East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

East Anglia THREE

Appendix 7.5

Metocean Data Report

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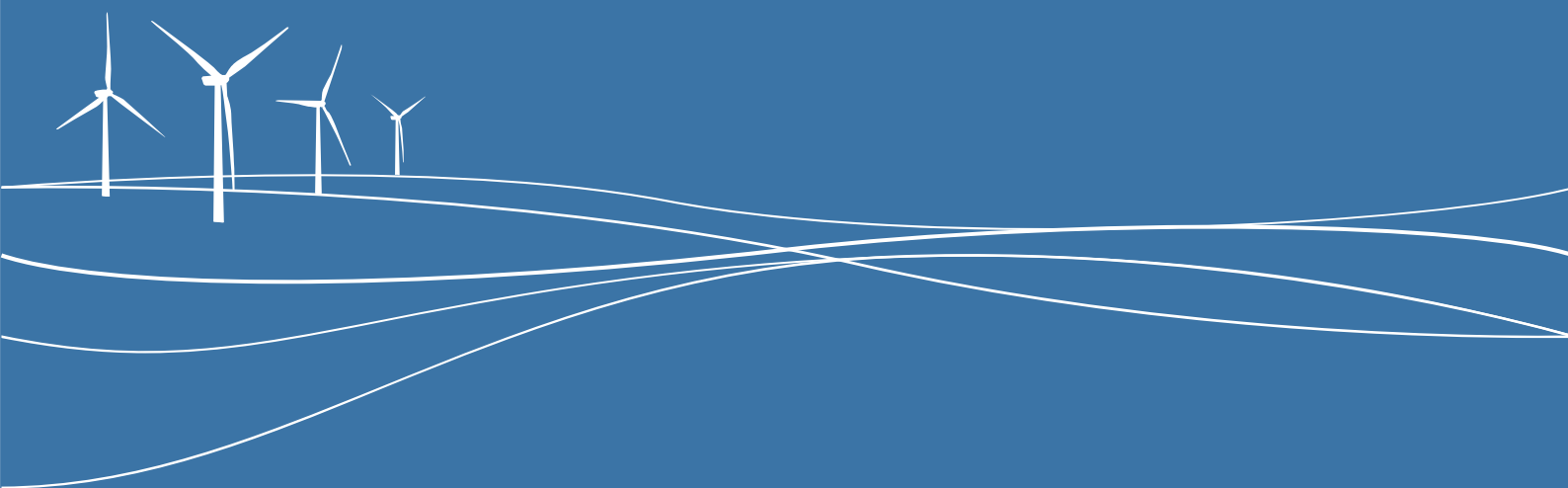

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7.5 METOCEAN DATA REPORT

1. This appendix contains a report written by Cefas providing oceanographic data for the development of the proposed East Anglia THREE project.

Cefas

Cefas Contract Report C5726/EA3-FT001

EAST ANGLIA THREE – CEFAS FINAL TECHNICAL REPORT

OCEANOGRAPHIC MEASUREMENTS/EAOW LTD (DECEMBER 2012 TO DECEMBER 2013)

Author: Dr David Pearce

Issue date: 14th March 2014

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Project Manager:	Dr David Pearce
Report compiled by:	Dr David Pearce
Quality control by:	Dave Sivyer
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EAST ANGLIA THREE – CEFAS FINAL TECHNICAL REPORT

OCEANOGRAPHIC MEASUREMENTS/EAOW LTD
(DECEMBER 2012 TO DECEMBER 2013)

Author: Dr David Pearce

Issue date: 14th March 2014

Head office

Centre for Environment, Fisheries & Aquaculture Science

Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK

Tel +44 (0) 1502 56 2244 Fax +44 (0) 1502 51 3865

www.cefas.defra.gov.uk

Cefas is an executive agency of Defra

Executive Summary

East Anglia Offshore Wind Ltd (EAOW) required specialist services to provide sufficient oceanographic data for the development of East Anglia THREE, a project area within the zone, which is situated around 70 km from the shore at its closest point. Additionally, some of the information will be used to inform the Zone Appraisal and Planning for EAOW.

A key driver for the work described in this report was the initial description of the physical processes baseline presented in the EAOW Zone Environmental Appraisal scoping report (EAOW July 2010). This report identified that further data would be required to enable a robust assessment of the coastal processes on site.

Time series data over a 12-month period has been collected by a Datawell MkIII Directional Waverider (DWR) buoy within the East Anglia THREE project area; this instrument measures wave parameters/spectra and sea surface temperature. During the same time period, Nortek Acoustic Waves and Currents (AWAC) acoustic Doppler current profilers, which measure current profiles, wave parameters/spectra and sea bottom temperature, were deployed on sea bed MiniLanders at a single location within the project area. Turbidity sensors were attached to the AWACs to obtain optical backscatter (OBS) data. Sediment samples collected using a Booner tube sediment trap attached to the MiniLanders were used to calculate estimates of the in-situ suspended sediment conditions from the OBS values. On each operational visit to the AWAC site, water and sediment grab samples were collected.

This project has provided EAOW with an extensive, high quality annual dataset (December 2012 to December 2013) describing the physical environments measured in the East Anglia THREE project area. Clearly, there will be inter-annual variability in many of the parameters collected and this should be considered when assessing the requirement for longer term monitoring during the construction and operations phases.

Several operational challenges were encountered during the deployments of Waveriders and MiniLanders. The biggest risk throughout was from the extensive and frequent vessel activity within the area. This was especially apparent as the sites chosen for this project were “new” sites to the maritime community, showing the importance of robust site selection and maximising stakeholder

awareness. Learning from a previous monitoring campaign in East Anglia ONE, larger guard buoys were employed as part of a strategy to minimise equipment, and therefore data, losses.

Cefas has now successfully delivered the full requirements and scope of this contract in a timely manner and obtained the high quality data noted above to facilitate assessment by others.

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1 Introduction

East Anglia Offshore Wind Ltd (EAOW) required specialist services to provide sufficient oceanographic data for the development of East Anglia THREE, a project within the zone, which is situated around 70 km from the shore at its closest point. Additionally, some of the information will be used to inform the Zone Appraisal and Planning for EAOW.

A key driver for the work described in this report was the initial description of the physical processes baseline presented in the EAOW Zone Environmental Appraisal scoping report (EAOW July 2010). That report identified that further data would be required to enable a robust assessment of the coastal processes on site.

- Local measurement of directional wave climate
- Local measurement of water levels
- Local measurements of currents, including vertical profile
- Local measurements of suspended sediment concentrations
- Local water samples
- Local samples of bottom material

Time series data over a 12-month period has been collected by a Datawell MkIII Directional Waverider (DWR) buoy within the East Anglia THREE project area; this instrument measures wave parameters/spectra and sea surface temperature. During the same time period, Nortek Acoustic Waves and Currents (AWAC) acoustic Doppler current profilers, which measure current profiles, wave parameters/spectra and sea bottom temperature, were deployed on sea bed MiniLanders at a single location within the project area.

Turbidity sensors were attached to the AWACs to obtain optical backscatter (OBS) data. Sediment samples collected using a Booner tube sediment trap attached to the MiniLanders were used to calculate estimates of the in-situ suspended sediment conditions the OBS values. These calibrations were undertaken in a sediment flume tank post-recovery.

On each operational visit to the AWAC site, water and grab samples were collected. These have been characterised for suspended sediment concentration and particle size respectively. In addition, the salinity of some of the water samples was measured.

Conductivity/temperature sensors (self-contained HOBO loggers on deployments 1 and 2; sensor on Cefas ESM2 logger for deployments 3 to 7) were fitted to the MiniLander and used to calculate in-situ salinity. The salinity of some of the water samples was measured and used to calibrate the sensor data.

A multibeam survey of the site was carried out prior to deploying the first MiniLander. Following an onboard assessment of the seabed topography the position of the MiniLander was moved approximately 200m south west off the top of a sand wave crest and into the adjacent trough. A further multibeam survey was undertaken after the final recovery to establish that the site had been cleared of debris.

Cefas has now delivered the full requirements and scope of this contract and obtained the data noted above to facilitate assessment by others.

2 Installation and Sampling Methodologies

2.1 Summary of Vessel activities

A total of eight trips were undertaken aboard RV Cefas Endeavour to accomplish the planned work. All trips departed and returned to Lowestoft except for the second deployment trip that disembarked in Swansea. Daily log sheets for all offshore planned activities are in Annex 3. On several occasions the EAOW operational work was undertaken as part of a longer trip on the vessel. Where this was the case, the daily log sheets cover only the periods where the activities on board were primarily to fulfil the EAOW contract.

2.2 Deployment Positions

The work comprised the deployments of two types of equipment (MiniLander equipped with Nortek AWAC current profiler/Cefas ESM2 logger and Directional Waverider) for a period of approximately 12 months in the East Anglia THREE project area (see figure 1).

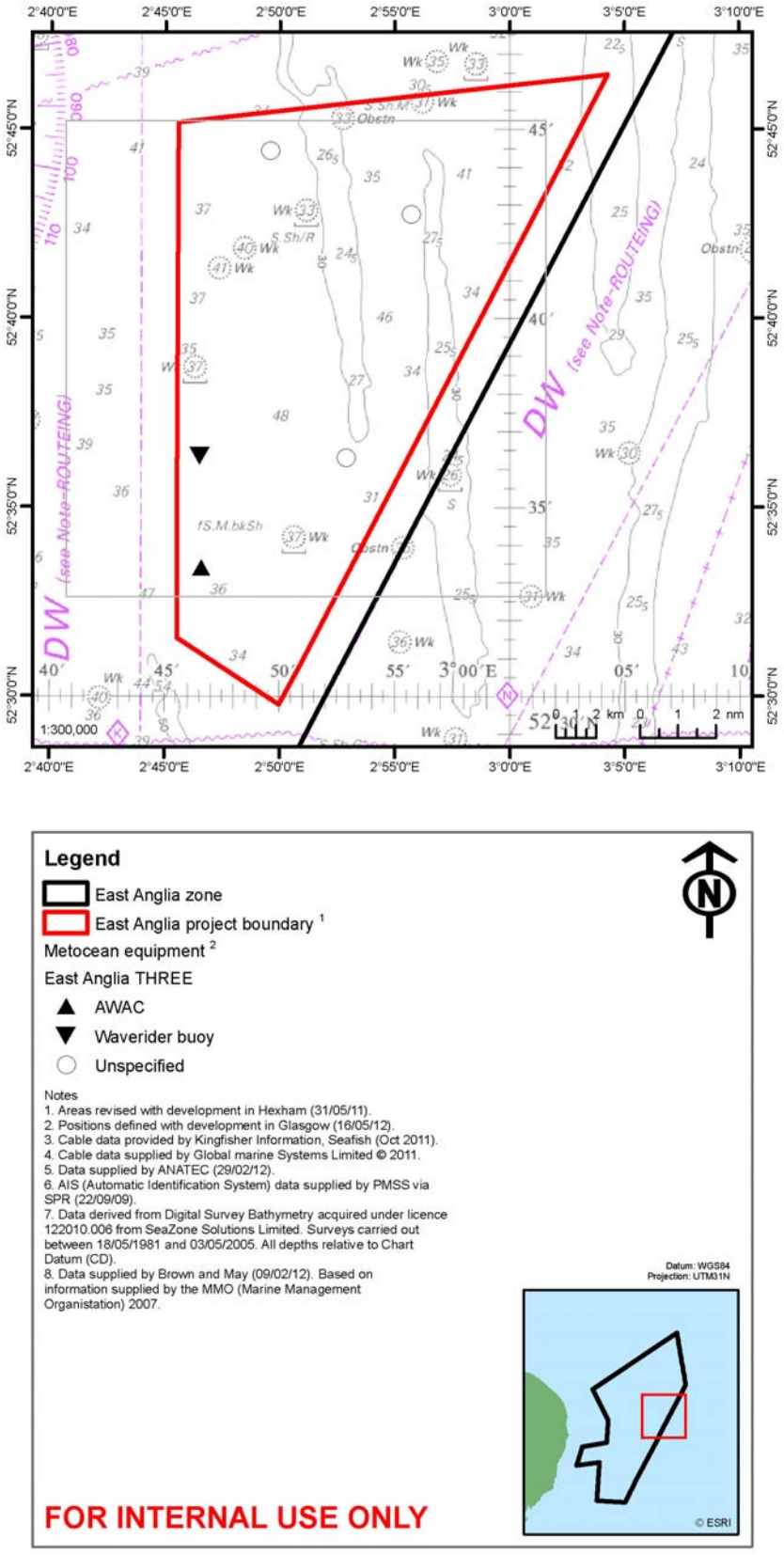


Figure 1 - Chart extract showing the general position of the Waverider and AWAC sites as per original Notice to Mariners.

The series of seven MiniLanders deployments, to measure currents, waves, turbidity and salinity, commenced on 4 December 2012 and finished on 3 December 2013. These MiniLanders were deployed at EAOW site AWAC 3.1. The table below show a summary of the deployment times, positions and approximate water depths (estimated from recovered AWACs) at the site.

AWAC 3.1	Latitude	Longitude	Depth (m)	Deployed (UTC)	Recovered (UTC)
Dep. 1	52°33'.352N	002°46'.427E	45	04/12/2012 14:20	08/02/2013 12:58
Dep. 2	52°33'.260N	002°46'.417E	44	08/02/2013 14:32	16/04/2013 08:01
Dep. 3	52°33'.396N	002°46'.444E	44	16/04/2013 08:50	05/06/2013 07:30
Dep. 4	52°33'.327N	002°46'.519E	44	05/06/2013 08:20	30/07/2013 12:58
Dep. 5	52°33'.341N	002°46'.444E	45	30/07/2013 13:38	07/09/2013 14:20
Dep. 6	52°33'.342N	002°46'.446E	44	07/09/2013 19:50	07/10/2013 07:20
Dep. 7	52°33'.348N	002°46'.514E	45	07/10/2013 08:05	03/12/2013 14:27

A Datawell Directional Waverider buoy was deployed at EAOW East Anglia THREE site DWR E. The table below show a summary of the deployment times and position for DWR E.

DWR E	Latitude	Longitude	Depth (m)	Deployed (UTC)	Recovered (UTC)
Dep. 1	52°36'.320N	002°46'.487E	43	04/12/2012 13:10	03/12/2013 15:27

2.3 Equipment Details

2.3.1 Waverider

The measurements reported here have been collected using a MkIII Directional Waverider (DWR) buoy manufactured by Datawell BV in the Netherlands. The buoy has a valid three-year calibration check certificate from the manufacturer. It was deployed with reference to the Datawell Waverider manual, the appropriate Cefas Standard Operating Procedure and Cefas Risk Assessments. The Waverider was fixed to the seabed using a standard Datawell rubber cord/rope mooring with 330kg clump. A large Cefas Guard Buoy was positioned nearby as part of the deployment. Figure 2 shows a typical Waverider mooring configuration for approximately 40-45m water depth.

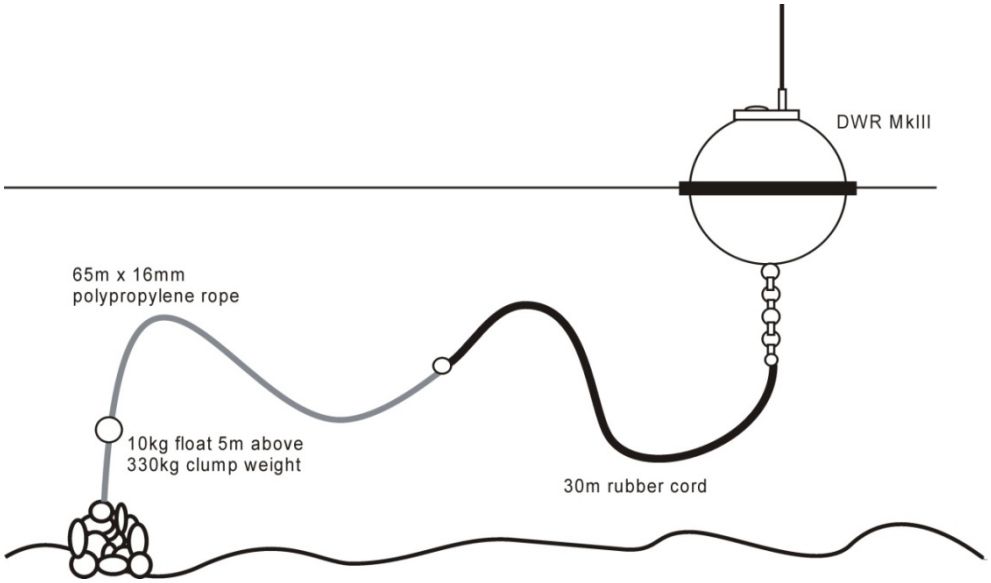


Figure 2. EAOW Datawell Directional Waverider mooring.

Data from the Waveriders (wave parameters and 14 frequency band compressed spectra) were telemetered in near-real time every half hour using the ORBCOMM satellite system.

The parameters telemetered included:-

1. Significant wave height (Hm0 in meters)
2. Peak wave period (Tpeak in seconds)
3. Mean wave period (Tz in seconds)
4. Peak wave (coming) direction (in degrees magnetic)
5. Wave spread (in degrees)
6. Sea temperature (in degrees Celsius)
7. X, Y and Z offsets and status information

The Waverider has been fitted with a GPS receiver and the location is included in the telemetered data messages. If the buoy goes outside a programmable watch circle, out-of-position email warnings are sent to a number of Cefas personnel.

After recovery of the Waverider, the raw data files were copied from the buoy logger's compact flash card and stored securely on a backed-up Cefas network drive. The monthly *.SDT files were then processed using Datawell W@ves21 v2.1.17 software to generate the half-hourly *.SPT full spectrum files, which were then processed as described in section 2.8.1.

2.3.2 MiniLander

Current and wave measurements have been collected using an Acoustic Waves and Current (AWAC) instrument manufactured by Nortek AS, Norway. The AWAC came with a functional test certificate from the manufacturer.

The parameters collected by the AWAC included:-

- Current profiles at 1m separation (speed in metres/sec, direction in degrees magnetic)
- Sea temperature (in degrees Celsius)
- Speed of sound (in metres/second)
- Pitch and roll (in degrees)
- Heading (in degrees magnetic)
- Pressure (in dBar)
- Significant wave height (Hm0 in metres)
- Peak wave period (Tpeak in seconds)
- Mean wave period (Tz in seconds)
- Peak wave (coming) direction (in degrees magnetic)
- Wave spread (in degrees)
- Surface current (speed in metres/sec, direction in degrees magnetic)
- Diagnostic and status information

In addition, a Seapoint optical backscatter (OBS) turbidity sensor (fitted with a Zebra-Tech Hydro-Wiper anti-biofouling device) was connected to the analogue input of the AWAC, which stored the OBS values as arbitrary units.

The platform used was the three-legged, Cefas MiniLander. The AWAC, a conductivity/temperature (CT) sensor (used to measure salinity) and a Booner tube (to collect an in-situ sediment sample from the water column throughout the duration of the deployment) were attached to the MiniLander. The MiniLander was deployed with reference to the appropriate Cefas Standard Operating Procedure and Risk Assessments. Two large Cefas Guard Buoys were positioned near to the Lander as part of the deployment. The MiniLander was fitted with the primary recovery system of a 22mm polypropylene rope to the surface that had three 450mm diameter buffs attached. The MiniLander was also fitted with an Applied Acoustics programmable release system and a 150m long, 12mm ground wire to a 100kg clump weight that offered two backup means of recovery should the primary system fail. Figure 3 over the page shows a typical mooring configuration for the Cefas MiniLander.

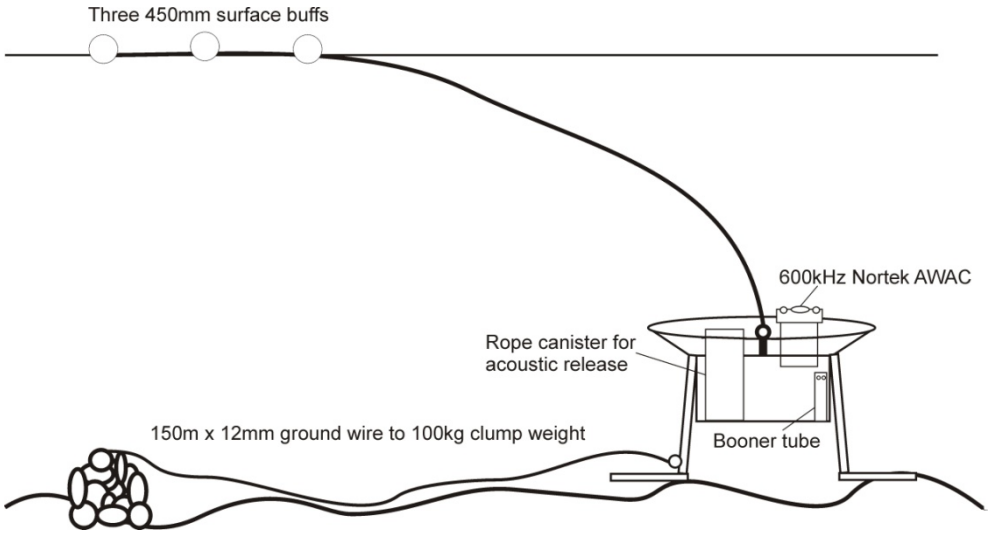


Figure 3. EAOW MiniLander mooring.

