Soay Sound

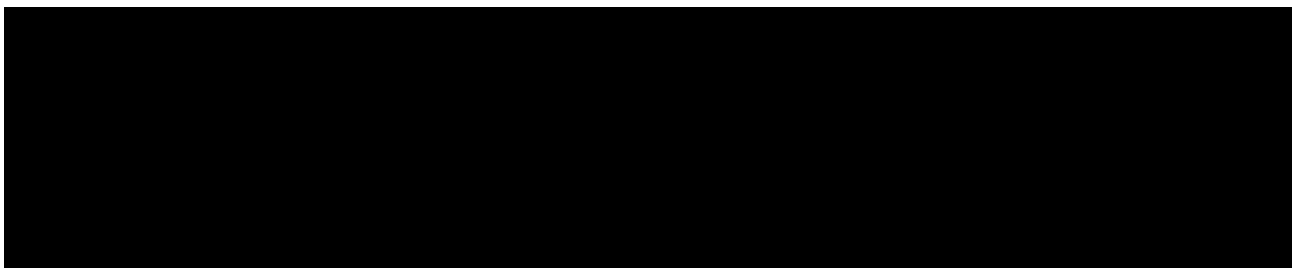
Hydrographic Data Report: Deployment ID233

11th July to 5th October 2018

[redacted]

January 2022

Mowi Scotland Limited



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QUALITY ASSURANCE

Mowi Scotland Ltd is ISO9001 and ISO14001 accredited and all project management follows policies designed to ensure that the collection, collation and reporting of information produced in the course of our operations is done to a consistently high standard meeting the requirements of the end user.

1. Introduction

Mowi Scotland Ltd. is applying to the Scottish Environmental Protection Agency (SEPA) for a technical variation to CAR/L/1004053 to modify an existing salmon farm site located at Soay Sound, West Loch Tarbert. Mowi Scotland Ltd. propose to increase to the maximum standing biomass, from 2012.5T to 2300T.

Mowi Scotland Ltd have carried out hydrographic surveys at the site in 2016 and again in 2018. Hydrographic data at Soay Sound was gathered during this time in two deployments:

i. 10th May to 15th June 2016 (ID081)
ii. 11th July to 18th October 2018 (ID233)

This report describes the data from the 11th July to 18th October 2018 deployment (ID233) at Soay Sound. The purpose of this report is to assess the suitability of the collected hydrographic data for input into a hydrodynamic model of the region and into the NewDepomod model.

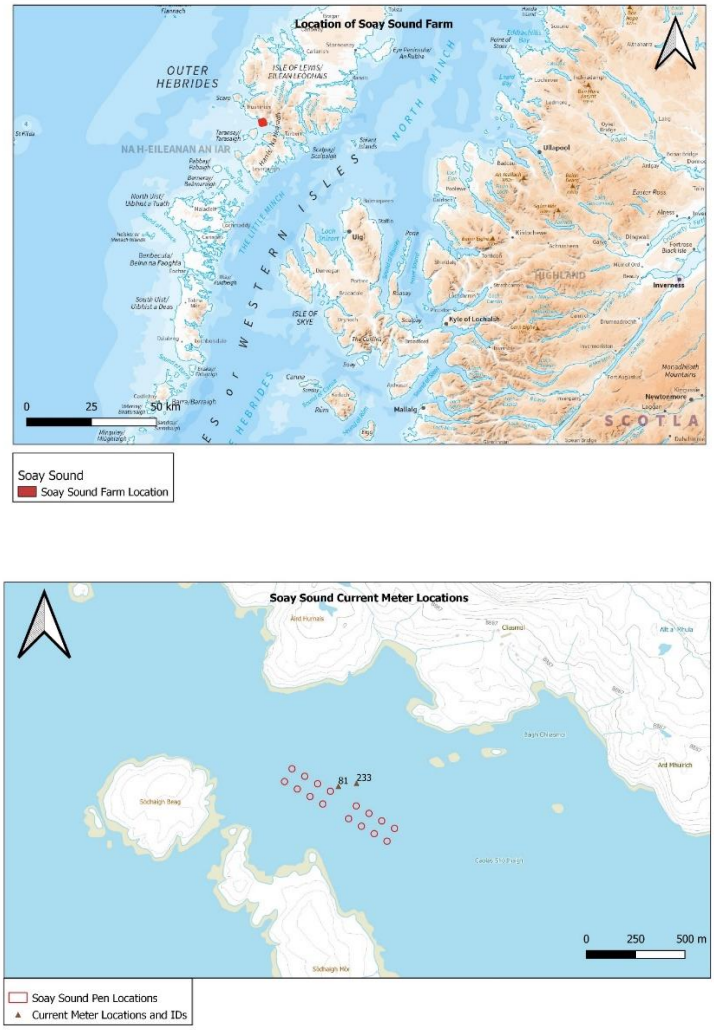

Figure 1. Site location (top) and layout (bottom) and of the salmon farm at Soay Sound. The current meter deployment locations are marked by the red triangles.

2. Materials & Methods

2.1 Bathymetry

Bathymetry for the study area was taken from the UKHO bathymetry data. NewDepomod modelling used a flat seabed as described with the SEPA default method.

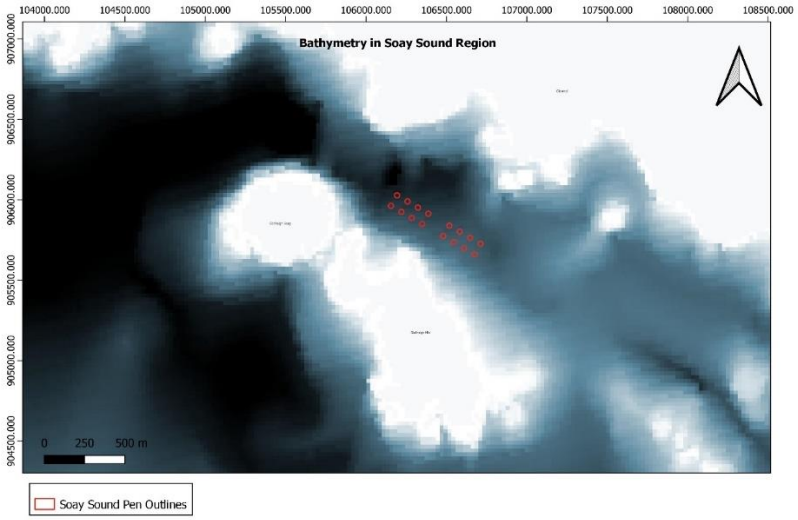

Figure 2. Bathymetry in the region around Soay Sound. The darker the shading, the greater the depth.

