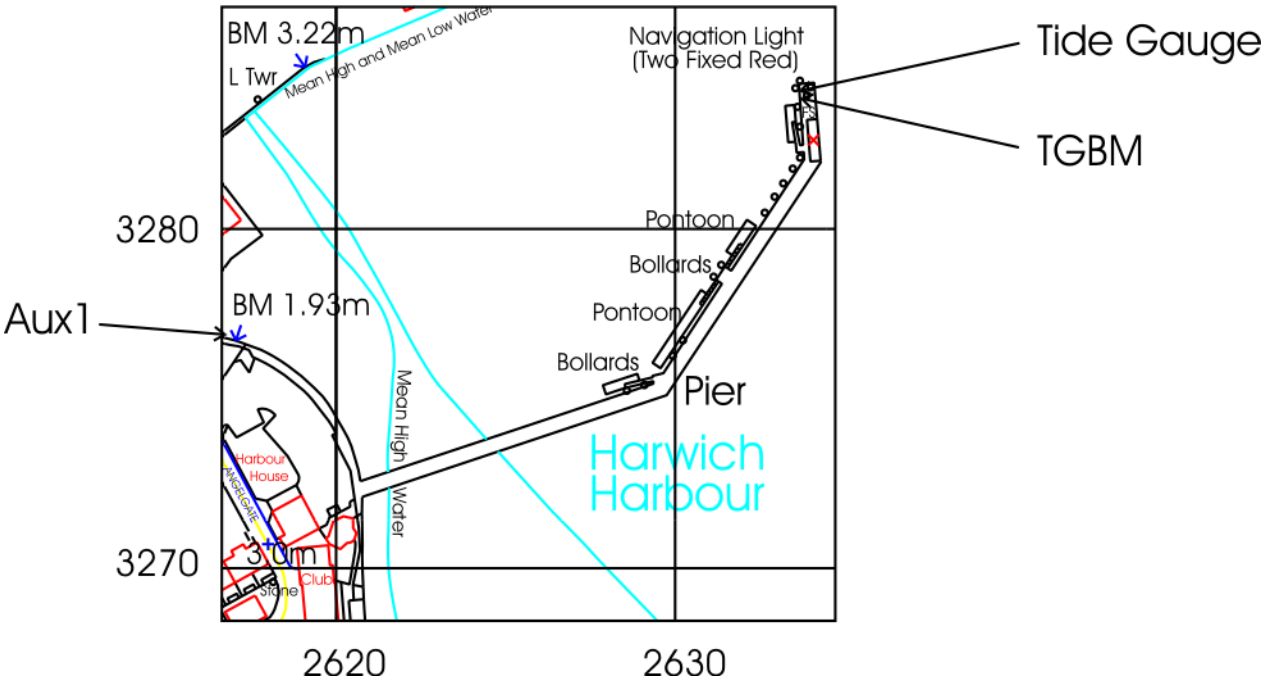
Levelling No levelling was carried out in 2011

Site visits
Day 125 General maintenance and inspection of electrical works

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	125

Harwich – Map & Images of Site



Harwich – Statistics

Surge maxima	Value	Day	Time
January	0.694	11	22:15:00
February	1.005	4	19:15:00
March	0.492	11	01:00:00
April	0.336	7	11:00:00
May	0.839	24	11:15:00
June	0.389	19	12:15:00
July	0.858	24	01:30:00
August	0.471	9	09:45:00
September	0.535	7	09:15:00
October	0.664	7	05:00:00
November	1.454	27	20:00:00
December	1.269	9	13:00:00

Surge minima	Value	Day	Time
January	-0.552	10	16:45:00
February	-0.717	4	02:00:00
March	-0.561	2	09:45:00
April	-0.316	5	02:00:00
May	-0.684	24	00:00:00
June	-0.31	1	10:30:00
July	-0.348	18	02:30:00
August	-0.354	10	17:15:00
September	-0.944	6	13:30:00
October	-0.617	24	22:45:00
November	-0.713	29	21:00:00
December	-1.34	8	18:45:00

Extreme maxima	Value	Day	Time
January	4.338	6	13:00:00
February	4.226	20	13:00:00
March	4.278	21	12:45:00
April	4.299	20	00:45:00
May	4.273	19	00:30:00
June	4.271	18	00:45:00
July	4.177	17	00:30:00
August	4.41	30	00:00:00
September	4.343	1	01:30:00
October	4.428	28	12:15:00
November	4.676	28	01:15:00
December	4.776	9	10:45:00

Extreme minima	Value	Day	Time
January	0.095	23	07:30:00
February	-0.192	4	06:00:00
March	-0.022	20	05:30:00
April	0.094	19	06:00:00
May	0.176	23	22:00:00
June	0.427	3	18:30:00
July	0.214	31	18:00:00
August	0.107	2	19:30:00
September	0.045	27	17:15:00
October	0.159	25	16:00:00
November	0.098	25	04:45:00
December	-0.114	28	08:15:00

Mean sea level	No days	MSL
January	31	2.16
February	28	2.085
March	31	2.039
April	30	2.119
May	31	2.123
June	30	2.164
July	31	2.203
August	31	2.22
September	30	2.202
October	31	2.203
November	30	2.225
December	31	2.288
	Sum	Avg
	365	2.169

Heysham – Tide Gauge Information

Latitude 54° 01' 54.6" N **Longitude** 02° 55' 12.9" W **Grid Ref** SD 3982 5993

Instrument Data acquisition system with two full tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** South side of the entrance to Heysham harbour
Measuring Points Heysham harbour

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SD 4030 6012	OSBM bolt on south quay 40.8m SW from SE angle of dock
Aux1	SD 4141 6005	Bridge parapet, E side of road
Aux2	SD 4026 6033	Pivot pin harbour wall 6.1M SW N angle of harbour
Aux3	SD 4026 6033	Rivet harbour wall 5.7M SW of N angle of Harbour
Aux4	SD 3982 5992	Brass bolt quay edge

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.90m below Ordnance Datum Newlyn (ODN)
TGZ = 12.098m below TGBM

Levelling No levelling was carried out in 2011

Site visits

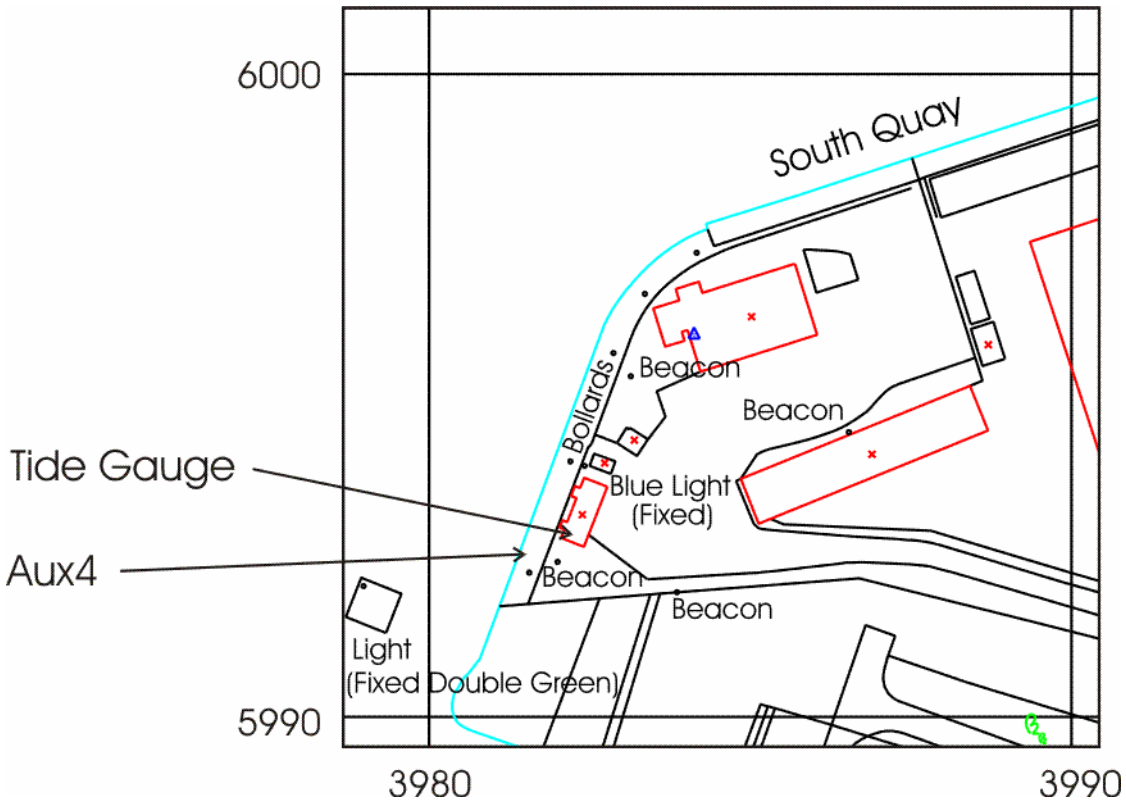
Day 005	Installed S500 logger to run in parallel with DATARING logger for a test period
Day 082	Upgraded software on S500 logger (faults found during testing)
Day 131	Tested new outstation

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
98	15 minutes	047-051,135-136,333-334	004-047,051-110,131-132,191-198,205-222,224,235-242,248-295,328-332,335-336,346

Notes on Completeness/Quality
From January to April, the primary and secondary channels were reading up to ~40 mm low, possibly due to siltation. Ongoing works at site may have been a contributory factor. The observed differences are acceptable for monitoring extremes but were flagged as unacceptable for the purposes of long-term sea level monitoring. From August to November the primary and secondary channels were at times ~40 mm low and high respectively. This was corrected during the outstation installation visit in November.

Heysham – Map & Images of Site



Heysham – Statistics

Surge maxima	Value	Day	Time
January	0.117	4	09:00:00
February			
March			
April	0.161	23	06:00:00
May	1.114	23	11:15:00
June	0.44	13	00:30:00
July	0.354	7	13:30:00
August	0.618	10	13:00:00
September	0.266	4	22:00:00
October	0.364	29	16:30:00
November	0.972	27	04:45:00
December	1.66	8	15:00:00

Surge minima	Value	Day	Time
January	-0.386	2	05:00:00
February			
March			
April	-0.296	26	11:15:00
May	-0.302	27	08:45:00
June	-0.382	4	16:45:00
July	-0.241	1	03:30:00
August	-0.178	22	06:00:00
September	-0.152	1	01:45:00
October	-0.195	28	08:30:00
November	-0.358	7	01:00:00
December	-0.463	30	08:15:00

Extreme maxima	Value	Day	Time
January	8.935	3	10:30:00
February			
March			
April	9.96	21	01:00:00
May	9.955	19	00:00:00
June	9.828	16	23:45:00
July	9.694	18	00:45:00
August	10.342	31	00:00:00
September	10.393	1	00:45:00
October	10.505	27	11:00:00
November	10.035	28	13:00:00
December	10.195	28	13:30:00

Extreme minima	Value	Day	Time
January	1.676	3	17:15:00
February			
March			
April	0.698	20	19:15:00
May	0.861	19	06:45:00
June	1.308	17	06:30:00
July	1.125	4	07:45:00
August	0.377	31	07:00:00
September	0.523	1	07:45:00
October	0.621	28	06:15:00
November	1.154	26	05:45:00
December	1.145	27	19:30:00

Mean sea level	No days	MSL
January	2	*
February	0	
March	0	
April	9	*
May	26	5.191
June	30	5.169
July	15	5.175
August	13	*
September	3	*
October	8	*
November	23	5.285
December	28	5.383
	Sum	Avg
	157	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Hinkley Point – Tide Gauge Information

Latitude 51° 12' 38.2" N **Longitude** 03° 07' 52.8" W **Grid Ref** ST 2107 4632

Instrument Dataring system with dual underwater pressure transducers
Location **Tide Gauge Building** Hinkley Point "A" power station
Measuring Points Underwater vented chambers suspended from a steel pole attached to a water intake tower (400m offshore)

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 2104 4634	Bolt on wall 0.962m NE of SE corner of steps
Aux1	ST 2078 4626	Rivet on sea wall 41.28m SW of corner of outfall
Aux2	ST 2094 4631	Bolt on sea wall 31.245m SW of end of railings
Aux3	ST 2123 4634	Bolt sea defence wall

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.80m below Ordnance Datum Newlyn (ODN)
TGZ = 14.639m below TGBM

Levelling No levelling was carried out in 2011

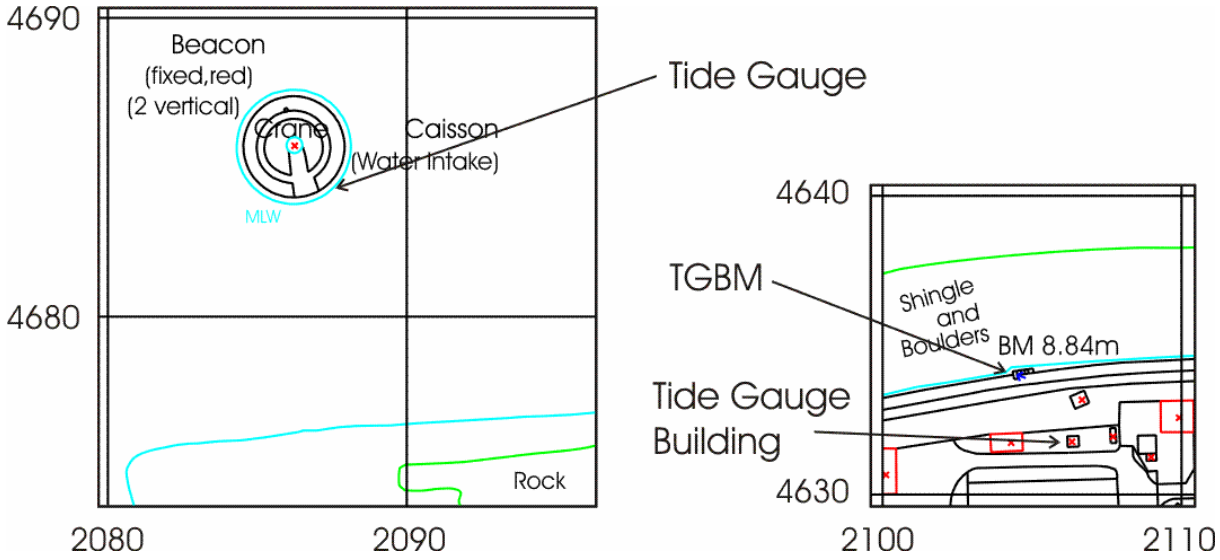
Site visits
None

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	001-365

Notes on Completeness/Quality
The clock in the DATARING logger drifted significantly and would not respond to remote commands to correct the error. Consequently, the data were flagged as suspect. The issue was resolved on installation of a new S500 logger in April 2012.

Hinkley Point – Map & Images of Site



Hinkley Point – Statistics

All the data for the primary channel at this site were flagged as suspect, so no statistics for 2011 could be produced.

Holyhead – Tide Gauge Information

Latitude 53° 18' 50.2" N **Longitude** 04° 37' 13.6" W **Grid Ref** SH 2553 8287

Instrument Data acquisition system with a full-tide and a mid-tide bubbler gauge, with a back-up Munro float gauge

Location **Tide Gauge Building** Salt Island jetty, close to the old harbour lighthouse
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 2553 8287	Bolt on concrete foundation, north side of tide gauge building
Aux1	SH 2556 8289	Cut mark lighthouse
Aux3	SH 2506 8292	Bolt Salt Island bridge

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.05m below Ordnance Datum Newlyn (ODN)
TGZ = 7.436m below TGBM

Levelling Site was levelled on Day 304

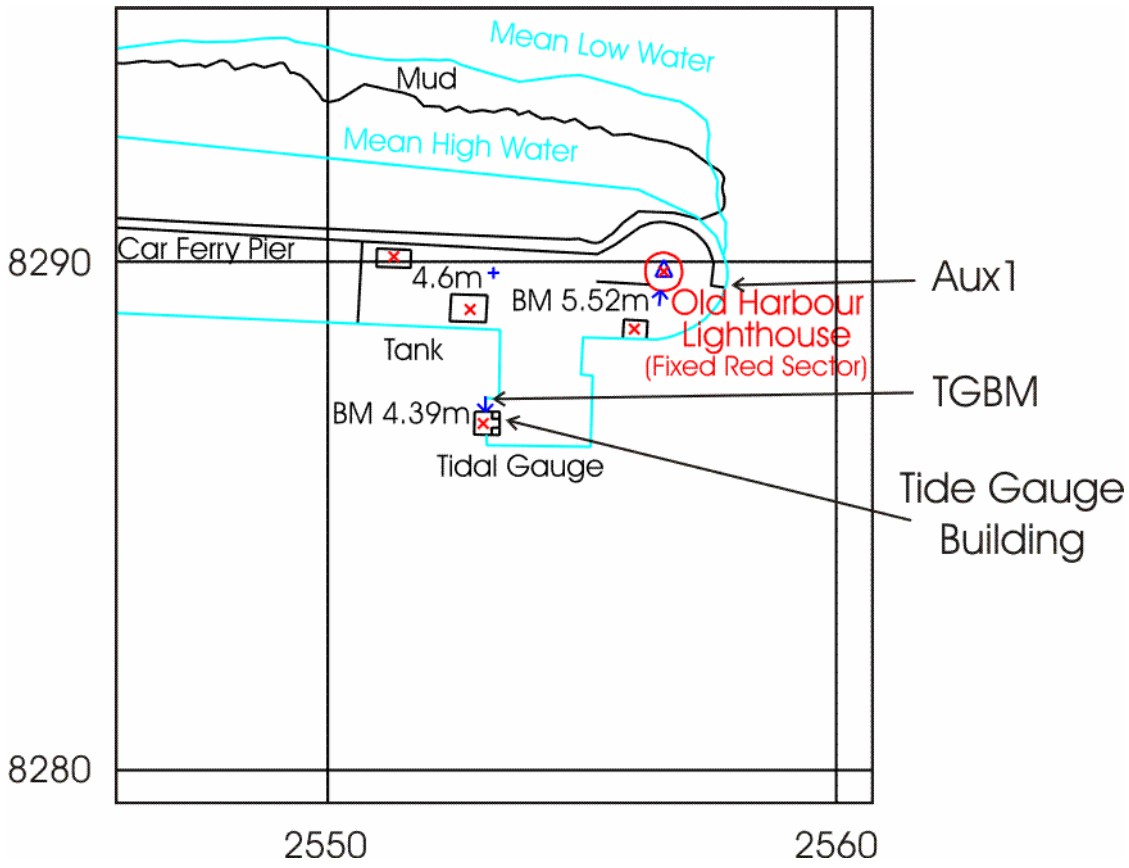
Site visits

Day 007	Installed S500 datalogger in parallel with DATARING for a trial period. Channel 1 lost from DATARING (can't split analogue potentiometer signal between the 2 loggers).
Day 019	Reworked the parallel wiring of the 2 systems
Day 039	Investigated a problem with the float gauge
Day 044	Investigated a fault with the S500 logger
Day 137	Upgraded the S500 logger
Day 304	Dive Team on site for diving, levelling and maintenance, including compressor change and to migrate the site to Swantel, decommissioning the old DATARING logger
Day 319	General maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	012-013,290	009-010,044,078,094,137-138,194,208,222,236,243,250-290,291-365

Holyhead – Map & Images of Site



Holyhead – Statistics

Surge maxima	Value	Day	Time
January	0.601	15	09:15:00
February	0.8	3	23:00:00
March	0.417	31	10:30:00
April	0.437	5	06:00:00
May	0.669	23	13:00:00
June	0.352	13	03:15:00
July	0.356	6	21:30:00
August	0.316	10	14:15:00
September	0.614	6	06:30:00
October	0.535	24	00:15:00
November			
December			

Surge minima	Value	Day	Time
January	-0.347	23	19:45:00
February	-0.331	28	02:00:00
March	-0.331	3	18:15:00
April	-0.218	12	06:00:00
May	-0.186	24	05:15:00
June	-0.24	2	19:00:00
July	-0.143	1	01:15:00
August	-0.098	22	10:45:00
September	-0.184	18	14:45:00
October	-0.241	7	07:00:00
November			
December			

Extreme maxima	Value	Day	Time
January	5.927	5	10:45:00
February	6.29	19	10:45:00
March	6.127	20	10:30:00
April	6.045	19	10:45:00
May	5.838	18	23:00:00
June	5.935	17	23:30:00
July	5.891	31	22:45:00
August	6.164	31	23:45:00
September	6.297	28	22:45:00
October	6.028	25	21:00:00
November			
December			

Extreme minima	Value	Day	Time
January	0.054	22	18:15:00
February	0.189	20	17:45:00
March	-0.018	21	17:15:00
April	0.178	18	16:15:00
May	0.474	19	05:15:00
June	0.867	3	05:00:00
July	0.739	4	06:00:00
August	0.22	31	05:15:00
September	0.183	29	05:00:00
October	0.583	1	06:15:00
November			
December			

Mean sea level	No days	MSL
January	26	3.288
February	28	3.393
March	31	3.197
April	30	3.244
May	27	3.327
June	30	3.316
July	31	3.3
August	31	3.34
September	30	3.418
October	24	3.408
November	0	
December	0	
	Sum	Avg
	288	**

** No yearly average value as more than one month's MSL missing

Ilfracombe – Tide Gauge Information

Latitude 51° 12' 40.1" N **Longitude** 04° 06' 44.6" W **Grid Ref** SS 5255 4789

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** North west corner of the car park, east of Lantern Hill
Measuring Points Seaward side of Ilfracombe pier at the harbour entrance

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SS 5263 4791	OSBM Bolt on concrete pier, south angle of tide gauge hut
Aux1	SS 5245 4782	Pier Hotel, The Quay
Aux2	SS 5251 4789	St Nicholas chapel N face 6.1m from NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.80m below Ordnance Datum Newlyn (ODN)
TGZ = 12.379m below TGBM
TGZ = 10.76m below Aux1
TGZ = 32.541m below Aux2

Levelling No levelling was carried out in 2011

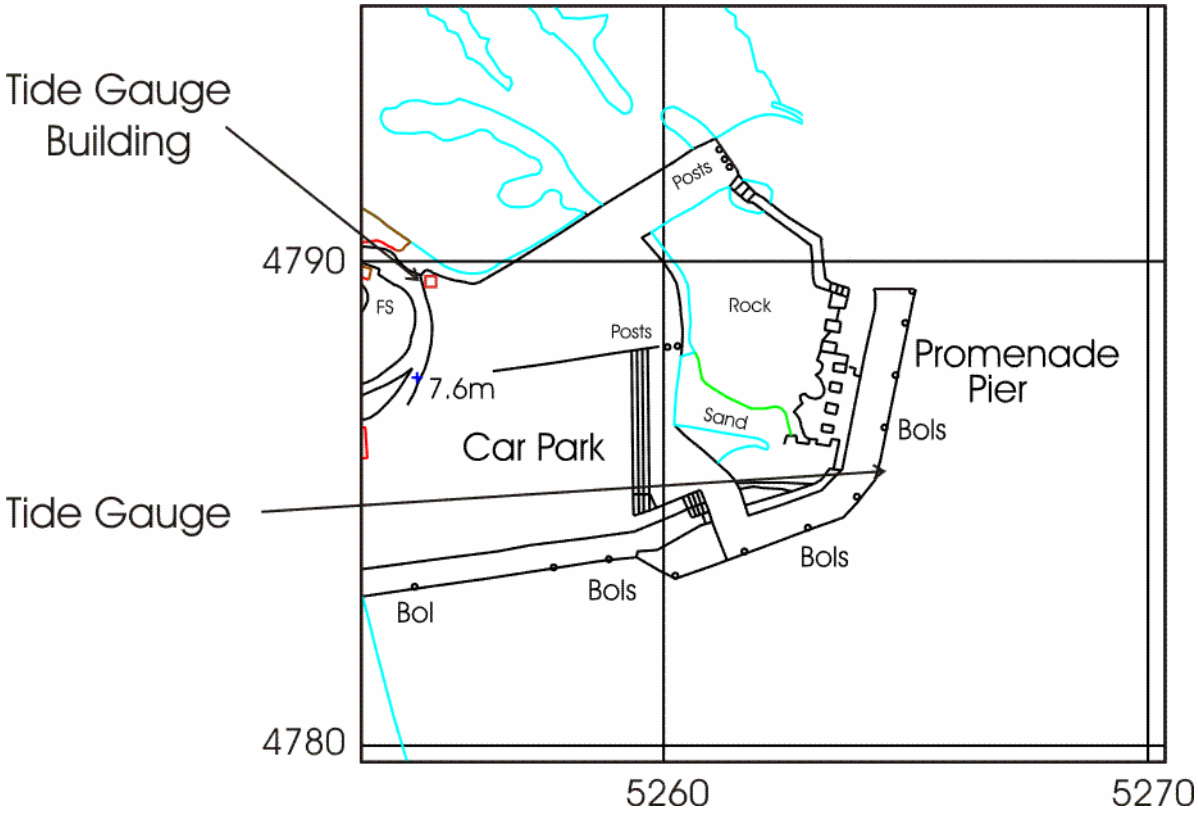
Site visits

Day 164	Delivered new outstation equipment.
Day 210	Repaired compressor non-return valve
Day 283	Installed new S500 outstation, migrated the site to Swantel and decommissioned DATARING logger