Following recovery, the *.WPR data file was extracted from the AWAC using Nortek AWAC AST v1.41 software. The current profile and sensor data were produced using the data conversion facility of the AWAC AST v1.41. The *.WPR data file was then loaded into Nortek Storm v1.10beta software and the wave data processed using the SUV (Surface tracking and U & V velocity) method (PdWaveBase Version 3.30). This was configured with the optimised spectrum setting, the mounting height as measured on the Lander prior to deployment and referenced to magnetic north. The wave data files were then extracted and, together with the current and parameter data, underwent a range of QA procedures (see section 2.8.2). The Cefas SmartBuoy/WaveNet Data Management System (version 1.8.6) was used to calculate salinity from the Aanderaa CT sensor's conductivity and temperature data and the pressure record from the Cefas ESM2 logger using the UNESCO PSS78 algorithm. Once the in-situ salinity samples had been analysed, the salinity time series was corrected for any apparent conductivity sensor proximity effects as the final part of the QA process.

2.4 Change to instrumentation for collecting in-situ salinity time series

It was noted in East Anglia THREE Data Reports 1 and 2 (Cefas contract reports C5726/EA3-D001 and C5726/EA3-D002) that, although the HOBO CT mini-logger recorded temperature correctly, the values of conductivity (and therefore calculated salinity) were highly suspect from the very start of the deployment. The manufacturer eventually admitted that the sensors were performing outside specification and agreed to Cefas returning them as not fit for purpose. Cefas then proposed to EAOW that, at no additional expense, Cefas would attach an ESM2 logger fitted with a high quality Aanderaa CT sensor (as used on Cefas' SmartBuoy network) to the AWAC MiniLander for the

remainder of the deployment schedule. This change of specification was accepted by EAOW and from deployment 3 onwards the new instrumentation was used.

2.5 Multibeam Surveys

Multibeam surveys of the AWAC site were undertaken before deployment and following final recovery of the equipment. The Kongsberg Maritime AS EM3002D system aboard RV Cefas Endeavour was deployed on a drop keel. It was used to map the geophysical features of the sea floor in Kongsberg's acquisition software SIS and the data was post-processed in Caris version 7.1. Depth has been tidally corrected using the C-NAV Precise Point Positioning service. Kinematic tidal height was extracted and reduced to chart datum using the UKHO Vertical Offset Reference Frame (VORF) model. Results from the both the December 2012 (pre-deployment) and December 2013 (post-recovery) are detailed in section 3.5.

2.6 Deployments and Recoveries

The Waverider was deployed and recovered with reference to the Datawell Waverider manual, the appropriate Cefas Standard Operating Procedure (SOP) and Cefas Risk Assessments (RA). A large Cefas Guard Buoy, fitted with efficient Echomax radar reflector and yellow navigation light with greater than three nautical mile range and flashing five times every 20 seconds, was positioned near to the Waverider as part of the deployment.

The MiniLander was deployed and recovered with reference to the appropriate Cefas SOP and Cefas RA. Two large Cefas Guard Buoys (as described above) were positioned near to each Lander as part of the deployment.

2.7 Sediment and Water Sampling Methods

On deployment and recovery of the equipment three replicate seabed sediment grab samples of at least 1 kg each were taken in close proximity of the MiniLander site (as appropriate to conditions at the time) to determine sediment type and be suitable for particle size analysis.

These sediment samples were collected using an industry standard Day grab. Once on board the vessel the samples were transferred into suitable closed containers and marked up with sample details such as date, time and location and stored in a cool location or freezer. Upon return to Cefas Lowestoft laboratory, the samples were stored in a freezer before being analysed using agreed protocols.

Also during each site visit, water samples for calibration of the Seapoint OBS turbidity sensor were collected using a conductivity/temperature/depth (CTD) instrument fitted to a Niskin bottle rosette sampler at the following approximate depths:-

- near-bed, (within 5m of sea bed)
- mid-depth
- near-surface (within 5m of surface)

A single set of samples was collected immediately prior to recovery of the MiniLander and another set following deployment.

Best scientific practice would suggest that water samples should be taken throughout the deployment at regular intervals (e.g. every 24 hours) to ensure that wave induced high suspended sediment events are captured. This offers the best chance that subsequent calibration of the OBS optimised throughout the range of suspended sediments observed. However, for this project such an approach was impractical due to cost and logistical considerations.

Cefas have a laboratory-based turbidity flume tank to calibrate the OBS sensors with sediment caught in the Booner tubes throughout the deployment. The use of this facility potentially allowed sensor, site and deployment-specific calibrations to be obtained.

2.8 Data Processing and Quality Control

All the instruments and sensors used during the project had factory check sheets and/or calibration certificates from the manufacturer (see annex 2 for details). In addition, the preparation, servicing and deployment of the equipment in accordance with manufacturer's recommendations ensured that data downloaded from the instruments and sensors were of the highest standard. Therefore, any data identified as unreliable were either due to reasons beyond Cefas' control (e.g., MiniLander disturbed by third parties, OBS sensor obscured by bio-fouling or debris, etc) or an inability of the sensor to make a reliable measurement under the ambient conditions (e.g., spectrally derived parameters from a Waverider are unreliable at low wave heights – see section 2.8.1).

2.8.1 Waverider

Post-recovery Waverider data undergoes a series of processing steps followed by automated and manual quality assurance (QA) processes. The 30-minute full spectrum (SPT) files were first renamed

to include the deployment name and uploaded to the Cefas SmartBuoy/WaveNet SQL2008 database using bespoke software that conducts automated QA on the wave parameters during the process. The QA process is as follows (see figure 4 for summary):-

1. Range checking QA is applied to wave parameters, except where Hm0 < 20cm where a caution flag is applied to Tpeak, W_PDir and wave spread (W_SPR) as these spectrally-derived parameters are unreliable at low Hm0.
2. All Null values flagged as error
3. Significant wave height (Hm0) – Observations that deviate more than 6 times the standard deviation from the monthly mean, or more than 2 times the standard deviation of the monthly data from both the previous and future observations, are identified as outliers and a caution flag applied to the data. If Hm0 is flagged then all other parameters are also flagged.
4. Zero crossing wave period (Tz) – As above for Hm0. If Tz is flagged then Tpeak, W_PDir and W_SPR are also flagged.
5. Peak/dominant wave period (Tpeak) – Observations that deviate more than 6 times the standard deviation from the monthly mean are identified as outliers and a caution flag applied to the data. If Tpeak is flagged then W_PDir, W_SPR and the full spectral file are also flagged.
6. Peak/dominant wave direction (W_PDir) –a caution flag applied to the data if any of the above parameters is flagged. No independent checks are made.

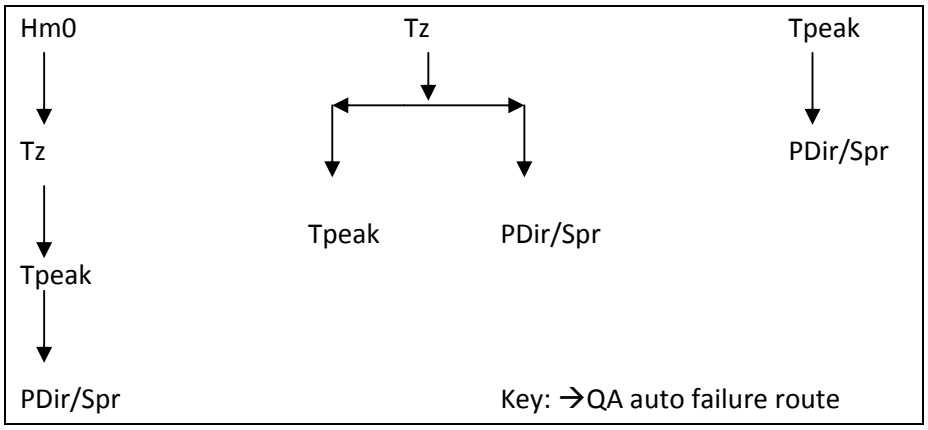


Figure 4. QA auto-failure cascade route for wave parameters

This automated process has been shown to be very successful in flagging inaccurate data. In addition, as the complete dataset is available post-recovery, this QA process is more rigorous than that applied to the telemetry data and does not incorrectly flag good data in the majority of cases. After the automated QA had been completed, a visual inspection QA was then undertaken to ensure that a high quality dataset was produced.

2.8.2 AWAC

Excel spreadsheets containing the AWAC data were compiled and selective graphs produced to aid data QA. The following data were inspected during the QA procedure:-

A. Currents and sensors

- Status and error.
- *.V2 file – bin 5 plotted as time series. Main current in the North Sea runs north/south.
- *.V1 file – bin 5 plotted as time series. Lower east/west currents.
- *.V3 file – bin 5 plotted as time series. Very low vertical component expected.
- Plot roll/pitch time series – should be <= 10% for good quality current and wave data.
- Heading time series.
- Battery time series.
- Pressure time series – not directly related to depth due to changes in atmospheric pressure.
- Temperature time series.
- Analogue input time series. Following turbidity tank calibration of Seapoint OBS sensor using sediment from the Booner tube sediment trap, the analogue input 1 analogue to digital converter (ADC) count values were converted to suspended sediment concentration.

B. Waves

- No detects.
- Bad detects – less than 10% required for good AST data.
- Error code.
- Parameter time series.

Periods of bad data for either waves, currents or both were identified and flagged in the final QA'd dataset.

2.8.3 Calculation of in-situ salinity from the CT sensor

The Cefas SmartBuoy/WaveNet Data Management System (version 1.8.6) was used to calculate Salinity from the Aanderaa CT sensor's conductivity and temperature data and the pressure record from the Cefas ESM2 logger using the UNESCO PSS78 algorithm. Once the in-situ salinity samples had been analysed, the salinity time series was corrected for any apparent conductivity sensor proximity effects as the final part of the QA process.

2.9 Sediment Samples (Day Grabs and Booner Tubes)

Particle size analysis of EAOW East Anglia THREE samples were completed by laser diffraction unless there was >5% gravel (>2mm) content. The samples were visually assessed before the analyses were undertaken and photos were taken in support of the visual assessment.

Laser diffraction methods measure particle sizes in the range of 0.4 – 2000µm. However, for practical reasons, the maximum diameter for marine sediment is 1000µm (1mm) when completing analysis using Malvern Mastersizer 2000.

If >5% gravel was present in the sample a full PSA was carried out using NMBAQC PSA Recommended Methodology (NMBAQC, in prep.). This included sieving sediment >1mm at 0.5 ϕ fractions and merging with laser data to produce a full particle size distribution (PSD).

Full details are available in "Standard Operating Procedure (EAOW_2011) (v1) – Particle Size Analysis (PSA) of EAOW Samples", which has been provided to EAOW Ltd.

2.10 Optical Backscatter Sensors (QA and Calibration)

OBS sensors emit light into the water. This light is scattered by suspended particles and some of the light is returned to the sensor. The Seapoint OBS sensors measure the intensity of this back-scattered light and output a voltage in proportion to this intensity. During the MiniLander deployments, this voltage was recorded by the AWAC as an ADC count (0-65535 units) on Analog_in channel 1.

The intensity of the back-scattered light depends on the concentration, size, shape and reflectivity of the particles suspended in the water. Calibration of an OBS sensor to derive a suspended sediment concentration (SSC) therefore requires sediments with similar properties to those encountered by the sensor in situ in order that the appropriate sensor response can be reproduced.

To calibrate the OBS sensors a sediment flume at the Cefas Laboratory was used to simulate the suspended sediment conditions present at the sensor's deployment location. Freshwater was used in the flume rather than sea water. It was unlikely the use of sea water would have improved the calibration as the highly dynamic environment maintained in the flume should have been sufficient to prevent flocculation during the calibration exercise. The provision of the necessary volume of filtered sea water would be time consuming and costly.

Suitable sediment samples for this calibration were acquired using a Booner tube suspended sediment trap attached to each MiniLander. It was preferable to use suspended sediment samples rather than benthic sediment samples (obtained using a grab, for example) as they are likely to provide a calibration more representative of the conditions in which the sensor was deployed.

Therefore, the procedure was designed to produce a site-specific calibration that cannot be applied to deployments in areas with different sediment characteristics from those of the location selected for calibration. The responses of individual sensors may not be identical, and therefore each sensor required calibrating when deployed at a new location.

Full details are available in previously-supplied "Standard Operating Procedure MPM-MAS-MOS-SOP-106, Issue 1.2 – Calibration of Campbell Scientific OBS-3+ turbidity sensors (connected to a Nortek AWAC) using the UEA sediment Flume", which describes the same set-up used in this work programme.

2.11 Health and Safety

Cefas have developed and implemented a Health and Safety Management System which is certified to OHSAS 18001. All activities have been planned and implemented following the comprehensive Cefas "Procedures and Guidance" documents within this framework, which covers risk assessments, field work, vessel selection, accident reporting, personal protective equipment, etc as well as defining personal roles, responsibilities and accountabilities.

In addition, Cefas produced a Health and Safety Plan for the operational work at sea that was agreed with the EAOW Project Manager. Throughout the duration of the project, the Cefas Project Leader provided monthly health and safety reports to the EAOW Offshore Health & Safety Advisor.

Overall almost 840 Cefas man hours were worked offshore, with an average of just under five persons per trip. There were no reported health and safety incidents amongst these persons. There were three reported incidents:-

1. Dropped pallet
2. Rope in Stern Gear
3. Damaged guard buoy

Copies of relevant HSE documentation have been provided to EAOW before (as part of the tender process) and during the project.

3 Results

3.1 Data Return Summary

It should be noted that the sites chosen for the study are very active with both fishing vessels (large European beam trawlers) and a range of merchant vessels. In spite of mitigating activities being undertaken (deploying guard buoys, issuing of notice to mariners, involvement of Brown and May to liaise with European fishermen, informing UK Hydrographic Office for inclusion on charts) equipment moored at these sites was considered to be extremely vulnerable to the activities of third parties.

3.1.1 Waverider

During the course of the work programme, Waverider DWR E was not set adrift and a data return of 100% was achieved.

Waverider DWR E data recovery for East Anglia THREE:-

DWR E data recovery for EAOW project (approximate)			
	Theoretical data points	Actual data points	% recovery
DWR E	17475	17475	100.0

3.1.2 AWAC

With no telemetry from the sea bed MiniLanders, it was not possible to obtain information as to whether they were still undisturbed on site until the service visit. Unfortunately, the first of the seven AWAC 3.1 deployments was disturbed during the deployment period. AWAC 3.1, deployment 1 – The AWAC recorded bad current and wave data after 11/12/2012 14:40 as the MiniLander was on its side until recovery at end of deployment. From the post-recovery evidence the MiniLander had been disturbed by a third party about a week after deployment.

This disturbance to the MiniLander deployment impacted the overall data recovery from the AWACs with an overall data recovery rate of about 84% for East Anglia THREE.

AWAC data recovery for East Anglia THREE:-

AWAC data recovery for EAOW project (approximate)			
	Theoretical data points	Actual data points	% recovery
AWAC 3.1	26101	21859	83.7%

Figure 5 shows the data availability from the AWAC 3.1 site.

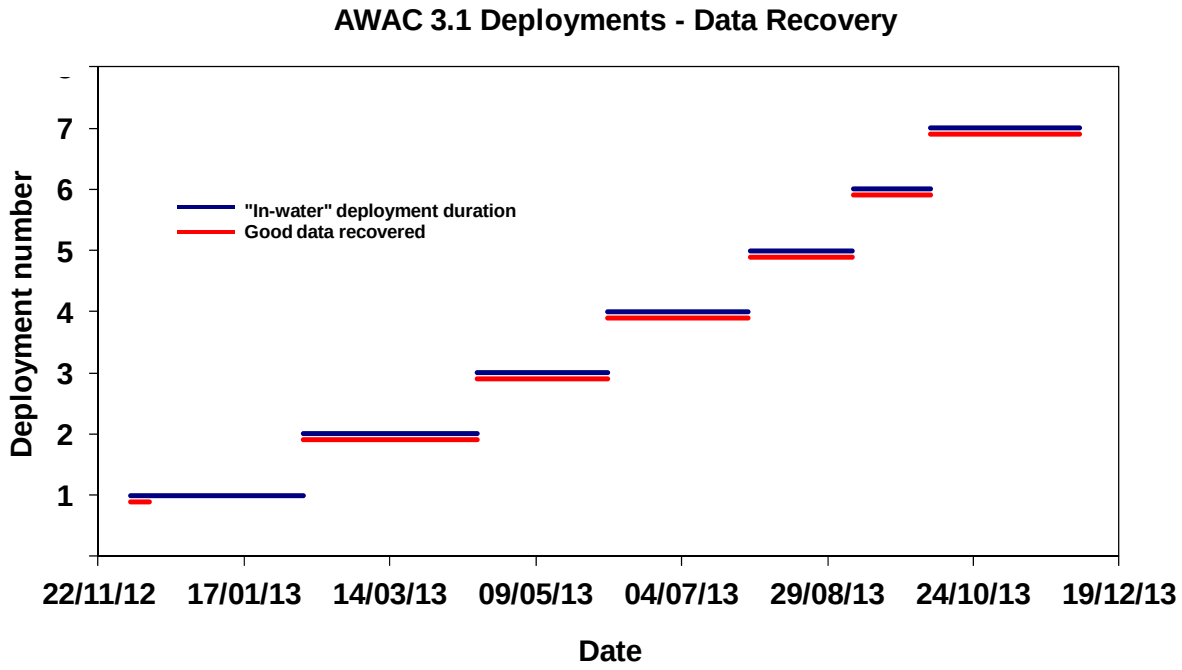


Figure 5. Data recovery for the AWAC 3.1 MiniLander deployments

3.2 Summary Statistics

It should be noted that the data described in this section must be treated as indicative-only and all interpretation of the Cefas-provided datasets should be undertaken by EAOW Ltd.

3.2.1 Waverider

Waverider DWR E has produced a good quality data set to illustrate the wave climate in EA THREE. In addition to this buoy, two other Waveriders were deployed at the same time within the EAOW zone. These were DWR C in East Anglia ONE and DWR F in East Anglia FOUR. The West Gabbard Waverider is part of the UKCMF-funded WaveNet strategic wave network and located to the south of the zone.

The approximate deployment locations of the four buoys are given in the table below:

Site	Latitude	Longitude
EAOW DWR F *	52°52'.4N	002°53'.7E
EAOW DWR E	52°36'.3N	002°46'.5E
EAOW DWR C	52°18'.6N	002°27'.6E
West Gabbard Waverider	51°59'.0N	002°04'.9E

* note – prior to April 2013 DWR F was deployed at approximately 52°50'.2N, 002°50'.8E, about 2.8 nautical miles away.

These four buoys form an approximate line in the southern North Sea, starting with West Gabbard in the south followed by DWR C and DWR E with DWR F in the north (see figure 6).

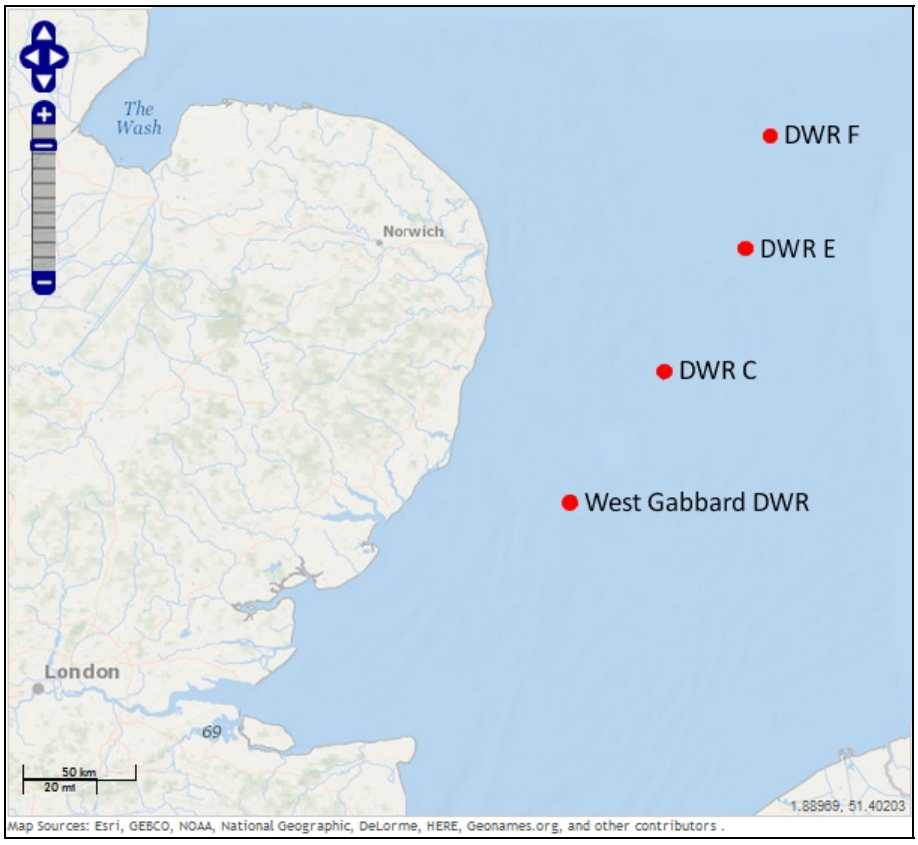


Figure 6. Map showing approximate locations of DWRs C, E and F and the West Gabbard Waverider.