2.2 Current Data

Mowi staff carried out hydrographic surveys at the site during 2016 and again in 2018. The purpose of this hydrographic report is to assess the suitability of the collected hydrographic data for use with NewDepomod. The data contained in this report were recorded at the site from 11th July to 18th October 2018 (85.93 days of data; deployment ID233). The data from an earlier deployment (ID081) is presented in a separate hydrographic report.

The Sentinel V100 (Wide) ADCP (Table 1), within its mooring frame, was positioned at 57.94585°N, 6.9618°W (106520E 905959N), which was approximately 415m from the nearest shoreline and approximately 130m from the centre of the proposed cage group (Figure 1). The transducer head was 0.7 m from the base of the mooring frame. The mean depth (derived from the pressure sensor) at the Sentinel V100 ADCP position was 30.86 m.

Initial soundings were taken to establish the possible depth the Sentinel V100 ADCP would be situated at during high tide and so that the most appropriate cell size could be determined. The cell size was set at 1.0 m and the number of cells to 50.

Data was automatically written and stored to the internal memory within the Sentinel V100 ADCP main body and then downloaded after completion of the deployment period via WiFi.

2.3 Magnetic Variation

No magnetic variation correction was made to the Sentinel V100 ADCP during deployment, this was undertaken to the data after the instrument was recovered and data downloaded. The magnetic variation used was -4.15°; this was determined using the World Magnetic Model, produced jointly with the US National Oceanographic and Atmospheric Administration's National Geophysical Data center. Further details can be found at http://www.geomag.bgs.ac.uk/navigation.html

2.4 Data Processing

Upon retrieval of the Sentinel V100 ADCP current meter, all data was downloaded to a computer for analysis. The raw data file was opened in Teledyne's Velocity software and MATLAB. Deployment diagnostic data (beam intensity, correlation, pitch and roll) were analysed to confirm that the deployment was successful with the instrument orientated upright. The heading data were also examined to identify any movement of the Sentinel V100 ADCP mooring frame during the deployment.

The diagnostic data suggested that velocities from the first 23 bins were valid. Calculations were undertaken to identify the cells to be used for surface and middle currents. Surface data was taken at an average depth (derived from the pressure sensor) of 4.84 m (cell 23), and cage-bottom data at 15.84 m (cell 12). Surface and middle cell heights above were 25.72m and 15.72 m from the seabed respectively. The bottom cell (cell 1) was at a depth of 27.84 m and 3.72 m above the seabed.

Table 1: Sentinel V100 ADCP Specifications.

		V20 (1000kHz)		V50 (500kHz)		V100 (300kHz)	
Depth Cell Size[1]	Depth Cell Size[1]	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow
	0.25m	18.0/22.6	19.2/36.5				
	0.3m	19.3/24.0	11.1/20.8				
	0.5m	20.2/24.9	7.1/13.4	44.1/57.6	19.2/36.5		
	1.0m	22.1/26.9	3.6/6.7	50.5/64.6	7.1/13.5	94.5/120.6	10.9/20.6
	2.0m	24.5/29.4	1.7/3.2	56.0/70.6	3.6/6.7	103.5/130.4	5.5/10.3
	4.0m	26.9/32.0	0.8/1.6	63.1/78.2	1.7/3.2	114.6/142.3	2.7/5.2
	6.0m			67.4/82.8	1.1/2.1	121.7/151.5	1.8/3.3
Communications and Recording	Wireless	802.11b/g/n					
	Internal memory	One 16GB Micro SD Card included					
Profile Parameters	Velocity accuracy	V20/V50: 0.3% of the water velocity relative to the ADCP ±0.3cm/s V100: 0.5% of the water velocity relative to the ADCP ±0.5cm/s					
	Velocity resolution	0.1cm/s					
	Velocity range	±5m/s (default); ±20m/s (maximum)					
	Ping rate	Up to 4Hz					
Echo Intensity Profile	Vertical resolution	Depth cell size					
	Dynamic range	80dB					
	Precision	±1.5dB					
Transducer and Hardware	Beam angle	25°					
	Configuration	4-beam, convex; 5th beam vertical					
	Depth rating	200m					
	Materials	Transducer, housing, and end cap: plastic Connector: metal shell					
Standard Sensors	Temperature (mounted on transducer)	Range -5° to 45°C, precision ±0.4°C, resolution 0.1°					
	Compass (magneto-inductive sensor)	Accuracy 2° RMS, resolution 0.1°, max. dip angle 85°					
	Tilt (MEMS accelerometers)	Pitch range ±90°, roll range ±180°, accuracy 2° RMS, precision 0.05° RMS, resolution 0.1°					
	Pressure sensor (mounted on transducer)	Range 300m, accuracy 0.1%FS					
Power	External DC input	12–20VDC					
	Internal battery voltage	18VDC new					
	Battery capacity; over-the-counter @0°C	100 watt hours (typical)					
	Battery pack @5°C	510 watt hours					
Software	Teledyne RDI's new software included	ReadyV—Pre-deployment (testing, planning, and data recovery)[5] Velocity—Post-processing (data handling, display, and export)[6]					
Environmental	Standard depth rating	200m					
	Operating temperature	-5° to 45°C					
	Storage temperature (without batteries)	-30° to 60°C					
	Weight in air	7.5kg – 16.0kg					
	Weight in water	1.6kg – 6.0kg					
Available Options	External battery case • AC/DC power converter • 5th beam (at time of order only) • Waves processing • Straight or right-angle metal shell connector						
Dimensions	Special configuration drawing available upon request						

1 User's choice of depth cell not limited to the typical values specified.
2 Ranges specified are typical at temperature of 5°C and salinity of 35psu; longer ranges are possible.
3 User selects the bandwidth mode; wide = 25% or narrow = 6%.
4 Standard deviations (Std Dev) are typical values for single ping data
5 Resident in ADCP accessed via a web browser.
6 Windows™ based software program.

