

Draft : Environmental Impact Statement

Appendix D.3

Climate and Coastal Oceanographic Data Summary Report

APPENDIX D.3



Cairns Shipping Development Project EIS Climatic and Coastal Oceanographic Data Collection Data Summary Report

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Cairns Shipping Development Project EIS Climatic and Coastal Oceanographic Data Collection Data Summary Report

Prepared for: Ports North

Prepared by: BMT WBM Pty Ltd (Member of the BMT group of companies)



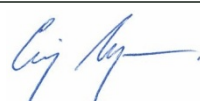
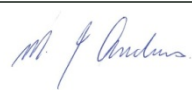



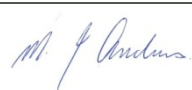
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<p>BMT WBM Pty Ltd Level 8, 200 Creek Street Brisbane Qld 4000 Australia PO Box 203, Spring Hill 4004</p> <p>Tel: +61 7 3831 6744 Fax: + 61 7 3832 3627</p> <p>ABN 54 010 830 421</p> <p>www.bmtwbm.com.au</p>	Document:	R.B20126.001.03.docx
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	Project Manager:	Malcolm Andrews
	Author:	Malcolm Andrews, Marcus Gregson
	Client:	Ports North
	Client Contact:	Alan Vico
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Synopsis: This report details the data collected in Cairns Harbour during the period January 2013 to July 2014.		

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Introduction

1 Introduction

To expedite the EIS (Environmental Impact Study) process for the Cairns Shipping Development Project, Ports North (PN) contracted BMT WBM to undertake the early collection of local climatic and coastal oceanographic data prior to the final EIS Terms of Reference being issued by the Queensland and federal governments.

A review of data expected to be required for the EIS was undertaken by BMT WBM in 2012 to ensure all likely future data requests were included in the data collection campaign. In particular, Ports North wanted to capture wet season measurements during the summer of 2012/2013, since the Cairns Harbour shipping channel is affected by siltation and currents during wet seasons and associated cyclonic events.

The wet season data collection campaign was initiated in February 2013 with data collected through until May 2013. The measurements were extended during the subsequent dry season through to August 2013. The data collection program was further extended to 12 months (concluding February 2014) by Ports North for selected sites. All instruments (with the exception of the weather stations) were recovered in April 2014. It is anticipated that the weather stations will remain on-site until July 2014, coinciding with the completion of water quality monitoring within Trinity Inlet.

The locations of the monitoring sites where instruments were deployed are depicted in Figure 1-1. The coordinates together with the deployment and retrieval times are tabulated in Table 1-1. The types of instruments and the nature of the moorings for each monitoring site are tabulated in Table 1-2. These locations were as specified in the initial brief for the data acquisition program with spatial and temporal extensions over time as dictated by the evolving EIS requirements. In essence the data collection campaign was initially devised to assist numerical model establishment and calibration and included data acquisition at the potential spoil sites, at various points along the navigation channel and at the port as well as other sites within Trinity Inlet for wider turbidity impact monitoring.

Sediment grab samples were collected from six locations adjacent to the Cairns shipping channel, refer to Figure 1-2. These samples provide the data required to categorise the surface sediments with respect to their particle size distribution (PSD).

To further assist in numerical model calibration tidal currents, both across and adjacent to the shipping channel and various berthing facilities, were measured using a boat mounted ADCP. BMT WBM collected the data during two separate data collection campaigns the first in April, the second in June 2013.

The data in its entirety has been processed in-house by BMT WBM and presented herewith in graphical form. For the instrument deployments each site is documented within a discrete chapter. Discrete chapters for the sediment grab sampling and the ADCP transects are also included.

In addition to the coastal data collection program, a separate 12 month water quality program was undertaken. This program included water quality monitoring at a number of sensitive ecological receptor locations. The data collected was used to characterise baseline conditions and to set trigger levels. Details of this program and data collected are included in Section 12.

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Table 1-1 Instrument Deployments: Coordinates and Deployment Periods

Site	Location	Northing	Easting	Latitude	Longitude	Deployment Date	Retrieval Date
1	DMPA	8144352	373219	-16.78040	145.81038	15/02/2013	15/04/2014 ¹
2	Alt. DMPA	8141198	372557	-16.80887	145.80400	15/02/2013	22/08/2013
3	Bcn. C2 Weather	8138495	375514	-16.83351	145.83159	16/02/2013	15/03/2014 ²
3	Bcn. C2 TIDE	8138198	375620	-16.83615	145.83257	20/02/2013	22/08/2013
4	Bcn. C7 AWAC	8135981	373886	-16.85609	145.81617	20/02/2013	15/04/2014 ³
4	Bcn. C7 CTD BUOY	8136010	373848	-16.85582	145.81582	21/02/2013	24/08/2013
5	Bcn. C11 Weather	8134527	373104	-16.86924	145.80875	17/02/2013	15/04/2014 ⁴
5	Bcn. C11 ADCP	8134369	373002	-16.87061	145.80779	20/02/2013	24/08/2013
5	Bcn. C11 CTD BUOY	8134401	372962	-16.87032	145.80741	21/02/2013	24/08/2013
6	Bcn. C20 Weather	8129938	370805	-16.91059	145.78690	21/02/2013	15/04/2014 ⁵

¹ Data collected to 4th February 2014.² Data collected beyond the 12 month requirement.³ Data collected to 4th February 2014.⁴ Data collected beyond the 12 month requirement.⁵ Data collected beyond the 12 month requirement.

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Table 1-2 Instrument Deployments: Instrument Types and Moorings

Site	Location	Moorings	Tide Recorder	ADCP	Nephelometer	CTD	Data Redundancy or Additional Data
1	DMPA	MSI trawl resistant bed mounted frame	20m range Seabird Model SBE26 plus	600 kHz Nortek AWAC	YSI Model 6600 EDS water quality instrument fitted with turbidity sensor.	Not required, though was collected using YSI Model 6600.	Tide (depth), non-directional waves, water temperature, electrical conductivity, PAR (Photosynthetically Available Radiation)
2	Alt. DMPA	MSI trawl resistant bed mounted frame	Not required.	600 kHz Nortek AWAC	YSI Model 6600 EDS water quality instrument fitted with turbidity sensor.	Not required, though was collected via YSI Model 6600.	Tide (depth), water temperature, electrical conductivity.
3	Bcn. C2	Ocean Sciences Sea Spider bed mounted frame.	20m range Seabird Model SBE26 plus	Not required	Not required	Not required	Additional data includes non-directional waves.
4	Bcn. C7	Ocean Sciences Sea Spider bed mounted frame. CTD deployed from floating Sealite Model 600 marker buoy.	Not required.	600 kHz Nortek AWAC.	YSI Model 6600 EDS water quality instrument fitted with turbidity sensor.	Teldyne RD Instruments Citadel CTD deployed from floating buoy.	Tide (depth), water temperature, and electrical conductivity.
5	Bcn. C11	Ocean Sciences Sea Spider bed mounted frame. CTD deployed from floating Sealite Model 600 marker buoy.	Not required.	1200 kHz Teledyne RD Instruments Workhorse Sentinel ADCP.	YSI Model 6600 EDS water quality instrument fitted with turbidity sensor.	Teldyne RD Instruments Citadel CTD deployed from floating buoy.	Tide (depth), water temperature, and electrical conductivity.

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Site	Location	Mooring	Tide Recorder	ADCP	Nephelometer	CTD	Data Redundancy or Additional Data
3,5,6	Bcns. C2, C11 and C20.	Environdata Model Weather Maestro Weather Stations. Affixed to Beacons.					Wind (speed and direction), rainfall, air temperature, relative humidity, atmospheric pressure (Beacon C11 only), solar radiation.

Introduction

Table 1-3 Measurements conducted from Vessel

Location	Data Campaign	Timing
Port Area: Smiths Creek and Trinity Inlet at the confluence of Smiths Creek (Senrab Point).	Vessel mounted ADCP velocity transects.	2 occasions (April and June 2013) spring tides – cross channel.
Port Area: Navy swing basin between berths 11 and 12 and between berths 10 and 11.	Vessel mounted ADCP transect with TSS and CTD profiles - TSS samples at profiler locations.	3 occasions (April, June and August 2013) spring tides – cross channel.
Inner Channel: Bcn. C20 to Bcn. C15	Vessel mounted ADCP transect with TSS and CTD profiles - TSS samples at profiler locations.	3 occasions (April, June and August 2013) spring tides – along channel and cross channel.
Outer Channel: Bcn. C15 to Bcn. C5	Vessel mounted ADCP transect with TSS and CTD profiles - TSS samples at profiler locations.	3 occasions (April, June and August 2013) spring tides – along channel and cross channel.
Adjacent to Channel	Particle Sizing of sediments at the locations indicated on Figure 1-2.	6 grab samples of surface sediments (August 2013).
Trinity Bay, Inner and Outer Channel, Port Area: DMPA, Alternative DMPA, Bcn. C2, Bcn. C7, Bcn. C11, Bcn. C20, Mouth of Barron River.	CTD and turbidity profiles. Water samples for TSS and particle size analyses.	4 occasions (February, May, June, August 2013)

2 Data Presentation

2.1 General

A brief summary of the data types collected and the methods of analysis and presentation are provided below. With the exception of the weather stations all instruments were self-contained and required scheduled servicing and maintenance at approximately six weekly intervals to replace batteries, remove marine biofouling and to recover the data. Due to the scheduled servicing, brief interruptions exist within the otherwise continuous data sets. Appendix A contains the technical specifications of the various instruments deployed.

2.2 Tide Data

Water levels recorded with pressure sensors (AWACs, ADCP and Seabirds) have been adjusted for atmospheric pressure and reduced to AHD. The data has been presented as time series plots.

2.3 Current Data

Current data from bed mounted instruments (AWACs and ADCP) are presented as time series plots of depth averaged current magnitude (m/s) and direction (degrees). The current directions are presented in the nautical convention for currents: 0° is north and clockwise is positive with the bearing indicating the direction currents are heading.

Current data from vessel mounted downward facing ADCPs are presented in both plan and profile view. The plan view plots comprise of arrows spaced along the track of the monitoring vessel where the arrows' size indicates the current magnitude and the arrows' direction the direction of flow. The currents depicted by the arrows correspond to the depth average. The profile view plots, located directly below the afore-mentioned plan view plots depict the current magnitudes throughout the water column along the monitoring vessel's track. These profile view plots provide an insight into the 3D nature of the current field. The position within the tidal cycle when the data was collected is indicated in the upper right-hand corner of the plan view plot.

2.4 Wave Data

The wave data recorded by the ADCP, AWACs and Seabirds have been presented herewith as time series plots. The wave parameters presented differ subtly between the acoustic based (ADCP and AWACs) and pressure based (Seabird) instruments. The ADCP and AWAC instruments provide the significant wave height, defined as four times the square root of the zeroth-order moment of the wave spectrum. The wave heights as provided by the Seabirds are defined as the average height of the largest third of the waves. There is a similar discrepancy with regard to the presented wave periods. Unlike the acoustic instruments, the Seabirds are unable to discern the direction of the waves. Wave directions are presented in the nautical convention for waves: 0° is north and clockwise is positive with the bearing indicating the direction from which the waves are propagating.

2.5 Weather Station Data

Atmospheric data (wind speed and direction, temperature, relative humidity, light, rainfall and barometric pressure (Beacon C11 only) have been collected by weather stations installed on Beacons C2, C11 and C20 and are presented as individual time series plots. Weather data was measured and recorded at 6 minute (0.1 hour) and hourly intervals at each location. Flooding of the weather station at Beacon C20 in March 2013 resulted in a loss of the six minute data in February, March and early April 2013. The available hourly data records at this site were substituted during this period.

2.6 Conductivity, Temperature and Turbidity

Conductivity, temperature and turbidity have been recorded at the DMPA, Alternative DMPA and Beacons C7 and C11 at 6 minute intervals using YSI and Teledyne instruments. This data is presented as individual time series plots for each of the sites.

The turbidity data measured in Nephelometric Turbidity Units (NTU) has been converted to Total Suspended Solids (TSS) concentrations in mg/L. The relationship between turbidity and TSS was derived by determining, via laboratory analysis, the TSS concentrations within a suite of water samples and comparing to the respective turbidity readings as measured in the field by a YSI probe. The samples used to derive the relationship were collected from within trinity inlet and throughout Trinity Bay, including over the existing and alternate spoil grounds. The derived relationship is presented in Figure 2-1. The more samples used to derive the relationship the more confidence can be afforded to the TSS concentrations derived from the turbidity measurements collected by the YSI instruments deployed throughout the study area. The more confidence afforded to the TSS measurements then the more confidence afforded to the outputs from the numerical model, the model initially calibrated and validated against the TSS measurements. Two sets of samples, separated by over two months, have been used to derive the relationship presented below.

Unfortunately the conductivity measurements were compromised due to the accumulation of sediment on the relevant probe. For this reason the salinity values (derived from the conductivity) are noticeably inconsistent between before and after the scheduled instrument cleaning. Further discussion is included in Chapter 11.

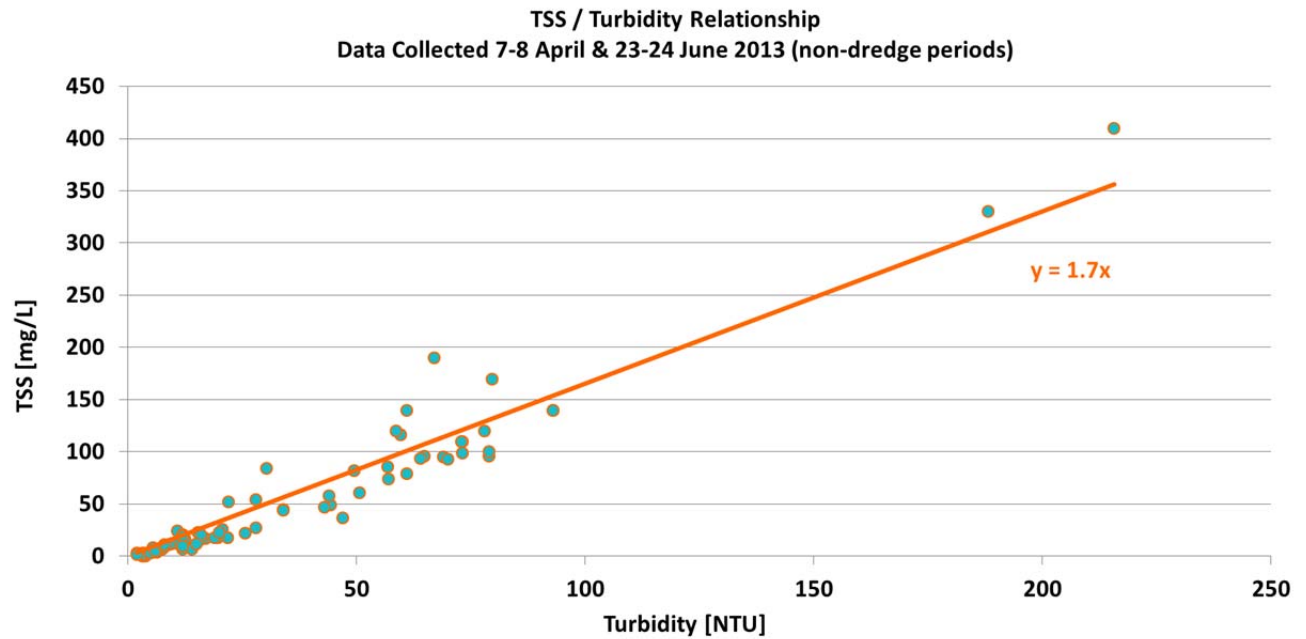


Figure 2-1 TSS-NTU Relationship applicable throughout Trinity Inlet and Trinity Bay

Site 1 - Dredged Material Placement Area

3 Site 1 - Dredged Material Placement Area

The following data was collected for twelve months (February 2013 to February 2014):

- AWAC – water level, currents, temperature and directional waves;
- Seabird SBE 26 – water level, temperature and non-directional waves; and
- YSI 6600 – Conductivity, temperature, depth (CTD) and turbidity (converted to TSS). Note salinity has been derived from conductivity and the data towards the end of each deployment period is unreliable (refer Chapter 11).

