Morlais Demo Zone (MDZ) Hydrographic & Geophysical Survey

P1830

Volume 1 – Operations Report

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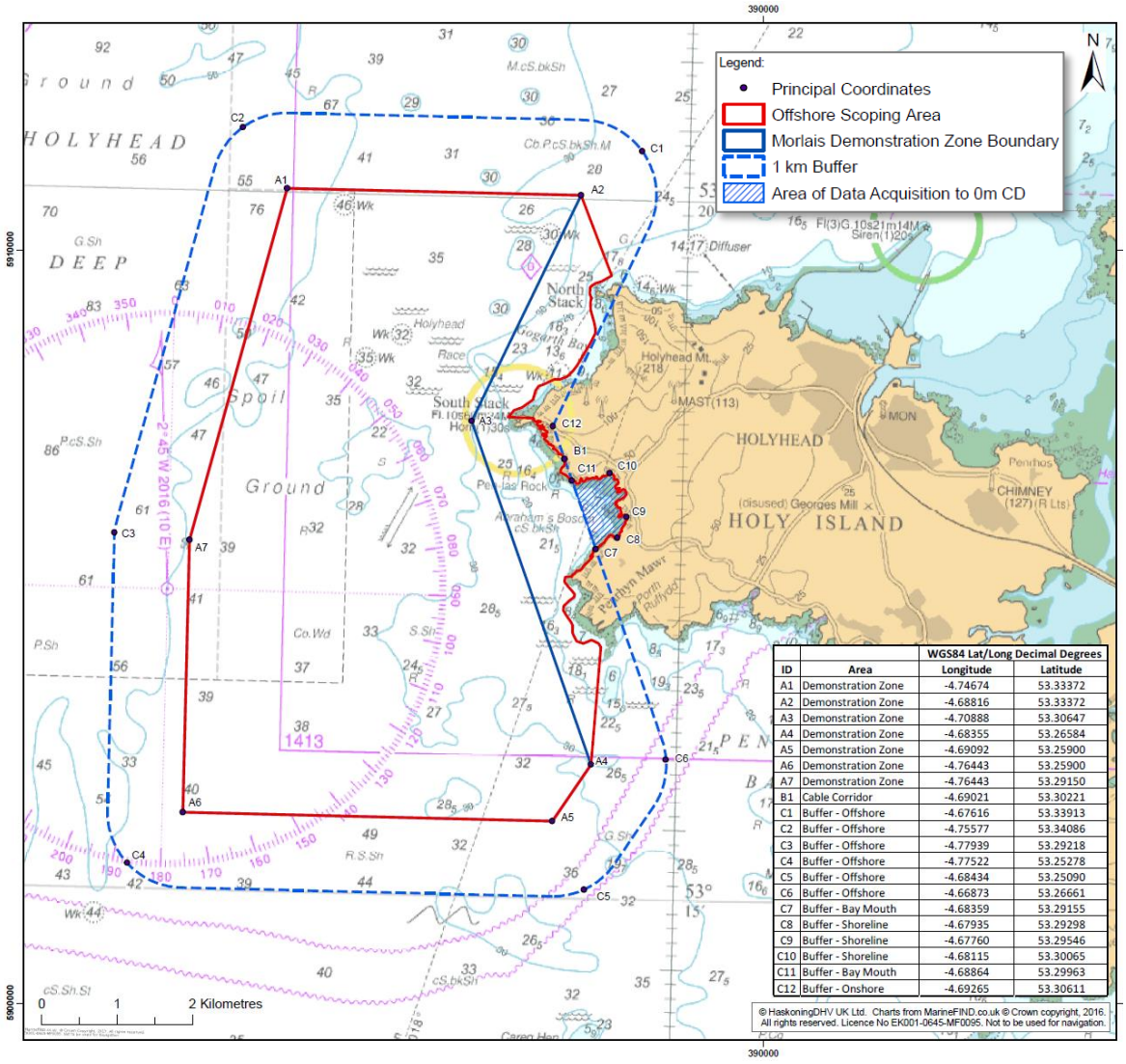
Abbreviations

AUV	Autonomous Underwater Vehicle
CD	Chart Datum
CPS	Cable Protection System
CTV	Crew Transfer Vessel
dGPS	Differential Global Positioning System
DTM	Digital Terrain Model
DVL	Doppler Velocity Log
ETRS	European Terrestrial Reference System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IAC	Inter Array Cable
IHO	International Hydrographic Organisation
INS	Inertial Navigation System
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LAT	Lowest Astronomical Tide
MBES	Multi-Beam Echo Sounder
MRU	Motion Reference Unit
MSL	Mean Sea Level
OD	Ordnance Datum
OSP	Offshore Substation
OWF	Offshore Wind Farm
QC	Quality Control
RAMS	Risk Assessed Method Statement
RTCM	Radio Technical Commission for Maritime Services
RTK	Real Time Kinematic
SBAS	Satellite-based augmentation systems
SD	Standard Deviation
THU	Total Horizontal Uncertainty
TVU	Total Vertical Uncertainty
USBL	Ultra-Short Baseline (underwater positioning)
UTM	Universal Transverse Mercator
VME	Vessel Mounted Echo sounder
VORF	Vertical Offshore Reference Frame
WGS	World Geodetic System
WTG	Wind Turbine Generator

1. INTRODUCTION

1.1 Project Overview

Partrac were commissioned by Mentor Môn to undertake a detailed multi-beam echo sounder, side scan sonar, magnetometer and single channel seismic hydrographic and geophysical survey of the Morlais Demonstration Zone (MDZ). Located to the west of Holy Island, Anglesey, the survey site consists of a 10.3km x 7.4km area (Including 1km buffer).