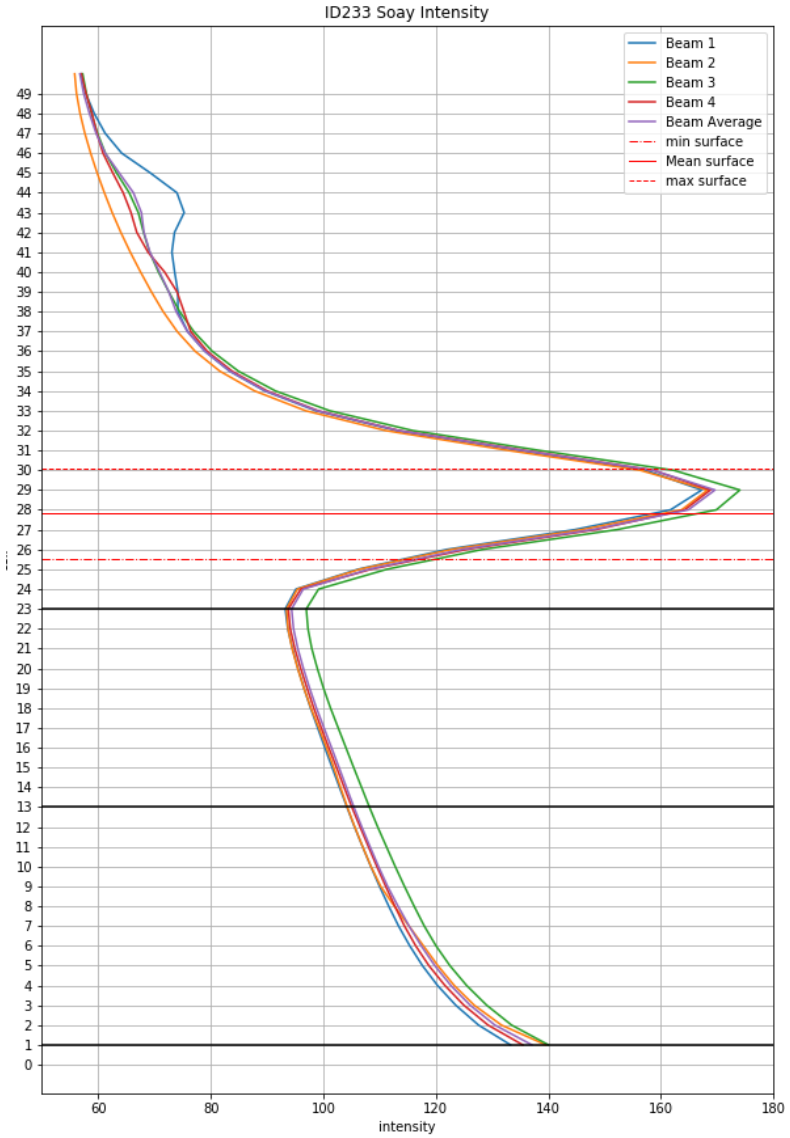

Figure 3. Mean intensity of the ADCP signal for the ID233 dataset plotted by cell

The 'first cell range' is automatically calculated by the instrument, which is the distance from the transducer head to the first cell. For this deployment, the first cell range was calculated as 3.02 m. This value is then added to the height of the instrument frame (0.7 m) to get the first cell height above the seabed, which equated to 3.72 m

This deployment had a cell size of 1m which equates to an Instrument StdDev of 10.9 cm/s.

2.5 Meteorological Data

The collection of meteorological data is no longer required to support the assessment process and consequently has not been undertaken. The current data used is collected using mulitple deployments and over a longer period and thus provides a more realistic representation of site conditions than short deployments, thus allowing an assessment of the influence of meterological conditions.

2.6 NewDepomod Flowmetry Stitching for Soay Sound

Velocity records from the two current meter (ADCP) deployments ID081 and ID233 were stitched together to create a 91.94 day long NewDepomod flowmetry file.

The near bed velocities from ID081 were adjusted using a factor of 1.0408 as the height from the seabed for ID081 Cell 1 velocities were 2.7m and ID233 Cell 1 velocities were 3.7m. This factor came from the law of the wall formula used by NewDepomod.

A subset of 6 days of current meter records from 1st June 2016 22:00 to 7th June 2016 (432 records) were used from ID081 (35.82 days in total).

All current meter records from ID233 were used (11th July 2018 20:00 to 5th October 2018) 6188 records (85.93 days).

Meter depth values of -25.5, -15.5 and -3.5 were used.

A flat bathymetry depth of -29.24 m was used in the NewDepomod modelling.

The ID081 records were appended to the end of the ID233 records where velocities were of a similar magnitude.

A near bed residual ratio of the combined records was calculated to be 0.19 below the 0.35 level where residual currents in the near bed velocities should be removed.

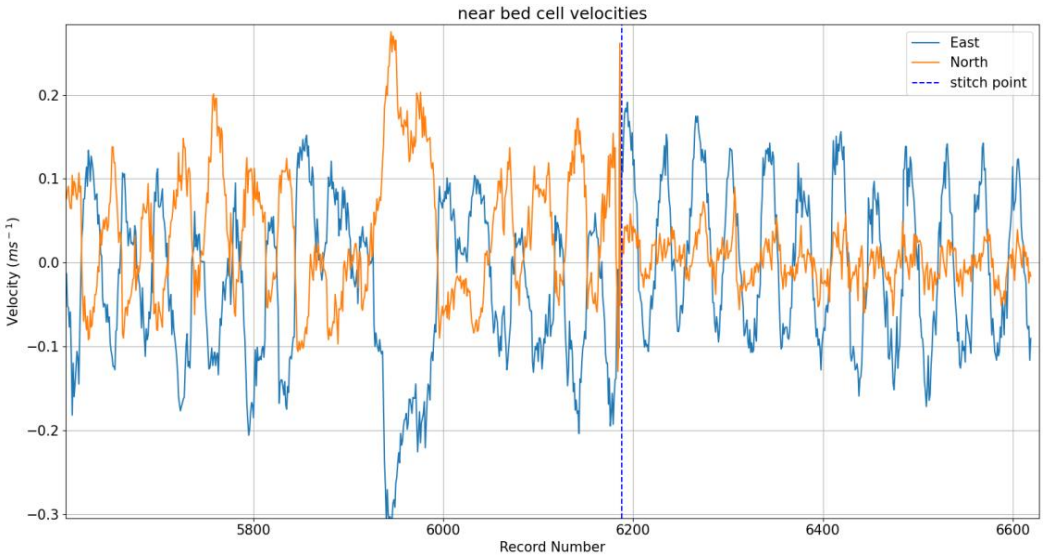

Figure 4. Near bed cell velocities East and North from complete flowmetry file with stitch point indicated with a blue dotted vertical line