3.1 AWAC Data

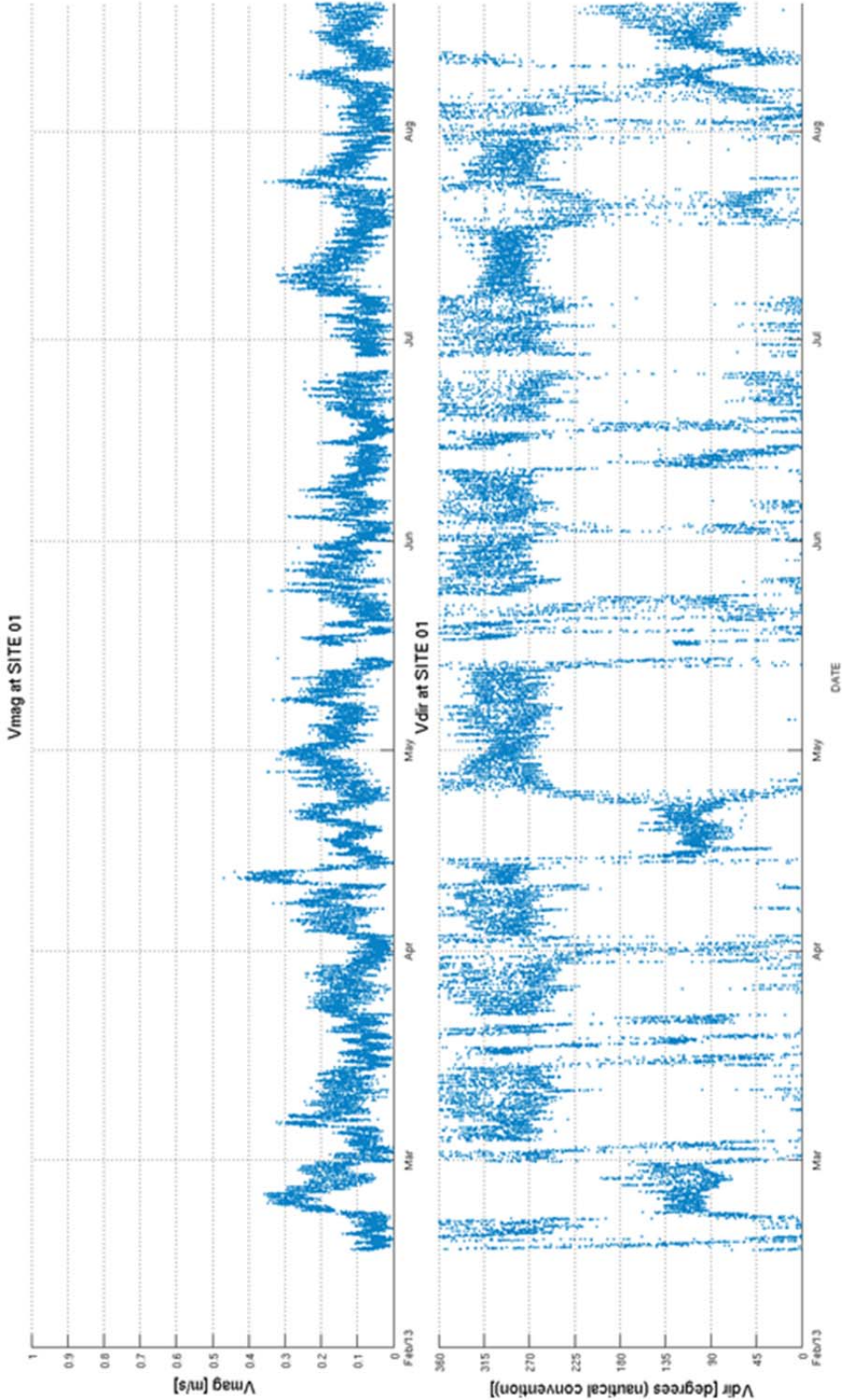


Figure 3-1 S1: Current speed and direction

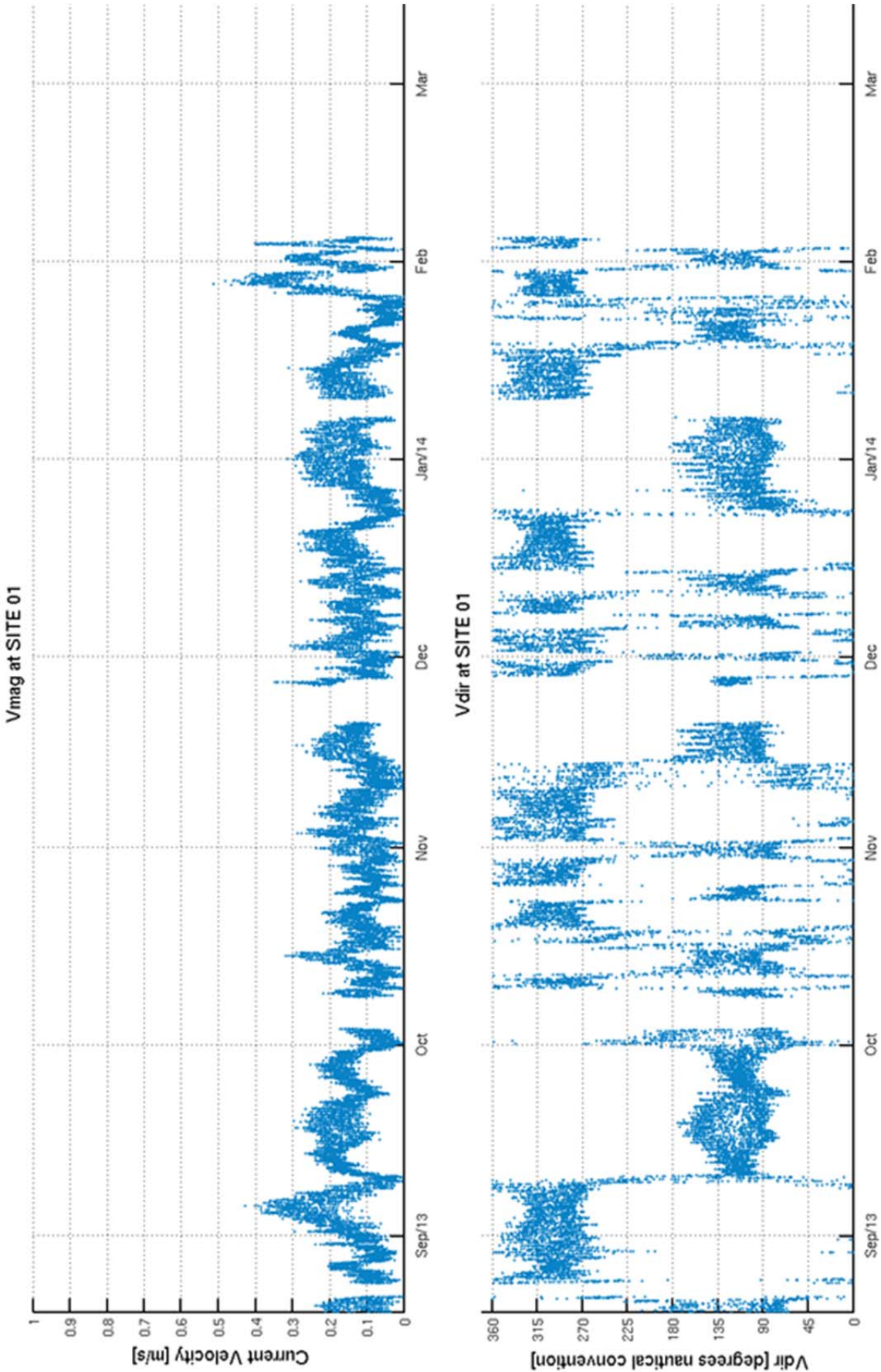


Figure 3-2 S1: Current speed and direction

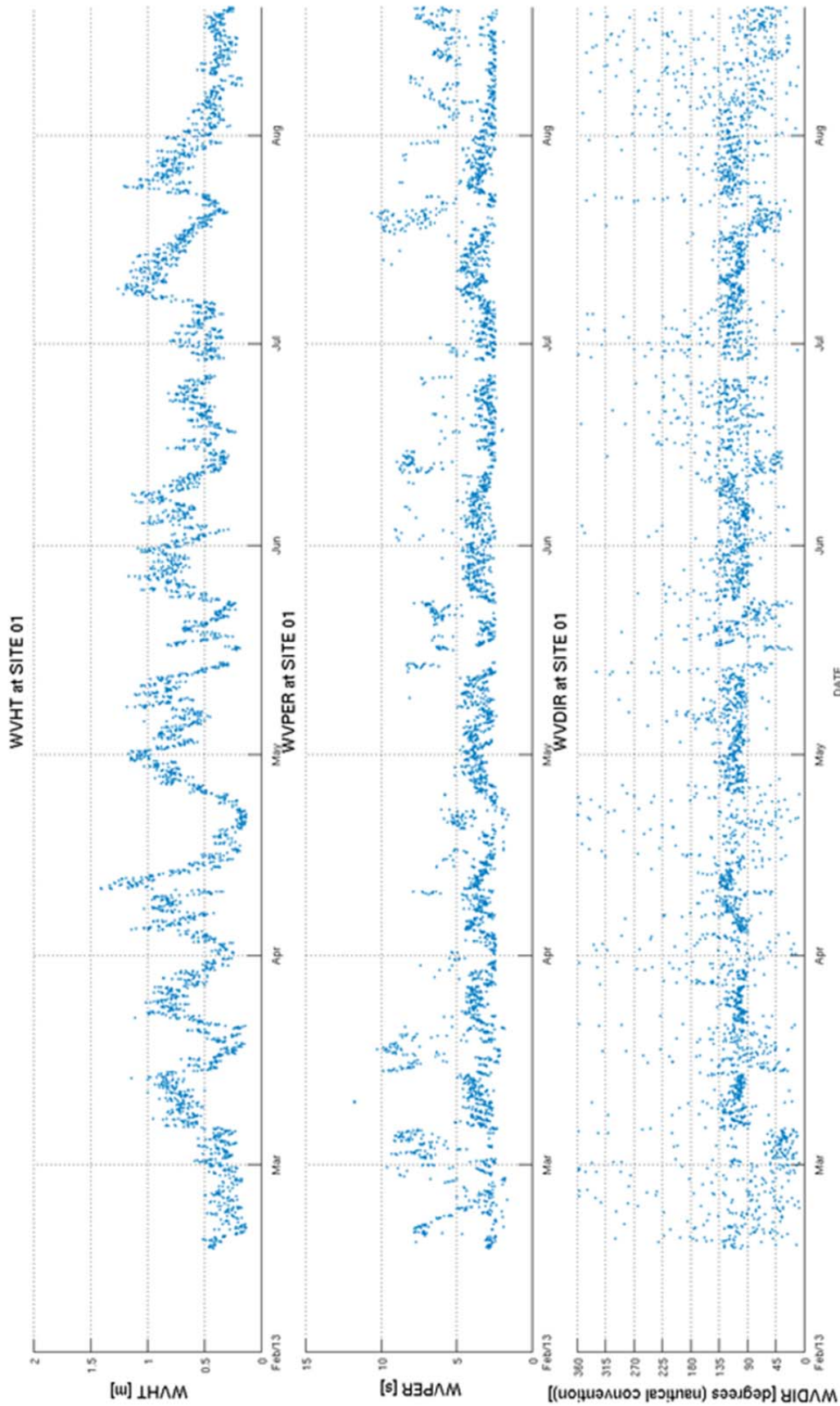


Figure 3-3 S1: Significant wave height, peak period and peak direction

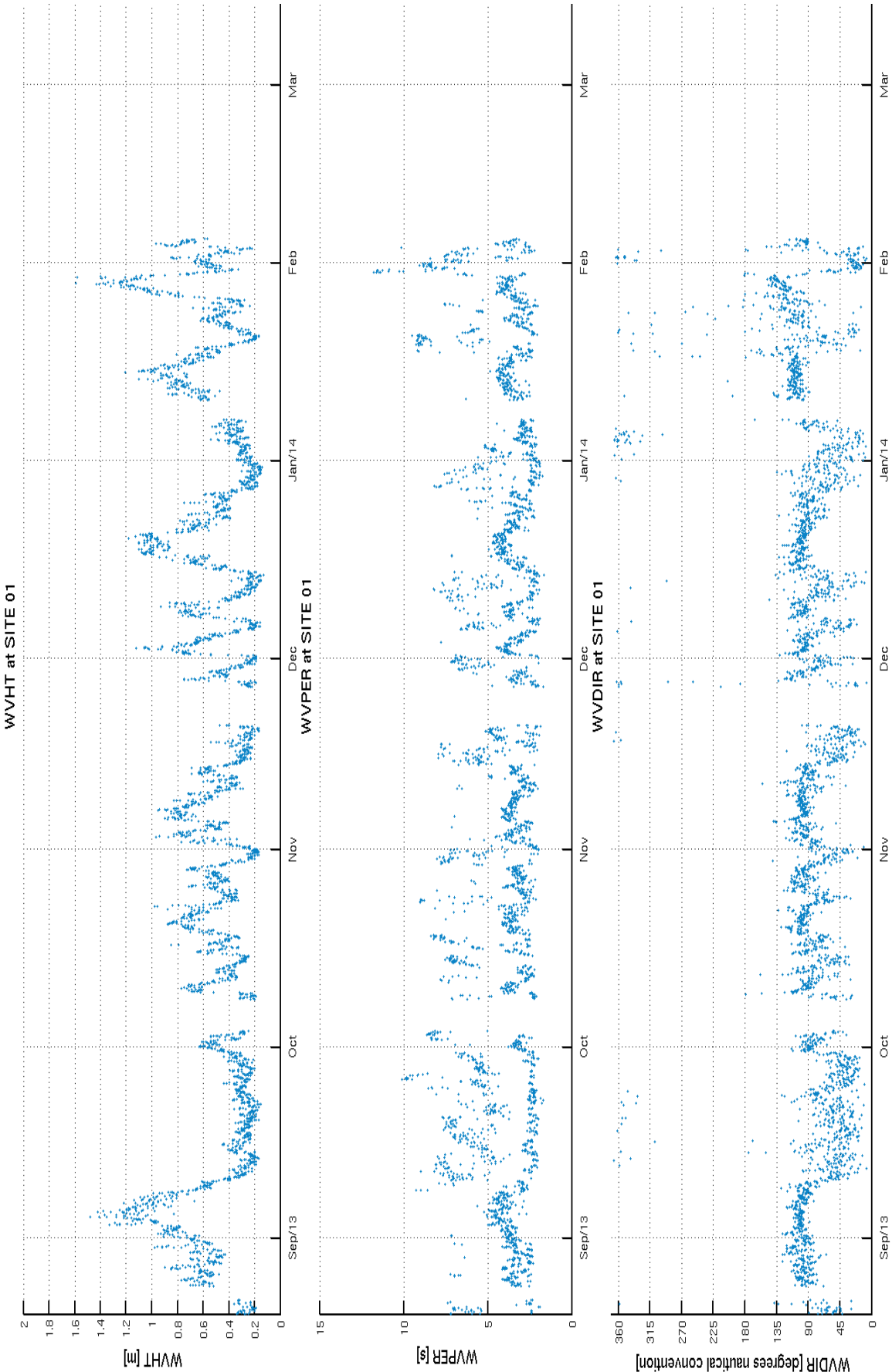


Figure 3-4 S1: Significant wave height, peak period and peak direction

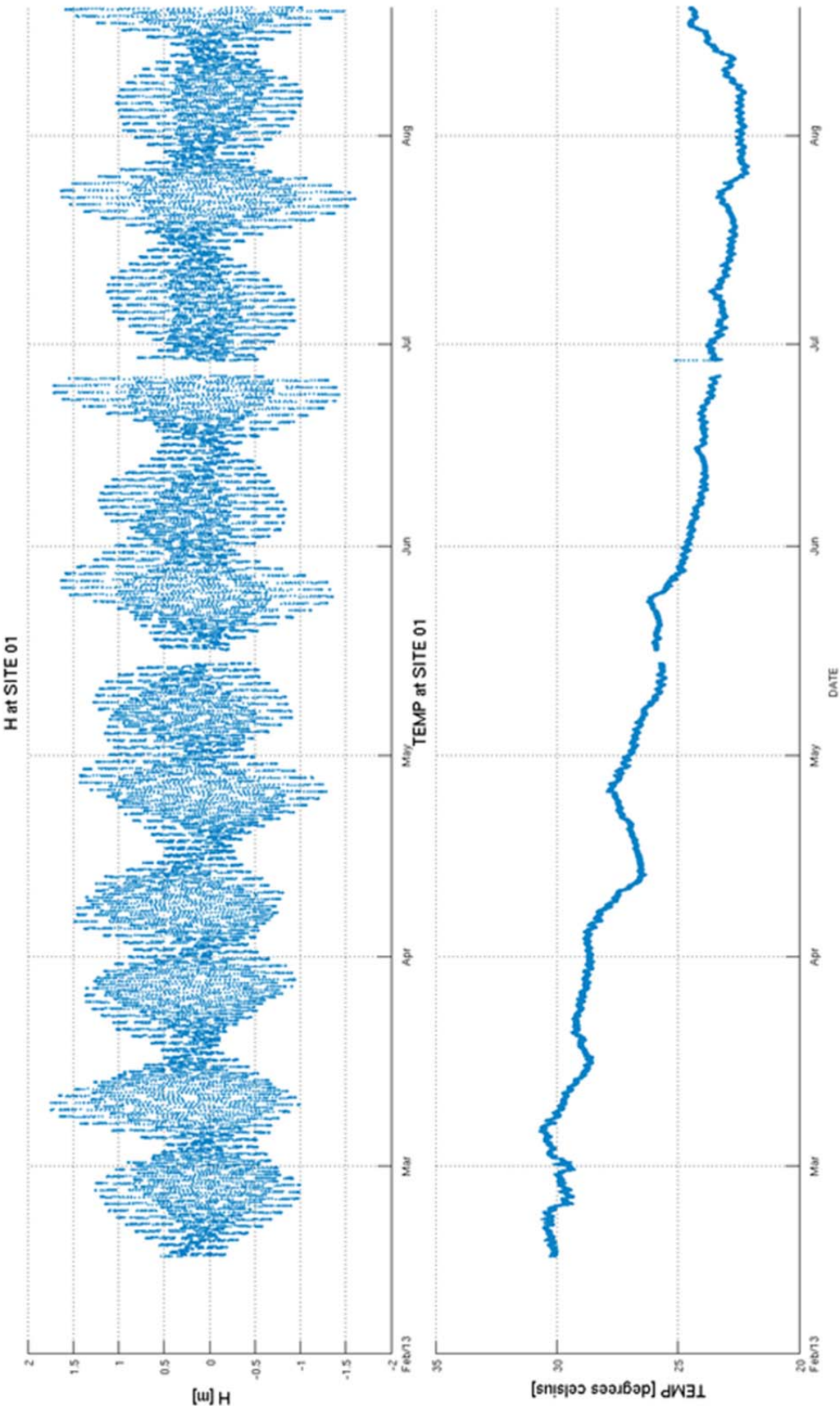


Figure 3-5 S1: Water level and temperature

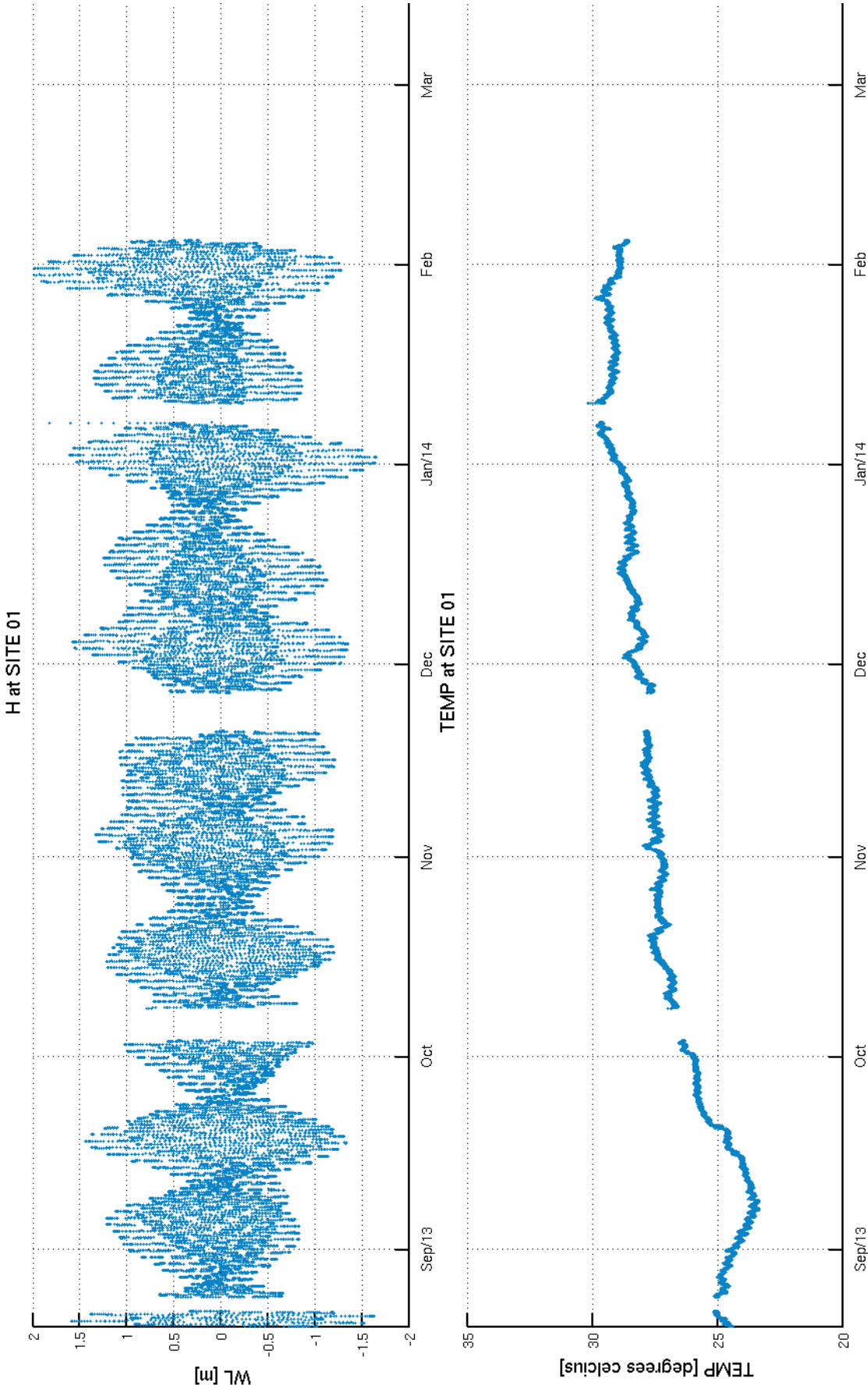


Figure 3-6 S1: Water level and temperature

3.2 Seabird Data

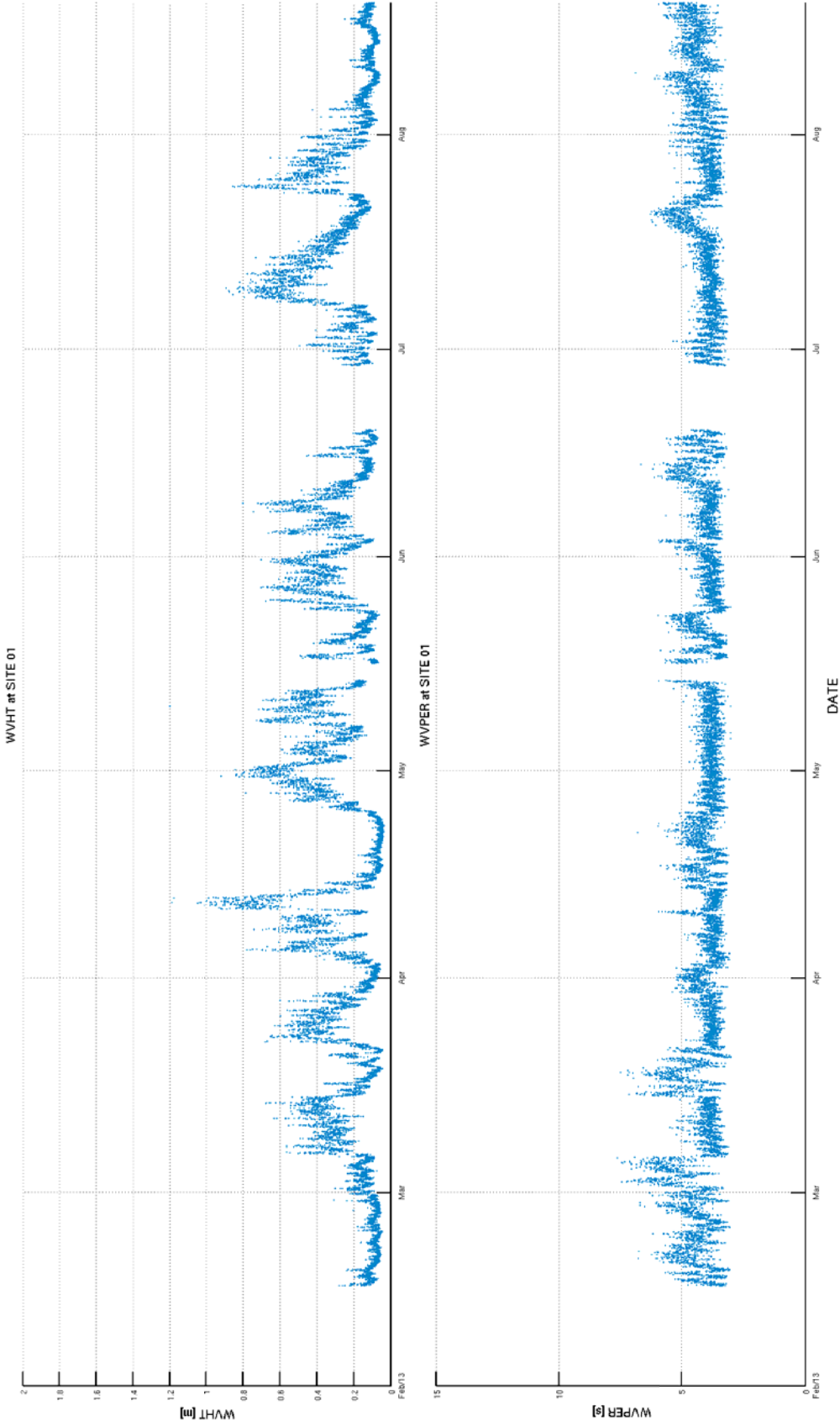


Figure 3-7 S1: Mean 1/3 wave height and Mean 1/3 period

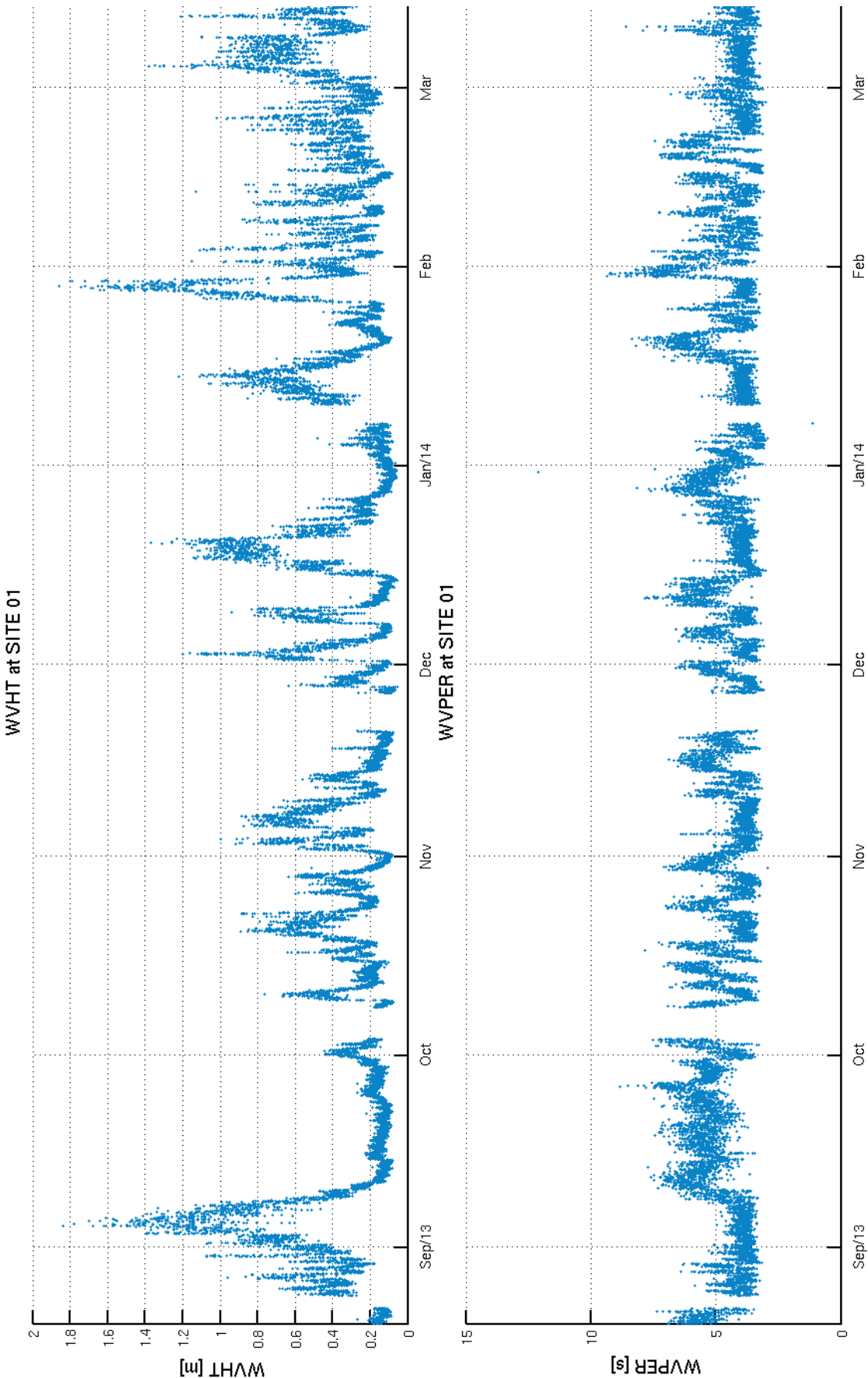


Figure 3-8 S1: Mean 1/3 wave height and mean 1/3 period

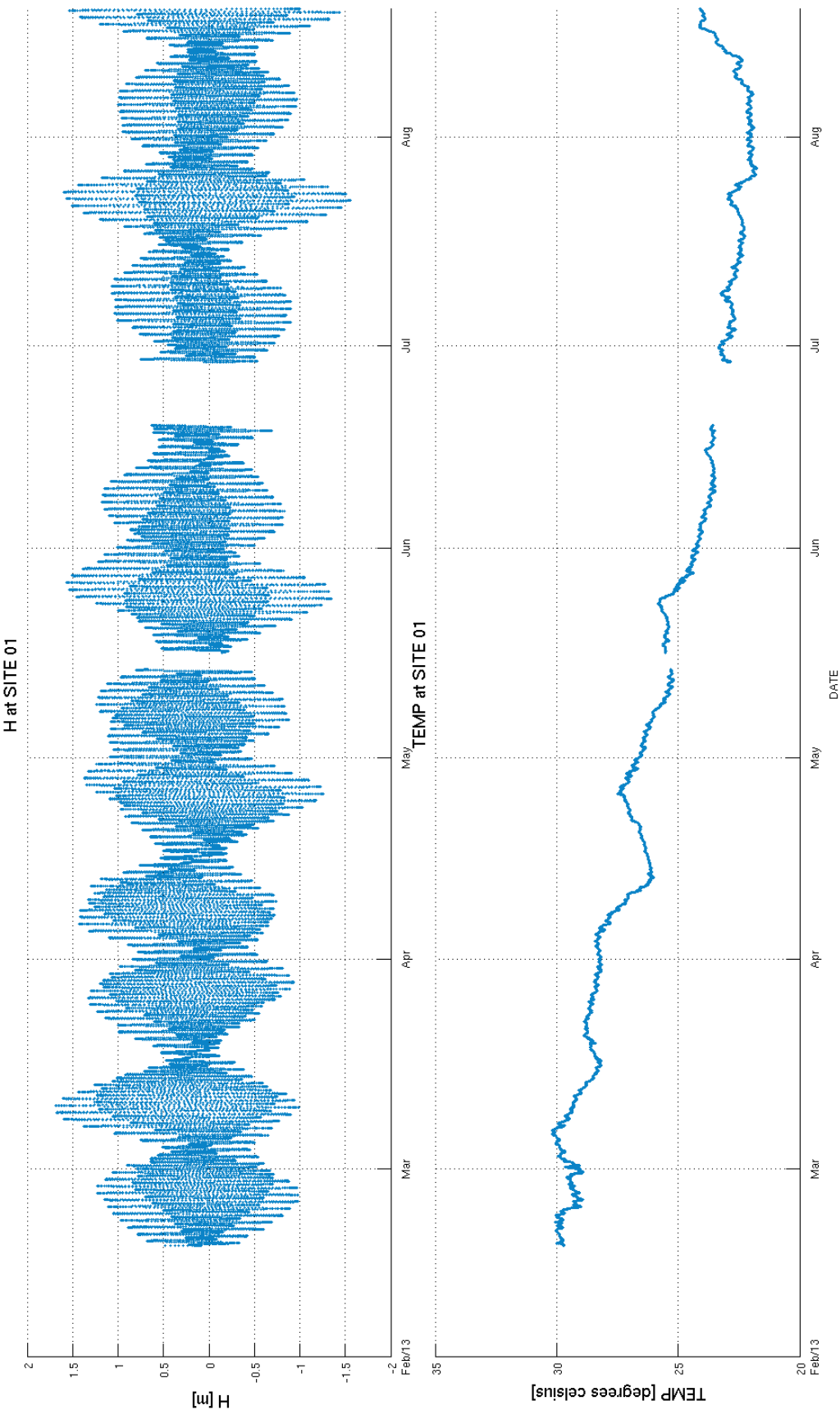


Figure 3-9 S1: Water level and water temperature

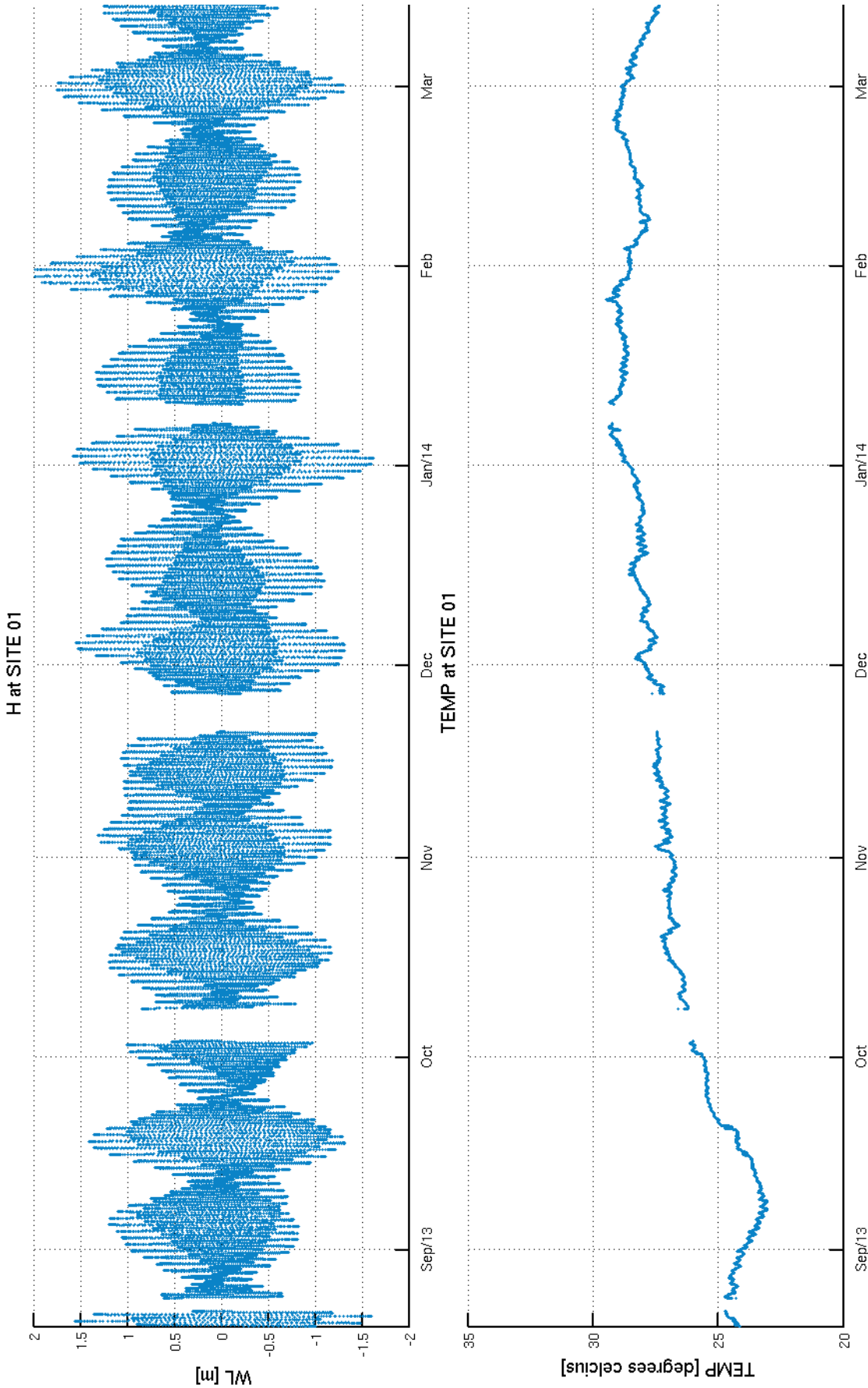


Figure 3-10 S1: Water level and temperature

3.3 YSI Data

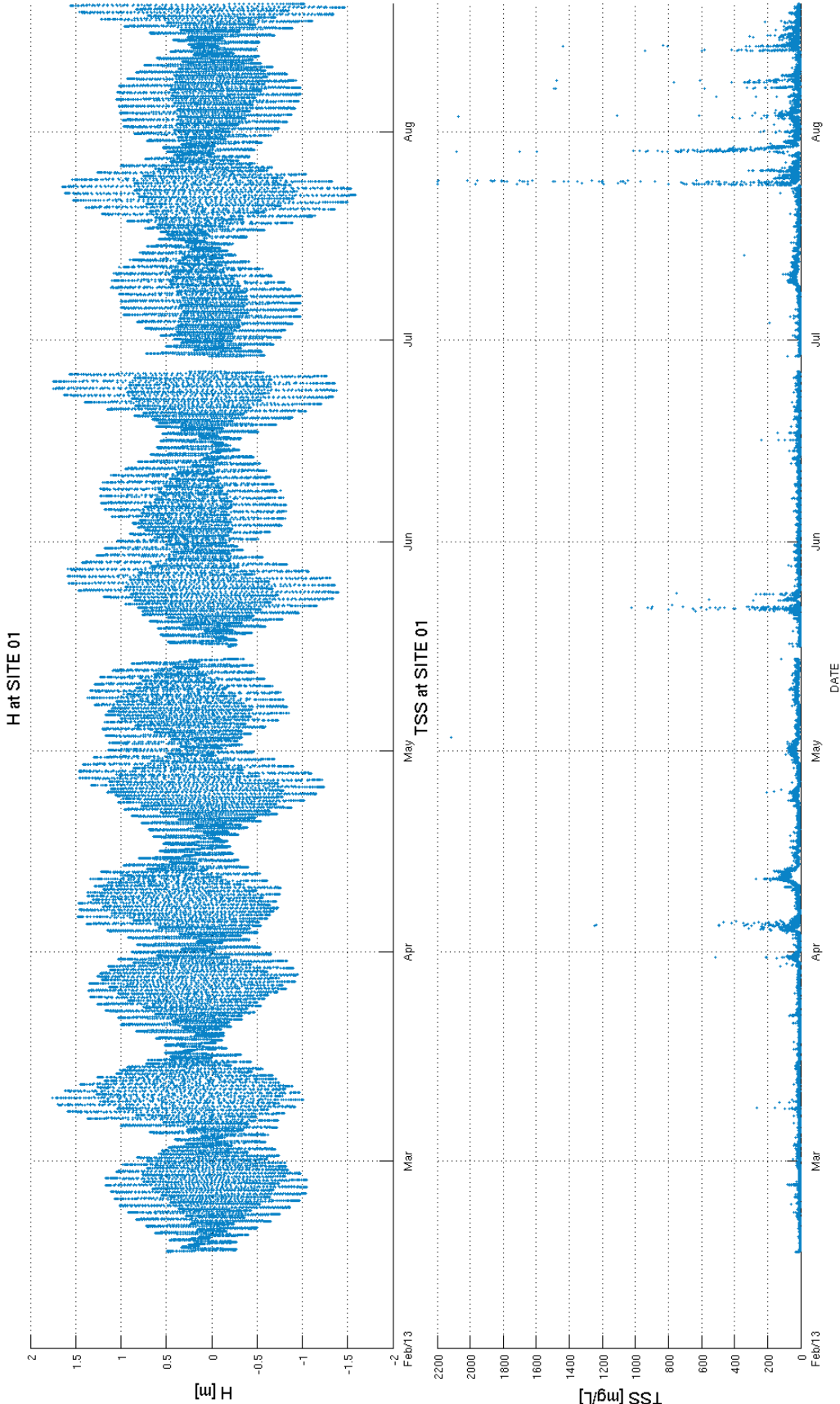


Figure 3-11 S1: Water level and TSS

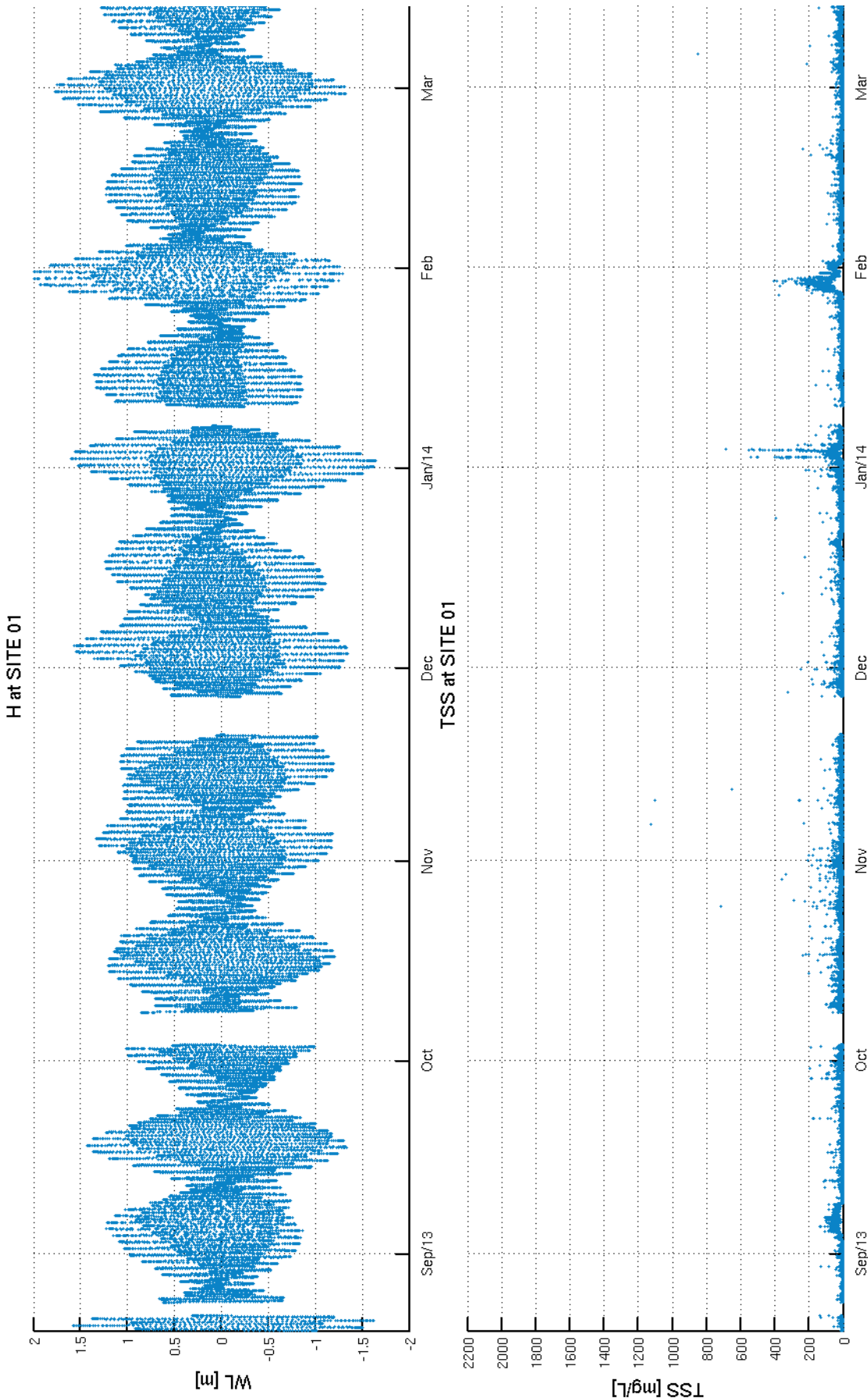


Figure 3-12 S1: Water level and TSS

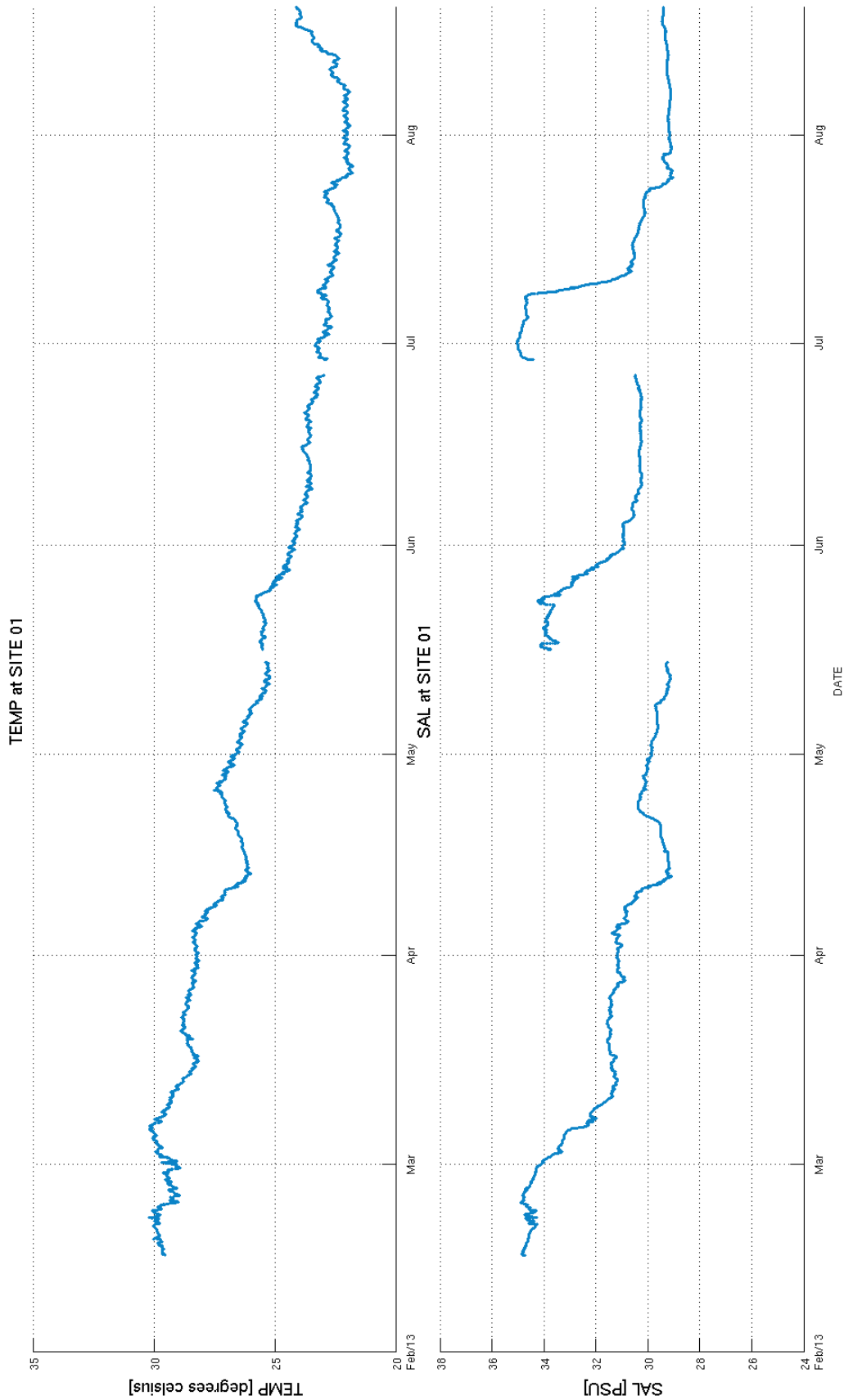


Figure 3-13 S1: Water temperature and salinity

Site 1 - Dredged Material Placement Area

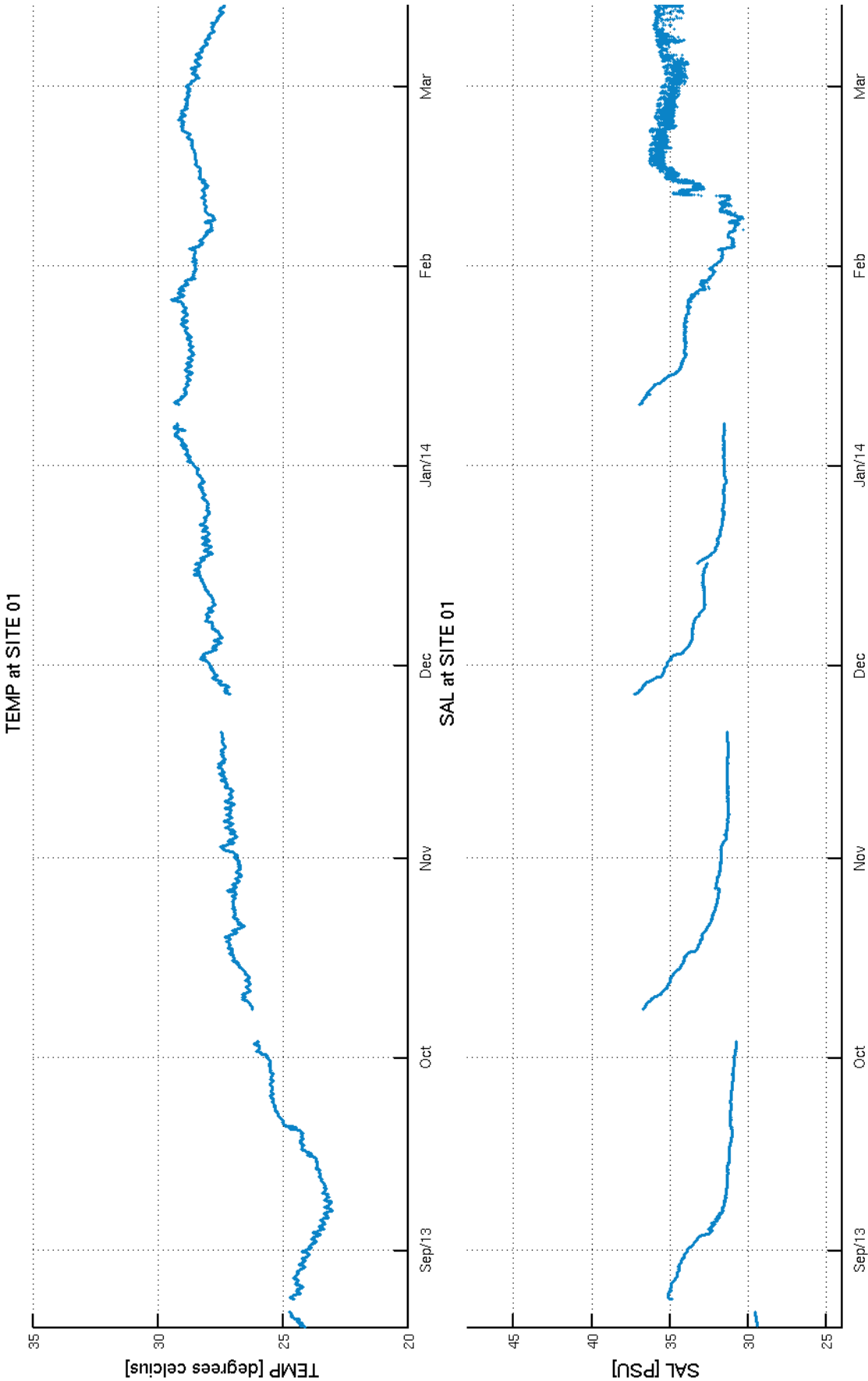


Figure 3-14 S1: Water temperature and salinity

Site 2 – Alternative Dredged Material Placement Area

4 Site 2 – Alternative Dredged Material Placement Area

Data was collected for six months (February 2013 through until August 2013) spanning the wet and dry seasons):

- AWAC – water level, currents, temperature and directional waves; and
- YSI 6600 – CTD and turbidity (converted to TSS). Note salinity has been derived from conductivity and the data towards the end of each deployment period is unreliable (refer Chapter 11).

4.1 AWAC Data

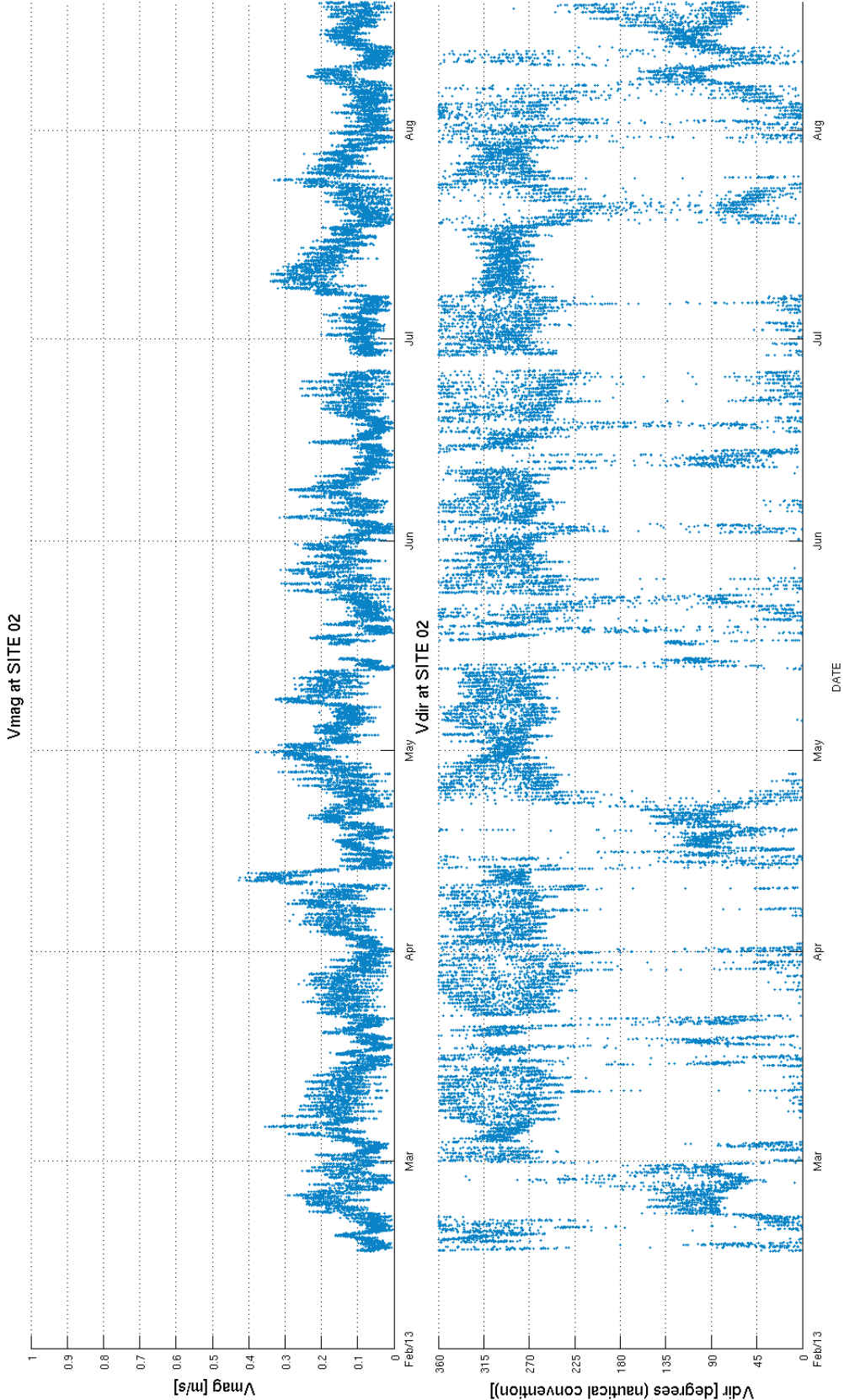


Figure 4-1 S2: Current speed and direction

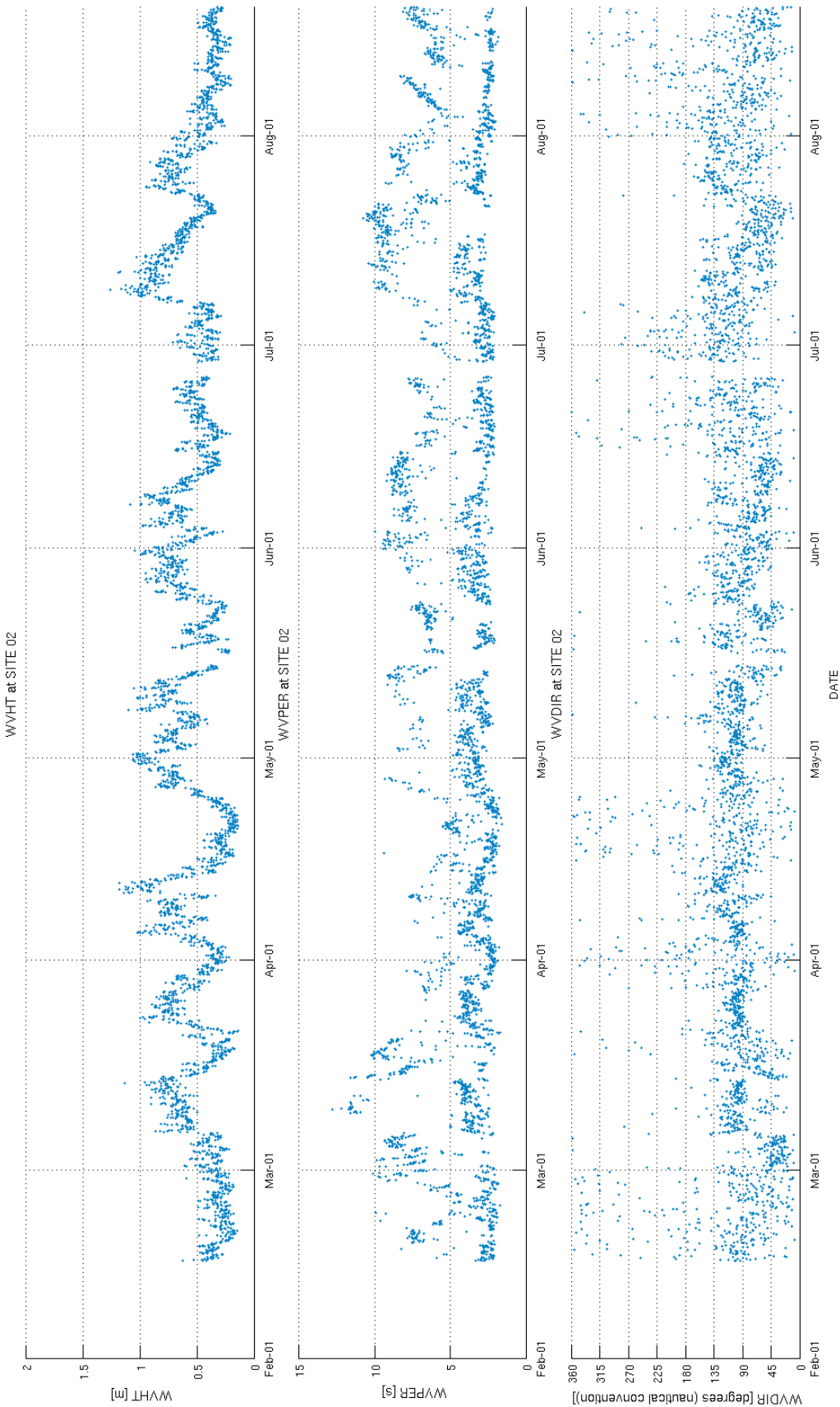


Figure 4-2 S2: Significant wave height, peak period and peak direction

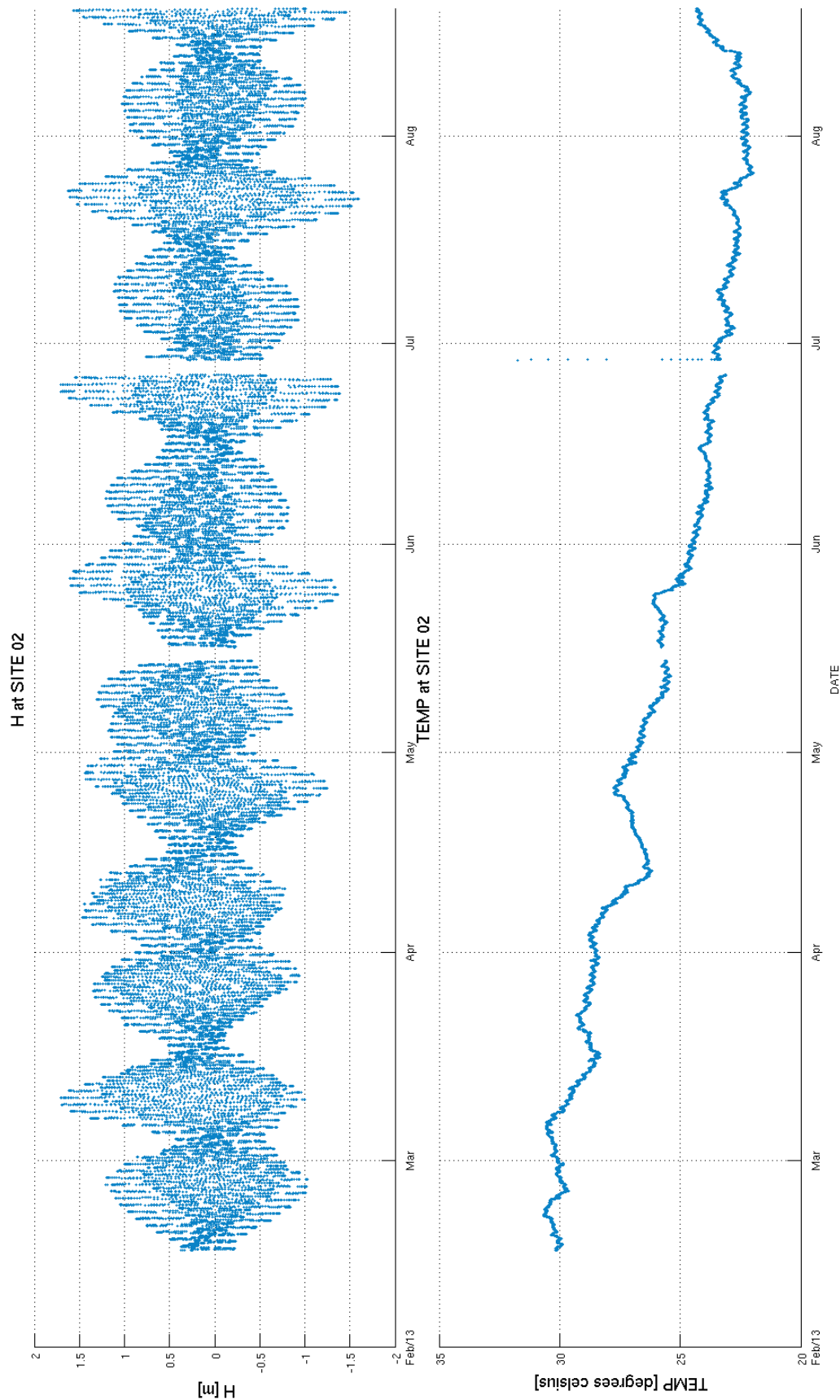


Figure 4-3 S2: Water level and water temperature

4.2 YSI Data

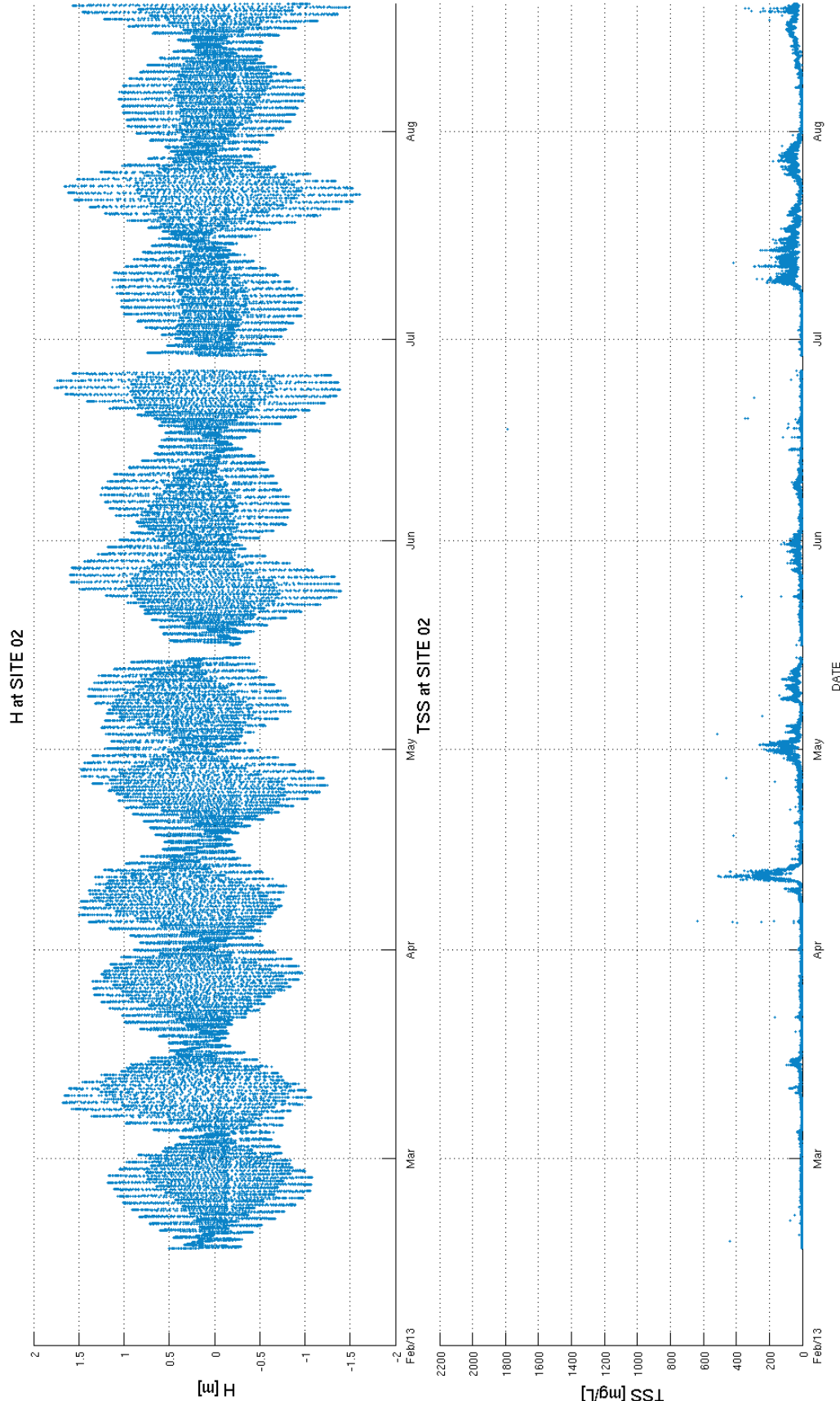


Figure 4-4 S2: Water level and TSS

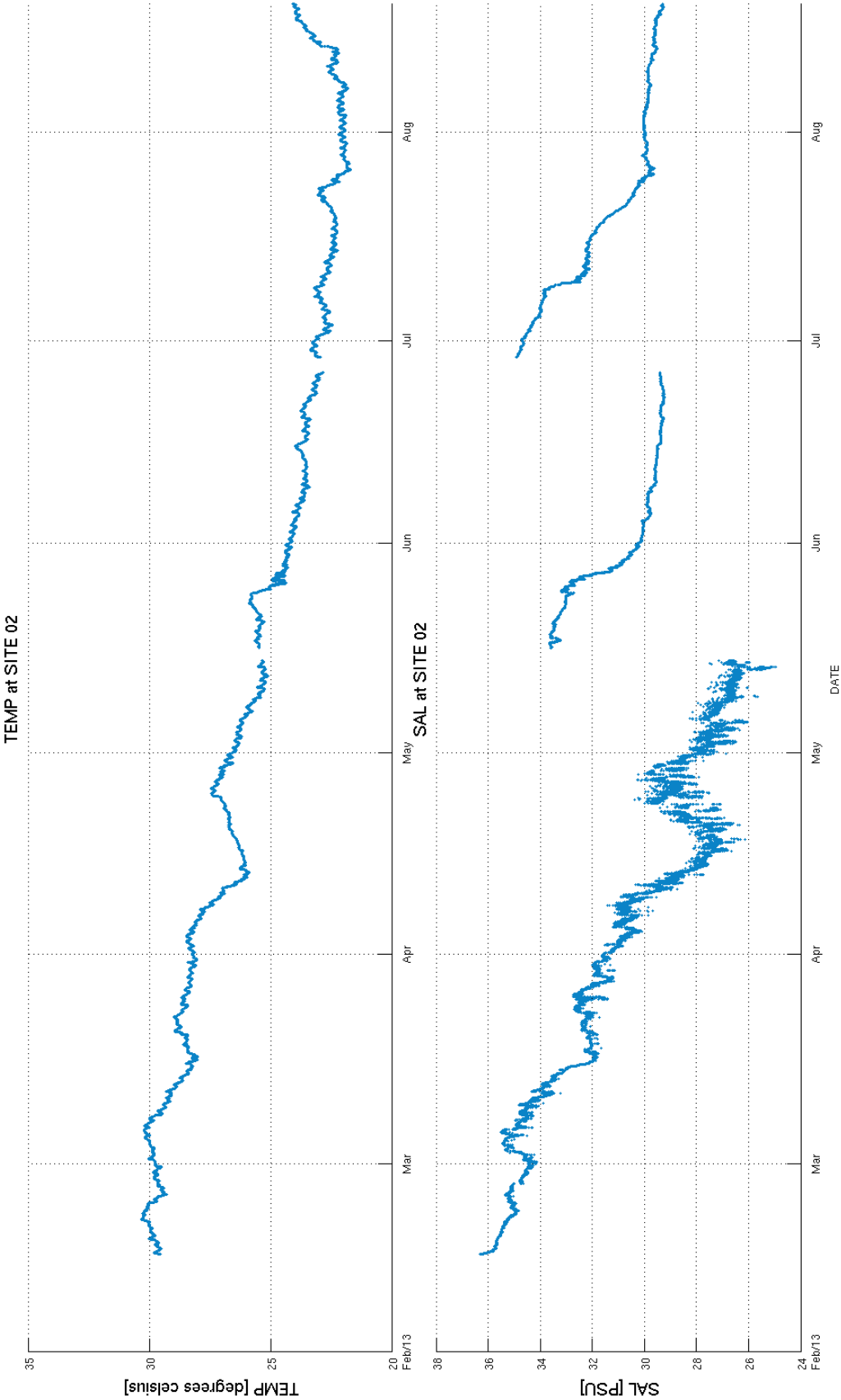


Figure 4-5 S2: Water temperature and salinity

5 Site 3 – Beacon C2

The following data was collected for six months (February 2013 through until August 2013) spanning the wet and dry seasons):

- Seabird SBE 26 – water level, temperature and non-directional waves; and
- Weather station records exceed 12 months.

5.1 Seabird Data

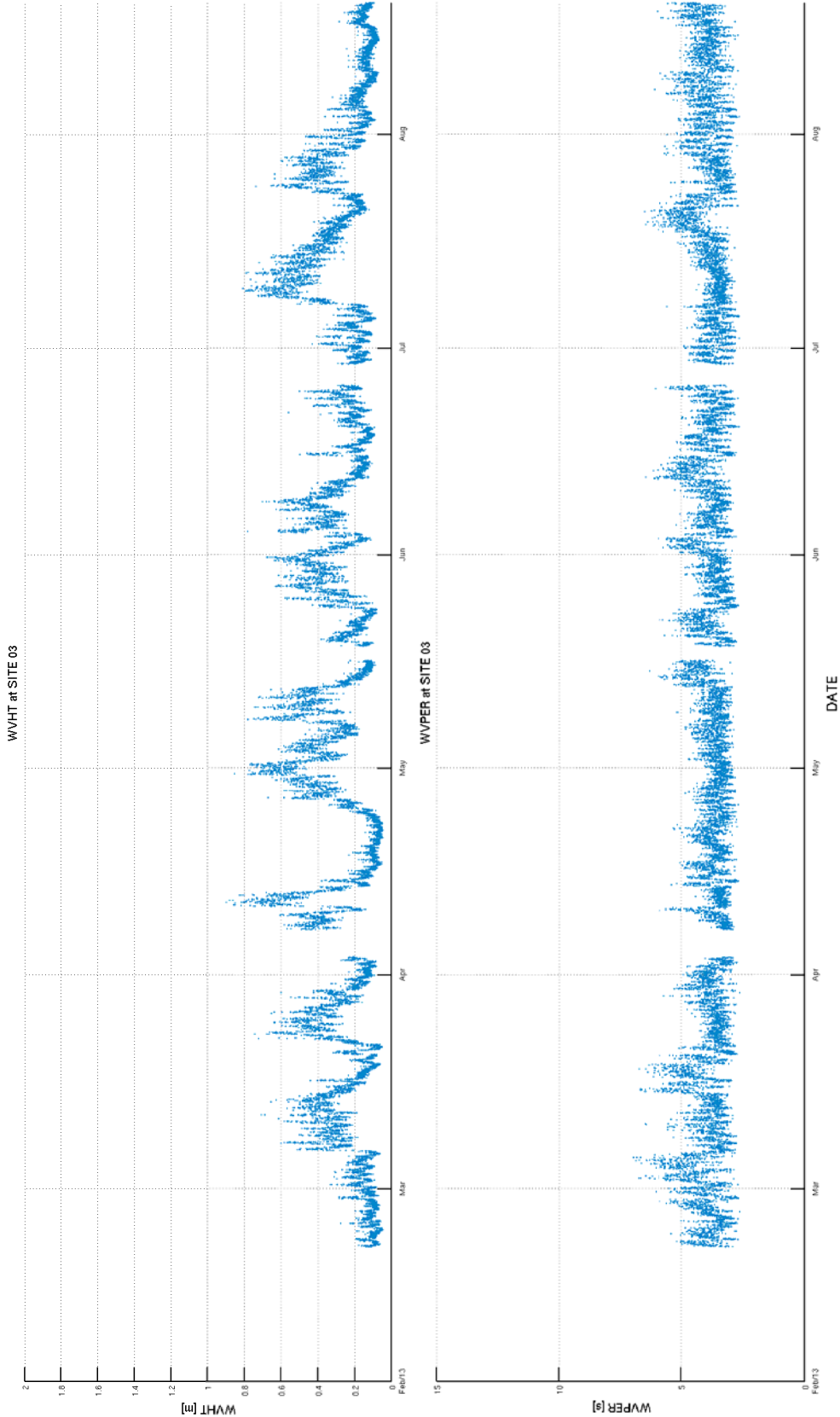


Figure 5-1 S3: Mean 1/3 Wave Height and Mean 1/3 period

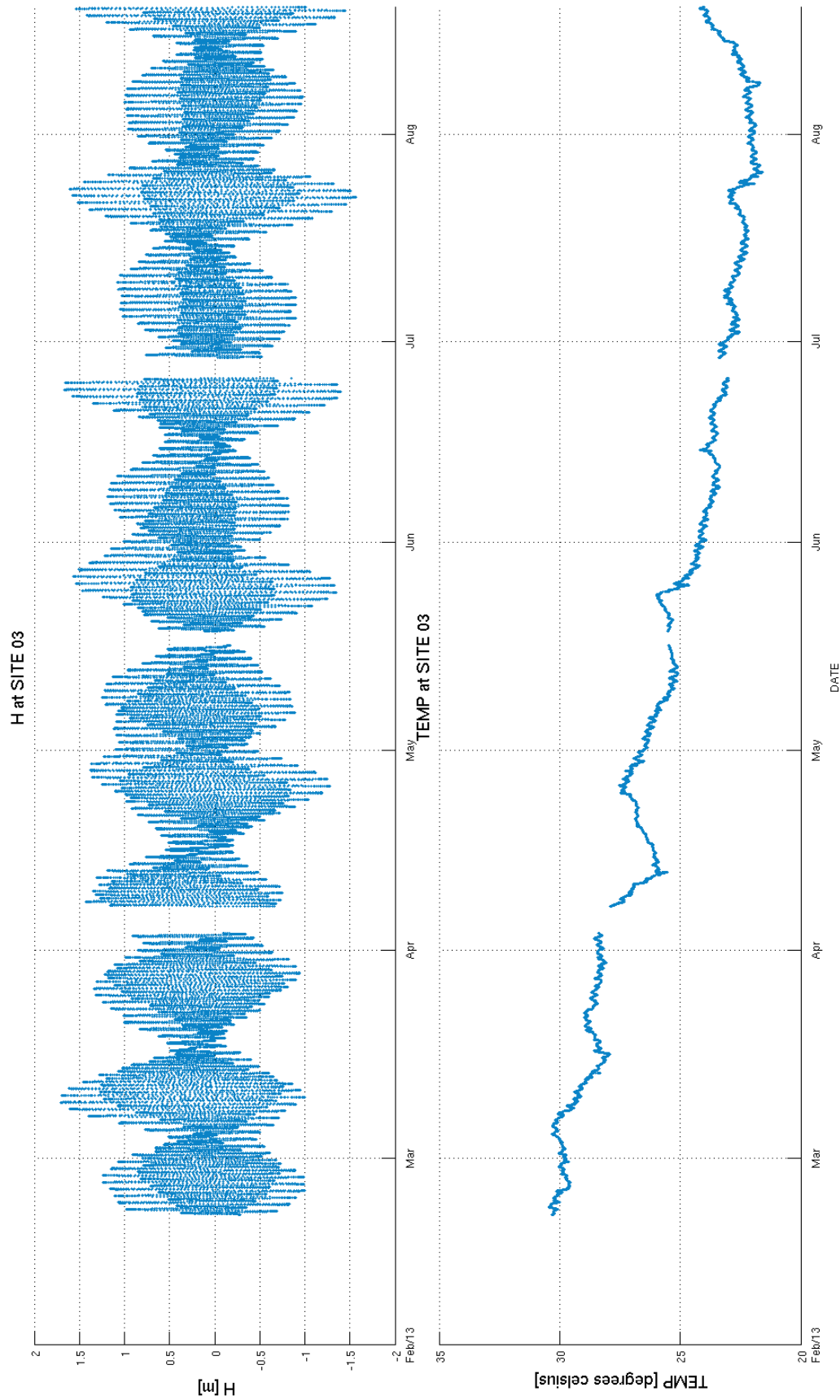


Figure 5-2 S3: Water level and water temperature

5.2 Weather Station Data

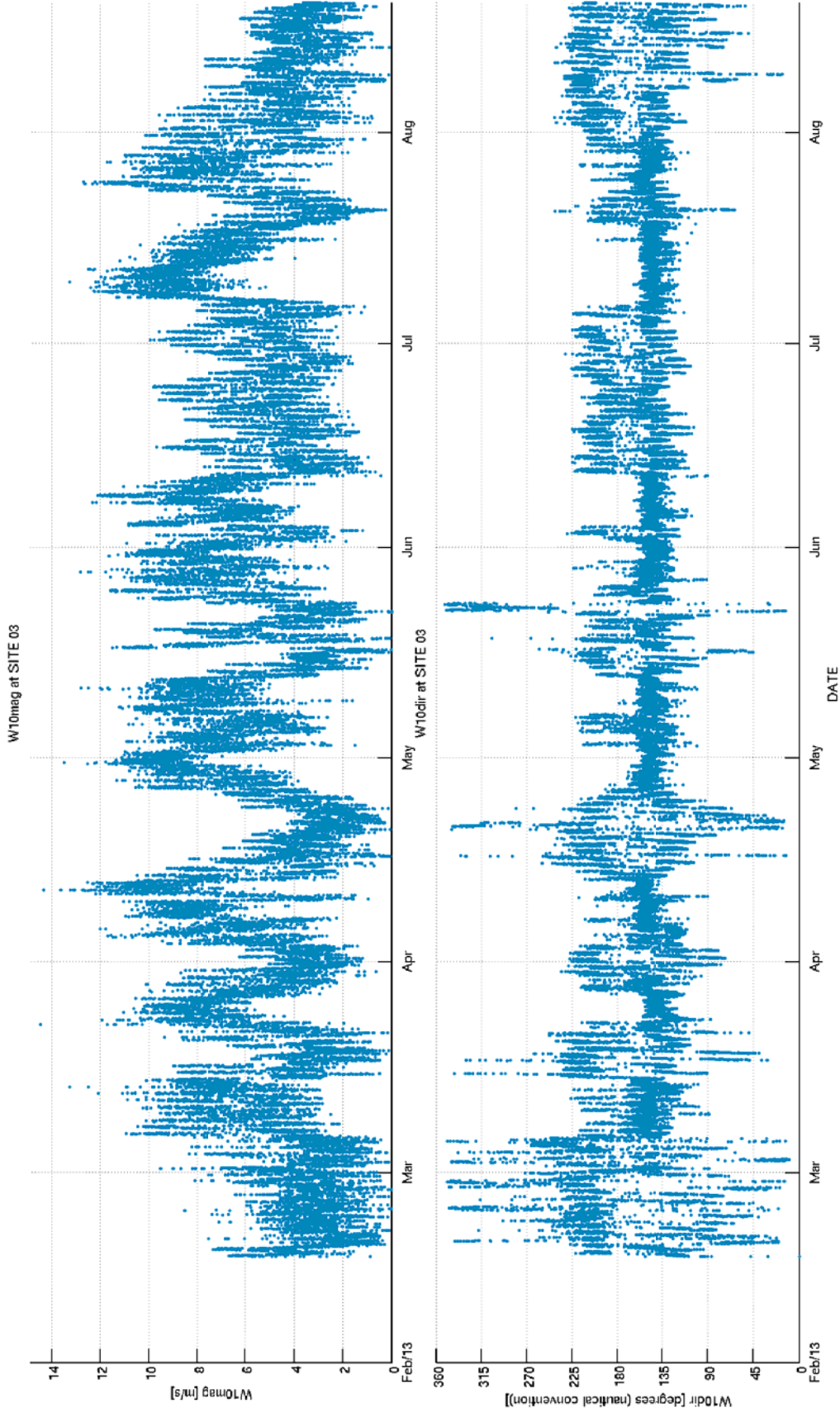


Figure 5-3 S3: Wind speed and direction

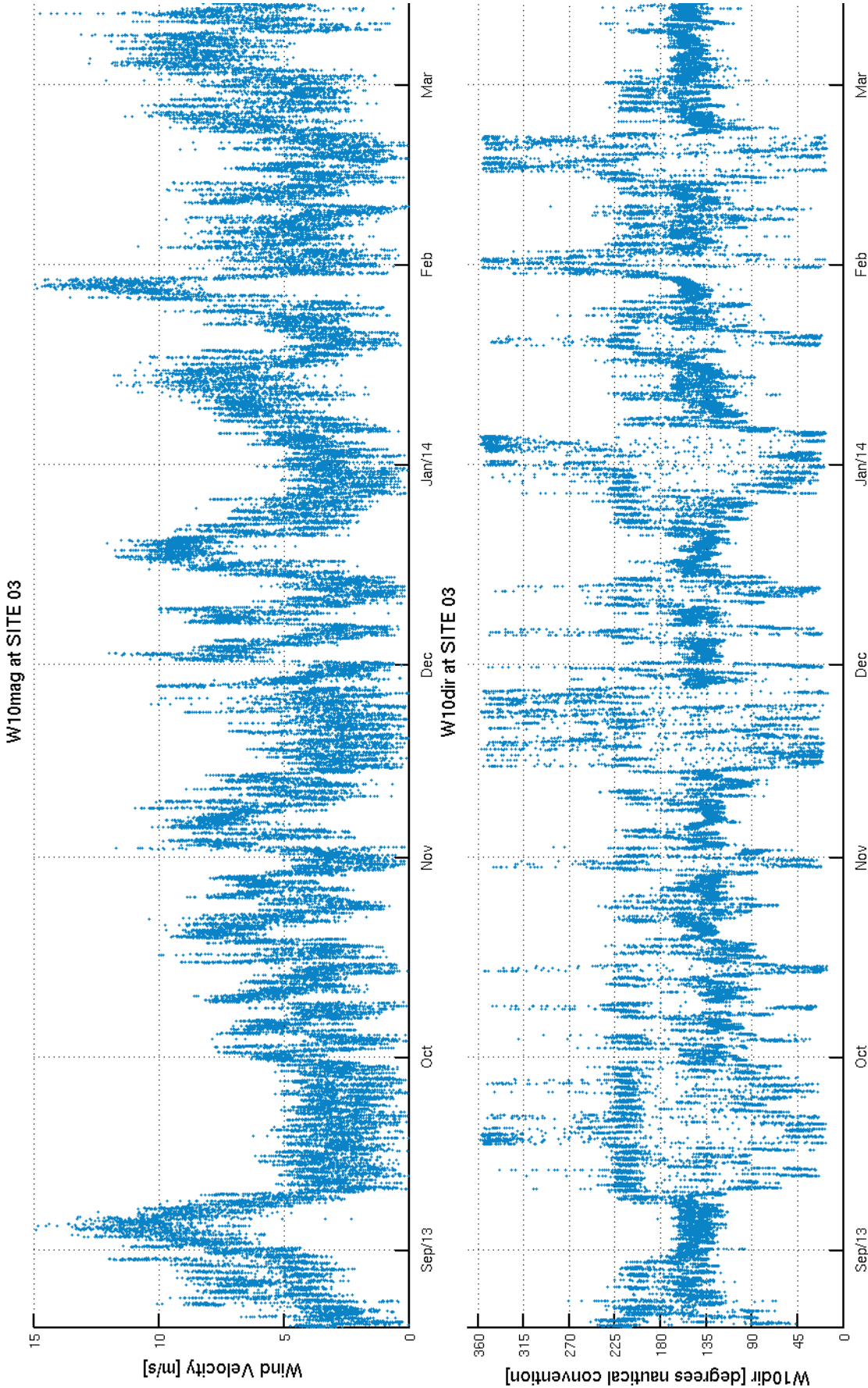


Figure 5-4 S3: Wind speed and direction

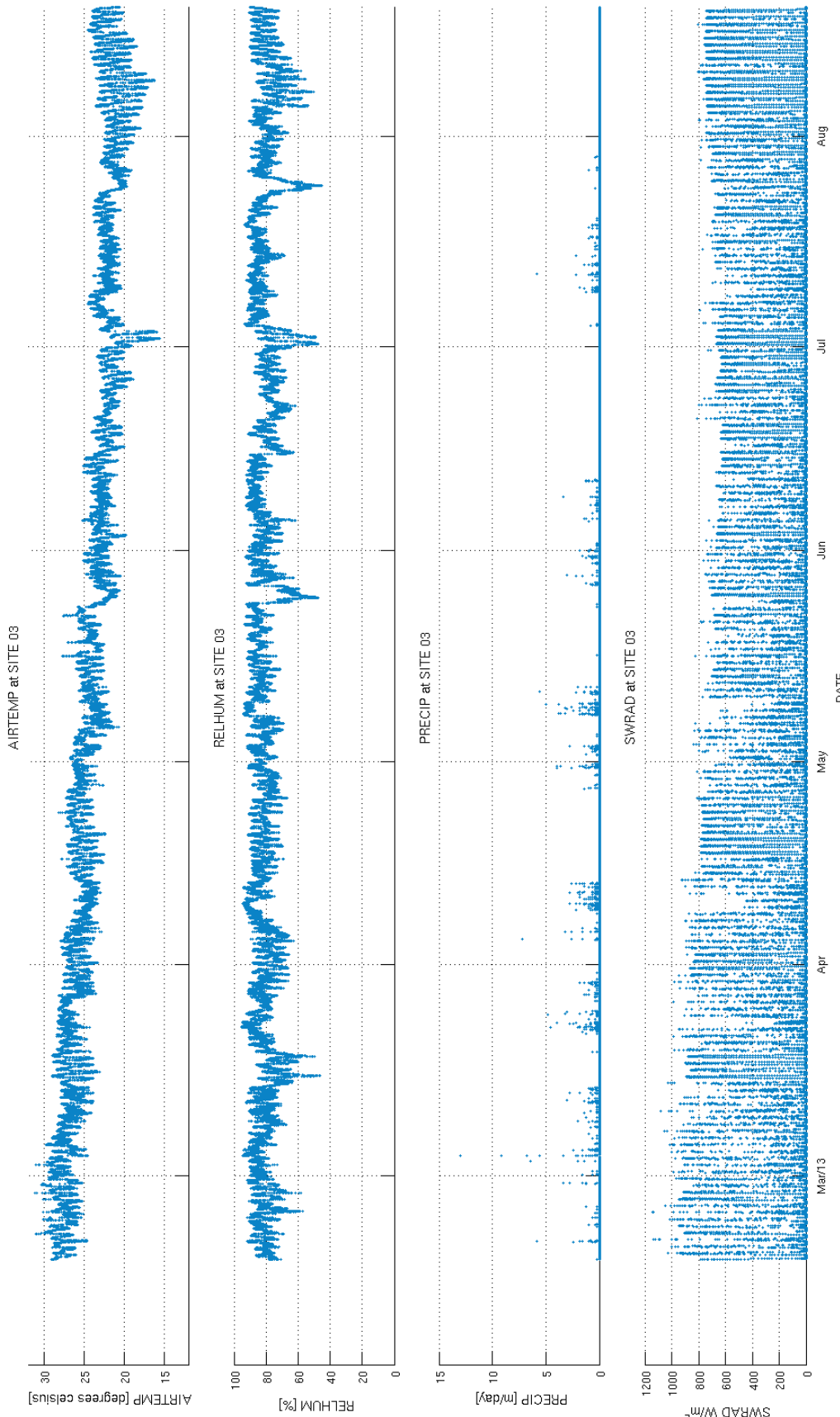


Figure 5-5 S3: Air temperature, relative humidity, precipitation and solar radiation