ID	Area	WGS84 Lat/Long Decimal Degrees Longitude	Latitude
A1	Demonstration Zone	-4.74674	53.33372
A2	Demonstration Zone	-4.68816	53.33372
A3	Demonstration Zone	-4.70888	53.30647
A4	Demonstration Zone	-4.68355	53.26584
A5	Demonstration Zone	-4.69092	53.25900
A6	Demonstration Zone	-4.76443	53.25900
A7	Demonstration Zone	-4.76443	53.29150
B1	Cable Corridor	-4.69021	53.30221
C1	Buffer - Offshore	-4.67616	53.33913
C2	Buffer - Offshore	-4.75577	53.34086
C3	Buffer - Offshore	-4.77939	53.29218
C4	Buffer - Offshore	-4.77522	53.25278
C5	Buffer - Offshore	-4.68434	53.25090
C6	Buffer - Offshore	-4.66873	53.26661
C7	Buffer - Bay Mouth	-4.68359	53.29155
C8	Buffer - Shoreline	-4.67935	53.29298
C9	Buffer - Shoreline	-4.67760	53.29546
C10	Buffer - Shoreline	-4.68115	53.30065
C11	Buffer - Bay Mouth	-4.68864	53.29963
C12	Buffer - Onshore	-4.69265	53.30611

Figure 1 General Location Map (OffshoreSurveyArea_RH_20180404)

	WGS84 - UTM 30N		WGS84 - DD	
ID	Easting	Northing	Longitude	Latitude
A1	383686.66	5910817.52	-4.74674	53.33372
A2	387587.10	5910723.71	-4.68816	53.33372
A3	386134.97	5907725.41	-4.70888	53.30647

A4	387716.12	5903165.92	-4.68355	53.26584
A5	387206.62	5902416.69	-4.69092	53.25900
A6	382303.54	5902535.20	-4.76443	53.25900
A7	382392.80	5906150.24	-4.76443	53.29150

Table 1 Morlais Demonstration Zone Boundary Coordinates

The site was accessed directly from the vessel's operational base at Holyhead Port within a one-hour transit time and all works were conducted during daylight hours.

Chart Datum water depths across the site range from -1.7 metres at the landfall to 80 metres north west of the site, with an average depth across the main site of approximately 40 metres. The survey was required to extend across the full area and the 1 km buffer zone up to the 10m CD contour, and where vessel safety allowed, up to the 5m CD contour, along the eastern coast, except for within the area known as "Abraham's Bosom". The shallow extents of the landing area within "Abraham's Bosom", was mapped to the 0m CD contour or as far inshore as possible without compromising vessel safety.

The aim of the Morlais Demonstrator Zone is for the development of tidal array projects. The zone will be used for test and demonstration centre and as a commercial development. Data collected will be used to characterise the site for the purposes of the Environmental Impact Assessment (EIA) process, and to inform further studies and assessments for receptors including:

- Physical Processes;
- Benthic Ecology; and
- Marine Archaeology.

To meet these objectives, a combined marine hydrographic and geophysical survey was conducted. The following techniques were employed during the survey.

- Multibeam echo sounding
- Side scan sonar
- Single channel marine seismic reflection profiling (boomer)
- Magnetometer

1.2 Report Structure

This volume (Volume 1) details the survey operations completed to meet the survey specification together with an outline assessment of the data quality obtained. The survey results and charts are presented with Volume 2 (Survey Report), which details the processing completed together with interpretation of the survey results.

2. OPERATIONAL SUMMARY

The survey team, complete with all equipment and resources, travelled to Holyhead, and started mobilisation on the vessel Tuesday 17th April 2018. Mobilisation occurred between the 17th and 21st April. Full setup information and calibrations can be found in the Mobilisation Report in Appendix 3

17/04/18	AM	Mobilising and system configuration
	PM	
18/04/18	AM	Mobilising and system configuration
	PM	Mobilising and system configuration & project briefing with full team and HIRA/RAMS review
19/04/18	AM	System configuration & heading alignment (GAMS)
	PM	System configuration, heading verification, multibeam calibration & trial deployment of side scan sonar
20/04/18	AM	System configuration
	PM	USBL calibration – Aborted due to currents
21/04/18	AM	USBL calibration
	PM	Wet testing all equipment (Interference issues solved)

Table 2 Daily Mobilisation Summary

Survey operations were performed at the site between 22nd April and 19th May. Demobilisation was completed in Holyhead Port on 19th May 2018.

22/04/2018	Survey operations
23/04/2018	Waiting on weather
24/04/2018	Waiting on weather – USBL frame recovered Survey operations in the afternoon
25/04/2018	Waiting on weather
26/04/2018	Waiting on weather
27/04/2018	Survey operations
28/04/2018	Survey operations
29/04/2018	Survey operations
30/04/2018	Survey operations
01/05/2018	Waiting on weather
02/05/2018	Waiting on weather
03/05/2018	Survey operations and waiting on weather in the afternoon
04/05/2018	Survey operations
05/05/2018	Survey operations and waiting on weather in the afternoon
06/05/2018	Survey operations
07/05/2018	Survey operations
08/05/2018	Waiting on weather and then survey operations late afternoon
09/05/2018	Survey operations and then waiting on weather in the afternoon

10/05/2018	Waiting on weather
11/05/2018	Waiting on weather
12/05/2018	Waiting on weather and then survey operations & infill
13/05/2018	Survey operations & reruns
14/05/2018	Survey operations & reruns
15/05/2018	Survey operations & reruns
16/05/2018	Waiting on weather
17/05/2018	Reruns
18/05/2018	Reruns
19/05/2018	Demobilisation