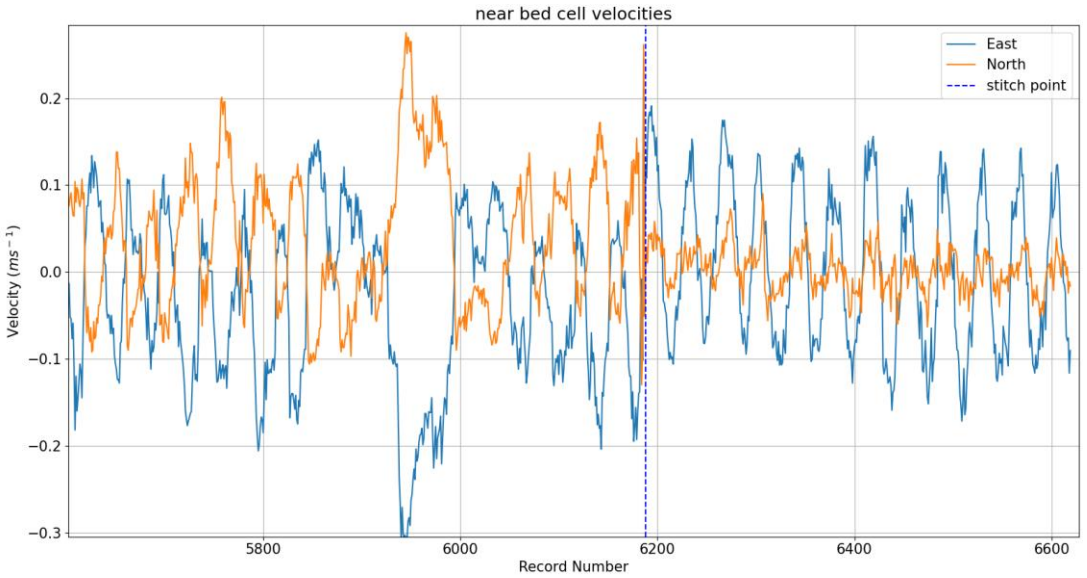

Figure 5. Near bed cell velocities East and North centered around the stitching point of the two current meter records

3. Results and Discussion

Summary of the current data is shown in Figure 4 through Figure 12, and in Table 2 through Table 5.

Over the period analysed for this report, the near-surface, middle and bottom cells had current speed averages of 7.6 cm/s, 8 cm/s and 8.2 cm/s respectively. This gave an overall average of 7.93 cm/s.

Residual currents at the surface and mid-depth were toward the north-west and south-east (305°G and 130°G respectively); near the seabed, the residual flows during the deployment period were to the north (323°G, Figure 9). The magnitude of the residual currents for the surface, middle and bottom cells were low, with mean values of 0.015 m/s, 0.003 m/s and 0.017 m/s respectively.

4. Hydrographic Data Summary Sheets

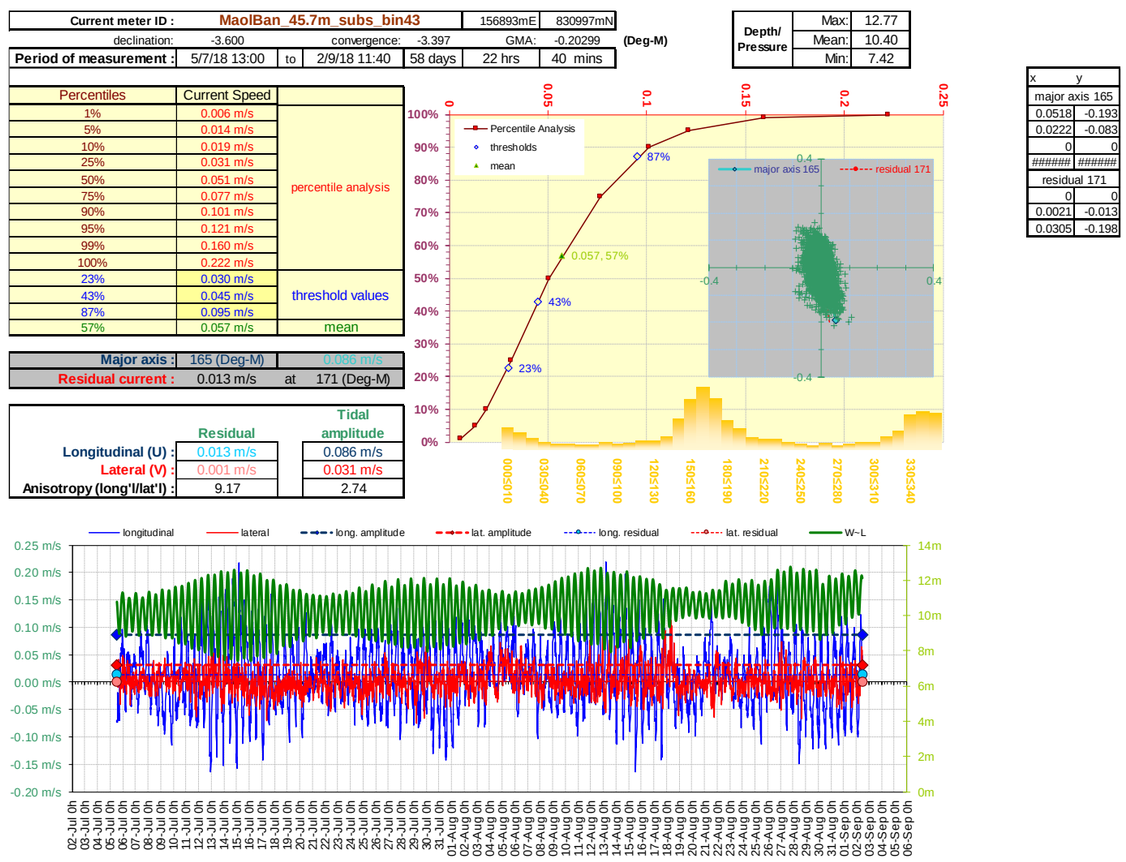

Figure 6. Current Data Summary Sheet for the surface current cell 26, 25.72m from seabed, 11th July to 18th October 2018 inclusive (ID233).