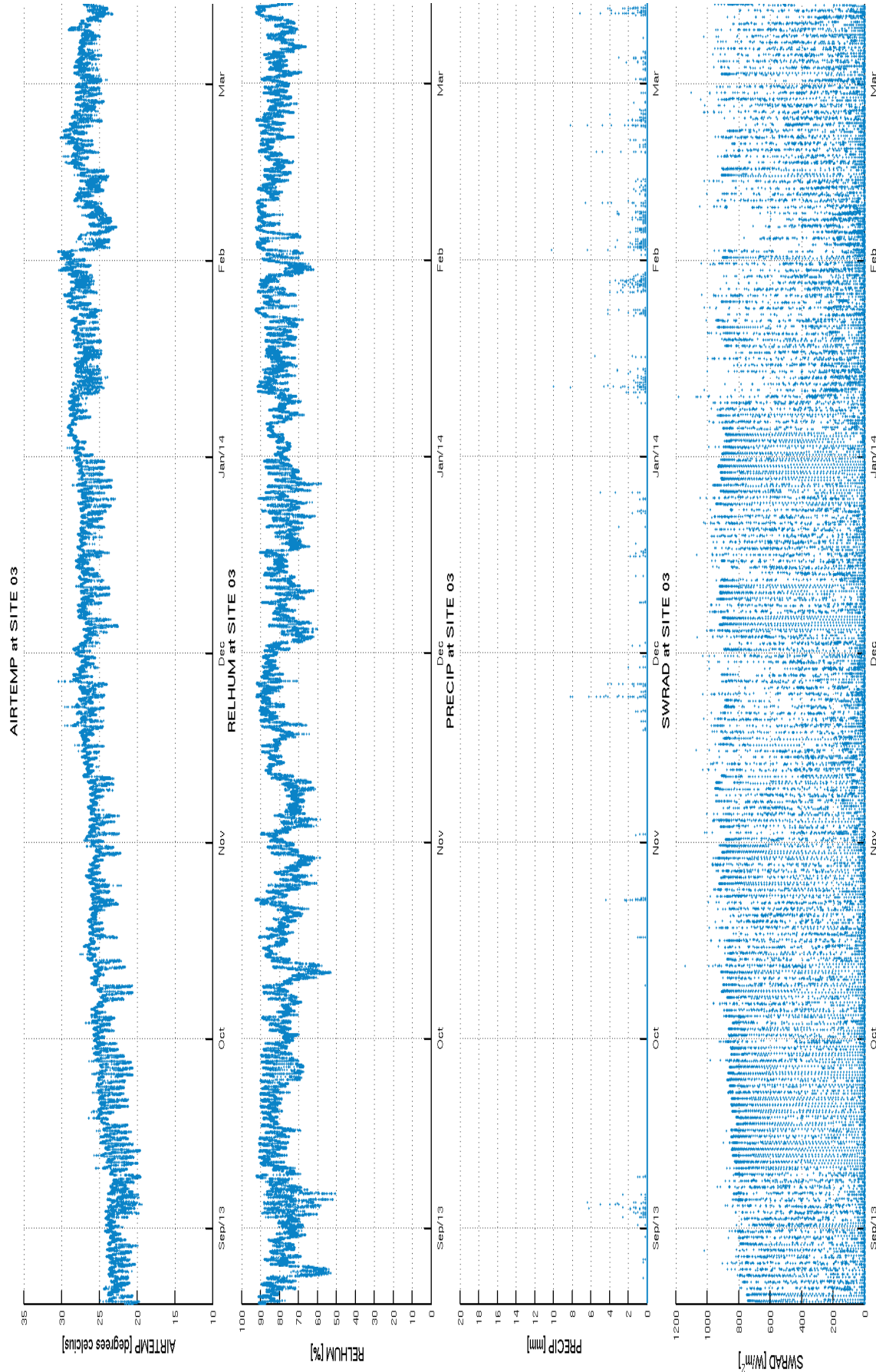


Figure 5-6 S3: Air temperature, relative humidity, precipitation and solar radiation

6 Site 4 – Beacon C7

The following data was collected for twelve months (February 2013 to February 2014):

- AWAC – water level, temperature, currents and directional waves;
- Teledyne Citadel – CTD; and
- YSI 6600 – Conductivity, temperature, depth (CTD) and turbidity (converted to TSS). Note salinity has been derived from conductivity and the data towards the end of each deployment period is unreliable (refer Chapter 11).

6.1 AWAC Data

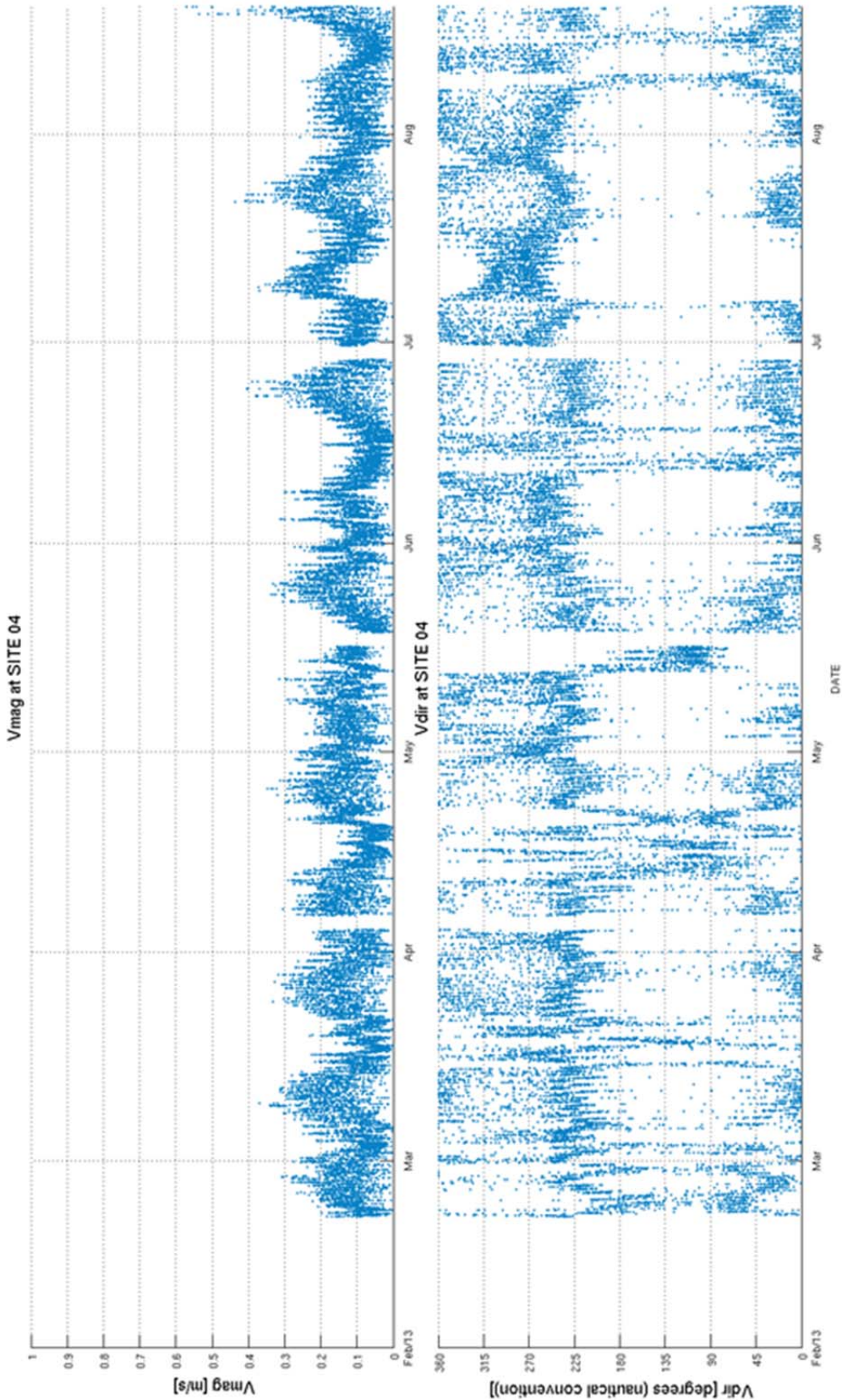


Figure 6-1 S4: Current speed and direction

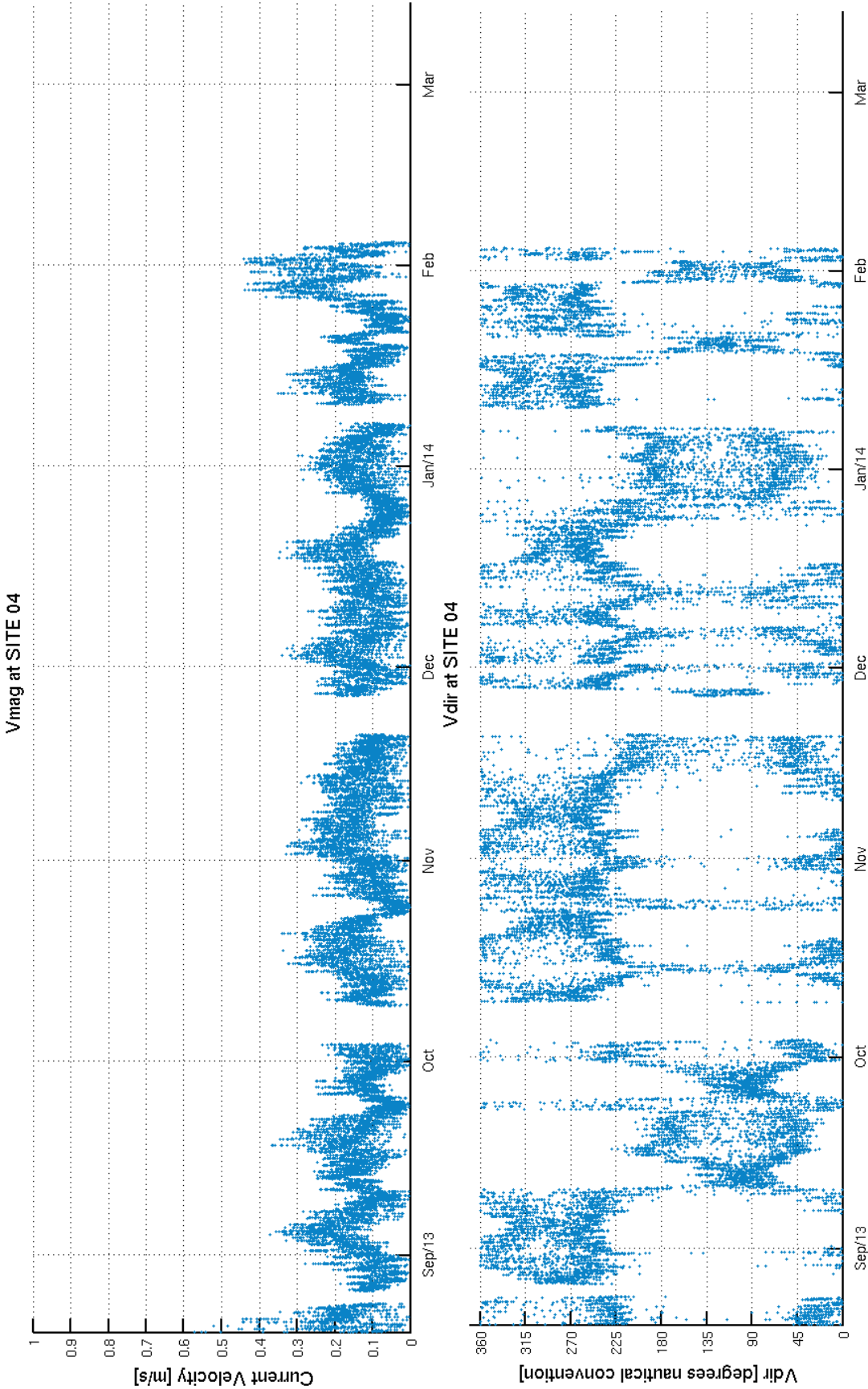


Figure 6-2 S4: Current speed and direction

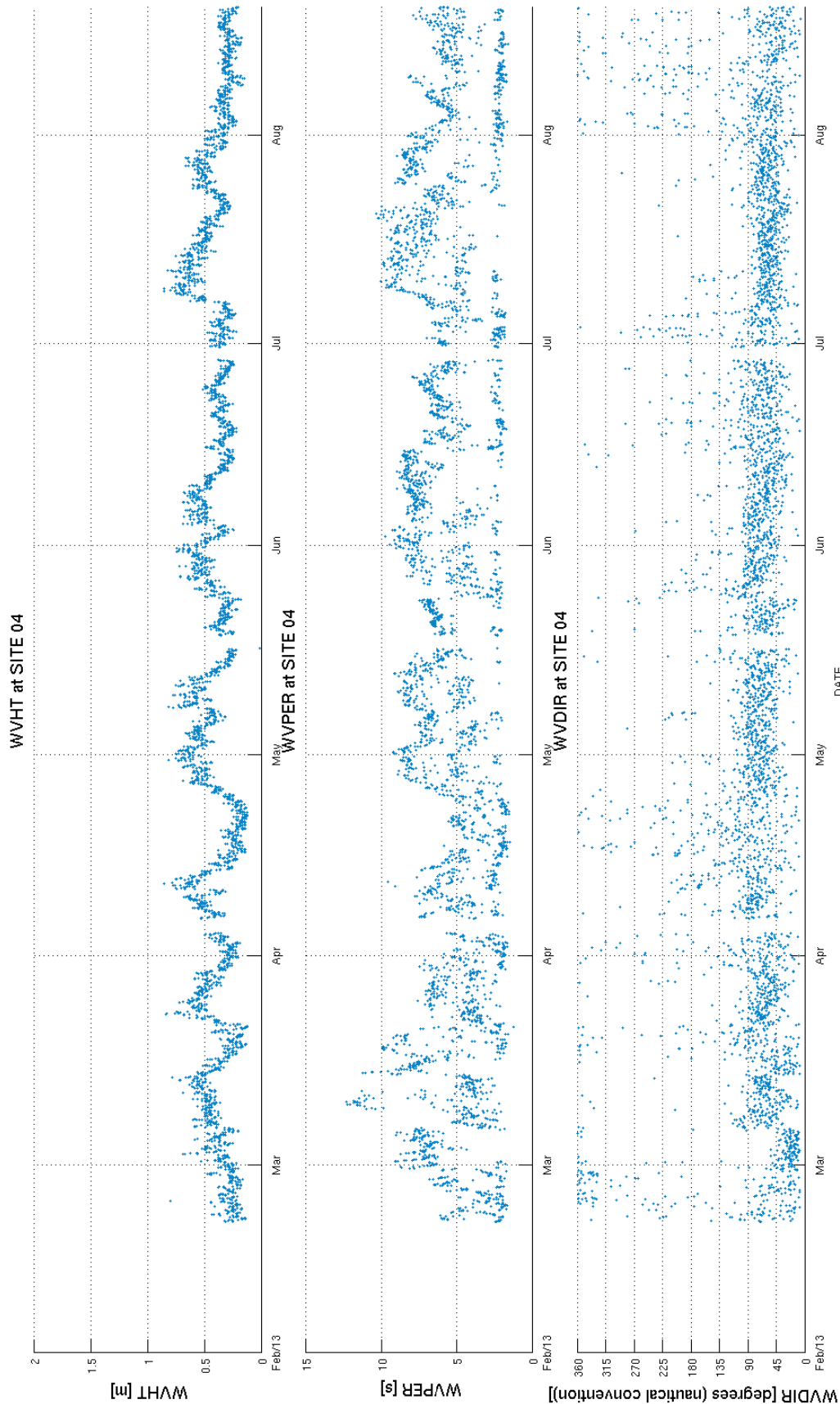


Figure 6-3 S4: Significant wave height, peak period and peak direction

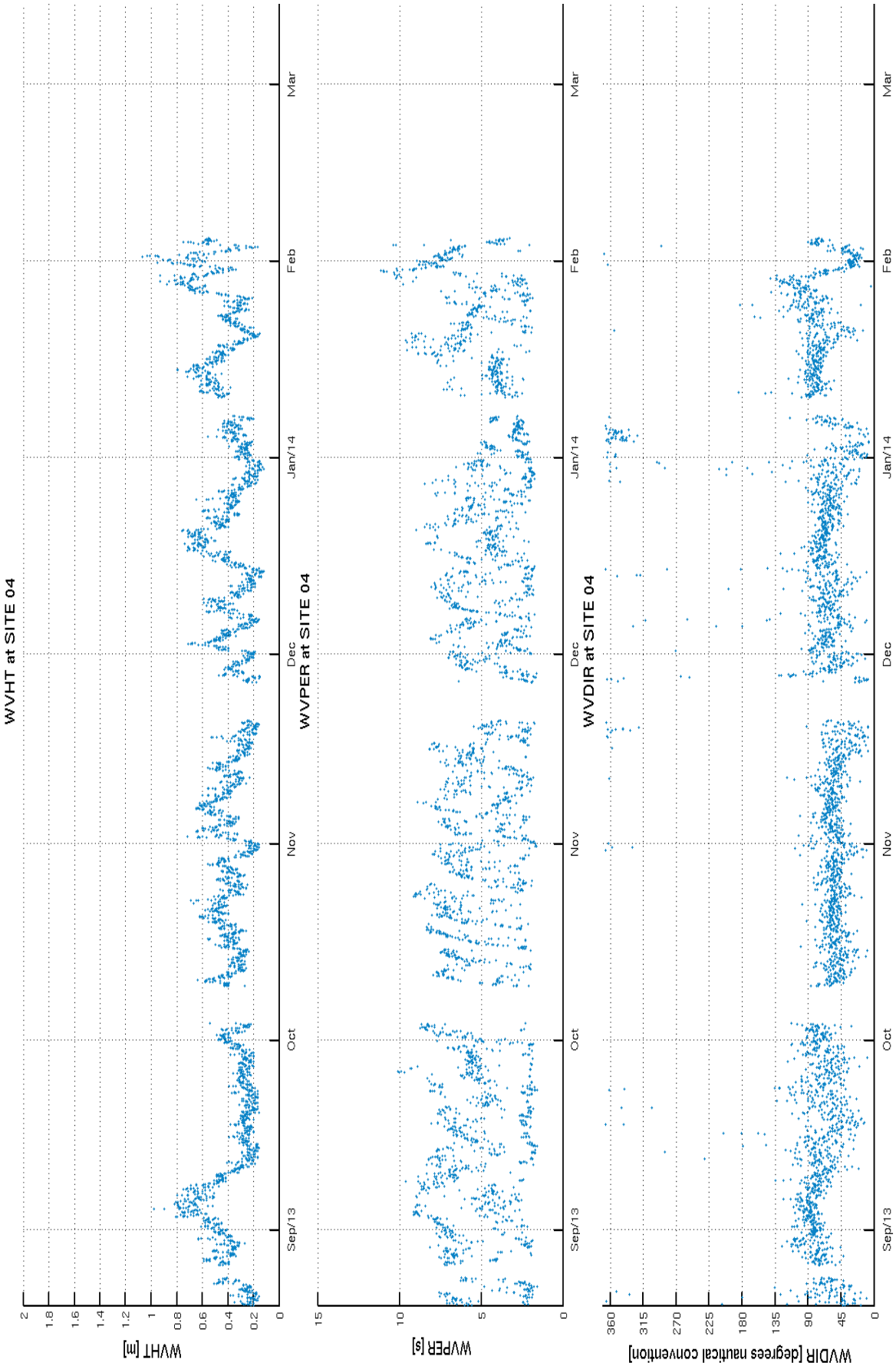


Figure 6-4 S4: Significant wave height, peak period and peak direction



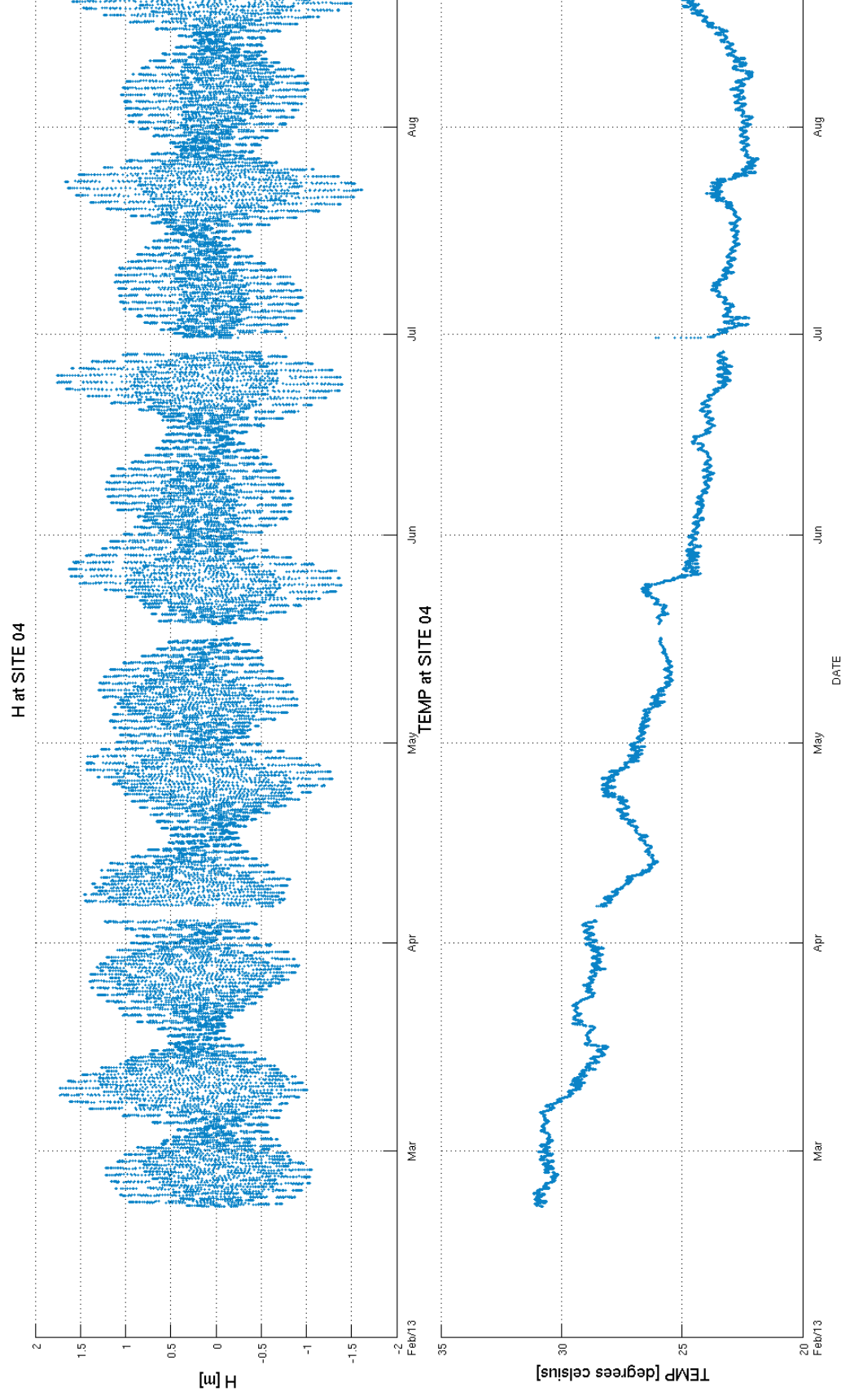


Figure 6-5 S4: Water level and water temperature

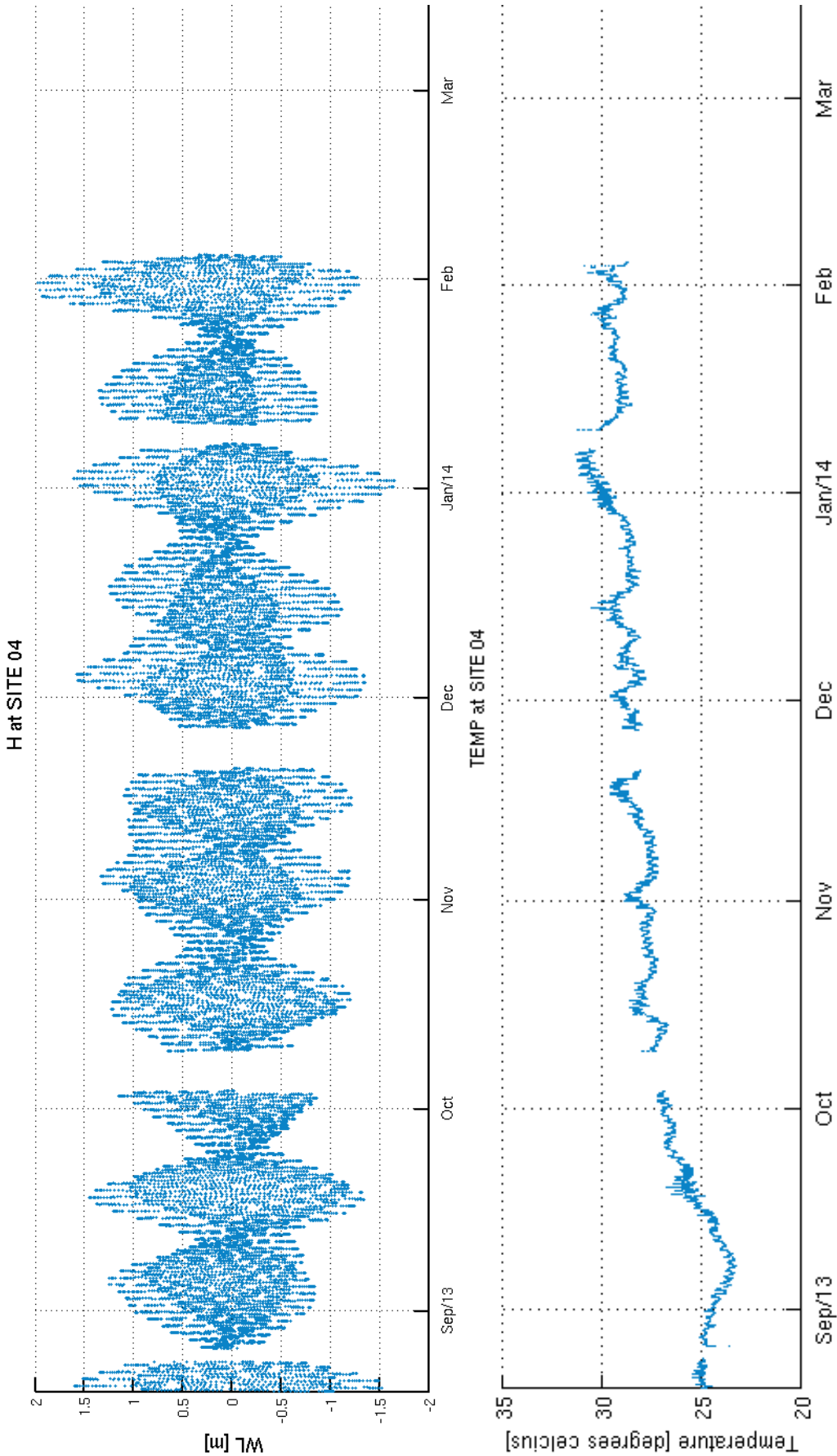


Figure 6-6 S4: Water level and water temperature

6.2 CTD Data

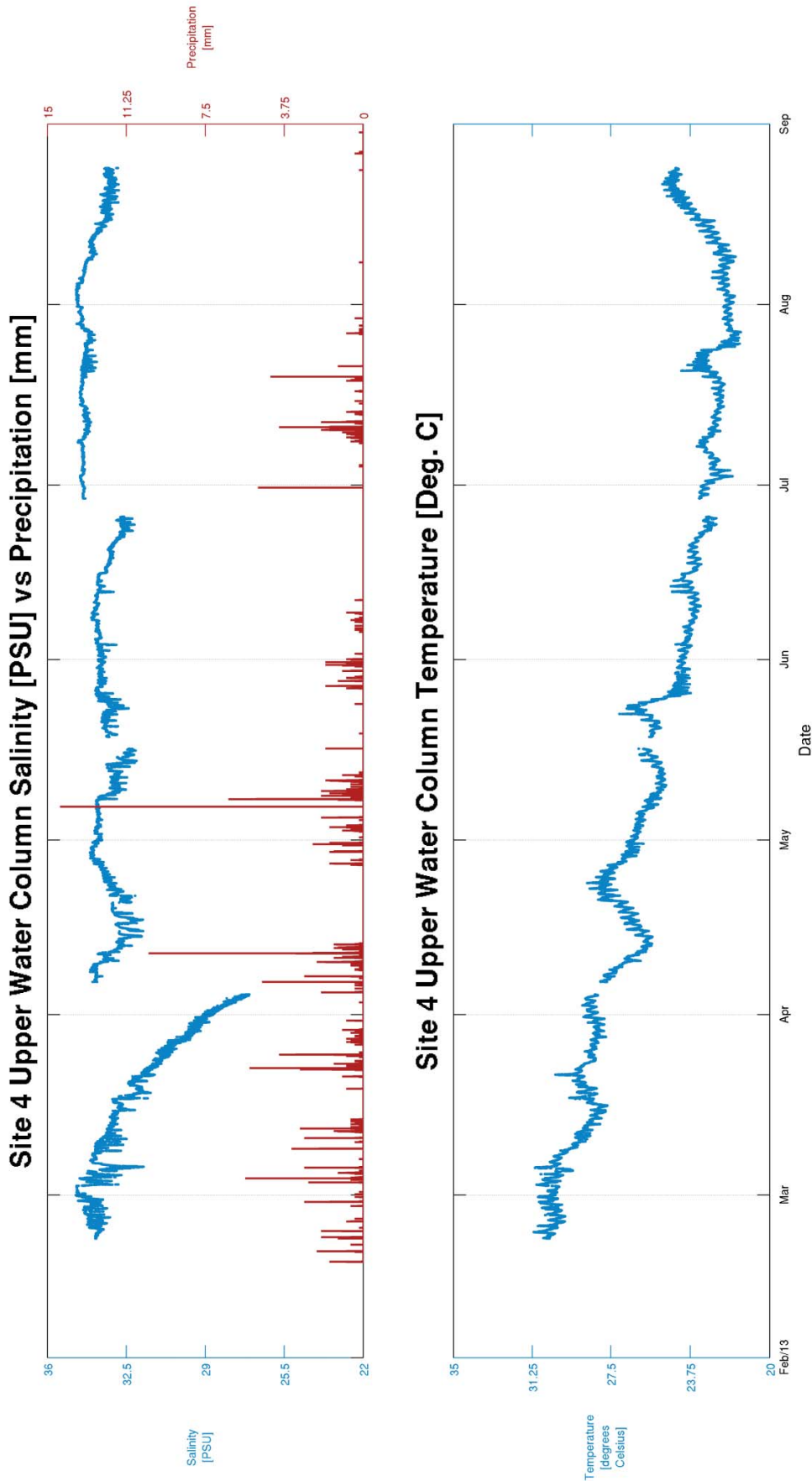


Figure 6-7 S4: Salinity vs. site 5 weather station precipitation and temperature

6.3 YSI Data

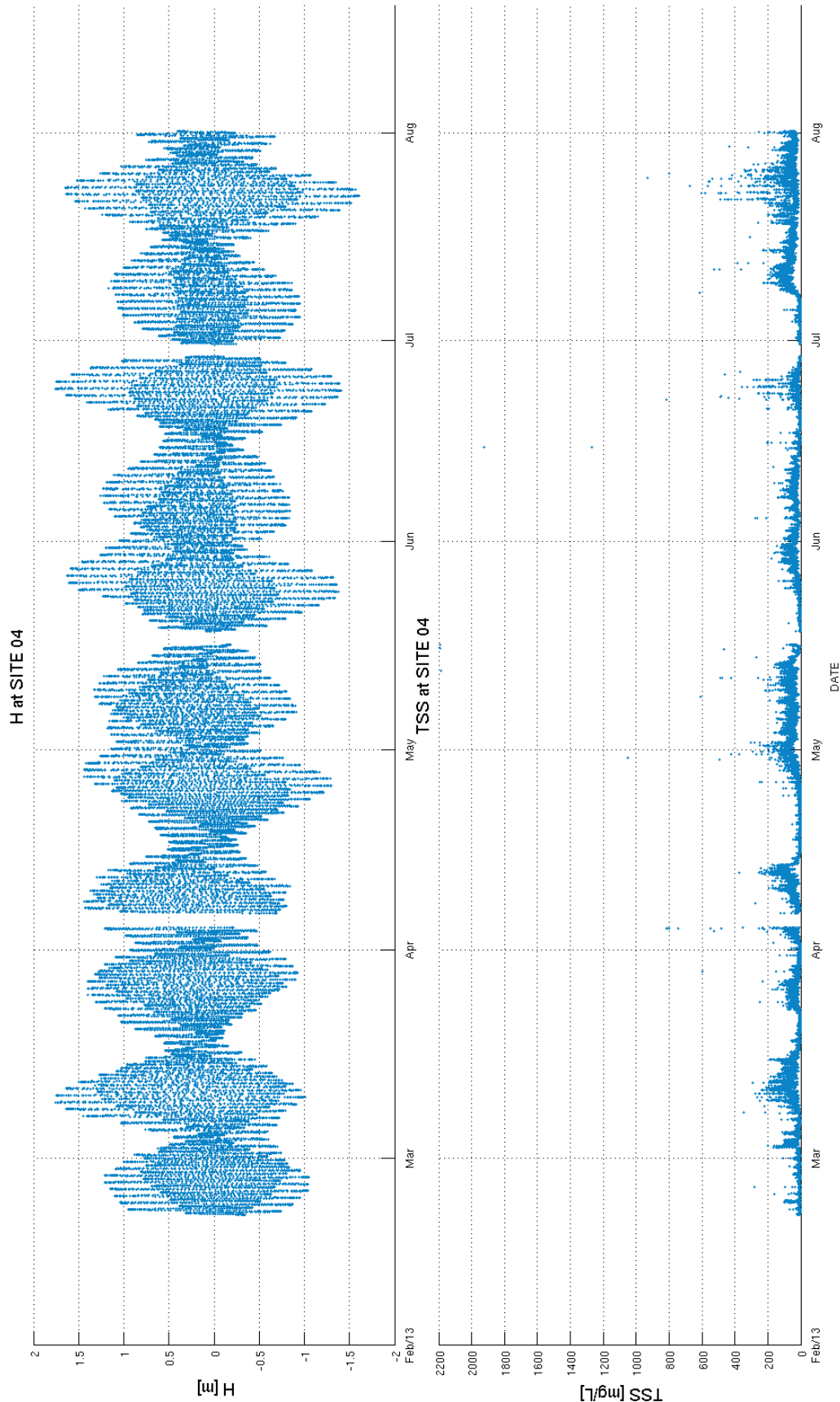


Figure 6-8 S4: Water level and TSS

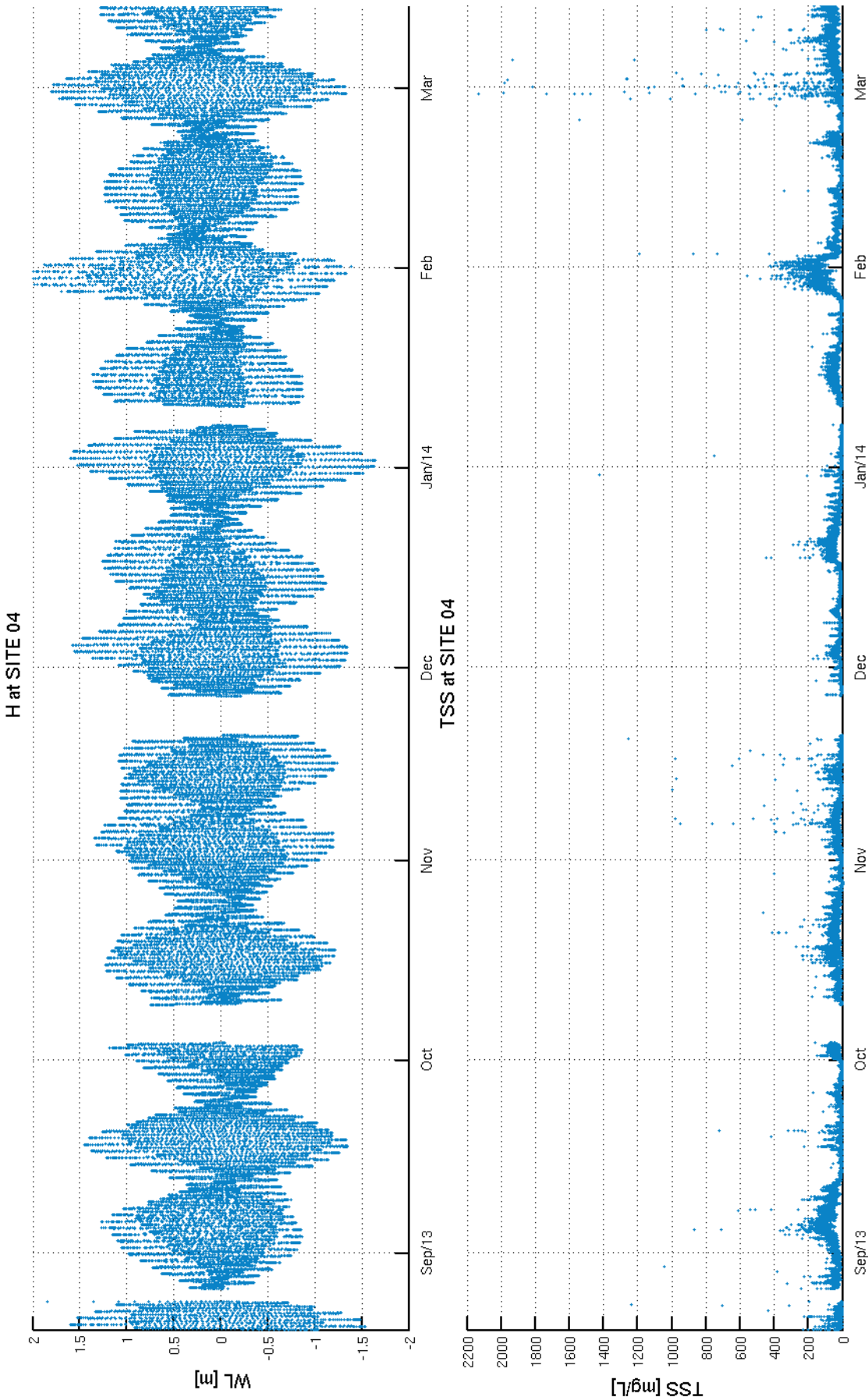


Figure 6-9 S4: Water level and TSS

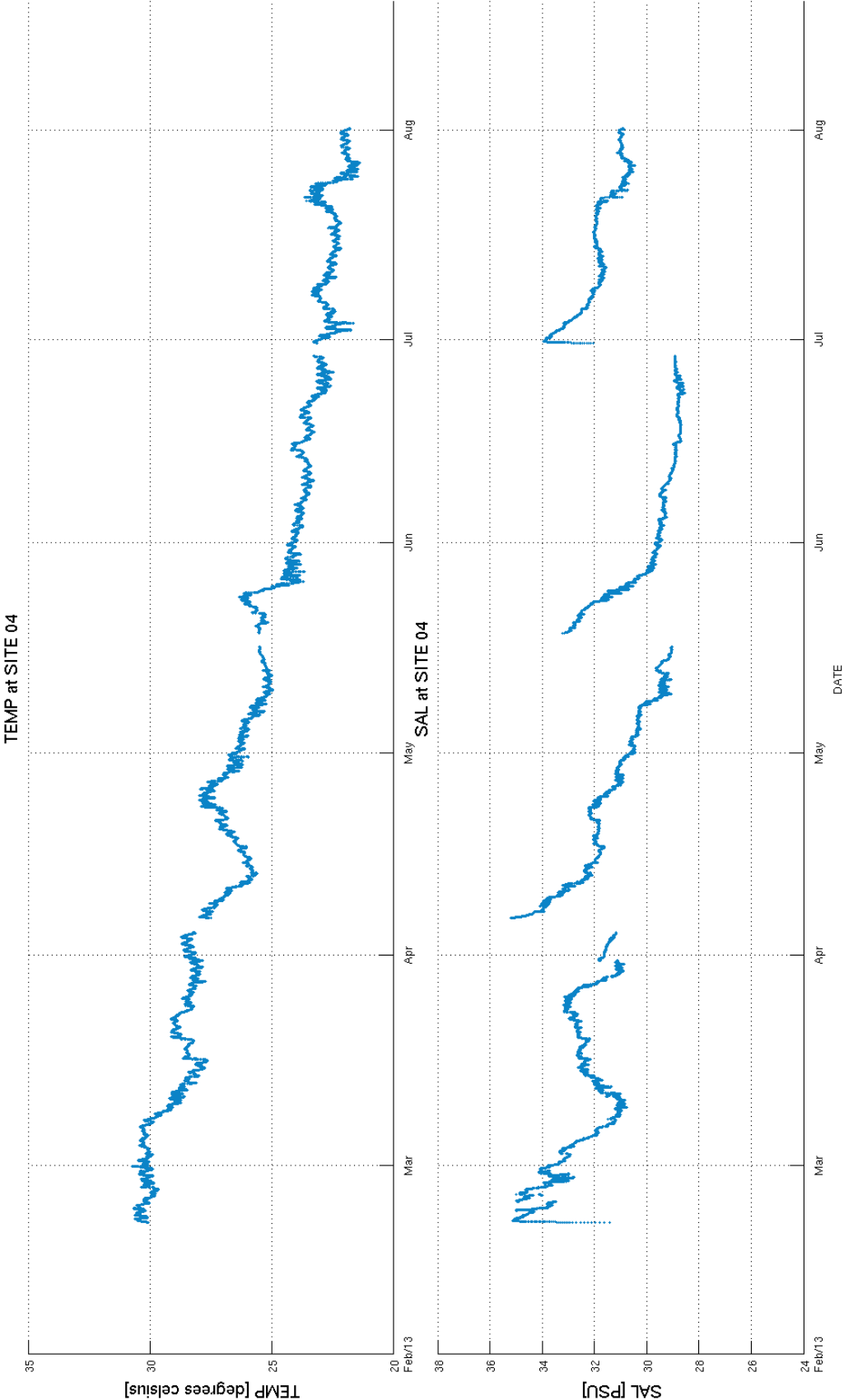


Figure 6-10 S4: Water temperature and salinity

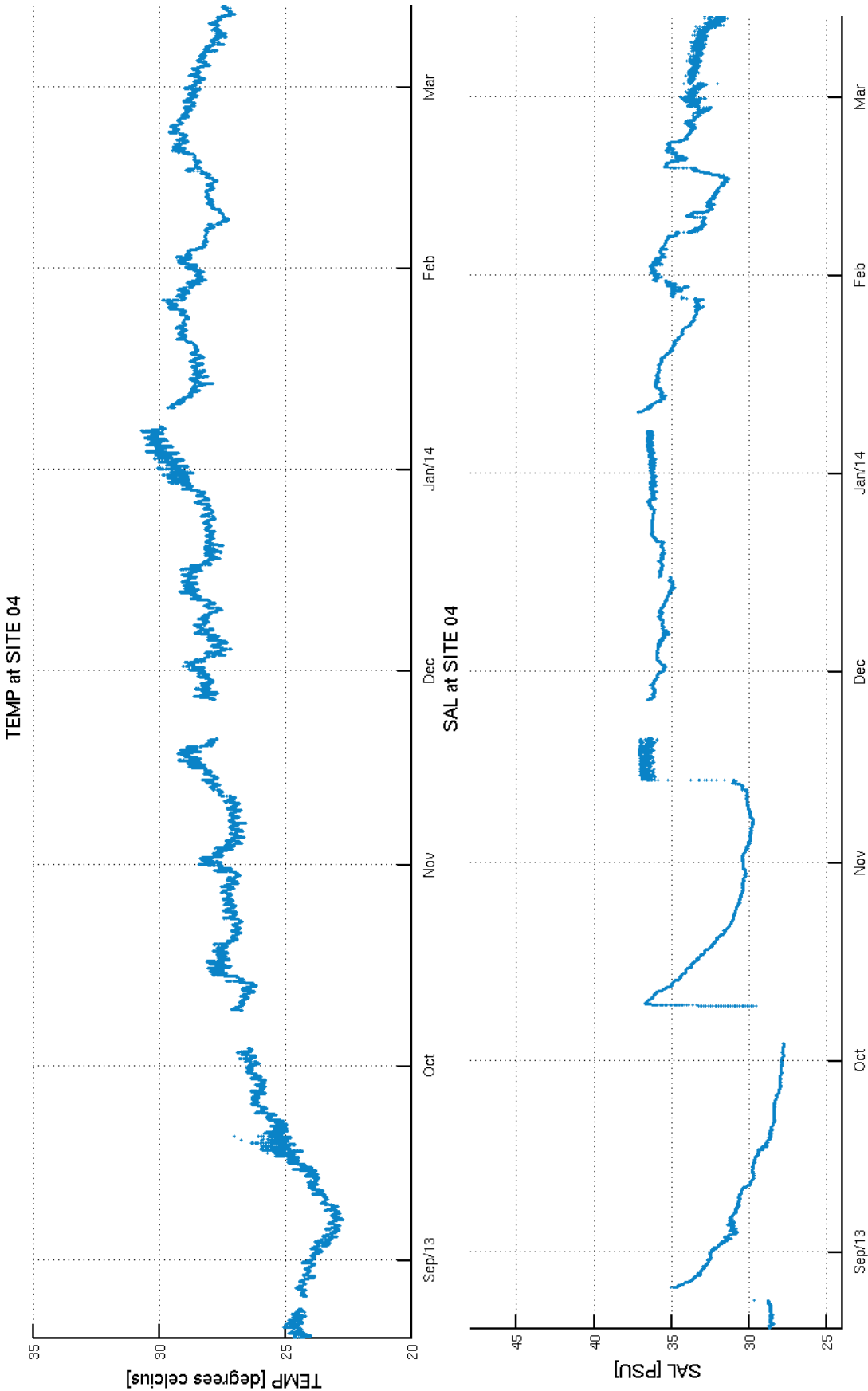


Figure 6-11 S4: Water temperature and salinity

7 Site 5 – Beacon C11

The following data was collected for a minimum twelve months (February 2013 to February 2014):

- ADCP – RDI – water levels, currents and directional waves;
- Teledyne Citadel – CTD;
- YSI 6600 – Conductivity, temperature, depth (CTD) and turbidity (converted to TSS). Note salinity has been derived from conductivity and the data towards the end of each deployment period is unreliable (refer Chapter 11); and
- Weather Station records exceed 12 months.