Monthly wave statistics (mean and maximum values) have been calculated for the three EAOW Waverider buoys and West Gabbard buoy where greater than 67% of available data had been collected during a given month. The parameters assessed were significant wave height, zero-crossing (mean) period and peak period. The graphs for significant wave height (figure 7), zero-crossing period (figure 8) and peak period (figure 9) are shown below:

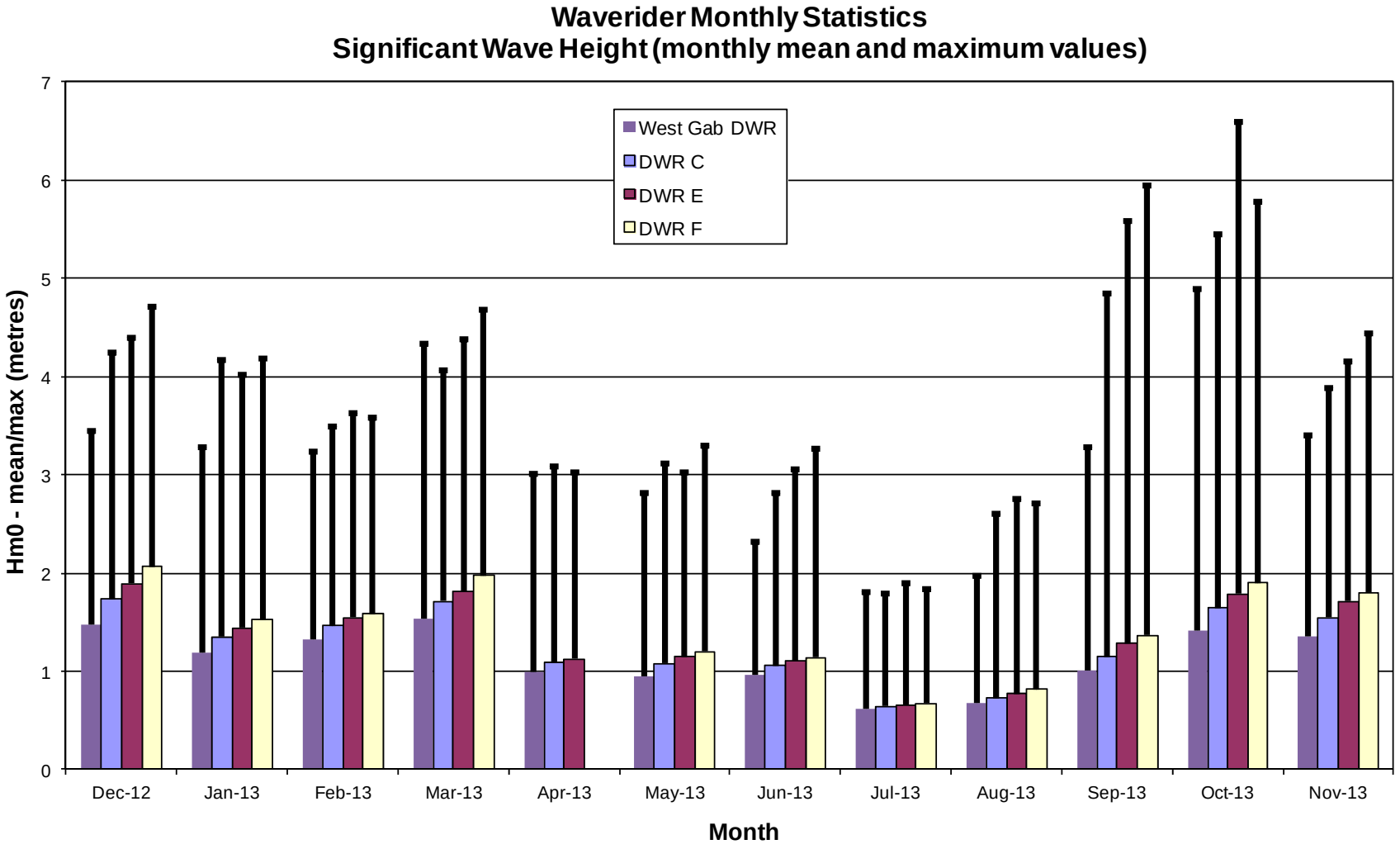


Figure 7. Monthly statistics of significant wave height measured by EAOW Waverider buoys (the more southerly West Gabbard WaveNet buoy has been added for comparison). Note: the bar indicates the mean and the top of the line the maximum values.

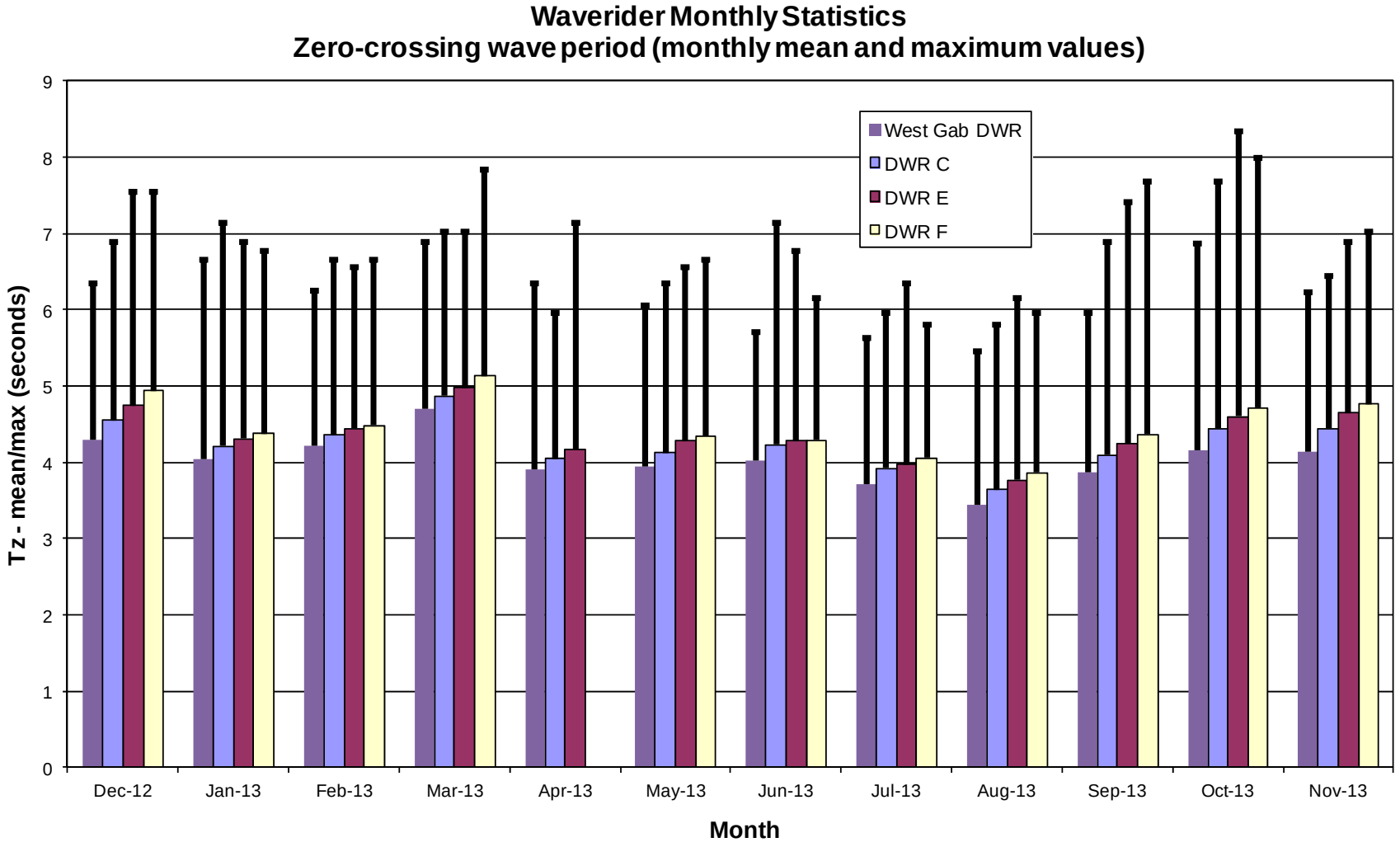


Figure 8. Monthly statistics of zero crossing (mean) wave period measured by EAOW Waverider buoys (the more southerly West Gabbard WaveNet buoy has been added for comparison). Note: the bar indicates the mean and the top of the line the maximum values.

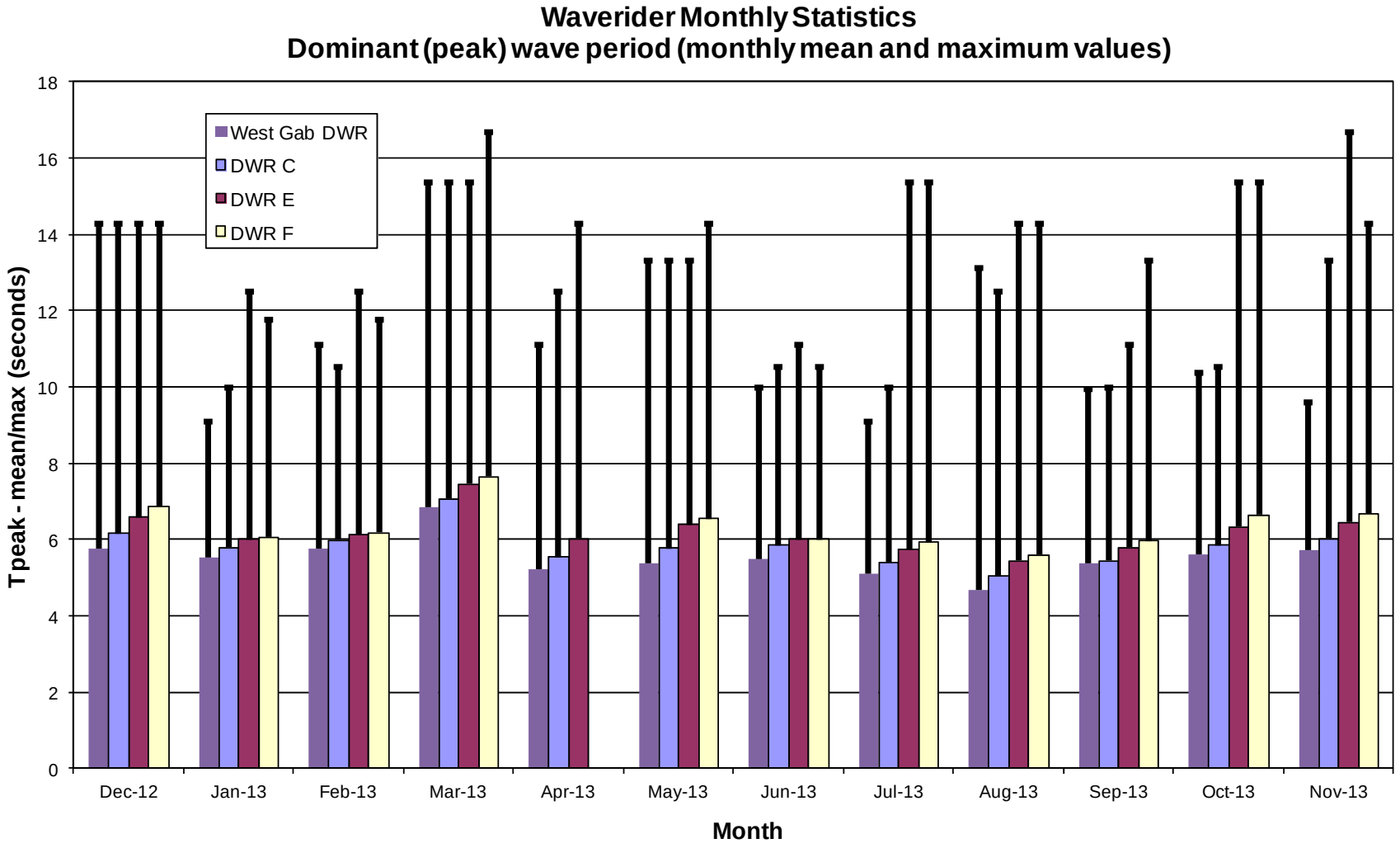


Figure 9. Monthly statistics of peak (dominant) wave period measured by EAOW Waverider buoys (the more southerly West Gabbard WaveNet buoy has been added for comparison). Note: the bar indicates the mean and the top of the line the maximum values.

3.2.2 AWAC

The series of seven AWAC deployments undertaken during this project have generated a large data set covering currents, waves, water temperature, turbidity and salinity. The table below gives a generalised indication of some of these parameters, which enable an overview of the site to be taken.

	AWAC 3.1
Maximum near bed current speed on spring tides (m/s)	0.8-0.9
Maximum near bed current speed on neap tides (m/s)	0.4-0.55
Typical near bed direction on the flooding tide (degrees mag.)	10
Typical near bed direction on the ebbing tide (degrees mag.)	190
Maximum summer bottom water temperature (degrees C)	17.8
Minimum winter bottom water temperature (degrees C)	4.8
Typical summer suspended sediment concentration (mg/l)	<5
Typical winter suspended sediment concentration (mg/l)	10-25
Typical salinity range (PSS78)	34-35

3.3 Estimating Suspended Load from OBS data

Obtaining good quality suspended sediment data from optical backscatter sensors requires a very rigorous calibration procedure that, by its very nature, adds uncertainties to the final data at a number of stages. As part of this work programme, several CTD profiles and Niskin water samples for suspended sediment concentration were undertaken at the beginning and end of each MiniLander deployment. In general, one set of samples (near sea bed, mid-water and near surface) was taken pre-recovery and a further set post-deployment. However, these samples do not provide the best possible calibration. Therefore, the turbidity tank procedure used in this study helped to provide the best quality, more robust calibration and was selected for a number of reasons:-

1. The turbidity tank calibration uses sediments that were collected in Booner tube sediment traps at approximately the same elevation above the seabed as the OBS sensors. In contrast typically the nearest water sample from the Niskin bottle rosette water sampling can be several metres from the seabed. This is important as a strong vertical gradient in SPM concentration can exist close to the seabed.
2. The Booner tube sediment trap samples used in the turbidity tank consist of the in-situ sediment collected over the whole duration of the deployment.

3. The SPM samples collected by the Niskin rosette water sampler are heavily biased towards calm conditions as it may be unsafe to take water samples during storm conditions. In contrast, the turbidity tank experiences a wider range of suspended sediment concentrations which may show any non-linear response that some OBS sensors can demonstrate (but generally at higher concentrations than found during this work).
4. In poor weather conditions, the vertical movements of the CTD/rosette system can vary by several metres as waves pass under the ship. This can result in water samples taken at (say) either 2m above the seabed or 4m. The Booner tube samples collect sediment continuously.
5. It is well known that collecting either very heavy (large) or very light (small with slow settling velocity) particles is intrinsically difficult with CTD/rosette systems. The turbidity tank methodology is less sensitive to particle size changes in the water column.
6. Although Day grab sea bed samples were taken, the particle size distributions observed were significantly different to the sediment collected by the Booner tubes and was not therefore used for turbidity tank calibration.

In spite of the significant advantages of using Booner tube samples in a calibration tank, several issues arose with some of the particular samples collected during this project. The most noticeable concern was the sediment samples collected in June, July and September. The samples were very dark and contained significant quantities of decayed organic matter.

Following each turbidity tank calibration, suspended sediment concentration was plotted against OBS analogue input ADC count recorded by the AWAC (see figure 10 for an example).

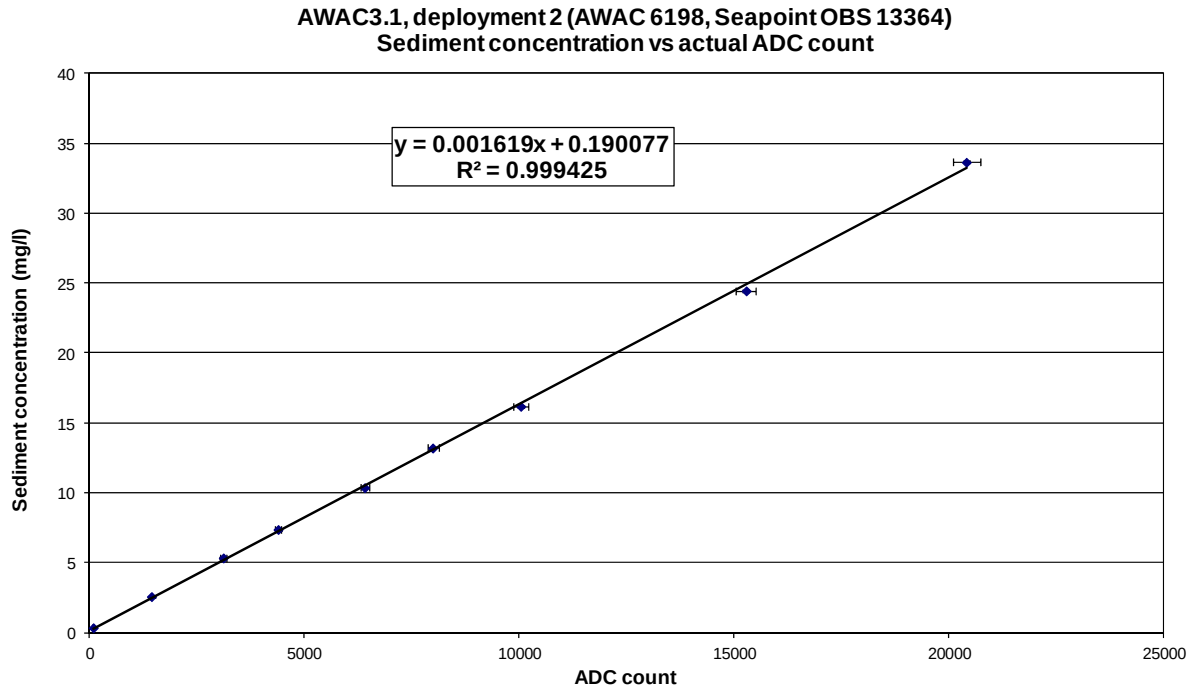


Figure 10. Turbidity tank OBS calibration for AWAC3.1, deployment 2

This provided a linear regression (slope and intercept) that could then in theory be used to calibrate the AWAC OBS data.

However, the data summary obtained from all the turbidity tank calibrations (see table below) corroborated the issue of the dark sediment samples. These calibrations gave much higher slopes compared to the samples not containing significant amounts of decayed organic matter. This was probably due to the dark water absorbing proportionately more light than reflected. If these calibrations with higher slopes were used they would give artificially high suspended sediment concentrations for those deployments affected.

Deployment	Month recvrd.	AWAC	Seapoint OBS	Slope	Intercept	r^2	% Sand	% Mud	Comment
AWAC 3.1, dep 1	Feb-13	6146	11161	**0.001669**	**1.019198**	**0.9850**	19.7%	80.3%	
AWAC 3.1, dep 2	Apr-13	6198	13364	**0.001619**	**0.190077**	**0.9994**	52.7%	47.3%	
AWAC 3.1, dep 3	Jun-13	6146	11161	0.002739	-1.257657	0.9652	50.5%	49.5%	Dark sediment
AWAC 3.1, dep 4	Jul-13	6198	13364	0.002398	-0.848812	0.9908	51.6%	48.4%	Dark sediment
AWAC 3.1, dep 5	Sep-13	6146	11161	0.001568	1.609455	0.9251	48.7%	51.3%	Dark sediment
AWAC 3.1, dep 6	Oct-13	6198	13364	**0.001797**	**0.355503**	**0.9901**	47.8%	52.2%	
AWAC 3.1, dep 7	Dec-13	6146	11161	**0.001516**	**0.254404**	**0.9840**	36.3%	63.7%	
Average				**0.001650**	**0.454796**				

Therefore, these data indicated that it was not possible to obtain discrete calibrations for all deployments from the Booner tube sediment samples obtained. The best solution in this instance (based on many years of undertaking OBS calibrations) was to average the four “good” calibrations from deployments 1, 2, 6 and 7 to give a “representative” calibration that could be applied to all the AWAC 3.1 deployments. This, in combination with the in-situ bottom water samples collected at service visits, gave a level of confidence to the data, with approximately a +/- 12% (2 standard deviation) uncertainty.