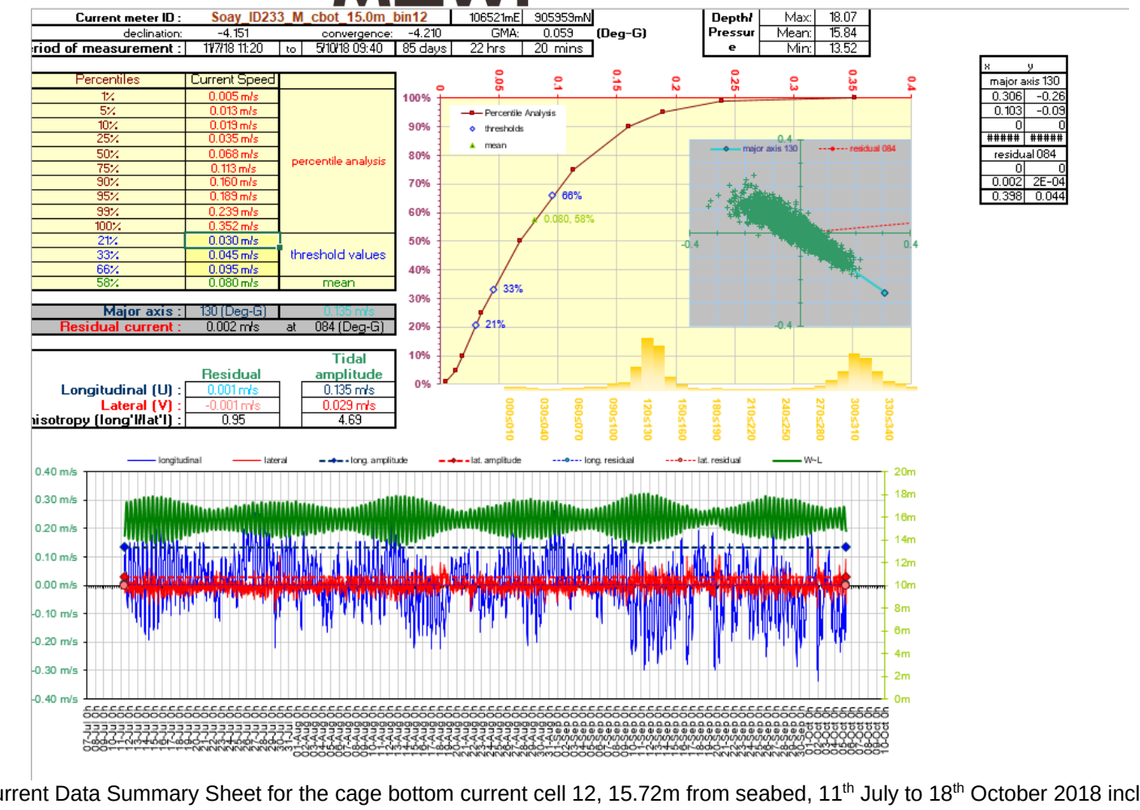

Figure 7. Current Data Summary Sheet for the cage bottom current cell 12, 15.72m from seabed, 11th July to 18th October 2018 inclusive (ID366).

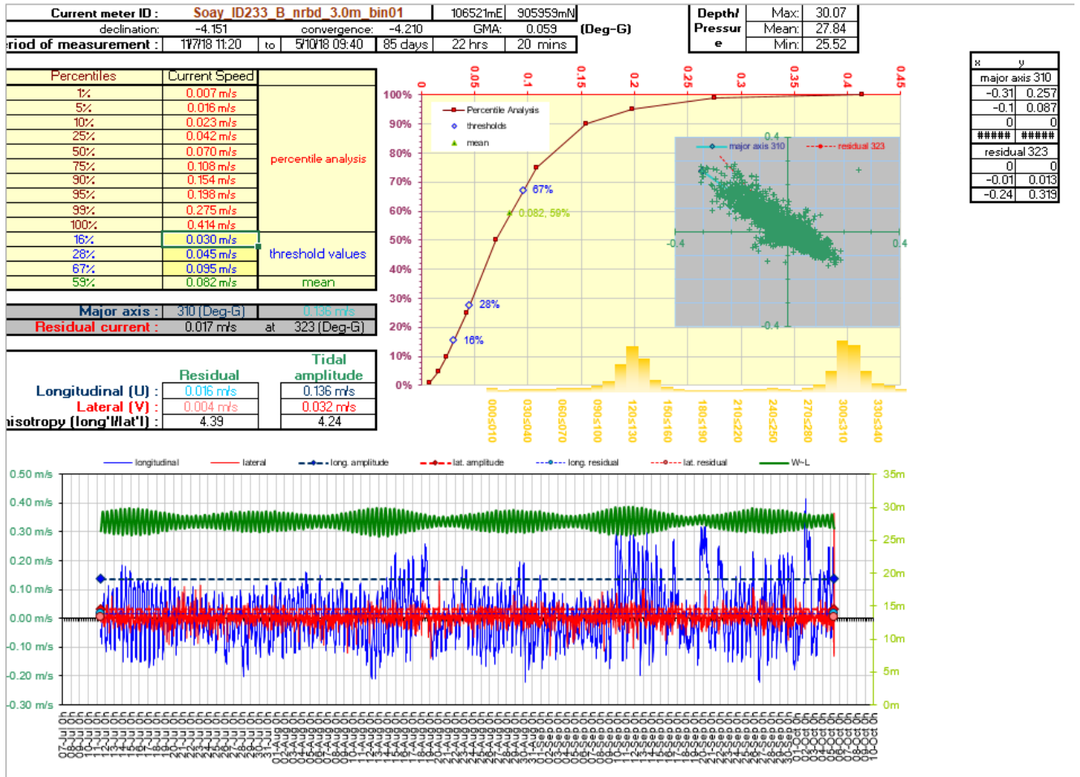

Figure 8. Current Data Summary Sheet for the near bottom current cell 01, 3.72m from seabed, 11th July to 18th October 2018 inclusive (ID233).