7.1 RDI ADCP Data

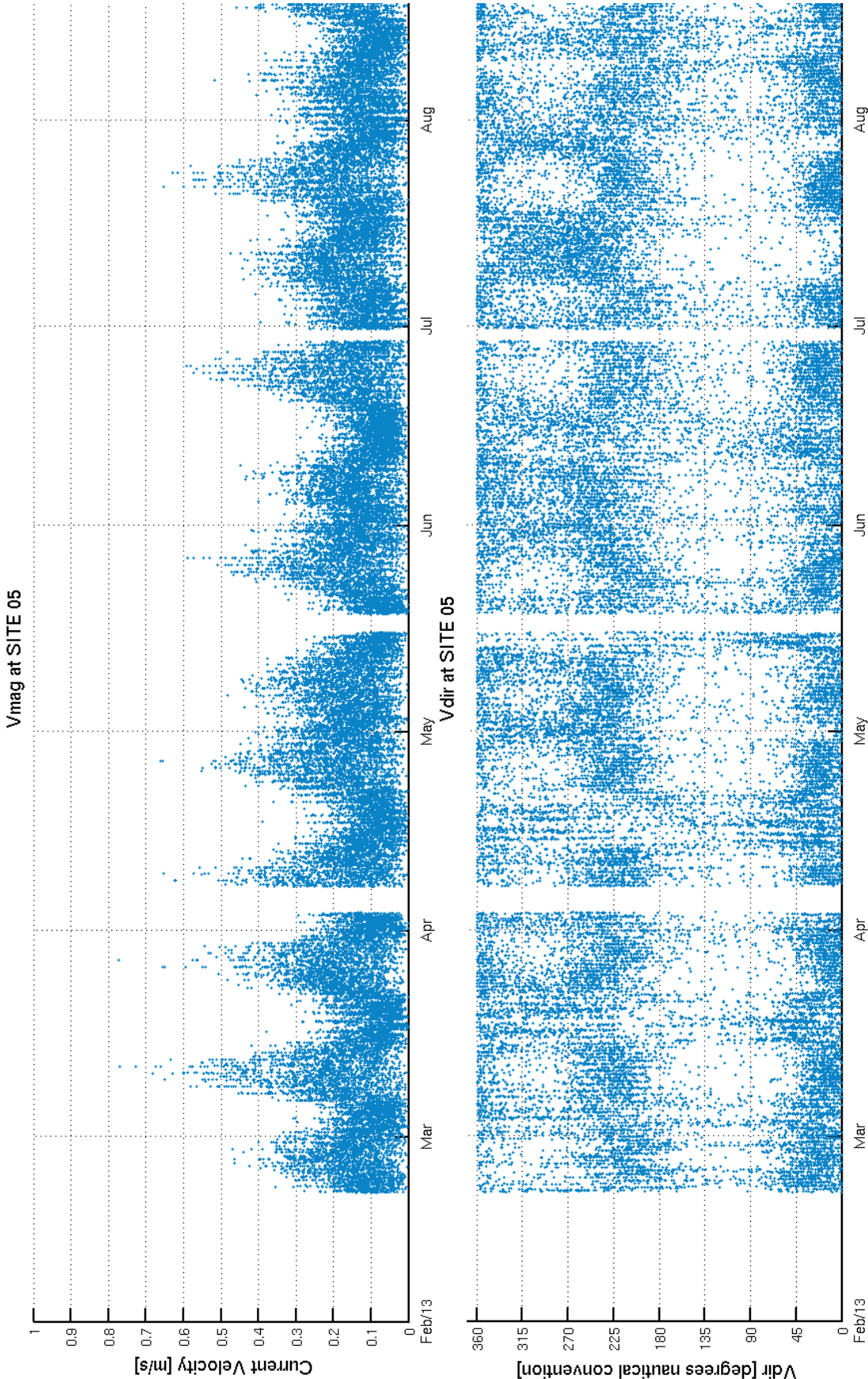


Figure 7-1 S5: Current speed and direction

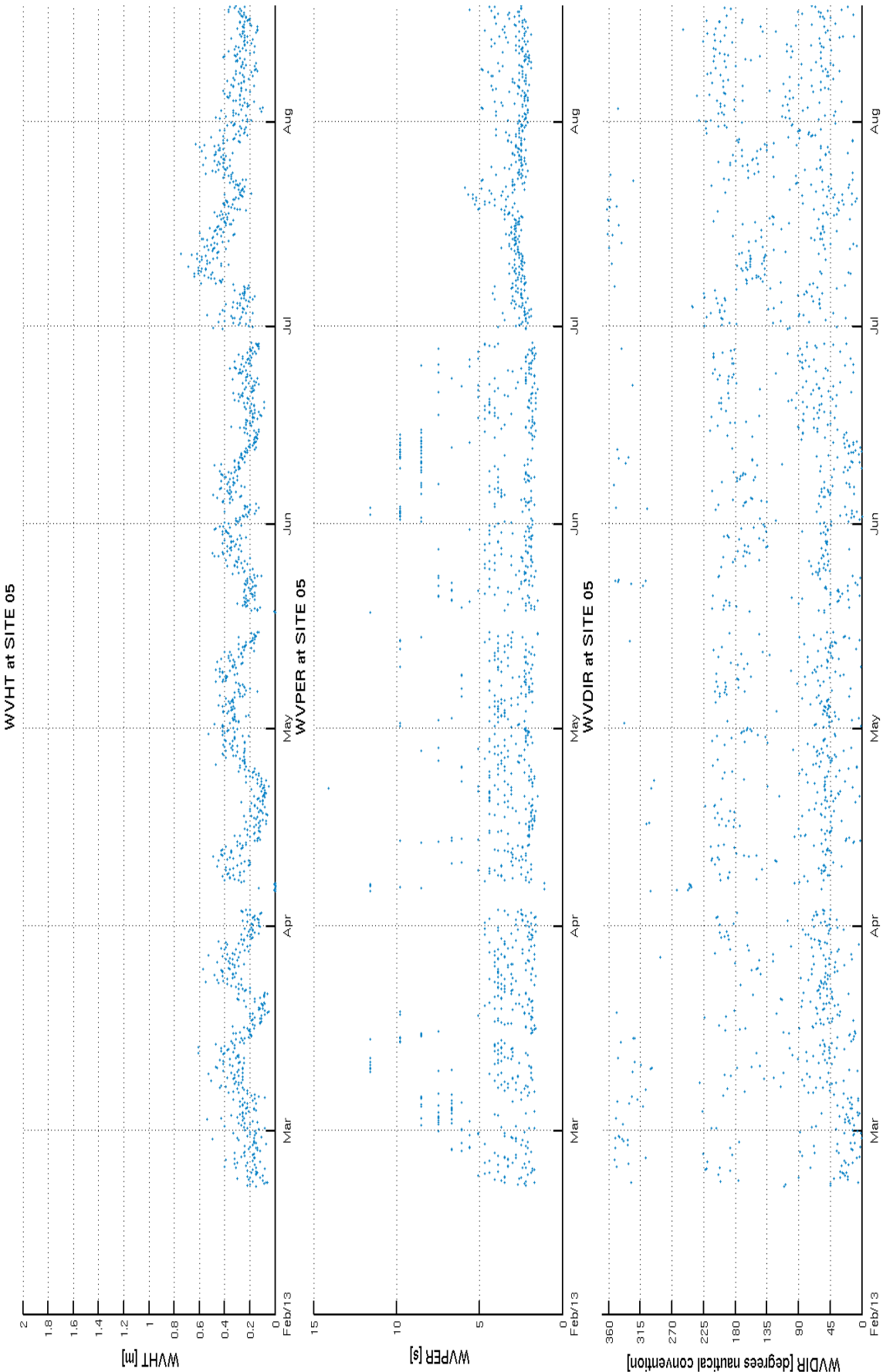


Figure 7-2 S5: Significant wave height, peak period and peak direction

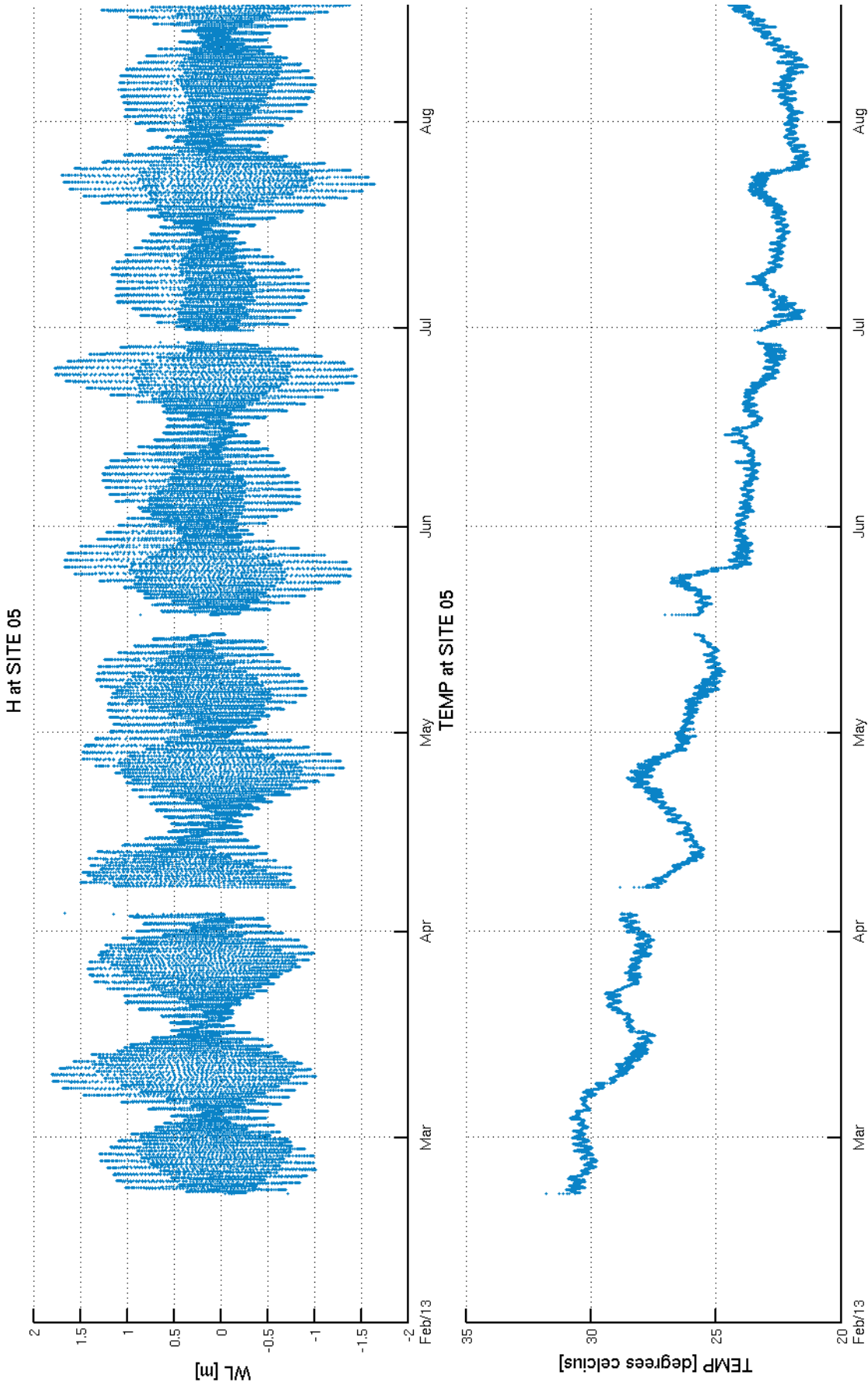


Figure 7-3 S5: Water level and water temperature

7.2 CTD Data

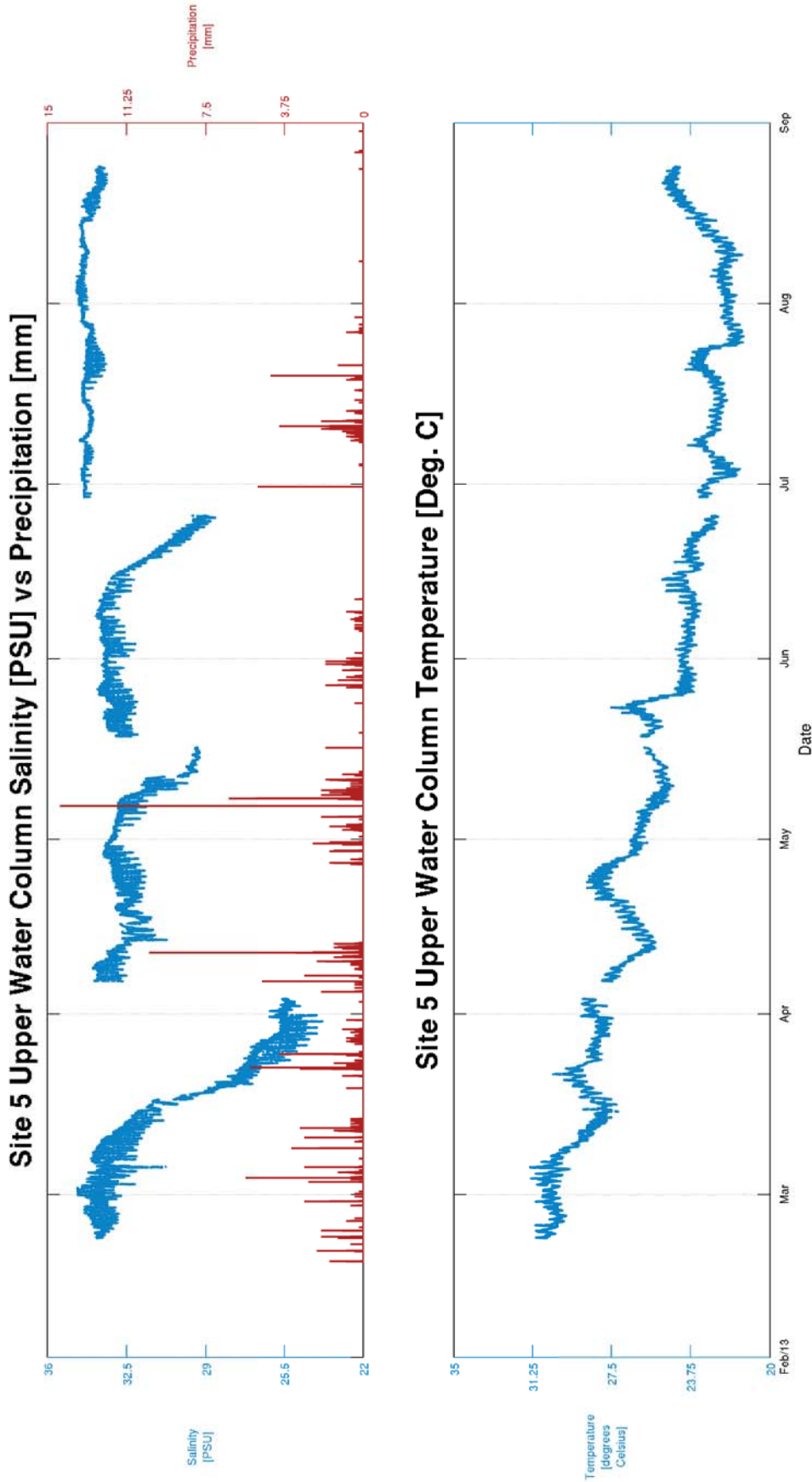


Figure 7-4 S5: Salinity vs. site 5 weather station precipitation and temperature

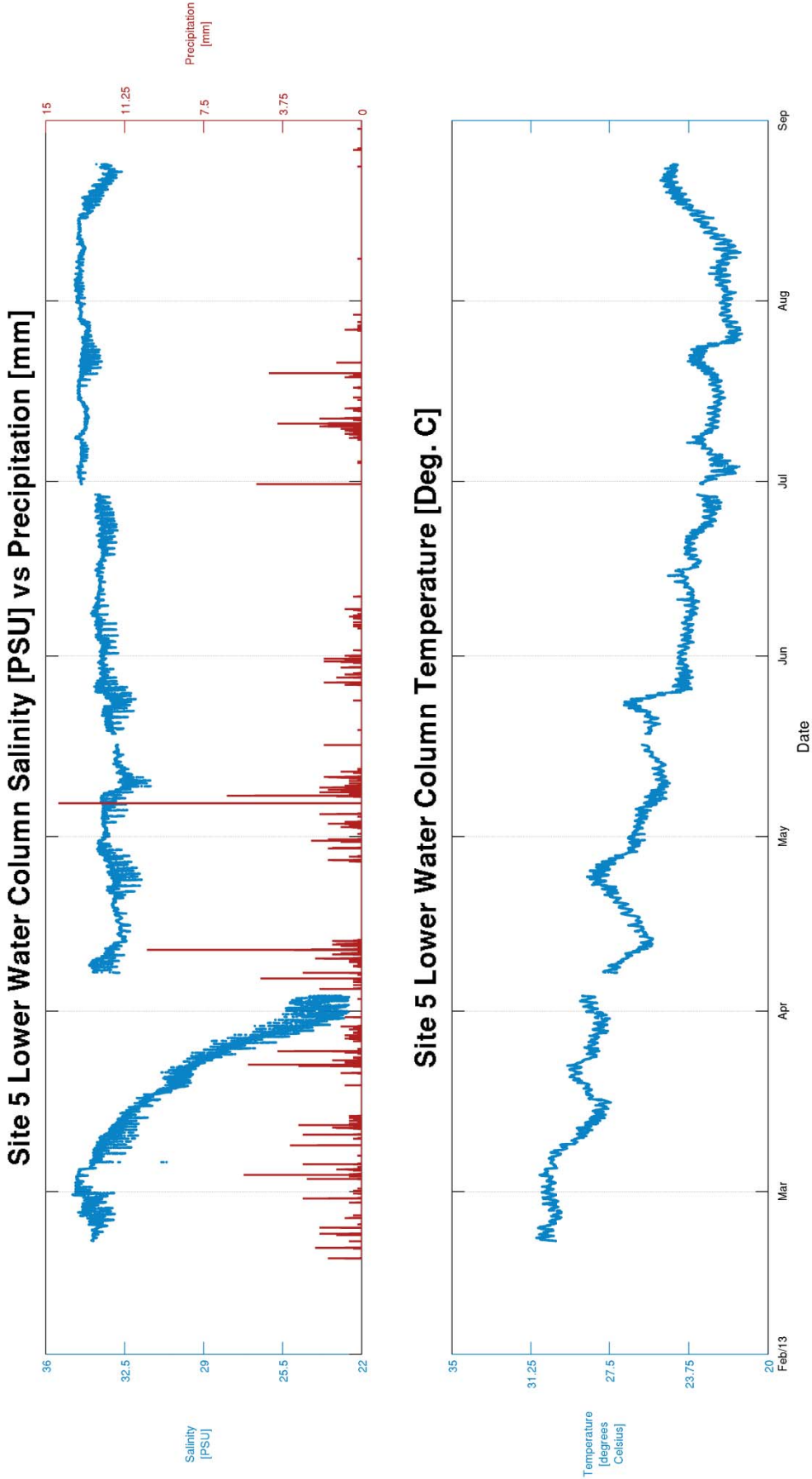


Figure 7-5 S5: Salinity vs. site 5 weather station precipitation and temperature

7.3 YSI Data

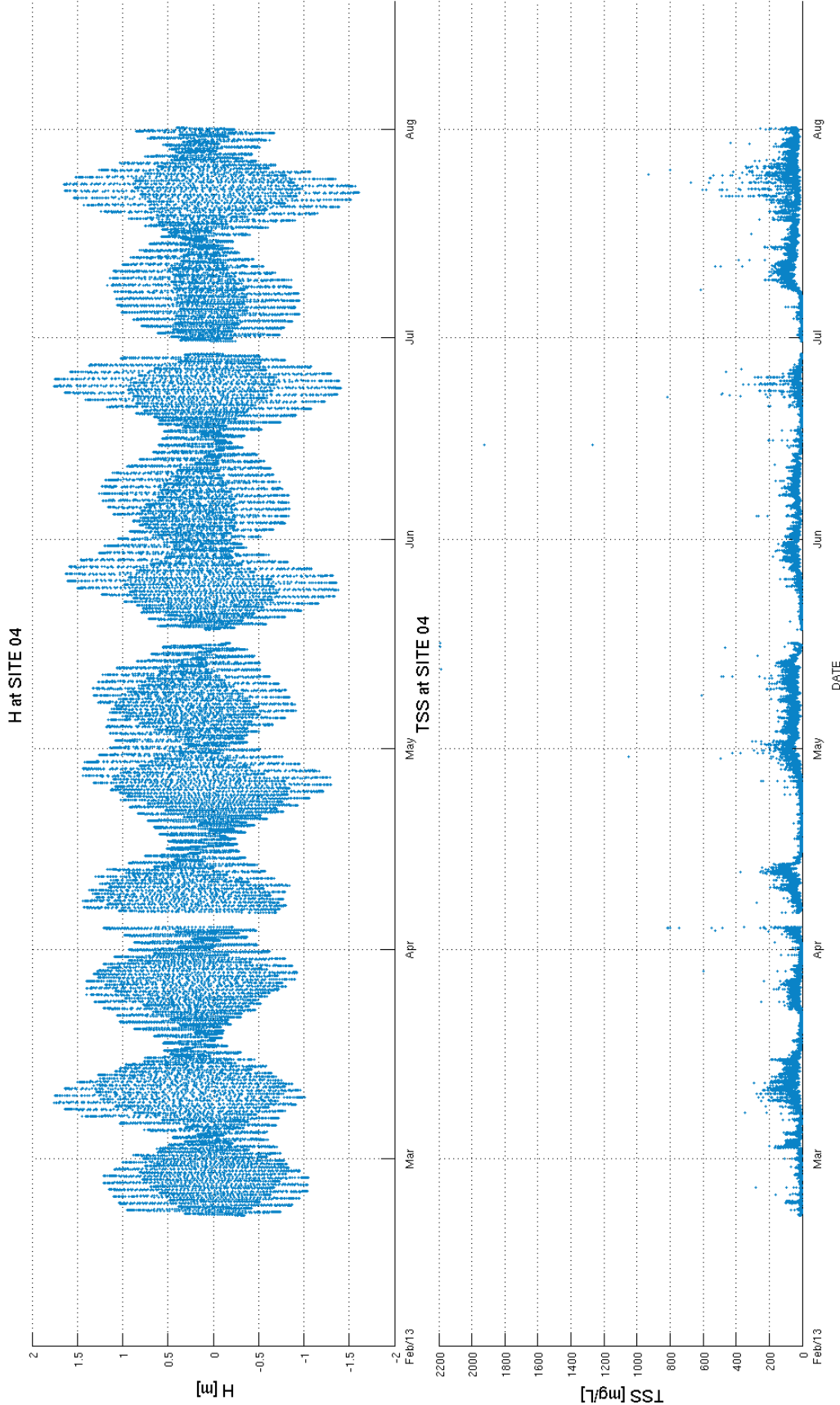


Figure 7-6 S5: Water level and TSS

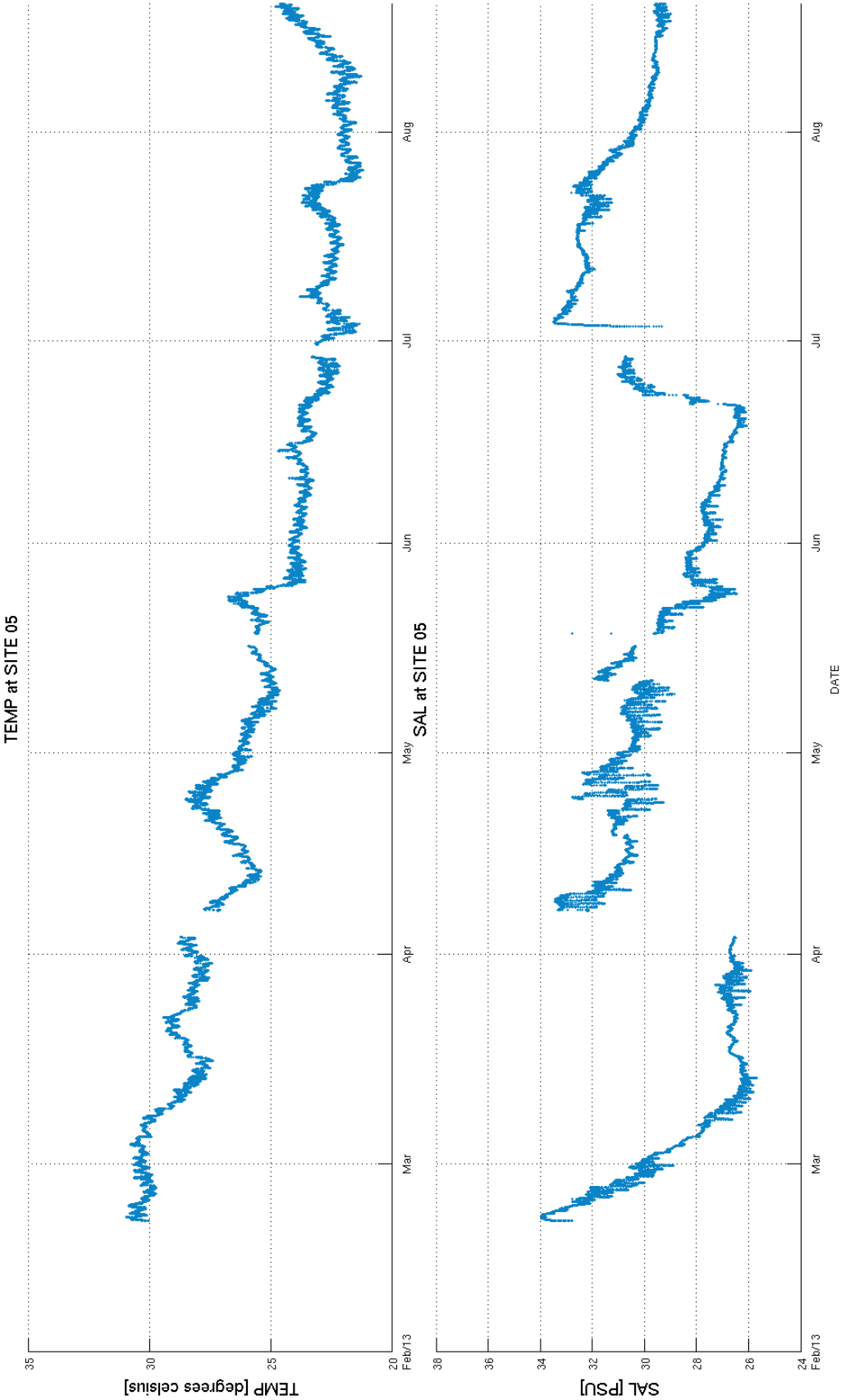


Figure 7-7 S5: Water temperature and salinity

7.4 Weather Station Data

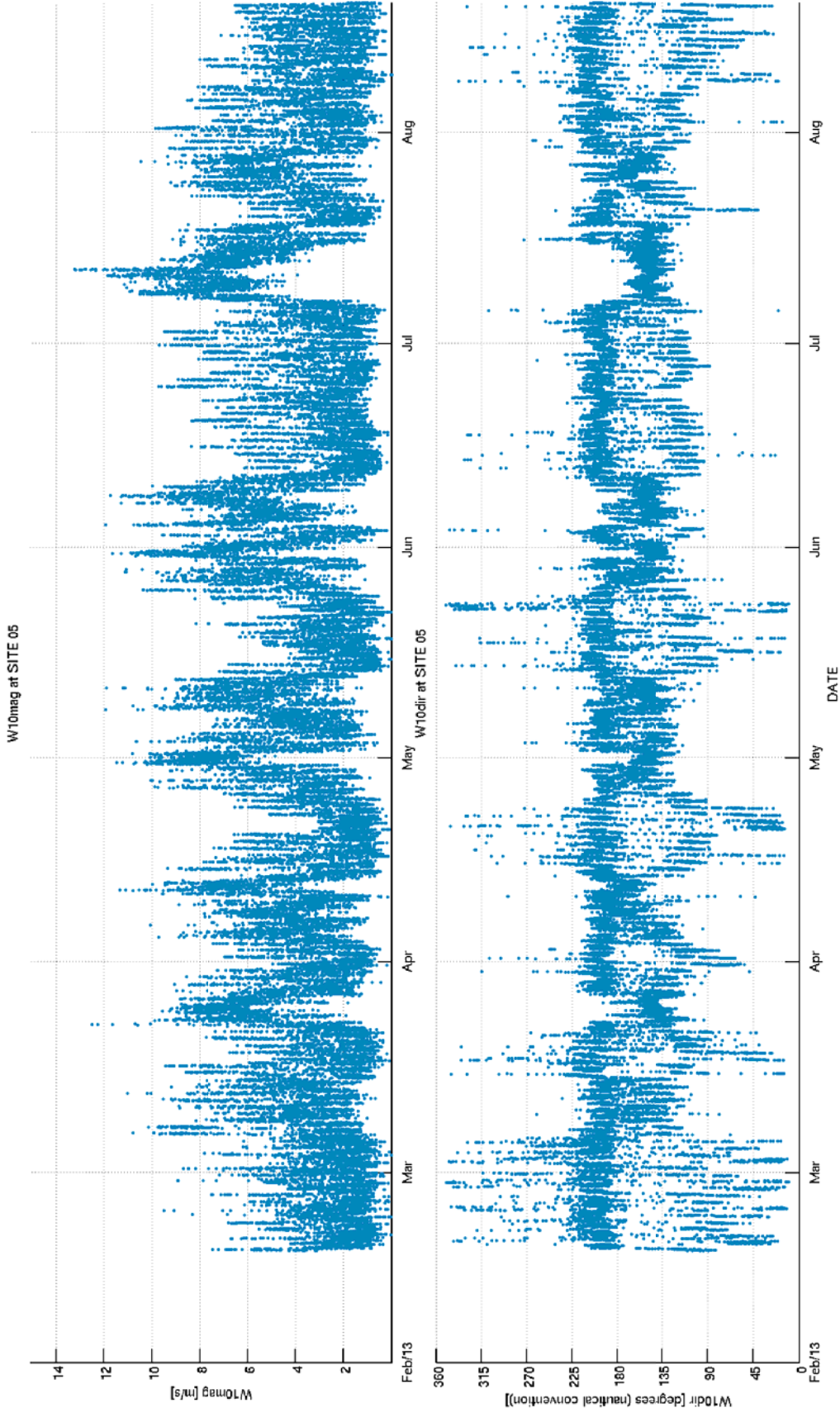


Figure 7-8 S5: Wind speed and direction

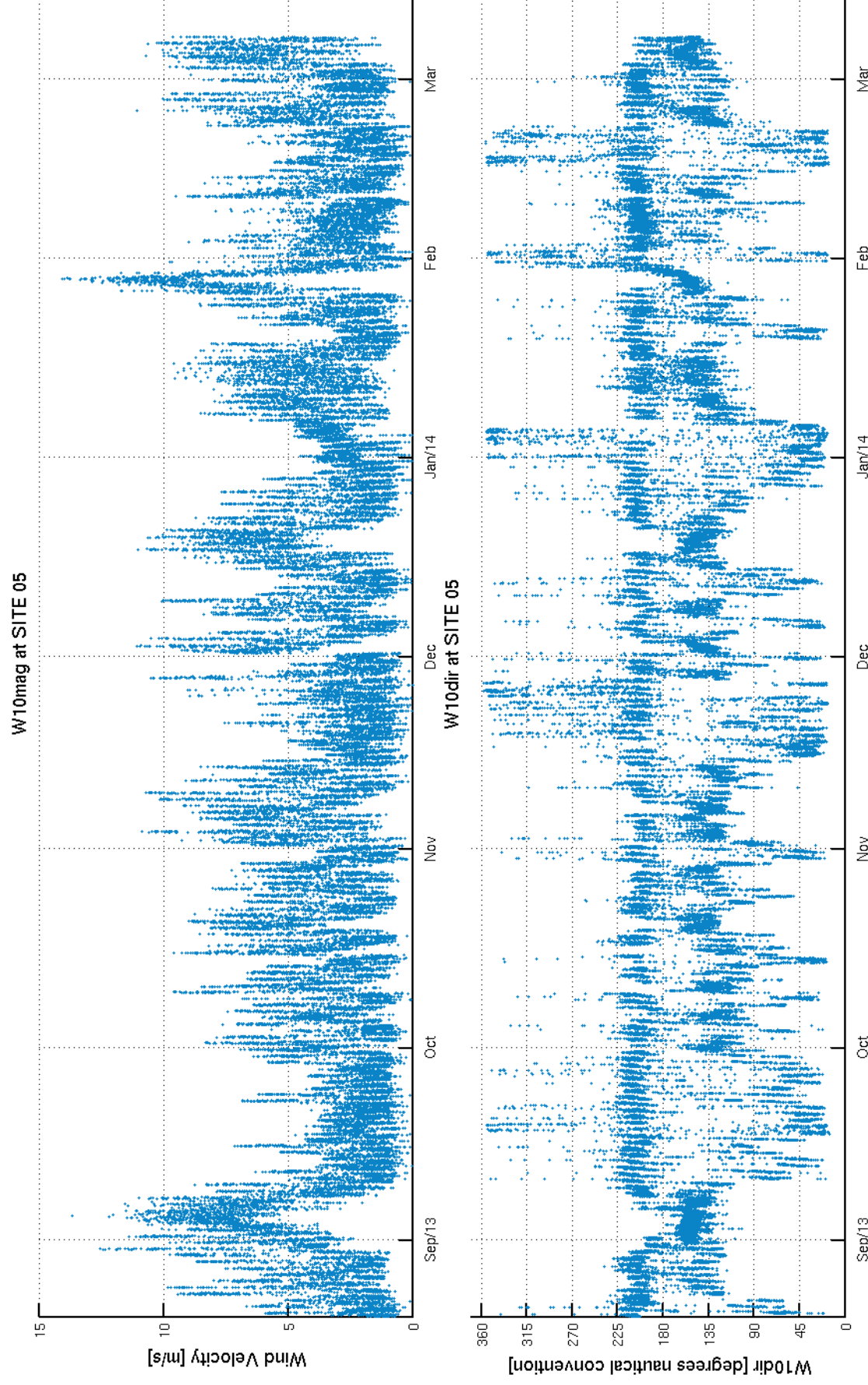


Figure 7-9 S5: Wind speed and direction

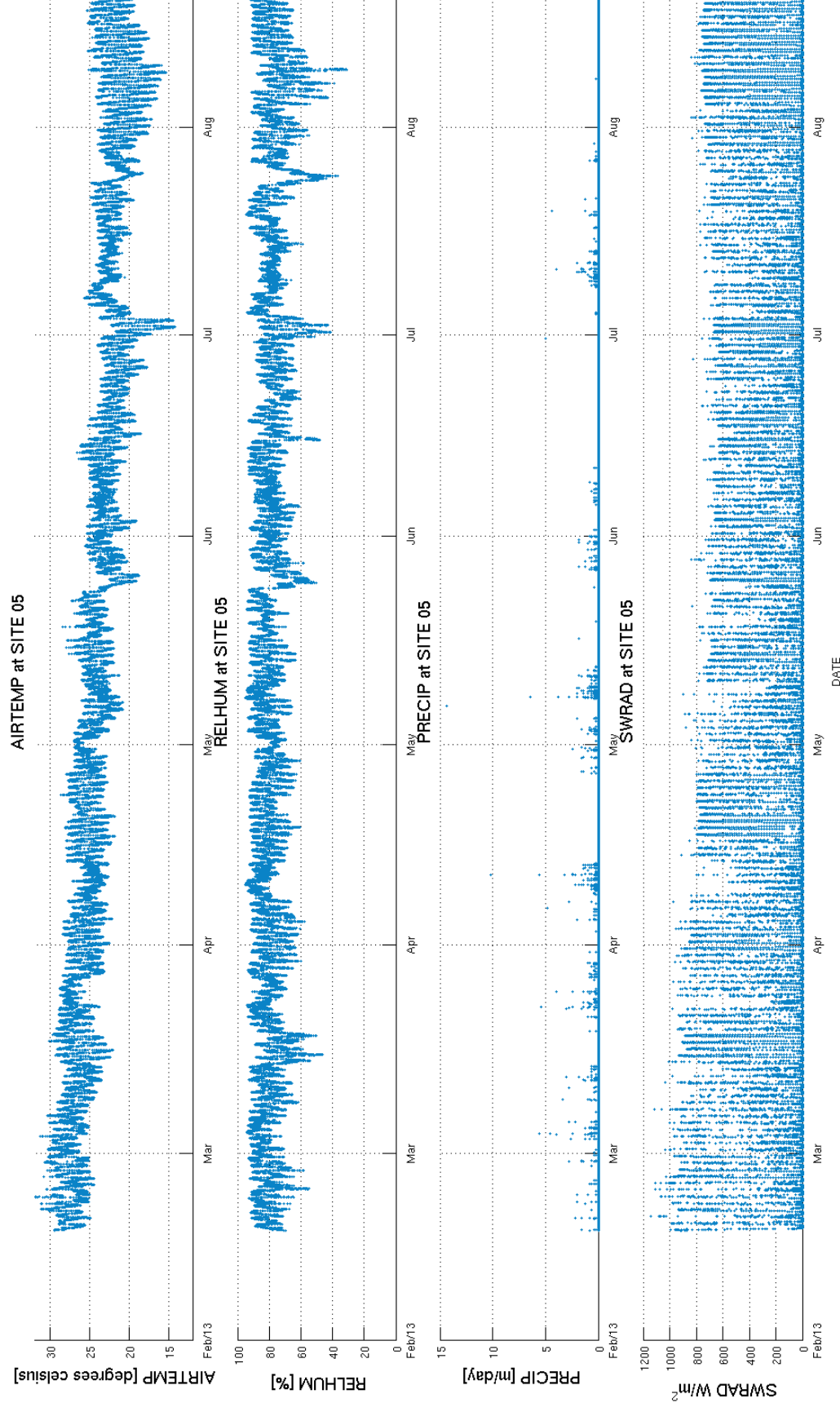


Figure 7-10 S5: Air temperature, relative humidity, precipitation and solar radiation

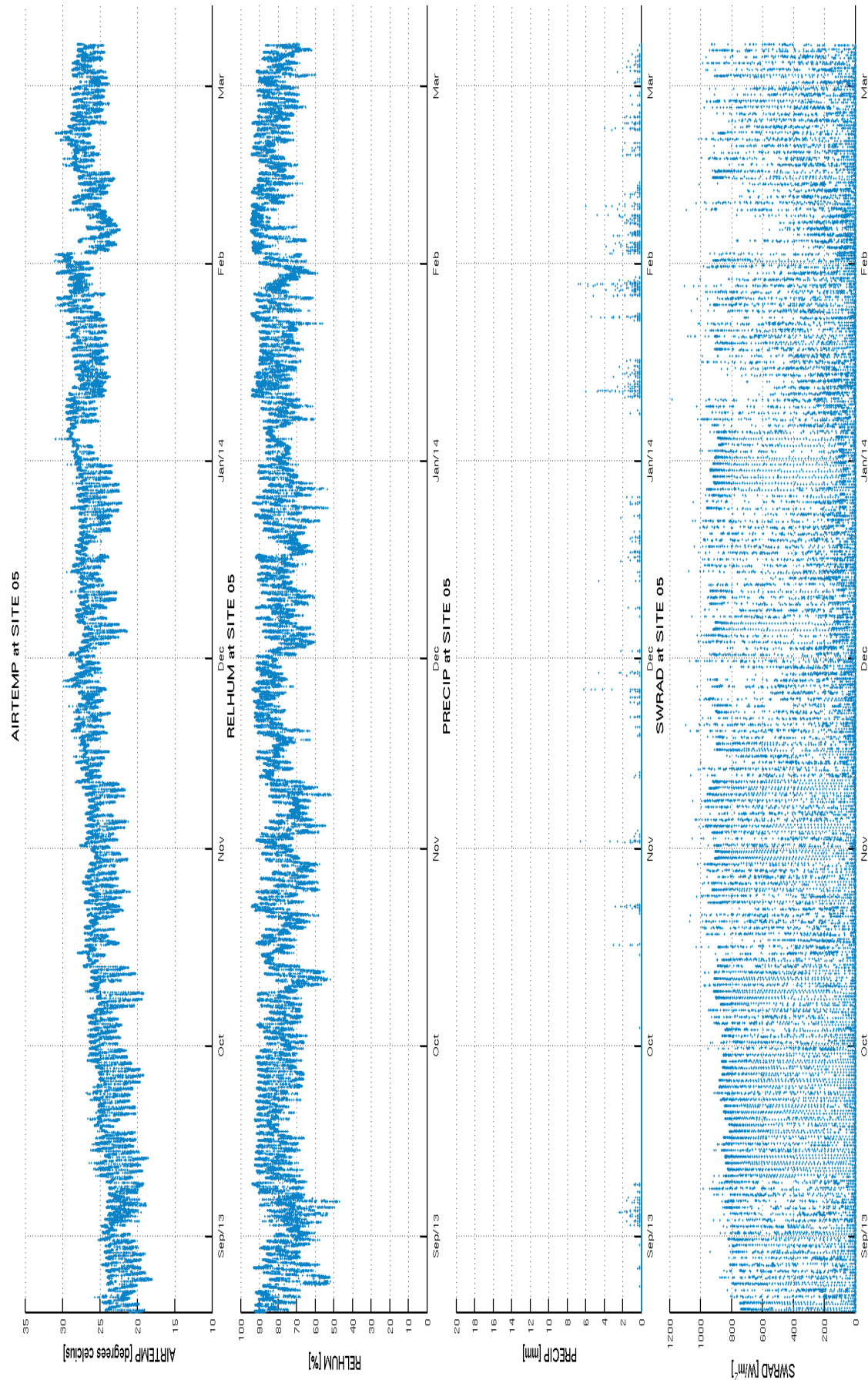


Figure 7-11 S5: Air temperature, relative humidity, precipitation and solar radiation

8 Site 6 – Beacon 20

Data from the weather station has been gathered over approximately 13 months (April 2013 to May 2014) with some data loss between February and April 2013.