Figure 11 shows calibrated suspended sediment concentration plots for the AWAC 3.1 site. The yellow triangles are the concentrations obtained from the water samples. As discussed above, it is difficult to obtain accurate values of suspended sediment concentration at a defined distance from the sea bed. Therefore, these data are indicative of typical concentrations and give an insight into variations between winter and summer conditions. Data can be excluded from the time series by QA procedures for several reasons. We are more confident as to the causes of some regions of no/bad data than others. The following list gives a range of causes from the easiest to identify to the hardest to interpret:-

- MiniLander trawled up and therefore not on site.
- OBS obscured by debris.

- OBS sensor biofouled – it is often difficult to establish the exact time this started to impact on data so it is usual to err on the side of caution. Biofouling of sensors was minimised by employing the Zebra-Tech Hydro-Wipers.
- Untypical high response due to presence of biological material (e.g., plankton sinking to the sea bed during and after a bloom event).

It is clear that the calibration of OBS data to provide values of in-situ suspended sediment concentration is fraught with operational difficulties and expert interpretation is required to achieve a representative data set.

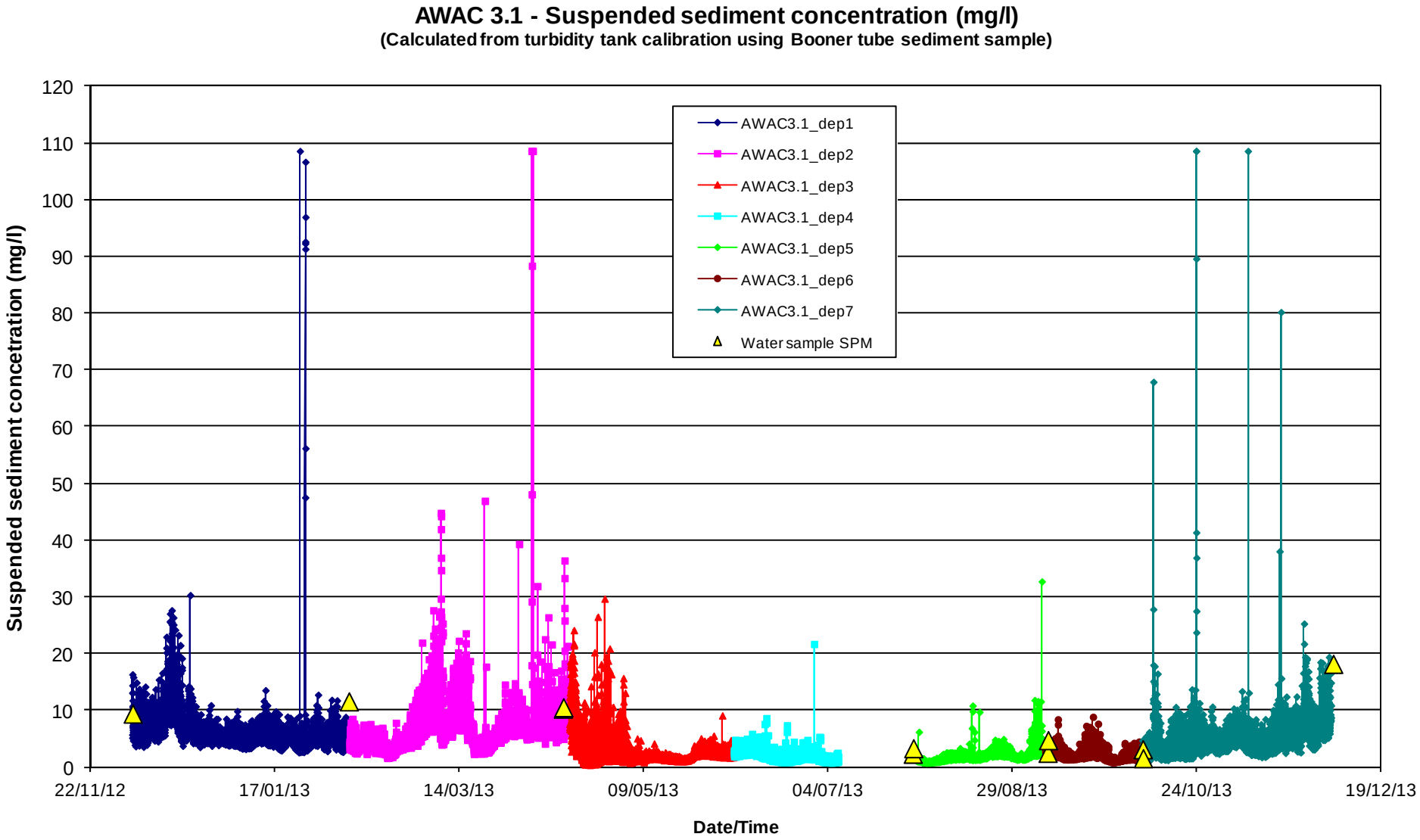


Figure 11. Suspended load calibration of AWAC 3.1 OBS sensor. The yellow triangles are suspended load concentrations for discrete water samples collected using the Niskin bottles during service visits.

3.4 Day Grab Sediment Samples

Three replicate sea bed sediment samples were taken using a Day grab at both sites on each service visit.

These underwent particle size analysis as described in section 2.9 to characterise the sediment types and to investigate any temporal changes in sediment composition. The full PSA size distribution data are available in the file "EAOW_EA_THREE_Day_grab_PSA_summary(140204).xls" on the East Anglia THREE Project DVD.

The Summary data for the AWAC 3.1 site is given below:-

Sample_ID	Date	Replicate	Mean	Sorting
AWAC 3.1, dep. 1	04/12/2012	Grab 1	Medium Sand	Well Sorted
AWAC 3.1, dep. 1	04/12/2012	Grab 2	Medium Sand	Well Sorted
AWAC 3.1, dep. 1	04/12/2012	Grab 3	Medium Sand	Well Sorted
AWAC 3.1, dep. 2	08/02/2013	Grab 1	Coarse Sand	Moderately Well Sorted
AWAC 3.1, dep. 2	08/02/2013	Grab 2	Medium Sand	Moderately Well Sorted
AWAC 3.1, dep. 2	08/02/2013	Grab 3	Medium Sand	Moderately Well Sorted
AWAC 3.1, dep. 3	16/04/2013	Grab 1	Medium Sand	Well Sorted
AWAC 3.1, dep. 3	16/04/2013	Grab 2	Medium Sand	Well Sorted
AWAC 3.1, dep. 3	16/04/2013	Grab 3	Medium Sand	Well Sorted
AWAC 3.1, dep. 4	05/06/2013	Grab 1	Medium Sand	Well Sorted
AWAC 3.1, dep. 4	05/06/2013	Grab 2	Medium Sand	Well Sorted
AWAC 3.1, dep. 4	05/06/2013	Grab 3	Medium Sand	Well Sorted
AWAC 3.1, dep. 5	30/07/2013	Grab 1	Medium Sand	Well Sorted
AWAC 3.1, dep. 5	30/07/2013	Grab 2	Medium Sand	Well Sorted
AWAC 3.1, dep. 5	30/07/2013	Grab 3	Medium Sand	Well Sorted
AWAC 3.1, dep. 6	07/09/2013	Grab 1	Medium Sand	Well Sorted
AWAC 3.1, dep. 6	07/09/2013	Grab 2	Medium Sand	Well Sorted
AWAC 3.1, dep. 6	07/09/2013	Grab 3	Medium Sand	Well Sorted
AWAC 3.1, dep. 7	07/10/2013	Grab 1	Medium Sand	Moderately Sorted
AWAC 3.1, dep. 7	07/10/2013	Grab 2	Medium Sand	Moderately Sorted
AWAC 3.1, dep. 7	07/10/2013	Grab 3	Medium Sand	Moderately Well Sorted
AWAC 3.1, rec. 7	04/12/2013	Grab 1	Medium Sand	Moderately Well Sorted
AWAC 3.1, rec. 7	04/12/2013	Grab 2	Medium Sand	Moderately Well Sorted
AWAC 3.1, rec. 7	04/12/2013	Grab 3	Medium Sand	Moderately Well Sorted

Particle size distribution plots for the AWAC 3.1 site are shown in figure 12. The plots confirm the general similarities between samples for the AWAC 3.1 site, with only very small amounts of sub-63µm material present.

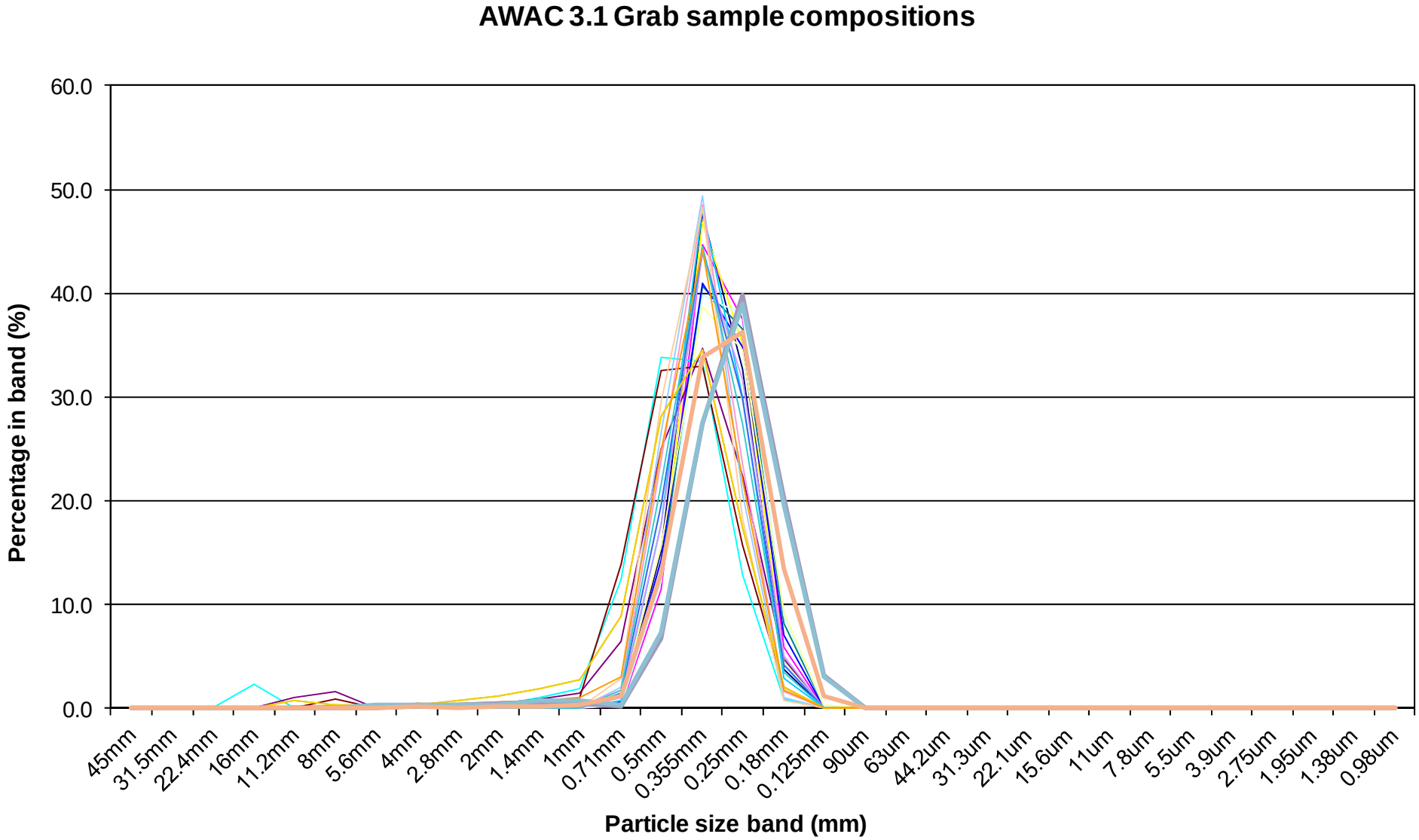


Figure 12. Particle size distribution plots for Day grab-collected sea bed samples from the AWAC 3.1 site. Each line represents 1 of 24 discrete samples detailed in the AWAC 3.1 summary table in section 3.4 above.

3.5 Multibeam Surveys

3.5.1 Pre-deployment (December 2012)

A multibeam survey of the proposed AWAC 3.1 site was carried out prior to deploying the first MiniLander on 4 December 2012. Following an onboard assessment of the seabed topography the position of the MiniLander was moved approximately 200m south west off the top of a sand wave crest and into the adjacent trough.

Ship: RV Cefas Endeavour **Cruise:** 20b/12
Site name: AWAC 3.1 **Position**: Lat: 52° 33'.404 N, Long: 002° 46'.577 E
Date: 04/12/12 **Time:** 00:54 to 02:49 **Operator:** N Lyman

	Sea State	Wind Speed	Wind direction
Start	2-3m swell	30-35 knots	270°
Finish	3-3.5m swell	30-35 knots	270°

	Start time	Start Lat	Start Long	Finish lat	Finish Long	End time
Line 0000	00:54	52.552	2.767	52.565	2.778	01:04
Line 0001	01:14	52.565	2.780	52.550	2.769	01:21
Line 0003	01:28	52.550	2.768	52.564	2.778	01:39
Line 0005	01:47	52.564	2.781	52.549	2.772	01:57
Line 0007	02:05	52.548	2.773	52.563	2.784	02:15
Line 0009	02:22	52.564	2.783	52.549	2.773	02:31
Line 0011	02:39	52.548	2.775	52.562	2.785	02:49

Filename saved as AWAC_20x_12

Comments: transit to AWAC 4.1 lines 0012 to 0013
Debris?

Flat/ripples? Large ripples within sand waves

Mega-ripples?

Any large objects?

Any wrecks?

Impact on proposed Lander position – yes/no (if yes, describe impact and action proposed) Yes, large sand waves ca. 500m peak to peak, therefore deploy the MiniLander in the trough closest to the nominal site.

The sea bed image produced from the survey (with AWAC planned and actual deployment positions included) is shown below (figure 13).

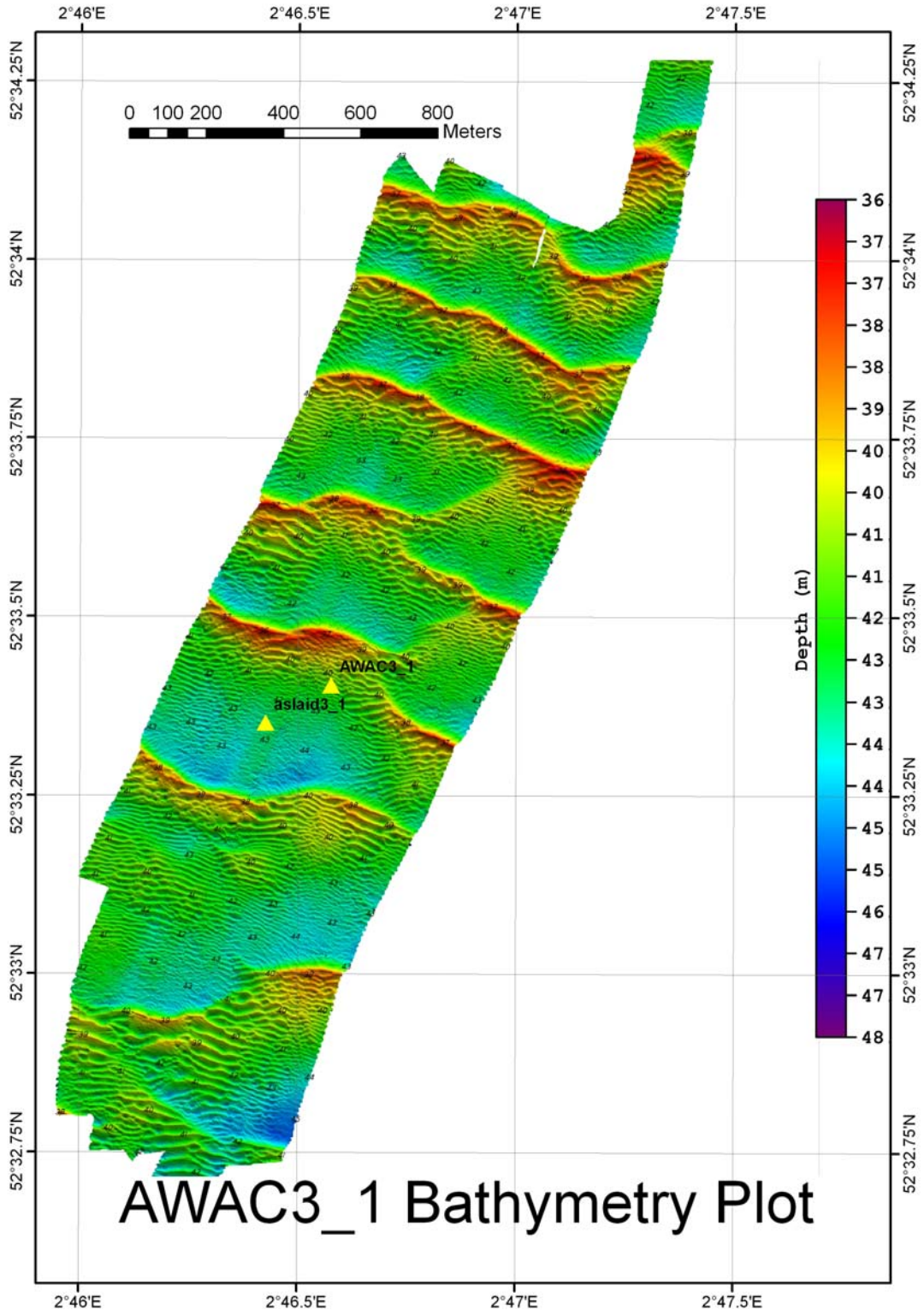


Figure 13. Sea bed image produced from the Multibeam survey taken prior to deployment at the AWAC 3.1 site. Coverage shows area of interest part of whole survey. Depths referenced to VORF-derived chart datum.

3.5.2 Post-recovery (December 2013)

A further multibeam survey of the AWAC 3.1 site was undertaken after the final recovery to establish that the site had been cleared of debris. This survey showed no identifiable debris or large objects in the area. Large sand waves were found at the site with depth ranges from about 37 to 45m. This survey explained the similar depths found for MiniLander deployments.

Ship: RV Cefas Endeavour **Cruise:** 24/13
Site name: AWAC 3.1 **Position**: Lat: 52° 33'.352 N, Long: 002° 46'.427 E
Date: 03/12/13 **Time:** 20:00 to 22:00 **Operator:** B Meadows

	Sea State	Wind Speed	Wind direction
Start	Calm	11 knots	260°
Finish	Calm	12 knots	260°

	Start time	Start Lat	Start Long	Finish lat	Finish Long	End time
Line 0000	20:01	52.5490	2.7713	52.5607	2.7711	20:10
Line 0003	20:21	52.5593	2.7727	52.5520	2.7725	20:25
Line 0005	20:40	52.5518	2.7742	52.5606	2.7739	20:46
Line 0007	20:54	52.5596	2.7755	52.5519	2.7756	20:58
Line 0009	21:12	52.5518	2.7769	52.5606	2.7771	21:18
Line 0011	21:27	52.5538	2.7807	52.5532	2.7671	21:23
Line 0013	21:43	52.5573	2.7672	52.5573	2.7831	21:49

Filename saved as 0000-0013_date_time_AWAC3D1dec

Comments:

Debris? None seen

Flat/ripples? Not flat

Mega-ripples? Yes and occasional large sand waves running east/west approximately 400m peak to peak

Any large objects? None seen

Any wrecks? None seen

The sea bed image produced from the survey (with AWAC and guard buoy deployment positions included) is shown below (figure 14).