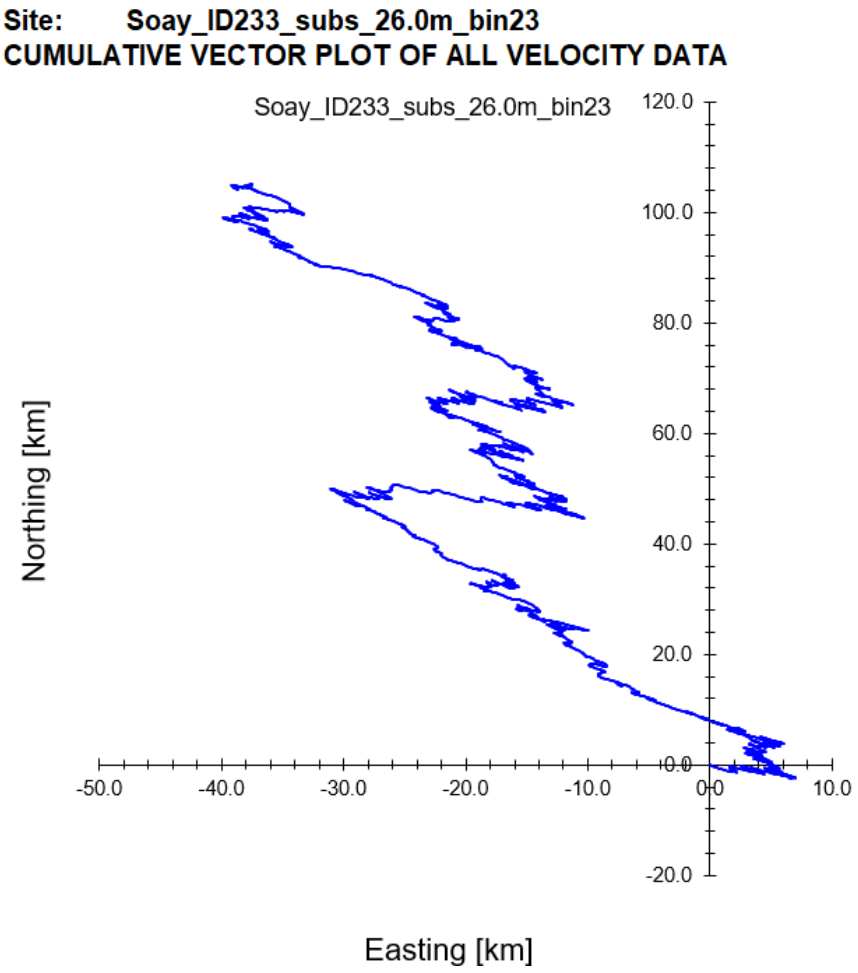

Figure 9. Cumulative Vector Plot of all velocity data from near surface cell for ID233.

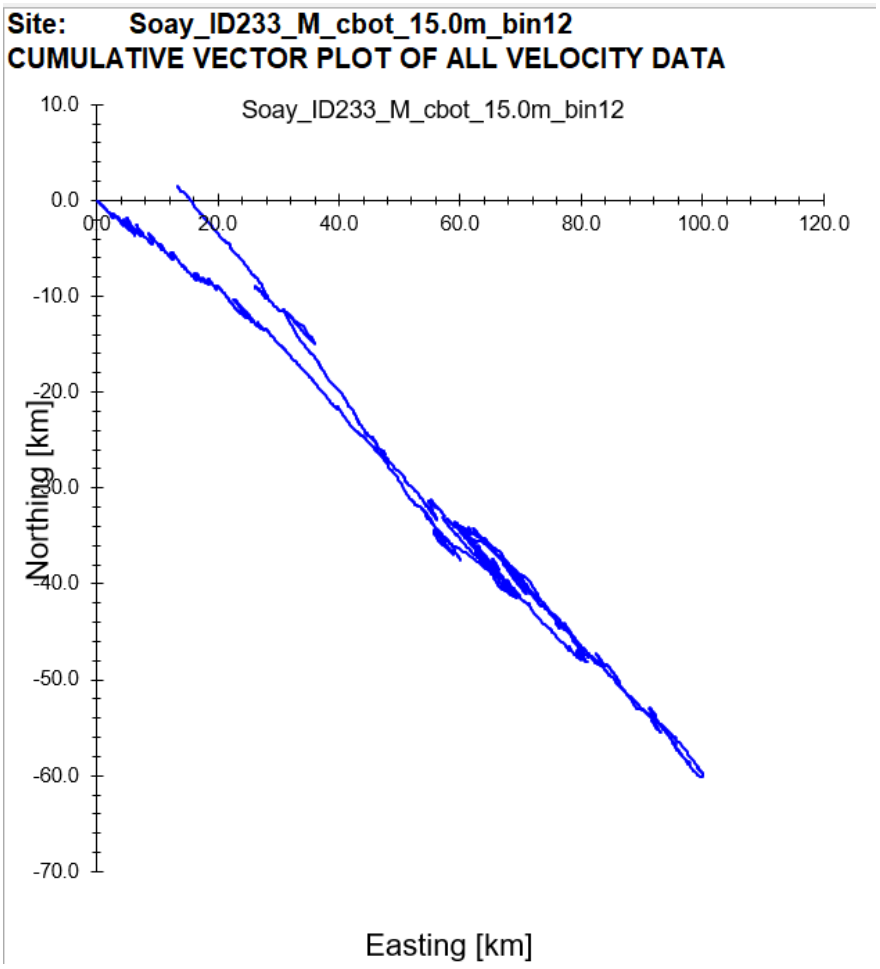

Figure 10. Cumulative Vector Plot of all velocity data from cage bottom cell for ID233.