8.1 Weather Station Data

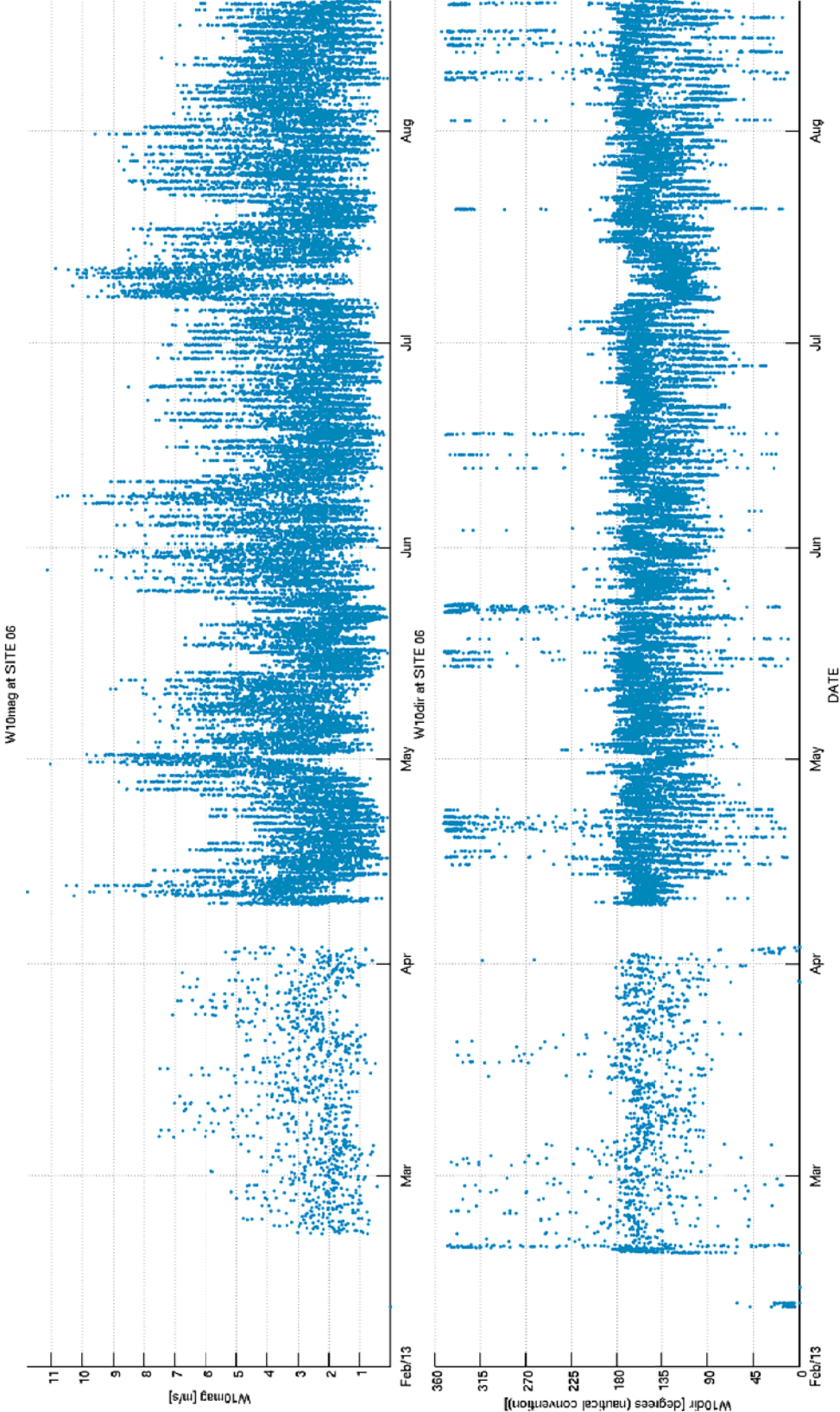


Figure 8-1 S6: Wind speed and direction

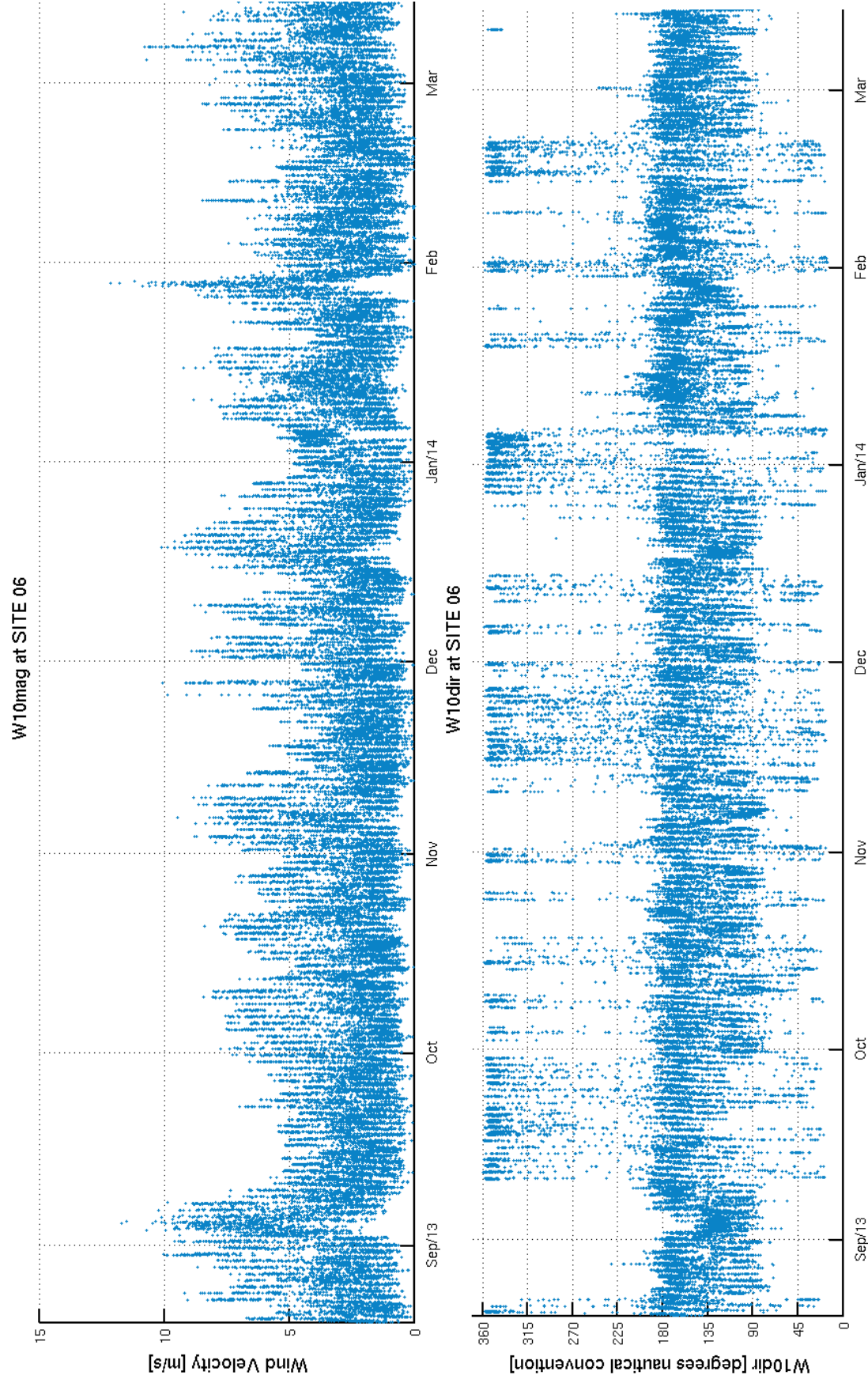


Figure 8-2 S6: Wind speed and direction

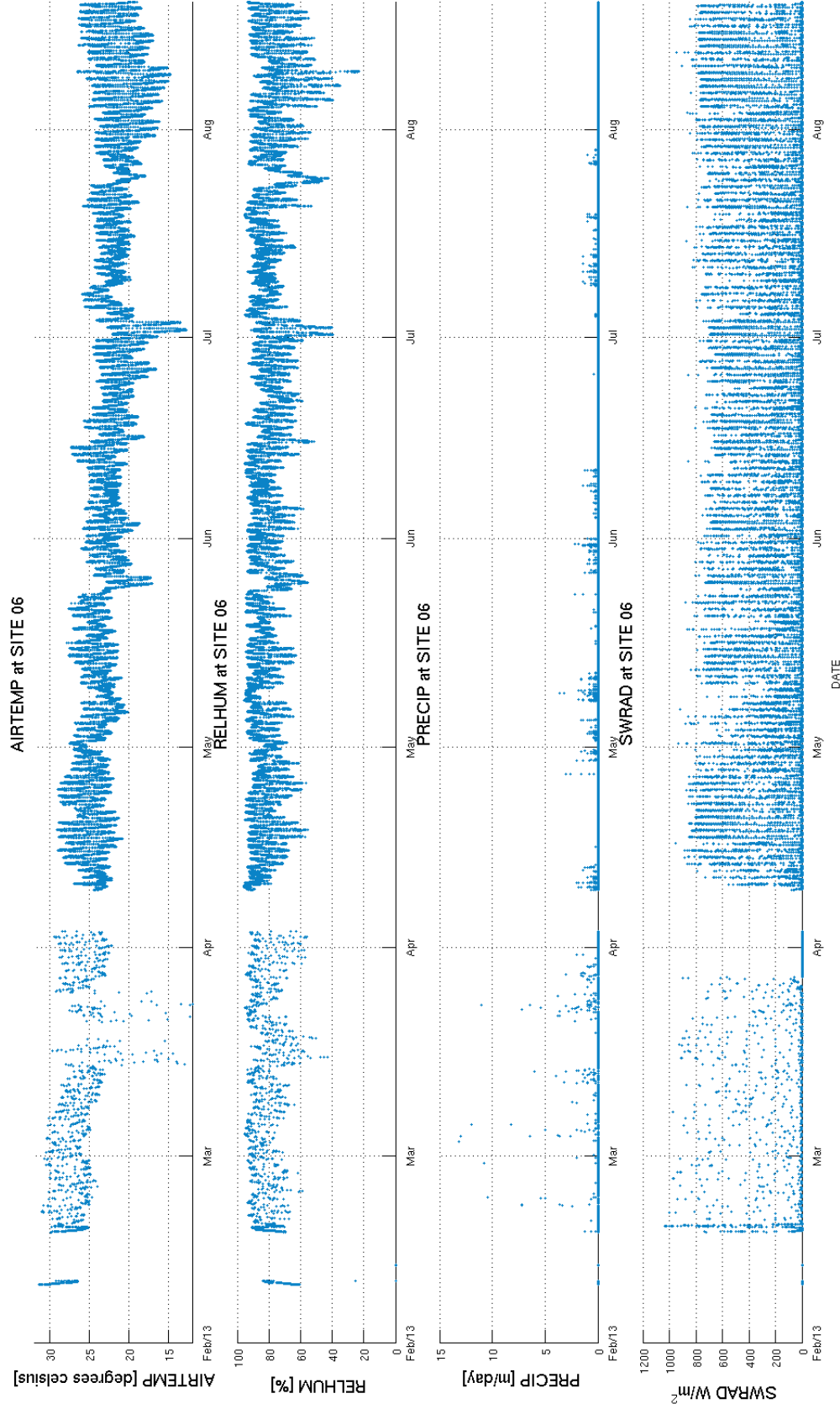


Figure 8-3 S6: Air temperature, relative humidity, precipitation and solar radiation

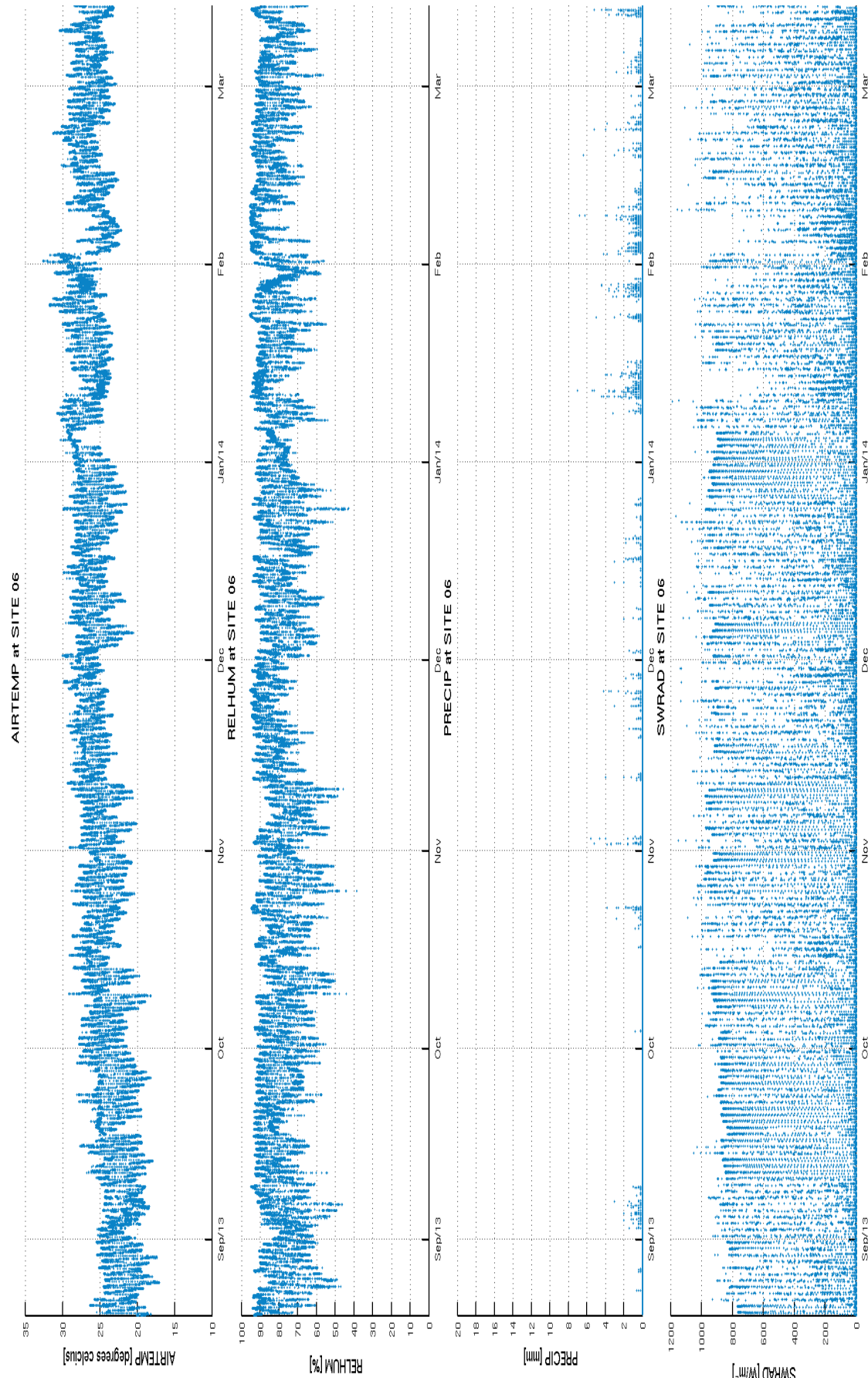


Figure 8-4 S6: Air temperature, relative humidity, precipitation and solar radiation

9 ADCP Measurement Transects

Individual ADCP current velocity transects and water quality data collected were as follows:

- April 2013:
 - Beacon 5 to Beacon 15
 - Beacon 15 to Beacon 20
 - Berth 10
 - Smiths Creek.
- June 2013:
 - Beacon 5 to Beacon 15
 - Outer Port
 - Inner Port
 - Berth 10
 - Smiths Creek.
- August 2013:
 - Inner Channel
 - Outer Channel.