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	278-283	035-036,046-048,051-052,211,256,283-284,291,292,303,308,309,312,322,331,347,349

Ilfracombe – Map & Images of Site



Ilfracombe – Statistics

Surge maxima	Value	Day	Time
January	0.49	7	17:45:00
February	0.528	13	08:30:00
March	0.346	12	19:45:00
April	0.309	2	02:45:00
May	0.353	8	03:30:00
June	0.409	17	16:15:00
July	0.387	6	17:00:00
August	0.257	7	13:30:00
September	0.513	12	01:15:00
October	0.495	23	19:00:00
November	0.646	29	13:00:00
December	0.812	13	03:15:00

Surge minima	Value	Day	Time
January	-0.371	23	18:15:00
February	-0.32	28	21:00:00
March	-0.359	1	08:45:00
April	-0.341	12	01:00:00
May	-0.294	15	01:45:00
June	-0.23	1	18:15:00
July	-0.173	1	06:00:00
August	-0.141	22	13:15:00
September	-0.335	29	18:15:00
October	-0.152	14	08:15:00
November	-0.329	27	14:15:00
December	-0.33	28	22:00:00

Extreme maxima	Value	Day	Time
January	9.448	22	07:30:00
February	10.14	20	07:15:00
March	9.988	21	06:45:00
April	9.849	19	18:45:00
May	9.429	18	18:30:00
June	9.39	17	19:00:00
July	9.335	31	18:30:00
August	9.959	31	19:30:00
September	10.079	28	18:30:00
October	10.098	27	05:45:00
November	9.736	26	06:15:00
December	9.438	26	06:45:00

Extreme minima	Value	Day	Time
January	0.259	23	02:00:00
February	0.337	22	02:15:00
March	-0.063	22	01:15:00
April	0.24	18	11:45:00
May	0.62	19	00:45:00
June	1.147	17	00:30:00
July	1.041	31	12:00:00
August	0.285	31	01:00:00
September	0.125	29	13:00:00
October	0.394	28	12:30:00
November	0.508	27	13:00:00
December	0.809	26	12:45:00

Mean sea level	No days	MSL
January	31	4.983
February	25	5.018
March	31	4.866
April	30	4.911
May	31	4.947
June	30	4.99
July	31	4.988
August	31	5.004
September	28	5.042
October	23	5.097
November	30	5.134
December	29	5.077
	Sum	Avg
	350	5.005

Immingham – Tide Gauge Information

Latitude 53° 37' 48.8" N **Longitude** 00° 11' 14.7" W **Grid Ref** TA 1996 1638

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Entrance to Immingham Docks, east of the lock gates
Measuring Points Fixed to a leg of the lead-in jetty on the east side of the dock entrance

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TA 1989 1630	Docks office, north angle, north east face
Aux1	TA 2005 1631	Customs house, east angle, north east face
Aux2	TA 1994 1640	Bolt on concrete base of tide gauge building
Aux3	TA 2000 1648	Stud in camera tower

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.90m below ODN
TGZ = 9.131m below TGBM

Levelling No levelling was carried out in 2011

Site visits

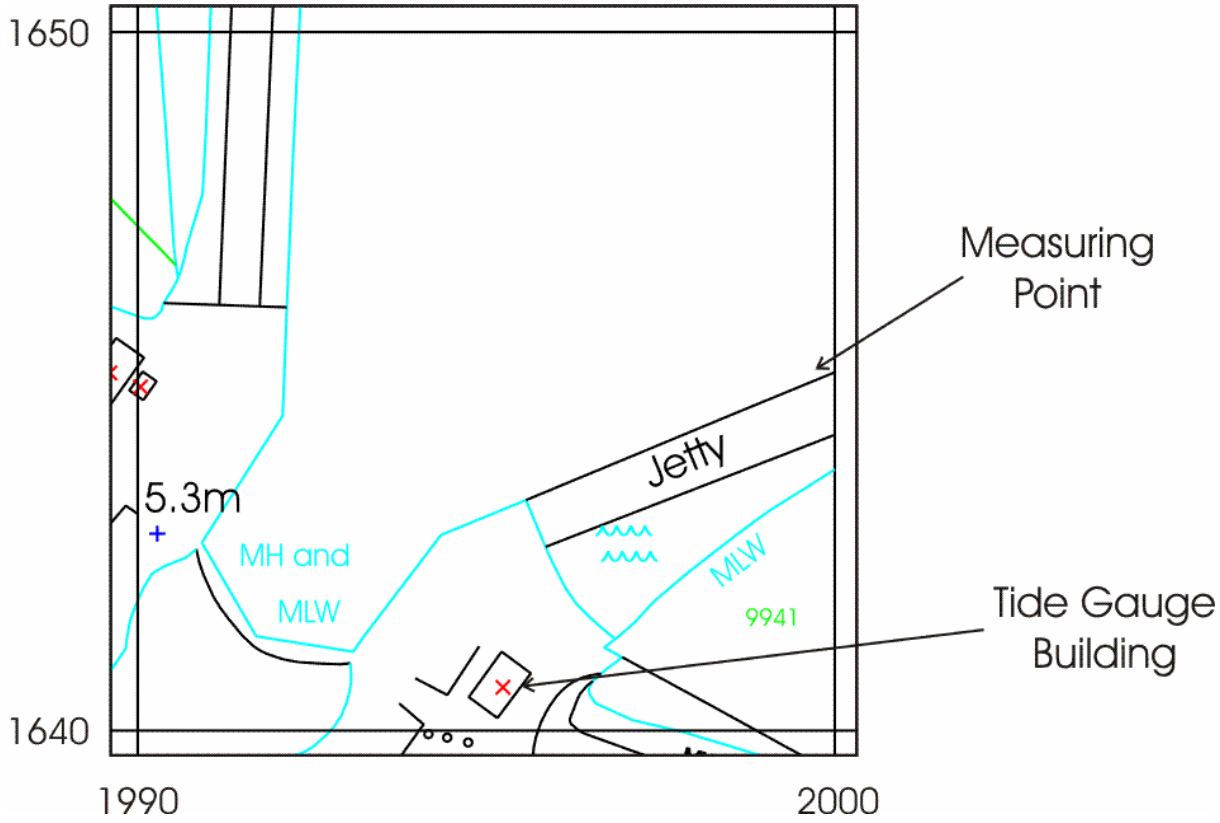
Day 035	Installed S500 telemetry outstation to be wired in parallel to DATARING logger for a test period
Day 047	Reworked outstation installation as it was disrupting DATARING
Day 049	Further investigated disruption to DATARING
Day 132	EA on site to upgrade outstation
Day 182	Compressor change and maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
97	15 minutes	035-046,049	021-023,047-048,050-059,061-069,075,077-083,092-097,101,106-122,126,132-218,239-246,248,256-259,261-275,277-365

Notes on Completeness/Quality
TGI made multiple visits in February to investigate faults arising from the new logger. Problems also arose following an upgrade in May. For the rest of the year, the primary channel was up to ~70 mm low. The pressure points are believed to be blocking periodically, due to siltation. A diving operation is required to clear this but, due to dangerous conditions, the Port Authority is reluctant to issue diving permits. TGI are therefore exploring alternative means of resolving this problem, including the possibility of installing alternative and more readily accessible steelwork.

Immingham – Map & Images of Site



Immingham – Statistics

Surge maxima	Value	Day	Time
January	0.694	11	16:45:00
February	0.585	3	02:45:00
March	0.349	9	15:30:00
April	0.355	8	13:15:00
May	0.802	24	06:45:00
June	-0.121	1	00:15:00
July			
August	0.422	29	11:45:00
September	0.509	7	05:45:00
October	0.724	4	06:00:00
November			
December			

Surge minima	Value	Day	Time
January	-0.463	12	14:15:00
February	-8.617	16	15:15:00
March	-0.439	14	13:45:00
April	-0.299	4	20:00:00
May	-0.718	23	19:15:00
June	-0.124	1	00:00:00
July			
August	-0.309	10	11:30:00
September	-0.565	6	11:15:00
October	-0.459	9	05:30:00
November			
December			

Extreme maxima	Value	Day	Time
January	7.45	6	19:00:00
February	7.669	21	20:00:00
March	7.815	21	19:00:00
April	7.572	19	19:00:00
May	7.403	19	06:45:00
June	1.899	1	00:15:00
July			
August	7.74	31	07:15:00
September	7.737	28	06:00:00
October	7.461	1	08:15:00
November			
December			

Extreme minima	Value	Day	Time
January	0.537	23	02:30:00
February	-2.434	16	15:15:00
March	0.329	20	00:30:00
April	0.402	19	00:45:00
May	1.008	18	12:45:00
June	1.735	1	00:00:00
July			
August	0.496	31	13:45:00
September	0.396	29	13:30:00
October	0.91	1	02:15:00
November			
December			

Mean sea level	No days	MSL
January	31	4.208
February	2	*
March	16	4.086
April	25	4.155
May	11	*
June	0	
July	0	
August	23	4.244
September	14	*
October	5	*
November	0	
December	0	
	Sum	Avg
	127	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Port Erin (Isle Of Man) – Tide Gauge Information

Latitude 54° 05' 07.4" N **Longitude** 04° 46' 05.0" W **Grid Ref** SC 1904 6904

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Port Erin lifeboat station
Measuring Points Close to the end of the lifeboat slipway (the mid-tide pressure point is attached to a concrete leg of the boathouse)

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SC 1904 6901	Bolt SE corner of the RNLI boathouse
Aux 2		Bolt on seawall NW of Marine labs
Aux 3	SC 1928 6903	Bolt base of light tower Raglan pier

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Local (ODL)
TGZ = 9.288m below TGBM

Levelling No levelling was carried out in 2011

Site visits
Day 006 Visit with EA electrical contractor for new telemetry enabling works site survey. Carried out maintenance.
Day 276 Installed new S500 datalogger, decommissioned DATARING and migrated to Swantel telemetry

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
98	15 minutes	271-277,278	241,249-259,268-271,277-278,283,294,338

Port Erin (Isle Of Man) – Map & Images of Site

Image: Isle of Man Government ©Google 2011

Port Erin (Isle Of Man) – Statistics

Surge maxima	Value	Day	Time
January	0.571	15	12:30:00
February	0.789	4	01:00:00
March	0.457	31	11:45:00
April	0.397	1	17:00:00
May	0.711	23	14:00:00
June	0.306	17	16:45:00
July	0.298	6	22:15:00
August	0.28	10	13:30:00
September	0.419	6	05:00:00
October	0.47	24	03:15:00
November	0.78	29	11:00:00
December	1.027	8	14:45:00

Surge minima	Value	Day	Time
January	-0.423	23	12:45:00
February	-0.386	28	03:45:00
March	-0.381	3	19:30:00
April	-0.247	12	07:00:00
May	-0.251	26	18:30:00
June	-0.268	2	19:45:00
July	-0.213	29	10:30:00
August	-0.157	9	05:00:00
September	-0.474	25	22:15:00
October	-0.261	7	07:00:00
November	-0.253	27	17:00:00
December	-0.362	29	02:00:00

Extreme maxima	Value	Day	Time
January	5.549	5	11:45:00
February	5.836	19	11:45:00
March	5.703	20	11:15:00
April	5.593	19	11:45:00
May	5.417	18	11:30:00
June	5.514	18	00:30:00
July	5.467	31	23:45:00
August	5.672	31	00:00:00
September	5.713	1	00:45:00
October	5.892	26	22:30:00
November	5.918	29	13:45:00
December	5.724	13	12:30:00

Extreme minima	Value	Day	Time
January	-0.271	22	19:15:00
February	-0.079	20	18:45:00
March	-0.266	21	18:15:00
April	-0.112	18	17:15:00
May	0.159	19	06:00:00
June	0.437	4	06:30:00
July	0.336	4	07:00:00
August	-0.087	31	06:15:00
September	0.036	1	07:00:00
October	0.139	28	05:30:00
November	0.081	27	18:30:00
December	0.42	27	19:00:00

Mean sea level	No days	MSL
January	31	2.896
February	28	2.98
March	31	2.774
April	30	2.821
May	31	2.894
June	30	2.886
July	31	2.867
August	31	2.916
September	11	*
October	26	3.035
November	30	3.091
December	31	3.055
	Sum	Avg
	341	2.933

* No mean sea level value as more than 15 days of data missing

Port Ellen (Isle of Islay) – Tide Gauge Information

Latitude 55° 37' 39.3" N **Longitude** 06° 11' 23.7" W **Grid Ref** NR 3636 4508

Instrument Data acquisition system with two full-tide bubbler gauges. Decommissioned February 2011.

Location
- **Tide Gauge Building** Caledonian MacBrayne storeroom next to Port Ellen ferry terminal
- **Measuring Points** South west of the ferry terminal offices

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NR 3635 4507	Bolt SE side Booking Office
Aux1	NR 3642 4515	Rivet angle wall NW side entrance to pier
Aux2	NR 3651 4526	Police Station SE side of road SW face W angle
Aux3	NR 3635 4521	Sea Farm C gable NW face W angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 0.19m below Ordnance Datum Newlyn (ODN)
TGZ = 2.839m below TGBM

Levelling No levelling was carried out in 2011

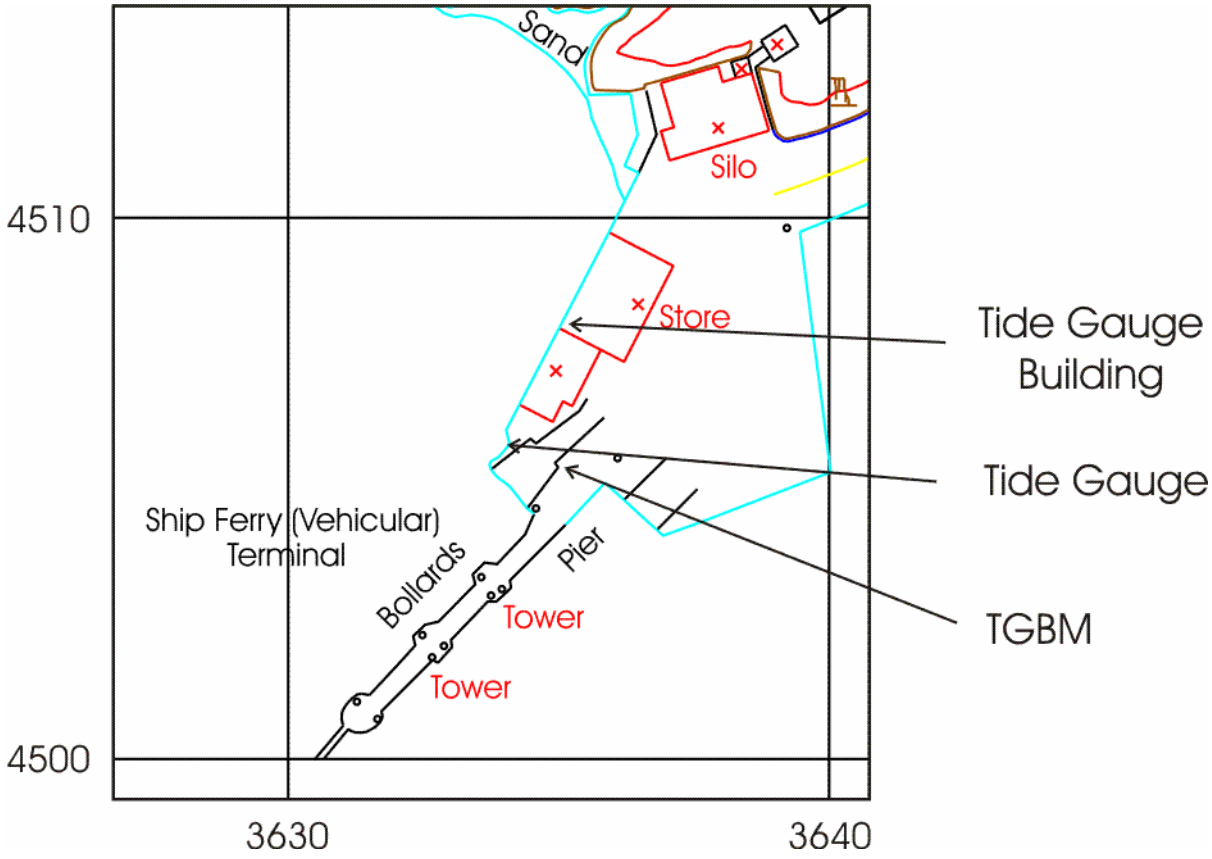
Site visits
Day 038 Removed all equipment pending redevelopment of the site. Port will provide brick building to house TG upon completion of redevelopment.

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
10	15 minutes	038-365	None

Notes on Completeness/Quality
Gauge was removed from network due to site refurbishment on 08 February 2011

Port Ellen (Isle of Islay) – Map & Images of Site



Port Ellen (Isle of Islay) – Statistics

Surge maxima	Value	Day	Time
January	0.661	15	13:30:00
February	0.848	4	01:45:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Surge minima	Value	Day	Time
January	-0.411	23	14:15:00
February	-0.142	1	19:45:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme maxima	Value	Day	Time
January	1.28	5	05:45:00
February	1.422	4	02:30:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme minima	Value	Day	Time
January	-0.494	23	01:00:00
February	0.112	1	20:45:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Mean sea level	No days	MSL
January	31	0.525
February	6	*
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
	Sum	Avg
	37	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

St Helier (Jersey) – Tide Gauge Information

Latitude 49° 10' 34" N **Longitude** 02° 06' 51 " W **Grid Ref** 13/11 6466 4763

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Victoria Pier, adjacent to the Port Control building
Measuring Points inside wall of the pier, 2m from the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	13/11 6465 4764	Pin bollard Victoria Pier
Aux1	13/11 6516 4764	Cut mark wall N side of road Mount Bingham
Aux2	13/11 6509 4780	"J" stone E face wall car park South Hill
Aux3	13/11 6507 4779	Cut mark S face wall car park South Hill
Aux4	13/11 6506 4784	Cut mark E face wall E side Commercial Rd

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.88m below Ordnance Datum Local (ODL)
TGZ = 13.658m below TGBM

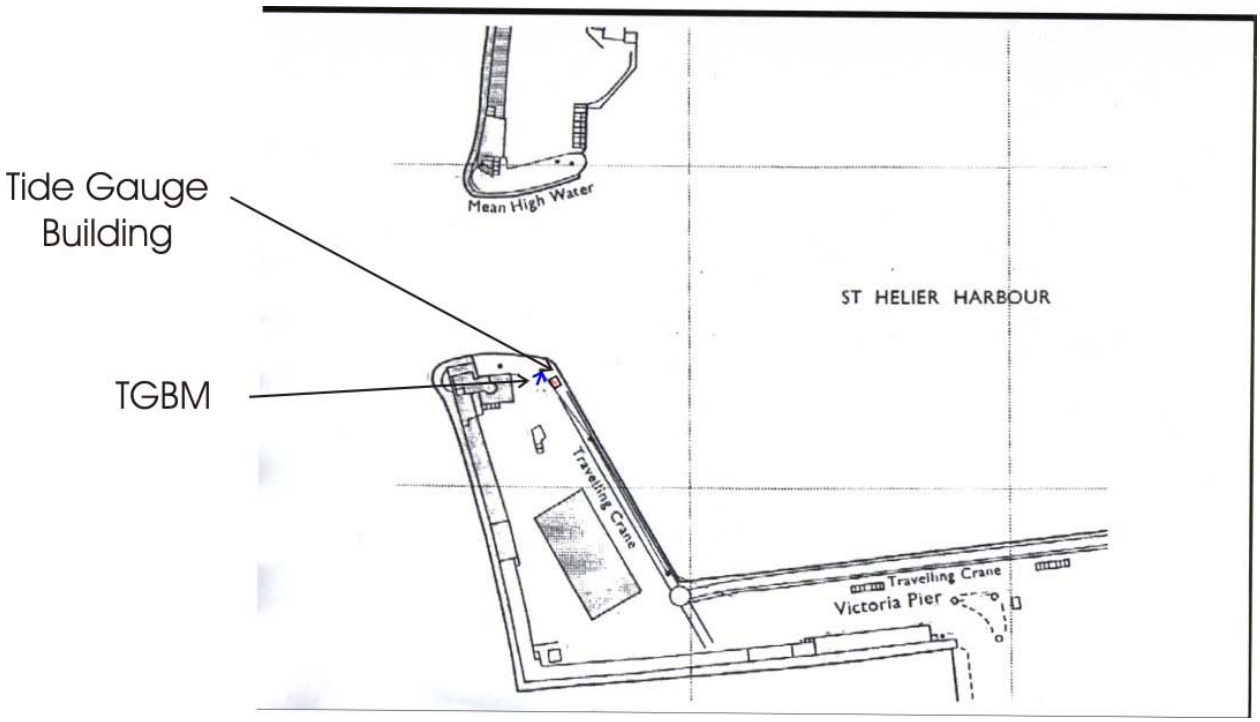
Levelling No levelling was carried out in 2011

Site visits
Day 252 Site survey with electrician for enabling works in advance of new telemetry system
Day 289-291 Installed new S500 datalogger, carried out general maintenance and migrated the site to Swantel

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	250-251,290-292	292-293,295,298,317,319

St Helier (Jersey) – Map & Images of Site



St Helier (Jersey) – Statistics

Surge maxima	Value	Day	Time
January	0.604	8	05:45:00
February	0.545	16	12:15:00
March	0.32	12	19:15:00
April	0.29	30	00:30:00
May	0.264	8	04:30:00
June	0.573	17	17:15:00
July	0.516	17	04:15:00
August	0.374	14	03:15:00
September	0.363	6	11:15:00
October	0.506	24	19:00:00
November	0.477	3	13:15:00
December	1.006	16	01:00:00

Surge minima	Value	Day	Time
January	-0.604	23	06:15:00
February	-0.385	28	07:45:00
March	-0.549	23	18:30:00
April	-0.362	12	12:00:00
May	-0.318	15	11:45:00
June	-0.302	1	09:15:00
July	-0.254	26	04:30:00
August	-0.331	30	21:30:00
September	-0.38	27	15:30:00
October	-0.326	28	16:30:00
November	-0.442	26	02:30:00
December	-0.372	24	14:00:00