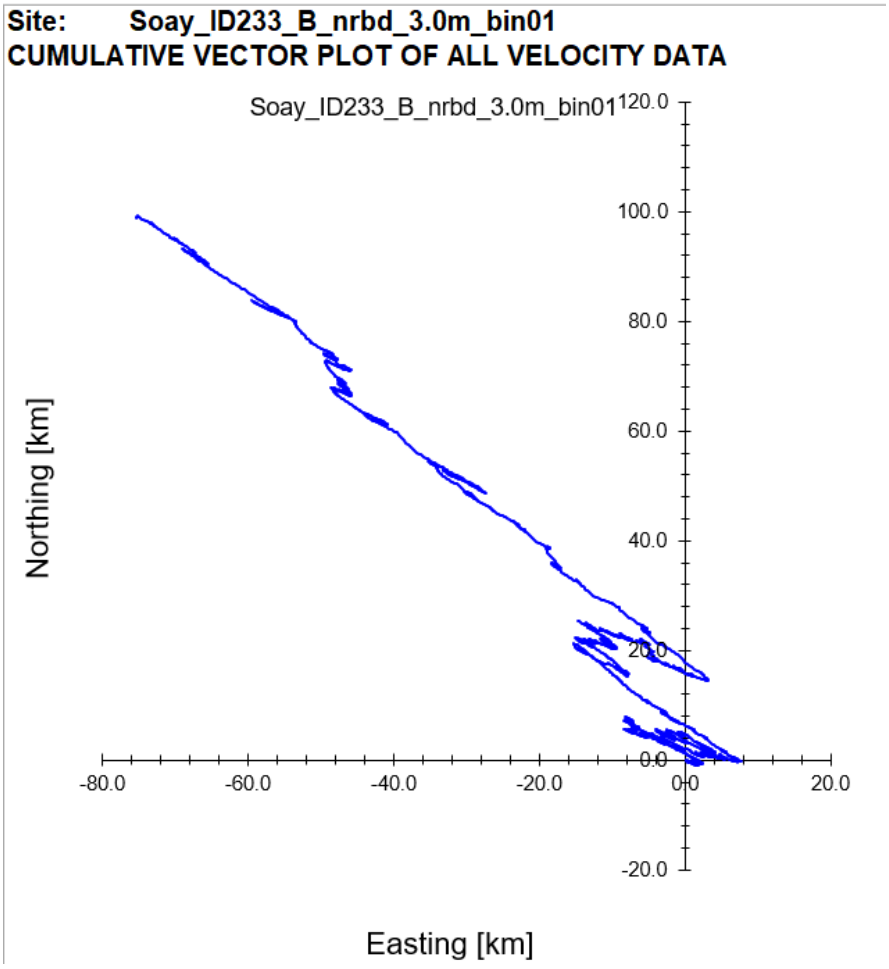

Figure 11. Cumulative Vector Plot of all velocity data from near bottom cell for ID233.

5. Summary of Current Data – ID233

Site Name: Soay Sound
Data start date: 11/07/2018
Data end date: 05/10/2018
Mean Water Depth: 31.56m

Table 2. Summary of current meter deployment

	Cell	Depth Below Surface (m)	Distance from Seabed (m)	Mean current speed (m/s)
Near surface:	26	4.84	25.72	0.076
Cage bottom:	12	15.84	15.72	0.080
Near bed:	1	27.84	3.72	0.082
			Average current speed:	0.079

Table 3. Ranked percentiles for current speed at all three depths

Cell	Ranked Percentile (%) for mean speed	≤3cm/s (%)	≥4.5cm/s (%)	≥9.5cm/s (%)
Near surface:	57	19	33	70
Cage bottom:	58	21	33	66
Near bed:	59	16	28	67

Table 4. Major axis

Cell	Major Axis (Deg-G)
Near surface:	305
Cage Bottom:	130
Near bed:	323

Table 5. Mean and residual currents

Cell	Mean Speed (m/s)	Residual Speed (m/s)	Residual Parallel (m/s)	Residual Normal (m/s)	Tidal Amplitude Parallel (m/s)	Tidal Amplitude Normal (m/s)
Near Surface:	0.075	0.015	0.012	0.009	0.122	0.031
Cage Bottom:	0.080	0.002	0.001	-0.001	0.135	0.029
Near Bed:	0.082	0.017	0.016	0.004	0.136	0.032

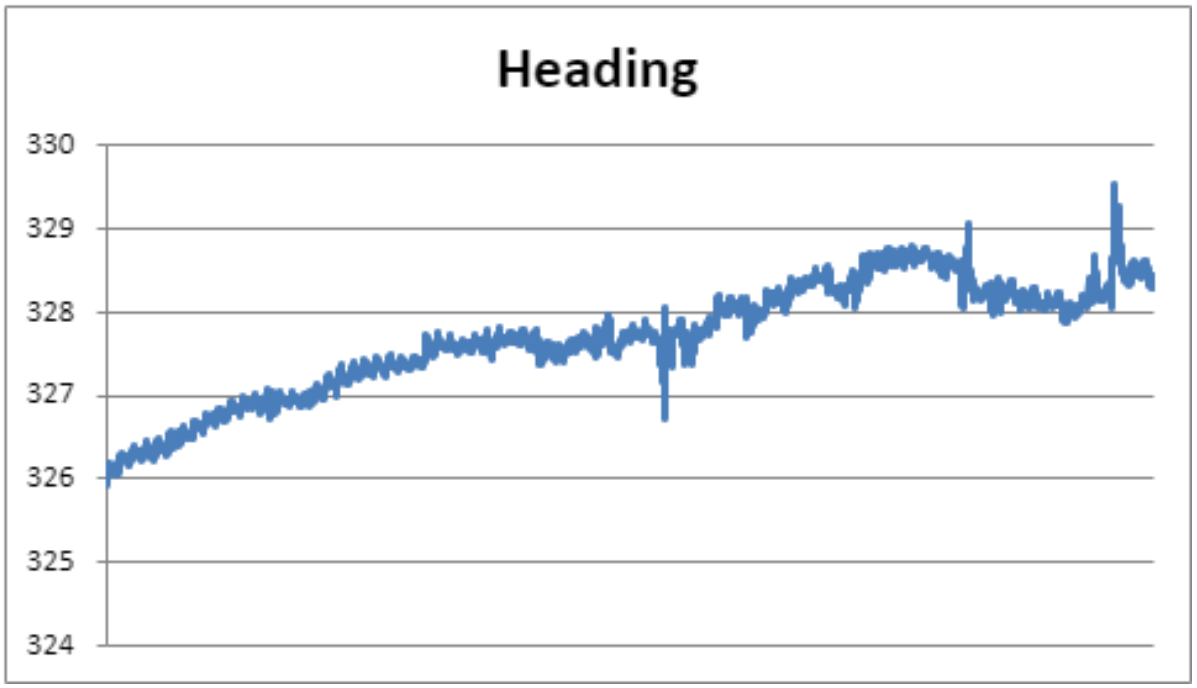

Figure 12. Summary of heading data from deployment ID233.