Table 3 Daily Operation Summary

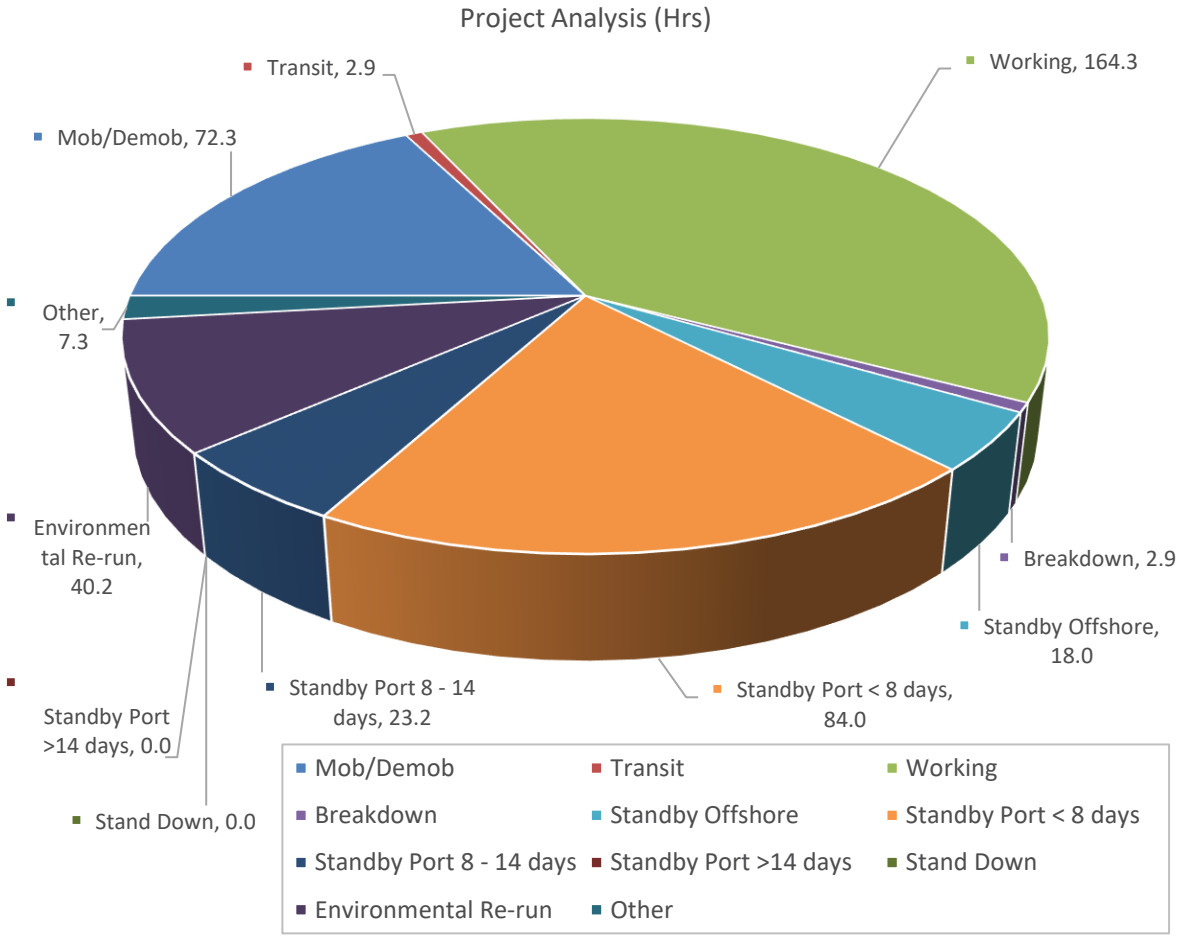


Figure 4. Assessment of Project Time (hrs).

Status	Cumulative (Hrs)	Percentage
Mob/Demob	72:15	17.41%
Transit	02:55	0.70%
Working	164:18	39.59%
Breakdown	02:52	0.69%
Standby Offshore	17:57	4.33%
Standby Port < 8 days	84:00	20.24%
Standby Port 8 - 14 days	23:10	5.58%
Standby Port >14 days	00:00	0.00%
Stand Down	00:00	0.00%
Environmental Re-run	40:14	9.69%
Other	07:19	1.76%
Total	415:00	100.00%

Table 4 Project Time Totals (Hrs & %)

Daily Progress Reports (DPR) can be found in Appendix 1.

2.1 Health and Safety

An initial safety meeting and project briefing was conducted during the mobilisation. All personal on site received a vessel induction. Tool Box talks were held prior to commencement of any activity during the survey (deployment, recovery, SVP etc.). Personal Protective Equipment (PPE) was used as required throughout the project. A man overboard safety drill was carried out on the 1st May 2018.

HSE Type	Number Recorded
Toolbox Talk	26
Safety Drills	1
Safety Inductions	4
Safety Observations	0
Near Miss	0
Safety Incident	2
Lost Time Incident	0
Other	0

Table 5 HSE Summary

Two HSE incidents occurred during the project (Incident reports created).

Date	Incident	Outcome
27/04/2018	Whilst transiting to the next line the side scan sonar snagged on what was believed to be old fishing gear (SSS 10m below surface in 30m of water). The SSS was recovered. SSS tripped, USBL Beacon jubilee clips lost (Hanging on secondary tether) and tension cog on winch had become loose (Bolt failure). No personnel injuries	SSS sacrificial trip pin replaced, USBL beacon reattached with jubilee clips and winch repaired with replacement bolt.
15/05/2018	Side scan sonar 'tripped' whilst running a survey line NE across Gogarth Bay from South Stack to North Stack. Reason for 'tripping' is unknown. Possible snagging on old fishing buoys seen in the area. Communication cable disconnected when tripped. No personnel injuries or equipment damage sustained	Communication cable was reconnected, and sacrificial trip pin replaced

Table 6 Incident Summary

2.2 Personnel

The following personnel were involved in the field operations:

- Vincent Nowell Vessel Master
- James Brady Vessel Engineer
- Graham Tattersall Hydrographic Surveyor
- Russell Venning Geophysicist / Project Manager
- Norman MacDonald Survey Engineer
- Gustav Pettersson Hydrographic Surveyor/Project Manager

2.3 Line Plan

Survey lines were defined at 125m spacing for most of the site with a bearing of 24° (tidal flow direction). Line spacing was decreased to 50m and 30m nearshore. A total of 5 crosslines were run across the site at suitable locations pre-agreed with the Consultant.

Lines were also run following the coastline to ensure maximum coverage in the shallow waters during high tide. Separate rerun lines were created when required to maximise coverage of the areas of poor data.