Extreme maxima	Value	Day	Time
January	11.313	22	08:00:00
February	12.077	20	07:45:00
March	11.966	21	07:30:00
April	11.774	19	07:00:00
May	11.211	18	19:00:00
June	11.13	17	19:30:00
July	11.073	31	18:45:00
August	11.822	31	20:00:00
September	11.962	28	19:00:00
October	11.908	27	06:15:00
November	11.425	27	07:30:00
December	11.099	26	07:15:00

Extreme minima	Value	Day	Time
January	0.519	22	15:00:00
February	0.343	20	14:30:00
March	0.048	21	14:15:00
April	0.509	18	13:00:00
May	0.908	18	01:00:00
June	1.446	17	01:30:00
July	1.453	4	02:30:00
August	0.491	31	02:00:00
September	0.342	29	01:45:00
October	0.626	28	13:45:00
November	0.838	26	13:30:00
December	1.087	26	14:00:00

Mean sea level	No days	MSL
January	31	5.998
February	28	6.023
March	31	5.898
April	30	5.949
May	31	5.966
June	30	6.022
July	31	6.019
August	31	6.036
September	26	6.05
October	27	6.072
November	30	6.134
December	31	6.139
	Sum	Avg
	357	6.026

Kinlochbervie – Tide Gauge Information

Latitude 58° 27' 23.8" N **Longitude** 05° 03' 01.3" W **Grid Ref** NC 2213 5608

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the ice plant, on the pier
Measuring Points On a leg of the jetty beneath the ice plant

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NC 2206 5613	Bolt S side harbour 19.5M SE angle of building
Aux1	NC 2210 5612	Rivet iceplant 7.45M from S angle of building
Aux2	NC 2210 5614	Rivet inside iceplant 3.5M E door
Aux3	NC 2203 5626	Rivet 12.3M SE N angle of building
Aux4	NC 2213 5621	Rivet 2.5M NW inside corner NE steps

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.50m below Ordnance Datum Newlyn (ODN)
TGZ = 7.213m below TGBM

Levelling No levelling was carried out in 2011

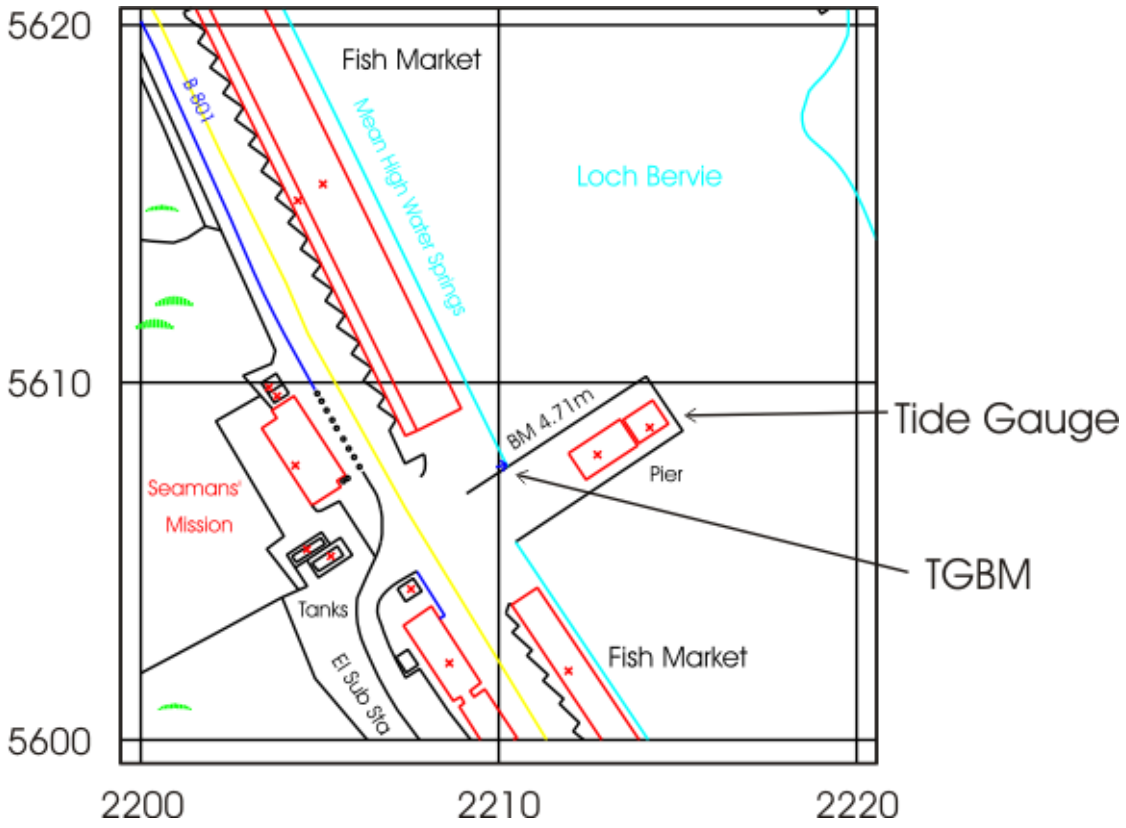
Site visits

Day 054	Maintenance and electrical survey with EA contractor in preparation for telemetry outstation enabling works
Day 188	Delivered new outstation equipment to site
Day 236	Installed new S500 telemetry outstation and migrated system to Swantel
Day 238	Replaced 1Kw heater in TG building
Day 329	Compressor change and maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	234-235,236	234,235-236,251,317,329,341,365

Kinlochbervie – Map & Images of Site



Kinlochbervie – Statistics

Surge maxima	Value	Day	Time
January	0.6	15	17:45:00
February	1.05	3	22:15:00
March	0.454	10	07:00:00
April	0.501	5	02:15:00
May	0.844	23	19:00:00
June	0.285	1	07:30:00
July	0.325	16	03:00:00
August	0.314	20	06:45:00
September	0.642	12	15:00:00
October	0.584	3	19:00:00
November	0.957	27	03:15:00
December	0.912	28	12:45:00

Surge minima	Value	Day	Time
January	-0.481	23	17:30:00
February	-0.359	28	11:00:00
March	-0.514	13	22:00:00
April	-0.211	26	11:30:00
May	-0.243	26	21:45:00
June	-0.221	4	23:00:00
July	-0.248	28	23:00:00
August	-0.187	28	15:45:00
September	-0.169	18	23:00:00
October	-0.26	7	06:15:00
November	-0.26	13	08:45:00
December	-0.455	30	04:30:00

Extreme maxima	Value	Day	Time
January	5.145	5	07:45:00
February	5.49	21	09:00:00
March	5.471	21	08:00:00
April	5.156	18	19:15:00
May	5.304	18	19:45:00
June	5.062	16	19:30:00
July	5.092	31	19:45:00
August	5.234	30	20:00:00
September	5.561	28	19:30:00
October	5.518	27	07:00:00
November	5.769	24	18:30:00
December	5.664	28	09:45:00

Extreme minima	Value	Day	Time
January	-0.022	22	15:15:00
February	0.201	20	14:45:00
March	-0.038	22	15:15:00
April	0.08	18	13:30:00
May	0.559	17	12:45:00
June	0.715	4	02:45:00
July	0.588	4	03:00:00
August	0.013	31	02:30:00
September	0.171	1	03:00:00
October	0.385	28	01:45:00
November	0.702	26	01:30:00
December	0.652	27	15:30:00

Mean sea level	No days	MSL
January	31	2.887
February	28	2.991
March	31	2.765
April	30	2.823
May	31	2.917
June	30	2.846
July	31	2.788
August	26	2.859
September	30	3.036
October	31	3.061
November	30	3.132
December	31	3.109
	Sum	Avg
	359	2.934

Leith – Tide Gauge Information

Latitude 55° 59' 23.4"N **Longitude** 03° 10' 54.1"W **Grid Ref** NT 2638 7806

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Lead-in jetty, east of the entrance to Leith docks
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NT 2643 7797	OSBM Bolt SE end of TG pier 0.9m N angle of pier
Aux1	NT 2648 7797	Rivet on top step SW side of road 1.6m S angle of building
Aux2	NT 2653 7789	Rivet top step SW side of road 11.9M W angle of building

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.90m below Ordnance Datum Newlyn (ODN)
TGZ = 7.84mm below TGBM

Levelling No levelling was carried out in 2011

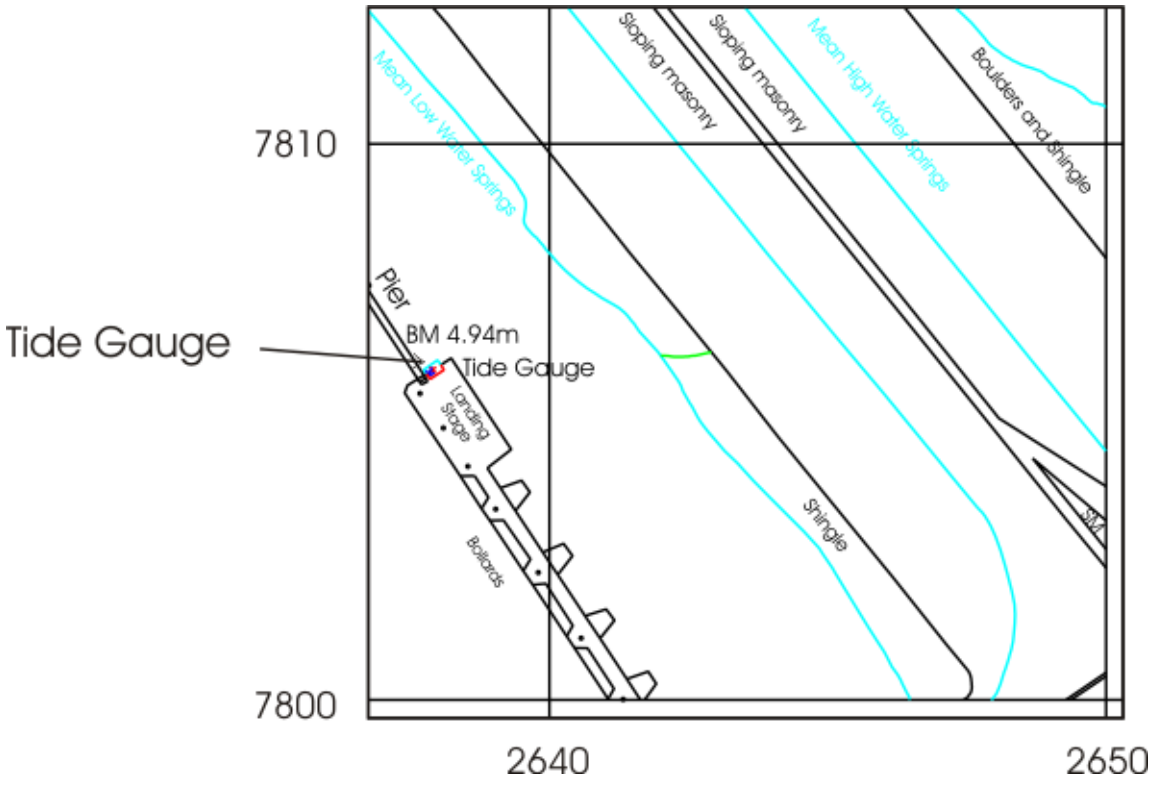
Site visits

Day 042	General maintenance and survey for telemetry outstation enabling works with EA contractor
Day 188	Delivered outstation equipment, oversaw electrical installation and carried out general maintenance
Day 221	Repaired compressor
Day 258	Installed S500 datalogger and migrated to Swantel telemetry outstation

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	259	195-196,217-221,258,259,306,310,314,333

Leith – Map & Images of Site



Leith – Statistics

Surge maxima	Value	Day	Time
January	0.483	16	03:00:00
February	1.425	4	11:00:00
March	0.482	8	19:30:00
April	0.359	5	15:30:00
May	0.567	24	03:00:00
June	0.295	18	05:15:00
July	0.305	17	02:30:00
August	0.294	11	00:15:00
September	0.417	7	08:45:00
October	0.698	4	03:00:00
November	0.914	27	13:45:00
December	1.187	25	23:15:00

Surge minima	Value	Day	Time
January	-0.352	23	12:00:00
February	-0.818	3	23:00:00
March	-0.419	3	09:30:00
April	-0.194	15	09:45:00
May	-0.885	23	16:30:00
June	-0.227	1	05:30:00
July	-0.193	27	08:15:00
August	-0.207	28	08:15:00
September	-0.243	12	16:15:00
October	-0.269	13	22:45:00
November	-0.533	28	00:45:00
December	-1.39	8	17:15:00

Extreme maxima	Value	Day	Time
January	5.605	5	15:15:00
February	5.972	21	16:45:00
March	6.079	21	15:30:00
April	5.962	19	15:15:00
May	5.821	18	15:00:00
June	5.761	18	04:00:00
July	5.753	17	03:30:00
August	6.057	31	03:30:00
September	6.218	29	03:15:00
October	6.14	27	02:00:00
November	6.416	27	15:15:00
December	6.145	26	03:00:00

Extreme minima	Value	Day	Time
January	-0.013	22	22:45:00
February	-0.052	19	21:30:00
March	0.001	20	21:15:00
April	0.063	18	20:45:00
May	0.581	17	20:30:00
June	0.794	3	09:15:00
July	0.501	31	08:45:00
August	0.125	31	10:00:00
September	0.141	29	09:30:00
October	0.325	27	08:30:00
November	0.552	26	09:00:00
December	0.207	8	18:45:00

Mean sea level	No days	MSL
January	31	3.176
February	28	3.198
March	31	3.062
April	30	3.126
May	31	3.159
June	30	3.19
July	28	3.168
August	26	3.213
September	28	3.284
October	31	3.287
November	30	3.329
December	31	3.309
	Sum	Avg
	355	3.208

Lerwick – Tide Gauge Information

Latitude 60° 09' 14.5" N **Longitude** 01° 08' 25.1" W **Grid Ref** HU 4783 4137

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Inner wall at breakwater entrance to the small boat harbour, south of Victoria Pier
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	HU 4783 4129	OSBM bolt on breakwater wall
Aux1	HU 4784 4125	Queen's Hotel 7.5m SW face south angle
Aux2	HU 4777 4110	Lerwick Parish Church North face NW angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.22m below Ordnance Datum Local (ODL)
TGZ = 4.57m below TGBM

Levelling No levelling was carried out in 2011

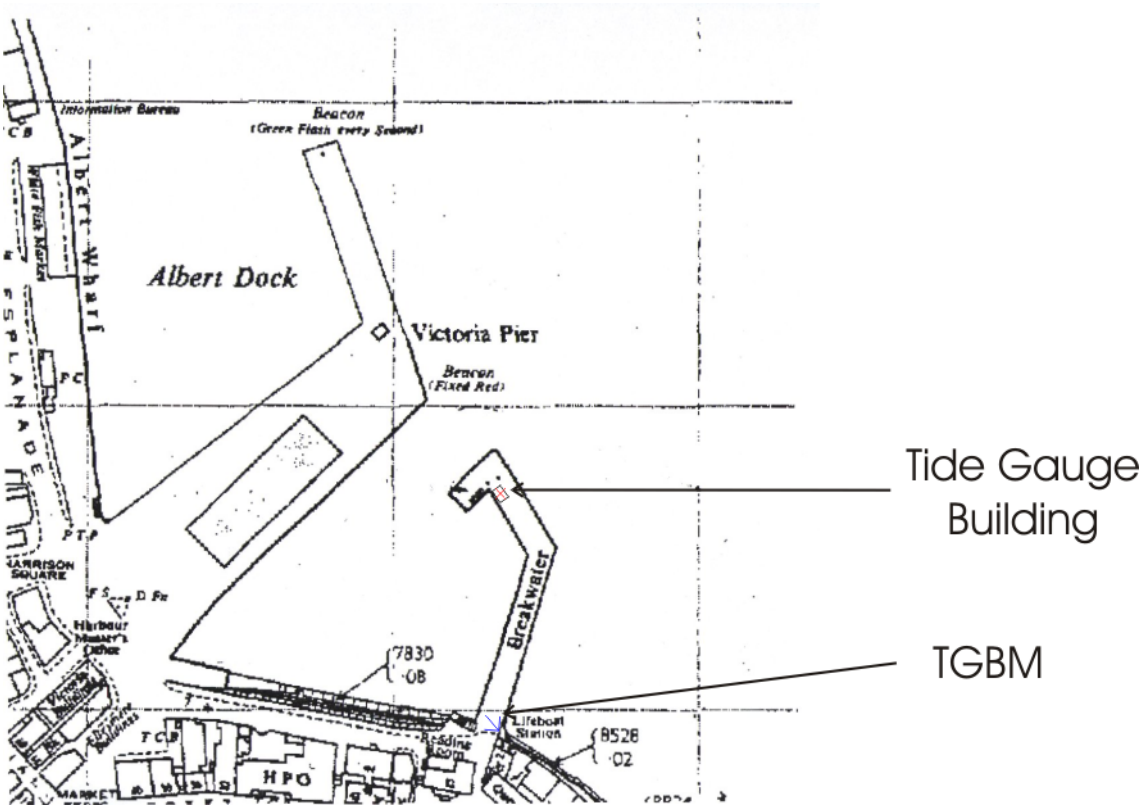
Site visits
None

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	001-174

Notes on Completeness/Quality
From January, the primary channel was reading ~30-50 mm low, possibly due to siltation, but the secondary channel was not affected. The problem resolved itself during June.

Lerwick – Map & Images of Site



Lerwick – Statistics

Surge maxima	Value	Day	Time
January			
February			
March			
April			
May			
June	0.219	27	20:45:00
July	0.23	17	03:45:00
August	0.27	7	14:30:00
September	0.449	12	21:00:00
October	0.416	4	04:15:00
November	0.525	25	14:15:00
December	0.587	13	21:30:00

Surge minima	Value	Day	Time
January			
February			
March			
April			
May			
June	-0.068	30	15:00:00
July	-0.146	29	09:15:00
August	-0.158	28	19:15:00
September	-0.092	30	22:30:00
October	-0.212	13	10:15:00
November	-0.178	13	08:45:00
December	-0.168	18	23:00:00

Extreme maxima	Value	Day	Time
January			
February			
March			
April			
May			
June	1.95	30	22:15:00
July	2.368	16	23:45:00
August	2.354	30	23:30:00
September	2.577	12	23:00:00
October	2.48	30	01:15:00
November	2.788	25	11:00:00
December	2.759	25	23:30:00

Extreme minima	Value	Day	Time
January			
February			
March			
April			
May			
June	0.597	30	04:00:00
July	0.244	4	06:30:00
August	0.096	31	06:00:00
September	0.178	28	05:00:00
October	0.363	28	05:15:00
November	0.575	27	18:00:00
December	0.406	27	18:45:00

Mean sea level	No days	MSL
January	0	
February	0	
March	0	
April	0	
May	0	
June	7	*
July	31	1.264
August	31	1.324
September	30	1.432
October	31	1.452
November	30	1.484
December	31	1.539
	Sum	Avg
	191	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Liverpool – Tide Gauge Information

Latitude 53° 26' 58.9" N **Longitude** 03° 01' 04.8" W **Grid Ref** SJ 3249 9525

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the old Lock Keeper's office at the entrance to Gladstone Dock
Measuring Points Seaward side of Gladstone Dock

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SJ 3249 9525	NBM rivet NE face E angle base of building
Aux1	SJ 3250 9523	Rivet E side of quay above hinge SW dock gate
Aux2	SJ 3244 9538	Building wall E face SE angle
Aux3	SJ 3294 9558	Rivet concrete adjacent to building No 335

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.93m below Ordnance Datum Newlyn (ODN)
TGZ = 14.475m below TGBM

Levelling No levelling was carried out in 2011

Site visits

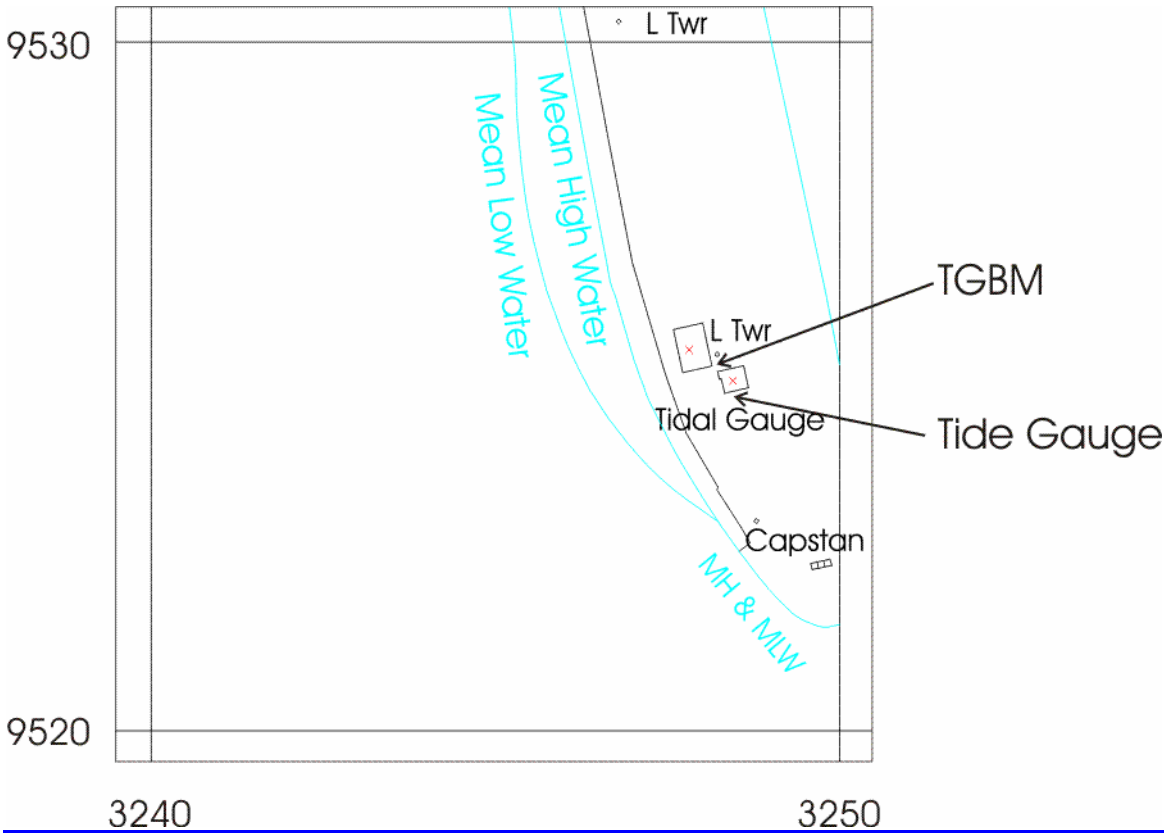
Day 018	Installed new S500 telemetry equipment in parallel to DATARING logger for test period
Day 061	Outstation testing/upgrade
Day 132	Outstation testing/upgrade
Day 186	Installed line voltage conditioner
Day 207	Removed S500 logger for bench-testing and replaced with another S500 device
Day 209	Replaced SIM card

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	001-005,007-008,010,012-013,016-022,026-033,035-058,061-067,070-071,073-129,130-133,136-141,159,161,165-166,177,184-185,209,228,287-289,356-357,359-362,364-365

Notes on Completeness/Quality
A line voltage conditioner was installed and the logger was replaced. Problems with the new logger interface board affected data quality during May and June. The primary channel was ~50 mm high at times from June to December, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring.