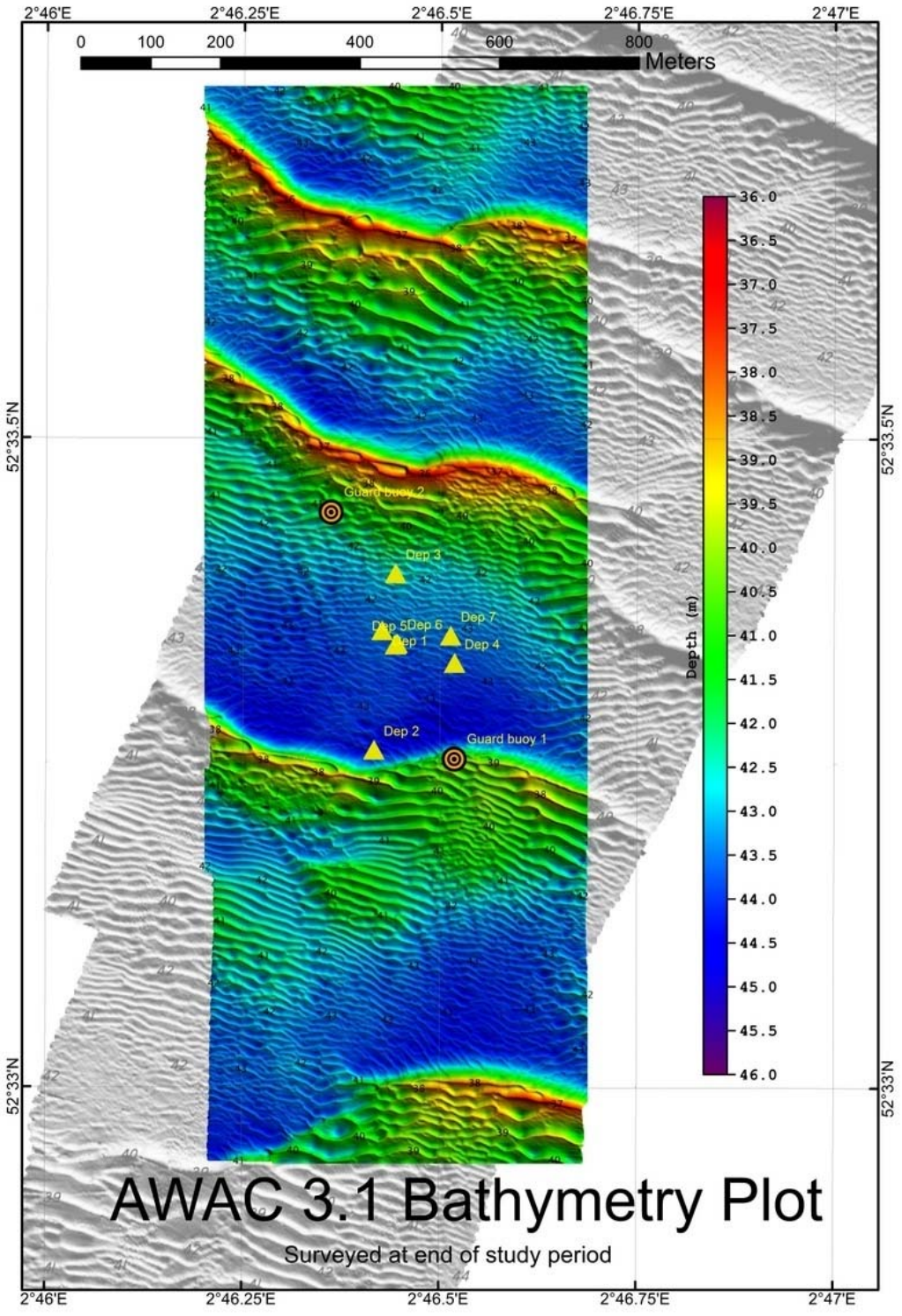


Figure 14. Sea bed image produced from the Multibeam survey taken following completion of the project at the AWAC 3.1 site. Circles are guard buoy positions; triangles are MiniLander positions. Depths referenced to VORF-derived chart datum..

4 Conclusions and Recommendations for Further Work

This project has provided EAOW Ltd with an extensive annual dataset describing the physical environment measured in the East Anglia THREE project area. Measurements included wave parameters and spectra, currents, suspended sediment concentration, water temperature and salinity. Data returns of 100% from the Waverider and almost 84% from the AWACs have been achieved.

From the outset, Cefas provided mitigation to minimise the risks to the equipment from the extensive and frequent vessel activity within the operational area. Cefas understood that the risks could potentially be high for this work programme as the chosen sites were “new” to the maritime community. However, following a recommendation from work carried out previously in East Anglia ONE, the use of larger guard buoys on both the Waverider and MiniLander sites is likely to have contributed to the much lower rate of disturbance on the deployed equipment by passing vessels (and therefore larger data returns) for this work programme.

Following on from another recommendation from the previous work carried out in East Anglia ONE, a different OBS sensor was employed for this work programme. The Seapoint OBS sensor fitted to the AWAC can be set up with four different gain settings. Therefore the OBS output to the AWAC was configured to best suit the expected in-situ conditions, thus maximising the accuracy of the readings. In addition, one of the most significant reasons for flagging OBS data as unreliable during the previous work programme was biofouling of the sensor’s optical windows. Therefore, in an attempt to minimise the affect of biofouling on data quality, the OBS sensors were fitted with a Zebra Tech Hydro-Wiper. This resulted in the loss of only about three weeks of data (mid to late July) during the whole year of deployments.

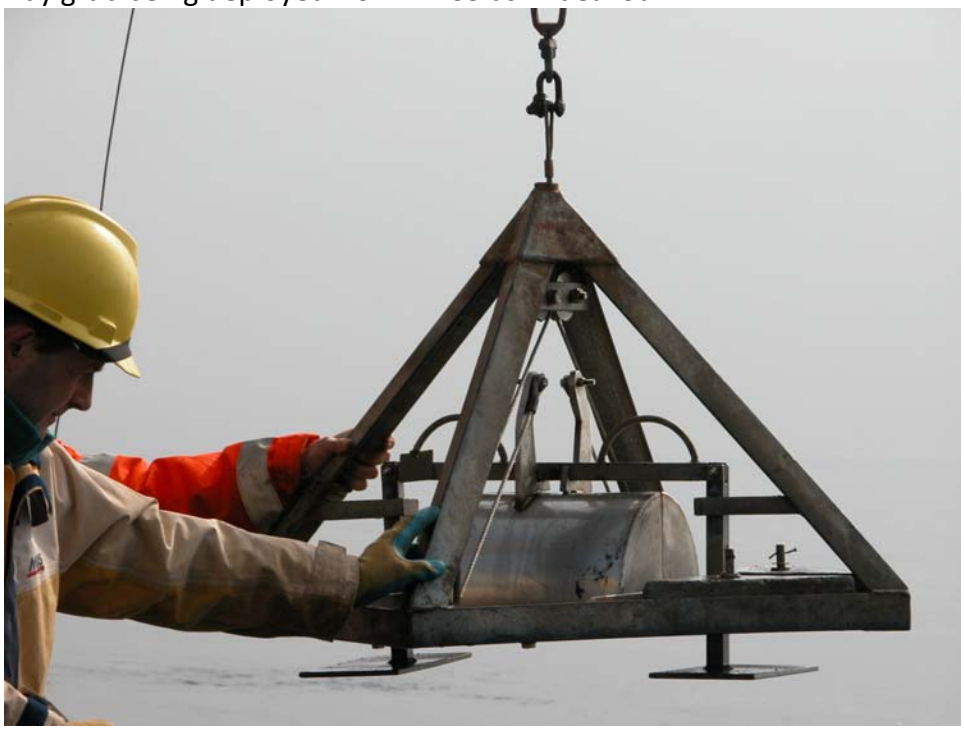
The improvements in equipment protection and sensor anti-biofouling employed for this work programme should be considered for any future work. The recent severe weather experienced during the past couple of months following the end of this 12-month measurement campaign clearly highlights the variable nature of conditions around the UK. This reinforces the importance of understanding inter-annual variability in many of the parameters collected and should be considered when assessing the requirement for longer term monitoring (especially of the wave climate) during the construction and operational phases of the development.

5 Annex 1 – Photographs of principal items of survey equipment used, including vessel

RV Cefas Endeavour

CTD rosette water sampler on board RV Cefas Endeavour

Day grab being deployed from RV Cefas Endeavour



Cefas MiniLander fitted with Nortek AWAC, Booner tube, Seapoint OBS sensor, Cefas ESM2 logger and Applied Acoustics acoustic release

Nortek 600kHz AWAC AST fitted to Cefas MiniLander

Acoustic release set-up on Cefas MiniLander

Booner Tube fitted to Cefas MiniLander

Seapoint OBS with Zebra-Tech Hydro-Wiper fitted to Cefas MiniLander

Cefas ESM2 logger with Aanderaa conductivity/temperature sensor fitted to Cefas MiniLander

Datawell Directional Waverider MkIII

6 Annex 2 – Navigation checks, data quality and calibration procedures

6.1 Navigation Checks

There are two navigation systems onboard RV Cefas Endeavour. A 'certified by Class' Leica Differential GPS (DGPS) system feeds into the Transas software and is used for safe navigation, pilotage, route planning and deploying equipment on station. In addition, a survey standard C-NAV 3050 DGPS with kinematic position derived from the OS net chain of reference stations provides position information for multibeam surveys; the motion of the multibeam heads was corrected with an MRU5 motion reference unit.

6.2 Nortek AWAC Factory Check Sheets

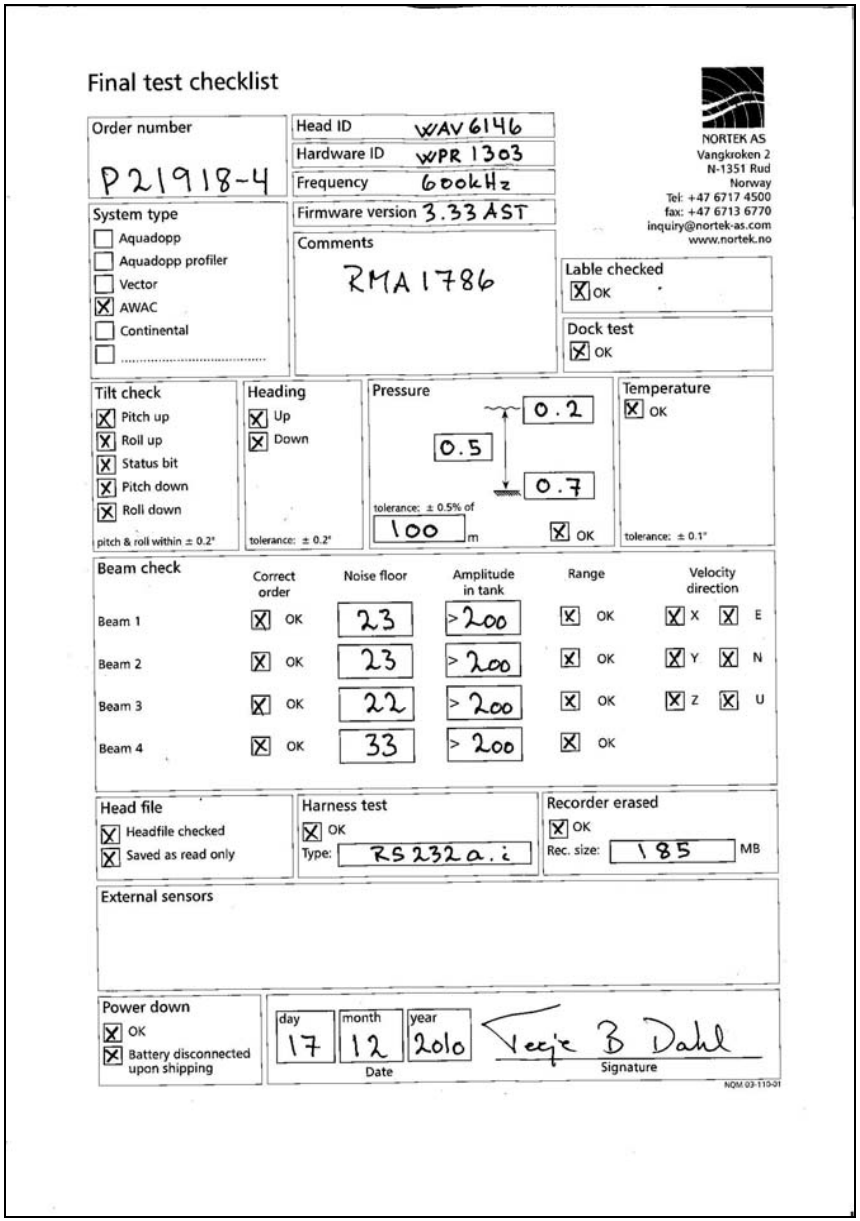
The following Nortek 600kHz AWACs were utilised for this work:-

WAV 6146
WAV 6198

Prior to deployments the AWAC compass was calibrated on the pre-assembled MiniLander. Using AWAC AST software, the Lander was rotated through 360 degrees whilst logging the required data internally within the AWAC. This calibration, which takes into account the magnetic signature of the setup, ensured that residual compass directions were accurate to 1 degree.

The AWACs were prepared, downloaded and maintained in accordance with the manufacturer's instruction manual.

The checklists for the AWAC used (as supplied by Nortek on delivery) are shown below.



Final test checklist

NORTEK AS
Vangkroken 2
N-1351 Rud
Norway
Tel: +47 6717 4500
fax: +47 6713 6770
inquiry@nortek-as.com
www.nortek.no

Order number: P21918-4
Head ID: WAV 6146
Hardware ID: WPR 1303
Frequency: 600kHz
Firmware version: 3.33 AST
Comments: RMA 1786

System type: [ ] Aquadopp [ ] Aquadopp profiler [ ] Vector [X] AWAC [ ] Continental [ ] .....

Lable checked: [X] OK
Dock test: [X] OK

Tilt check: [X] Pitch up [X] Roll up [X] Status bit [X] Pitch down [X] Roll down — pitch & roll within ± 0.2°
Heading: [X] Up [X] Down — tolerance: ± 0.2°
Pressure: 0.2 / 0.5 / 0.7 — tolerance: ± 0.5% of 100 m [X] OK
Temperature: [X] OK — tolerance: ± 0.1°

Beam check

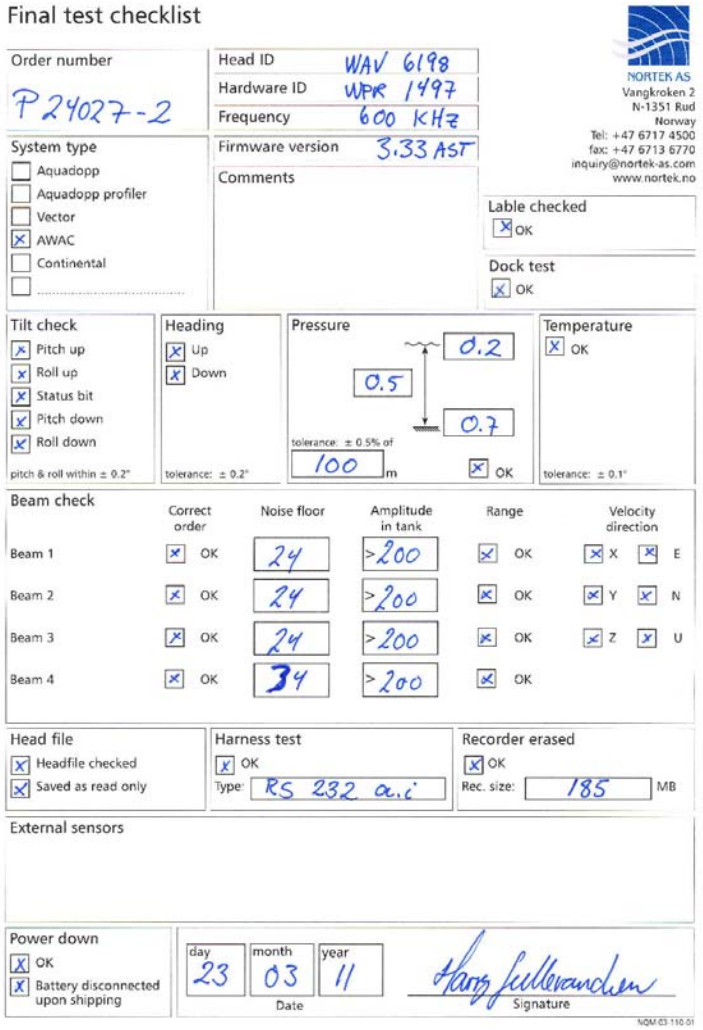
	Correct order	Noise floor	Amplitude in tank	Range	Velocity direction
Beam 1	[X] OK	23	>200	[X] OK	[X] X [X] E
Beam 2	[X] OK	23	>200	[X] OK	[X] Y [X] N
Beam 3	[X] OK	22	>200	[X] OK	[X] Z [X] U
Beam 4	[X] OK	33	>200	[X] OK	

Head file: [X] Headfile checked [X] Saved as read only
Harness test: [X] OK Type: RS232a.i
Recorder erased: [X] OK Rec. size: 185 MB

External sensors:

Power down: [X] OK [X] Battery disconnected upon shipping
Date: day 17 / month 12 / year 2010
Signature: Terje B Dahl

NOM-03-110-01



Final test checklist

NORTEK AS
Vangkroken 2
N-1351 Rud
Norway
Tel: +47 6717 4500
fax: +47 6713 6770
inquiry@nortek-as.com
www.nortek.no

Order number: P24027-2
Head ID: WAV 6198
Hardware ID: WPR 1497
Frequency: 600 KHz
Firmware version: 3.33 AST
Comments:

System type: [ ] Aquadopp [ ] Aquadopp profiler [ ] Vector [X] AWAC [ ] Continental [ ] .....

Lable checked: [X] OK
Dock test: [X] OK

Tilt check: [X] Pitch up [X] Roll up [X] Status bit [X] Pitch down [X] Roll down — pitch & roll within ± 0.2°
Heading: [X] Up [X] Down — tolerance: ± 0.2°
Pressure: 0.2 / 0.5 / 0.7 — tolerance: ± 0.5% of 100 m [X] OK
Temperature: [X] OK — tolerance: ± 0.1°

Beam check

	Correct order	Noise floor	Amplitude in tank	Range	Velocity direction
Beam 1	[X] OK	24	>200	[X] OK	[X] X [X] E
Beam 2	[X] OK	24	>200	[X] OK	[X] Y [X] N
Beam 3	[X] OK	24	>200	[X] OK	[X] Z [X] U
Beam 4	[X] OK	34	>200	[X] OK	

Head file: [X] Headfile checked [X] Saved as read only
Harness test: [X] OK Type: RS 232 a.i
Recorder erased: [X] OK Rec. size: 185 MB

External sensors:

Power down: [X] OK [X] Battery disconnected upon shipping
Date: day 23 / month 03 / year 11
Signature: Hans Fellevaachen

NOM-03-110-01

6.3 Seapoint OBS Information

The following Seapoint OBS sensors were utilised for this work:-

11161
13364

A sensor was used with only one AWAC for multiple deployments, thus maintaining “matched pairs”. The AWAC-to-OBS cable was wired to use the 20x gain setting of the OBS sensor, which gave a nominal range of 0 to 125 FTU.

The OBS sensors were fitted to the MiniLander in a plastic clamp ensuring that the sensor window had an unobscured view into the water column. In addition, they were fitted with Zebra-Tech Hydro-Wipers to help minimise biofouling of the optical windows.

The specification sheet is shown below. It should be noted that because the OBS sensors were calibrated using the flume tank, the calibrations provided here to convert voltage to FTU were not used to provide the final outputs of suspended sediment concentrations in milligrams per litre.

Seapoint Turbidity Meter

Features

- wVery low power requirements
- wSmall size
- w6000 m depth capability
- wOptically confined sensing volume
- wInsensitive to ambient light
- wLinear output over more than 5 decades
- wFour programmable sensitivity options
- wOptical feedback compensates for temperature coefficient and aging of optical components
- wVery low offset voltage does not require adjustment
- wInterfaces easily with data acquisition systems
- wRugged, corrosion-free materials
- wPin compatible with Seapoint Chlorophyll Fluorometer

Applications

- wPollution Monitoring
- wWater and Wastewater Quality
- wSediment Transport
- wOcean Profiling
- wRiver and Stream Monitoring

Description

The Seapoint Turbidity Meter detects light scattered by particles suspended in water, generating an output voltage proportional to turbidity or suspended solids. The low power requirements make it ideal for applications where battery drain is a concern. Sensitivity is selected by two digital lines which can be hard wired or microprocessor controlled, thereby choosing the appropriate range and resolution for measurement of extremely clean to very turbid waters. The offset voltage is within 1 mV of zero and requires no adjustment across gains. The unique optical design confines the sensing volume to within 5 cm of the sensor allowing near-bottom measurements and minimizing errant reflections in restricted spaces. The sensor is easily interfaced with data acquisition packages; a 5 ft pigtail is supplied. Custom configurations are available.