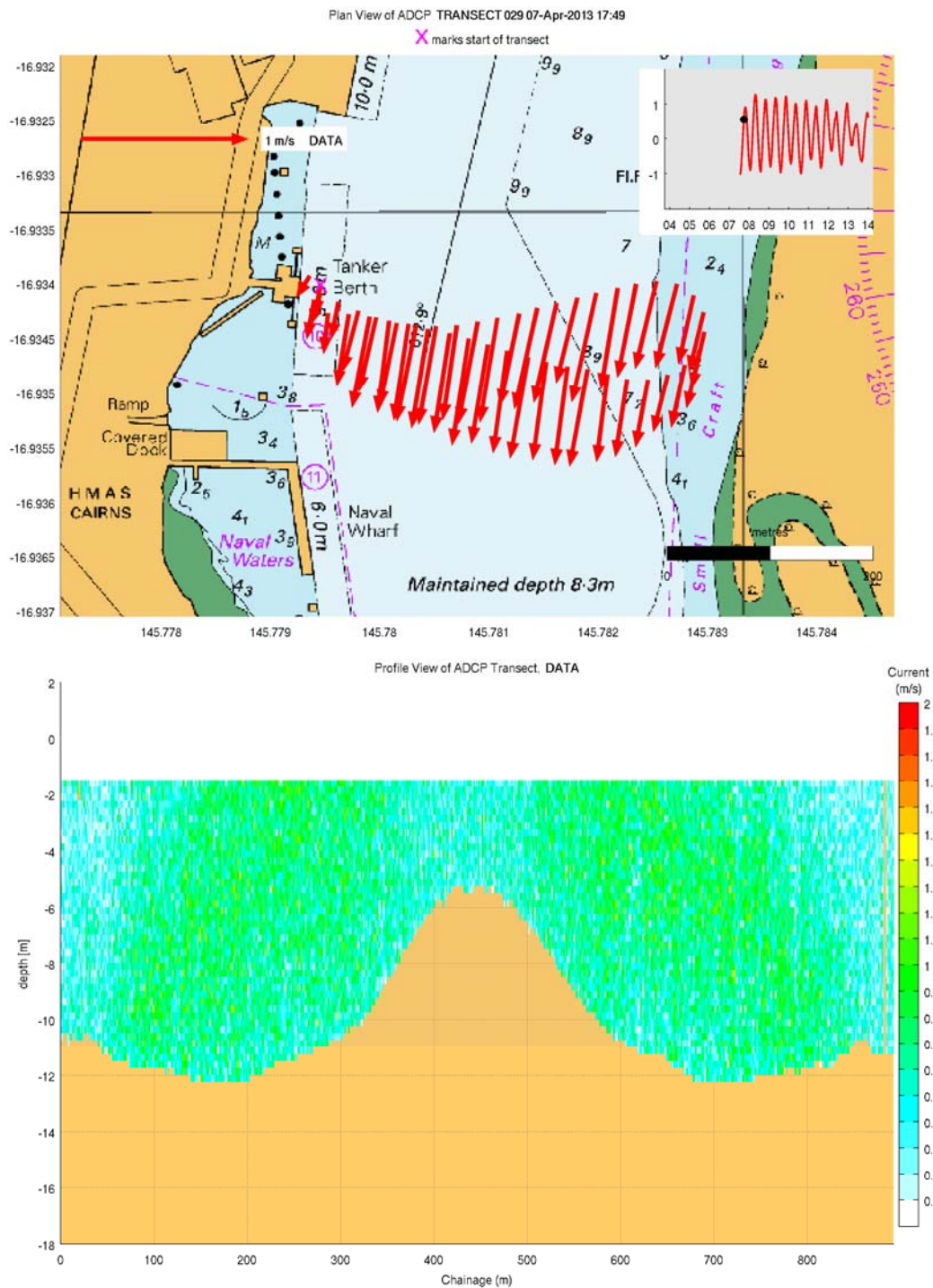


Figure 9-2 ADCP transect, April 2013, Berth 10-11, Note: transect crosses back

9.1.2 Inner Channel - Between Beacon C20 and C15



Figure 9-3 ADCP all transects, April 2013, Inner Channel

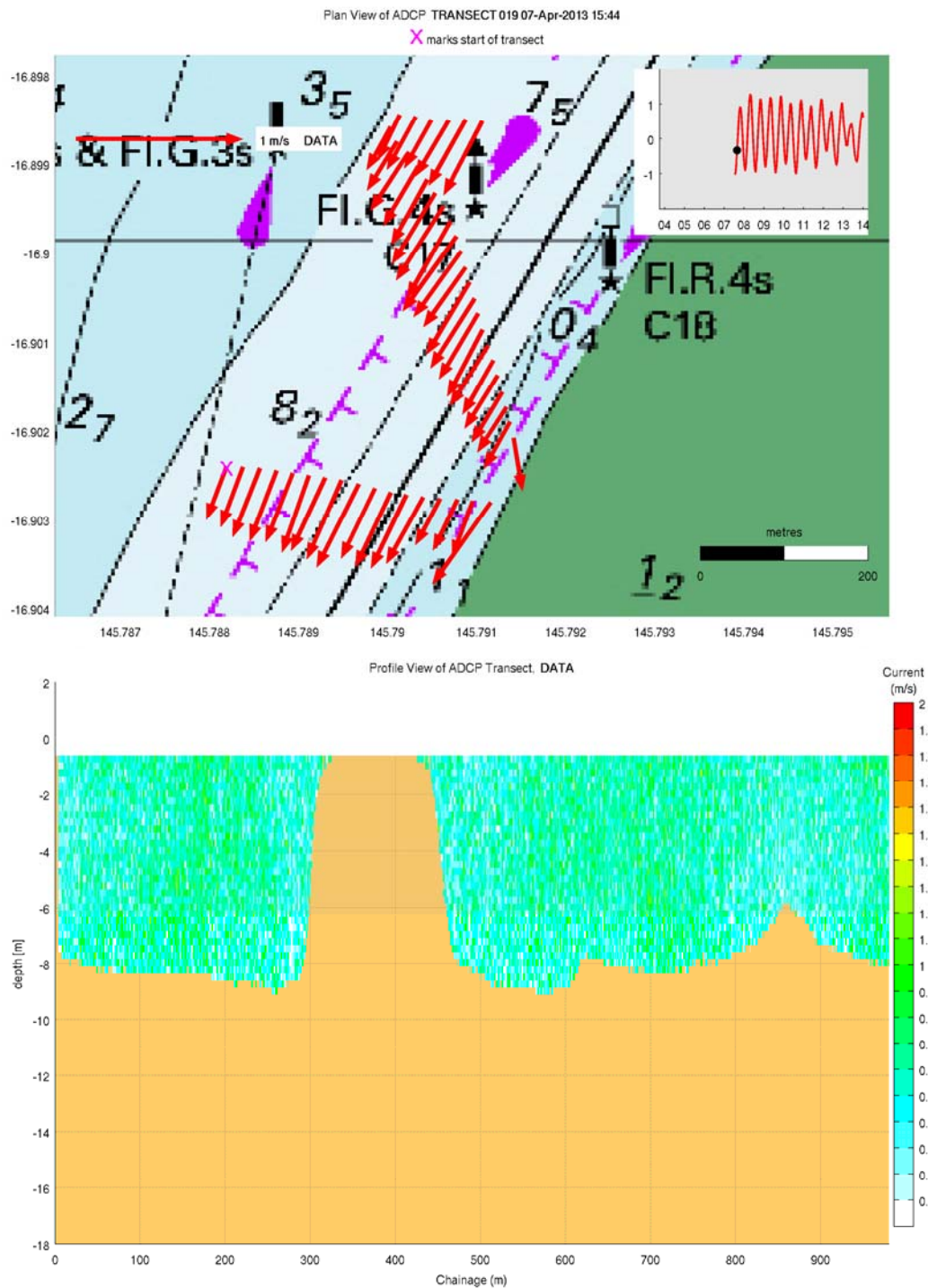


Figure 9-4 ADCP transect, April 2013, Beacons C20-C15

9.1.3 Outer Channel - Between Beacon C5 and C15

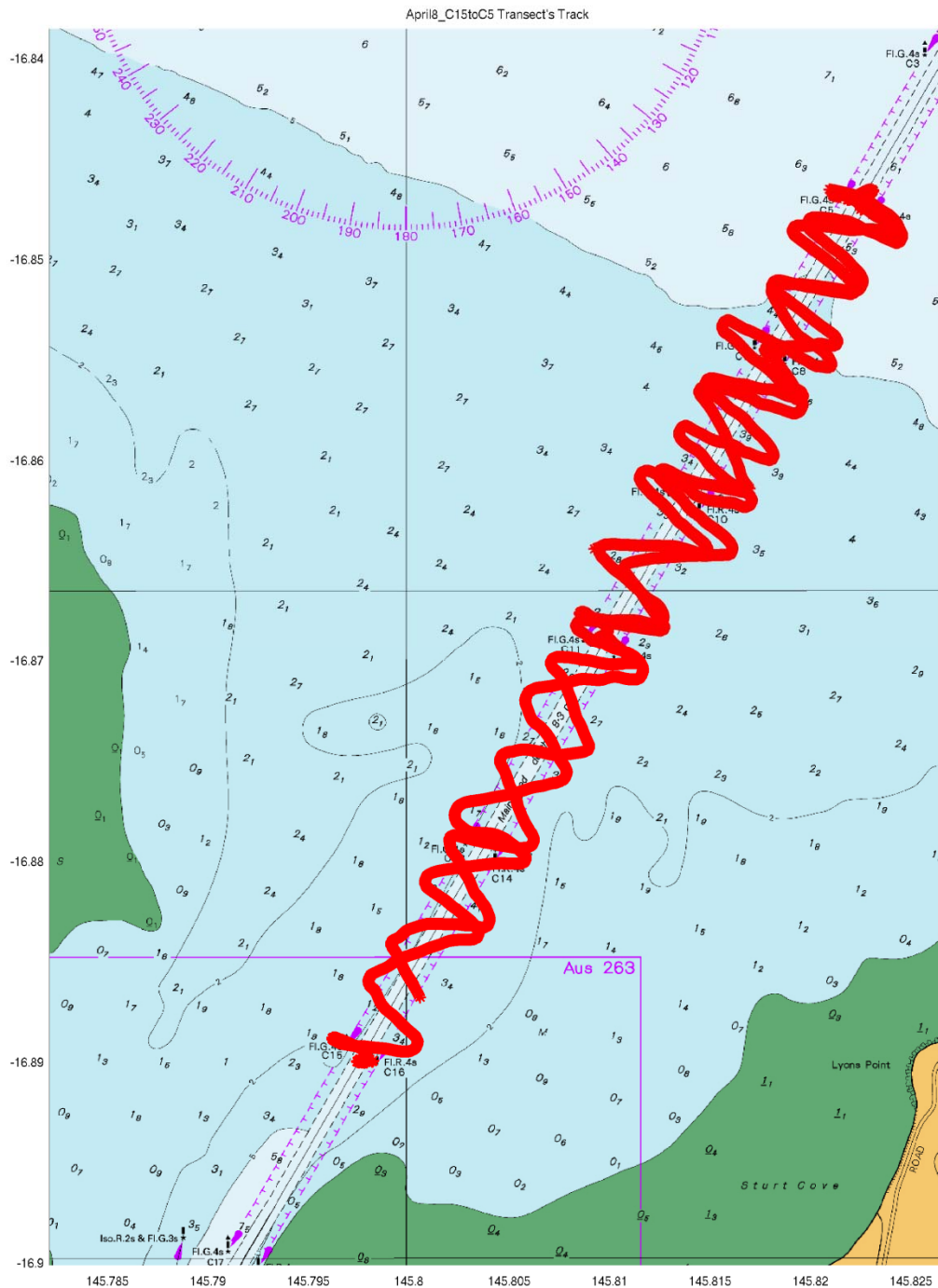


Figure 9-5 ADCP all transects, April 2013, Outer Channel

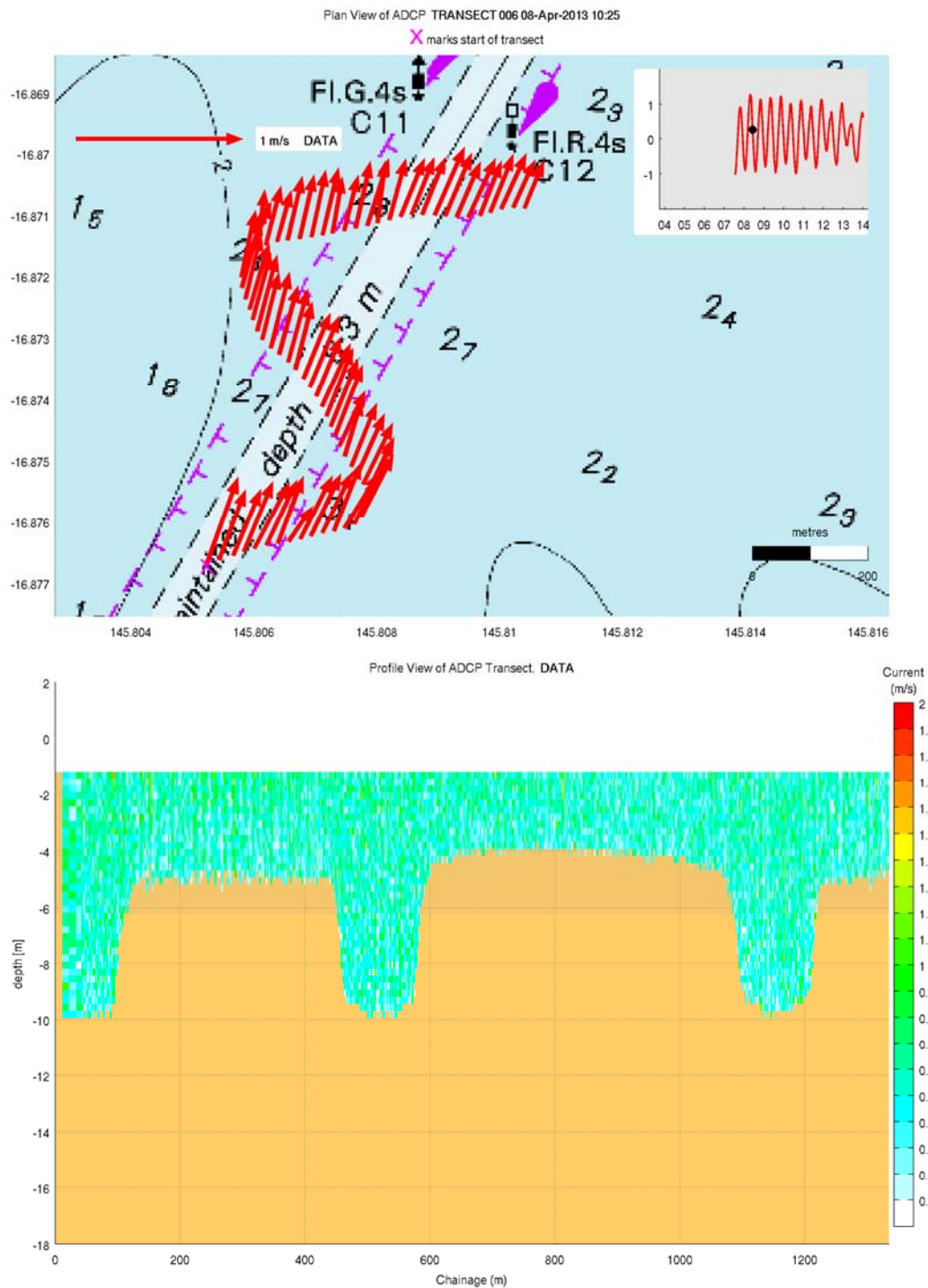


Figure 9-6 ADCP transect, April 2013, Beacons C15-C11

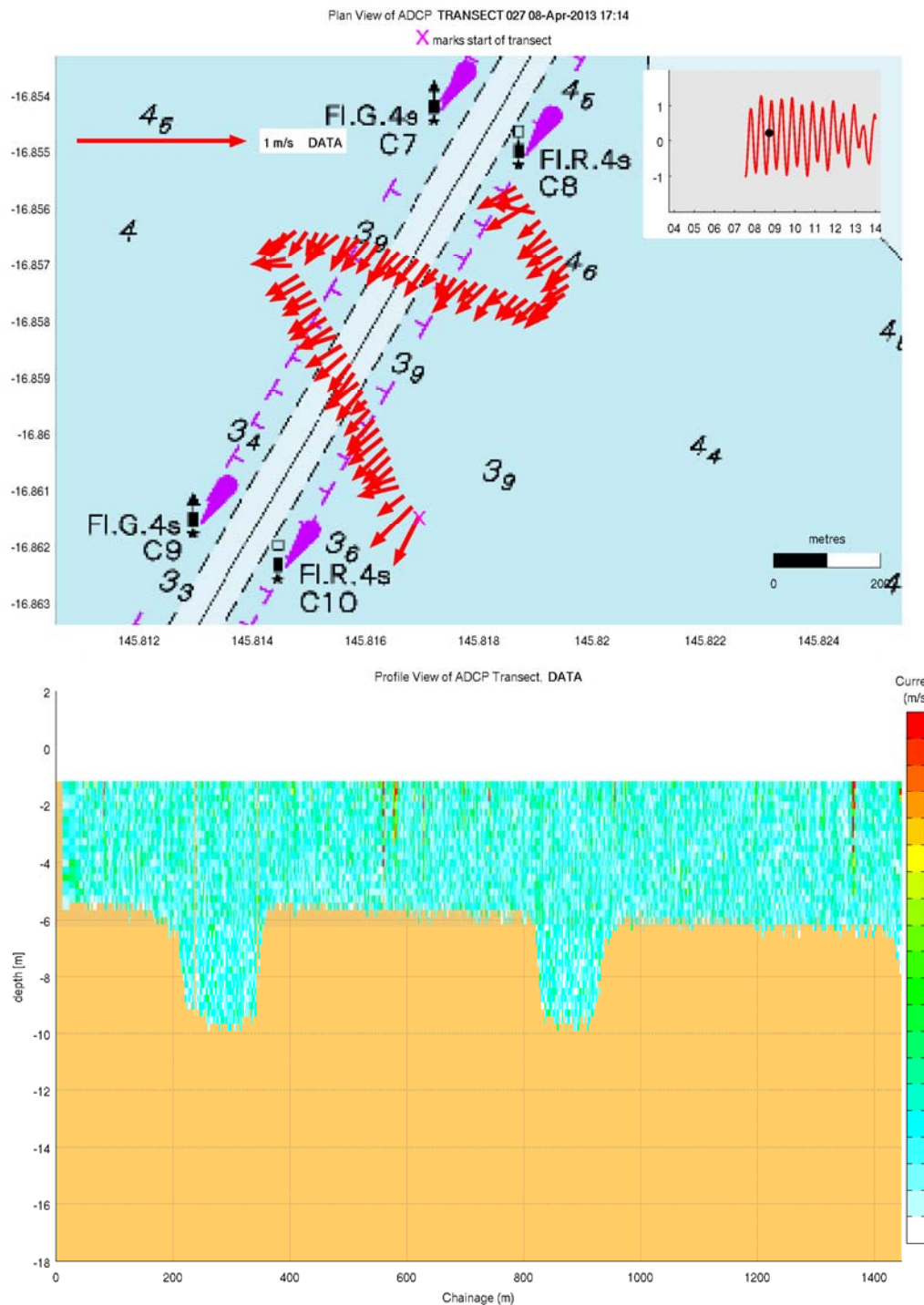


Figure 9-7 ADCP transect, April 2013, Beacons C9-C5

9.2 June 2013

9.2.1 Inner Channel - from Port Berth 11 to Beacon C15

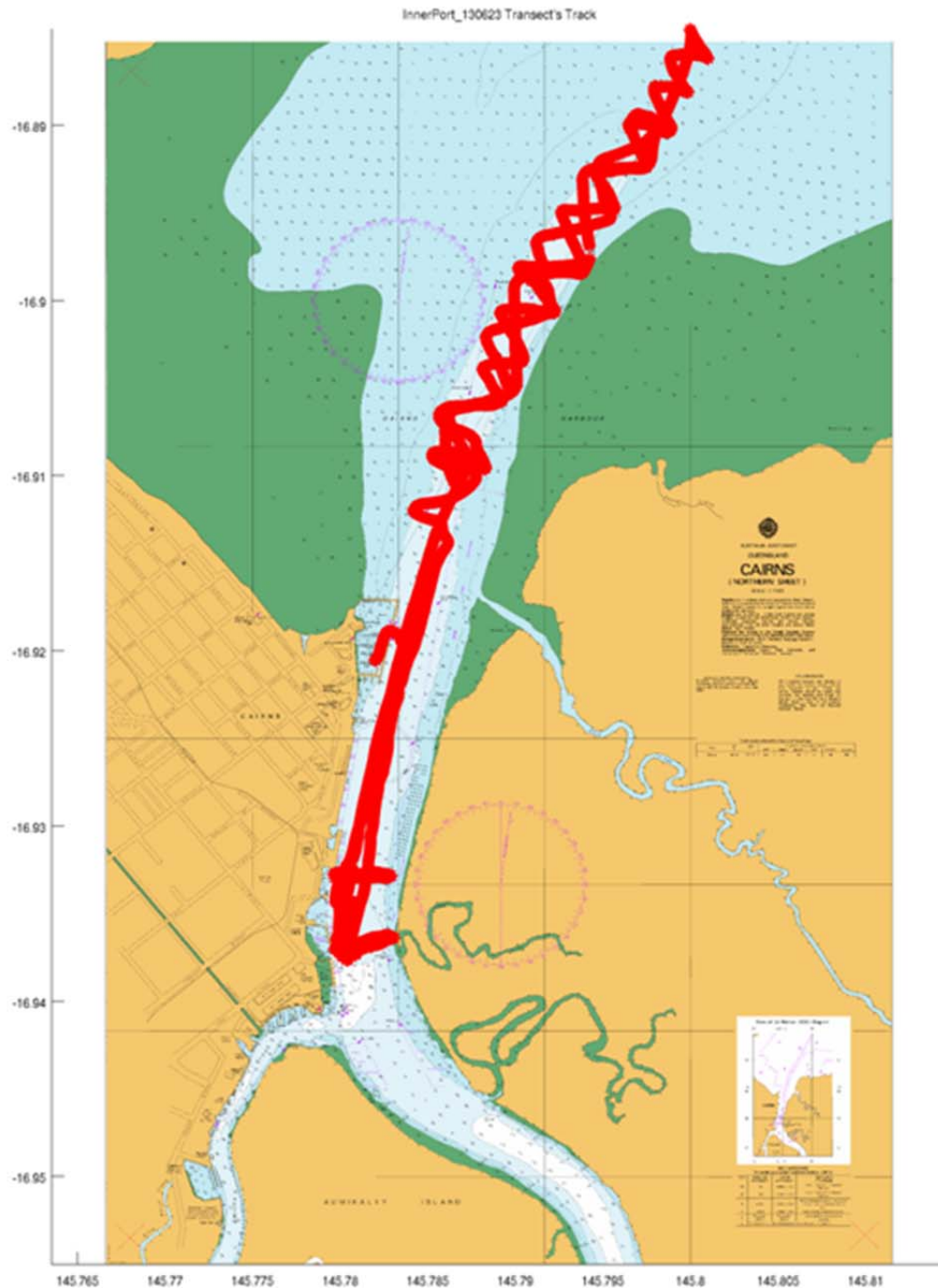


Figure 9-8 ADCP all transects, June 2013, Inner Channel

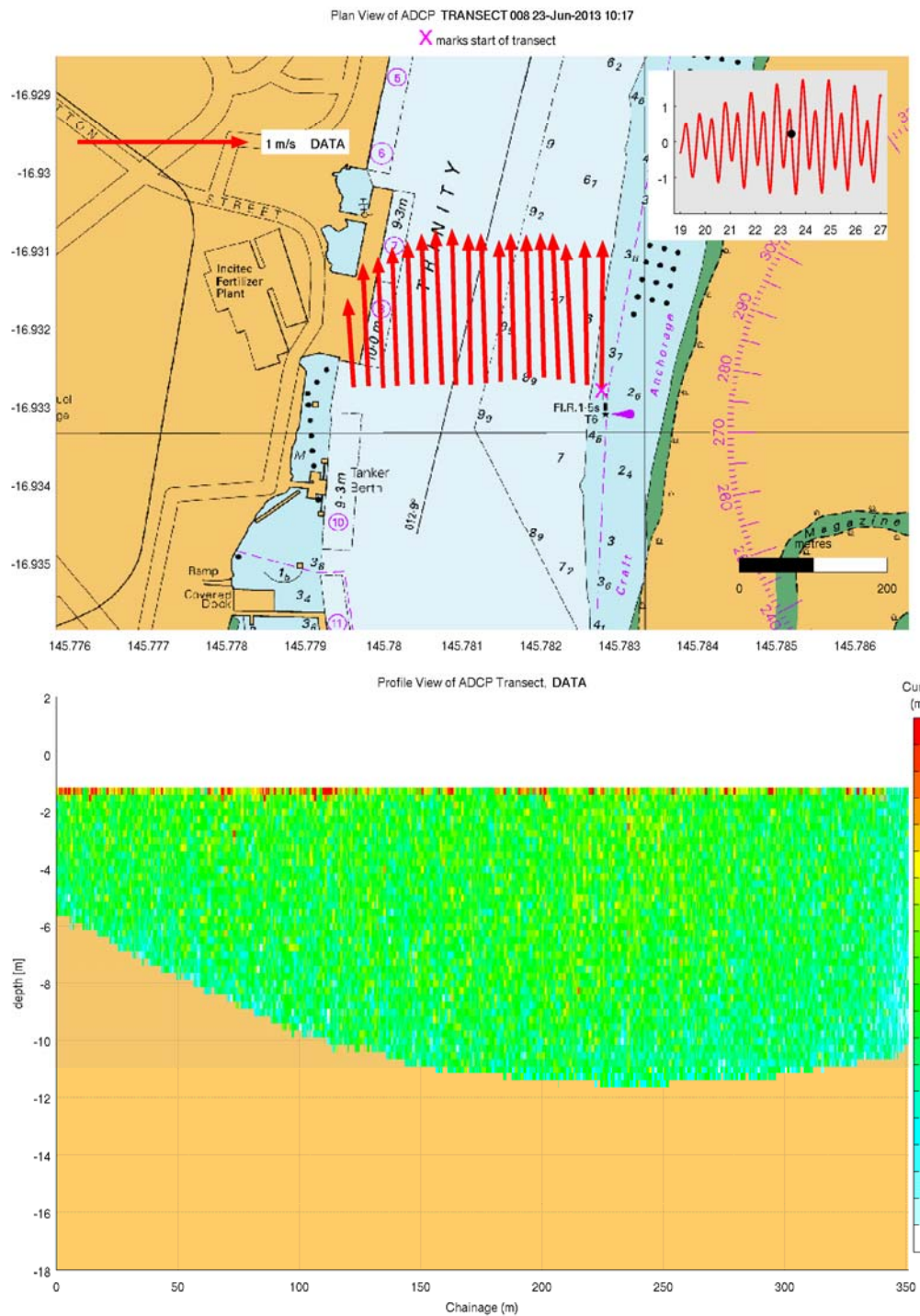


Figure 9-9 ADCP transect, June 2013, Berth 10-11

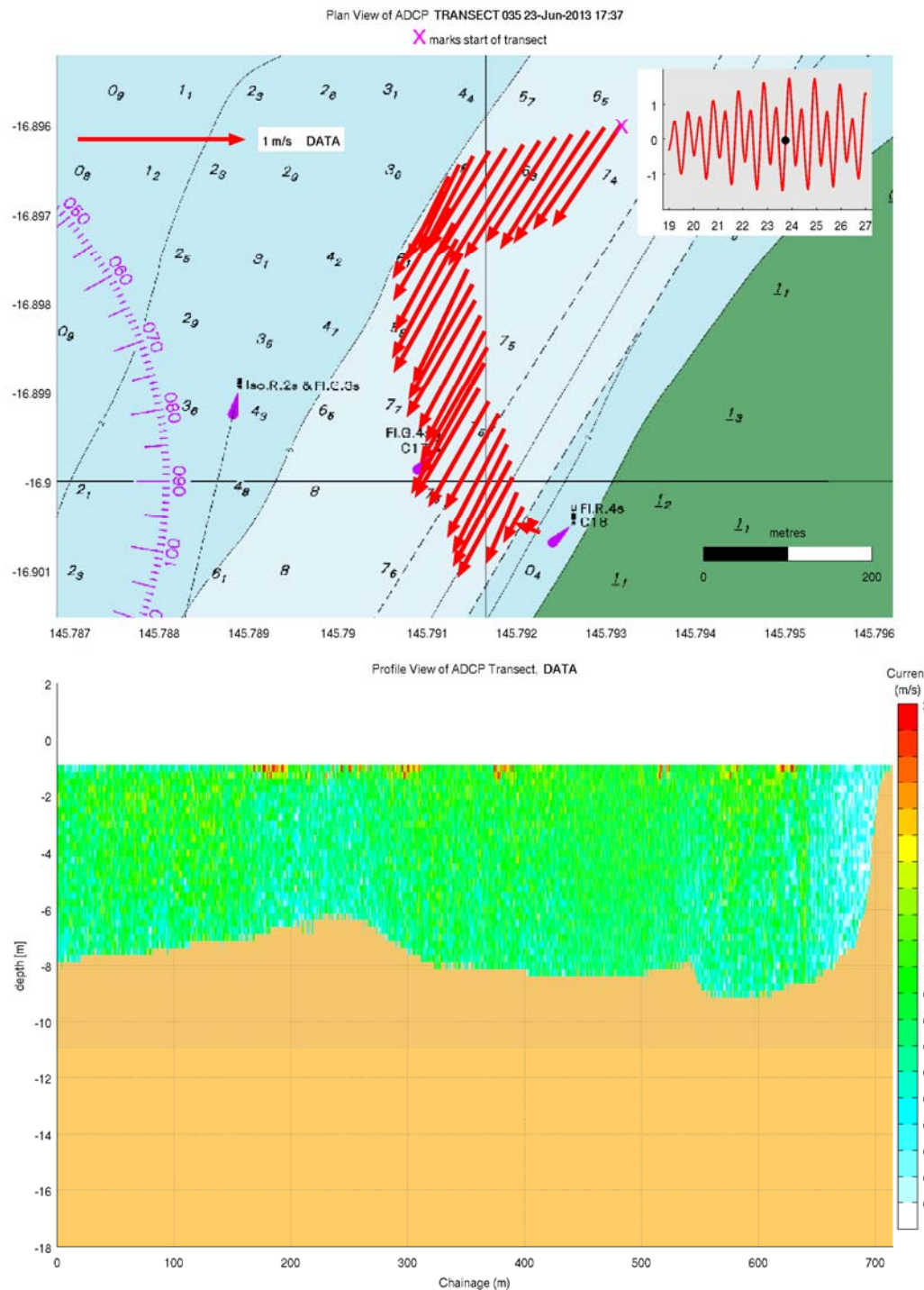


Figure 9-10 ADCP transect, June 2013, Beacons C20-C15

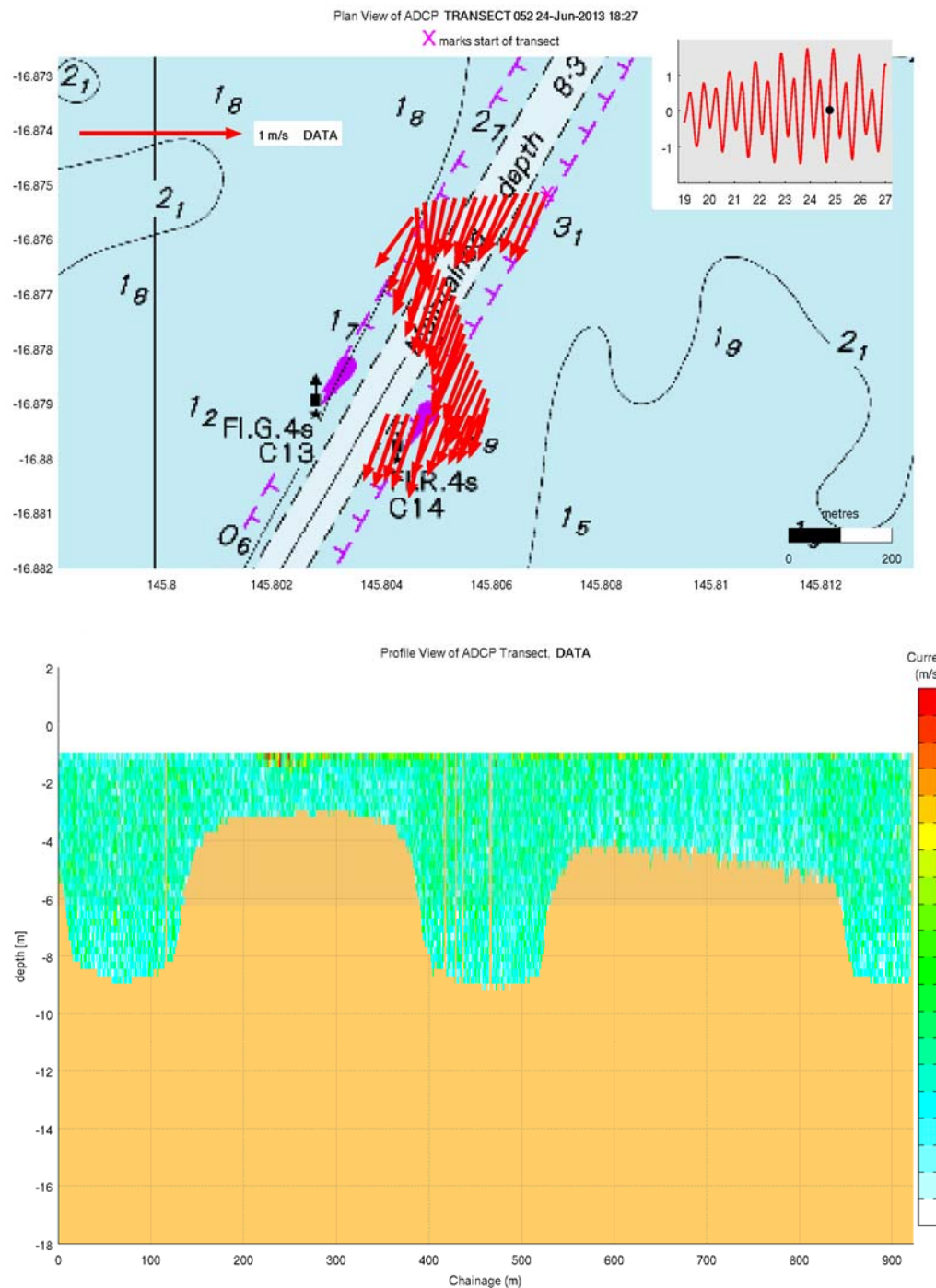


Figure 9-12 ADCP transect, June 2013, Beacons C15-C11

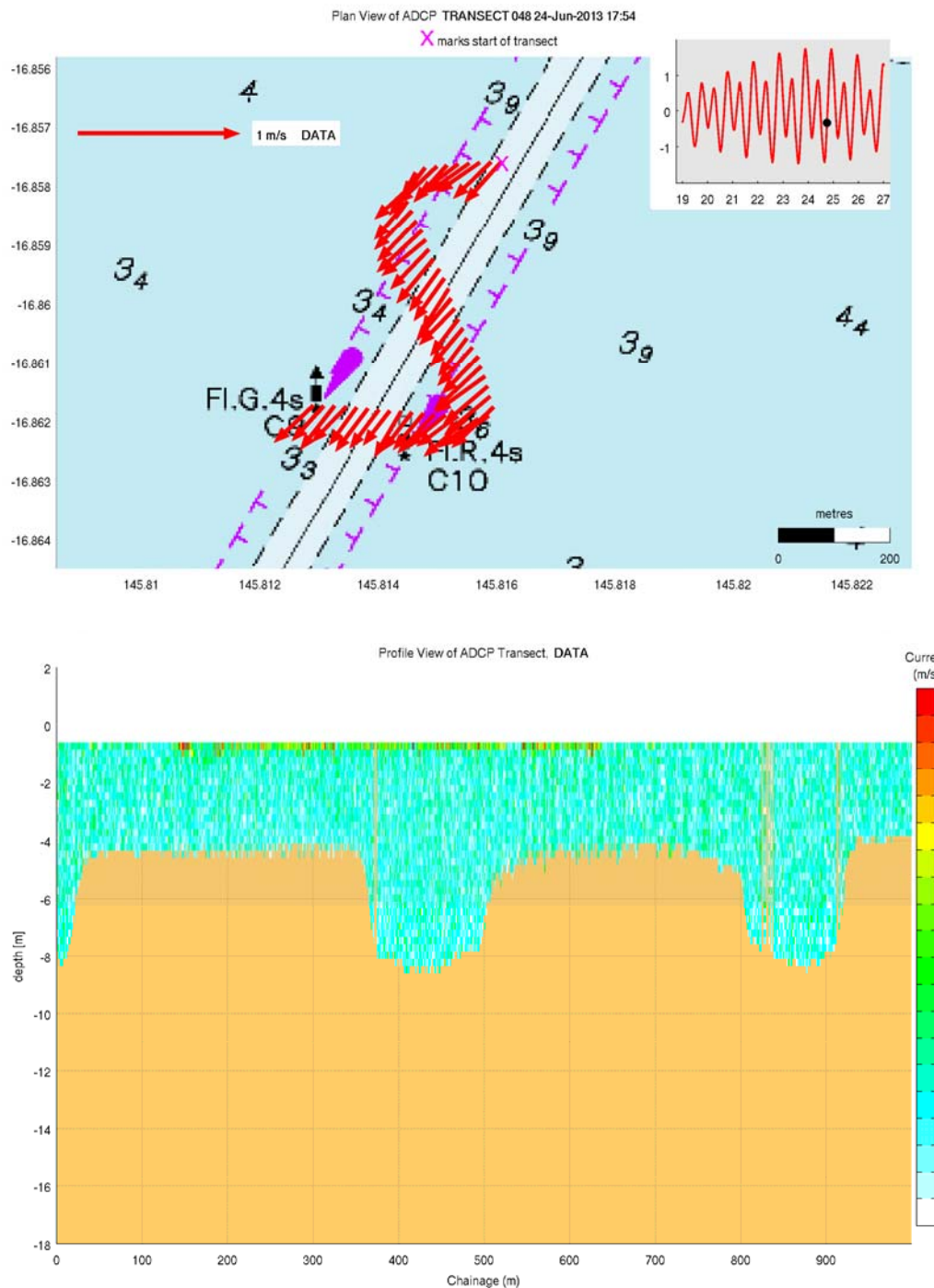


Figure 9-13 ADCP transect, June 2013, Beacons C9-C5

9.3 August 2013

9.3.1 Inner Channel

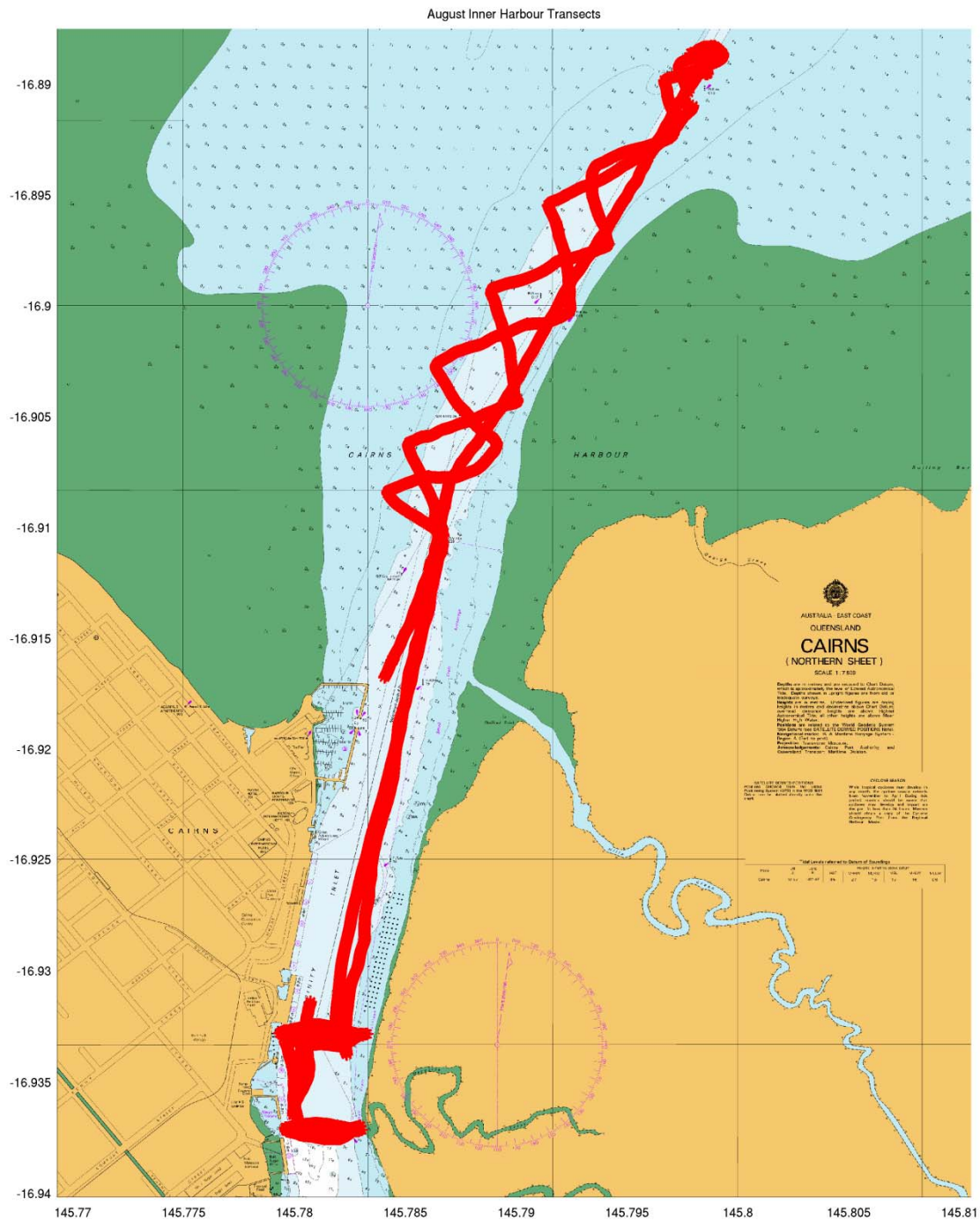


Figure 9-14 ADCP All Transects, August 2013, Inner Channel

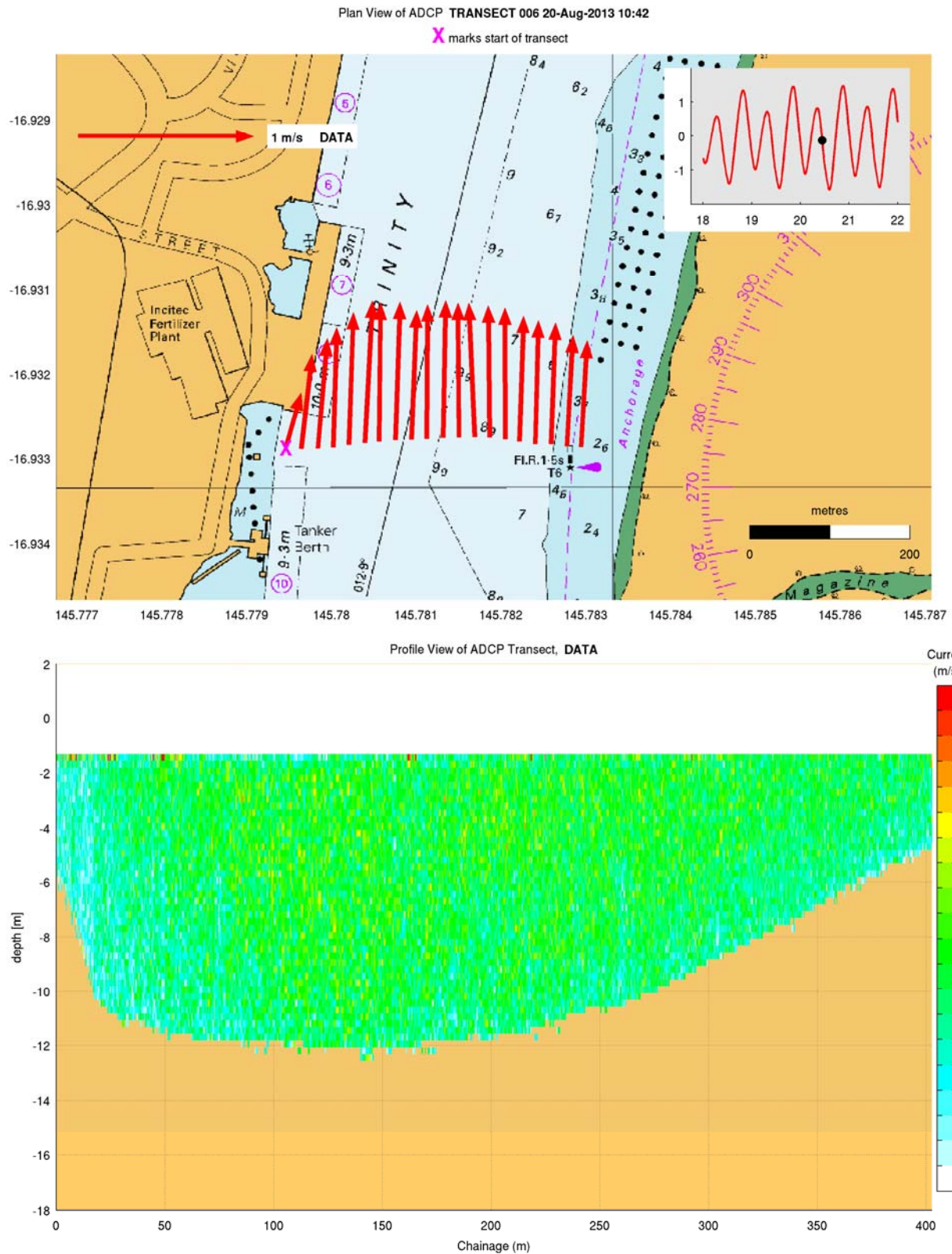
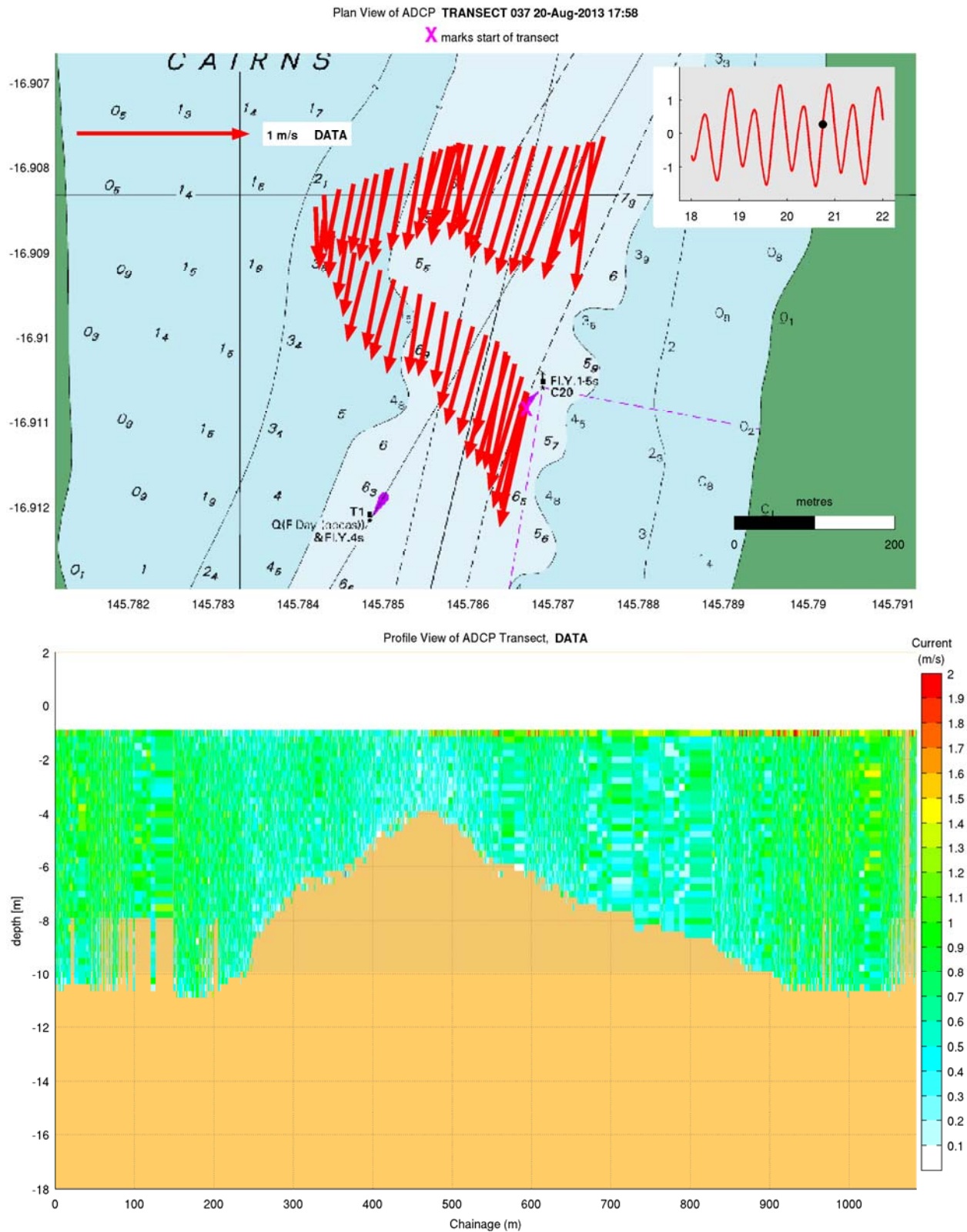


Figure 9-15 ADCP Transect, August 2013, Berth 8 – Berth 10



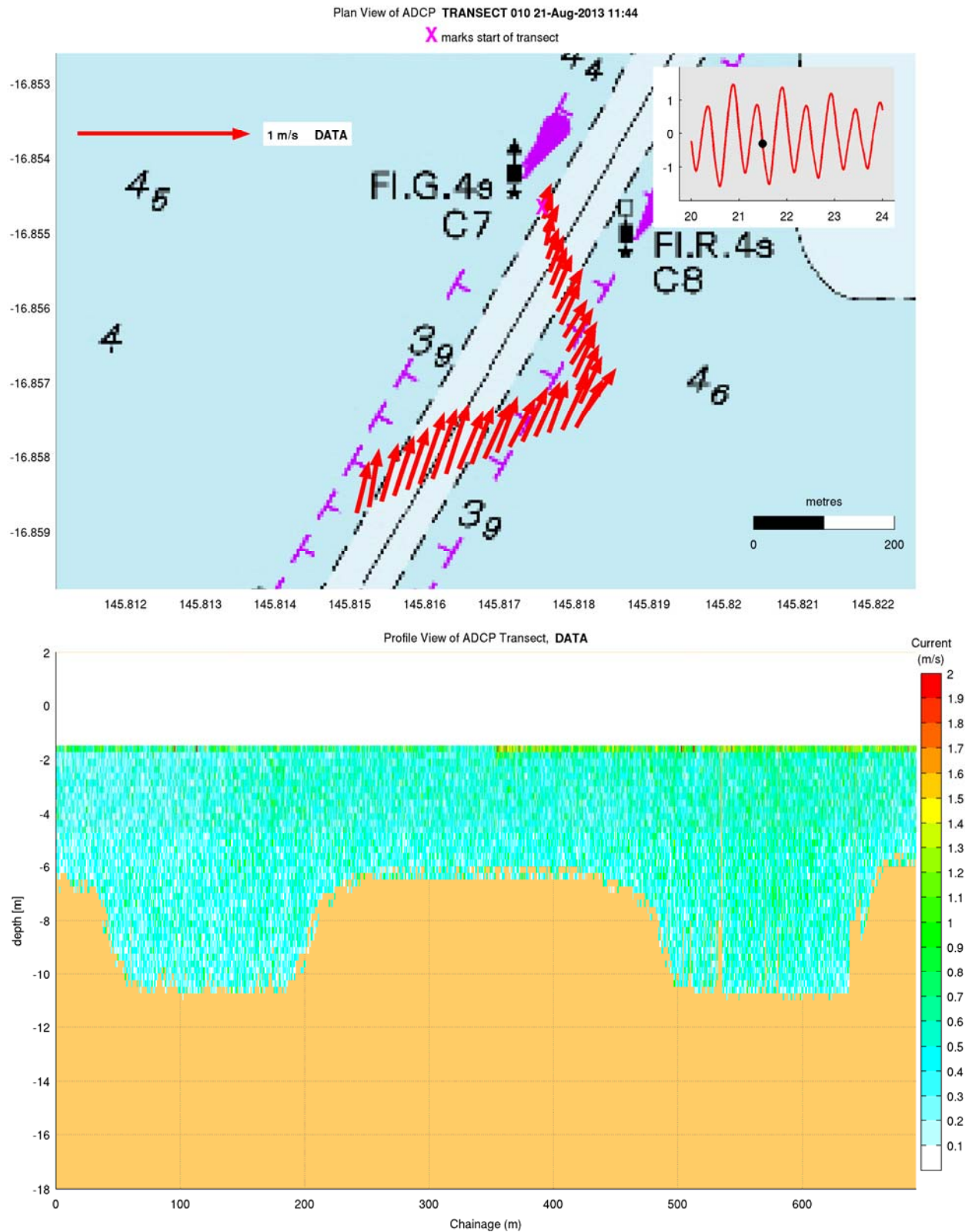
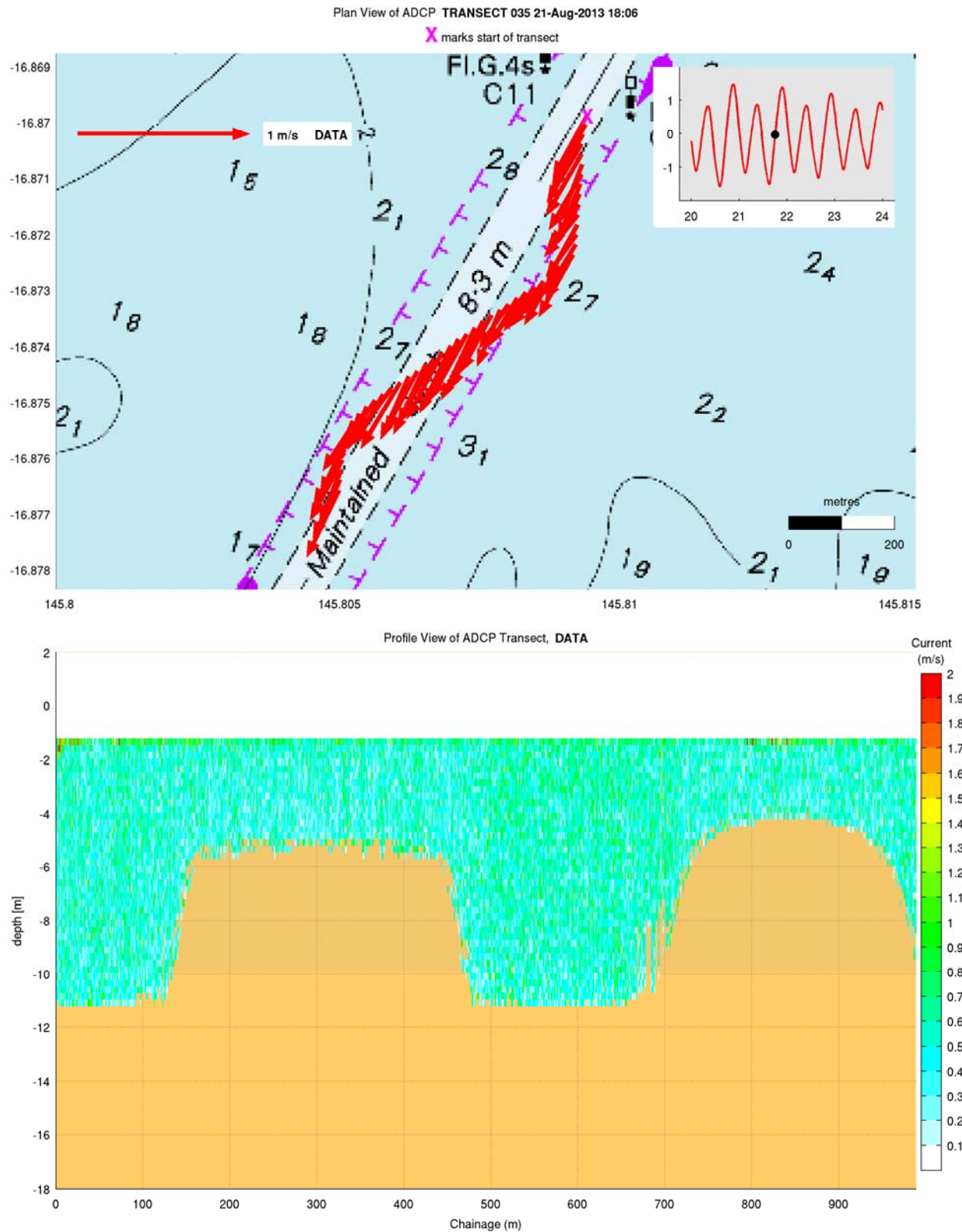


Figure 9-18 ADCP Transect, August 2013, Beacons C7 – C8



10 Sediment Grabs

Based upon the collection of six surface grab samples in June 2013, the sediment texture adjoining the entrance channel varied from silt to fine sand, though was commonly sandy silt or silty sand. The field classification of the sediment texture from the collected samples is summarised in Table 10-1 below. The laboratory particle sizing analysis by sieve and hydrometer for each of the samples are shown in Appendix B.

Table 10-1 Texture of Collected sediment Samples

Location (refer to Figure 1-2)	Field Texture	D50 from Laboratory Sieve Analysis (mm)
Sample 1	Sandy Silt	0.04
Sample 2	Silty Sand	0.075
Sample 3	Sand, with small amount of silt	0.13
Sample 4	Sandy Silt	0.037
Sample 5	Silt	0.028
Sample 6	Silty Sand	0.09

11 Coastal Data Quality and Limitations

Data presented herein has the following known anomalies or deficiencies:

- AWAC Wave and Current Data – high quality data – no known anomalies. Data deficiency at Sites 1 and 5 (DMPA and Beacon C7 respectively), whereby both instruments failed prematurely on the 4th February 2014, approximately 2 weeks prior to the intended 12 month term for data collection. In each instance the data record was cut short due to water ingress and internal corrosion within the AWAC battery cable bulkhead connector.
- ADCP Wave and Current Data – high quality data – no known anomalies.
- Seabird Data Wave and Tide level Data – high quality data – no known anomalies.
- Citadel (CTD) Data – high quality data – no known anomalies.
- YSI Data – a known anomaly identified for electrical conductivity (EC) and salinity, whereby the EC (salinity) sensor is affected by sediment build-up over the deployment period, resulting in erroneous EC and salinity measurements whereby each decreased during the course of each deployment period. No other instrument sensors (eg. water temperature or turbidity) were affected. Despite enquiries to the equipment manufacturer, no fix other than vertically mounting the instruments was identified for solving the sensor problem. The YSI instruments were mounted horizontally so that they could be accommodated within the trawl resistant seabed frames and thus be protected from commercial trawling operations.
- Weather station data – high quality data – no known anomalies. Data deficiency at Site 6 resulting in the presentation of hourly (rather than 6 minute) data during February, March 2013. Flooding of the weather station at Beacon C20 in March 2013 associated with a faulty door lock seal on the data logger box resulted in corrosion of the memory chip associated with the recording of the six minute data and loss of the six minute data in February, March and early April 2013. The available hourly data records (stored on a different memory chip) were substituted during this period.

12 Water Quality Monitoring Program

12.1 Background

An ambient water quality monitoring program was undertaken over a 12 month period at sensitive ecological receptor locations in the Cairns region. The aim of this program is to develop a baseline data set that allows the quantification of spatial and temporal patterns in water quality parameters. These data will be used to inform the EIS for the Cairns Shipping Development Project (CSDP), and the development of water quality management trigger values for future environmental monitoring.

The water quality monitoring program was comprised of the following components:

- Logger-based *in-situ* measurements of various parameters
- Grab samples collected for the analytical measurement of water chemistry
- Depth profiles at offshore locations for baseline turbidity data

12.2 Methodology

12.2.1 Sites

Water quality instruments were attached to frames and deployed at six locations in the Cairns area on the 17th July 2013 and removed on the 22nd July 2014. The six locations are shown in Figure 12-1, as follows:

- Site 1 - Palm Beach
- Site 2 - Yorkeys Knob
- Site 3 - Trinity Bay
- Site 4 - Trinity Inlet
- Site 5 - False Cape
- Site 6 - Cape Grafton

Figure 12-1 also shows the location of vertical profiling sites (Deep 1 to Deep 4) established offshore from Cairns for the measurement of background turbidity.

12.2.2 Unattended Instrumentation

Water quality data at all sites were recorded using YSI 6600V2 water quality instruments. These instruments are capable of continuous logging of data for a range of parameters, with anti-fouling guards and sensor wiping apparatus to prevent interference to sensors from marine growth. All instruments were equipped with a combined temperature/conductivity sensor, as well as a turbidity sensor. Instruments at Palm Beach, Trinity Inlet and False Cape were also fitted with pH and dissolved oxygen sensors. Table 12-1 specifies the range and resolution for each parameter.

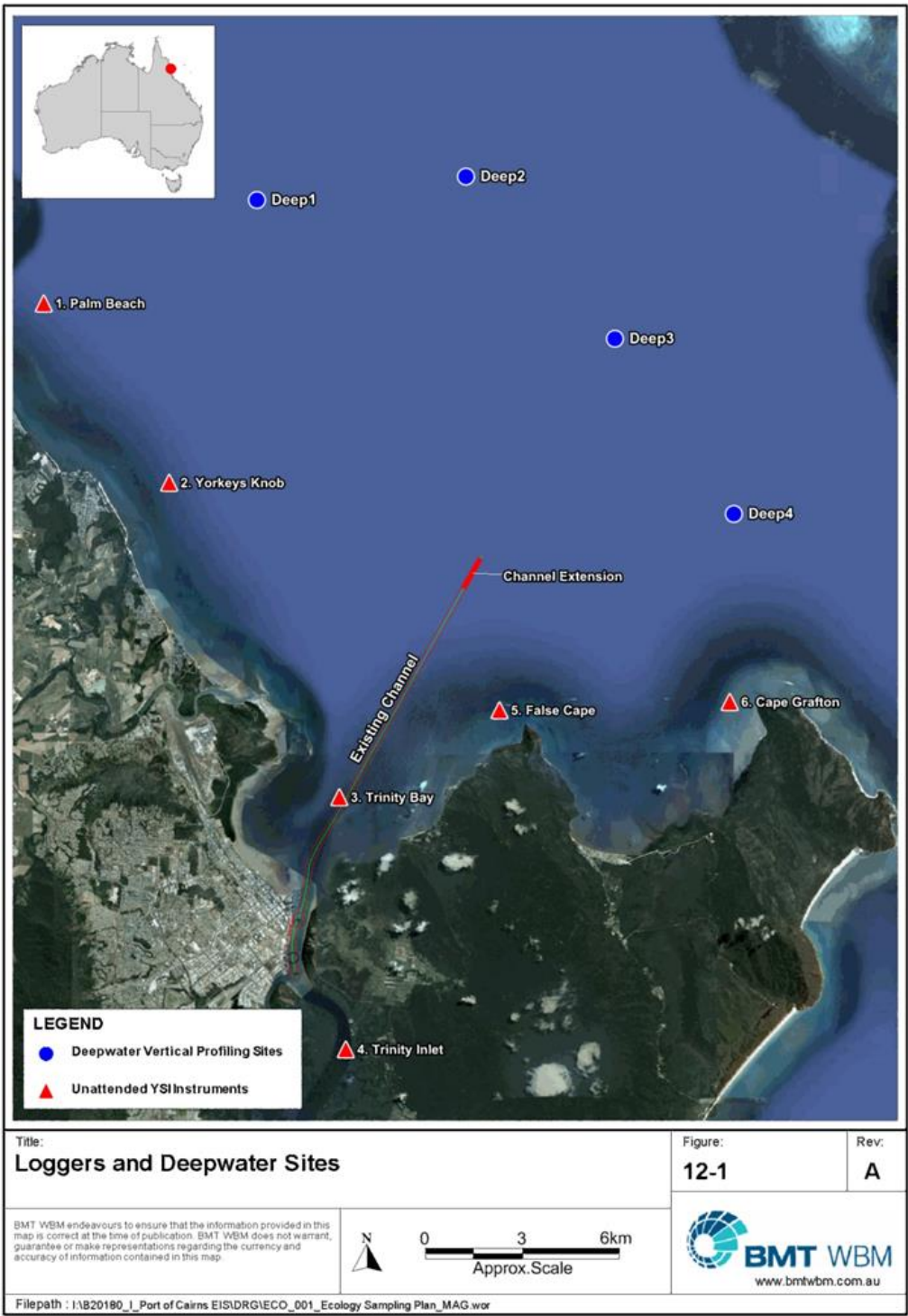


Figure 12-1 Logger and deepwater profiling sites

Table 12-1 Range and resolution for each parameter on the YSI 6600V2 multiprobe sondes

Parameter	Instrument Measurement Range	Resolution
Turbidity (NTU)	0 – 1000 NTU	0.1 NTU
Dissolved oxygen (mg/L)	0 – 50 mg/L	0.01 mg/L
Dissolved oxygen (% saturation)	0 – 500%	0.10 %
pH (pH units)	0-14 (pH units)	0.01 units
Electrical conductivity (µS/cm)	0-100 (mS/cm)	0.001 – 0.1 mS/cm (range dependent)
Water temperature (°C)	-5 - 50°C	0.01°e
Water depth (m)	0-61 m	0.001 m

During the October 2013 servicing trip, a photo-synthetically active radiation (PAR) sensor (supplied by James Cook University, Cairns) was deployed alongside the water quality instrument at Site 3 (Trinity Bay).

Instruments were programmed to log every six minutes. Instruments were serviced and recalibrated every 4-6 weeks, and data were downloaded.

12.2.3 Water Grab Samples

Water grab samples were taken at four instances over the 12 month monitoring period; two in the dry season (August and October 2013), and two in the wet season (November 2013 and January 2014). Samples were taken by van Dorn sampler, allowing a sample to be taken at an "upper" location (~1 m below water surface) and a "lower" location (~ 1 m above sea floor). All dissolved components were field-filtered at the time of collection using a syringe and a 0.45 µm filter. Samples were taken at the location of each unattended instrument during the deployment or retrieval of the instrument.

12.2.4 Depth Profiling

Depth profiling at four offshore, deepwater locations were conducted on five occasions over the course of the 12 month monitoring program to determine background turbidity. Profiles were conducted by deploying the YSI 6600V2 from the boat and held at approximately 1 m depth. The sensors were then mechanically cleaned with the installed wipers to remove any bubbles that may have adhered to the sensor windows. This reduces interference on the optical sensors (DO and turbidity). Once cleaned, data collection commenced and the instrument was lowered slowly to the sea floor; data collection ceased once the instrument reached the bottom (evident from the depth value and turbidity spike). Given the exposed, offshore nature of these locations, there was not always suitable weather to sample at these sites.

12.3 Data Quality

12.3.1 Quality Assurance (QA) Procedures

12.3.1.1 Unattended Instruments (QA Procedures)

The following QA procedures were in place prior to instrument deployment:

- All instruments were calibrated as recommended by the manufacturer using standard solutions prepared from National Institute of Standards and Technology (NIST) traceable reagents.
- New Energizer 'ProCell' batteries were used throughout the campaign.
- An in-house checklist was followed for programming instruments. The checklist prescribed:
 - Download data file from instrument to PC
 - Verify data file is complete and without error. Reattempt download if data file is incomplete
 - Download calibration file to PC
 - Delete all files from instrument
 - Synchronise instrument time to 'real' time (obtainable from PC connected to internet)
 - Check sensor wiping is on and set to correct interval (5)
 - Check correct sensors are enabled
 - Check correct reporting fields are selected
 - Set start time and date. Ensure logging date is correct and period is set to '365' days
 - Ensure battery voltage is >12.0 v
 - Ensure battery life and free memory exceed the expected duration of sampling
 - Commence logging
 - Verify instrument is logging in 'Status' screen
 - Verify instrument is logging just prior to deployment by observing wiper on optical sensor.

12.3.1.2 Water Grab Samples (QA Procedures)

Sampling was conducted with guidance from DEHP (2009a) and ARMCANZ & ANZECC (2000a). The quality assurance procedures in place during the Ports North sampling program are summarised below:

- All bottles were obtained from a NATA accredited laboratory, sealed until the day of sampling.
- All bottles were pre-labelled in indelible ink prior to sampling with sufficient time to dry before sampling.
- The van Dorn sampler was washed in DeCon90 decontamination liquid prior to sampling and rinsed in fresh seawater from each sampling site prior to a sample being taken.

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- All sampling was conducted with gloved hands, with new gloves used for each sampling location.
- All sample bottles (except for those prefilled with preservative) were rinsed with water from the sample site prior to obtaining the sample.
- Pre-packaged 0.45 µm filters were used for dissolved fractions.
- Syringes were rinsed three times with water from the sample site prior to obtaining a sample.
- Samples were immediately placed on ice. At the completion of sampling, the bottles were sealed in eskies with ice bricks, and air freighted overnight to Brisbane for analysis. A chain-of-custody form, completed and reviewed by separate field officers, accompanied the samples to the laboratory.

12.3.2 Quality Control (QC) Procedures

12.3.2.1 Unattended Instruments (QC Procedures)

Water quality instruments in the marine environment are subjected to harsh conditions so it is necessary to check data for quality and rigour to ensure only reliable data is retained. To do this, it must be determined whether recorded data are real and representative of actual conditions, or whether they may be affected by instrument anomalies or non-representative outlier events. Data anomalies may be caused by, for example:

- Temporary spikes created by drifting material or animals, or disturbance of sediments by boats, animals or humans;
- Sensor malfunction;
- Sensor siltation;
- Invertebrate/algal fouling of sensors; and/or
- Human error (e.g. calibration error).

The following quality control procedures were implemented at the end of each deployment period (4-6 weeks):

- Following retrieval, the instruments and sensors were thoroughly inspected and any significant fouling or damage was noted in order to compare with reported values.
- Raw data were plotted as a time series and suspected outliers were investigated with the following process:
 - Suspected outliers were compared to data within the same instrument dataset from a similar period of time to determine if data were correct. For example, human or animal interaction was suspected in the event of short-term, single event turbidity spikes when turbidity readings either side of these spikes were significantly lower.
 - Figure 12-12 illustrates examples where turbidity values exceed surrounding values by an order of magnitude (1. ~70 NTU vs ~700 NTU; 2. ~50 NTU vs ~500 NTU).

- Data were then examined with consideration to the meteorological conditions at the time (with data from the BMT WBM weather stations and Bureau of Meteorology) to determine whether rainfall or wind conditions may have affected the measurements in question. If high rainfall or strong winds did not accompany dips in EC or spikes in turbidity, the data were considered potentially erroneous and subjected to further scrutiny.
- The questionable data were also compared with trends in data from other instruments known to experience similar conditions. If other instruments did not show similar patterns, the data were considered potentially erroneous.
- Finally, recalibration of the equipment for subsequent deployments identified whether an individual sensor, or entire sonde, could be responsible for erroneous readings (for example, a turbidity wiper inoperable, or a pH probe out of specification).

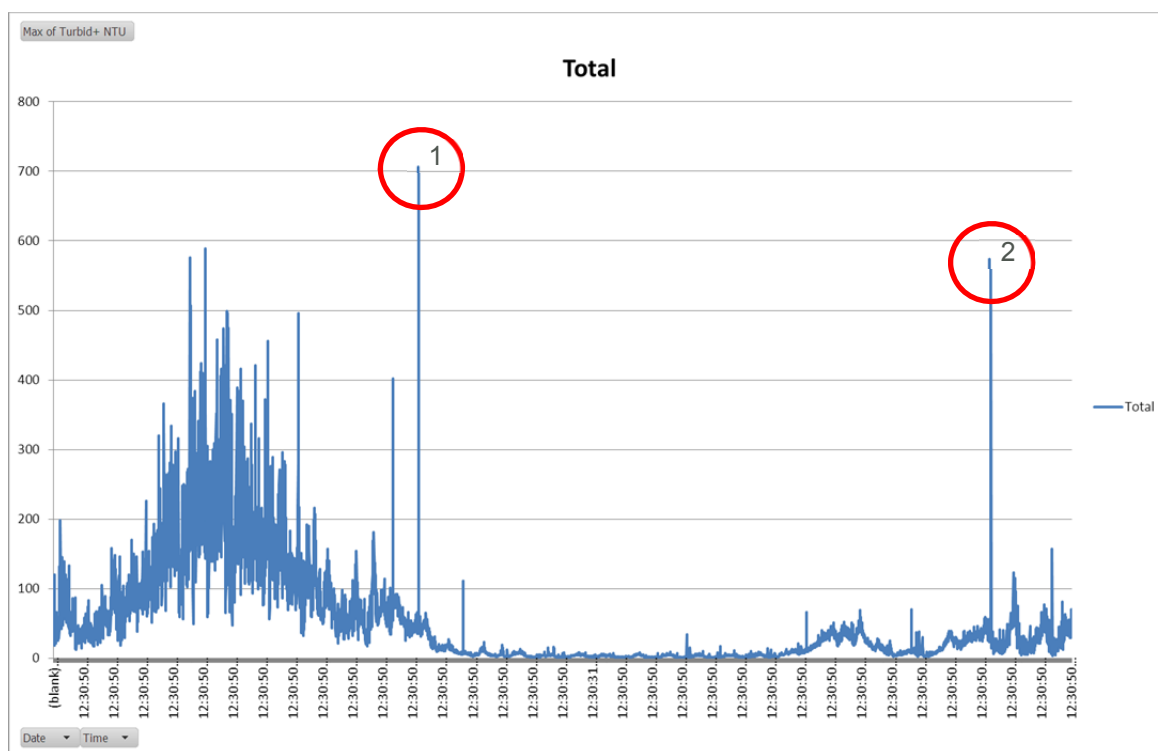


Figure 12-2 Turbidity outliers (circled) which greatly exceed other values recorded immediately before or after

After completing the described QC methods, in cases where the cause for unexpected, although reasonable, readings was not readily apparent, data were retained. However if data spikes or erroneous data were suspected, the data were quarantined from the data set and not used in analyses.

Data quality was categorised according to the percentage of data that was quarantined following quality control procedures (<5%, 5-30%, 30-50%, >50%). Since turbidity was the main parameter of interest, the categorisation was based solely on this parameter.

12.3.2.2 Water Grab Samples (QC Procedures)

Most of the QC procedures regarding water grab samples were implemented by the analytical laboratory. These included:

- Intra-sample duplicates;
- Blank samples; and
- Spiked samples.

Laboratory reports indicated no quality issues within the laboratory methods. Laboratory quality reports are included in Appendix C. BMT WBM internal QC procedures for water grab samples included:

- Examination of laboratory results for erroneous data such as high readings, or discrepancies between dissolved and total fractions; and
- Examination of laboratory quality reports to check duplicate, blank and spike samples were within guideline levels.

12.3.3 Instrument Malfunction

During the twelve month monitoring program there were instances of sensor malfunction. In January 2014, three of the six instruments had a major malfunction, with sensors on two instruments flooding, and the pressure housing flooding on another instrument. The resulting loss of data is summarised below:

- Palm Beach- 8 weeks data lost;
- Trinity Inlet- 5 weeks data lost; and
- False Cape- 7 weeks data lost.

12.4 Data Summary

12.4.1 Unattended Instrument Water Quality

Overall data quality was high, with 46 out of the 54 sampling events (9 campaigns x 6 instruments) retaining more than 95% of the collected data (Table 12-12).

Table 12-13 provides summary statistics (minimum, maximum, median, 20th, 50th, 80th and 95th percentile values) for water quality parameters measured *in situ* by YSI multi-probe loggers at each site.

Table 12-2 Categorisation of data quality (percentage of turbidity data quarantined)

Campaign	Commenced	Ceased	1. Palm Beach	2. Yorkeys Knob	3. Trinity Bay	4. Trinity Inlet	5. False Cape	6. Cape Grafton
1	17/07/2013	28/08/2013	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	30/08/2013	3/10/2013	0.00%	0.00%	0.00%	0.00%	27.03%	0.00%
3	8/10/2013	21/11/2013	0.06%	27.26%	0.00%	0.00%	0.00%	0.00%
4	25/11/2013	17/01/2014	100.00%	0.05%	0.00%	79.98%	83.77%	0.00%
5	25/01/2014	20/02/2014	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	23/02/2014	4/04/2014	0.02%	0.00%	30.76%	45.71%	0.00%	0.00%
7	7/04/2014	20/05/2014	0.00%	0.00%	0.00%	46.98%	0.00%	0.00%
8	22/05/2014	21/06/2014	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
9	24/06/2014	22/07/2014	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 12-3 Summary of water quality data (July 2013 - July 2014)

Monitoring Site	Summary Statistic	Temp (°C)	EC (mS/cm)	Salinity (ppt)	Turbidity (NTU)	DO (% sat)	DO (mg/L)
1. Palm Beach	Minimum	20.9	39.0	24.7	0.0	72.4	4.9
	20 th percentile	23.1	49.3	31.3	4.0	95.2	6.4
	Median	26.3	52.7	34.3	14.2	97.3	6.6
	80 th percentile	27.5	54.7	36.1	47.0	99.0	6.9
	95 th percentile	28.4	55.7	36.8	116.0	101.6	7.1
	Maximum	29.6	60.2	40.0	1304.9	118.2	7.7
2. Yorkeys Knob	Minimum	20.3	0.1	30.7	0.2	-	-
	20 th percentile	23.0	51.2	33.6	4.7	-	-
	Median	26.3	52.1	34.5	18.4	-	-
	80 th percentile	27.5	53.9	35.9	54.2	-	-
	95 th percentile	28.3	55.3	36.8	121.3	-	-
	Maximum	29.8	56.0	37.2	1480.3	-	-
3. Trinity Bay	Minimum	21.0	25.4	15.5	0.4	-	-
	20 th percentile	23.3	49.3	32.2	7.1	-	-
	Median	27.0	52.6	34.6	18.0	-	-
	80 th percentile	28.3	54.6	36.1	54.8	-	-
	95 th percentile	29.5	55.4	36.7	161.2	-	-
	Maximum	31.2	56.3	37.4	1422.7	-	-
4. Trinity Inlet	Minimum	20.9	18.7	11.1	1.0	43.9	3.0
	20 th percentile	23.6	47.9	31.2	4.3	72.5	4.8
	Median	27.2	51.0	33.4	7.6	81.0	5.4
	80 th percentile	28.4	52.9	34.8	18.4	86.8	6.0
	95 th percentile	29.5	54.5	36.0	60.1	91.1	6.4
	Maximum	31.3	55.7	36.9	1387.3	101.5	7.0
5. False Cape	Minimum	20.4	27.3	16.7	0.1	33.7	2.5
	20 th percentile	23.2	51.3	33.7	8.8	97.0	6.4
	Median	26.5	52.7	34.7	37.9	98.7	6.6
	80 th percentile	27.8	55.3	36.6	106.7	100.4	6.9
	95 th percentile	28.8	55.7	36.9	397.4	103.3	7.1
	Maximum	30.2	57.1	38.0	1355.2	117.3	7.7
6. Cape Grafton	Minimum	20.5	24.1	14.6	-0.1	-	-
	20 th percentile	23.3	48.9	32.0	4.2	-	-
	Median	27.0	52.3	34.4	31.8	-	-
	80 th percentile	28.2	54.2	35.9	151.0	-	-
	95 th percentile	29.1	55.4	36.6	732.2	-	-
	Maximum	31.1	55.8	36.9	1983.8	-	-

As turbidity is a key parameter of interest, time series graphs have been produced showing mean daily turbidity at the six monitoring sites (Figure 12-3).

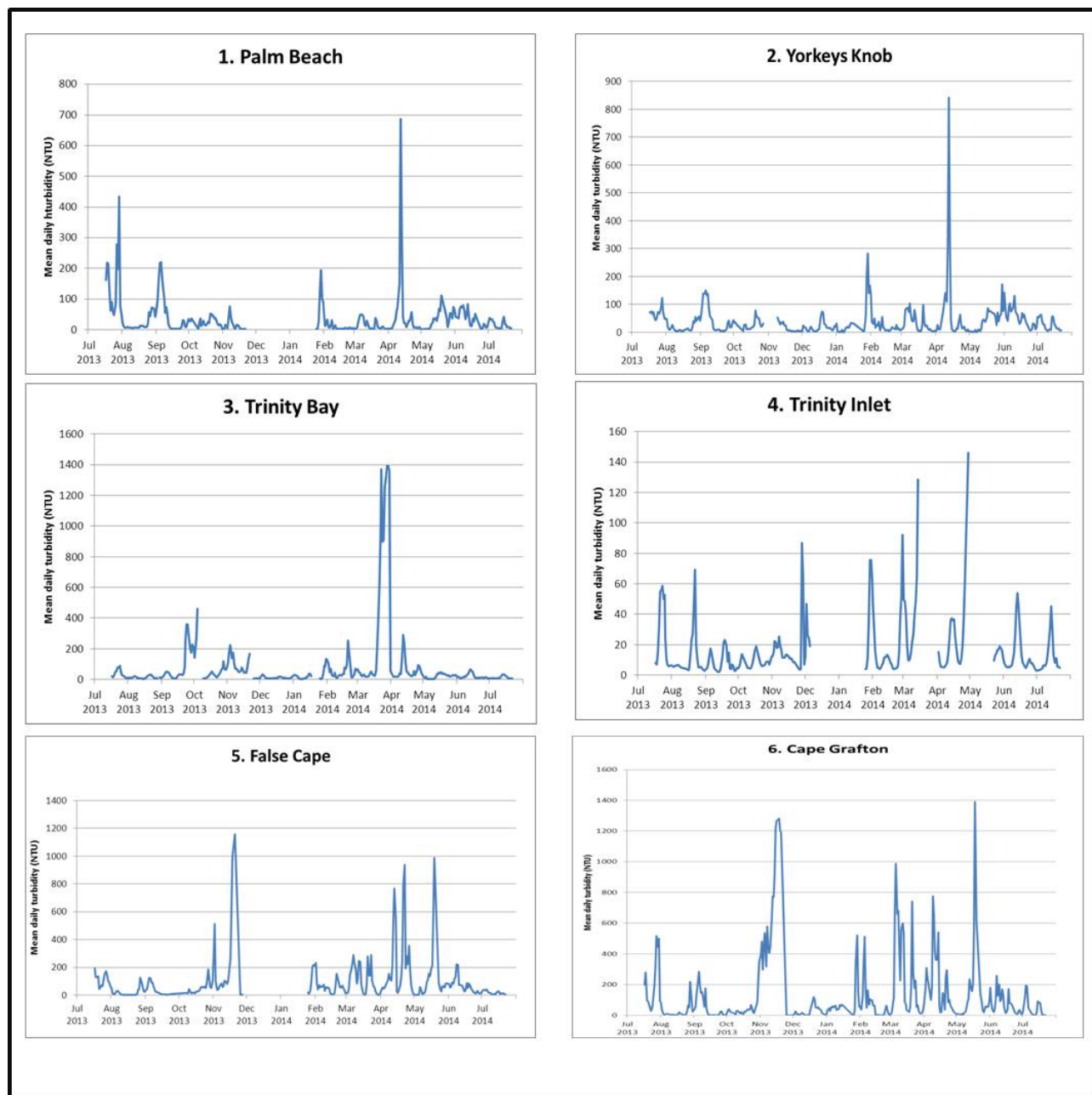


Figure 12-3 Mean daily turbidity at instrument locations (note, varying y-axis scales)

12.4.2 Grab Sampling Water Chemistry

Water chemistry data collected during two dry season sampling events (August, October 2013) and two wet season sampling events (November 2013 and January 2014) were pooled and 95th percentile values (metals) and medians (nutrients) were calculated and are presented in Table 12-4. Note, values which were below laboratory levels of reporting (LOR) are reported as half the LOR value. Laboratory reports are included in Appendix C.

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Table 12-4 Water chemistry data – 95th percentile values for metals, median values for nutrients. Values calculated from four events; two dry, two wet (values <LOR are reported as half the LOR)

Parameter	Guideline (µg/L)	Palm Beach		Yorkeys Knob		Trinity Bay		Trinity Inlet		False Cape		Cape Grafton	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Aluminium [#]	0.5 ^a	32.95	30.85	31.75	33.85	33.15	33.60	27.35	15.40	36.45	34.05	37.55	36.40
Arsenic [#]	2.3 ^a	2.32	2.38	2.32	2.32	2.32	2.32	2.26	2.34	2.40	2.38	2.40	2.38
Cadmium	0.7 ^b	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.32	0.31	0.31	0.33	0.31
Chromium	4.4 ^c	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.00	1.43	1.43	1.43	1.43
Copper	1.3 ^c	2.55	2.30	3.01	2.30	3.33	2.99	3.93	3.20	2.81	1.75*	3.07	1.84
Iron [#]	300.0 ^a	54.20	10.85	10.00	10.00	10.00	10.85	11.70	9.66	10.00	32.95	10.00	10.00
Lead	4.4 ^c	0.44	0.44	0.43	0.45	0.43	0.46	0.47	0.46	0.43	0.43	0.44	0.43
Manganese [#]	80.0 ^a	2.84	3.01	3.65	2.76	4.97	4.71	55.65	22.80	2.93	3.35	4.03	3.86
Nickel	7.0 ^b	1.39	1.37	1.37	1.37	1.37	1.37	1.40	1.43	1.38	1.42	1.43	1.42
Silver	1.4 ^c	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.46	0.46
Zinc	15.0 ^c	12.64	18.30	10.31	13.55	13.61	9.13	16.55	12.27	14.10	11.50	14.25	2.50
Mercury	0.1 ^b	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0005	0.0001	0.0001	0.0001	0.0001
Total Metals (µg/L)													
Aluminium [#]	0.5 ^a	150.00	175.50	158.30	626.00	211.00	298.50	773.00	148.60	177.00	833.00	954.50	385.50
Arsenic [#]	50.0 ^a	2.43	2.44	2.43	2.44	2.44	2.59	2.29	2.38	2.47	2.47	2.43	2.44
Cadmium	0.7 ^a	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.32	0.31	0.31	0.31	0.31
Chromium	4.4 ^a	1.43	1.43	1.43	2.95	1.43	1.43	1.43	1.00	1.43	2.61	3.29	3.12
Copper	1.3 ^a	3.98	3.39	9.71	4.22	3.68	4.02	9.94	10.14	3.01	4.26	6.01	2.43
Iron [#]	300.0 ^a	146.20	165.15	110.00	535.00	235.00	319.50	632.00	134.90	155.50	684.50	787.50	364.50
Lead	4.4 ^a	0.50	2.64	0.53	2.75	0.53	0.49	0.72	1.64	0.46	1.52	1.20	1.48

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Manganese [#]	80.0 ^a	7.30	8.13	12.25	38.50	37.65	31.15	62.15	25.80	11.25	37.80	52.65	18.80
Nickel	7.0 ^a	1.41	1.42	1.46	1.49	1.46	1.46	1.44	1.47	1.42	1.49	1.43	1.44
Silver	1.4 ^a	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.46	0.46
Zinc	15.0 ^c	15.40	15.25	12.70	15.25	15.98	17.80	17.55	16.85	34.93	19.50	15.07	16.44
Mercury	0.1 ^b	0.0001	0.0008	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nutrients (µg/L unless stated)													
Ammonia	2.0 ^d , Trinity Inlet=15 ^e	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Ortho-P	n/a	1.00	1.00	1.50	2.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.50
NO3+NO2	2.0 ^d , Trinity Inlet =20.0 ^e	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00
Total-P	20.0 ^d	10.00	10.00	11.00	10.00	11.00	16.00	16.00	16.00	11.00	15.00	10.00	11.00
Total-N	140.0 ^d , Trinity Inlet=250.0 ^e	90.00	80.00	80.00	90.00	100.00	140.00	150.00	140.00	90.00	110.00	90.00	80.00
TBT	0.006 ^a	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Diuron	0.9 ^f	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total oil and grease (mg/L)	n/a	3.00	2.00	2.50	3.00	3.00	3.00	3.50	3.00	4.50	2.00	4.50	5.00
Total Suspended Solids (mg/L)	n/a	1.00	1.00	2.50	1.50	3.50	4.00	3.00	2.00	3.50	8.50	6.00	7.00
a. ANZECC & ARMCANZ (2000b) Toxicant Trigger Values (% protection level not specified, usually because of limited data available for accurate calculations)													
b. ANZECC & ARMCANZ (2000b) Toxicant Trigger Values (Based on the 99% protection level to protect against chronic toxicity to related species and bioaccumulation)													
c. ANZECC & ARMCANZ (2000b) Toxicant Trigger Values (Based on 95% protection level as recommended for slightly to moderately disturbed)													
d. QLD Water Quality Guidelines (DEHP 2009b) - Annual median values (open coastal)													
e. QLD Water Quality Guidelines (DEHP 2009b)- Annual median values (enclosed coastal)													
f. Water Quality Guidelines for the Great Barrier Reef Marine Park (GBRMPA 2010), 99% protection level													
# Marine guideline is of low reliability													
* One sample (False Cape; July 2013; lower; dissolved) removed from dataset as lab error or field contamination resulted in dissolved concentration> total concentration													
N.B. Total values are compared against a dissolved guideline, so are indicative only													

12.4.3 Depth Profiling

Turbidity at each of the deepwater locations was typically very low. Depth averaged turbidity data is presented for each of the four locations in Table 12-5.