Liverpool – Map & Images of Site



Liverpool – Statistics

Surge maxima	Value	Day	Time
January	0.785	15	14:00:00
February	1.178	7	09:45:00
March	0.801	10	08:30:00
April	0.672	5	07:30:00
May	1.218	23	11:30:00
June	0.435	12	23:45:00
July	0.533	17	19:45:00
August	0.512	10	15:15:00
September	1.067	12	17:45:00
October	1.063	17	17:45:00
November	1.221	27	06:45:00
December	1.664	8	16:45:00

Surge minima	Value	Day	Time
January	-0.617	22	21:15:00
February	-0.387	28	17:30:00
March	-0.507	22	21:15:00
April	-0.25	17	18:30:00
May	-0.191	15	07:15:00
June	-0.281	2	20:15:00
July	-0.19	12	04:00:00
August	-0.132	31	08:30:00
September	-0.302	28	07:15:00
October	-0.28	1	09:30:00
November	-0.318	27	20:30:00
December	-0.373	30	08:45:00

Extreme maxima	Value	Day	Time
January	9.635	22	12:45:00
February	10.215	20	12:15:00
March	10.159	21	12:00:00
April	10.009	19	11:30:00
May	9.695	18	23:45:00
June	9.634	18	00:15:00
July	9.596	17	00:00:00
August	10.049	31	00:00:00
September	10.249	28	23:30:00
October	10.205	27	10:45:00
November	10.306	29	13:45:00
December	9.885	26	12:00:00

Extreme minima	Value	Day	Time
January	0.4	22	20:00:00
February	0.263	20	19:45:00
March	0.174	21	19:15:00
April	0.391	18	18:00:00
May	0.929	17	17:45:00
June	1.361	17	06:30:00
July	1.221	4	07:30:00
August	0.478	31	07:15:00
September	0.332	29	06:45:00
October	0.682	28	06:30:00
November	0.929	27	19:15:00
December	1.215	27	19:45:00

Mean sea level	No days	MSL
January	18	5.34
February	18	5.392
March	19	5.294
April	27	5.257
May	26	5.343
June	29	5.324
July	31	5.315
August	31	5.368
September	30	5.454
October	28	5.468
November	30	5.462
December	24	5.587
	Sum	Avg
	311	5.384

Llandudno – Tide Gauge Information

Latitude 53° 19' 54.0" N **Longitude** 03° 49' 30.8" W **Grid Ref** SH 7855 8319

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** A sub-platform under the pavilion at the end of Llandudno pier
Measuring Points A leg of the pier below the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SH 7834 8292	Rivet stone butt gate entrance
Aux1	SH 7827 8255	OSBM bolt concrete step SE side of slipway
Aux2	SH 7840 8243	OSBM bolt bottom concrete step
Aux3	SH 7864 8229	OSBM bolt concrete ramp 6.5M NW C slipway

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.85m below Ordnance Datum Newlyn (ODN)
TGZ = 12.558m below TGBM

Levelling No levelling was carried out in 2011

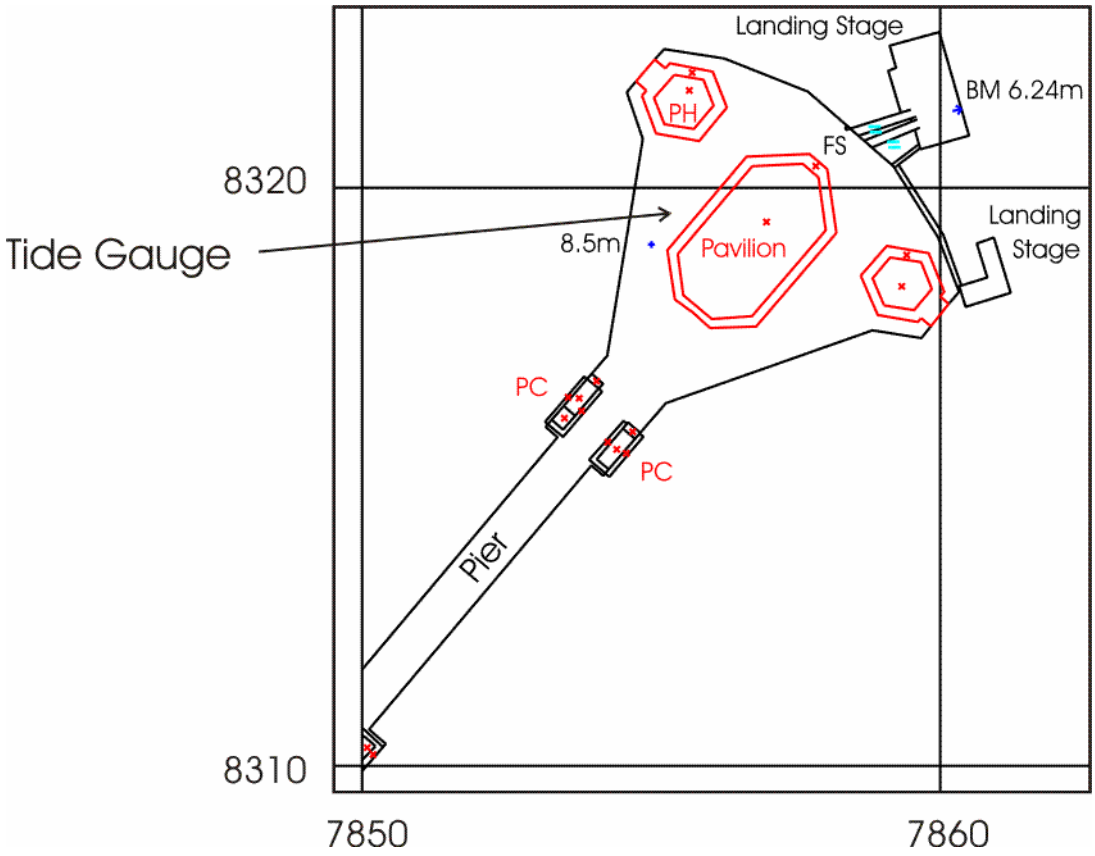
Site visits

Day 020	Maintenance and electrical survey work
Day 061	Delivered outstation equipment
Day 077	Electrical installation
Day 160	Completed S500 outstation installation, to run in parallel with DATARING logger for trial period
Day 183	Replaced compressor and battery
Day 215	Replaced compressor
Day 349	Decommissioned DATARING logger and completed migration to Swantel

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	160,306	021,028,038,172,179

Llandudno – Map & Images of Site



Llandudno – Statistics

Surge maxima	Value	Day	Time
January	0.563	15	09:15:00
February	0.772	4	00:15:00
March	0.474	31	10:45:00
April	0.466	5	07:30:00
May	0.753	23	11:30:00
June	0.307	13	00:00:00
July	0.294	6	22:15:00
August	0.275	10	14:30:00
September	0.64	6	07:45:00
October	0.633	17	17:30:00
November	0.728	29	13:30:00
December	1.11	8	13:45:00

Surge minima	Value	Day	Time
January	-0.497	26	14:00:00
February	-0.403	28	03:00:00
March	-0.416	3	08:15:00
April	-0.28	12	05:30:00
May	-0.43	26	19:30:00
June	-0.317	2	20:30:00
July	-0.229	29	09:15:00
August	-0.284	9	02:15:00
September	-0.243	19	00:00:00
October	-0.341	7	05:15:00
November	-0.343	27	14:45:00
December	-0.42	29	03:30:00

Extreme maxima	Value	Day	Time
January	7.796	22	12:15:00
February	8.365	19	11:15:00
March	8.251	21	11:30:00
April	8.149	19	11:15:00
May	7.855	17	22:30:00
June	7.84	17	23:45:00
July	7.786	16	23:30:00
August	8.211	30	23:30:00
September	8.397	28	23:00:00
October	8.351	27	10:15:00
November	8.3	29	13:30:00
December	8.018	26	11:30:00

Extreme minima	Value	Day	Time
January	-0.283	22	19:00:00
February	-0.299	20	18:45:00
March	-0.439	21	18:15:00
April	-0.223	18	17:15:00
May	0.195	19	06:00:00
June	0.658	17	05:45:00
July	0.485	4	07:00:00
August	-0.166	31	06:15:00
September	-0.208	29	06:00:00
October	0.015	28	05:30:00
November	0.1	27	18:30:00
December	0.474	27	19:00:00

Mean sea level	No days	MSL
January	31	4.051
February	28	4.118
March	25	3.934
April	30	3.979
May	31	4.036
June	22	4.055
July	28	4.039
August	27	4.083
September	30	4.16
October	31	4.154
November	30	4.203
December	28	4.188
	Sum	Avg
	341	4.083

Lowestoft – Tide Gauge Information

Latitude 52° 28' 23.2" N **Longitude** 01° 45' 00.4" E **Grid Ref** TM 5478 9274

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** East of the Harbour Master's office
Measuring Points On the quay wall, east of the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TM 5482 9273	Bolt on quay wall S side of pier
Aux1	TM 5477 9272	Bolt on concrete jetty at SW corner of TG building
Aux2	TM 5478 9274	CM Harbour Masters Office SE angle S face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.50m below Ordnance Datum Newlyn (ODN)
TGZ = 4.483m below TGBM

Levelling No levelling was carried out in 2011

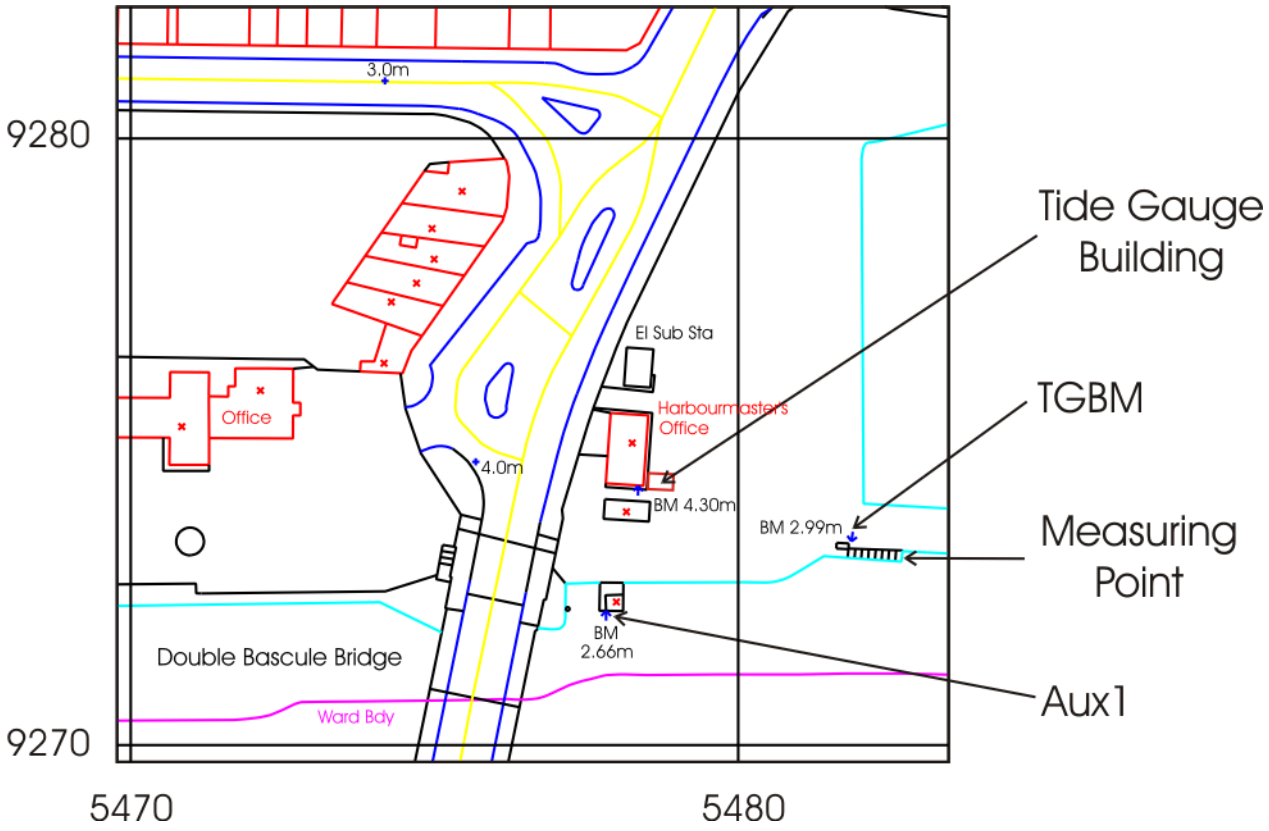
Site visits

Day 062	Installed S500 datalogger to run in parallel with DATARING logger for trial period
Day 109	EA on site to repair battery charger fault and install new logger and modem
Day 125	Replaced DATARING logger
Day 144	EA on site for new outstation testing
Day 154	EA on site to upgrade S500 software

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
92	15 minutes	091-096,103-125,154,180	069,082-090,124,144-154

Lowestoft – Map & Images of Site



Lowestoft – Statistics

Surge maxima	Value	Day	Time
January	0.678	11	20:30:00
February	1.154	4	17:15:00
March	0.44	11	00:00:00
April	0.315	8	17:15:00
May	0.79	24	09:30:00
June	0.304	19	10:15:00
July	0.759	23	23:30:00
August	0.5	9	09:00:00
September	0.553	7	07:45:00
October	0.665	7	03:30:00
November	1.494	27	18:15:00
December	1.455	9	11:45:00

Surge minima	Value	Day	Time
January	-0.493	10	16:30:00
February	-0.784	4	02:45:00
March	-0.397	2	08:30:00
April	-0.189	10	10:15:00
May	-0.576	23	22:30:00
June	-0.21	25	10:45:00
July	-0.243	31	17:15:00
August	-0.305	10	13:15:00
September	-0.637	6	11:45:00
October	-0.547	24	23:30:00
November	-0.626	25	03:30:00
December	-1.082	8	16:00:00

Extreme maxima	Value	Day	Time
January	2.947	6	22:30:00
February	3.067	4	21:45:00
March	2.829	21	22:30:00
April	2.633	7	11:45:00
May	2.738	19	10:15:00
June	2.837	19	11:30:00
July	2.786	23	14:30:00
August	3.006	29	08:45:00
September	2.929	13	09:45:00
October	2.955	7	05:15:00
November	3.833	27	22:00:00
December	3.482	9	08:45:00

Extreme minima	Value	Day	Time
January	0.227	23	06:00:00
February	-0.175	4	04:15:00
March	0.083	20	03:45:00
April	0.699	9	18:45:00
May	0.162	23	20:00:00
June	0.507	8	20:30:00
July	0.297	31	16:15:00
August	0.207	2	17:30:00
September	0.156	27	15:30:00
October	0.213	25	14:00:00
November	0.139	25	02:45:00
December	-0.128	1	07:45:00

Mean sea level	No days	MSL
January	31	1.662
February	28	1.58
March	19	1.512
April	4	*
May	17	1.615
June	26	1.672
July	31	1.701
August	31	1.722
September	30	1.71
October	31	1.709
November	30	1.723
December	31	1.821
	Sum	Avg
	309	1.669

* No mean sea level value as more than 15 days of data missing

Milford Haven – Tide Gauge Information

Latitude 51° 42' 26.6" N **Longitude** 05° 03' 05.5" W **Grid Ref** SM 8925 0537

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Store room at the shore end of Milford Haven Port Authority jetty
Measuring Points Seaward end of the jetty

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SM 8921 0536	OSBM Bolt on wall W side of entrance to jetty
Aux1	SM 8918 0541	Fl Br G4977 office buildings. SW face NW angle.
Aux2	SM 9001 0601	OSBM bolt wall Victoria Road

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.71m below Ordnance Datum Newlyn (ODN)
TGZ = 16.734m below TGBM

Levelling No levelling was carried out in 2011

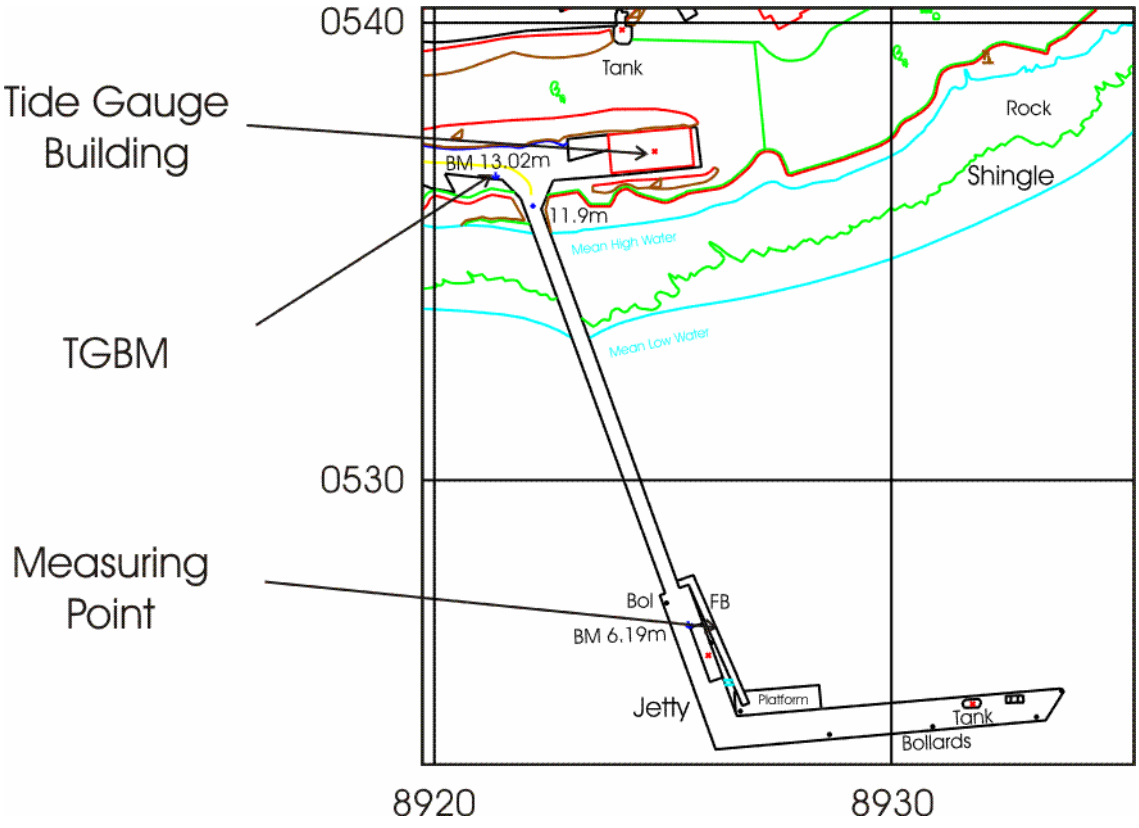
Site visits

Day 013	General maintenance. Accompanied EA contractor during electrical survey for new telemetry system enabling works.
Day 167	Planned electrical installation with EA contractor and carried out general maintenance
Day 262	Installation of S500 datalogger could not proceed due to incomplete electrical works
Day 307	Decommissioned DATARING logger, installed S500 outstation and migrated to Swantel telemetry system

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	305-306	046,052,092,130,167,306-365

Milford Haven – Map & Images of Site



Milford Haven – Statistics

Surge maxima	Value	Day	Time
January	0.52	10	16:30:00
February	0.5	16	11:30:00
March	0.338	31	00:45:00
April	0.374	2	01:15:00
May	0.4	8	05:45:00
June	0.396	12	13:15:00
July	0.407	6	15:00:00
August	0.291	25	09:15:00
September	0.525	12	03:00:00
October	0.588	23	21:15:00
November	0.141	1	06:15:00
December			

Surge minima	Value	Day	Time
January	-0.32	23	17:30:00
February	-0.259	27	20:00:00
March	-0.29	3	04:30:00
April	-0.303	12	00:30:00
May	-0.245	15	02:45:00
June	-0.216	2	22:00:00
July	-0.126	1	05:00:00
August	-0.069	9	07:15:00
September	-0.13	22	11:30:00
October	-0.208	8	07:15:00
November	0.036	1	14:15:00
December			

Extreme maxima	Value	Day	Time
January	7.18	22	07:45:00
February	7.838	20	07:30:00
March	7.633	21	07:00:00
April	7.566	19	06:45:00
May	7.222	18	18:45:00
June	7.245	17	19:15:00
July	7.215	31	18:45:00
August	7.718	31	19:45:00
September	7.814	28	18:30:00
October	7.764	27	06:00:00
November	6.495	1	09:45:00
December			

Extreme minima	Value	Day	Time
January	0.209	22	14:15:00
February	0.247	20	13:45:00
March	-0.06	22	01:45:00
April	0.257	18	12:15:00
May	0.538	19	01:15:00
June	1.048	16	00:15:00
July	0.932	4	02:00:00
August	0.303	31	01:30:00
September	0.205	29	13:15:00
October	0.383	28	13:00:00
November	1.892	1	03:30:00
December			

Mean sea level	No days	MSL
January	31	3.902
February	28	3.965
March	31	3.793
April	30	3.842
May	31	3.878
June	30	3.902
July	31	3.91
August	31	3.946
September	30	3.984
October	31	3.981
November	0	
December	0	
	Sum	Avg
	304	**

** No yearly average value as more than one month's MSL missing

Millport – Tide Gauge Information

Latitude 55° 44' 59.3" N **Longitude** 04° 54' 22.8" W **Grid Ref** NS 1769 5454

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Store room at the shore end of the University Marine Biological Station pier
Measuring Points Seaward end of the pier

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NS 1757 5449	Fl Br G4602 Marine station
Aux1	NS 1772 5457	OSBM bolt rock SE side Rd 5M NE end wall
Aux2	NS 1769 5454	Rivet pier 0.8M prod SE face of TG building
Aux3	NS 1718 5451	No 45 Marine Parade NW angle N face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.62m below Ordnance Datum Newlyn (ODN)
TGZ = 7.825m below TGBM

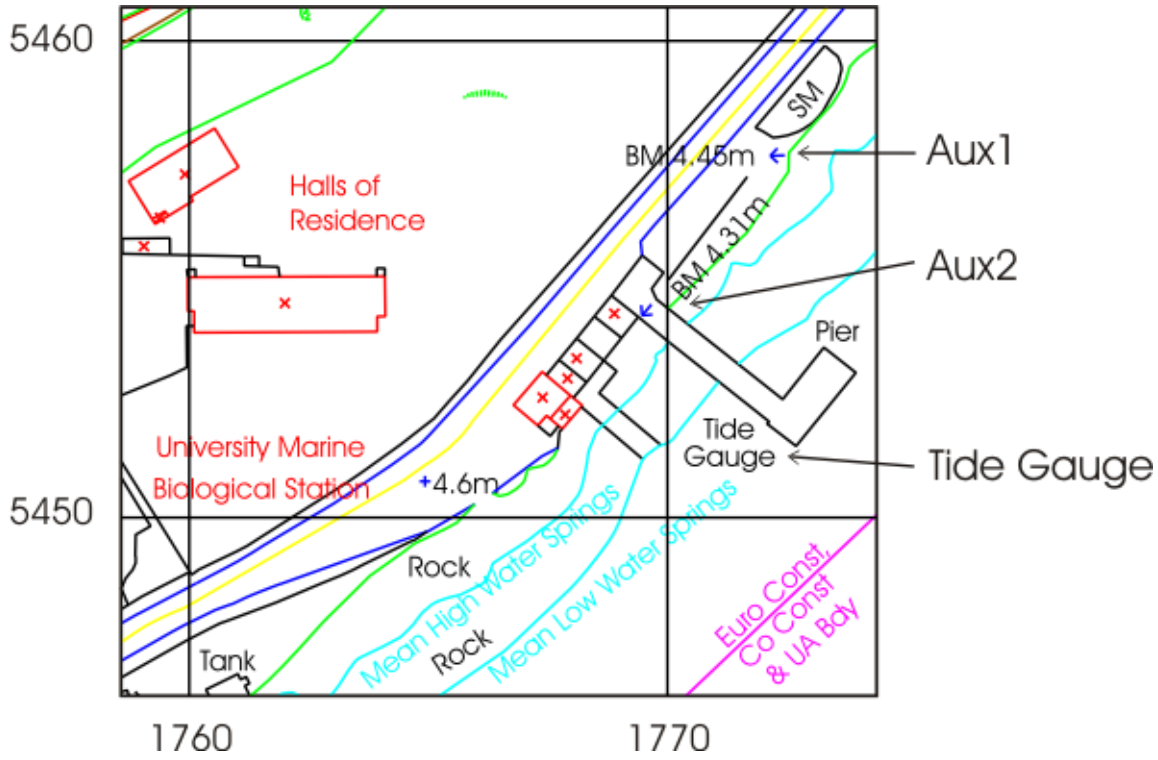
Levelling No levelling was carried out in 2011