Seapoint Sensors, inc.
87 North Road w Kingston, NH 03848-3056 w USA
Tel: (603) 642-4921 w Fax: (603) 642-4922
seapoint@seapoint.com w www.seapoint.com

8/00

Specifications

wPower Requirements:	7-20 VDC, 3.5 mA avg, 6 mA pk
wOutput	0-5.0 VDC
wOutput Time Constant	0.1 sec
wRMS Noise	< 1 mV
wPower-up Transient Period	< 1 sec
wLight Source Wavelength	880 nm
wSensing Distance (from windows)	< 5 cm (approx.)
wLinearity	< 2% deviation 0-750 FTU

wSensitivity/Range

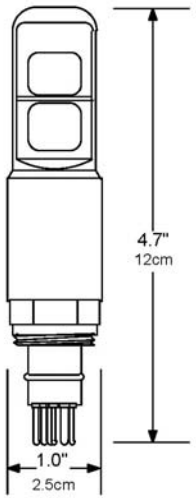
Gain	Sensitivity (mV/FTU)	Range (FTU)
100x	200	25
20x	40	125
5x	10	500
1x	2	**

(** output is non-linear above 750 FTU)

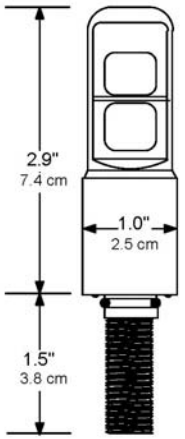
wTemperature Coefficient	< 0.05%/°C
wDepth Capability	6000 m (19,685 ft)
wWeight (dry)	86 g (3.0 oz)
wOperating Temperature	0°C to 65°C (32°F to 149°F)
wMaterial	ABS plastic, epoxy
wUnderwater Connector	Impulse AG-306/206 (others available on request)

Dimensions

Connector Version



Bulkhead Version



9/00

6.4 Datawell Directional Waverider MkIII Calibration Certificate

The following Datawell Waverider was utilised for this work:-

DWR 30549

The Waverider was prepared, downloaded and maintained in accordance with the manufacturer's instruction manual. The calibration/service certificate is shown below.

DATAWELL BV

Directional Waverider hull no.: 30549-6 Date in: 20-2-2012

Customer: CEFAS Sold: May 2006

Packing	Frame
Hatchcover no.	43131B
Tx-crystal (MHz)	--
Fender	Yes
Chaincoupling	No
Antenna nut	No

Hull Status

Performance		Limits	Before repair	After repair	Remarks
Heave at:	6.25 sec	98 ÷ 102 %	1.010	0.997	Testrig radius = 0.9m
	12.5 sec	98 ÷ 102 %		0.996	
(A-filter)	20 sec	94 ÷ 98 %	--	--	
(C-filter)	20 sec	97 ÷ 102 %	1.000	0.983	
Mean direction error at:	6.25 sec	+2° ÷ -2°	-1.0°	-0.3°	= measured direction minus direction of testrig
	12.5 sec	+2° ÷ -2°		0°	
	20 sec	+2° ÷ -2°	-0.9°	-0.2°	
Spreading at:	6.25 sec	< 2°	1.4°	1.9°	
	12.5 sec	< 3.5°		1.5°	
	20 sec	< 6°	2.5°	2.6°	
Check factor K at:	6.25 sec	1 ÷ 1.05	1.01	1.03	
	12.5 sec	1.05 ÷ 1.15		1.09	
	20 sec	1.2 ÷ 1.3	1.24	1.25	
Compass: Offset Hx		< 0.3 A/m	-0.07	-0.09	
Offset Hy		< 0.3 A/m	-0.22	-0.13	
Scale factor Hx/Hy		0.99 ÷ 1.01	1.003	0.995	
Sensor offsets: Platform		< 0.5°	0.11°	0.06°	
Av (m/sec/sec)			+0.12	-0.09	
Ax (m/sec/sec)			-0.02	0	
Ay (m/sec/sec)			+0.70	+0.14	
Battery voltage			19.8V	24.1V	45 batt RC20B
Temperature		± 0.2°C	-0.09°	ok	

Remarks Datawell repair: Orbcomm ID: 26

Buoy checked.
Visual inspection showed a loop in the nylon support wire of the platform suspension wires, also the platform position was too high which might lead to instability of the platform. Attempts to remove this loop permanently were not successful.
Hippy sensor (s/n 30472) replaced with sensor 30982 and buoy calibrated.
Testbox replaced with the intelligent testbox (ITB).
Electronics unit replaced with FB2 unit (s/n 70208B-01) to fit the battery booster.
New set of 45 batteries installed

Checked by: H.de Leeuw Date: 4-4-2012

Datawell BV
Zomerluststraat 4
2012 LM Haarlem
The Netherlands
T +31 23 531 60 53
F +31 23 531 19 86
E sales@datawell.nl
W www.datawell.nl

Service Department
Voltastraat 3
1704 RP Heerhugowaard
The Netherlands
T +31 72 571 82 19
F +31 72 571 29 50
E servdept@datawell.nl

7 Annex 3 – Daily Log Sheets

Daily Report (01/12/12)

Ship: Cefas Endeavour **Cruise:** 20a/11 **Date:** 01/12/2012

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Tom Hull, James Parker, Bill Meadows

Report	Comment
Health & Safety Incidents	Near Miss Incident (NMI) while loading. This is currently being investigated through the Cefas Safety Alert system.
Environment Incidents	N/A
Weather 00:00 UTC	N/A
Sea State 00:00 UTC	N/A
Position 00:00 UTC	N/A
Weather 04:00 UTC	N/A
Sea State 04:00 UTC	N/A
Position 04:00 UTC	N/A
Weather 08:00 UTC	N/A
Sea State 08:00 UTC	N/A
Position 08:00 UTC	N/A
Weather 12:00 UTC	N/A
Sea State 12:00 UTC	N/A
Position 12:00 UTC	N/A
Weather 16:00 UTC	Wind 250° 15knots, partly cloudy, visibility to 10 miles, 1022mbar
Sea State 16:00 UTC	swell <0.5m at 250°, wave height <0.5m
Position 16:00 UTC	51° 58'.8 N 001° 43'.3E
Weather 20:00 UTC	Wind 270° 16kts, cloudy, visibility to 10 miles, 1021mbar
Sea State 20:00 UTC	swell <0.5m at 270°, wave height 0.5m
Position 20:00 UTC	51° 31'.3 N 001° 10'.5E
Issues	None
Problems	None
Any other comment	12:30 UTC sailed from Lowestoft, no EAOW operations today only preparations on ship.

Details recorded by: J Parker, D Sivyer

Daily Report (02/12/12)

Ship: Cefas Endeavour **Cruise:** 20a/11 **Date:** 02/12/2012

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Tom Hull, James Parker, Bill Meadows

Report	Comment
Health & Safety Incidents	None
Environment Incidents	None
Weather 00:00 UTC	Wind 280° 18knots, cloudy, visibility to 10 miles, 1024mbar
Sea State 00:00 UTC	swell <0.5m at 270°, wave height 0.5m
Position 00:00 UTC	51° 41'.3 N 001° 19'.6E
Weather 04:00 UTC	Wind 320° 20-30 knots, overcast, visibility to 10 miles, 1022mbar
Sea State 04:00 UTC	swell 1-1.5m at 300°, wave height 1-1.5m
Position 04:00 UTC	52° 10'.01 N 002° 08'.0E
Weather 08:00 UTC	Wind 320° 30 knots, overcast, visibility to 10 miles, 1022mbar
Sea State 08:00 UTC	swell 1m at 300°, wave height 0.5m
Position 08:00 UTC	52° 19'.02 N 002° 25'.1E
Weather 12:00 UTC	N/A
Sea State 12:00 UTC	N/A
Position 12:00 UTC	N/A
Weather 16:00 UTC	N/A
Sea State 16:00 UTC	N/A
Position 16:00 UTC	N/A
Weather 20:00 UTC	N/A
Sea State 20:00 UTC	N/A
Position 20:00 UTC	N/A
Issues	None
Problems	None
Any other comment	05:30 UTC arrived site DWR C 06:40 UTC DWR C deployed - 52° 18'.624 N 002° 27'.559 E 07:14 UTC guard buoy DWR C # 1 deployed - 52° 18'.680 N 002° 27'.404 E 07:40 guard buoy DWR C # 2 deployed - 52° 18'.577 N 002° 27'.730 E

	07:50 UTC depart site DWR C 11:45 UTC docked Lowestoft

Details recorded by: D Sivyer and J Parker

Daily Report (03/12/12)

Ship: Cefas Endeavour **Cruise:** 20b/11 **Date:** 03/12/2012

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Tom Hull, Bill Meadows, Nigel Lyman, James Parker, Paul Nelson

Report	Comment
Health & Safety Incidents	N/A
Environment Incidents	N/A
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	
Weather 12:00 UTC	
Sea State 12:00 UTC	
Position 12:00 UTC	
Weather 16:00 UTC	Wind 270° 30knots, part cloudy, visibility to 6 miles, 1015mbar
Sea State 16:00 UTC	swell 1m at 260°, wave height 0.5m
Position 16:00 UTC	51° 58'.9 N 002° 05'.3E
Weather 20:00 UTC	Wind 270° 30knots, part cloudy, visibility to 10 miles, 1015mbar
Sea State 20:00 UTC	swell 1.5m at 260°, wave height 1m
Position 20:00 UTC	51° 59'.2 N 002° 04'.9E
Issues	
Problems	
Any other comment	12:00 UTC sailed from Lowestoft 16:00 West Gabbard (Cefas SmartBuoy and camera trials) 20:00 on DP recovering camera at West Gabbard 20:30 – en-route to AWAC 3.1

Details recorded by: D Sivyer

Daily Report (04/12/12)

Ship: Cefas Endeavour **Cruise:** 20b/11 **Date:** 04/12/2012

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Tom Hull, Bill Meadows, Nigel Lyman, James Parker, Paul Nelson

Report	Comment
Health & Safety Incidents	
Environment Incidents	
Weather 00:00 UTC	Wind 270° 30knots, part cloudy, visibility to 10 miles, 1014mbar
Sea State 00:00 UTC	swell 1.5m at 260°, wave height 1.5m
Position 00:00 UTC	52° 31'.6 N 002° 44'.6E
Weather 04:00 UTC	Wind 275° 35knots, part cloudy, visibility to 10 miles, 1009mbar
Sea State 04:00 UTC	swell 2m at 270°, wave height 2m
Position 04:00 UTC	52° 46'.4 N 002° 51'.8E
Weather 08:00 UTC	Wind 275° 36knots, part cloudy, visibility to 6 miles, 1007mbar
Sea State 08:00 UTC	swell 1.5m at 260°, wave height 1.5m
Position 08:00 UTC	52° 51'.8 N 002° 52'.9E
Weather 12:00 UTC	Wind 285° 30knots, overcast, visibility to 6 miles, 1008mbar
Sea State 12:00 UTC	swell 1.5m at 260°, wave height 1.5m
Position 12:00 UTC	52° 41'.7 N 002° 47'.1E
Weather 16:00 UTC	Wind 310° 18knots, cloudy, visibility to 10 miles, 1010mbar
Sea State 16:00 UTC	swell 1.5m at 260°, wave height 1m
Position 16:00 UTC	52° 33'.5 N 002° 46'.3E
Weather 20:00 UTC	Wind 350° 18knots, partly cloudy, visibility to 10 miles, 1010mbar
Sea State 20:00 UTC	swell 1.5m at 320°, wave height 0.5m
Position 20:00 UTC	52° 46'.0 N 002° 34'.3E
Issues	Immediately after the deployment of DWR E a Dutch Beam Trawler was noted approaching the location. Cefas Endeavour responded by staying close to the deployment site to present a large visual presence and made a number of attempts to contact the

	fishing vessel. Eventually the vessel responded and moved away, in addition the Beam Trawler offered to pass the location details on to other Dutch trawlers who operate in the area. During this period the Endeavour came into contact with DWR E, which was subsequently visually checked as a precaution and confirmed to be transmitting data in line with expectations.
Problems	
Any other comment	00:54 start first line of multibeam at AWAC 3.1 02:49 finish multibeam at AWAC 3.1 05:00 start first line of multibeam at AWAC 4.1 Conditions required additional survey lines to be run to infill for weather 07:54 finish multibeam at AWAC 4.1 09:13 deploy guard buoy #1 at AWAC 4.1 09:44 deploy guard buoy #2 at AWAC 4.1 Conditions unsuitable for AWAC 4.1 deployment, commence transit to DWR F 10:38 deploy waverider at DWR F 11:09 deploy guard buoy at DWR F 12:45 deploy guard buoy at DWR E 13:10 deploy waverider at DWR E 14:20 deploy minilander at AWAC 3.1 14:35 – 14:55 water samples at AWAC 3.1 15:04 – 15:13 grab samples at AWAC 3.1 15:23 deploy guard buoy #1 at AWAC 3.1 15:58 deploy guard buoy #2 at AWAC 3.1 18:00 deploy minilander at AWAC 4.1 18:20 – 18:28 grab samples at AWAC 3.1 18:38 – 18:42 water samples at AWAC 3.1 18:50 depart for Lowestoft 23:55 dock in Lowestoft

Details recorded by: D Sivyer & J Parker

Daily Report (08/02/13)

Ship: Cefas Endeavour **Cruise:** 1/13 **Date:** 08/02/2012

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Neil Needham, Chris Read, Tom Hull, Briony Silburn, Elisa Capuzzo

Report	Comment
Health & Safety Incidents	None
Environment Incidents	None
Weather 00:00 UTC	Wind 000° 17 knots, overcast, visibility to 30 miles, 1025 mbar
Sea State 00:00 UTC	Swell 1.0m at 030°, wave height 0.5m
Position 00:00 UTC	52° 49'.5 N, 001° 56'.4E
Weather 04:00 UTC	Wind 350° 18 knots, part cloudy, visibility to 10 miles, 1025 mbar
Sea State 04:00 UTC	Swell 2.0m at 350°, wave height 0.5m
Position 04:00 UTC	52° 30'.2 N, 002° 43'.8E
Weather 08:00 UTC	Wind 020° 10 knots, part cloudy, visibility to 10 miles, 1027 mbar
Sea State 08:00 UTC	Swell 1.5m at 350°, wave height 0.5m
Position 08:00 UTC	52° 52'.3 N, 002° 53'.6E
Weather 12:00 UTC	Wind light airs, part cloudy, visibility to 10 miles, 1029 mbar
Sea State 12:00 UTC	Swell 1.0m at 340°, wave height 0.5m
Position 12:00 UTC	52° 35'.4 N, 002° 47'.8E
Weather 16:00 UTC	Wind light airs, cloudy, visibility to 8 miles, 1029 mbar
Sea State 16:00 UTC	Swell 0.5-1.0m variable°, wave height 0.5m
Position 16:00 UTC	52° 24'.8 N, 002° 35'.6E
Weather 20:00 UTC	N/A
Sea State 20:00 UTC	N/A
Position 20:00 UTC	N/A
Issues	On arriving at AWAC 4.1 site it was observed that the secondary recovery system had deployed. On recovery of the MiniLander it appeared that the ground wire had fouled the surface rope. The surface rope then wound around the MiniLander and is likely to have broken the release lever on the

	acoustic release, thus deploying the secondary recovery system. The surface rope was not fouling the AWAC beams on recovery. On arrival at AWAC 3.1 site it was observed that the MiniLander had been moved much closer to the north-western guard buoy, likely by a passing vessel. The surface rope was extremely frayed and one of the three buffs appears to have been caught in a propeller and burst open. It is likely that the secondary recovery system deployed during this movement and then tangled around the main surface rope. The ropes appeared not to have fouled the AWAC beams. Analysis of the dataset will determine whether the MiniLander remained upright when it was dragged.
Problems	None
Any other comment	04:00 arrive at AWAC 3.1 site 04:15 - 04:30 pre-recovery water samples at AWAC 3.1 04:40 - 04:50 grab samples at AWAC 3.1 04:55 depart from AWAC 3.1 site 06:50 arrive at AWAC 4.1 site 07:00 - 07:10 grab samples at AWAC 4.1 07:15 - 07:30 pre-recovery water samples at AWAC 4.1 08:20 recover MiniLander at AWAC 4.1 09:20 deploy MiniLander at AWAC 4.1 09:55 - 10:30 post-deployment water samples at AWAC 4.1 10:35 depart from AWAC 4.1 site 12:00 arrive at AWAC 3.1 site 13:00 recover MiniLander at AWAC 3.1 14:30 deploy MiniLander at AWAC 3.1 14:50 - 15:05 post-deployment water samples at AWAC 3.1 15:10 depart AWAC 3.1 site

Details recorded by: D Sivyer/D Pearce

Daily Report (14/04/13)

Ship: Cefas Endeavour **Cruise:** 04/13 **Date:** 14/04/2013

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Dave Pearce, Elisa Capuzzo

Report	Comment
Health & Safety Incidents	None
Environment Incidents	None
Weather 00:00 UTC	Wind 155° 27knots, 1019.3mbar, cloudy, visibility to 5 miles
Sea State 00:00 UTC	Wave height 1.5m, swell 1.0m at 135°,
Position 00:00 UTC	54° 24'.5 N 000° 09'.4E
Weather 04:00 UTC	Wind 160° 26knots, 1020mbar, cloudy, visibility to 5 miles
Sea State 04:00 UTC	Wave height 1.0m, swell 1.0m at 135°,
Position 04:00 UTC	53° 53'.1 N 001° 07'.5E
Weather 08:00 UTC	Wind 160° 27knots, 1023mbar, rain and overcast, visibility to 5 miles
Sea State 08:00 UTC	Wave height 1.5m, swell 1.0m at 150°,
Position 08:00 UTC	53° 19'.4 N 002° 03'.5E
Weather 12:00 UTC	Wind 180° 27knots, 1026mbar, part cloudy, visibility to 5 miles
Sea State 12:00 UTC	Wave height 1.5m, swell 1.0m at 180°,
Position 12:00 UTC	52° 52'.35 N 002° 53'.6E
Weather 16:00 UTC	Wind 190° 17knots, 1024.5mbar, part cloudy, visibility to 10 miles
Sea State 16:00 UTC	Wave height 1.0m, swell 1.5m at 180°,
Position 16:00 UTC	52° 45'.5 N 002° 39'.7E
Weather 20:00 UTC	
Sea State 20:00 UTC	
Position 20:00 UTC	
Issues	None
Problems	None
Any other comments	09:30 - 09:40 – pre-recovery water samples at AWAC 4.1 10:30 recover MiniLander at AWAC 4.1 12:05 deploy MiniLander at AWAC 4.1 12:40 deploy Waverider at AWAC 4.1

	13:00 – 13:15 post-deployment water samples at AWAC 4.1 13:25 – 13:40 grab samples at AWAC 4.1 13:40 depart for Lowestoft

Details recorded by: D Sivyer

Daily Report (16/04/13)

Ship: Cefas Endeavour **Cruise:** 04/13 **Date:** 16/04/2013

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Neil Needham, Chris Read, Dave Pearce, Paul Nelson

Report	Comment
Health & Safety Incidents	None
Environment Incidents	None
Weather 00:00 UTC	Light airs, 1028mbar, no cloud, visibility to 8 miles
Sea State 00:00 UTC	Wave height 0.5m, slight swell
Position 00:00 UTC	52° 14'.7 N 002° 24'.0E
Weather 04:00 UTC	Light airs, 1027mbar, no cloud, visibility to 8 miles
Sea State 04:00 UTC	Wave height 0.5m, slight swell
Position 04:00 UTC	52° 29'.0 N 002° 37'.4E
Weather 08:00 UTC	Wind 200°, 21knots, 1025mbar, part cloudy, visibility to 7 miles
Sea State 08:00 UTC	Wave height 0.5m, swell 1.0m at 180°,
Position 08:00 UTC	52° 35'.5 N 002° 46'.7E
Weather 12:00 UTC	Wind 205°, 25knots, 1026mbar, overcast, visibility to 7 miles
Sea State 12:00 UTC	Wave height 1.0m, swell 1.5m at 185°,
Position 12:00 UTC	52° 34'.4 N 002° 40'.3E
Weather 16:00 UTC	Wind 210°, 27knots, 1026mbar, overcast, visibility to 6 miles
Sea State 16:00 UTC	Wave height 1.0m, swell 1.5m at 200°
Position 16:00 UTC	52° 24'.7 N 001° 47'.2E (anchored off Lowestoft)
Weather 20:00 UTC	
Sea State 20:00 UTC	
Position 20:00 UTC	
Issues	None
Problems	None
Any other comments	07:00 - 07:15 – water samples at AWAC 3.1 08:00 recover MiniLander at AWAC 3.1 08:40 deploy MiniLander at AWAC 3.1 09:10 – 09:20 water samples at AWAC 3.1 09:30 – 09:40 grab samples at AWAC 3.1 10:15 – Waverider and guard buoy checked visually at DWR ‘E’