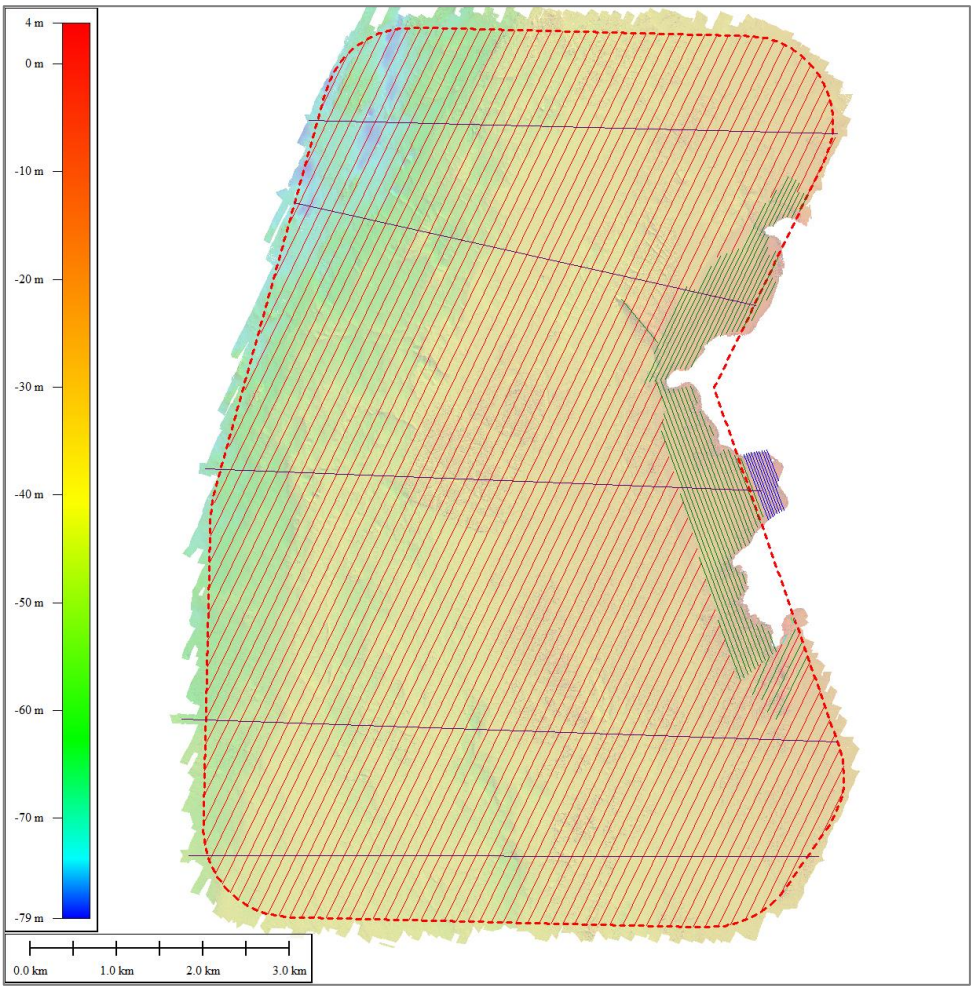


Figure 2 Line Plan

(Line spacing: Red = 125m, Green = 50m, Blue = 30m & Black = crosslines)

2.4 Weather and Tidal Flows

The StormGeo forecasts provided by Mentor Môn were found to be relatively reliable. It should be noted that wave height on occasions was higher than forecasted due to local environmental conditions when tidal flow was against wind direction.

Survey lines were orientated to best match the predominant current flow direction (~25°/ 205°) to minimise the effects on data collection (line keeping etc.). At times, especially further inshore, the current direction varied from this expected prevailing current direction. This is likely to be associated with effects on the flow by the bays and protruding headlands.

Standing waves were observed near North Stack during periods of flood tide flow which were further increased in size when the wind direction was opposing the tidal flow. During these periods, the area was avoided to prevent degradation of the survey data quality and survey operations re-located to workable areas of the site.

2.5 Site Photographs

A selection of site photographs taken during the survey have been presented in Appendix 2.

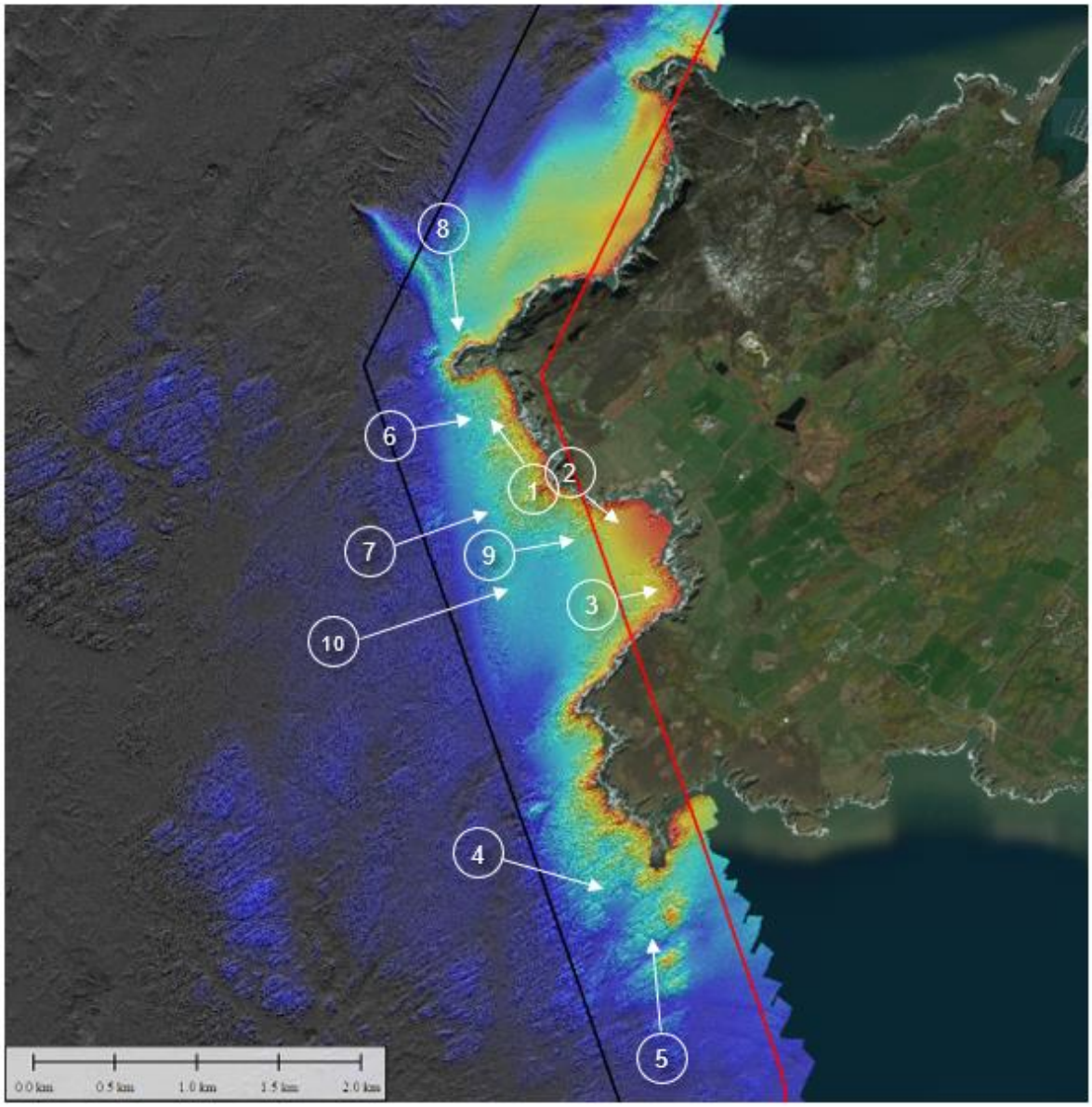


Figure 3 Photo Locations

2.6 Project Geodetics

Both survey GNSS systems outputted a WGS84 position in geodetic coordinates to the navigation software, which was projected to the Cartesian coordinate system of UTM30N using the following geodetic projection parameters:

Parameter	Value
Datum	World Geodetic System 1984
Spheroid	WGS84

Semi-major axis	6378137.000000
Semi-minor axis	6356752.314245
Inverse Flattening (I/F)	298.2572236
Projection	Universal Transverse Mercator
False Easting	500000 m
False Northing	0 m
Latitude of Origin	0°
Central Meridian	3° W
Central Scale Factor	0.9996
UTM Zone	30 North
Scale Factor on CM	0.9996
Units	Metres

Table 7 Project Geodetics

For this project, the UKHO Vertical Offshore Reference Frame (VORF) model was used to apply a Datum separation to the GNSS antenna height to reduce the accurate height online to Chart Datum (CD) at the survey site.