Site visits
Day 039 Carried out general maintenance
Day 342 Carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	329-332,333,342,350	232-263,265-277,279-282,312-313,314-315,316-317,332,342-343,350,363

Millport – Map & Images of Site



Millport – Statistics

Surge maxima	Value	Day	Time
January	0.758	15	13:00:00
February	0.939	4	00:45:00
March	0.721	31	10:00:00
April	0.575	1	16:00:00
May	1.268	23	14:45:00
June	0.429	17	11:45:00
July	0.327	16	11:45:00
August	0.367	19	19:45:00
September	0.523	21	11:45:00
October	0.502	24	02:30:00
November	0.834	30	23:45:00
December	1.016	13	17:30:00

Surge minima	Value	Day	Time
January	-0.571	26	17:30:00
February	-0.494	28	04:45:00
March	-0.443	1	17:30:00
April	-0.264	25	22:45:00
May	-0.313	26	22:00:00
June	-0.269	4	20:15:00
July	-0.279	28	23:30:00
August	-0.227	9	07:15:00
September	-0.129	29	20:15:00
October	-0.244	19	17:15:00
November	-0.246	6	23:45:00
December	-0.421	17	20:30:00

Extreme maxima	Value	Day	Time
January	3.791	5	12:45:00
February	4.022	4	00:45:00
March	3.762	31	10:15:00
April	3.712	4	13:00:00
May	4.01	23	16:00:00
June	3.64	18	01:30:00
July	3.649	7	03:45:00
August	3.719	4	02:45:00
September	3.759	29	00:45:00
October	3.995	31	15:00:00
November	4.096	29	14:30:00
December	4.497	13	13:45:00

Extreme minima	Value	Day	Time
January	-0.196	23	20:15:00
February	0.121	20	19:15:00
March	-0.097	22	19:30:00
April	0.008	20	06:45:00
May	0.115	19	06:45:00
June	0.27	4	07:00:00
July	0.237	4	07:30:00
August	0.153	3	07:45:00
September	0.127	28	05:30:00
October	0.215	1	07:45:00
November	0.505	24	04:00:00
December	0.367	17	22:15:00

Mean sea level	No days	MSL
January	31	2.005
February	28	2.105
March	31	1.885
April	30	1.931
May	31	2.023
June	30	1.982
July	31	1.95
August	19	2.014
September	1	*
October	24	2.184
November	17	2.206
December	26	2.191
	Sum	Avg
	298	2.031

* No mean sea level value as more than 15 days of data missing

Mumbles – Tide Gauge Information

Latitude 51° 34' 12.0" N **Longitude** 03° 58' 31.6" W **Grid Ref** SS 6319 8753

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Mumbles lifeboat station
Measuring Points Near the end of the lifeboat slipway

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SS 6298 8743	OSBM bolt living rock S side of road
Aux1	SS 6317 8752	OSBM bolt lifeboat station Mumbles Pier
Aux2	SS 6284 8750	OSBM bolt concrete base bollard Lifeboat Cottages
Aux3	SS 6258 8760	Rivet SE side concrete chamber

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.00m below Ordnance Datum Newlyn (ODN)
TGZ = 13.821m below TGBM

Levelling No levelling was carried out in 2011

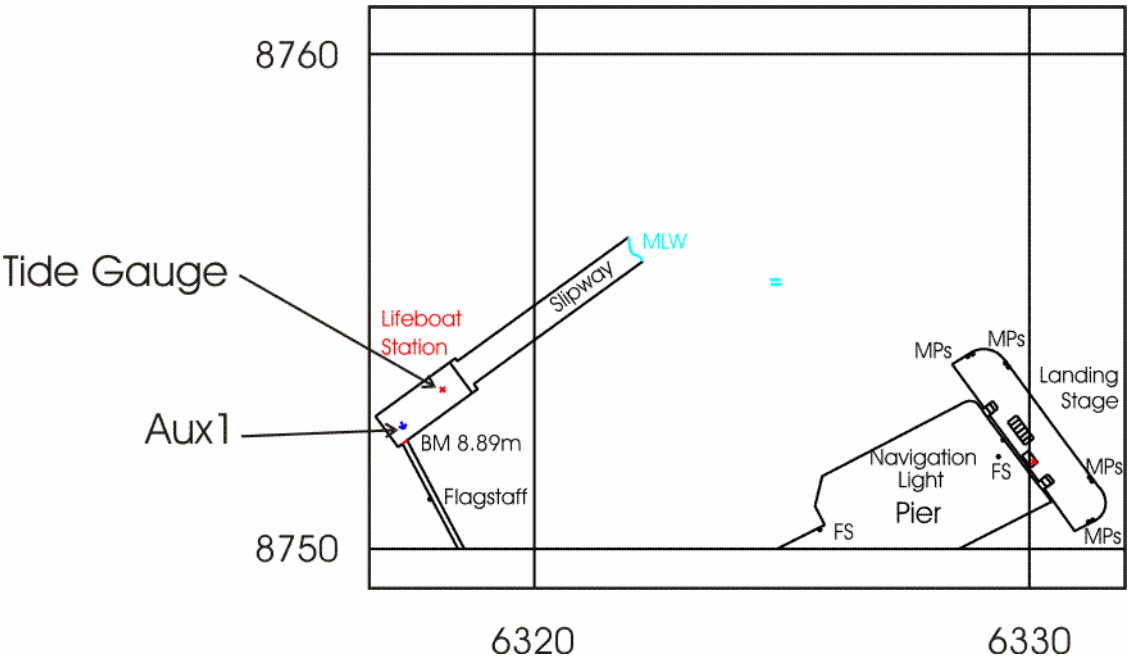
Site visits
Day 322 Repaired compressor

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	093-094,104-365

Notes on Completeness/Quality
The primary and secondary channels were at times reading ~40 mm low, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring. A pneumatic problem, caused by biofouling of the slipway and pneumatic lines, may be the cause of this under-recording as the compressor failed and had to be repaired in November.

Mumbles – Map & Images of Site



Mumbles – Statistics

Surge maxima	Value	Day	Time
January	0.431	10	16:30:00
February	0.486	3	22:30:00
March	0.268	31	01:15:00
April	0.258	5	03:30:00
May			
June			
July			
August			
September			
October			
November			
December			

Surge minima	Value	Day	Time
January	-0.487	23	18:00:00
February	-0.4	28	21:45:00
March	-0.439	1	09:15:00
April	-0.391	12	01:00:00
May			
June			
July			
August			
September			
October			
November			
December			

Extreme maxima	Value	Day	Time
January	9.649	22	07:45:00
February	10.354	20	07:30:00
March	10.196	21	07:00:00
April	9.284	5	07:15:00
May			
June			
July			
August			
September			
October			
November			
December			

Extreme minima	Value	Day	Time
January	0.375	23	02:15:00
February	0.31	21	02:00:00
March	0.135	21	01:00:00
April	1.289	5	13:15:00
May			
June			
July			
August			
September			
October			
November			
December			

Mean sea level	No days	MSL
January	31	5.174
February	28	5.237
March	31	5.071
April	11	*
May	0	
June	0	
July	0	
August	0	
September	0	
October	0	
November	0	
December	0	
	Sum	Avg
	101	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Newhaven – Tide Gauge Information

Latitude 50° 46' 54.4" N **Longitude** 00° 03' 25.3" E **Grid Ref** TQ 4511 0004

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** Within the Port Control building on West Pier
Measuring Points On the pier wall, south east of the Port Control building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TQ 4510 0003	Bolt concrete 7.4M SW of SW angle of tower
Aux1	TQ 4495 0001	OSBM bolt concrete sea wall 154.3M SW of tower
Aux2	TQ 4503 0008	Steel ball Gun mount

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.52m below Ordnance Datum Newlyn (ODN)
TGZ = 8.783m below TGBM

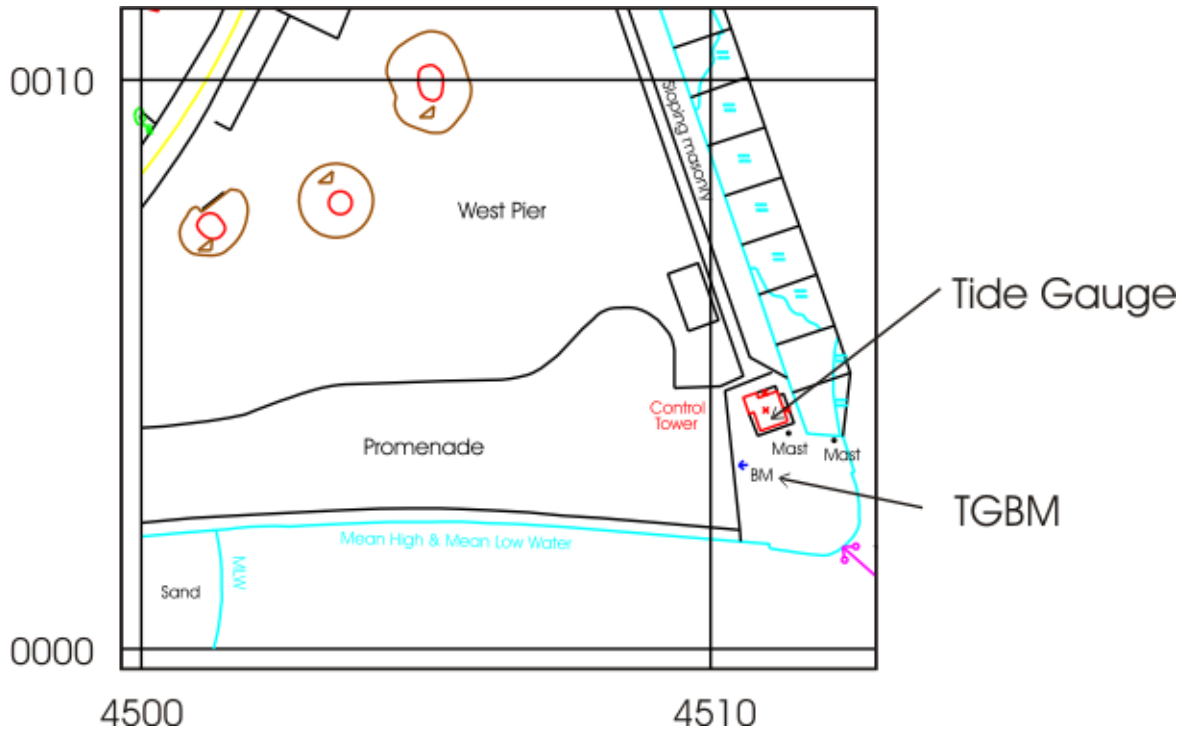
Levelling No levelling was carried out in 2011

Site visits
Day 315 Maintenance and meeting with electrical contractor

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	040	156,172

Newhaven – Map & Images of Site



Newhaven – Statistics

Surge maxima	Value	Day	Time
January	0.371	6	11:00:00
February	0.491	4	22:45:00
March	0.278	11	05:00:00
April	0.191	30	05:15:00
May	0.354	24	17:00:00
June	0.289	17	23:00:00
July	0.365	24	04:00:00
August	0.253	8	04:00:00
September	0.309	12	08:00:00
October	0.339	18	12:15:00
November	0.528	28	01:45:00
December	0.667	16	05:30:00

Surge minima	Value	Day	Time
January	-0.426	23	11:15:00
February	-0.369	4	08:00:00
March	-0.48	3	21:00:00
April	-0.214	13	07:30:00
May	-0.314	23	23:00:00
June	-0.279	3	10:00:00
July	-0.169	30	22:30:00
August	-0.227	10	15:45:00
September	-0.367	27	20:45:00
October	-0.33	14	11:45:00
November	-0.344	25	10:00:00
December	-0.614	8	21:45:00

Extreme maxima	Value	Day	Time
January	6.785	6	12:15:00
February	7.089	20	12:30:00
March	7.143	22	00:30:00
April	7.121	20	00:15:00
May	6.84	18	23:45:00
June	6.725	17	12:00:00
July	6.732	17	12:30:00
August	7.134	31	12:30:00
September	7.177	29	12:15:00
October	7.299	27	11:00:00
November	7.325	28	00:45:00
December	7.096	26	12:00:00

Extreme minima	Value	Day	Time
January	0.321	22	19:15:00
February	0.184	19	18:15:00
March	0.121	20	18:00:00
April	0.318	18	17:30:00
May	0.502	18	05:30:00
June	0.801	17	06:00:00
July	0.764	4	07:15:00
August	0.385	31	06:30:00
September	0.304	29	06:15:00
October	0.477	28	18:15:00
November	0.439	26	18:00:00
December	0.523	26	18:30:00

Mean sea level	No days	MSL
January	31	3.618
February	28	3.615
March	31	3.501
April	30	3.571
May	31	3.581
June	30	3.638
July	31	3.656
August	31	3.673
September	30	3.685
October	31	3.684
November	30	3.706
December	31	3.761
	Sum	Avg
	364	3.641

Newlyn – Tide Gauge Information

Latitude 50° 06' 10.8" N **Longitude** 05° 32' 34.2" W **Grid Ref** SW 4676 2856

Instrument Data acquisition system with a full-tide and mid-tide bubbler gauge and a back-up potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** Tidal Observatory at the end of South Pier, next to the lighthouse

Measuring Points Seaward side of the pier, behind the lighthouse

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SW 4677 2856	Brass bolt in the floor of the recorder hut.
Aux1	SW 4673 2851	Flush Bracket 1565 on wall S pier NW face 17.8m SW
Aux2	SW 4659 2841	F Bracket 1520 wall SE side of S Pier Rd NW face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.05m below Ordnance Datum Newlyn (ODN)
TGZ = 7.801m below TGBM

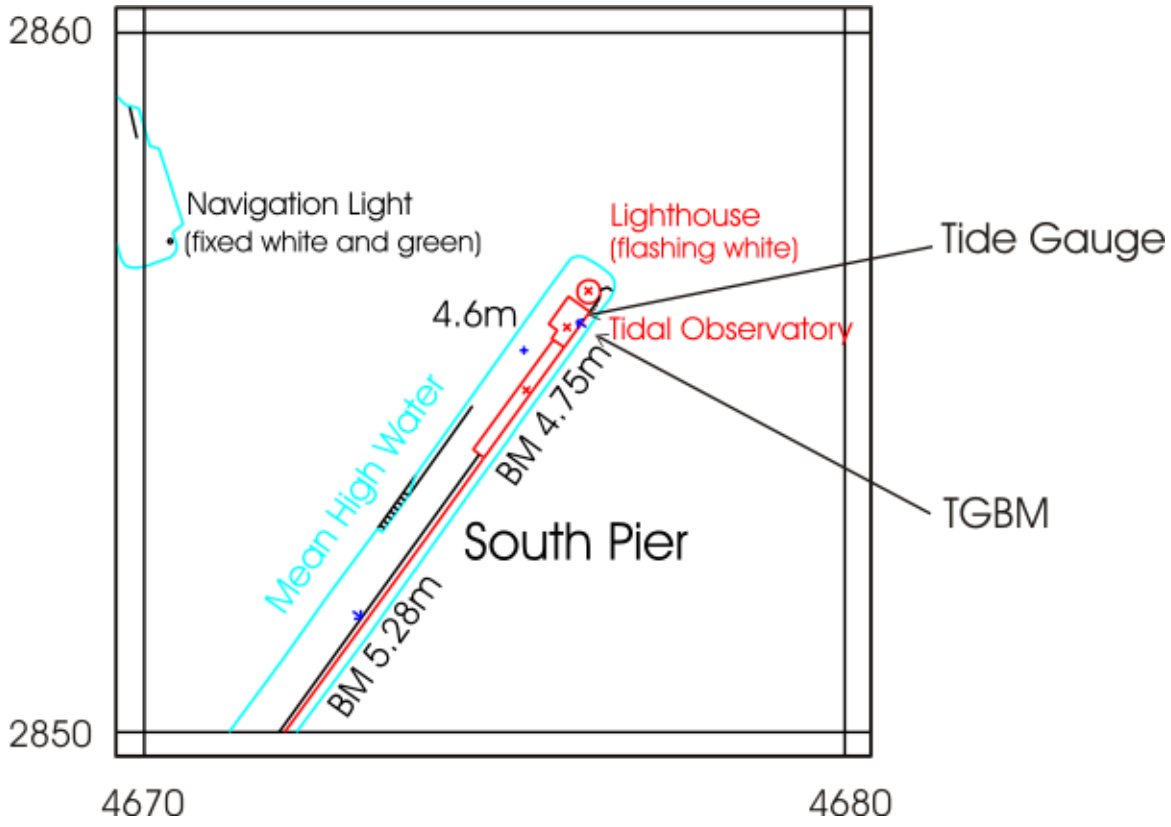
Levelling No levelling was carried out in 2011

Site visits
Day 194 Investigated problem; complete failure of compressor
Day 210 Replaced compressor

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	271	092,188-210

Newlyn – Map & Images of Site



Newlyn – Statistics

Surge maxima	Value	Day	Time
January	0.433	7	23:00:00
February	0.528	16	09:45:00
March	0.261	12	18:30:00
April	0.218	30	22:30:00
May	0.299	8	02:30:00
June	0.314	17	13:00:00
July	0.179	6	15:00:00
August	0.21	7	14:00:00
September	0.277	10	11:15:00
October	0.457	23	20:15:00
November	0.419	3	05:30:00
December	0.344	13	01:30:00

Surge minima	Value	Day	Time
January	-0.315	23	08:30:00
February	-0.238	27	21:30:00
March	-0.299	3	01:30:00
April	-0.311	11	23:15:00
May	-0.249	15	03:45:00
June	-0.235	1	14:45:00
July	-0.16	1	03:45:00
August	-0.124	10	20:45:00
September	-0.206	6	22:00:00
October	-0.255	9	19:00:00
November	-0.3	25	13:15:00
December	-0.436	28	18:45:00

Extreme maxima	Value	Day	Time
January	5.763	7	06:30:00
February	6.087	19	05:15:00
March	5.891	21	05:30:00
April	5.885	19	05:15:00
May	5.591	18	17:15:00
June	5.71	17	17:45:00
July	5.674	31	17:00:00
August	6.009	31	18:00:00
September	6.026	28	17:00:00
October	6.131	27	04:15:00
November	5.791	28	06:30:00
December	5.518	12	17:30:00

Extreme minima	Value	Day	Time
January	0.265	22	13:00:00
February	0.39	20	12:30:00
March	0.118	21	12:15:00
April	0.398	18	11:00:00
May	0.55	19	00:00:00
June	0.896	16	23:45:00
July	0.771	31	23:45:00
August	0.409	31	00:15:00
September	0.327	28	23:45:00
October	0.457	28	11:45:00
November	0.538	27	12:30:00
December	0.619	25	11:30:00

Mean sea level	No days	MSL
January	31	3.203
February	28	3.222
March	31	3.104
April	30	3.149
May	31	3.154
June	30	3.187
July	6	*
August	31	3.219
September	30	3.228
October	31	3.243
November	30	3.326
December	31	3.204
	Sum	Avg
	340	3.200

* No mean sea level value as more than 15 days of data missing

Newport – Tide Gauge Information

Latitude 51° 33' 00.0" N **Longitude** 02° 59' 14.8" W **Grid Ref** ST 3163 8392

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** West side of the entrance to Newport Docks
Measuring Points Attached to the dock wall on the west side of the dock entrance, close to the lock gates

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 3163 8392	Brass bolt adjacent to TG building
Aux1	ST 3160 8414	Pin in quay west side of South Lock
Aux2	ST 3160 8426	Pin in quay east side of South Lock
Aux3	ST 3147 8427	Pin in quay south west corner of South Dock

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 5.81m below Ordnance Datum Newlyn (ODN)
TGZ = 14.525m below TGBM

Levelling No levelling was carried out in 2011

Site visits

Day 168	Removed all equipment pending building refurbishment
Day 177	Reinstalled DATARING logger and S500 logger in advance of telemetry migration
Day 320	Migrated system to Swantel and decommissioned DATARING logger

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
96	15 minutes	005-007,166-178,222	178-207,231,240-244,249-260,314-315,316,318,319,320,358

Newport – Map & Images of Site

Newport – Statistics

Surge maxima	Value	Day	Time
January	0.813	13	06:30:00
February	0.959	13	22:00:00
March	0.911	13	06:15:00
April	0.617	11	06:00:00
May	0.891	8	05:00:00
June	0.675	7	18:15:00
July	0.59	27	11:15:00
August	0.575	22	18:30:00
September	0.967	6	07:30:00
October	1.036	17	17:00:00
November	0.716	29	15:45:00
December	1.299	13	04:00:00

Surge minima	Value	Day	Time
January	-0.911	23	04:45:00
February	-0.662	22	17:15:00
March	-0.976	23	05:00:00
April	-0.646	20	16:00:00
May	-0.614	16	00:30:00
June	-0.411	14	12:15:00
July	-0.265	29	18:15:00
August	-0.403	2	16:15:00
September	-0.973	28	15:15:00
October	-0.758	1	04:30:00
November	-0.8	27	15:45:00
December	-0.625	30	05:00:00

Extreme maxima	Value	Day	Time
January	12.551	22	08:45:00
February	13.358	20	08:30:00
March	13.213	21	08:15:00
April	13.02	19	20:15:00
May	12.531	18	19:45:00
June	11.671	14	17:45:00
July	12.296	31	19:30:00
August	12.731	2	21:00:00
September	13.336	28	19:45:00
October	13.19	27	07:00:00
November	12.869	26	07:30:00
December	12.525	26	08:00:00

Extreme minima	Value	Day	Time
January	0.165	23	17:00:00
February	0.175	20	16:15:00
March	0.095	23	04:45:00
April	0.193	20	03:30:00
May	0.487	19	03:00:00
June	0.766	2	14:00:00
July	0.539	31	14:30:00
August	0.33	3	04:30:00
September	0.157	29	15:45:00
October	0.29	28	15:15:00
November	0.406	27	15:30:00
December	0.667	27	16:00:00

Mean sea level	No days	MSL
January	27	6.101
February	28	6.221
March	31	6.046
April	30	6.101
May	31	6.157
June	13	*
July	4	*
August	25	6.233
September	15	*
October	31	6.297
November	23	6.297
December	31	6.339
	Sum	Avg
	289	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

North Shields – Tide Gauge Information

Latitude 55° 00' 26.8" N **Longitude** 01° 26' 23.2" W **Grid Ref** NZ 3592 6823

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** North side of the River Tyne, close to the Port of Tyne Authority offices
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NZ 3592 6823	Bolt adjacent to tide gauge building
Aux1	NZ 3626 6842	PA Bolt low lighthouse W face SW angle
Aux2	NZ 3630 6895	PA Bolt butt N side railway

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.60m below Ordnance Datum Newlyn (ODN)
TGZ = 6.754m below TGBM