	12:10 – Waverider and two guard buoys checked visually at DWR ‘C’ 12:20 depart for Lowestoft

Details recorded by: D Sivyer

Daily Report (04/06/13)

Ship: Cefas Endeavour **Cruise:** 8/13 **Date:** 04/06/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Paul Nelson, Neil Needham.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	
Weather 12:00 UTC	Wind 010° 15 knots, 1040mbar, clear sky, visibility to 30 miles
Sea State 12:00 UTC	<0.5m wave height, slight swell
Position 12:00 UTC	53°03'.1N, 001°51'.0E
Weather 16:00 UTC	Wind 020° 18 knots, 1036mbar, clear sky, visibility to 30 miles
Sea State 16:00 UTC	0.5m wave height, swell 0.5m 005°
Position 16:00 UTC	53°56'.3N, 002°28'.9E
Weather 20:00 UTC	Wind 020° 19 knots, 1035.5mbar, overcast, visibility to 30 miles
Sea State 20:00 UTC	Wave height 0.5m, swell <0.5m 010°
Position 20:00 UTC	52°52'.14N, 002°53'.69E
Issues	MiniLander rope caught on ship during recovery, had to deploy the acoustic release to aid recovery.
Problems	None
Any other comment	15:13 UTC – arrived on AWAC 4.1 site 15:25 UTC – water samples (T=pre-rec) at AWAC 4.1 - CTD rosette 15:33 – 15:57 UTC – manoeuvre to grapple surface buffs on AWAC 4.1 (dep. 3)

	16:50 UTC – acoustic release fired 17:50 UTC - MiniLander recovered 19:23 UTC – AWAC 4.1 (dep. 4) MiniLander deployed 20:10 UTC – Water samples (T=post dep) at AWAC 4.1 – CTD rosette 20:30 UTC – day grab samples at AWAC 1 site 20:50 – left AWAC 4.1 site All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (04/06/13)

Ship: Cefas Endeavour **Cruise:** 8/13 **Date:** 04/06/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Paul Nelson, Neil Needham.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	
Weather 12:00 UTC	Wind 010° 15 knots, 1040mbar, clear sky, visibility to 30 miles
Sea State 12:00 UTC	<0.5m wave height, slight swell
Position 12:00 UTC	53°03'.1N, 001°51'.0E
Weather 16:00 UTC	Wind 020° 18 knots, 1036mbar, clear sky, visibility to 30 miles
Sea State 16:00 UTC	0.5m wave height, swell 0.5m 005°
Position 16:00 UTC	53°56'.3N, 002°28'.9E
Weather 20:00 UTC	Wind 020° 19 knots, 1035.5mbar, overcast, visibility to 30 miles
Sea State 20:00 UTC	Wave height 0.5m, swell <0.5m 010°
Position 20:00 UTC	52°52'.14N, 002°53'.69E
Issues	MiniLander rope caught on ship during recovery, had to deploy the acoustic release to aid recovery.
Problems	None
Any other comment	15:13 UTC – arrived on AWAC 4.1 site 15:25 UTC – water samples (T=pre-rec) at AWAC 4.1 - CTD rosette 15:33 – 15:57 UTC – manoeuvre to grapple surface buffs on AWAC 4.1 (dep. 3)

	16:50 UTC – acoustic release fired 17:50 UTC - MiniLander recovered 19:23 UTC – AWAC 4.1 (dep. 4) MiniLander deployed 20:10 UTC – Water samples (T=post dep) at AWAC 4.1 – CTD rosette 20:30 UTC – day grab samples at AWAC 1 site 20:50 – left AWAC 4.1 site All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (05/06/13)

Ship: Cefas Endeavour **Cruise:** 8/13 **Date:** 05/06/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Paul Nelson, Neil Needham.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 020° 15 knots, 1034.5mbar, clear sky, visibility to 30 miles
Sea State 00:00 UTC	<0.5m wave height, slight swell
Position 00:00 UTC	52°37'.9N, 002°48'.5E
Weather 04:00 UTC	Wind 020° 10 knots, 1034mbar, overcast, visibility to 30 miles
Sea State 04:00 UTC	<0.5m wave height, slight swell
Position 04:00 UTC	52°33'.5N, 002°48'E
Weather 08:00 UTC	Wind 020° 13 knots, 1033.5mbar, overcast, visibility to 30 miles
Sea State 08:00 UTC	<0.5m wave height, slight swell
Position 08:00 UTC	52°33'.4N, 002°46'.5E
Weather 12:00 UTC	Wind 020° 14 knots, 1033mbar, overcast, visibility to 30 miles
Sea State 12:00 UTC	<0.5m wave height, slight swell
Position 12:00 UTC	52°33'.2N, 002°46'.4E
Weather 16:00 UTC	Wind 020° 12 knots, 1033mbar, overcast, visibility to 20 miles
Sea State 16:00 UTC	0.5m wave height, swell 0.5m 010°
Position 16:00 UTC	52°23'.6N, 002°2'.2E
Weather 20:00 UTC	
Sea State 20:00 UTC	
Position 20:00 UTC	
Issues	None
Problems	None
Any other comment	05:30 UTC – arrived on AWAC 3.1 site 06:10 UTC – water samples (T=pre-rec) at AWAC 3.1 - CTD rosette 06:55 – 07:15 UTC – manoeuvre to grapple surface buffs on AWAC 3.1 (dep. 3)

	07:29 UTC - MiniLander recovered 08:20 UTC – AWAC 3.1 (dep. 4) MiniLander deployed 08:45 UTC – Water samples (T=post dep) at AWAC 3.1 – CTD rosette 09:10 UTC – day grab samples at AWAC 3.1 site 10:35 – 11:30 UTC - guard buoys (toroid 40 and 30) recovered, refurbished and re-deployed on original positions 11:45 UTC – left AWAC 3.1 site 12:15 UTC – arrive DWR "E" 12:30 – 13:10 UTC - guard buoy (toroid 52) recovered, refurbished and re-deployed on original position 13:20 UTC – depart DWR "E" 14:20 UTC – visual inspection of site DWR "C" 14:25 UTC – depart for docking in Lowestoft 18:30 UTC – docked in Lowestoft All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (29/07/13)

Ship: Cefas Endeavour **Cruise:** 14/13 **Date:** 29/07/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Chris Read, Neil Needham, Briony Silburn.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	
Weather 12:00 UTC	Wind 150° 10knots, 1021mbar, partly cloudy, visibility to 10 miles
Sea State 12:00 UTC	Wave height 0.5m, swell 0.5m at 170°,
Position 12:00 UTC	53° 56'.4 N 002° 19'.6E
Weather 16:00 UTC	Wind 150° 15knots, 1023mbar, partly cloudy, visibility to 10 miles
Sea State 16:00 UTC	Wave height 0.5m, swell 1m at 170°,
Position 16:00 UTC	52° 52'.3 N 002° 53'.8E
Weather 20:00 UTC	Wind 180° 15knots, 1023mbar, partly cloudy, visibility to 10 miles
Sea State 20:00 UTC	Wave height 0.5m, swell 1m at 170°,
Position 20:00 UTC	52° 53'.1 N 002° 19'.6E
Issues	AWAC 4.1 MiniLander recovery line caught on the southern guard buoy
Problems	None
Any other comment	12:00 in transit to AWAC 4.1 15:10 arrive at AWAC 4.1 and observe that MiniLander recovery buffs are fouled on guard buoy. 15:20 – 15:32 pre-recovery water samples via CTD rosette at AWAC 4.1 15:50 guard buoy recovered and MiniLander buffs

	untangled 15:59 guard buoy mooring recovered 16:17 MiniLander recovered 16:26 MiniLander clump recovered 17:29 guard buoy re-deployed 18:22 MiniLander deployed 18:37 MiniLander clump deployed 18:45 – 19:10 post dep water samples collected via CTD rosette 19:30 – 19:36 – day grabs 21:00 begin 13hour ADCP transect in EA FOUR (close to AWAC 4.1 site) All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (30/07/13)

Ship: Cefas Endeavour **Cruise:** 14/13 **Date:** 30/07/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Chris Read, Neil Needham, Briony Silburn.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 220° 18knots, 1024mbar, partly cloudy, visibility to 10 miles
Sea State 00:00 UTC	Wave height 0.5m, swell 1m at 180°,
Position 00:00 UTC	52° 52' N 002° 58'.5E
Weather 04:00 UTC	Wind 210° 17knots, 1025mbar, partly cloudy, visibility to 10 miles
Sea State 04:00 UTC	Wave height 0.5m, swell 0.5m at 180°,
Position 04:00 UTC	52° 52' N 002° 58'E
Weather 08:00 UTC	Wind 210° 16knots, 1025mbar, partly cloudy, visibility to 10 miles
Sea State 08:00 UTC	Wave height 0.5m, swell 0.5m at 180°,
Position 08:00 UTC	52° 52' N 002° 58'E
Weather 12:00 UTC	Wind 190° 10knots, 1025mbar, cloudy, visibility to 10 miles
Sea State 12:00 UTC	Wave height 0.5m, swell 0.5m at 190°,
Position 12:00 UTC	52° 35.9' N 002° 47.8'E
Weather 16:00 UTC	Wind 190° 18knots, 1024mbar, overcast, visibility to 5 miles
Sea State 16:00 UTC	Wave height 0.5m, swell 1m at 190°,
Position 16:00 UTC	52° 41.4' N 002° 50.9'E
Weather 20:00 UTC	Wind 220° 14knots, 1022mbar, overcast, visibility to 5 miles
Sea State 20:00 UTC	Wave height 0.5m, swell 1m at 190°,
Position 20:00 UTC	52° 41.4' N 002° 53.5'E
Issues	None
Problems	None
Any other comment	10:45 – complete ADCP survey in EA FOUR (close to AWAC 4.1 site) 12:15 – arrive AWAC 3.1 12:20 – 12:27 - pre-recovery water samples via CTD

	rosette at AWAC 3.1 12:58 – MiniLander recovered 13:09 – MiniLander clump recovered 13:38 – MiniLander deployed AWAC 3.1 (Dep 5) 13:59 – MiniLander clump deployed 14:05 - 14:14 - post-deployment water samples via CTD rosette at AWAC 3.1 14:20 – 14:30 - day grabs 15:45 – start ADCP survey in EA THREE (9 miles north of AWAC 3.1 MiniLander) All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (31/07/13)

Ship: Cefas Endeavour **Cruise:** 14/13 **Date:** 31/07/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Tom Hull, Chris Read, Neil Needham, Briony Silburn.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 220° 12knots, 1023mbar, overcast, visibility to 5 miles
Sea State 00:00 UTC	Wave height 0.5m, swell 1m at 190°,
Position 00:00 UTC	52° 41.5' N 002° 53.4'E
Weather 04:00 UTC	Wind 250° 9knots, 1024.5mbar, cloudy, visibility to 30 miles
Sea State 04:00 UTC	Wave height 0.5m, swell 0.5m at 210°,
Position 04:00 UTC	52° 41.2' N 002° 54'E
Weather 08:00 UTC	Wind 250° 14knots, 1026mbar, partly cloudy, visibility to 30 miles
Sea State 08:00 UTC	Wave height 0.5m, swell 0.5m at 230°,
Position 08:00 UTC	52° 52.5' N 002° 54.2'E
Weather 12:00 UTC	Wind 200° 9knots, 1026.5mbar, cloudy, visibility to 5 miles
Sea State 12:00 UTC	Wave height 0.5m, swell 0.5m at 220°,
Position 12:00 UTC	52° 36' N 002° 12.3'E
Weather 16:00 UTC	
Sea State 16:00 UTC	
Position 16:00 UTC	
Weather 20:00 UTC	
Sea State 20:00 UTC	
Position 20:00 UTC	
Issues	None
Problems	None
Any other comment	04:56 – finish ADCP survey in EA THREE 3 07:20 – SPI camera at AWAC4.1 08:05 – NIOZ box corer at AWAC4.1 08:38 – recover northern guard buoy at AWAC 4.1

	09:08 – re-deploy serviced guard buoy at AWAC 4.1 10:10 – set course for Lowestoft All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (06/09/13)

Ship: Cefas Endeavour **Cruise:** 16/13 **Date:** 06/09/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Tom Hull, Paul Nelson, Neil Needham, Briony Silburn, Bill Meadows, Chris Read.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	
Weather 12:00 UTC	
Sea State 12:00 UTC	
Position 12:00 UTC	
Weather 16:00 UTC	
Sea State 16:00 UTC	
Position 16:00 UTC	
Weather 20:00 UTC	Light airs, 1021.0 mbar, overcast, visibility to 10 miles
Sea State 20:00 UTC	0.5m wave height, swell slight
Position 20:00 UTC	52°19'.4N, 002°30'.1E
Issues	None
Problems	None
Any other comment	20:00 UTC – arrive East Anglia THREE 20:30 UTC – commence 13hr ADCP survey

Details recorded by: Dave Sivyer

Daily Report (07/09/13)

Ship: Cefas Endeavour **Cruise:** 16/13 **Date:** 07/09/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Tom Hull, Paul Nelson, Neil Needham, Briony Silburn, Bill Meadows.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 200° 16 knots, 1023mbar, clear sky, visibility to 30 miles
Sea State 00:00 UTC	<0.5m wave height, slight swell
Position 00:00 UTC	52°41'.1N, 002°53'.0E
Weather 04:00 UTC	Wind 190° 14 knots, 1023.5mbar, part cloudy sky, visibility to 30 miles
Sea State 04:00 UTC	<0.5m wave height, swell 170° 0.5m
Position 04:00 UTC	52°41'.1N, 002°53'.0E
Weather 08:00 UTC	Wind 180° 09 knots, 1025mbar, part cloudy sky, visibility to 30 miles
Sea State 08:00 UTC	0.5m wave height, swell 180° 0.5m
Position 08:00 UTC	52°41'.6N, 002°53'.5E
Weather 12:00 UTC	Wind 180° 22 knots, 1026mbar, part cloudy sky, visibility to 30 miles
Sea State 12:00 UTC	1m wave height, swell 180° 1m
Position 12:00 UTC	52°41'.1N, 002°52'.4E
Weather 16:00 UTC	Wind 180° 23 knots, 1028mbar, cloudy sky, visibility to 10 miles
Sea State 16:00 UTC	0.5m wave height, swell 180° 1m
Position 16:00 UTC	52°33'.4N, 002°46'.5E
Weather 20:00 UTC	Wind 190° 19 knots, 1029mbar, part cloudy sky, visibility to 10 miles
Sea State 20:00 UTC	0.5m wave height, swell 180° 1m
Position 20:00 UTC	52°33'.4N, 002°46'.4E
Issues	Guard buoy at AWAC3.1 hit, damaged and replaced
Problems	CTD rosette misfired and some casts had to be repeated
Any other comment	10:00 UTC – complete ADCP survey East Anglia THREE site 10:20 UTC – 12:20 UTC complete multibeam survey

	at East Anglia Three 12:20 – move to AWAC 3.1 MiniLander site 13:20 UTC – water samples (T=pre-rec) at AWAC 3.1 - CTD rosette 13:40 – 14:05 UTC – manoeuvre to grapple surface buffs on AWAC 3.1 (dep. 5) 14:30 UTC - MiniLander recovered 14:35 UTC – contact with guard buoy 14:45 – 18:50 UTC – recover guard buoy 20:20 – guard buoy deployed (toroid 45) 19:50 UTC – AWAC 3.1 (dep. 6) MiniLander deployed 20:25 UTC-21:00 UTC – Water samples (T=post dep) at AWAC 3.1 – CTD rosette 21:10 UTC – 21:20 UTC – day grab samples at AWAC 3.1 site 21:25 UTC – left AWAC 3.1 site for AWAC 4.1 ADCP survey 23:30 UTC – commence 13hour ADCP survey AWAC 4.1 All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (08/09/13)

Ship: Cefas Endeavour **Cruise:** 16/13 **Date:** 08/09/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Tom Hull, Paul Nelson, Neil Needham, Briony Silburn, Bill Meadows.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 190° 18 knots, 1029mbar,part cloudy sky, visibility to 30 miles
Sea State 00:00 UTC	1m wave height, 1m swell 180°
Position 00:00 UTC	52°38'.9N, 002°50'.04E
Weather 04:00 UTC	Wind 200° 13 knots, 1029mbar,part cloudy sky, visibility to 10 miles
Sea State 04:00 UTC	0.5m wave height, 1m swell 180°
Position 04:00 UTC	52°52'.1N, 002°54'.5E
Weather 08:00 UTC	Wind 270° 10 knots, 1030mbar, cloudy sky, visibility to 10 miles
Sea State 08:00 UTC	0.5m wave height, 1m swell 180°
Position 08:00 UTC	52°52'.1N, 002°54'.7E
Weather 12:00 UTC	Wind 270° 14 knots, 1029mbar, part cloudy sky, visibility to 30 miles
Sea State 12:00 UTC	0.5m wave height, 1m swell 180°
Position 12:00 UTC	52°52'.2N, 002°56'.1E
Weather 16:00 UTC	Wind 230° 12 knots, 1029mbar, clear sky, visibility to 30 miles
Sea State 16:00 UTC	0.5m wave height, 0.5m swell 220°
Position 16:00 UTC	52°52'.2N, 002°53'.6E
Weather 20:00 UTC	Wind 200° 11 knots, 1028.5mbar, part cloudy sky, visibility to 30 miles
Sea State 20:00 UTC	0.5m wave height, 0.5m swell 220°
Position 20:00 UTC	52°52'.1N, 002°58'.9E
Issues	None
Problems	CTD rosette misfired and some casts had to be repeated
Any other comment	13:20 UTC – complete ADCP survey East Anglia FOUR site

	13:30 – move to AWAC 4.1 MiniLander site 13:40 UTC – water samples (T=pre-rec) at AWAC 4.1 - CTD rosette 14:00 – 14:20 UTC – manoeuvre to grapple surface buffs on AWAC 4.1 (dep. 5) 14:40 UTC - MiniLander recovered 15:20 UTC – AWAC 4.1 (dep. 6) MiniLander deployed 15:45 UTC-17:00 UTC – Water samples (T=post dep) at AWAC 3.1 – CTD rosette 17:15 UTC – 17:30 UTC – day grab samples at AWAC 4.1 site 18:25 UTC – 19:20 UTC complete multibeam survey over East Anglia FOUR 19:30 UTC – depart for Lowestoft All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

Details recorded by: Dave Sivyer

Daily Report (07/10/13)

Ship: Cefas Endeavour **Cruise:** 19/13 **Date:** 07/10/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Tom Hull, Paul Nelson, Neil Needham, James Cook.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Light airs, 1036mbar, part cloudy, visibility to 10 miles
Sea State 00:00 UTC	<0.5m wave height, slight swell
Position 00:00 UTC	51° 52'.5 N, 001° 48' E
Weather 04:00 UTC	Light airs, 1036mbar, cloudy, visibility to 10 miles
Sea State 04:00 UTC	<0.5m wave height, slight swell
Position 04:00 UTC	52° 24'.8 N, 002° 33'.2 E
Weather 08:00 UTC	Light airs, 1036mbar, cloudy, visibility to 10 miles
Sea State 08:00 UTC	<0.5m wave height, slight swell
Position 08:00 UTC	52° 33'.4 N, 002° 46'.5 E
Weather 12:00 UTC	Wind 230° 10 knots, 1035mbar, cloudy, visibility to 10 miles
Sea State 12:00 UTC	<0.5m wave height, slight swell
Position 12:00 UTC	52° 52'.3 N, 002° 53'.7 E
Weather 16:00 UTC	Wind 220° 10 knots, 1034mbar, part cloudy, visibility to 10 miles
Sea State 16:00 UTC	<0.5m wave height, slight swell
Position 16:00 UTC	52° 56'.3 N, 002° 38'.8 E
Weather 20:00 UTC	Light airs, 1034mbar, part cloudy, visibility to 10 miles
Sea State 20:00 UTC	<0.5m wave height, slight swell
Position 20:00 UTC	53° 00'.8 N, 002° 05'.5 E
Issues	None
Problems	
Any other comment	All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

	05:15 - Arrive at site AWAC 3.1 06:05 to 06:25 – CTD Rosette sampling 07:00 – pick up MiniLander buffs 07:20 – MiniLander on deck 07:30 – clump on deck 08:00 to 08:20 – deploy MiniLander (dep 7) at AWAC 3.1 08:30 to 08:50 – CTD Rosette sampling 08:50 to 09:00 – day grabs at AWAC 3.1 09:05 – depart site AWAC 3.1 11:15 – arrive site AWAC 4.1 11:30 to 11:45 - CTD Rosette sampling 12:00 – pick up MiniLander buffs 12:15 – MiniLander on deck 12:25 – clump on deck 12:50 to 13:05 – deploy MiniLander (dep 7) at AWAC 4.1 13:10 to 13:25 – CTD Rosette sampling 13:30 to 13:40 – day grabs at AWAC 4.1 13:50 – depart site AWAC 4.1

Details recorded by: Dave Sivyer

Daily Report (03/12/13)

Ship: Cefas Endeavour **Cruise:** 24/13 **Date:** 03/12/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Neil Needham, Tom Hull, Chris Read, Bill Meadows, Paul Nelson.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	
Sea State 00:00 UTC	
Position 00:00 UTC	
Weather 04:00 UTC	
Sea State 04:00 UTC	
Position 04:00 UTC	
Weather 08:00 UTC	
Sea State 08:00 UTC	
Position 08:00 UTC	Lowestoft Harbour
Weather 12:00 UTC	Light airs, 1039mbar, cloudy, visibility to 30 miles
Sea State 12:00 UTC	0.5m wave height, slight swell
Position 12:00 UTC	52° 18'.6 N, 002° 27'.5 E
Weather 16:00 UTC	Light airs, 1038mbar, cloudy, visibility to 30 miles
Sea State 16:00 UTC	0.5m wave height, slight swell
Position 16:00 UTC	52° 36'.3 N, 002° 46'.5 E
Weather 20:00 UTC	Wind 260° 12 knots, 1037mbar, cloudy, visibility to 10 miles
Sea State 20:00 UTC	0.5m wave height, slight swell
Position 20:00 UTC	52°32'.8N, 002°46'.2E
Issues	None
Problems	None
Any other comment	All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination 07:30 – let go Cefas Quay Lowestoft 10:35 – arrive DWR 'C' 11:20 – DWR 'C' Waverider recovered

	11:50 – deploy Waverider DWR ‘C’ 13:50 – arrive site AWAC3.1 14:00 – 14:10 - CTD rosette 14:15 – 14:55 – recover AWAC 3.1 MiniLander and clump 15:10 – arrive site DWR ‘E’ 15:20 – 15:55 - recover Waverider and clump 16:05 – 16:35 – recover guard buoy 17:40 – arrive site AWAC 3.1 17:50 – 18:05 - recover north guard buoy and clump 18:20 – 18:50 – recover south guard buoy and clump 19:00 – 19:10 – day grabs x3 20:00 – 21:50 – multibeam survey at site AWAC 3.1

Details recorded by: Dave Sivyer

Daily Report (04/12/13)

Ship: Cefas Endeavour **Cruise:** 24/13 **Date:** 04/12/13

Cefas Scientific Staff: Dave Sivyer (Scientist in Charge), Dave Pearce, Neil Needham, Tom Hull, Chris Read, Bill Meadows, Paul Nelson.