Table 12-5 Depth averaged turbidity for the deepwater baseline sites

Depth (m)	Average Turbidity (NTU)			
	Deepwater 1	Deepwater 2	Deepwater 3	Deepwater 4
0-1	0.4	0.3	0.5	0.5
1-2	0.4	0.1	0.5	0.4
2-3	0.3	0.2	0.3	0.3
3-4	0.4	0.0	0.2	0.2
4-5	0.4	0.2	0.2	0.2
5-6	0.4	0.1	0.1	0.3
6-7	0.3	0.2	0.2	0.2
7-8	0.5	0.2	0.2	0.4
8-9	0.5	0.1	0.2	0.5
9-10	0.4	0.2	0.0	0.4
10-11	0.4	0.2	0.2	0.4
11-12	0.5	0.0	0.1	0.4
12-13	0.4	0.2	0.2	0.5
13-14	0.5	0.2	0.2	0.4
14-15	0.6	0.2	0.2	0.2
15-16	0.5	0.1	0.1	0.5
16-17	0.6	0.2	0.2	0.5
17-18	0.8	0.2	0.3	0.5
18-19	1.4	0.2	0.2	0.5
19-20	-	-	0.3	0.6
20-21	-	-	0.3	0.9
21-22	-	-	0.3	0.9
22-23	-	-	0.4	1.2
23-24	-	-	1.3	0.8
24-25	-	-	1.2	0.9
25-26	-	-	1.2	0.7
26-27	-	-	0.5	-
Full depth range average	0.5	0.2	0.3	0.5
Sampling dates: 28 th August/ 2 nd October/20 th November 2013, 25 th January/23 rd February 2014				

References

13 References

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Appendix A Instrumentation

A.1 Tidal Height (and Wave) Data

A.1.1 Instruments

High accuracy tidal height data was collected using Sea-Bird SBE 26plus tide and wave recorders (http://www.seabird.com/products/spec_sheets/26plusdata.htm) owned by BMT WBM (Figure A-1).

The SBE 26 plus instruments met the required specifications of the Scope of Works and were equipped with appropriate range pressure transducers for the expected water depths. Two Sea-Bird SBE 26plus tide recorders rated to 20m depth range were located at the DMPA and Beacon C2 and were supported by a range of several other water level measuring recording devices including Nortek AWACs, RDI ADCPs, and RDI Citadel CTDs at other measurements sites.

Figure A- 1 provides a summary of instrument specifications for the Sea-Bird SBE 26plus. Recording of tidal height data was undertaken with a recording interval of 6 minutes and an averaging period of 60 seconds, consistent with the data record collected with the AWAC and ADCP current meters.

Since the Seabird Instruments are fully submersible the external measurement of atmospheric pressure at Beacon C11 was used to reduce the measured tidal data.

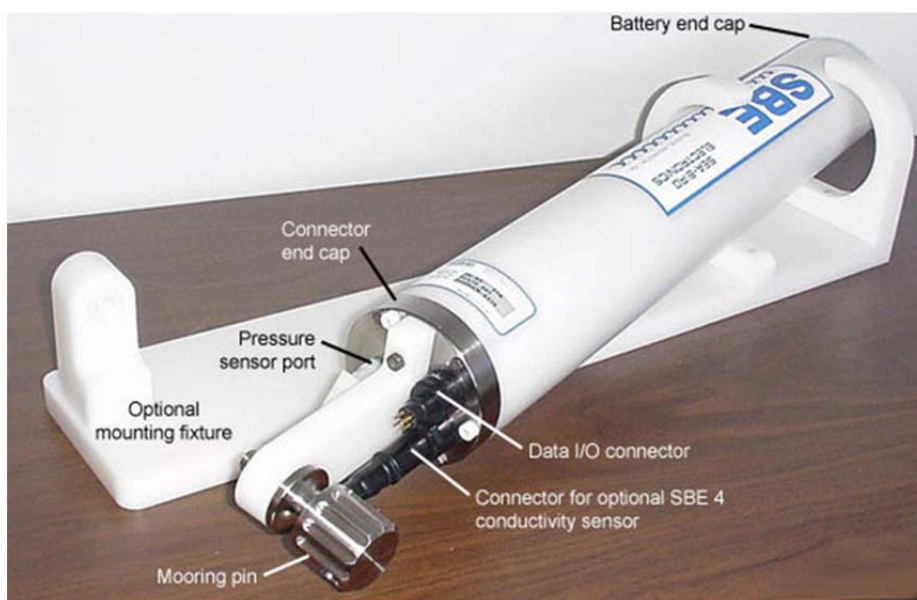


Figure A-1 Sea-Bird SBE 26Plus Tide and Wave Recorder with Mounting Fixture

Table A-1 Specifications for Sea-Bird SBE 26 Plus Tide and Wave Recorder (45 Psia Version) equipped with Quartz pressure transducers

Parameter	Quartz Pressure Transducer	Temperature (°C)
Measurement Range	0-20 m depth (45 psia)	-5 to +35
Accuracy	0.01% of full scale, i.e. - 3 mm for 45 psia range	0.01
Resolution	Tide measurements: 45 psia transducer - 0.2 mm for 1-minute integration - 0.01 mm for 15-minute integration	0.001
Calibration	0 psia to full scale pressure	+1 to +32
Repeatability	0.005% of full scale, i.e. - 1.5 mm for 45 psia range	N/A
Hysteresis	0.005% of full scale, i.e. - 1.5 mm for 45 psia range	N/A

A.1.2 Seabed Frames

The Seabird instruments were located within the bed mounted instrument frames positioned at the DMPA and also at the seaward end of the Outer Channel (Beacon C2).

A.2 Current (and Wave) Data

A.2.1 Instruments

In accordance with the Scope of Works, currents were measured through the water column using bed-mounted Nortek AWACs (Acoustic Wave and Current Meters) and a Teledyne RD Instruments Acoustic Doppler Current Profiler (ADCP) or a vessel-mounted ADCP. All instruments were owned by BMT WBM.

The major difference between the Teledyne RD Instruments ADCPs and the Nortek AWAC (Acoustic Wave and Current Recorder) is the flexibility to use the Teledyne RD Instruments ADCPs in both bed-mounted and vessel-mounted configurations; compared with the Nortek AWAC's which are bed-mounted instruments.

The 1200kHz ADCPs and 600kHz AWACs were capable of measuring the current speed and direction through the water column, as well as the water depth and water temperature (and directional and non-directional wave climate) at the required deployment locations.

The sensor and instrument specifications for the 1200kHz Teledyne RD Instruments Workhorse Sentinel ADCPs (<http://www.rdinstruments.com/sen.aspx>) owned by BMT WBM are shown in

Instrumentation

Table A-2. Specifications for the bed-mounted Nortek AWACs (<http://www.nortek-as.com/en/products/wave-systems/awac>) are provided in Table A- 3. Specifications of the ADCPs and AWACs met the instrument requirements outlined in the study brief. Although the pressure sensors on both the Teledyne ADCPs and Nortek AWACs are quite capable they do not have the high accuracy of the Digiquartz transducers on the Sea-Bird SBE 26 plus wave and tide recorders.

Table A-2 Specifications and Measurement Capabilities for the 1200kHz Teledyne RD Instruments Workhorse Sentinel ADCPs

Parameter	ADCP Acoustic Frequency
	1200kHz
Pressure	Yes
- Range	50m
- Accuracy	0.25% Full Scale (+/-6.25cm)
- Resolution	0.001m
Temperature	Yes
- Range	-5° to 45°C
- Accuracy	+/- 0.4°C
- Resolution	0.01°C
Tilt	Yes
- Range	+/- 15°
- Accuracy	+/- 0.5°
- Resolution	0.01°
Current Speed	
- Standard Deviation, (0.5m bin size, 50 ping ensemble)	<1.0cm/sec
- Standard Deviation, (1.0m bin size, 50ping ensemble)	0.5cm/sec
Compass (Current Direction)	Yes
- Accuracy	+/-2°
- Resolution	0.01°
Waves Array Software	Yes
High Resolution Modes 5, 8, 11	Yes
Bottom Track	Yes
Memory Capacity	2Gbyte
Typical max depth measurement capability	15m
Battery Life (Current only, No Waves)	
(0.5m bin size, 50 ping ensemble, 6 minute ensemble interval)	>7 months

Instrumentation

The bed-mounted 1200kHz Teledyne RDI ADCP was used to measure the water currents (and waves) in the shallow water at Beacon C11 (less than 5m below datum). The battery life was the limiting feature of the deployed ADCP being approximately 75 days; based upon the measurement of water temperature, depth and currents every 6 minutes and directional waves every 3 hours, using a bin size of 0.5m.

A vessel-mounted 1200kHz Teledyne RD Instruments Workhorse Sentinel ADCP was used to measure current speed and direction, current flows and sediment backscatter (a proxy of suspended sediment concentrations) in real-time. The instrument was used to collect transecting measurements of current velocities, flows and sediment backscatter concentrations required at the Port area and Inner and Outer Channel reaches.

Three bed-mounted 600kHz Nortek AWACs with Acoustic Surface Tracking (AST) were used for the current and wave measurement locations at the DMPA, Alternative DMPA and at Beacon C7.

The AWACs measured:

- Waves (non-directional⁶ and directional) - wave height and period;
- Currents⁷ through the depth profile;
- Tidal water level; and
- Water temperature.

Table A-3 Measurement Specifications for the bed-mounted 600KHz NORTEK AWACs

Parameter	Value	
Wave height	Range	-20m to +20m
	Resolution	0.01m
	Accuracy	< 1.0% of measured value
	Period	1.0s to 30s (non-directional);
Wave direction	Range	0° to 360°
	Resolution	0.1
	Accuracy	2°
	Period	3.1-4.0s to 30s (depth dependant)
Wave measurements	Maximum Depth	60m
	Sampling Rate	1Hz standard, 2 Hz AST
	Number of Samples per burst	512, 1024, 2048
Water temperature	Range	-4°C to +40°C
	Resolution	0.01°C
	Accuracy	0.1°C (sensor accuracy)
Current	Transducer Configuration	Standard, 3 beams 120° apart, 1 beam at 0°.
	Range	to 50m
	Depth Cell Size	0.5 to 8.0m
	No of Cells	typical 20-40, maximum 128
Data Recording	Internal Memory	4Gbyte PROLOG (processed wave data; processed internally after each wave burst)

⁶ The directional estimates of short period waves are limited by the depth of deployment. The greater the water depth, the larger is the minimum wavelength which can be resolved.

⁷ When burst sampling for waves measurements, the AWAC does not concurrently measure the water speed and direction through the depth profile.

The battery life of the AWACs was calculated at a minimum 150 days based upon current measurements every 6 minutes and directional wave measurements every hour with 0.5m bins.

A.2.2 Seabed Frames

Because trawling of the instruments was a concern at the offshore deployment locations, the bed-mounted AWACs at Site 1 (DMPA) and Site 2 (Alternative DMPA) were deployed in trawl resistant frames equipped with acoustic releases and recovery floats and ropes (refer to Figure A- 2). The AWAC and ADCP at Sites 4 and 5 (Beacons C7 and C11 respectively) were mounted in Sea Spider frames (refer to Figure A-3). Both types of frames were constructed of fibreglass with 316 marine grade non-magnetic stainless steel fittings and fixtures and were equipped with sacrificial zinc anodes to reduce the potential for corrosion of the instruments and fittings.



Figure A-2 Trawl Resistant Frames containing Nortek AWACs being positioned on survey vessel 'Viking' prior to deployment



Figure A-3 Sea Spider frame equipped with 600kHz Nortek AWAC (Centre of Frame), AWAC battery cannister (right hand side) and YSI Model 6600 Water Quality Instrument (foreground left side) and acoustic transponder (foreground centre) ready for deployment at Site 4 - Beacon C7.

A.3 Conductivity, Temperature, Depth (CTD) and Turbidity and TSS Data

During the ADCP transects within the Port, CTD and turbidity were spot measured through the depth profile using a YSI Model 6600 multi-parameter water quality instrument and also a Campbell Scientific Model OBS3A optical backscatter (turbidity) measuring instrument. Profiling measurements of turbidity were collected at 1 second intervals through the profiles using the instruments. Time tagged water samples were collected concurrently for Total Suspended Solids (TSS) analysis via a suction hose mounted beside the YSI Model 6600 and Campbell Scientific optical sensors. In this way the pumped water samples collected aboard Viking were representative of the water quality being measured by the adjacent instruments. Table A-4 and Table A- 5 summarise the measurement capabilities and specifications of the YSI Model 6600 and Campbell Scientific Model OBS3A instruments. Turbidity measurements from each instrument were subsequently converted to Total Suspended solids (TSS) concentrations in mg/L.

Instrumentation

The YSI Model 6600 water quality instruments were also deployed at the DMPA, Alternative DMPA and the Outer Channel (Beacon C7) to provide for the nephelometric measurement of turbidity close to the seabed.

Table A-4 YSI Model 6600 Water Quality Instrument Specifications

Water Quality Parameter	Range	Resolution	Accuracy
Water Temperature	-5 to +50°C	0.01°C	±0.15°C
Electrical Conductivity	0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater.
Depth	61 m	0.001 m	±0.12 m
Turbidity	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU, whichever is greater.

Table A-5 Campbell Scientific Model OBS3A Instrument Specifications

Water Quality Parameter	Range	Resolution	Accuracy
Water Temperature	0 to +35°C	0.01°C	±0.15°C
Electrical Conductivity	0 to 65 mS/cm	0.001 to 0.1 mS/cm (range dependent)	1% of reading
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater.
Depth	0 to 100 m	0.001 m	±0.5% of full scale
Turbidity	0.4 to 4,000 NTU	0.1 NTU	<2% of reading.

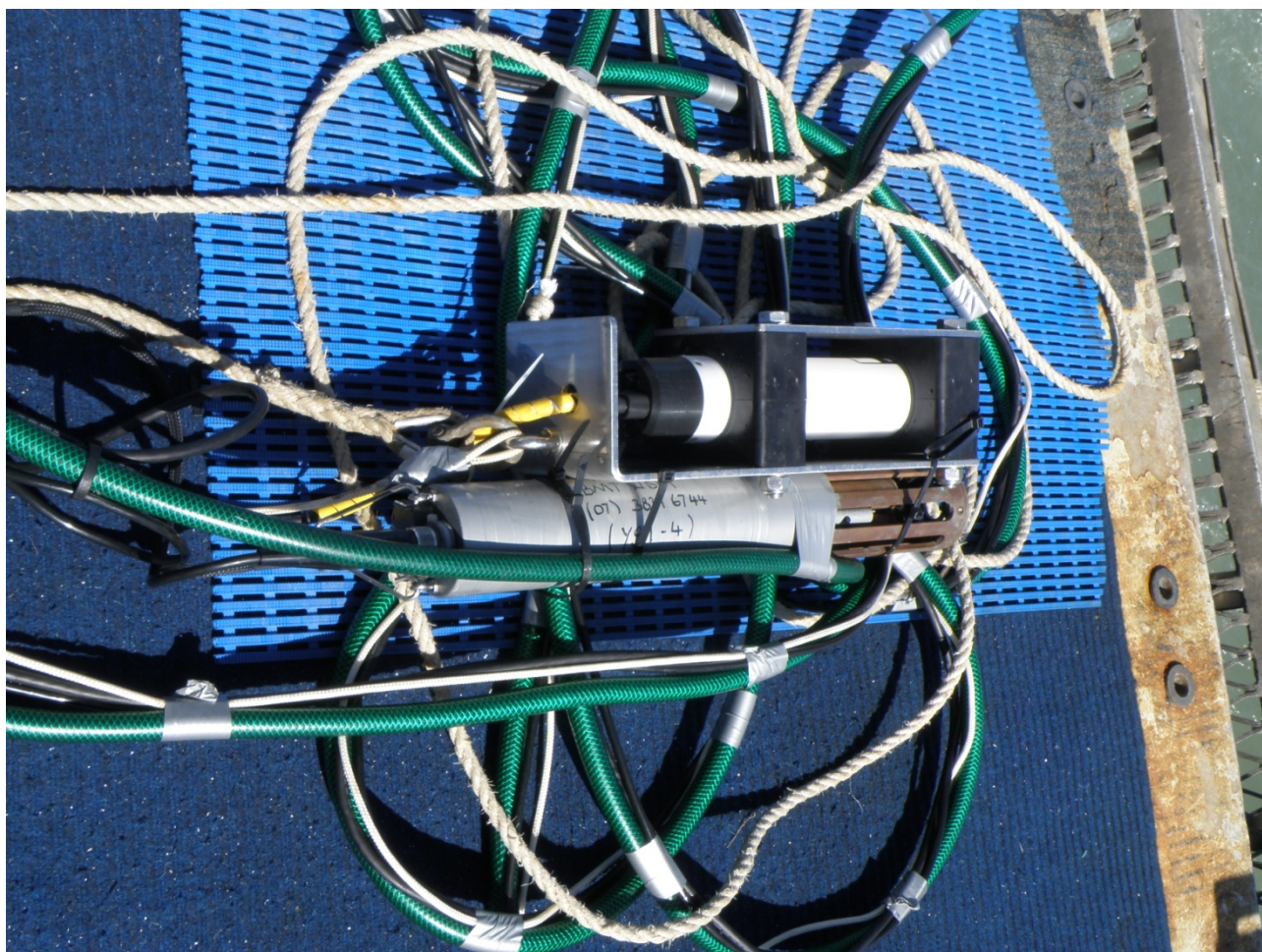


Figure A-4 Combined YSI Model 6600 Water Quality Instrument and Campbell Scientific Model OBS 3A Optical Backscatter together with water sampling tubing used for water quality profiling and water sampling

Teledyne RD Instruments Citadel Model CTD-NH instruments (http://www.rdinstruments.com/pdfs/citadel_ctd-nh.pdf) were deployed for the duration of wet and dry season measurements in the Outer Channel (at Beacons C7 and C11) within the likely zone of influence of flood runoff from the Barron River. These instruments were deployed both on a floating moorings with the sensors set approximately 1m below the water surface and also at the seabed at Beacon C11. The Citadel Model CTD-NH instrument was selected for deployment at these shallow locations because the sensor set was specifically designed for high accuracy measurements with the capability to resist biofouling in longer term deployments. The instrument uses copper sheathing to deter marine fouling organisms. The instruments were programd to measure CTD at 6 minute intervals (consistent with the ADCP and AWAC at these locations) based upon four 20 second averages. Specifications for the Teledyne RD Instruments Citadel are included in Table A- 5.

Table A-6 Specifications for the Teledyne RD Instruments Citadel CTD-NH

Water Quality Parameter	Range	Resolution	Accuracy
Water Temperature	-5 to 35°C	0.001°C	±0.005°C
Electrical Conductivity	0-7.0 S/m (0-70 mS/cm)	0.00001 S/m (0.0001 mS/cm)	±0.0009 S/m (±0.009 mS/cm)
Pressure (Depth)	20m depth	0.001% full scale = 0.2mm	0.05% full scale = 1cm.



Figure A-5 Teledyne RD Instruments Citadel Model CTD-NH prepared for deployment at Beacons C7 and C11



Figure A-6 Marker Buoy at Beacon C11 used to moor the Citadel CTD Instrument 1m below the water surface

A.4 Sediment Sampling

Surface sediment samples were gathered from six sites for the purpose of sediment texture characterisation using a small Van Veen Grab as shown below. The collected samples were laid into a clean plastic tray and photographed and their characteristics such as sample location, colour, field texture etc. recorded in a project log sheet. The samples were packaged within plastic bags to allow for descriptive analysis of grain size as required.



Figure A-7 Stainless Steel Van Veen Sediment Sampler used for Sediment Sample Collection

A.5 Weather Data

Weather measurements were collected at Beacon C2 (the most seaward port hand entrance channel beacon), Beacon C11 (intermediate starboard hand channel marker) and Beacon C20 (port hand entrance channel marker at the shoreward end of the entrance channel) using Envirodata Model Weather Maestro Weather Stations with stand-alone data loggers at all 3 measurement locations. The Weather Maestro measurements included the following at 6 minute intervals through the 12 month deployment period:

- Air Temperature;
- Relative Humidity;
- Wind Speed and Direction;
- Rainfall;
- Barometric Pressure (measured only at Beacon C11); and
- Solar Radiation.

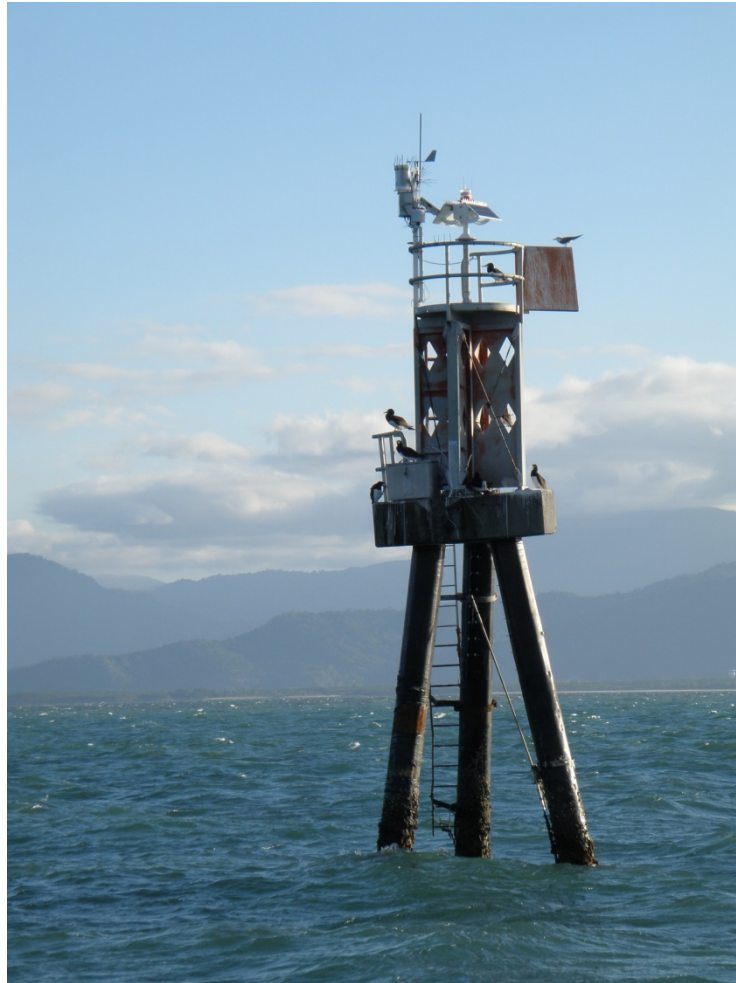


Figure A-8 Envirodata Maestro Weather Station Installation at Site 3 (Beacon C2)



Figure A-9 Envirodata Maestro Weather Station Installation at Site 5 (Beacon C11)



Figure A-10 Envirodata Maestro Weather Station Installation at Site 6 (Beacon C20)

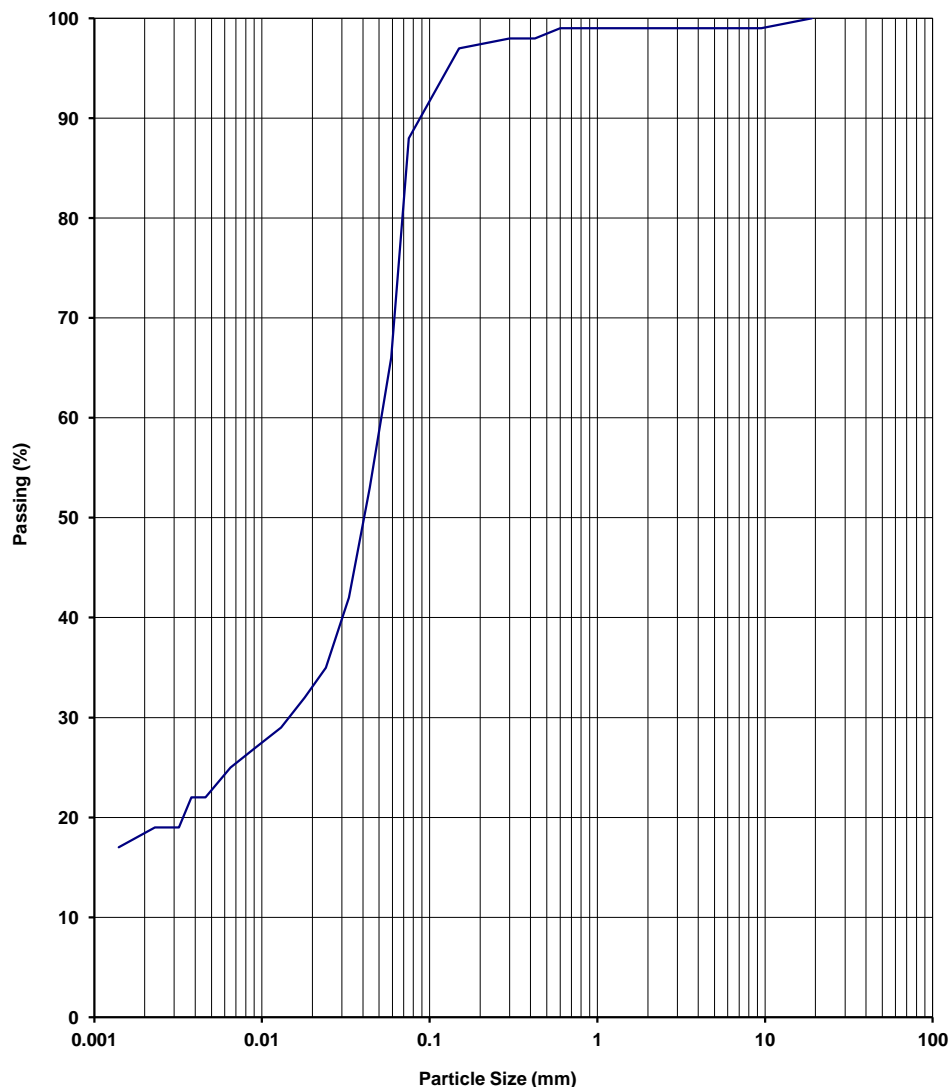
Appendix B Sediment Sample Particle Size Analysis Results

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070345-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	15/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 1 - 13:21 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	100
9.5	99
4.75	99
2.36	99
1.18	99
0.600	99
0.425	98
0.300	98
0.150	97
0.075	88
0.059	66
0.044	53
0.033	42
0.024	35
0.018	32
0.013	29
0.0092	27
0.0065	25
0.0046	22
0.0038	22
0.0032	19
0.0027	19
0.0023	19
0.0014	17



NOTES/REMARKS:

-
Moisture Content 74.9% -2.36mm Soil Particle Density(t/m³) 2.80
Sample/s supplied by the client

Page 1 of 1 REP03902

Accredited for compliance with ISO/IES 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory



C. Park



Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.

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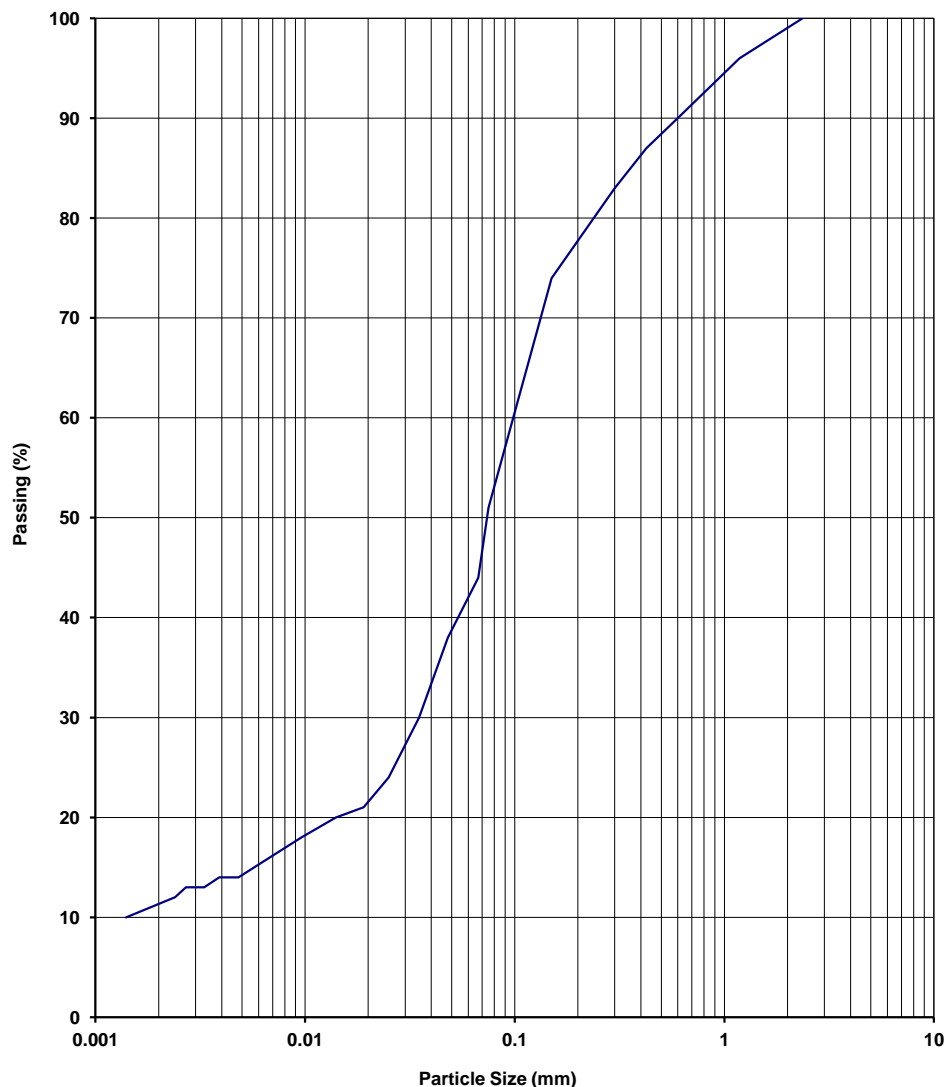
Trilab Pty Ltd ABN 25 065 630 506

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070346-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	15/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 2 - 13:10 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	100
1.18	96
0.600	90
0.425	87
0.300	83
0.150	74
0.075	51
0.067	44
0.048	38
0.035	30
0.025	24
0.019	21
0.014	20
0.0096	18
0.0068	16
0.0048	14
0.0039	14
0.0033	13
0.0027	13
0.0024	12
0.0014	10



NOTES/REMARKS:

-
Moisture Content 53.6% -2.36mm Soil Particle Density(t/m³) 2.80
Sample/s supplied by the client

Page 1 of 1 REP03902

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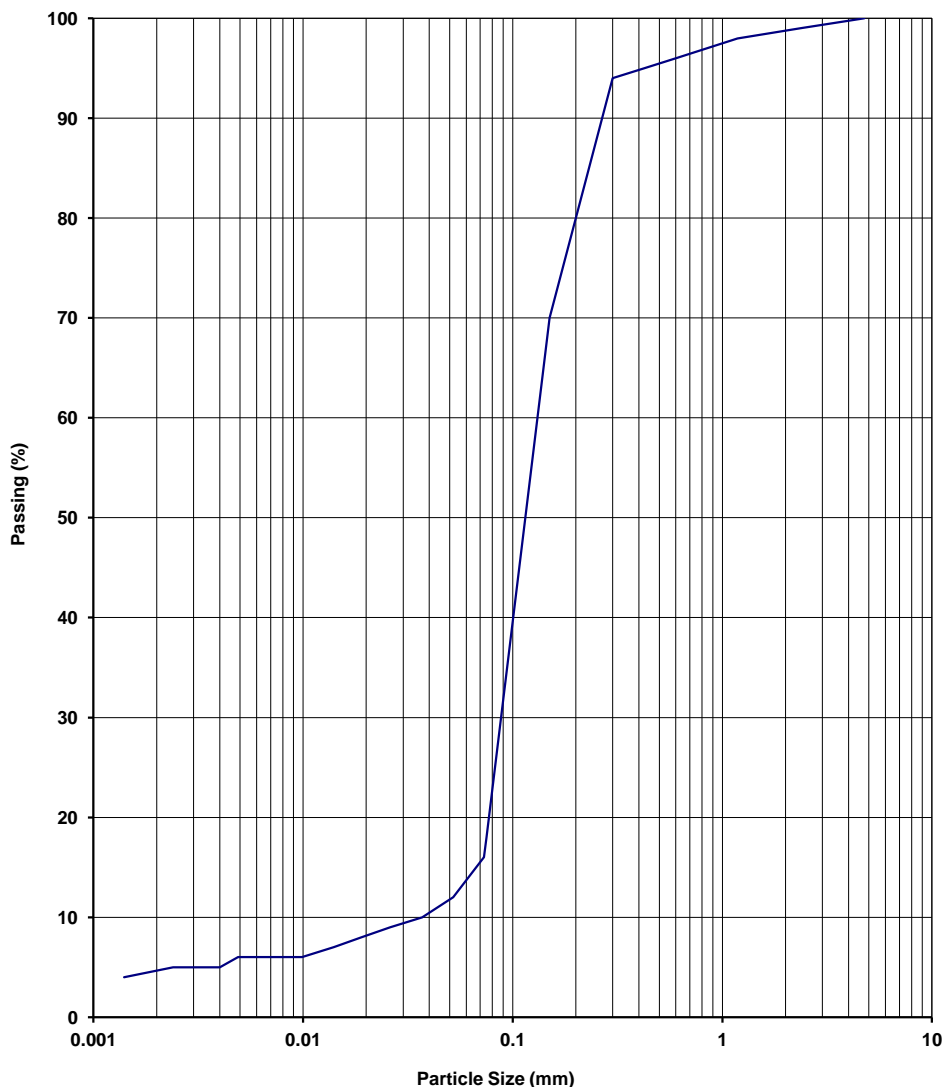
ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070347-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	15/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 3 - 13:40 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	98
0.600	96
0.425	95
0.300	94
0.150	70
0.075	18
0.073	16
0.052	12
0.037	10
0.026	9
0.019	8
0.014	7
0.0099	6
0.007	6
0.0049	6
0.004	5
0.0034	5
0.0028	5
0.0024	5
0.0014	4



NOTES/REMARKS:

-
Moisture Content 49.2% -2.36mm Soil Particle Density(t/m³) 2.79
Sample/s supplied by the client

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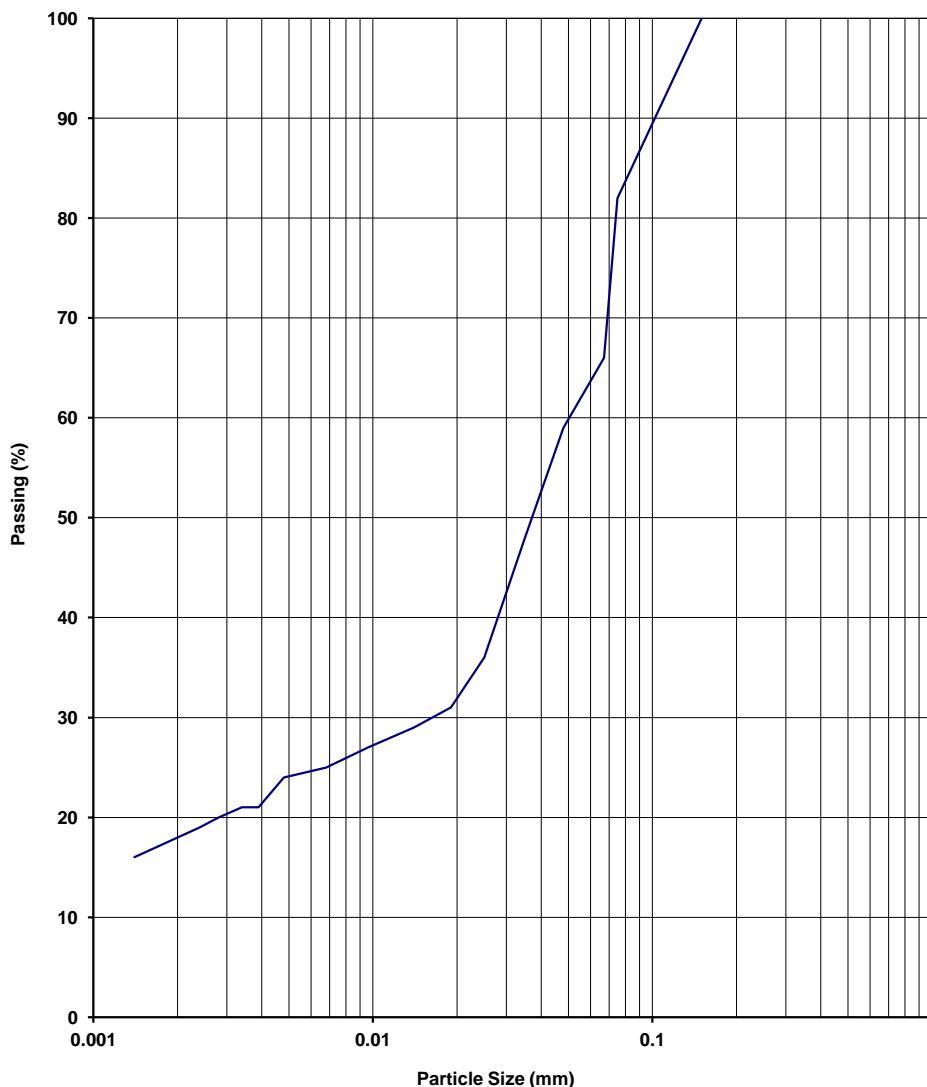
ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070348-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	15/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 4 - 13:50 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	100
0.075	82
0.067	66
0.048	59
0.035	48
0.025	36
0.019	31
0.014	29
0.0096	27
0.0068	25
0.0048	24
0.0039	21
0.0034	21
0.0028	20
0.0024	19
0.0014	16



NOTES/REMARKS:

-
Moisture Content 102.3% -2.36mm Soil Particle Density(t/m³) 2.76
Sample/s supplied by the client

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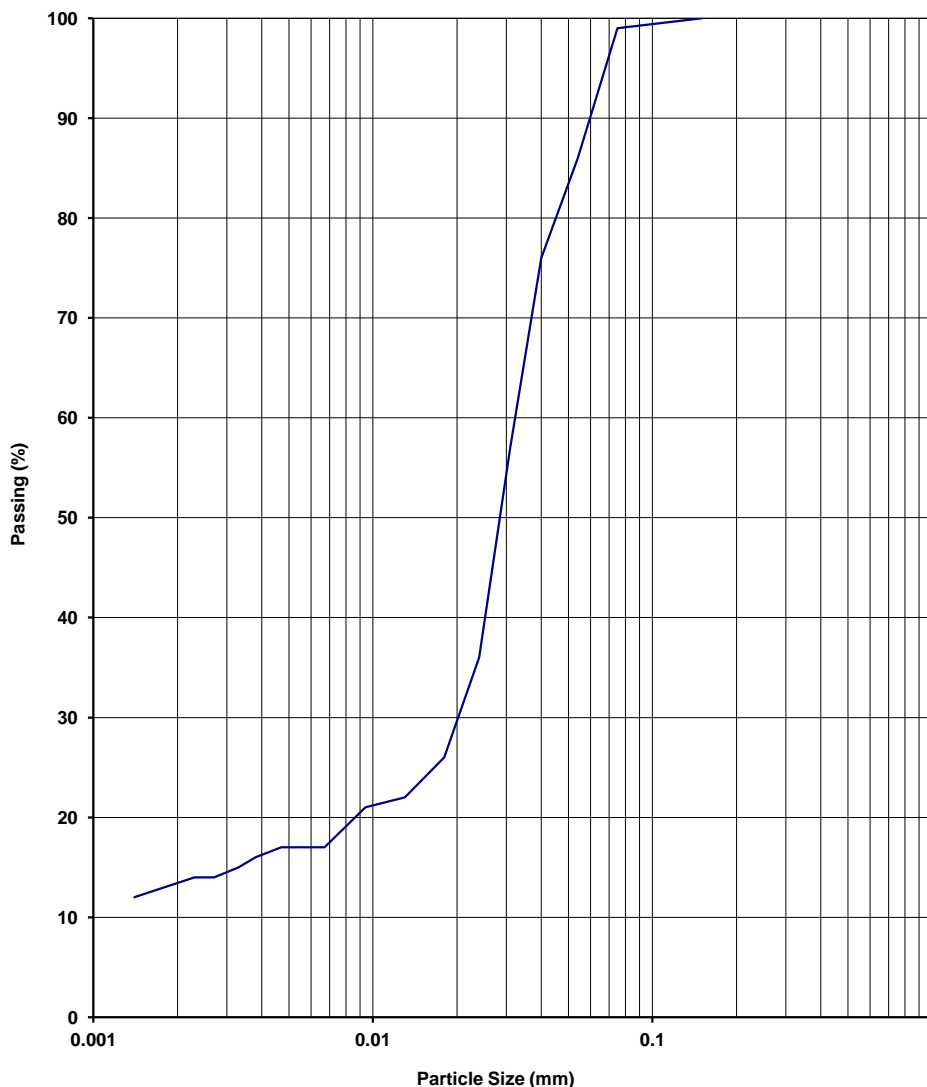
ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070349-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	13/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 5 - 14:10 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	100
0.075	99
0.054	86
0.04	76
0.031	57
0.024	36
0.018	26
0.013	22
0.0094	21
0.0067	17
0.0047	17
0.0038	16
0.0033	15
0.0027	14
0.0023	14
0.0014	12



NOTES/REMARKS:

-
Moisture Content 81.1% -2.36mm Soil Particle Density(t/m³) 2.82
Sample/s supplied by the client

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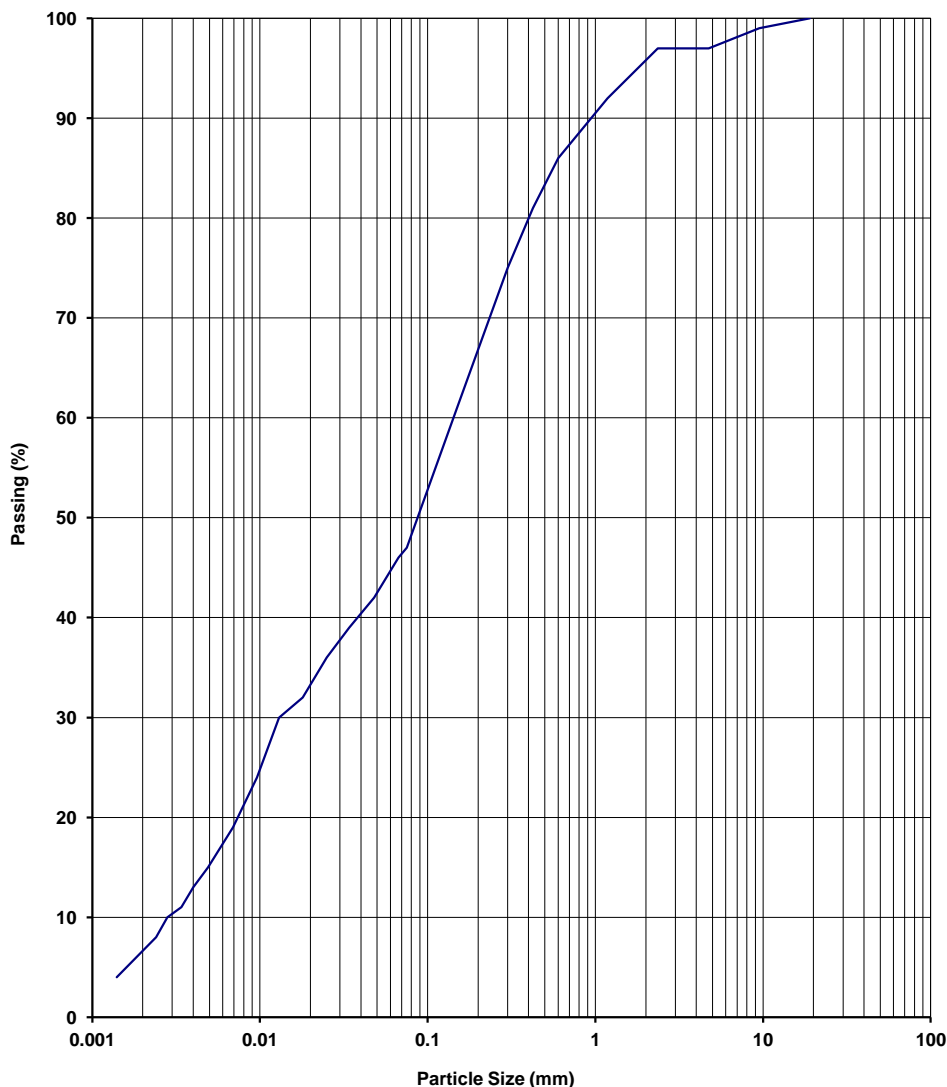
ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	BMT WBM Pty Ltd	Report No.	13070350-G
Project	B20126 - Cairns Wet Season Data Collection	Test Date	15/7/13-18/7/13
		Report Date	18/7/2013
Client ID	Sediment 6 - 14:00 30/6/2013	Depth (m)	Not Supplied

Sieve Size (mm)	Passing %
150.0	
75.0	
53.0	
37.5	
26.5	
19.0	100
9.5	99
4.75	97
2.36	97
1.18	92
0.600	86
0.425	81
0.300	75
0.150	61
0.075	47
0.067	46
0.048	42
0.034	39
0.025	36
0.018	32
0.013	30
0.0096	24
0.0069	19
0.0049	15
0.004	13
0.0034	11
0.0028	10
0.0024	8
0.0014	4



NOTES/REMARKS:

-
Moisture Content 97.5% -2.36mm Soil Particle Density(t/m³) 2.73
Sample/s supplied by the client

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Trilab Pty Ltd ABN 25 065 630 506

Appendix C Water Grab Sample Laboratory Reports



REPORT OF ANALYSIS

Laboratory Reference: A13/3463-A [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20180
Project: Marine Water Testing - Total
Sample Type: Water
No. of Samples: 12
Date Received: 24/07/2013
Date Completed: 7/08/2013

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release. This is the Final Report and supersedes any reports previously issued with this batch number. This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.



Issue Date: 7 August 2013

Page 1 of 7

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	150	180	29	710
Arsenic - Total	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Total	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	3.2
Copper - Total	04-015	µg/L	2.0	2.3	<1.0	1.9
Iron - Total	04-015	µg/L	160	180	37	610
Lead - Total	04-015	µg/L	<1.0	3.0	<1.0	3.1
Manganese - Total	04-015	µg/L	7.3	8.5	8.0	43
Nickel - Total	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Total	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Total	04-015	µg/L	12	16	5.3	16
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	0.0009	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.08	0.06	0.05	0.07
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	0.4	0.2	0.3	0.4
Total Ammonia as N	SUB	mg/L	<0.1	<0.1	<0.1	<0.1
Nitrate as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Nitrite as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Phosphate as P	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids	SUB	mg/L	<2	4	6	31
Particle Size Distribution	SUB		See Comments	See Comments	See Comments	See Comments



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	100	110	860	46
Arsenic - Total	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Total	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	1.2	<1.0	1.8	1.7
Iron - Total	04-015	µg/L	130	130	710	89
Lead - Total	04-015	µg/L	<1.0	<1.0	<1.0	1.8
Manganese - Total	04-015	µg/L	13	13	46	15
Nickel - Total	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Total	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Total	04-015	µg/L	18	20	18	18
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.05	0.05	0.06	0.05
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	0.2	0.1	0.2	0.3
Total Ammonia as N	SUB	mg/L	<0.1	<0.1	<0.1	<0.1
Nitrate as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Nitrite as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Phosphate as P	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids	SUB	mg/L	4	4	<2	2
Particle Size Distribution	SUB		See Comments	See Comments	See Comments	See Comments



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	100	860	1,100	420
Arsenic - Total	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Total	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Total	04-015	µg/L	<2.0	2.8	3.6	3.4
Copper - Total	04-015	µg/L	<1.0	1.2	<1.0	2.0
Iron - Total	04-015	µg/L	130	710	900	390
Lead - Total	04-015	µg/L	<1.0	1.7	1.2	1.7
Manganese - Total	04-015	µg/L	12	42	60	20
Nickel - Total	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Total	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Total	04-015	µg/L	40	21	16	18
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.05	0.06	0.06	0.05
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	0.2	0.3	0.3	0.2
Total Ammonia as N	SUB	mg/L	<0.1	<0.1	<0.1	<0.1
Nitrate as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Nitrite as N	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Phosphate as P	SUB	mg/L	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids	SUB	mg/L	26	40	14	35
Particle Size Distribution	SUB		See Comments	See Comments	See Comments	See Comments

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L
04-003	Metals by ICP-OES
SUB	Subcontracted Analyses



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.