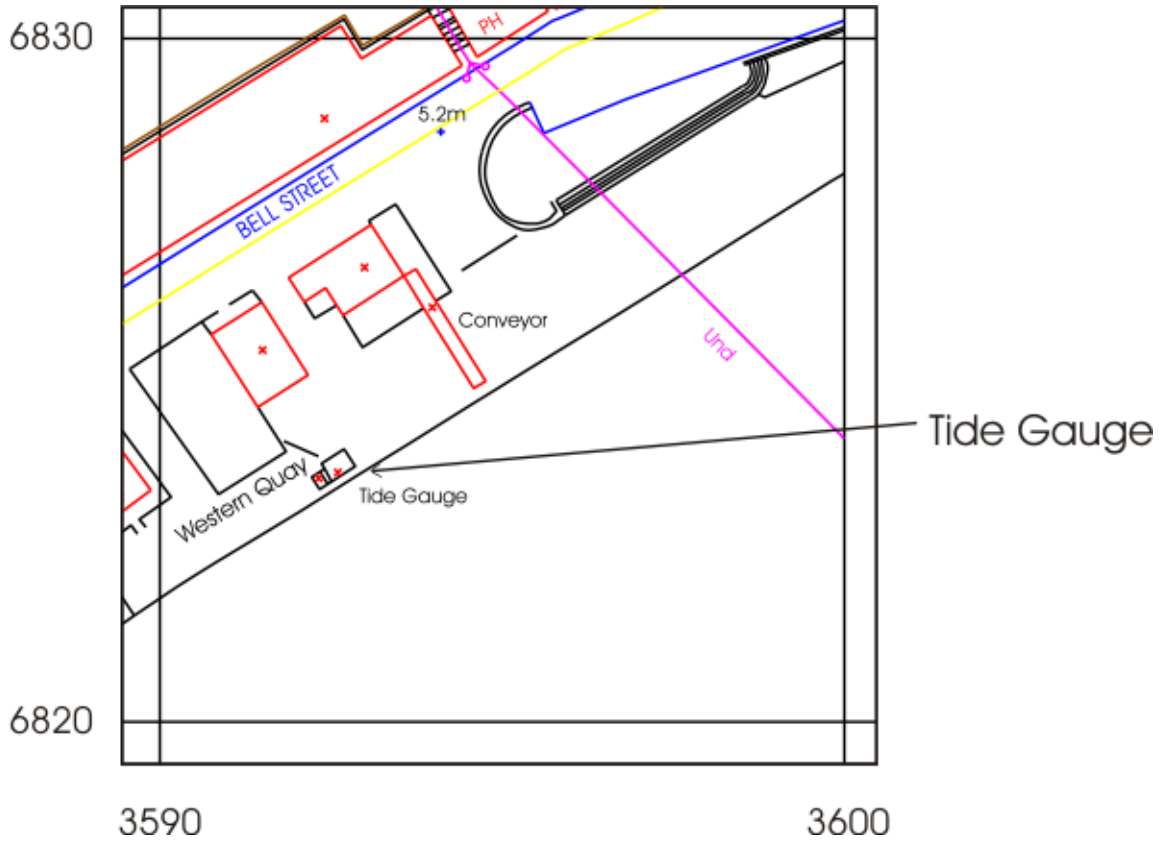
Levelling No levelling was carried out in 2011

Site visits
Day 040 Carried out maintenance and accompanied EA contractor during electrical site survey in advance of new telemetry system

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	None

North Shields – Map & Images of Site



North Shields – Statistics

Surge maxima	Value	Day	Time
January	0.399	16	03:45:00
February	1.374	4	11:00:00
March	0.294	8	23:30:00
April	0.37	5	13:30:00
May	0.559	24	05:00:00
June	0.317	18	13:30:00
July	0.394	23	20:30:00
August	0.395	29	12:30:00
September	0.389	7	09:15:00
October	0.755	4	04:15:00
November	1.023	27	13:45:00
December	1.137	9	06:30:00

Surge minima	Value	Day	Time
January	-0.341	12	11:00:00
February	-0.523	3	22:45:00
March	-0.391	14	11:45:00
April	-0.199	4	19:30:00
May	-0.68	23	19:30:00
June	-0.261	1	06:45:00
July	-0.221	31	06:45:00
August	-0.235	2	07:45:00
September	-0.254	27	05:45:00
October	-0.371	9	04:45:00
November	-0.486	30	22:30:00
December	-1.115	8	17:45:00

Extreme maxima	Value	Day	Time
January	5.266	6	16:30:00
February	5.511	4	15:45:00
March	5.627	21	16:15:00
April	5.44	19	16:00:00
May	5.337	19	04:00:00
June	5.314	18	04:30:00
July	5.29	17	04:15:00
August	5.598	31	04:15:00
September	5.682	29	03:45:00
October	5.595	28	03:30:00
November	6.054	27	16:30:00
December	5.645	26	03:45:00

Extreme minima	Value	Day	Time
January	0.105	22	23:45:00
February	-0.054	19	22:30:00
March	0.037	20	22:15:00
April	0.085	18	21:45:00
May	0.546	17	21:30:00
June	0.749	3	10:15:00
July	0.475	31	09:45:00
August	0.178	31	10:45:00
September	0.126	28	09:45:00
October	0.309	27	09:30:00
November	0.547	24	20:45:00
December	0.356	27	23:45:00

Mean sea level	No days	MSL
January	31	2.957
February	28	2.937
March	31	2.825
April	30	2.892
May	31	2.92
June	30	2.952
July	31	2.951
August	31	2.998
September	30	3.03
October	31	3.026
November	30	3.057
December	31	3.093
	Sum	Avg
	365	2.970

Portbury – Tide Gauge Information

Latitude 51° 30' 00.0" N **Longitude** 02° 43' 42.5" W **Grid Ref** ST 4953 7815

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Western, seaward side of the jetty
Measuring Points On the wall below the tide gauge cabinet

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ST 4953 7815	Brass bolt quay edge adjacent to tide gauge
AUX 1	ST 4986 7774	Brass pin coping stone SW corner Portbury Dock

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 6.50m below Ordnance Datum Newlyn (ODN)
TGZ = 9.226m below TGBM

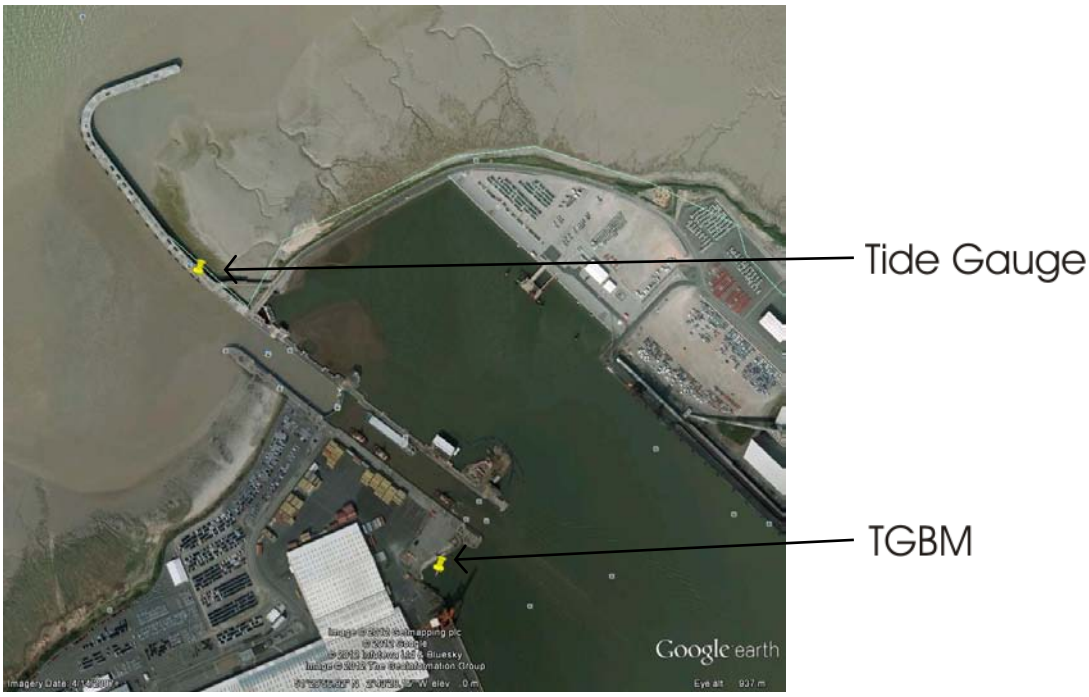
Levelling No levelling was carried out in 2011

Site visits
Day 177 Changed compressor and carried out general maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	187	098,104,114-115,178,286-299,301-365

Portbury – Map & Images of Site



Portbury Tide Gauge Cabinet

Portbury – Statistics

Surge maxima	Value	Day	Time
January	1.042	13	07:00:00
February	1.087	13	08:15:00
March	1.002	13	06:45:00
April	0.724	2	12:30:00
May	0.699	29	12:00:00
June	0.888	27	11:15:00
July	0.912	24	20:45:00
August	0.728	22	19:00:00
September	0.976	12	02:30:00
October	4.814	31	23:45:00
November			
December			

Surge minima	Value	Day	Time
January	-0.784	27	10:00:00
February	-0.639	28	22:30:00
March	-0.903	21	05:30:00
April	-0.821	26	07:30:00
May	-0.716	24	06:30:00
June	-0.594	26	04:30:00
July	-0.574	24	16:15:00
August	-0.8	31	05:45:00
September	-0.939	28	04:45:00
October	-0.961	7	10:15:00
November			
December			

Extreme maxima	Value	Day	Time
January	13.704	22	09:00:00
February	14.539	20	08:30:00
March	14.434	21	08:15:00
April	14.218	19	20:15:00
May	13.701	18	20:00:00
June	13.425	17	20:30:00
July	13.426	31	19:45:00
August	14.33	31	21:00:00
September	14.503	28	19:45:00
October	15.355	31	23:45:00
November			
December			

Extreme minima	Value	Day	Time
January	0.431	22	03:45:00
February	0.295	21	04:15:00
March	0.093	21	03:15:00
April	0.452	19	02:45:00
May	0.901	19	03:00:00
June	1.368	3	14:45:00
July	1.229	31	14:30:00
August	0.512	31	15:45:00
September	0.364	29	15:30:00
October	0.609	28	15:00:00
November			
December			

Mean sea level	No days	MSL
January	31	7
February	28	7.082
March	31	6.907
April	28	6.965
May	31	7.031
June	30	7.055
July	28	7.037
August	31	7.103
September	30	7.171
October	14	*
November	0	
December	0	
	Sum	Avg
	282	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Portpatrick – Tide Gauge Information

Latitude 54° 50' 33.2" N **Longitude** 05° 07' 12.1" W **Grid Ref** NW 9976 5421

Instrument Data acquisition system with a full-tide bubbler gauge and a potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** The western corner of Portpatrick harbour

Measuring Points The stilling well is directly underneath the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NW 9976 5421	Bolt Harbour wall 13.84M NE angle of building
Aux1	NW 9977 5411	Rivet E side of Jetty wall 16.6M SE angle Lifeboat HQ
Aux2	NW 9995 5412	Rivet S angle No 53 Main St
Aux3	NX 0006 5423	Church hall SE side of Rd W angle

Benchmark Relationships

TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.80m below Ordnance Datum Newlyn (ODN)
TGZ = 6.827m below TGBM

Levelling Site was levelled on Day 302

Site visits

Day 040	General maintenance and electrical survey with EA contractor in advance of new telemetry system
Day 188	Delivered new telemetry equipment
Day 302	Investigation dive (stilling well found to be buried in silt), compressor change, levelling and decommissioning DATARING logger, replacing it with S500 outstation and migrating to Swantel
Day 326	Electrical repair

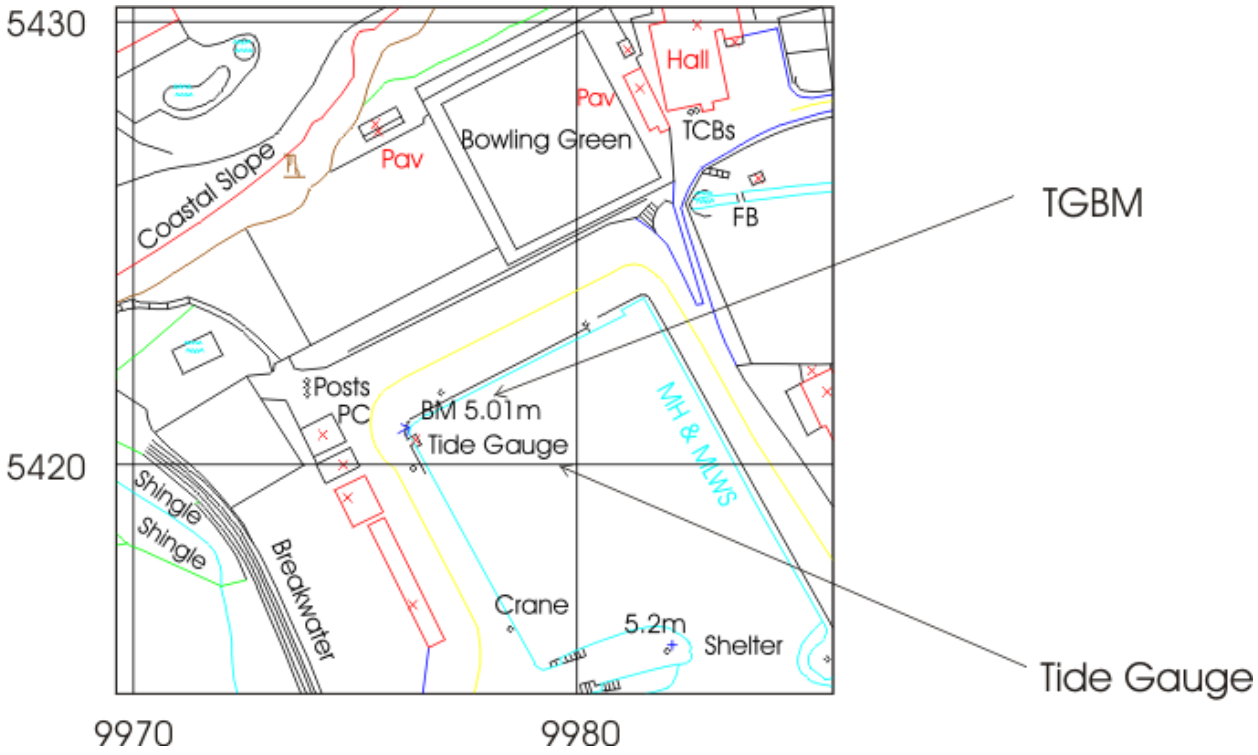
Data quality

CI%	Sample Interval	Missing Data	Suspect Data
93	15 minutes	003,047-048,053-054,194-195,202,208-210,216,285-301,302	001-002,003-120,151-194,195-201,202-208,210-215,216-285,301-302,302-325

Notes on Completeness/Quality

The stilling well has become buried in sediment and requires an additional aperture to be cut into the side of the well above the level of the silt. This work was postponed until completion of the migration programme.

Portpatrick – Map & Images of Site



Portpatrick – Statistics

Surge maxima	Value	Day	Time
January	0.668	15	13:45:00
February	0.819	4	00:30:00
March	0.548	31	08:45:00
April	0.455	1	16:00:00
May	0.962	23	14:30:00
June	0.345	17	11:30:00
July	0.3	6	23:00:00
August	0.295	10	12:00:00
September	0.827	12	12:45:00
October	0.361	5	14:00:00
November			
December	-0.057	20	10:00:00

Surge minima	Value	Day	Time
January	-0.465	23	13:15:00
February	-0.426	28	04:15:00
March	-0.361	3	20:00:00
April	-0.234	12	06:30:00
May	-0.279	26	20:15:00
June	-0.248	4	15:45:00
July	-0.179	29	14:30:00
August	-0.184	9	01:45:00
September	-0.214	18	13:15:00
October	-0.3	7	07:45:00
November			
December	-0.057	20	10:00:00

Extreme maxima	Value	Day	Time
January	4.246	5	12:15:00
February	4.371	4	00:30:00
March	4.158	20	11:45:00
April	4.08	19	12:15:00
May	4.08	23	15:45:00
June	4.136	18	00:45:00
July	4.104	15	23:45:00
August	4.155	31	00:30:00
September	4.353	12	11:30:00
October	4.109	1	01:30:00
November			
December	2.279	20	10:00:00

Extreme minima	Value	Day	Time
January	-0.177	22	19:15:00
February	0.121	20	19:00:00
March	-0.118	22	19:30:00
April	0.012	17	16:45:00
May	0.143	19	06:30:00
June	0.322	4	06:45:00
July	0.291	4	07:15:00
August	0.051	31	06:30:00
September	0.123	28	05:30:00
October	0.274	1	07:45:00
November			
December	2.279	20	10:00:00

Mean sea level	No days	MSL
January	29	2.184
February	20	2.273
March	31	2.053
April	30	2.103
May	31	2.186
June	30	2.161
July	19	2.167
August	29	2.186
September	30	2.305
October	10	*
November	0	
December	0	
	Sum	Avg
	259	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Portrush – Tide Gauge Information

Latitude 55° 12' 24.4" N **Longitude** 06° 39' 24.6" W **Grid Ref** NW 0416 9952

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Portrush RNLI boathouse
Measuring Points Fixed to a leg of the boathouse slipway

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NR 0385 0018	Pin RNLI slipway
Aux1	NR 0395 0008	Cut mark wall Kerr St
Aux2	NW 0406 9992	Cut mark wall Kerr St

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.24m below Ordnance Datum Belfast (ODB)
TGZ = 2.844m below TGBM

Levelling No levelling was carried out in 2011

Site visits

Day 032	Visit with electrical contractor to survey for new telemetry electrical works and carry out general maintenance
Day 087	Diving work to clear pressure points and nozzles
Day 227	Decommissioned old DATARING logger, installed S500 logger and migrated to Swantel system
Day 266	General maintenance

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	227-228	236,251,268,302,304,339

Portrush – Map & Images of Site

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Portrush – Statistics

Surge maxima	Value	Day	Time
January	0.475	15	13:00:00
February	0.753	4	01:45:00
March	0.511	31	09:00:00
April	0.392	1	18:30:00
May	0.933	23	15:00:00
June	0.266	17	12:30:00
July	0.259	16	04:00:00
August	0.261	10	17:45:00
September	0.897	12	12:15:00
October	0.413	6	12:30:00
November	0.597	30	22:45:00
December	0.981	8	12:15:00

Surge minima	Value	Day	Time
January	-0.449	23	15:00:00
February	-0.368	28	03:30:00
March	-0.467	14	08:15:00
April	-0.24	12	07:15:00
May	-0.308	26	21:15:00
June	-0.273	4	01:30:00
July	-0.296	28	22:45:00
August	-0.212	9	07:45:00
September	-0.232	18	18:45:00
October	-0.256	7	14:45:00
November	-0.249	12	23:00:00
December	-0.449	17	20:30:00

Extreme maxima	Value	Day	Time
January	2.507	5	07:15:00
February	2.633	19	06:45:00
March	2.438	20	06:30:00
April	2.284	5	07:15:00
May	2.33	18	19:00:00
June	2.456	17	19:45:00
July	2.439	16	19:15:00
August	2.404	30	19:15:00
September	2.842	12	18:30:00
October	2.615	29	07:45:00
November	2.774	24	17:45:00
December	2.841	28	08:45:00

Extreme minima	Value	Day	Time
January	-0.136	23	02:15:00
February	0.114	20	01:00:00
March	-0.081	22	01:15:00
April	0.063	17	12:00:00
May	0.3	17	12:15:00
June	0.263	3	13:15:00
July	0.299	4	14:00:00
August	0.073	31	13:30:00
September	0.113	29	13:00:00
October	0.338	1	14:45:00
November	0.333	26	00:15:00
December	0.358	23	23:30:00

Mean sea level	No days	MSL
January	31	1.271
February	28	1.362
March	31	1.151
April	30	1.204
May	31	1.295
June	30	1.246
July	31	1.215
August	28	1.281
September	30	1.406
October	31	1.4
November	30	1.462
December	30	1.431
	Sum	Avg
	361	1.310

Portsmouth – Tide Gauge Information

Latitude 50° 48' 08.1" N **Longitude** 01° 06' 40.5" W **Grid Ref** SU 6273 0068

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Victory Jetty in Portsmouth Royal Naval base
Measuring Points On a leg at the north west corner of the jetty

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SU 6269 0053	Bolt in concrete jetty TG building S angle
Aux1	SU 6330 9996	GP N side entrance to HMS Vernon
Aux2	SU 6274 0039	Building SW face 0.6M S angle
Aux3	SU 6283 0050	Building SW side of Main Rd NE face N angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.73m below Ordnance Datum Newlyn (ODN)
TGZ = 6.007m below TGBM

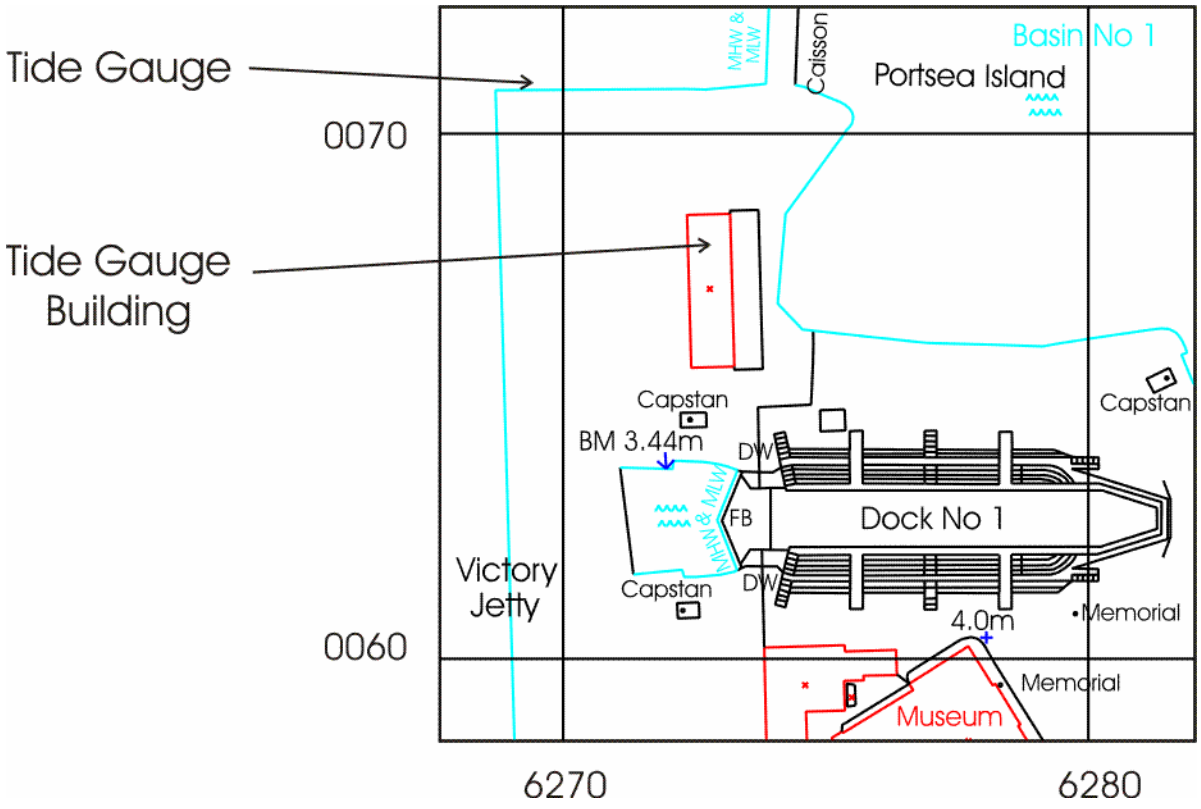
Levelling No levelling was carried out in 2011

Site visits
None

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	68	None

Portsmouth – Map & Images of Site



Portsmouth – Statistics

Surge maxima	Value	Day	Time
January	0.538	8	06:00:00
February	0.467	5	00:15:00
March	0.293	13	01:15:00
April	0.234	22	05:45:00
May	0.324	24	16:15:00
June	0.352	12	15:15:00
July	0.322	24	12:45:00
August	0.283	4	09:45:00
September	0.423	12	03:45:00
October	0.308	27	13:00:00
November	0.474	28	03:00:00
December	0.61	12	22:45:00

Surge minima	Value	Day	Time
January	-0.413	23	13:15:00
February	-0.358	4	07:15:00
March	-0.451	2	16:00:00
April	-0.21	9	21:45:00
May	-0.317	24	04:45:00
June	-0.268	1	12:00:00
July	-0.147	1	12:30:00
August	-0.166	10	22:15:00
September	-0.361	6	19:00:00
October	-0.302	9	11:00:00
November	-0.316	25	07:00:00
December	-0.633	8	23:00:00

Extreme maxima	Value	Day	Time
January	4.93	6	12:30:00
February	5.034	5	00:15:00
March	4.91	22	00:45:00
April	4.99	20	00:30:00
May	4.808	19	00:00:00
June	4.828	18	13:00:00
July	4.789	17	12:45:00
August	4.974	31	12:45:00
September	4.998	29	12:15:00
October	5.27	27	11:00:00
November	5.195	28	01:00:00
December	5.12	26	12:15:00

Extreme minima	Value	Day	Time
January	0.181	22	18:30:00
February	0.237	19	17:30:00
March	0.086	21	17:45:00
April	0.328	18	16:45:00
May	0.519	18	04:45:00
June	0.755	3	05:15:00
July	0.694	4	06:15:00
August	0.333	31	05:45:00
September	0.286	28	04:45:00
October	0.472	28	05:00:00
November	0.463	26	17:15:00
December	0.555	26	17:45:00

Mean sea level	No days	MSL
January	31	2.857
February	28	2.87
March	31	2.747
April	30	2.812
May	31	2.822
June	30	2.879
July	31	2.894
August	31	2.91
September	30	2.927
October	31	2.926
November	30	2.962
December	31	2.974
	Sum	Avg
	365	2.970

Sheerness – Tide Gauge Information

Latitude 51° 26' 44.3" N **Longitude** 00° 44' 36.4" E **Grid Ref** TQ 9074 7542

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** On the jetty at Garrison Point, Port of Sheerness
Measuring Points As above

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	TQ 9080 7549	Flush bracket 11859, Garrison Fort, S angle, SW building
Aux1	TQ 9133 7532	Flush bracket G.4790, on house, NW angle, N face
Aux2	TQ 9115 7533	Wall on SW side of road, NE angle
Aux3	TQ 9147 7516	Bolt Ch. Dis, SW side of road, E face, NE angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.90m below Ordnance Datum Newlyn (ODN)
TGZ = 7.532m below TGBM

Levelling No levelling was carried out in 2011

Site visits
Day 214 Delivered new outstation equipment to site

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	001-365

Notes on Completeness/Quality
The primary channel was under-recording at high water and over-recording at low water. The suspected cause is biofouling of underwater equipment but a diving survey is required to confirm this.