The separation between the Ellipsoidal height and CD at the centre of the site is 51.91 metres. There is no published offset between Chart Datum and Lowest Astronomical Tide at Holyhead

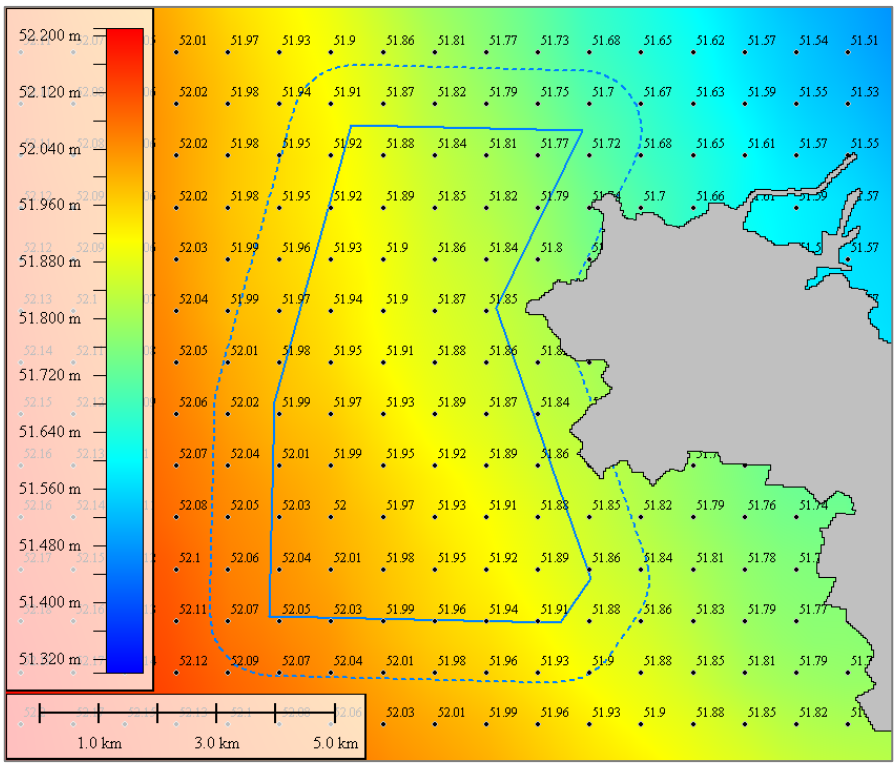


Figure 4 UKHO VORF Model

2.7 Survey Vessel

Partrac mobilised a local MCA category 2 coded workboat for this survey. "MV Norse" based at and operated from Holyhead, Anglesey, is a 23.3 m "Schottel" survey vessel, with a 60-mile operating limit.

Offering a fast transit speed, of over 13 knots, and the capability to work consistently at slow speeds, the vessel provided an ideal platform for survey at this site. The vessel operated on a nominal 12-hour quayside to quayside working basis from her home port.

Figure 5 Survey Vessel "Norse"

Built	Schottel, Holland 1983 - Rebuilt and re-engined 2010
Classification	Bureau Veritas1 - Hull - Mach. Special Service 'Coastal Area' UK MCA Workboat Code of Practice - Category 2 - up to 60 miles from safe haven.
Dimensions	LOA 23.3m Beam 5.1m Depth 2.9m Draft aft 1.4m
Main Engines	2 x Scania 430 BHP Engines, total 860 BHP, @ 2,200 RPM, each driving twin open propellers through twin disc reverse reduction gearboxes.
Speed	13 knots
Fuel Capacity	5,000 litres
Navigation Aids	Kelvin Hughes RSR 1000 sea radar with electronic chart display, Nucleus 5000R river radar, GPS compass, echo sounder, Fluxgate compass, Navtex receiver, D/F, 3 x VHF radios including GMDSS set, telephone, searchlight.
Accommodation	For four crew
Included Equipment	2 x 16/20 kva silenced gensets, Electric bowthruster, domestic boiler, 24v - 220v invertors, spacious wheelhouse with dinette, survey desk, spacious interior below with large galley / messroom and seating, large clear aft deck. 660mm x 350mm, plus 350mm x 250mm moonpools.

Table 8 Norse Vessel Specifications

2.8 Survey Equipment

The following survey equipment was mobilised aboard the MV Norse for the duration of the survey.

- Hydrofix NaviSTAK compact modular survey system comprising:
- Primary Positioning – "Trimble" SP855 GNSS RTK Rover with Marinestar G2+ corrections;
- Secondary Positioning & Vertical Control – "Applanix" WaveMaster GPS with real-time Marinestar G2+ corrections, logged for Post Processing Solution;
- Multibeam Echo Sounder – "Norbit" 0.9^0x0.9^0, 512 beam system, with integrated INS and sound velocity correction;
- SVS – AML Mini SVS;
- Inertial Navigation System (INS) (Motion Reference) – "Applanix" WaveMaster INS;
- Navigational Software – "QPS" QINSy;
- Sound Velocity 1 – Valeport Swift SVP;
- Sound Velocity 2 – Valeport Monitor SVP (Spare);
- Edgetech – 100 & 400 kHz digital dual frequency (Inc. 1 spare towfish);
- Sheave block -- Hytech T-count;
- Winch – AGO CSW-7V;
- Magnetometer – "Geometrics" G882 caesium vapour (Inc. 1 spare towfish);
- Seismic – Applied Acoustics CSP-P300 (AAE AA200 Boomer plate & SES Hydrophone); and
- Sub-surface positioning – "Sonardyne" Scout ultra-short baseline (USBL).

3. ACQUIRED DATA QUALITY INFORMATION

All acquired data was reviewed in real time online and offline in the office. Any data that did not meet project specifications or Partrac's standards was identified and rerun.