Analysis was subcontracted to Sydney Analytical Laboratories (NATA Number 1884);
reference SAL report number SAL24731

Particle size analysis was subcontracted to Microanalysis Australia; see attached
Microanalysis Particle Counting reports.zip



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Total	µg/L	<20	A13/3463-A-1	150 150 RPD: 0	A13/3463-A-1	128%
Arsenic - Total	µg/L	<5.0	A13/3463-A-1	<5.0 <5.0	A13/3463-A-1	#
Cadmium - Total	µg/L	<0.7	A13/3463-A-1	<0.7 <0.7	A13/3463-A-1	110%
Chromium - Total	µg/L	<2.0	A13/3463-A-1	<2.0 <2.0	A13/3463-A-1	104%
Copper - Total	µg/L	<1.0	A13/3463-A-1	2.0 2.3 RPD: 14	A13/3463-A-1	96%
Iron - Total	µg/L	<20	A13/3463-A-1	160 170 RPD: 6	A13/3463-A-1	#
Lead - Total	µg/L	<1.0	A13/3463-A-1	<1.0 <1.0	A13/3463-A-1	101%
Manganese - Total	µg/L	<5.0	A13/3463-A-1	7.3 5.5 RPD: 28	A13/3463-A-1	117%
Nickel - Total	µg/L	<3.0	A13/3463-A-1	<3.0 3.0	A13/3463-A-1	119%
Silver - Total	µg/L	<1.0	A13/3463-A-1	<1.0 <1.0	A13/3463-A-1	105%
Zinc - Total	µg/L	<5.0	A13/3463-A-1	12 12 RPD: 0	A13/3463-A-1	107%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Total	mg/L	<0.0001	A13/3463-A-1	<0.0001 <0.0001	A13/3463-A-1	102%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Phosphorus - Total	mg/L	<0.02	A13/3463-A-1	0.08 0.08 RPD: 0	A13/3463-A-1	103%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results
Total Nitrogen	mg/L	<0.1	A13/3463-A-10	0.3 0.2 RPD: 40

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Total	µg/L	[NT]	A13/3463-A-11	1100 1100 RPD: 0
Arsenic - Total	µg/L	[NT]	A13/3463-A-11	<5.0 <5.0
Cadmium - Total	µg/L	[NT]	A13/3463-A-11	<0.7 <0.7
Chromium - Total	µg/L	[NT]	A13/3463-A-11	3.6 4.1 RPD: 13
Copper - Total	µg/L	[NT]	A13/3463-A-11	<1.0 2.5
Iron - Total	µg/L	[NT]	A13/3463-A-11	900 970 RPD: 7
Lead - Total	µg/L	[NT]	A13/3463-A-11	1.2 1.1 RPD: 9
Manganese - Total	µg/L	[NT]	A13/3463-A-11	60 55 RPD: 9
Nickel - Total	µg/L	[NT]	A13/3463-A-11	<3.0 <3.0
Silver - Total	µg/L	[NT]	A13/3463-A-11	<1.0 <1.0
Zinc - Total	µg/L	[NT]	A13/3463-A-11	16 14 RPD: 13



Batch Number: A13/3463-A [R00]
Project Reference: Marine Water Testing - Total

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Total	mg/L	[NT]	A13/3463-A-11	<0.0001 <0.0001

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Phosphorus - Total	mg/L	[NT]	A13/3463-A-11	0.06 0.06 RPD: 0

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results > 10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A13/3463-B [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20180
Project: Marine Water Testing - Dissolved
Sample Type: Water
No. of Samples: 12
Date Received: 24/07/2013
Date Completed: 6/08/2013

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release. This is the Final Report and supersedes any reports previously issued with this batch number. This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.



Issue Date: 7 August 2013

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A13/3463-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	<20	<20	<20	<20
Arsenic - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Dissolved	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	1.3	2.3	<1.0	1.2
Iron - Dissolved	04-015	µg/L	<20	<20	<20	<20
Lead - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Manganese - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Nickel - Dissolved	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Dissolved	04-015	µg/L	14	21	11	15
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A13/3463-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	<20	<20	<20	<20
Arsenic - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Dissolved	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	1.1	<1.0	<1.0	<1.0
Iron - Dissolved	04-015	µg/L	<20	<20	<20	<20
Lead - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Manganese - Dissolved	04-015	µg/L	5.0	<5.0	9.2	<5.0
Nickel - Dissolved	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Dissolved	04-015	µg/L	15	10	17	13
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	0.0005



Batch Number: A13/3463-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	17/07/2013	17/07/2013	17/07/2013	17/07/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	<20	<20	<20	<20
Arsenic - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Cadmium - Dissolved	04-015	µg/L	<0.7	<0.7	<0.7	<0.7
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	<1.0	6.8	1.0	<1.0
Iron - Dissolved	04-015	µg/L	<20	<20	<20	<20
Lead - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Manganese - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Nickel - Dissolved	04-015	µg/L	<3.0	<3.0	<3.0	<3.0
Silver - Dissolved	04-015	µg/L	<1.0	<1.0	<1.0	<1.0
Zinc - Dissolved	04-015	µg/L	16	13	16	<5.0
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.



Batch Number: A13/3463-B [R00]
Project Reference: Marine Water Testing - Dissolved

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	<20	A13/3463-B-1	<20 <20	A13/3463-B-1	123%
Arsenic - Dissolved	µg/L	<5.0	A13/3463-B-1	<5.0 <5.0	A13/3463-B-1	103%
Cadmium - Dissolved	µg/L	<0.7	A13/3463-B-1	<0.7 <0.7	A13/3463-B-1	100%
Chromium - Dissolved	µg/L	<2.0	A13/3463-B-1	<2.0 <2.0	A13/3463-B-1	102%
Copper - Dissolved	µg/L	<1.0	A13/3463-B-1	1.3 1.0 RPD: 26	A13/3463-B-1	100%
Iron - Dissolved	µg/L	<20	A13/3463-B-1	<20 <20	A13/3463-B-1	99%
Lead - Dissolved	µg/L	<1.0	A13/3463-B-1	<1.0 <1.0	A13/3463-B-1	105%
Manganese - Dissolved	µg/L	<5.0	A13/3463-B-1	<5.0 <5.0	A13/3463-B-1	122%
Nickel - Dissolved	µg/L	<3.0	A13/3463-B-1	<3.0 <3.0	A13/3463-B-1	111%
Silver - Dissolved	µg/L	<1.0	A13/3463-B-1	<1.0 <1.0	A13/3463-B-1	101%
Zinc - Dissolved	µg/L	<5.0	A13/3463-B-1	14 11 RPD: 24	A13/3463-B-1	112%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Dissolved	mg/L	<0.0001	A13/3463-B-1	<0.0001 <0.0001	A13/3463-B-1	98%

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Dissolved	µg/L	[NT]	A13/3463-B-11	<20 <20
Arsenic - Dissolved	µg/L	[NT]	A13/3463-B-11	<5.0 <5.0
Cadmium - Dissolved	µg/L	[NT]	A13/3463-B-11	<0.7 <0.7
Chromium - Dissolved	µg/L	[NT]	A13/3463-B-11	<2.0 <2.0
Copper - Dissolved	µg/L	[NT]	A13/3463-B-11	1.0 1.2 RPD: 18
Iron - Dissolved	µg/L	[NT]	A13/3463-B-11	<20 <20
Lead - Dissolved	µg/L	[NT]	A13/3463-B-11	<1.0 <1.0
Manganese - Dissolved	µg/L	[NT]	A13/3463-B-11	<5.0 <5.0
Nickel - Dissolved	µg/L	[NT]	A13/3463-B-11	<3.0 <3.0
Silver - Dissolved	µg/L	[NT]	A13/3463-B-11	<1.0 <1.0
Zinc - Dissolved	µg/L	[NT]	A13/3463-B-11	16 16 RPD: 0



Batch Number: A13/3463-B [R00]
Project Reference: Marine Water Testing - Dissolved

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Dissolved	mg/L	[NT]	A13/3463-B-11	<0.0001 <0.0001

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results >10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A13/4827-A [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Total
Sample Type: Water
No. of Samples: 16
Date Received: 03/10/2013
Date Completed: 21/10/2013

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.





Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	02/10/203	02/10/203	02/10/203	02/10/203
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	22	17	75	75
Arsenic - Total	04-015	µg/L	2.0	2.0	2.0	2.1
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	2.7	3.3	2.4	3.2
Iron - Total	04-015	µg/L	45	44	110	100
Lead - Total	04-015	µg/L	<0.10	<0.10	0.23	0.23
Manganese - Total	04-015	µg/L	7.3	6.0	13	13
Nickel - Total	04-015	µg/L	0.55	0.54	0.73	0.64
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	1.5	1.3	1.6	1.8
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.05	0.05	0.05	0.05
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	76	93	98	99
Date Extracted	04-061	-	4/10/2013	4/10/2013	4/10/2013	4/10/2013
Date Analysed	04-061	-	6/10/2013	6/10/2013	6/10/2013	6/10/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMS MS	µg/L	<0.10	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	3	<2	4	<2
Total Oil and Grease		mg/L	5	3	4	5



Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	160	240	22	14
Arsenic - Total	04-015	µg/L	1.9	2.0	0.93	0.92
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	3.9	4.2	11	11
Iron - Total	04-015	µg/L	250	330	64	53
Lead - Total	04-015	µg/L	0.54	0.45	0.16	<0.10
Manganese - Total	04-015	µg/L	42	34	14	14
Nickel - Total	04-015	µg/L	1.2	0.94	0.41	0.35
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	4.2	2.7	5.3	2.8
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.07	0.08	0.06	0.06
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	83	83	85	88
Date Extracted	04-061	-	4/10/2013	4/10/2013	4/10/2013	4/10/2013
Date Analysed	04-061	-	6/10/2013	6/10/2013	6/10/2013	6/10/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMS MS	µg/L	<0.10	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	7	9	2	2
Total Oil and Grease		mg/L	6	5	5	4



Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	110	150	130	190
Arsenic - Total	04-015	µg/L	1.3	1.5	1.5	<0.30
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	2.5	2.9	2.1	1.8
Iron - Total	04-015	µg/L	160	210	150	220
Lead - Total	04-015	µg/L	<0.10	0.25	0.20	0.20
Manganese - Total	04-015	µg/L	6.5	14	11	12
Nickel - Total	04-015	µg/L	0.28	0.51	0.29	0.28
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	0.93	2.0	1.3	1.1
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.06	0.05	0.06	0.06
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	108	104	102	91
Date Extracted	04-061	-	4/10/2013	4/10/2013	4/10/2013	4/10/2013
Date Analysed	04-061	-	6/10/2013	6/10/2013	6/10/2013	6/10/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMS MS	µg/L	<0.10	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	6	9	8	12
Total Oil and Grease		mg/L	5	6	6	6



Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/13	/14	/15	/16
Client Reference:	-	-	Deep 1	Deep 2	Deep 3	Deep 4
Date Sampled:	-	-	02/10/203	02/10/203	02/10/203	02/10/203
Analysis Description	Method	Units				
Trace Elements						
Mercury						
Trace Elements						
Organotins						
Ultra-trace Residue LCMSMS						
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	<2	<2	<2
Total Oil and Grease		mg/L	NT	NT	NT	NT

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L
04-003	Metals by ICP-OES
04-061	Tributyltin in saline waters by GCMS, µgSn/L
LCMSMS	*Analysis by LCMSMS
SUB	Subcontracted Analyses

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.

- Spike recovery could not be accurately determined due to a significant background analyte concentration. Analysis was subcontracted to Sydney Analytical Laboratories (NATA Number 1884); reference SAL report number SAL24731

Particle size analysis was subcontracted to Microanalysis Australia; see attached Microanalysis Particle Counting reports.zip



Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Total	µg/L	<5.0	A13/4827-A-1	22 38 RPD: 53	[NA]	91%
Arsenic - Total	µg/L	<0.30	A13/4827-A-1	2.0 2.0 RPD: 0	[NA]	68%
Cadmium - Total	µg/L	<0.02	A13/4827-A-1	<0.02 <0.02	[NA]	89%
Chromium - Total	µg/L	<2.0	A13/4827-A-1	<2.0 <2.0	[NA]	104%
Copper - Total	µg/L	<0.20	A13/4827-A-1	2.7 1.4 RPD: 63	[NA]	77%
Iron - Total	µg/L	<5.0	A13/4827-A-1	45 46 RPD: 2	[NA]	111%
Lead - Total	µg/L	<0.10	A13/4827-A-1	<0.10 <0.10	[NA]	73%
Manganese - Total	µg/L	<0.60	A13/4827-A-1	7.3 5.2 RPD: 34	[NA]	111%
Nickel - Total	µg/L	<0.10	A13/4827-A-1	0.55 0.75 RPD: 31	[NA]	90%
Silver - Total	µg/L	<0.50	A13/4827-A-1	<0.50 <0.50	[NA]	101%
Zinc - Total	µg/L	<0.40	A13/4827-A-1	1.5 1.0 RPD: 40	[NA]	78%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Total	mg/L	<0.0001	A13/4827-A-1	<0.0001 <0.0001	A13/4827-A-1	95%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Phosphorus - Total	mg/L	<0.02	A13/4827-A-1	0.05 0.06 RPD: 18	A13/4827-A-1	120%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Tributyl tin	µgSn/L	<0.005	[NT]	[NT]	External	94%
Surrogate 1 Recovery	%	93	[NT]	[NT]	External	95%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Diuron	µg/L	<0.10	A13/4827-A-1	<0.10 <0.10	A13/4827-A-1	99%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results
Total Nitrogen	mg/L	<0.1	A13/4827-A-10	See Comments NT



Batch Number: A13/4827-A [R00]
Project Reference: Marine Water Testing - Total

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Total	µg/L	[NT]	A13/4827-A-11	130 140 RPD: 7
Arsenic - Total	µg/L	[NT]	A13/4827-A-11	1.5 1.5 RPD: 0
Cadmium - Total	µg/L	[NT]	A13/4827-A-11	<0.02 <0.02
Chromium - Total	µg/L	[NT]	A13/4827-A-11	<2.0 <2.0
Copper - Total	µg/L	[NT]	A13/4827-A-11	2.1 1.9 RPD: 10
Iron - Total	µg/L	[NT]	A13/4827-A-11	150 150 RPD: 0
Lead - Total	µg/L	[NT]	A13/4827-A-11	0.20 0.21 RPD: 5
Manganese - Total	µg/L	[NT]	A13/4827-A-11	11 11 RPD: 0
Nickel - Total	µg/L	[NT]	A13/4827-A-11	0.29 0.29 RPD: 0
Silver - Total	µg/L	[NT]	A13/4827-A-11	<0.50 <0.50
Zinc - Total	µg/L	[NT]	A13/4827-A-11	1.3 1.3 RPD: 0

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Total	mg/L	[NT]	A13/4827-A-11	<0.0001 <0.0001

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Phosphorus - Total	mg/L	[NT]	A13/4827-A-11	0.06 0.06 RPD: 0

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Diuron	µg/L	[NT]	A13/4827-A-11	<0.10 <0.10

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results > 10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A13/4827-B [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Dissolved
Sample Type: Water
No. of Samples: 16
Date Received: 03/10/2013
Date Completed: 21/10/2013

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
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Issue Date: 22 October 2013

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A13/4827-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	9.1	13	19	16
Arsenic - Dissolved	04-015	µg/L	<0.30	1.7	<0.30	<0.30
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	1.7	2.3	2.5	2.3
Iron - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	1.3	1.1	1.5	1.8
Nickel - Dissolved	04-015	µg/L	0.26	0.39	0.47	0.39
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	1.1	1.5	1.6	1.6
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A13/4827-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	17	20	18	16
Arsenic - Dissolved	04-015	µg/L	<0.30	<0.30	<0.30	<0.30
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	3.6	3.2	4.3	3.5
Iron - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Lead - Dissolved	04-015	µg/L	<0.10	0.21	0.32	<0.10
Manganese - Dissolved	04-015	µg/L	3.7	4.2	31	24
Nickel - Dissolved	04-015	µg/L	0.65	0.63	0.81	0.77
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	5.7	4.2	14	5.7
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	0.0004	<0.0001



Batch Number: A13/4827-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	22	23	18	16
Arsenic - Dissolved	04-015	µg/L	1.8	1.7	1.8	1.7
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	3.0	1.8	2.3	1.9
Iron - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	1.7	1.9	2.1	1.3
Nickel - Dissolved	04-015	µg/L	0.45	0.41	0.39	0.43
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	3.3	3.0	2.7	2.5
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.



Batch Number: A13/4827-B [R00]
Project Reference: Marine Water Testing - Dissolved

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	<5.0	A13/4827-B-1	9.1 8.8 RPD: 3	A13/4827-B-1	NR
Arsenic - Dissolved	µg/L	<0.30	A13/4827-B-1	<0.30 <0.30	A13/4827-B-1	NR
Cadmium - Dissolved	µg/L	<0.02	A13/4827-B-1	<0.02 <0.02	A13/4827-B-1	NR
Chromium - Dissolved	µg/L	<2.0	A13/4827-B-1	<2.0 <2.0	A13/4827-B-1	NT
Copper - Dissolved	µg/L	<0.20	A13/4827-B-1	1.7 1.8 RPD: 6	A13/4827-B-1	NR
Iron - Dissolved	µg/L	<5.0	A13/4827-B-1	<5.0 <5.0	A13/4827-B-1	NT
Lead - Dissolved	µg/L	<0.10	A13/4827-B-1	<0.10 <0.10	A13/4827-B-1	NT
Manganese - Dissolved	µg/L	<0.60	A13/4827-B-1	1.3 1.1 RPD: 17	A13/4827-B-1	NR
Nickel - Dissolved	µg/L	<0.10	A13/4827-B-1	0.26 0.26 RPD: 0	A13/4827-B-1	NT
Silver - Dissolved	µg/L	<0.50	A13/4827-B-1	<0.50 <0.50	A13/4827-B-1	145%
Zinc - Dissolved	µg/L	<0.40	A13/4827-B-1	1.1 1.2 RPD: 9	A13/4827-B-1	NR

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Dissolved	mg/L	<0.0001	A13/4827-B-1	<0.0001 <0.0001	A13/4827-B-1	89%

TEST	Units	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	[NT]	A13/4827-B-11	18 21 RPD: 15	A13/4827-B-2	72%
Arsenic - Dissolved	µg/L	[NT]	A13/4827-B-11	1.8 <0.30	A13/4827-B-2	85%
Cadmium - Dissolved	µg/L	[NT]	A13/4827-B-11	<0.02 <0.02	A13/4827-B-2	86%
Chromium - Dissolved	µg/L	[NT]	A13/4827-B-11	<2.0 <2.0	A13/4827-B-2	104%
Copper - Dissolved	µg/L	[NT]	A13/4827-B-11	2.3 1.6 RPD: 36	A13/4827-B-2	92%
Iron - Dissolved	µg/L	[NT]	A13/4827-B-11	<5.0 <5.0	A13/4827-B-2	111%
Lead - Dissolved	µg/L	[NT]	A13/4827-B-11	<0.10 <0.10	A13/4827-B-2	75%
Manganese - Dissolved	µg/L	[NT]	A13/4827-B-11	2.1 2.3 RPD: 9	A13/4827-B-2	79%
Nickel - Dissolved	µg/L	[NT]	A13/4827-B-11	0.39 0.39 RPD: 0	A13/4827-B-2	81%
Silver - Dissolved	µg/L	[NT]	A13/4827-B-11	<0.50 <0.50	A13/4827-B-2	NR
Zinc - Dissolved	µg/L	[NT]	A13/4827-B-11	2.7 2.8 RPD: 4	A13/4827-B-2	84%



Batch Number: A13/4827-B [R00]
Project Reference: Marine Water Testing - Dissolved

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Dissolved	mg/L	[NT]	A13/4827-B-11	<0.0001 <0.0001

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results >10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A13/5775-A [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Total
Sample Type: Water
No. of Samples: 16
Date Received: 21/11/2013
Date Completed: 13/01/2014

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
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Issue Date: 14 January 2014

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	S1 Top	S1 Bottom	S2 Top	S2 Bottom
Date Sampled:	-	-	20/11/2013	20/11/2013	20/11/2013	20/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	66	79	92	87
Arsenic - Total	04-015	µg/L	1.4	2.1	2.0	1.9
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	1.3	1.2	1.3	2.3
Iron - Total	04-015	µg/L	27	42	60	55
Lead - Total	04-015	µg/L	<0.10	<0.10	<0.10	0.29
Manganese - Total	04-015	µg/L	3.1	3.8	4.4	4.6
Nickel - Total	04-015	µg/L	0.50	0.49	1.1	0.68
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	1.7	2.4	2.0	4.4
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	102	103	109	111
Date Extracted	04-061	-	26/11/2013	26/11/2013	26/11/2013	26/11/2013
Date Analysed	04-061	-	26/11/2013	26/11/2013	26/11/2013	26/11/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	<0.10	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	<2	<2	<2
Total Oil and Grease		mg/L	<2	<2	<2	<2



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	S3 Top	S3 Bottom	S4 Top	S4 Bottom
Date Sampled:	-	-	20/11/2013	20/11/2013	20/11/2013	20/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	150	300	130	160
Arsenic - Total	04-015	µg/L	2.1	2.6	1.1	1.3
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	1.7	1.7	3.3	2.4
Iron - Total	04-015	µg/L	120	260	110	140
Lead - Total	04-015	µg/L	0.14	0.27	0.23	0.19
Manganese - Total	04-015	µg/L	9.1	15	31	27
Nickel - Total	04-015	µg/L	0.92	1.2	1.1	1.2
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	3.0	4.2	15	6.5
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	106	111	105	101
Date Extracted	04-061	-	26/11/2013	26/11/2013	26/11/2013	26/11/2013
Date Analysed	04-061	-	27/11/2013	27/11/2013	27/11/2013	27/11/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	0.24	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	4	4	<2
Total Oil and Grease		mg/L	2	<2	2	3



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	S5 Top	S5 Bottom	S6 Top	S6 Bottom
Date Sampled:	-	-	20/11/2013	20/11/2013	20/11/2013	20/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	160	140	95	90
Arsenic - Total	04-015	µg/L	2.3	2.3	2.0	2.1
Cadmium - Total	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Total	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Total	04-015	µg/L	2.1	1.4	1.6	1.3
Iron - Total	04-015	µg/L	120	110	59	56
Lead - Total	04-015	µg/L	0.26	0.17	<0.10	<0.10
Manganese - Total	04-015	µg/L	7.0	7.0	5.8	5.9
Nickel - Total	04-015	µg/L	0.94	1.1	1.0	0.81
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	3.0	2.2	2.7	2.4
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	108	103	106	112
Date Extracted	04-061	-	26/11/2013	26/11/2013	26/11/2013	26/11/2013
Date Analysed	04-061	-	27/11/2013	27/11/2013	27/11/2013	27/11/2013
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	<0.10	<0.10	<0.10	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	<2	<2	2
Total Oil and Grease		mg/L	4	2	4	4



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/13	/14	/15	/16
Client Reference:	-	-	Deep 1	Deep 2	Deep 3	Deep 4
Date Sampled:	-	-	20/11/2013	20/11/2013	20/11/2013	20/11/2013
Analysis Description	Method	Units				
Trace Elements						
Mercury						
Organotins						
Ultra-trace Residue LCMSMS						
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	2	<2	<2

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L
04-061	Tributyltin in saline waters by GCMS, µgSn/L
LCMSMS	*Analysis by LCMSMS
SUB	Subcontracted Analyses

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.

Analysis was subcontracted to Sydney Analytical Laboratories (NATA Number 1884);
reference SAL report number SAL24884B

Ultra Trace Nutrients were subcontracted to MAFRL WA see attached report.



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Total	µg/L	<5.0	A13/5775-A-1	66 58 RPD: 13	A13/5775-A-1	100%
Arsenic - Total	µg/L	<0.30	A13/5775-A-1	1.4 1.7 RPD: 19	A13/5775-A-1	100%
Cadmium - Total	µg/L	<0.02	A13/5775-A-1	<0.02 <0.02	A13/5775-A-1	136%
Chromium - Total	µg/L	<2.0	A13/5775-A-1	<2.0 <2.0	A13/5775-A-1	108%
Copper - Total	µg/L	<0.20	A13/5775-A-1	1.3 1.3 RPD: 0	A13/5775-A-1	122%
Iron - Total	µg/L	<5.0	A13/5775-A-1	27 27 RPD: 0	A13/5775-A-1	110%
Lead - Total	µg/L	<0.10	A13/5775-A-1	<0.10 <0.10	A13/5775-A-1	111%
Manganese - Total	µg/L	<0.60	A13/5775-A-1	3.1 2.9 RPD: 7	A13/5775-A-1	117%
Nickel - Total	µg/L	<0.10	A13/5775-A-1	0.50 0.47 RPD: 6	A13/5775-A-1	103%
Silver - Total	µg/L	<0.50	A13/5775-A-1	<0.50 <0.50	A13/5775-A-1	#
Zinc - Total	µg/L	<0.40	A13/5775-A-1	1.7 1.8 RPD: 6	A13/5775-A-1	132%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Total	mg/L	<0.0001	A13/5775-A-1	<0.0001 <0.0001	[NA]	93%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Tributyl tin	µgSn/L	<0.005	[NT]	[NT]	External	87%
Surrogate 1 Recovery	%	102	[NT]	[NT]	External	103%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Diuron	µg/L	<0.10	A13/5775-A-1	<0.10 <0.10	A13/5775-A-2	114%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results
Total Nitrogen	mg/L	<0.1	A13/5775-A-10	See Comments NT

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Total	µg/L	[NT]	A13/5775-A-11	95 81 RPD: 16
Arsenic - Total	µg/L	[NT]	A13/5775-A-11	2.0 2.1 RPD: 5
Cadmium - Total	µg/L	[NT]	A13/5775-A-11	<0.02 <0.02
Chromium - Total	µg/L	[NT]	A13/5775-A-11	<2.0 <2.0
Copper - Total	µg/L	[NT]	A13/5775-A-11	1.6 1.6 RPD: 0
Iron - Total	µg/L	[NT]	A13/5775-A-11	59 58 RPD: 2
Lead - Total	µg/L	[NT]	A13/5775-A-11	<0.10 <0.10
Manganese - Total	µg/L	[NT]	A13/5775-A-11	5.8 6.2 RPD: 7
Nickel - Total	µg/L	[NT]	A13/5775-A-11	1.0 0.99 RPD: 1



Batch Number: A13/5775-A [R00]
Project Reference: Marine Water Testing - Total

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Silver - Total	µg/L	[NT]	A13/5775-A-11	<0.50 <0.50
Zinc - Total	µg/L	[NT]	A13/5775-A-11	2.7 3.1 RPD: 14

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Total	mg/L	[NT]	A13/5775-A-11	<0.0001 <0.0001

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Diuron	µg/L	[NT]	A13/5775-A-11	<0.10 <0.10

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results >10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits:

Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A13/5775-B [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Dissolved
Sample Type: Water
No. of Samples: 16
Date Received: 21/11/2013
Date Completed: 13/01/2014

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
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Issue Date: 14 January 2014

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A13/5775-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	S1 Top	S1 Bottom	S2 Top	S2 Bottom
Date Sampled:	-	-	21/11/2013	21/11/2013	21/11/2013	21/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	<5.0	<5.0	<5.0	<5.0
Arsenic - Dissolved	04-015	µg/L	1.3	1.4	1.3	1.3
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	<0.02	<0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	<0.20	<0.20	<0.20	<0.20
Iron - Dissolved	04-015	µg/L	6.6	11	8.6	6.6
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	2.9	3.1	2.8	2.8
Nickel - Dissolved	04-015	µg/L	0.77	0.37	0.43	0.32
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	2.8	2.4	1.8	2.5
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A13/5775-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	S3 Top	S3 Bottom	S4 Top	S4 Bottom
Date Sampled:	-	-	21/11/2013	21/11/2013	21/11/2013	21/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	6.7	8.1	5.3	5.6
Arsenic - Dissolved	04-015	µg/L	1.3	1.3	0.87	0.94
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	0.03	0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	<0.20	<0.20	<0.20	<0.20
Iron - Dissolved	04-015	µg/L	7.9	11	12	6.6
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	3.9	4.8	18	12
Nickel - Dissolved	04-015	µg/L	0.36	0.38	0.64	0.57
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	3.3	2.7	3.9	4.6
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A13/5775-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	S5 Top	S5 Bottom	S6 Top	S6 Bottom
Date Sampled:	-	-	21/11/2013	21/11/2013	21/11/2013	21/11/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	6.5	6.9	<5.0	<5.0
Arsenic - Dissolved	04-015	µg/L	1.4	1.4	1.3	1.4
Cadmium - Dissolved	04-015	µg/L	<0.02	<0.02	0.2	<0.02
Chromium - Dissolved	04-015	µg/L	<2.0	<2.0	<2.0	<2.0
Copper - Dissolved	04-015	µg/L	<0.20	<0.20	<0.20	<0.20
Iron - Dissolved	04-015	µg/L	7.5	37	9.3	5.2
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	3.0	3.5	4.3	4.1
Nickel - Dissolved	04-015	µg/L	0.30	0.41	0.37	0.32
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	1.9	2.1	2.1	1.9
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.
samples in Tray W29,32-A/B - 22/11/2013



Batch Number: A13/5775-B [R00]
Project Reference: Marine Water Testing - Dissolved

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	<5.0	A13/5775-B-1	<5.0 7.0	A13/5775-B-1	135%
Arsenic - Dissolved	µg/L	<0.30	A13/5775-B-1	1.3 1.3 RPD: 0	A13/5775-B-1	90%
Cadmium - Dissolved	µg/L	<0.02	A13/5775-B-1	<0.02 <0.02	A13/5775-B-1	NR
Chromium - Dissolved	µg/L	<2.0	A13/5775-B-1	<2.0 <2.0	A13/5775-B-1	93%
Copper - Dissolved	µg/L	<0.20	A13/5775-B-1	<0.20 <0.20	A13/5775-B-1	NR
Iron - Dissolved	µg/L	<5.0	A13/5775-B-1	6.6 7.0 RPD: 6	A13/5775-B-1	93%
Lead - Dissolved	µg/L	<0.10	A13/5775-B-1	<0.10 <0.10	A13/5775-B-1	119%
Manganese - Dissolved	µg/L	<0.60	A13/5775-B-1	2.9 3.1 RPD: 7	A13/5775-B-1	NR
Nickel - Dissolved	µg/L	<0.10	A13/5775-B-1	0.77 NT	A13/5775-B-1	107%
Silver - Dissolved	µg/L	<0.50	A13/5775-B-1	<0.50 <0.50	A13/5775-B-1	NR
Zinc - Dissolved	µg/L	<0.40	A13/5775-B-1	2.8 2.7 RPD: 4	A13/5775-B-1	NR

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Dissolved	mg/L	<0.0001	A13/5775-B-1	<0.0001 <0.0001	A13/5775-B-1	125%

TEST	Units	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	[NT]	A13/5775-B-11	<5.0 <5.0	A13/5775-B-2	NR
Arsenic - Dissolved	µg/L	[NT]	A13/5775-B-11	1.3 1.4 RPD: 7	A13/5775-B-2	NR
Cadmium - Dissolved	µg/L	[NT]	A13/5775-B-11	0.2 <0.02	A13/5775-B-2	128%
Chromium - Dissolved	µg/L	[NT]	A13/5775-B-11	<2.0 <2.0	A13/5775-B-2	NT
Copper - Dissolved	µg/L	[NT]	A13/5775-B-11	<0.20 <0.20	A13/5775-B-2	101%
Iron - Dissolved	µg/L	[NT]	A13/5775-B-11	9.3 8.1 RPD: 14	A13/5775-B-2	NT
Lead - Dissolved	µg/L	[NT]	A13/5775-B-11	<0.10 <0.10	A13/5775-B-2	NR
Manganese - Dissolved	µg/L	[NT]	A13/5775-B-11	4.3 5.1 RPD: 17	A13/5775-B-2	107%
Nickel - Dissolved	µg/L	[NT]	A13/5775-B-11	0.37 0.25 RPD: 39	A13/5775-B-2	NR
Silver - Dissolved	µg/L	[NT]	A13/5775-B-11	<0.50 <0.50	A13/5775-B-2	95%
Zinc - Dissolved	µg/L	[NT]	A13/5775-B-11	2.1 2.1 RPD: 0	A13/5775-B-2	85%



Batch Number: A13/5775-B [R00]
Project Reference: Marine Water Testing - Dissolved

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Dissolved	mg/L	[NT]	A13/5775-B-11	<0.0001 <0.0001

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results >10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A14/0413-A [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Total
Sample Type: Water
No. of Samples: 16
Date Received: 28/01/2014
Date Completed: 10/03/2014

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.



Issue Date: 10 March 2014

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	25/01/2014	25/01/2014	25/01/2014	25/01/2014
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	150	150	170	150
Arsenic - Total	04-015	µg/L	1.3	1.4	1.4	1.5
Cadmium - Total	04-015	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium - Total	04-015	µg/L	<3	<3	<3	<3
Copper - Total	04-015	µg/L	4.2	3.4	11	4.4
Iron - Total	04-015	µg/L	68	81	110	110
Lead - Total	04-015	µg/L	0.49	0.61	0.53	0.76
Manganese - Total	04-015	µg/L	3.5	3.8	6.7	4.8
Nickel - Total	04-015	µg/L	0.91	0.96	1.2	1.4
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	16	11	14	11
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.13	0.14	0.11	0.11
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	139	108	107	116
Date Extracted	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Date Analysed	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	0.12	<0.10	0.15	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	<2	<2	2
Total Oil and Grease		mg/L	8	6	5	7



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	25/01/2014	25/01/2014	25/01/2014	25/01/2014
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	220	290	280	[NA]
Arsenic - Total	04-015	µg/L	1.5	1.6	1.0	[NA]
Cadmium - Total	04-015	µg/L	<0.1	<0.1	<0.1	[NA]
Chromium - Total	04-015	µg/L	<3	<3	<3	[NA]
Copper - Total	04-015	µg/L	2.4	3.0	3.9	[NA]
Iron - Total	04-015	µg/L	150	200	190	[NA]
Lead - Total	04-015	µg/L	0.20	0.43	0.76	[NA]
Manganese - Total	04-015	µg/L	7.2	6.5	65	[NA]
Nickel - Total	04-015	µg/L	1.1	1.0	1.1	[NA]
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	[NA]
Zinc - Total	04-015	µg/L	4.5	5.3	6.3	[NA]
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	Sample missing
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.12	0.13	0.12	Sample missing
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	107	114	109	109
Date Extracted	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Date Analysed	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	<0.10	0.30	0.43	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	3	3	4	<2
Total Oil and Grease		mg/L	4	8	8	9



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	25/01/2014	25/01/2014	25/01/2014	25/01/2014
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Total	04-015	µg/L	180	680	130	120
Arsenic - Total	04-015	µg/L	1.5	1.9	1.6	1.5
Cadmium - Total	04-015	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium - Total	04-015	µg/L	<3	<3	<3	<3
Copper - Total	04-015	µg/L	3.1	4.5	6.7	2.5
Iron - Total	04-015	µg/L	120	540	73	62
Lead - Total	04-015	µg/L	0.19	0.51	1.2	0.25
Manganese - Total	04-015	µg/L	3.7	9.4	3.6	4.0
Nickel - Total	04-015	µg/L	0.97	1.4	1.0	1.1
Silver - Total	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Total	04-015	µg/L	6.2	11	9.8	7.6
Mercury						
Mercury - Total	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
Trace Elements						
Phosphorus - Total	04-003	mg/L	0.11	0.11	0.12	0.12
Organotins						
Tributyl tin	04-061	µgSn/L	<0.005	<0.005	<0.005	<0.005
Surrogate 1 Recovery	04-061	%	103	111	102	112
Date Extracted	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Date Analysed	04-061	-	31/01/2014	31/01/2014	31/01/2014	31/01/2014
Ultra-trace Residue LCMSMS						
Diuron	LCMSMS	µg/L	<0.10	0.14	0.15	<0.10
Subcontract Analysis - Water						
Total Nitrogen	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Ammonia as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrate as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Nitrite as N	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Phosphate as P	SUB	mg/L	See Comments	See Comments	See Comments	See Comments
Total Suspended Solids	SUB	mg/L	<2	8	4	<2
Total Oil and Grease		mg/L	8	2	5	6



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

Laboratory Reference:	-	-	/13	/14	/15	/16
Client Reference:	-	-	Deep 1	Deep 2	Deep 3	Deep 4
Date Sampled:	-	-	25/01/2014	25/01/2014	25/01/2014	25/01/2014
Analysis Description	Method	Units				
Trace Elements						
Mercury						
Trace Elements						
Organotins						
Ultra-trace Residue LCMSMS						
Subcontract Analysis - Water						
Total Suspended Solids	SUB	mg/L	<2	<2	<2	<2

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L
04-003	Metals by ICP-OES
04-061	Tributyltin in saline waters by GCMS, µgSn/L
LCMSMS	*Analysis by LCMSMS
SUB	Subcontracted Analyses

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.

Analysis was subcontracted to Sydney Analytical Laboratories (NATA Number 1884);
reference SAL report number SAL24957B

Ultra Trace Nutrients were subcontracted to MAFRL WA see attached report.

Sample #8 was missing for totals.



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Total	µg/L	<5.0	A14/0413-A-1	150 140 RPD: 7	[NA]	93%
Arsenic - Total	µg/L	<0.30	A14/0413-A-1	1.3 1.4 RPD: 7	[NA]	101%
Cadmium - Total	µg/L	<0.1	A14/0413-A-1	<0.1 <0.1	[NA]	84%
Chromium - Total	µg/L	<2.0	A14/0413-A-1	<3 <3	[NA]	99%
Copper - Total	µg/L	<0.20	A14/0413-A-1	4.2 5.3 RPD: 23	[NA]	90%
Iron - Total	µg/L	<5.0	A14/0413-A-1	68 75 RPD: 10	[NA]	99%
Lead - Total	µg/L	<0.10	A14/0413-A-1	0.49 0.49 RPD: 0	[NA]	73%
Manganese - Total	µg/L	<0.60	A14/0413-A-1	3.5 3.7 RPD: 6	[NA]	68%
Nickel - Total	µg/L	<0.10	A14/0413-A-1	0.91 0.96 RPD: 5	[NA]	102%
Silver - Total	µg/L	<0.50	A14/0413-A-1	<0.50 <0.50	[NA]	#
Zinc - Total	µg/L	<0.40	A14/0413-A-1	16 17 RPD: 6	[NA]	97%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Total	mg/L	<0.0001	A14/0413-A-2	<0.0001 <0.0001	[NA]	88%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Phosphorus - Total	mg/L	<0.02	A14/0413-A-1	0.13 0.12 RPD: 8	[NA]	115%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Tributyl tin	µgSn/L	<0.005	[NT]	[NT]	External	98%
Surrogate 1 Recovery	%	99	[NT]	[NT]	External	114%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Diuron	µg/L	<0.10	A14/0413-A-12	<0.10 <0.10	External	88%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results
Total Nitrogen	mg/L	<0.1	A14/0413-A-10	See Comments NT



Batch Number: A14/0413-A [R00]
Project Reference: Marine Water Testing - Total

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Total	µg/L	[NT]	A14/0413-A-11	130 130 RPD: 0
Arsenic - Total	µg/L	[NT]	A14/0413-A-11	1.6 1.4 RPD: 13
Cadmium - Total	µg/L	[NT]	A14/0413-A-11	<0.1 <0.1
Chromium - Total	µg/L	[NT]	A14/0413-A-11	<3 <3
Copper - Total	µg/L	[NT]	A14/0413-A-11	6.7 11 RPD: 49
Iron - Total	µg/L	[NT]	A14/0413-A-11	73 83 RPD: 13
Lead - Total	µg/L	[NT]	A14/0413-A-11	1.2 1.2 RPD: 0
Manganese - Total	µg/L	[NT]	A14/0413-A-11	3.6 3.7 RPD: 3
Nickel - Total	µg/L	[NT]	A14/0413-A-11	1.0 1.1 RPD: 10
Silver - Total	µg/L	[NT]	A14/0413-A-11	<0.50 <0.50
Zinc - Total	µg/L	[NT]	A14/0413-A-11	9.8 14 RPD: 35

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Phosphorus - Total	mg/L	[NT]	A14/0413-A-11	0.12 0.15 RPD: 22

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results > 10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



REPORT OF ANALYSIS

Laboratory Reference: A14/0413-B [R00]

Client: BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane QLD 4000

Contact: Marcus Gregson

Order No: B20407
Project: Marine Water Testing - Dissolved
Sample Type: Water
No. of Samples: 16
Date Received: 28/01/2014
Date Completed: 10/03/2014

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Ian Eckhard
Technical Director

Comments:

All samples tested as submitted by client. All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.
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Issue Date: 10 March 2014

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Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au



Batch Number: A14/0413-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/1	/2	/3	/4
Client Reference:	-	-	1 Top	1 Bottom	2 Top	2 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	37	34	34	37
Arsenic - Dissolved	04-015	µg/L	1.3	1.3	1.2	1.3
Cadmium - Dissolved	04-015	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium - Dissolved	04-015	µg/L	<3	<3	<3	<3
Copper - Dissolved	04-015	µg/L	2.7	2.3	3.1	2.3
Iron - Dissolved	04-015	µg/L	62	<20	<20	<20
Lead - Dissolved	04-015	µg/L	0.11	0.12	<0.10	0.15
Manganese - Dissolved	04-015	µg/L	1.7	1.9	3.8	2.4
Nickel - Dissolved	04-015	µg/L	0.79	0.65	0.66	0.64
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	4.9	3.0	6.4	5.3
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A14/0413-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/5	/6	/7	/8
Client Reference:	-	-	3 Top	3 Bottom	4 Top	4 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	36	36	29	39
Arsenic - Dissolved	04-015	µg/L	1.2	1.2	0.73	1.3
Cadmium - Dissolved	04-015	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium - Dissolved	04-015	µg/L	<3	<3	<3	<3
Copper - Dissolved	04-015	µg/L	1.8	1.8	1.8	1.8
Iron - Dissolved	04-015	µg/L	<20	<20	<20	<20
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	<0.10	<0.10
Manganese - Dissolved	04-015	µg/L	4.8	2.2	60	5.5
Nickel - Dissolved	04-015	µg/L	0.62	0.64	0.57	0.63
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	1.9	1.6	14	13
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001



Batch Number: A14/0413-B [R00]
Project Reference: Marine Water Testing - Dissolved

Laboratory Reference:	-	-	/9	/10	/11	/12
Client Reference:	-	-	5 Top	5 Bottom	6 Top	6 Bottom
Date Sampled:	-	-	02/10/2013	02/10/2013	02/10/2013	02/10/2013
Analysis Description	Method	Units				
Trace Elements						
Aluminium - Dissolved	04-015	µg/L	39	36	41	40
Arsenic - Dissolved	04-015	µg/L	1.3	1.3	1.3	1.3
Cadmium - Dissolved	04-015	µg/L	<0.1	<0.1	<0.1	<0.1
Chromium - Dissolved	04-015	µg/L	<3	<3	<3	<3
Copper - Dissolved	04-015	µg/L	1.7	1.3	3.2	1.5
Iron - Dissolved	04-015	µg/L	<20	<20	<20	<20
Lead - Dissolved	04-015	µg/L	<0.10	<0.10	0.12	<0.10
Manganese - Dissolved	04-015	µg/L	1.3	1.8	2.3	2.2
Nickel - Dissolved	04-015	µg/L	0.68	0.95	1.0	0.95
Silver - Dissolved	04-015	µg/L	<0.50	<0.50	<0.50	<0.50
Zinc - Dissolved	04-015	µg/L	2.9	1.5	4.3	1.8
Mercury						
Mercury - Dissolved	04-009	mg/L	<0.0001	<0.0001	<0.0001	<0.0001

Method	Method Description
04-015	Low level metals in waters by ICPMS, µg/L
04-009	Mercury by CVAAS, mg/L or µg/L

Result Comments

[<] Less than

[INS] Insufficient sample for this test

[NA] Test not required

*Analyte is not covered by NATA scope of accreditation.



Batch Number: A14/0413-B [R00]
Project Reference: Marine Water Testing - Dissolved

QUALITY ASSURANCE REPORT

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Aluminium - Dissolved	µg/L	<5.0	A14/0413-B-1	37 33 RPD: 11	A14/0413-B-1	91%
Arsenic - Dissolved	µg/L	<0.30	A14/0413-B-1	1.3 1.2 RPD: 8	A14/0413-B-1	130%
Cadmium - Dissolved	µg/L	<0.1	A14/0413-B-1	<0.1 <0.1	A14/0413-B-1	106%
Chromium - Dissolved	µg/L	<2.0	A14/0413-B-1	<3 <3	A14/0413-B-1	99%
Copper - Dissolved	µg/L	<0.20	A14/0413-B-1	2.7 2.6 RPD: 4	A14/0413-B-1	124%
Iron - Dissolved	µg/L	<5.0	A14/0413-B-1	62 61 RPD: 2	A14/0413-B-1	97%
Lead - Dissolved	µg/L	<0.10	A14/0413-B-1	0.11 0.11 RPD: 0	A14/0413-B-1	90%
Manganese - Dissolved	µg/L	<0.60	A14/0413-B-1	1.7 1.7 RPD: 0	A14/0413-B-1	120%
Nickel - Dissolved	µg/L	<0.10	A14/0413-B-1	0.79 0.79 RPD: 0	A14/0413-B-1	135%
Silver - Dissolved	µg/L	<0.50	A14/0413-B-1	<0.50 <0.50	A14/0413-B-1	105%
Zinc - Dissolved	µg/L	<0.40	A14/0413-B-1	4.9 4.9 RPD: 0	A14/0413-B-1	125%

TEST	UNITS	Blank	Duplicate Sm#	Duplicate Results	Spike Sm#	Spike Results
Mercury - Dissolved	mg/L	<0.0001	A14/0413-B-1	<0.0001 <0.0001	A14/0413-B-1	89%

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Aluminium - Dissolved	µg/L	[NT]	A14/0413-B-11	41 39 RPD: 5
Arsenic - Dissolved	µg/L	[NT]	A14/0413-B-11	1.3 1.3 RPD: 0
Cadmium - Dissolved	µg/L	[NT]	A14/0413-B-11	<0.1 <0.1
Chromium - Dissolved	µg/L	[NT]	A14/0413-B-11	<3 <3
Copper - Dissolved	µg/L	[NT]	A14/0413-B-11	3.2 2.1 RPD: 42
Iron - Dissolved	µg/L	[NT]	A14/0413-B-11	<20 <20
Lead - Dissolved	µg/L	[NT]	A14/0413-B-11	0.12 <0.10
Manganese - Dissolved	µg/L	[NT]	A14/0413-B-11	2.3 2.3 RPD: 0
Nickel - Dissolved	µg/L	[NT]	A14/0413-B-11	1.0 0.97 RPD: 3
Silver - Dissolved	µg/L	[NT]	A14/0413-B-11	<0.50 <0.50
Zinc - Dissolved	µg/L	[NT]	A14/0413-B-11	4.3 3.9 RPD: 10



Batch Number: A14/0413-B [R00]
Project Reference: Marine Water Testing - Dissolved

TEST	Units	Blank	Duplicate Sm#	Duplicate Results
Mercury - Dissolved	mg/L	[NT]	A14/0413-B-11	<0.0001 <0.0001

Comments:

RPD = Relative Percent Deviation

[NT] = Not Tested

[N/A] = Not Applicable

'#' = Spike recovery data could not be calculated due to high levels of contaminants

Acceptable replicate reproducibility limit or RPD: Results < 10 times LOR: no limits

Results > 10 times LOR: 0% - 50%

Acceptable matrix spike & LCS recovery limits: Trace elements 70-130%

Organic analyses 50-150%

SVOC & speciated phenols 10-140%

Surrogates 10-140%

When levels outside these limits are obtained, an investigation into the cause of the deviation is performed before the batch is accepted or rejected, and results are released.



BMT WBM Bangalow	6/20 Byron Street, Bangalow 2479 Tel +61 2 6687 0466 Fax +61 2 66870422 Email bmtwbm@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Brisbane	Level 8, 200 Creek Street, Brisbane 4000 PO Box 203, Spring Hill QLD 4004 Tel +61 7 3831 6744 Fax +61 7 3832 3627 Email bmtwbm@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Denver	8200 S. Akron Street, #B120 Centennial, Denver Colorado 80112 USA Tel +1 303 792 9814 Fax +1 303 792 9742 Email denver@bmtwbm.com Web www.bmtwbm.com
BMT WBM London	International House, 1st Floor St Katharine's Way, London E1W 1AY Email london@bmtwbm.co.uk Web www.bmtwbm.com
BMT WBM Mackay	PO Box 4447, Mackay QLD 4740 Tel +61 7 4953 5144 Fax +61 7 4953 5132 Email mackay@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Melbourne	Level 5, 99 King Street, Melbourne 3000 PO Box 604, Collins Street West VIC 8007 Tel +61 3 8620 6100 Fax +61 3 8620 6105 Email melbourne@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Newcastle	126 Belford Street, Broadmeadow 2292 PO Box 266, Broadmeadow NSW 2292 Tel +61 2 4940 8882 Fax +61 2 4940 8887 Email newcastle@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Perth	Level 3, 20 Parkland Road, Osborne, WA 6017 PO Box 1027, Innaloo WA 6918 Tel +61 8 9328 2029 Fax +61 8 9486 7588 Email perth@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Sydney	Level 1, 256-258 Norton Street, Leichhardt 2040 PO Box 194, Leichhardt NSW 2040 Tel +61 2 8987 2900 Fax +61 2 8987 2999 Email sydney@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Vancouver	Suite 401, 611 Alexander Street Vancouver British Columbia V6A 1E1 Canada Tel +1 604 683 5777 Fax +1 604 608 3232 Email vancouver@bmtwbm.com Web www.bmtwbm.com