Sheerness – Map & Images of Site

Sheerness – Statistics

All the data for the primary channel at this site were flagged as suspect, so no statistics for 2011 could be produced.

St Mary's (Isles of Scilly) – Tide Gauge Information

Latitude 49° 55' 04.3" N **Longitude** 06° 19' 02.0" W **Grid Ref** SV 9021 1090

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Cabinet in the Harbour Office storeroom on the quay, Hugh Town
Measuring Points End of the quay

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	N/A	Bolt by VTS
Aux1	N/A	Bolt by VTS 2
Aux2	N/A	Bolt by top of steps
Aux3	N/A	Bolt by top of steps
Aux4	SV 9028 1097	Point above pressure points
Aux5	SV 9014 1071	Cut Mark east angle Mermaid Inn
Aux6	SV 9007 1065	Cut Mark Guard House top of Garrison Hill
VTS	SV 9023 1091	Tide staff 7.210 metre mark
VTS2	N/A	Tide staff 7.245 metre mark

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.91m below Ordnance Datum Local (ODL)
TGZ = 7.425m below TGBM
TGZ = 7.399m below Aux 1
TGZ = 6.776m below Aux 2

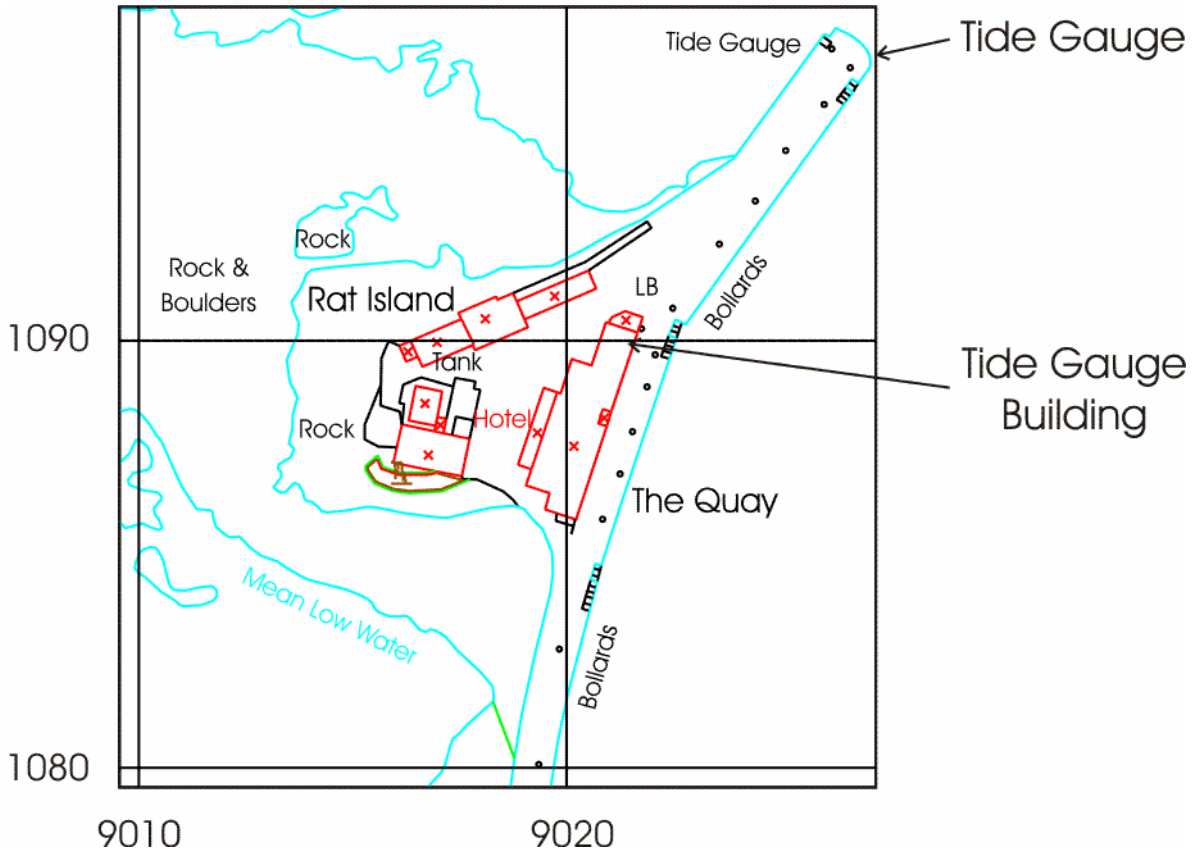
Levelling No levelling was carried out in 2011

Site visits
None

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	005	046-047

St Mary's (Isles of Scilly) – Map & Images of Site



St Mary's (Isles of Scilly) – Statistics

Surge maxima	Value	Day	Time
January	0.39	7	22:45:00
February	0.414	16	21:30:00
March	0.174	12	19:15:00
April	0.167	22	08:00:00
May	0.237	8	02:45:00
June	0.281	17	12:00:00
July	0.199	6	15:00:00
August	0.218	7	14:00:00
September	0.277	10	23:30:00
October	0.452	23	20:15:00
November	0.41	3	06:45:00
December	0.297	13	01:45:00

Surge minima	Value	Day	Time
January	-0.32	22	14:15:00
February	-0.247	28	21:30:00
March	-0.336	3	02:00:00
April	-0.286	11	23:15:00
May	-0.249	15	02:30:00
June	-0.258	2	03:30:00
July	-0.181	1	03:30:00
August	-0.119	9	20:30:00
September	-0.161	28	02:15:00
October	-0.209	8	04:45:00
November	-0.23	27	13:00:00
December	-0.367	29	00:30:00

Extreme maxima	Value	Day	Time
January	5.826	6	05:45:00
February	6.283	20	06:00:00
March	6.064	21	05:30:00
April	6.046	19	05:15:00
May	5.742	18	17:15:00
June	5.808	17	17:45:00
July	5.747	31	17:15:00
August	6.144	31	18:00:00
September	6.186	28	17:15:00
October	6.29	27	04:15:00
November	5.862	26	05:00:00
December	5.706	26	05:30:00

Extreme minima	Value	Day	Time
January	0.155	22	12:45:00
February	0.257	20	12:30:00
March	-0.026	21	12:00:00
April	0.258	18	11:00:00
May	0.469	18	23:45:00
June	0.849	16	23:30:00
July	0.654	31	23:45:00
August	0.293	31	00:00:00
September	0.231	29	11:45:00
October	0.36	28	11:45:00
November	0.441	27	12:15:00
December	0.541	26	11:45:00

Mean sea level	No days	MSL
January	31	3.178
February	26	3.176
March	31	3.071
April	30	3.112
May	31	3.129
June	30	3.171
July	31	3.163
August	31	3.179
September	30	3.218
October	31	3.226
November	30	3.294
December	31	3.207
	Sum	Avg
	363	3.205

Stornoway – Tide Gauge Information

Latitude 58° 12' 28.1" N **Longitude** 06° 23' 20.3" W **Grid Ref** NB 4228 3274

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** By the weighbridge at the entrance to Stornoway Port Authority, No. 2 wharf
Measuring Points Attached to a leg on the east side of the wharf

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NB 4228 3264	OSBM bolt E side of No 2 wharf
Aux1	NB 4215 3271	OSBM bolt STS NE angle King Edwards Wharf
Aux2	NB 4212 3275	Amity House E side of Espl Rd N face NW angle
Aux3	NB 4223 3280	BK S side Worth Beach NW angle N face

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.71m below Ordnance Datum Local (ODL)
TGZ = 6.368m below TGBM

Levelling No levelling was carried out in 2011

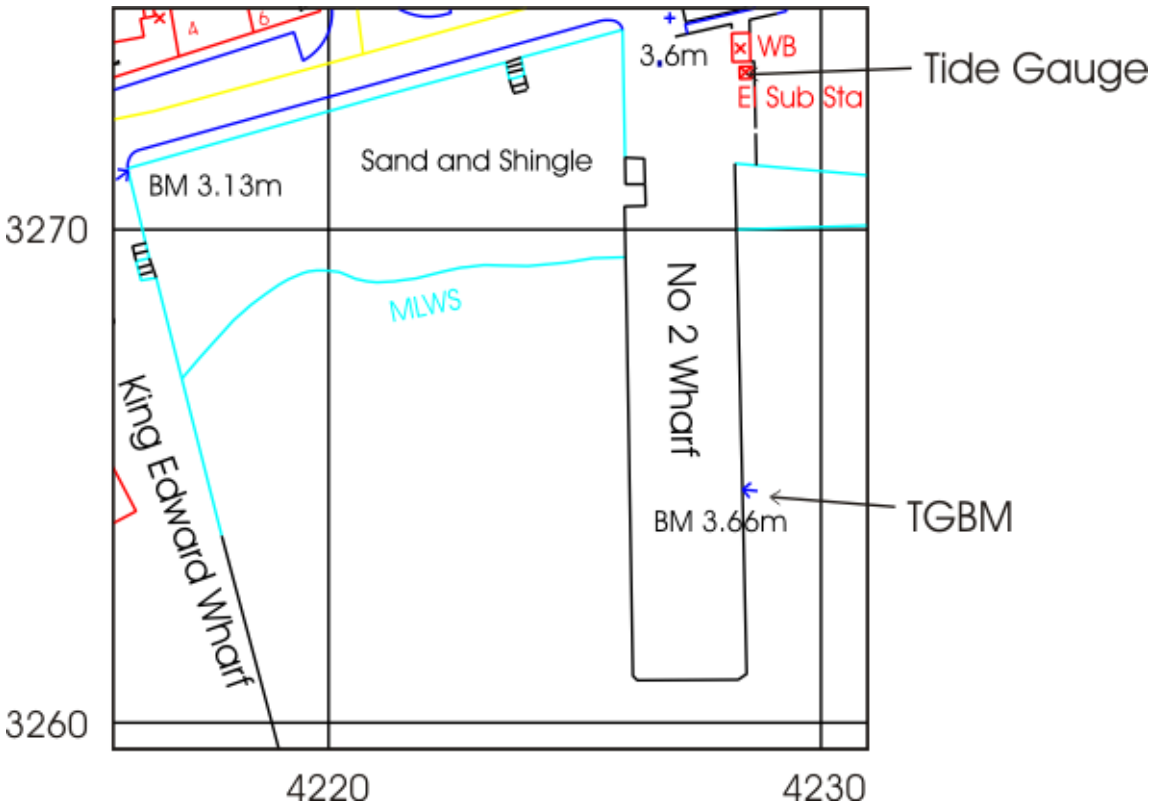
Site visits
Day 244 Made emergency repair after pneumatic line severed by EA contractor. Installed S500 logger and migrated to Swantel telemetry. DATARING logger left in place as GLOSS site.

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	047-051	033-036,047-365

Notes on Completeness/Quality
Electrical contractors severed the pneumatic lines during telemetry enabling works, causing water to enter the system and both channels to under-record. TGI attempted to flush the lines, but were unable to drain residual seawater from the tubing. A diving operation was scheduled for November to replace the tubing, but was cancelled due to adverse weather conditions and has been rescheduled for March 2012. Differences of ~40 mm were noted between the primary and secondary channels. These were deemed acceptable for monitoring extremes but flagged as unacceptable for long term sea level records.

Stornoway – Map & Images of Site



Stornoway – Statistics

Surge maxima	Value	Day	Time
January	0.47	15	20:15:00
February	0.321	2	14:45:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Surge minima	Value	Day	Time
January	-0.493	23	17:00:00
February	-0.152	10	12:30:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme maxima	Value	Day	Time
January	5.102	5	07:15:00
February	4.84	6	08:15:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Extreme minima	Value	Day	Time
January	0.033	22	15:00:00
February	1.025	6	15:00:00
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Mean sea level	No days	MSL
January	31	2.886
February	8	*
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
	Sum	Avg
	39	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Tobermory – Tide Gauge Information

Latitude 56° 37' 23.2" N **Longitude** 06° 03' 51.2" W **Grid Ref** NM 5079 5531

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the Caledonian MacBrayne ferry terminal on Mishnish Pier
Measuring Points Attached to a leg of the pier

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NM 5069 5530	F bracket G5186 on SW angle of Royal bldg
Aux2	NM 5077 5529	NBM rivet in sea wall of Mishnish Pier

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.39m below Ordnance Datum Newlyn (ODN)
TGZ = Chart Datum = 6.856m below TGBM

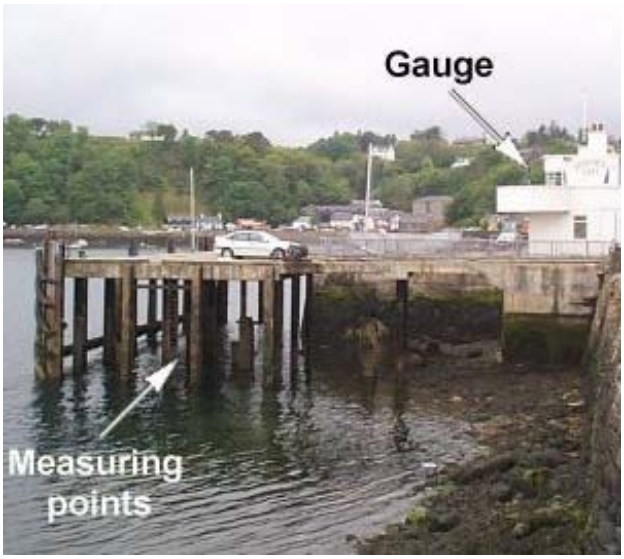
Levelling No levelling was carried out in 2011

Site visits
None

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	166

Tobermory – Map & Images of Site



Tobermory – Statistics

Surge maxima	Value	Day	Time
January	0.602	16	09:00:00
February	0.691	3	21:00:00
March	0.597	31	10:15:00
April	0.471	4	12:15:00
May	1.181	23	13:30:00
June	0.288	25	07:30:00
July	0.292	16	02:45:00
August	0.296	19	18:30:00
September	0.996	12	12:00:00
October	0.405	3	11:45:00
November	0.624	24	17:30:00
December	1.244	8	11:45:00

Surge minima	Value	Day	Time
January	-0.492	23	16:45:00
February	-0.404	28	03:30:00
March	-0.403	14	03:00:00
April	-0.222	26	06:15:00
May	-0.318	26	20:45:00
June	-0.249	4	01:30:00
July	-0.268	28	22:45:00
August	-0.232	9	07:45:00
September	-0.19	18	22:45:00
October	-0.313	7	16:30:00
November	-0.252	13	02:00:00
December	-0.413	17	18:30:00

Extreme maxima	Value	Day	Time
January	4.847	5	06:15:00
February	5.163	19	06:30:00
March	5.028	20	06:00:00
April	4.841	18	18:00:00
May	4.84	18	18:30:00
June	4.802	17	19:00:00
July	4.744	31	18:15:00
August	4.981	31	19:15:00
September	5.291	12	17:45:00
October	5.263	27	05:30:00
November	5.28	24	17:15:00
December	5.321	28	08:15:00

Extreme minima	Value	Day	Time
January	0.119	23	02:15:00
February	0.273	20	01:00:00
March	0.063	21	00:45:00
April	0.241	20	01:00:00
May	0.633	17	11:45:00
June	0.747	4	13:30:00
July	0.703	4	14:00:00
August	0.248	31	13:15:00
September	0.258	29	13:00:00
October	0.544	28	12:30:00
November	0.676	26	00:00:00
December	0.719	27	13:45:00

Mean sea level	No days	MSL
January	31	2.724
February	28	2.818
March	31	2.602
April	30	2.659
May	31	2.758
June	30	2.699
July	31	2.659
August	31	2.727
September	30	2.877
October	31	2.864
November	30	2.936
December	31	2.904
	Sum	Avg
	364	2.769

Ullapool – Tide Gauge Information

Latitude 57° 53' 42.9" N **Longitude** 05° 09' 28.4" W **Grid Ref** NH 1293 9391

Instrument Data acquisition system with a full-tide and a mid-tide bubbler gauge and a back-up potentiometer attached to a Munro float gauge

Location **Tide Gauge Building** On the Ullapool harbour pier
Measuring Points Below the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NH 1288 9391	OSBM Pier NW Para 8.2M NE steps
Aux1	NH 1303 9425	PA bolt Church SW side of road NE face N angle
Aux2	NH 1288 9398	No 8 Shore Street SE face 0.3M S angle
Aux3	NH 1253 9376	Rivet Fnd No 21 West Shore Street S angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 2.75m below Ordnance Datum Newlyn (ODN)
TGZ = 7.155m below TGBM

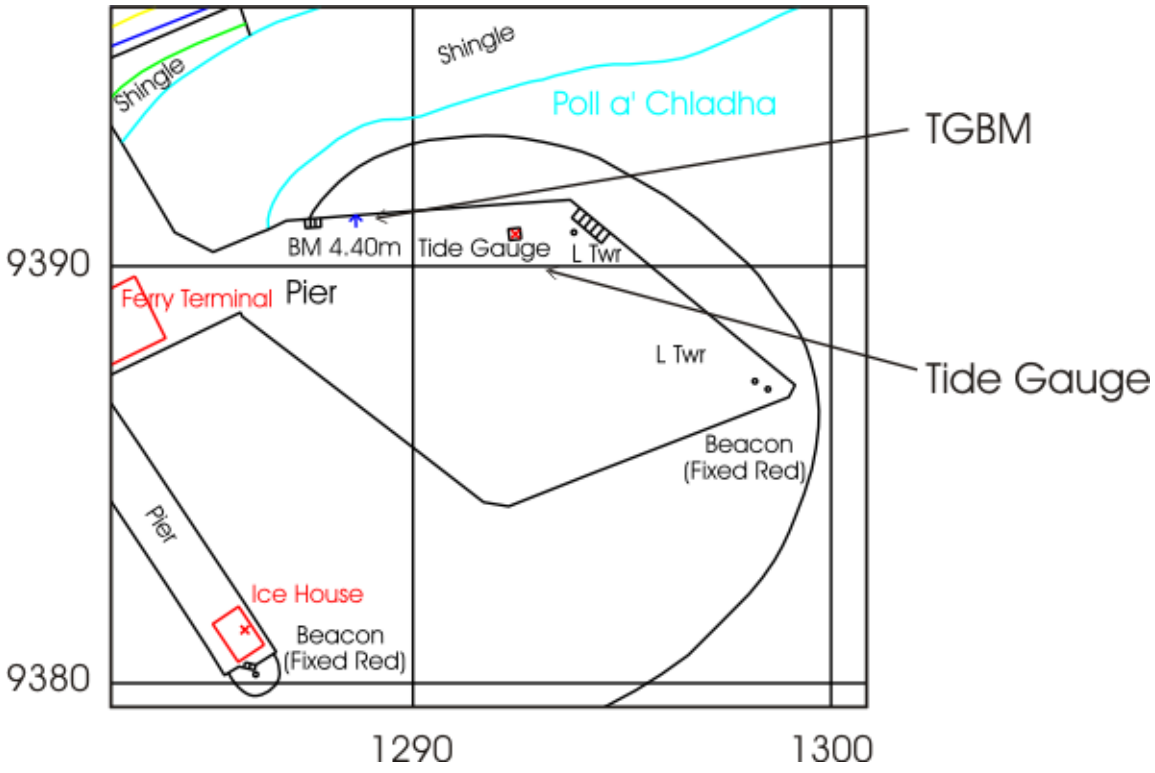
Levelling No levelling was carried out in 2011

Site visits
Day 188 Delivered new outstation equipment
Day 235 Removed old DATARING logger and replaced with S500 outstation. Migrated to Swantel telemetry. Performed general maintenance.