Report	Comment
Health & Safety Incidents	Nothing to report
Environment Incidents	Nothing to report
Weather 00:00 UTC	Wind 260° 12 knots, 1036mbar, cloudy, visibility to 10 miles
Sea State 00:00 UTC	0.5m wave height, slight swell
Position 00:00 UTC	52°34'.6N, 002°48'.3E
Weather 04:00 UTC	Wind 270° 14 knots, 1034mbar, cloudy, visibility to 10 miles
Sea State 04:00 UTC	0.5m wave height, slight swell
Position 04:00 UTC	52°41'.9N, 002°50'.7E
Weather 08:00 UTC	Wind 280° 23 knots, 1033mbar, cloudy, visibility to 2 miles
Sea State 08:00 UTC	0.5m wave height, 1m swell at 270°
Position 08:00 UTC	52°52'.2N, 002°53'.8E
Weather 12:00 UTC	Wind 360° 26 knots, 1035mbar, cloudy, visibility to 5 miles
Sea State 12:00 UTC	1m wave height, 1m swell at 340°
Position 12:00 UTC	52°52'.6N, 002°53'.6E
Weather 16:00 UTC	Wind 280° 27 knots, 1038mbar, broken cloud, visibility to 10 miles
Sea State 16:00 UTC	1m wave height, 1m swell at 340°
Position 16:00 UTC	52°31'.0N, 002°12'.5E
Weather 20:00 UTC	
Sea State 20:00 UTC	
Position 20:00 UTC	
Issues	AWAC 4.1 northern guard buoy missing
Problems	None
Any other comment	All CTD water samples filtered in preparation for SPM analysis All grab samples stored and labelled prior to PSA determination

	Steam slowly to arrive at AWAC 4.1 07:00 – 07:15 – CTD rosette 08:05 – 08:20 – AWAC 4.1 southern guard buoy and clump recovered 08:25 – 08:55 – MiniLander recovered 09:05 – 09:35 – DWR ‘F’ recovered 10:00 – 10:10 – day grabs 10:50 – 12:50 – multibeam site AWAC 4.1 13:00 – leave AWAC 4.1 and cease EAOW operations

Details recorded by: Dave Sivyer

8 Annex 4 – Vessel Safety Inspection Report- RV Cefas Endeavour

The most recent Marine Inspection Report for RV Cefas Endeavour (number BCS/J/10061/02, dated 10 June 2013) is available on request.

BCTQ
Burness Corlett Three Quays

INSPECTION REPORT
Cefas Endeavour
BCS/J/10061/02

Issued To:	Cefas
Date of Issue:	10 June 2013
Author:	M M Bryce

MARINE INSPECTION

REPORT

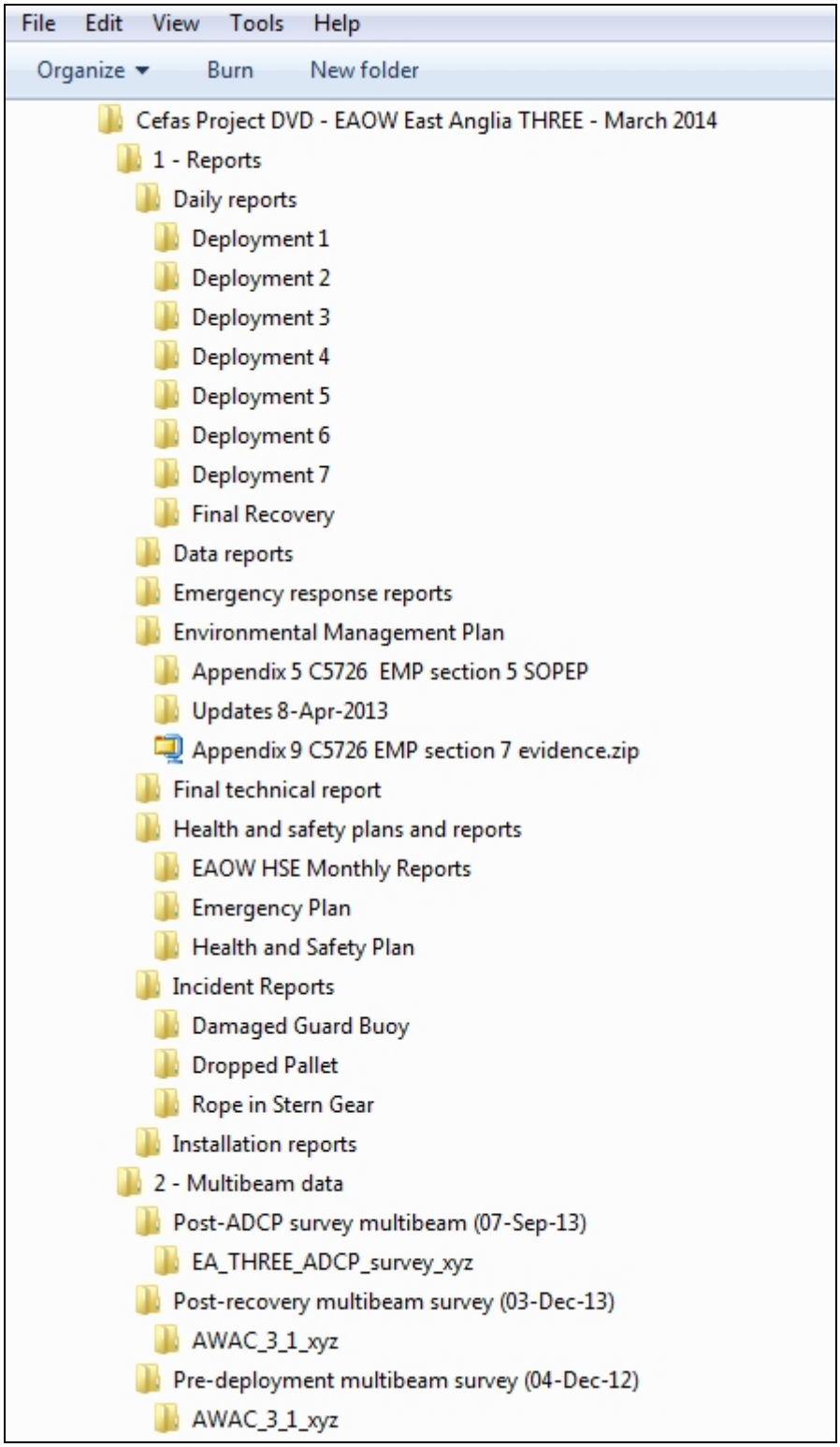
"CEFAS ENDEAVOUR"

Dates:	31 May 2013
At:	Lowestoft
Master:	Captain P. Kersey
Chief Engineer:	Mr. G. McCoy
MSS Consultant:	Mr. M. Bryce

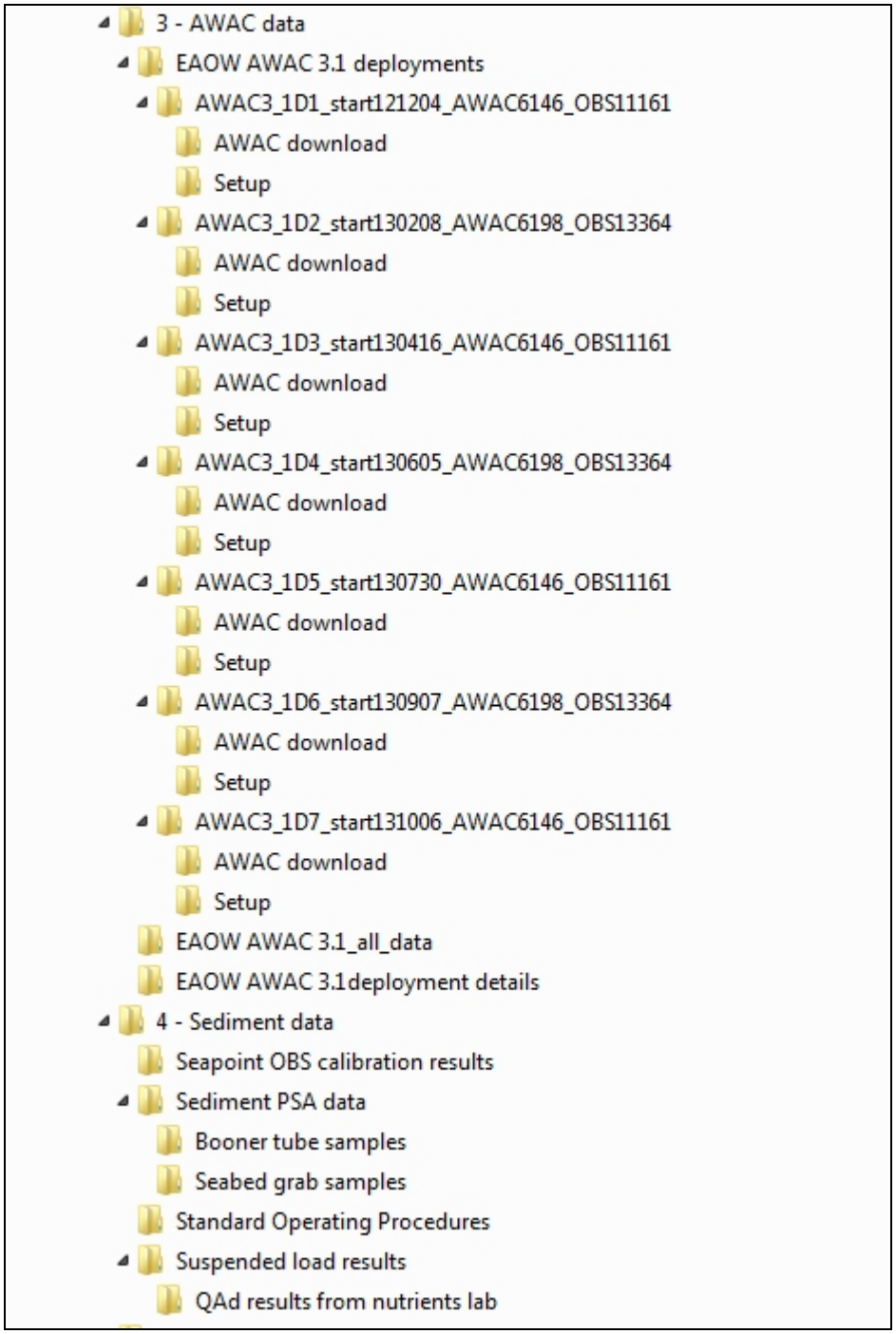
Prepared by: Burness Corlett Three Quays Ltd
Marine Survey & Safety Services
19 – 21 Great Tower Street
London EC3R 5AR

Telephone: 020 7929 2299
Fax: 020 7621 2961
Email: mss@bctq.com

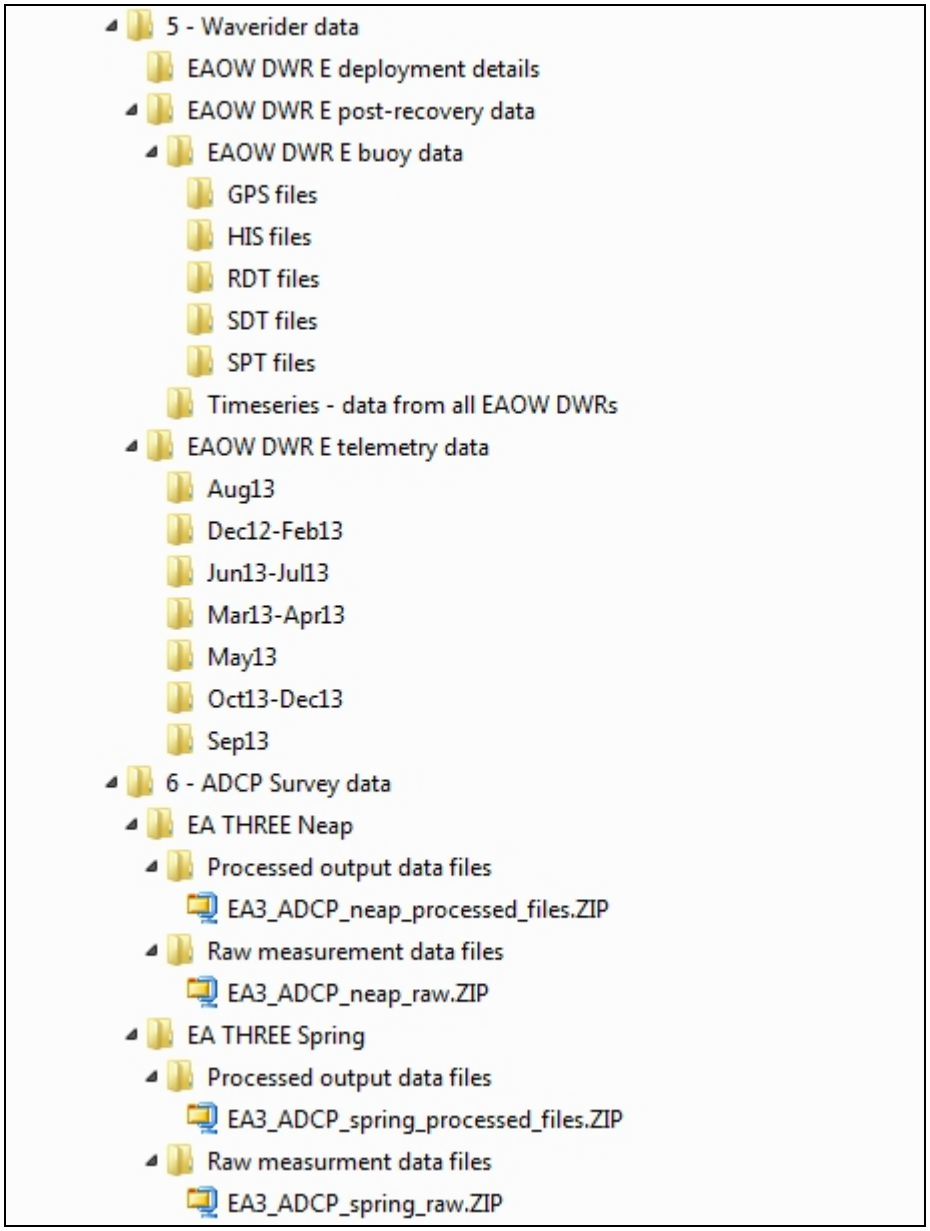
9 Annex 5 – File Structure of EAOW East Anglia THREE Project DVD



Continued...


3 - AWAC data
EAOW AWAC 3.1 deployments
AWAC3_1D1_start121204_AWAC6146_OBS11161
AWAC download
Setup
AWAC3_1D2_start130208_AWAC6198_OBS13364
AWAC download
Setup
AWAC3_1D3_start130416_AWAC6146_OBS11161
AWAC download
Setup
AWAC3_1D4_start130605_AWAC6198_OBS13364
AWAC download
Setup
AWAC3_1D5_start130730_AWAC6146_OBS11161
AWAC download
Setup
AWAC3_1D6_start130907_AWAC6198_OBS13364
AWAC download
Setup
AWAC3_1D7_start131006_AWAC6146_OBS11161
AWAC download
Setup
EAOW AWAC 3.1_all_data
EAOW AWAC 3.1deployment details
4 - Sediment data
Seapoint OBS calibration results
Sediment PSA data
Booner tube samples
Seabed grab samples
Standard Operating Procedures
Suspended load results
QAd results from nutrients lab

Continued...


5 - Waverider data
EAOW DWR E deployment details
EAOW DWR E post-recovery data
EAOW DWR E buoy data
GPS files
HIS files
RDT files
SDT files
SPT files
Timeseries - data from all EAOW DWRs
EAOW DWR E telemetry data
Aug13
Dec12-Feb13
Jun13-Jul13
Mar13-Apr13
May13
Oct13-Dec13
Sep13
6 - ADCP Survey data
EA THREE Neap
Processed output data files
EA3_ADCP_neap_processed_files.ZIP
Raw measurement data files
EA3_ADCP_neap_raw.ZIP
EA THREE Spring
Processed output data files
EA3_ADCP_spring_processed_files.ZIP
Raw measurment data files
EA3_ADCP_spring_raw.ZIP

About us

Cefas is a multi-disciplinary scientific research and consultancy centre providing a comprehensive range of services in fisheries management, environmental monitoring and assessment, and aquaculture to a large number of clients worldwide.

We have more than 500 staff based in 2 laboratories, our own ocean-going research vessel, and over 100 years of fisheries experience.

We have a long and successful track record in delivering high-quality services to clients in a confidential and impartial manner. (www.cefas.defra.gov.uk)

Cefas Technology Limited (CTL) is a wholly owned subsidiary of Cefas specialising in the application of Cefas technology to specific customer needs in a cost-effective and focussed manner.

CTL systems and services are developed by teams that are experienced in fisheries, environmental management and aquaculture, and in working closely with clients to ensure that their needs are fully met. (www.cefastechnology.co.uk)

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Customer focus

With our unique facilities and our breadth of expertise in environmental and fisheries management, we can rapidly put together a multi-disciplinary team of experienced specialists, fully supported by our comprehensive in-house resources.

Our existing customers are drawn from a broad spectrum with wide ranging interests. Clients include:

- international and UK government departments
- the European Commission
- the World Bank
- Food and Agriculture Organisation of the United Nations (FAO)
- oil, water, chemical, pharmaceutical, agro-chemical, aggregate and marine industries
- non-governmental and environmental organisations
- regulators and enforcement agencies
- local authorities and other public bodies

We also work successfully in partnership with other organisations, operate in international consortia and have several joint ventures commercialising our intellectual property

Head office
Centre for Environment, Fisheries & Aquaculture Science
Pakefield Road, Lowestoft,
Suffolk NR33 0HT UK

Tel +44 (0) 1502 56 2244
Fax +44 (0) 1502 51 3865

Web www.cefas.defra.gov.uk

Centre for Environment, Fisheries & Aquaculture Science
Barrack Road, The Nothe
Weymouth, DT4 8UB

Tel +44 (0) 1305 206600
Fax +44 (0) 1305 206601

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Appendix 7.5 Ends Here