3.1 Positioning

3.1.1 GNSS

Primary positioning was provided by the Trimble SPS855 using the Marinestar G2+ corrections that offer an accuracy of 0.04cm XY and 0.08cm Z (95%). Secondary positioning was provided by the Applanix POS MV Wavemaster INS with Marinestar G2+ corrections. The POS MV Wavemaster data was also logged for postprocessing if required. The SPS855 was initially setup with Trimble VRS RTK corrections, but the corrections were re-configured to Marinestar G2+ corrections due to poor GSM reception in the survey area (Marinestar G2+ is a satellite-based correction service)

The SPS855, with G2+ corrections, was checked against an Ordnance Survey Passive Station during the mobilisation. Subsequently, both GNSS were checked against each other confirming the positioning of the POS MV and the offsets. In real-time, during the survey, various parameters of both systems were assessed to confirm positioning accuracy (Satellite Count, Position SD, RMS values, primary and secondary GNSS receiver position comparison etc.).

Both GNSS performed well during the survey and no quality alerts were raised for the positioning systems.

3.1.2 Motion Reference

Vessel motion was provided by the POS MV Wavemaster INS, integrated to the Norbit iWBMS. The system performed well for most of the survey, however, during a few survey lines, the system was not adequately measuring the vessel motion and artefacts of vessel movement were visible within the MBES data. These lines were marked for rerun as data quality was deemed unacceptable.

3.1.3 USBL

Acoustic positioning was provided by the Sonardyne Scout Plus USBL system utilising the omnidirectional Wideband Sub Mini Beacons (WSM5). The USBL system was interfaced with the primary GPS and POS MV for improved positioning accuracy (0.5% slant range typical).

Throughout the survey, the USBL system performed with no issues and with high quality positioning.

3.2 Multibeam

3.2.1 IHO Order 1a Standard

The scope of work for this project is to meet the IHO Order 1a standard (Table 9). TVU and THU values relevant to this project can be seen in Figure 6 and Figure 7.

Order	Special	1a	1b
Description of areas	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but features of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.
Maximum allowable THU 95% Confidence level	2 metres	5 metres + 5% of depth	5 metres + 5% of depth
Maximum allowable TVU 95% Confidence level	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013
Full Sea floor Search	Required	Required	Not required
Feature Detection	Cubic features > 1 metre	Cubic features > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres	Not Applicable
Positioning of fixed aids to navigation and topography significant to navigation. (95% Confidence level)	2 metres	2 metres	2 metres
Positioning of the Coastline and topography less significant to navigation	10 metres	20 metres	20 metres
Mean position of floating aids to navigation (95% Confidence level)	10 metres	10 metres	10 metres

Table 9 Extract of IHO Standards Minimum Requirements

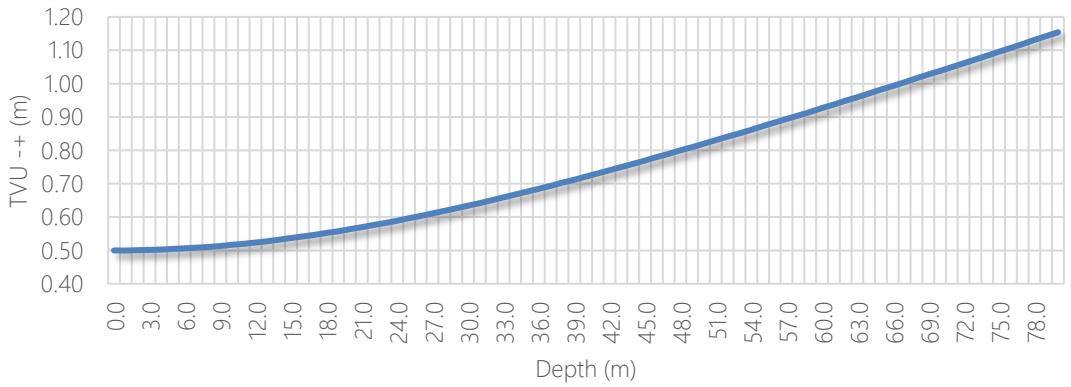


Figure 6 IHO Order 1a TVU Values Relevant to Survey Area

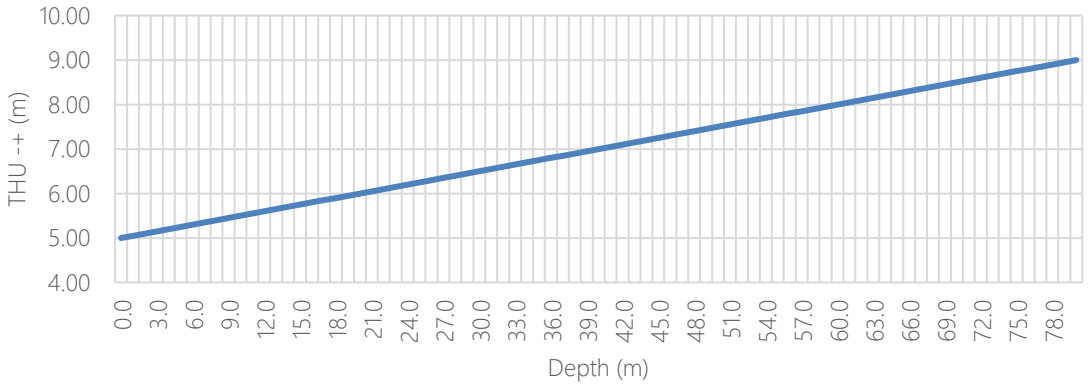


Figure 7 IHO Order 1a THU Values Relevant to Survey Area

A TPU error budget was calculated for the complete survey system using the Rijkswaterstaat Apriori multibeam Uncertainty Simulation Tool (AMUST) software and can be seen in Figure 8 and Figure 9.

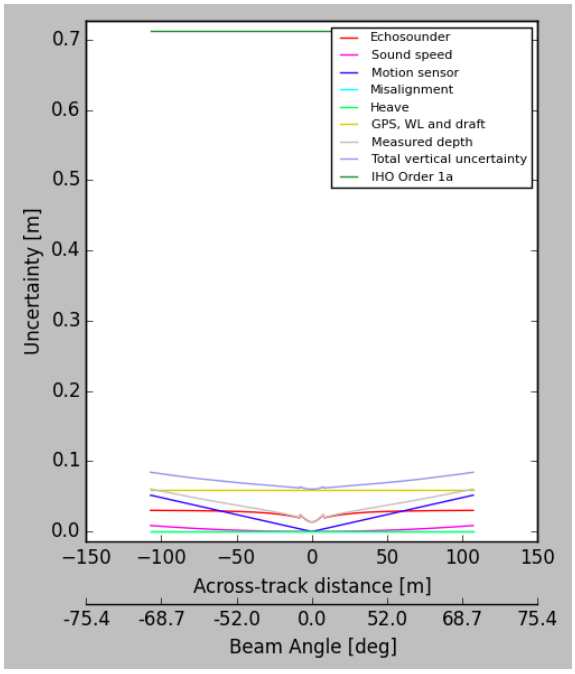


Figure 8 Calculated TVU at 40m Depth (Average depth on site)