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	234-235	081,235-236,251,272,275,280,281,290,294,333,345-350

Ullapool – Map & Images of Site



Ullapool – Statistics

Surge maxima	Value	Day	Time
January	0.528	15	17:30:00
February	0.992	3	22:00:00
March	0.451	10	07:15:00
April	0.494	5	01:00:00
May	0.809	23	16:15:00
June	0.263	26	19:15:00
July	0.334	16	03:00:00
August	0.267	20	00:45:00
September	0.672	12	14:30:00
October	0.537	3	17:15:00
November	0.869	27	03:30:00
December	1.202	8	17:30:00

Surge minima	Value	Day	Time
January	-0.544	23	16:30:00
February	-0.409	28	02:45:00
March	-0.523	13	22:15:00
April	-0.21	26	06:45:00
May	-0.265	26	22:30:00
June	-0.243	4	03:15:00
July	-0.273	29	00:45:00
August	-0.197	9	08:00:00
September	-0.214	18	23:45:00
October	-0.237	7	17:45:00
November	-0.273	13	09:00:00
December	-0.419	30	05:30:00

Extreme maxima	Value	Day	Time
January	5.434	5	07:15:00
February	5.784	20	08:00:00
March	5.727	21	07:30:00
April	5.509	18	19:00:00
May	5.565	18	19:30:00
June	5.355	17	20:00:00
July	5.404	31	19:15:00
August	5.575	30	19:45:00
September	5.917	28	19:15:00
October	5.869	27	06:30:00
November	6.015	24	17:45:00
December	5.873	28	09:30:00

Extreme minima	Value	Day	Time
January	0.045	22	15:00:00
February	0.244	20	14:45:00
March	0.002	22	15:00:00
April	0.118	18	13:15:00
May	0.591	17	12:45:00
June	0.839	4	02:30:00
July	0.701	4	02:45:00
August	0.06	31	02:15:00
September	0.218	29	01:45:00
October	0.436	28	01:15:00
November	0.721	26	01:00:00
December	0.717	27	15:15:00

Mean sea level	No days	MSL
January	31	3.083
February	28	3.18
March	31	2.961
April	30	3.022
May	31	3.114
June	30	3.051
July	31	2.998
August	27	3.07
September	30	3.24
October	31	3.259
November	30	3.322
December	23	3.291
	Sum	Avg
	353	3.133

Weymouth – Tide Gauge Information

Latitude 50° 36' 30.6" N **Longitude** 02° 26' 52.6" W **Grid Ref** SY 6840 7885

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** Commercial Pier, next to the ferry terminal
Measuring Points On the pier wall, directly in front of the tide gauge building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	SY 6826 7882	Bolt corner of quay wall NW side N angle
Aux1	SY 6822 7886	Bolt sea wall 5.5M W steps
Aux2	SY 6813 7888	Right base NW pillar NE entrance Alexandra gardens
Aux3	SY 6810 7893	Bolt sea wall 10.1M NW shelter
Aux4	SY 6806 7908	Bolt N base STS aquarium E side of esplanade
REFBM	SY 6837 7884	Bolt concrete SW corner of building next to tide gauge hut

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.02m below Ordnance Datum Newlyn (ODN)
TGZ = 4.334m below TGBM

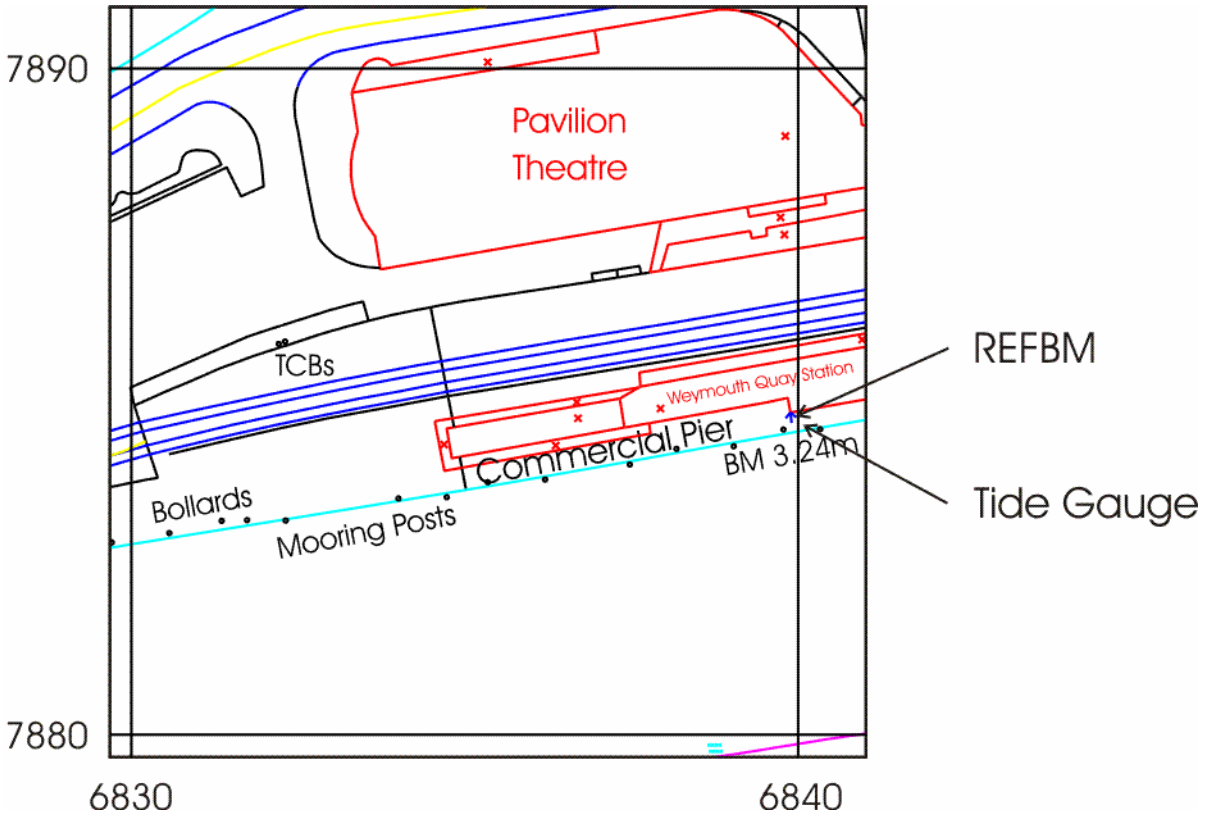
Levelling No levelling was carried out in 2011

Site visits
Day 164 Delivered new outstation equipment
Day 272 Decommissioned DATARING, installed S500 logger and migrated to Swantel. General maintenance completed.

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	272	272-273,331,362

Weymouth – Map & Images of Site



Weymouth – Statistics

Surge maxima	Value	Day	Time
January	0.442	8	04:15:00
February	0.348	15	07:30:00
March	0.249	13	03:45:00
April	0.163	30	00:00:00
May	0.208	8	02:15:00
June	0.301	17	15:45:00
July	0.226	17	05:00:00
August	0.185	7	23:00:00
September	0.257	12	03:15:00
October	0.289	24	18:00:00
November	0.341	3	09:30:00
December	0.499	12	23:00:00

Surge minima	Value	Day	Time
January	-0.519	23	05:45:00
February	-0.407	28	22:15:00
March	-0.441	23	14:00:00
April	-0.286	11	23:45:00
May	-0.367	24	05:30:00
June	-0.296	2	00:45:00
July	-0.201	1	05:45:00
August	-0.249	10	08:45:00
September	-0.369	6	19:30:00
October	-0.288	9	16:45:00
November	-0.356	25	10:45:00
December	-0.502	27	01:15:00

Extreme maxima	Value	Day	Time
January	2.438	7	08:45:00
February	2.591	19	07:30:00
March	2.382	21	07:45:00
April	2.409	19	20:00:00
May	2.243	19	20:15:00
June	2.403	17	19:45:00
July	2.309	16	19:45:00
August	2.509	31	20:30:00
September	2.522	28	19:30:00
October	2.691	27	06:45:00
November	2.377	26	07:15:00
December	2.401	12	20:00:00

Extreme minima	Value	Day	Time
January	-0.375	22	16:45:00
February	-0.231	19	15:45:00
March	-0.395	21	16:00:00
April	-0.162	18	15:00:00
May	0.013	18	03:00:00
June	0.133	3	12:15:00
July	0.108	4	04:30:00
August	-0.189	31	04:00:00
September	-0.233	28	03:00:00
October	-0.018	28	03:15:00
November	-0.049	27	16:00:00
December	-0.064	27	00:45:00

Mean sea level	No days	MSL
January	31	1.066
February	28	1.09
March	31	0.962
April	30	1.022
May	31	1.034
June	30	1.086
July	31	1.099
August	31	1.113
September	28	1.135
October	31	1.153
November	30	1.203
December	30	1.173
	Sum	Avg
	362	1.095

Whitby – Tide Gauge Information

Latitude 54° 29' 24.0" N **Longitude** 00° 36' 52.9" W **Grid Ref** NZ 8984 1140

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** In the Harbourmaster's office
Measuring Points Underneath the quay, next to the Harbour Office

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	NZ 8986 1141	E side of Pier Rd
Aux1	NZ 8992 1105	Bolt butt of Whitby Bridge
Aux2	NZ 8985 1134	Rivet quayside SE side of Pier Rd
Aux3	NZ 8983 1142	Rivet wall angle S side of road angle of lifeboat museum

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 3.00m below Ordnance Datum Newlyn (ODN)
TGZ = 9.105m below TGBM

Levelling No levelling was carried out in 2011

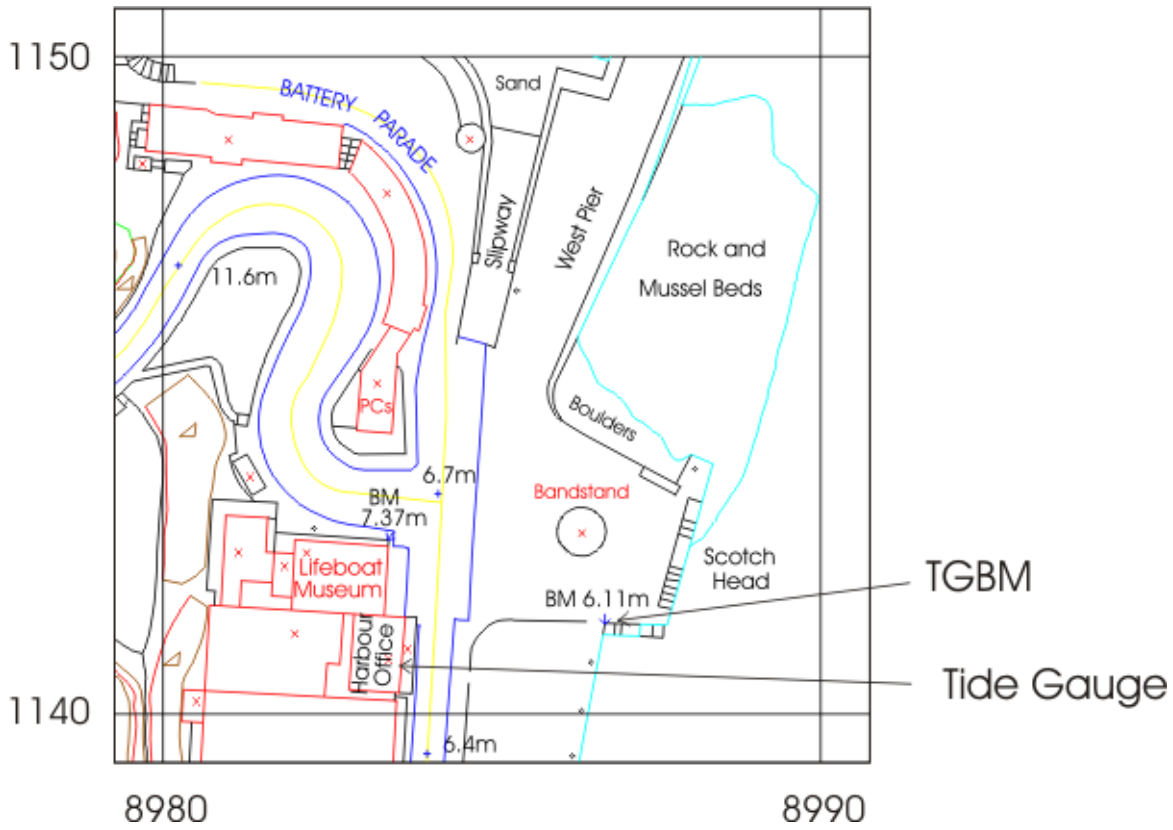
Site visits

Day 041	General maintenance and meeting with EA contractor and MEICA engineer for electrical survey to support new telemetry system
Day 181	Carried out maintenance and delivered new outstation equipment
Day 203	Visit with Dive Team to replace/relocate pressure points becoming submerged in silt

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	203,204	005-007,012,064-065,117-118,203-204,213-215,242-244,270-273,299-301,303-365

Whitby – Map & Images of Site



Whitby – Statistics

Surge maxima	Value	Day	Time
January	0.5	16	03:00:00
February	1.423	4	11:45:00
March	0.446	8	22:45:00
April	0.42	5	19:00:00
May	0.687	24	10:45:00
June	0.377	27	16:15:00
July	0.594	24	00:30:00
August	0.476	29	08:30:00
September	0.482	7	05:45:00
October	0.804	4	03:30:00
November			
December			

Surge minima	Value	Day	Time
January	-0.231	10	09:15:00
February	-0.538	3	23:45:00
March	-0.315	14	11:15:00
April	-0.128	10	04:15:00
May	-0.599	23	19:15:00
June	-0.152	1	11:30:00
July	-0.08	31	12:15:00
August	-0.141	10	08:30:00
September	-0.201	27	11:30:00
October	-0.251	24	22:00:00
November			
December			

Extreme maxima	Value	Day	Time
January	5.836	6	17:15:00
February	6.021	4	16:45:00
March	6.209	21	17:00:00
April	6.025	19	16:45:00
May	5.923	19	04:45:00
June	5.894	18	05:15:00
July	5.849	17	05:00:00
August	6.176	31	05:00:00
September	6.253	29	04:30:00
October	6.203	28	04:15:00
November			
December			

Extreme minima	Value	Day	Time
January	0.504	23	00:15:00
February	0.371	19	22:45:00
March	0.411	20	23:00:00
April	0.445	18	22:30:00
May	0.937	17	22:00:00
June	1.13	17	11:00:00
July	0.816	31	10:15:00
August	0.781	1	10:45:00
September	0.772	27	08:45:00
October	0.815	28	10:30:00
November			
December			

Mean sea level	No days	MSL
January	27	3.44
February	28	3.424
March	28	3.333
April	26	3.409
May	31	3.435
June	30	3.467
July	28	3.455
August	28	3.498
September	28	3.534
October	31	3.535
November	0	
December	0	
	Sum	Avg
	285	**

** No yearly average value as more than one month's MSL missing

Wick – Tide Gauge Information

Latitude 58° 26' 27.5" N **Longitude** 03° 05' 10.7" W **Grid Ref** ND 3668 5081

Instrument Data acquisition system with two full-tide and a mid-tide bubbler gauge
Location **Tide Gauge Building** Northwest corner of Wick harbour, next to the ship repair slipway
Measuring Points Attached to an unused stilling well beneath the building

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
TGBM	ND 3667 5081	New OSBM bolt quay E angle tide gauge building
Aux1	ND 3670 5084	Rivet base of wall 15.5M NE angle of building
Aux2	ND 3670 5083	NBM rivet base SE end of wall NE side of N pier
Aux3	ND 3705 5055	Wall base of steps SE side of pier

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 1.71m below Ordnance Datum (ODN)
TGZ = 5.084m below TGBM

Levelling No levelling was carried out in 2011

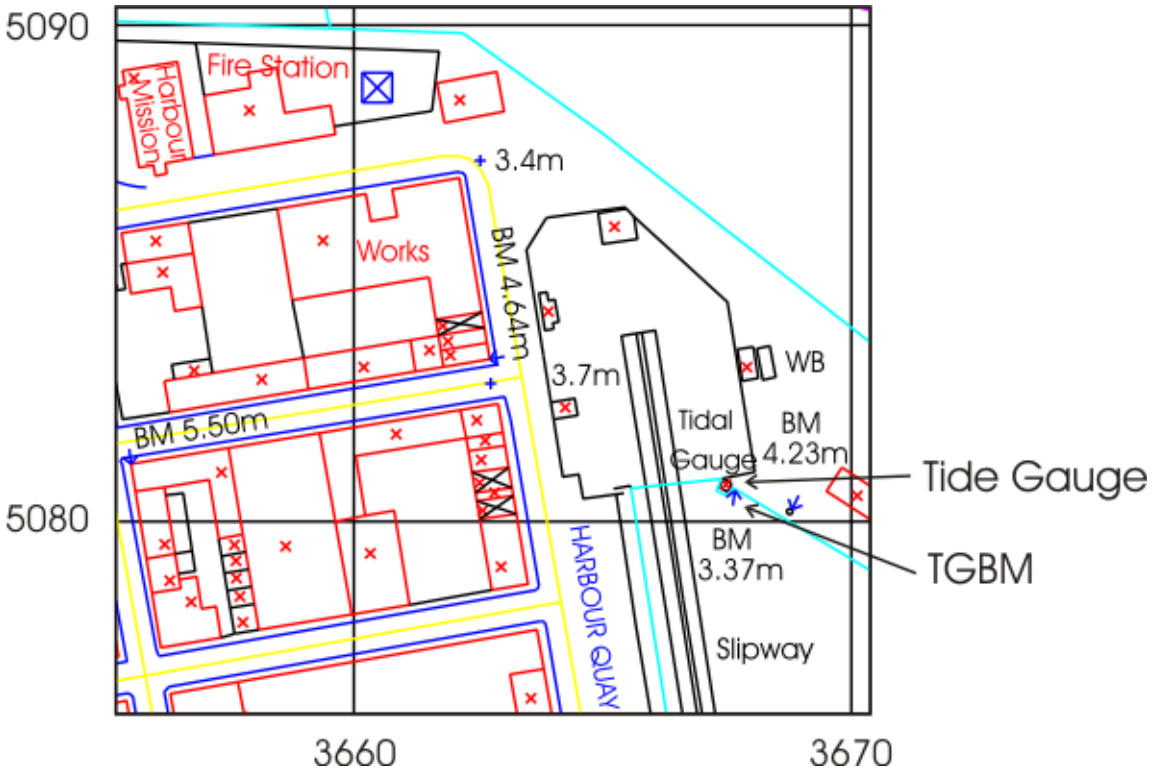
Site visits
Day 055 Met electrical contractors re install of new telemetry system and carried out routine maintenance
Day 188 Delivered new outstation equipment
Day 329 Compressor change and diving survey

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
100	15 minutes	None	012-147,256-284,299-318,329

Notes on Completeness/Quality
The primary channel was problematic during rising tides from January to May, but the issue resolved itself in June. From September to November the primary channel was occasionally up to 35 mm low, which was acceptable for monitoring extremes but was flagged as unacceptable for the purposes of long-term sea level monitoring. The problem was corrected during the outstation installation and a maintenance visit in November.

Wick – Map & Images of Site



Wick – Statistics

Surge maxima	Value	Day	Time
January	0.165	8	14:15:00
February			
March	0.246	31	15:00:00
April	0.388	5	16:45:00
May	0.339	28	13:15:00
June	0.233	27	03:15:00
July	0.292	16	22:00:00
August	0.213	20	20:45:00
September	0.462	12	23:15:00
October	0.37	17	19:15:00
November	0.79	25	07:15:00
December	0.781	25	20:45:00

Surge minima	Value	Day	Time
January	-0.332	2	14:15:00
February			
March	-0.279	22	19:00:00
April	-0.214	26	09:30:00
May	-0.162	27	10:45:00
June	-0.185	4	18:45:00
July	-0.235	29	14:30:00
August	-0.178	31	01:15:00
September	-0.144	15	08:45:00
October	-0.268	13	13:15:00
November	-0.17	15	16:45:00
December	-0.366	30	09:30:00

Extreme maxima	Value	Day	Time
January	3.693	5	11:45:00
February			
March	3.631	22	13:00:00
April	3.579	18	11:30:00
May	3.562	19	00:45:00
June	3.668	18	00:30:00
July	3.734	17	00:15:00
August	3.741	31	00:15:00
September	3.974	12	23:15:00
October	3.725	25	22:00:00
November	4.224	27	12:00:00
December	4.137	25	23:45:00

Extreme minima	Value	Day	Time
January	0.733	6	18:15:00
February			
March	0.059	22	19:00:00
April	0.084	18	17:15:00
May	0.501	15	15:00:00
June	0.494	5	07:00:00
July	0.38	4	07:00:00
August	0.11	31	06:15:00
September	0.227	1	06:45:00
October	0.522	26	04:00:00
November	0.668	27	18:30:00
December	0.466	27	19:15:00

Mean sea level	No days	MSL
January	11	*
February	0	
March	0	
April	0	
May	4	*
June	30	2.028
July	31	1.978
August	31	2.041
September	11	*
October	13	*
November	15	2.272
December	31	2.261
	Sum	Avg
	177	**

* No mean sea level value as more than 15 days of data missing
** No yearly average value as more than one month's MSL missing

Workington – Tide Gauge Information

Latitude 54° 39' 02.6" N **Longitude** 03° 34' 01.8" W **Grid Ref** NX 9898 2953

Instrument Data acquisition system with two full-tide bubbler gauges
Location **Tide Gauge Building** North side of the dock entrance
Measuring Points Behind fender piles on the north seaward side of the dock gates

Datum All data refer to Admiralty Chart Datum (ACD)

Benchmark	Grid Ref	Description
Aux1	NX 9917 2928	Building SW face 3.7M from S angle Workington Dock
Aux2	NX 9948 2967	NBM works building S side Rd N face NE angle

Benchmark Relationships
TGZ = Admiralty Chart Datum (ACD)
TGZ = 4.20m below Ordnance Datum Newlyn (ODN)
TGZ = 11.59m below Aux1

Levelling No levelling was carried out in 2011

Site visits
Day 107 Delivered S500 datalogger and supervised electrical installation
Day 255 Installed S500 datalogger, decommissioned DATARING and migrated system to Swantel

Data quality

CI%	Sample Interval	Missing Data	Suspect Data
99	15 minutes	255,263,269	131,255,264,266,270,305,307,315,321

Workington – Map & Images of Site

Workington – Statistics

Surge maxima	Value	Day	Time
January	0.734	15	11:30:00
February	1.079	7	10:45:00
March	0.687	31	09:30:00
April	0.474	5	07:15:00
May	0.994	23	14:00:00
June	0.297	13	00:30:00
July	0.314	6	23:45:00
August	0.38	10	14:30:00
September	0.954	12	07:45:00
October	0.941	17	15:45:00
November	0.901	29	12:30:00
December	1.379	8	16:00:00

Surge minima	Value	Day	Time
January	-0.625	23	16:15:00
February	-0.542	28	04:45:00
March	-0.509	3	07:30:00
April	-0.387	12	07:30:00
May	-0.363	26	19:45:00
June	-0.404	4	16:15:00
July	-0.321	1	01:45:00
August	-0.357	9	03:45:00
September	-0.291	18	13:15:00
October	-0.372	7	12:00:00
November	-0.405	27	16:15:00
December	-0.487	17	23:30:00

Extreme maxima	Value	Day	Time
January	8.463	22	13:00:00
February	9.09	20	12:30:00
March	8.981	21	12:15:00
April	8.818	19	12:00:00
May	8.554	17	23:15:00
June	8.479	18	00:30:00
July	8.449	15	23:45:00
August	8.894	31	00:15:00
September	9.143	28	23:45:00
October	9.08	29	12:45:00
November	9.111	26	11:45:00
December	8.799	26	12:15:00

Extreme minima	Value	Day	Time
January	0.08	22	19:45:00
February	0.152	20	19:15:00
March	0.011	21	19:00:00
April	0.14	18	17:45:00
May	0.625	19	06:45:00
June	0.971	4	07:15:00
July	0.823	4	07:30:00
August	0.182	31	07:00:00
September	0.238	29	06:30:00
October	0.47	28	06:15:00
November	0.658	27	19:00:00
December	0.938	27	07:15:00

Mean sea level	No days	MSL
January	31	4.474
February	28	4.576
March	31	4.355
April	30	4.397
May	31	4.497
June	30	4.471
July	31	4.442
August	31	4.501
September	28	4.642
October	31	4.644
November	30	4.694
December	31	4.689
	Sum	Avg
	363	4.532

* No mean sea level value as more than 15 days of data missing