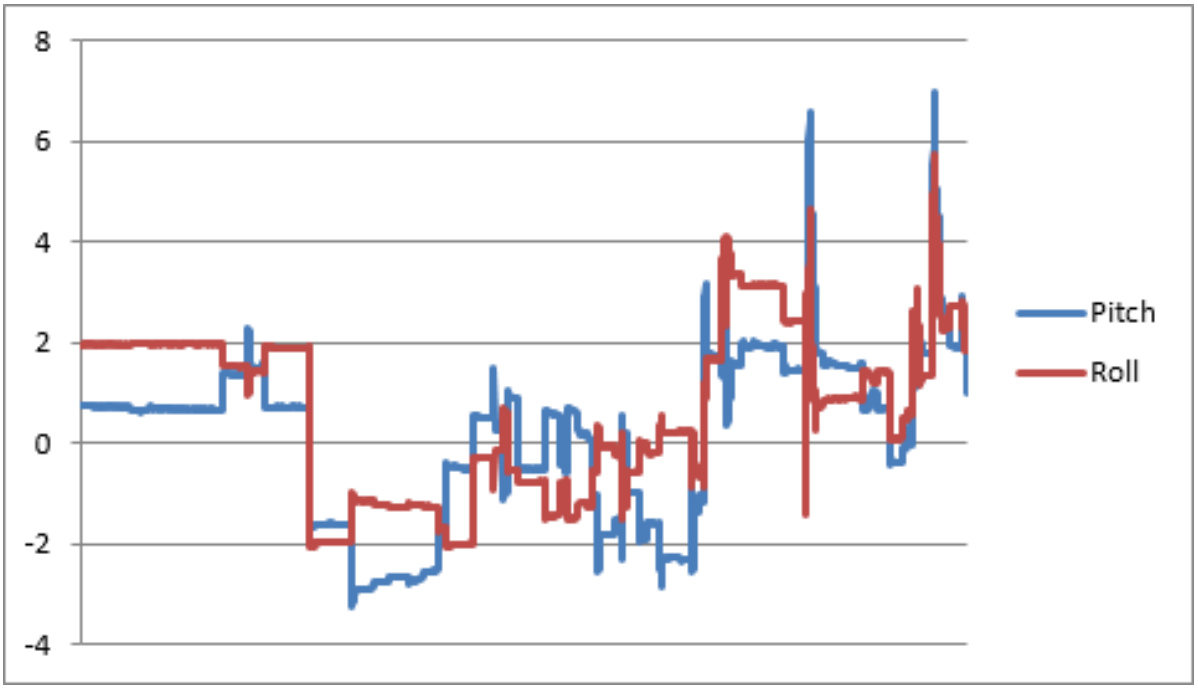

Figure 13. Summary of pitch and roll data from deployment ID233.

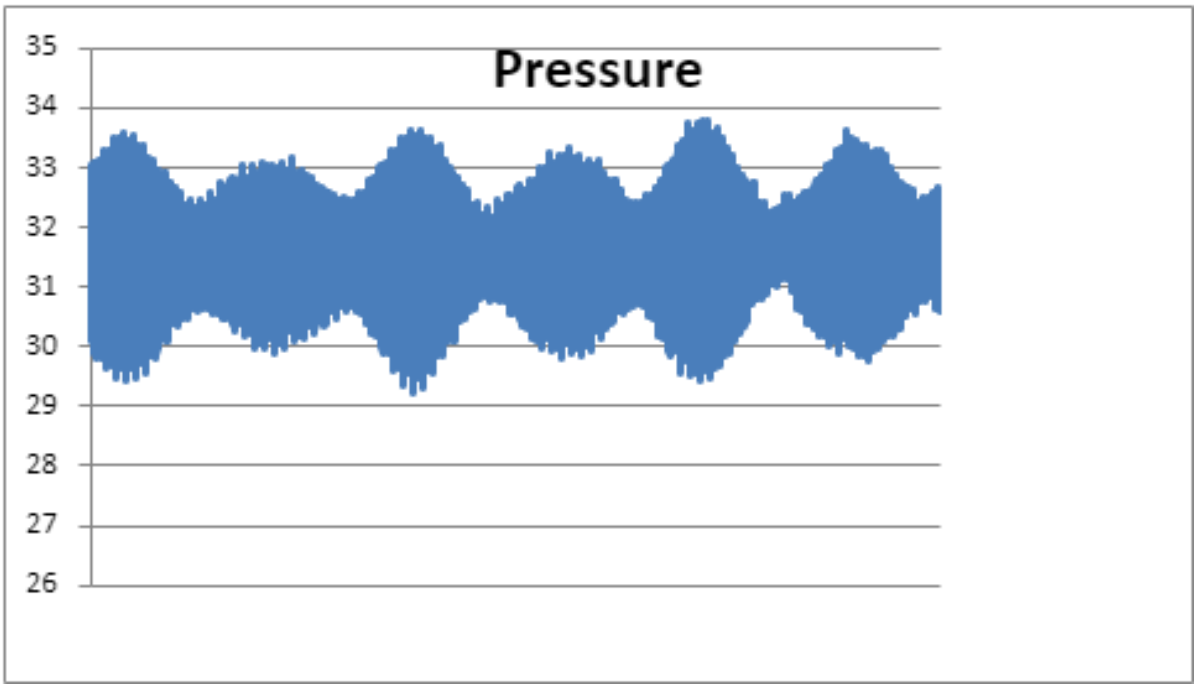

Figure 14. Pressure data from deployment ID233

6. Conclusion

MOWI has collected and analysed current and bathymetric data for the proposed technical variation at the Soay Sound fish farm. The analysed current data for the 85 days and 22.32 hours period are believed to be reliable and representative of the proposed location. The bathymetric data from the wider-area UKHO bathymetry data provided a coherent bathymetric dataset for the site.

Annex 1. Survey Equipment Deployment Log

Location:	Soay Sound
Nearest tidal port:	Tarbert, West Loch Tarbert, Isle of Harris
Time zone:	UTC
Meter switched on:	11:20 11/07/2018
Meter switched off:	10:00 05/10/2018
Period used for this report:	11:20 11/07/2018 – 09:40 05/10/2021
ADCP serial number:	24560
Meter position:	57.94585°N 6.9618°W
	E 106520 N 905955
Minimum water depth:	29.24 m (28.53m measured by ADCP + 0.7 m *)
Mean water depth:	31.56 m (30.86 measured by ADCP + 0.7 m *)
Height of meter from seabed:	0.7 m to transducer head
Sounding at deployment:	32 m @ 11:00 on 11/07/2018

Table A1. ADCP meter settings:

Reference:	Transducer
Bin size (m):	1.0
Dist to 1st bin (m):	3.02
Number of bins:	50
Frequency (kHz):	307
Recording interval (mins):	20
No. pings per ensemble:	300
Magnetic correction:	0
Ensemble:	300
Standard Deviation (cm/sec):	10.9
Time/Ping (seconds):	2