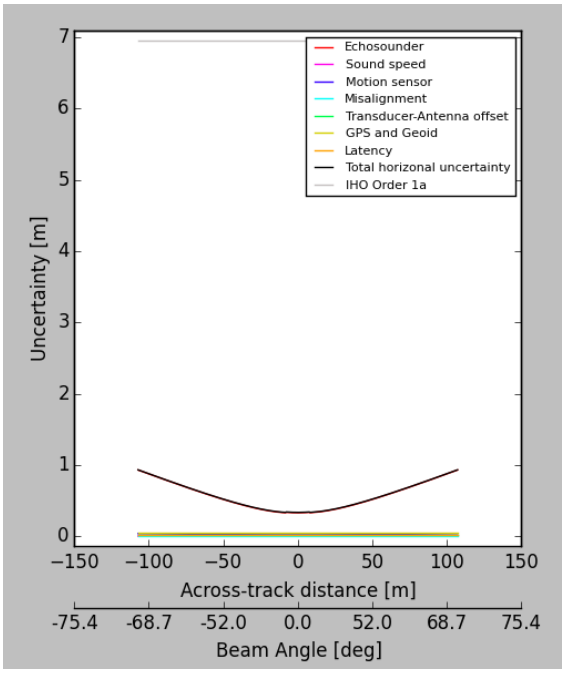


Figure 9 Calculated THU at 40m Depth (Average depth on site)

Data was checked throughout the survey to ensure that IHO Order 1a standard was met.

3.2.2 Bathymetry

The bathymetry data was collected with the Norbit iWBMS 0.9° system, with SVS and motion sensor tightly integrated with the sonar.

The multibeam echo sounder tuning was continually adjusted to ensure an optimum balance of coverage, feature detection, sounding density and noise reduction. An online grid of raw bathymetry and sounding density was monitored to ensure that the project requirements were achieved. 0.5m bin was achieved for most of the data acquired in water depths less than 50m CD. Any data that fell outside the project or Partrac's specifications was rerun.

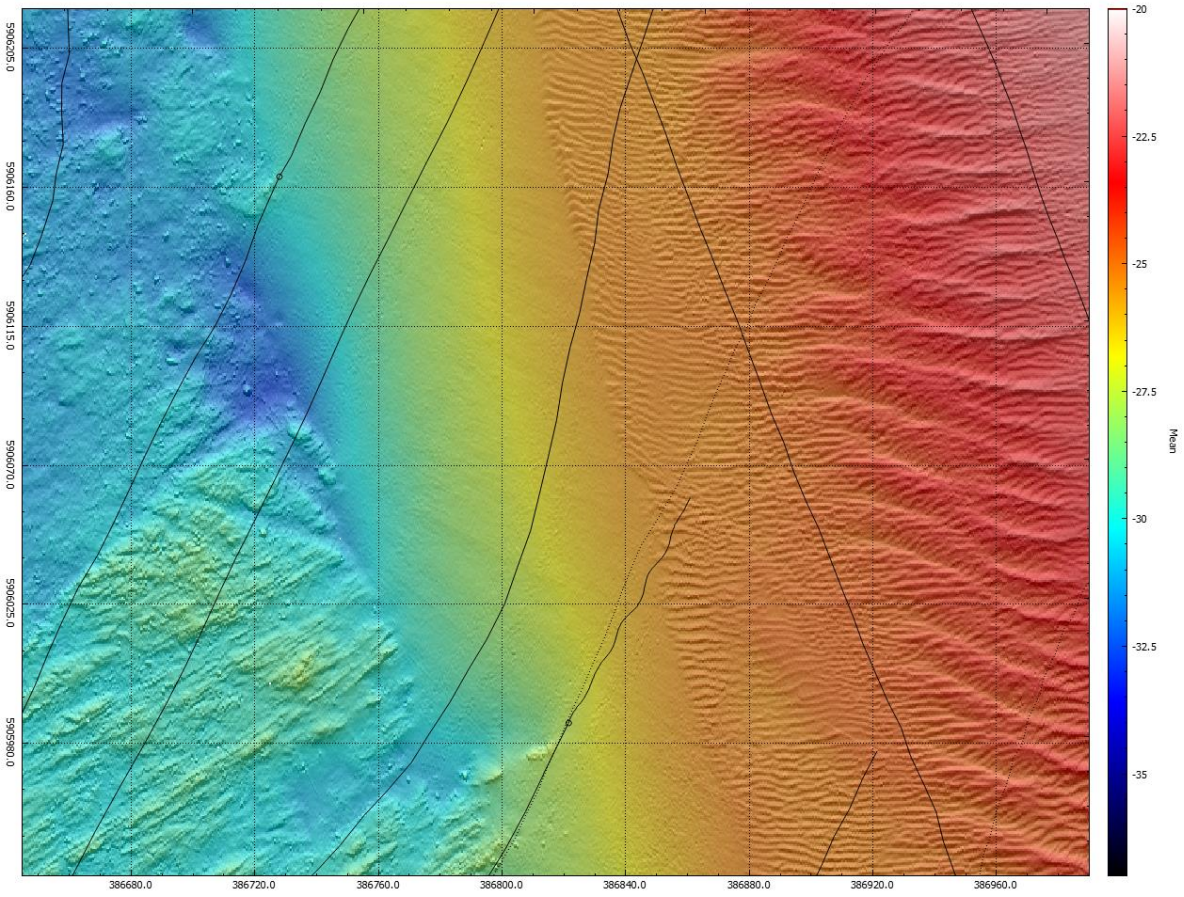


Figure 10 Bathymetry Data Example (0.5m bin)

Full bathymetry coverage was achieved which includes coverage inshore along the cliff face and the beach landing in Abrahams Bosom.

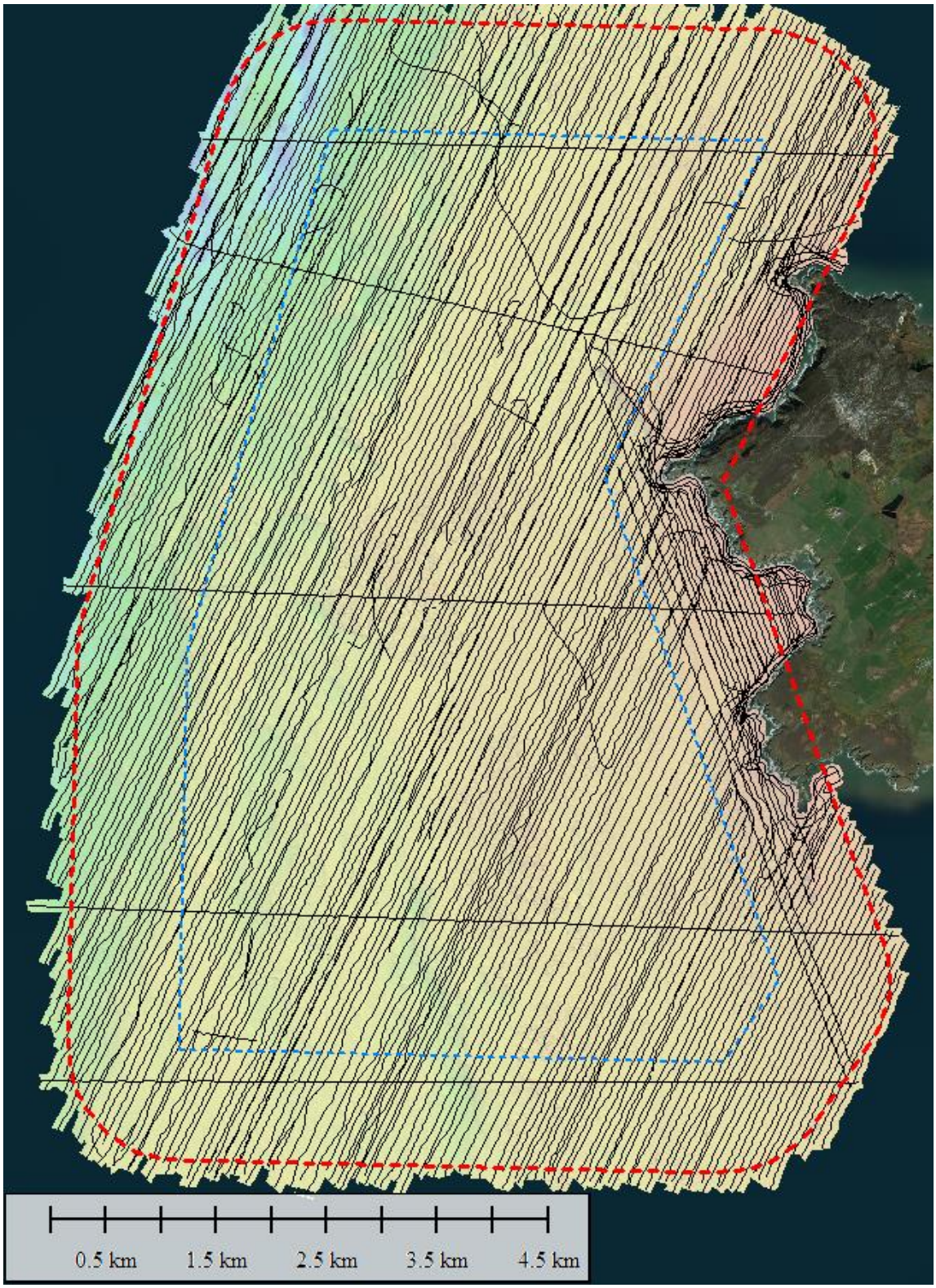


Figure 11 Multibeam Coverage and Track Plot

Sound velocity profiles were acquired at least twice a day and loaded into QPS QINSy. The difference between the multibeam SVS and SVP profiles was monitored during the day. The mean values of the collected sound velocity profiles can be seen in Figure 12 and full collected sound velocity profiles can be found in Appendix 3.

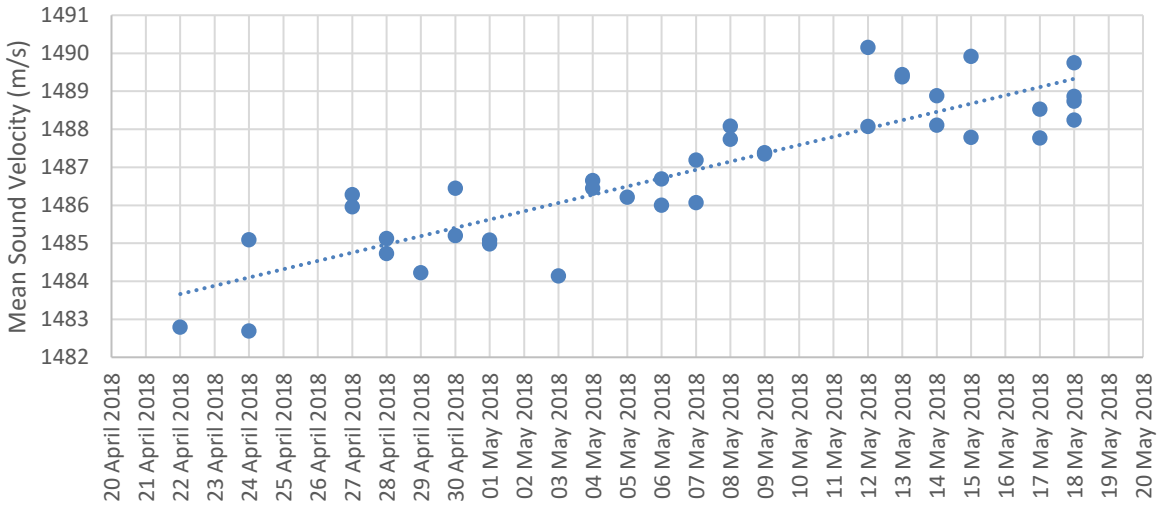


Figure 12 Mean Sound Velocity Values

3.3 Side Scan Sonar

An Edgetech 4200 dual frequency (200 & 400 kHz) side scan sonar system was utilised throughout the survey. The SSS was positioned by the USBL system with the WSM5 USBL beacon located 1m up the tow cable. The SSS was controlled and data recorded within the Edgetech Discover software.

A 150m range was used for most of the survey, with the low frequency reaching the full 150m and the useable high frequency extending between 120m and 140m dependent upon the tidal conditions at the time. The 4200 was flown at a height above the seabed of approximately 15 to 20 percent water depth.

Data quality was monitored both in real-time and following data review, any lines not achieving the required standard were marked for rerun. A minimum 200% coverage was achieved with the low frequency data and near 200% coverage achieved with the high frequency.

Figure 13 Side Scan Sonar Coverage and Track Plot

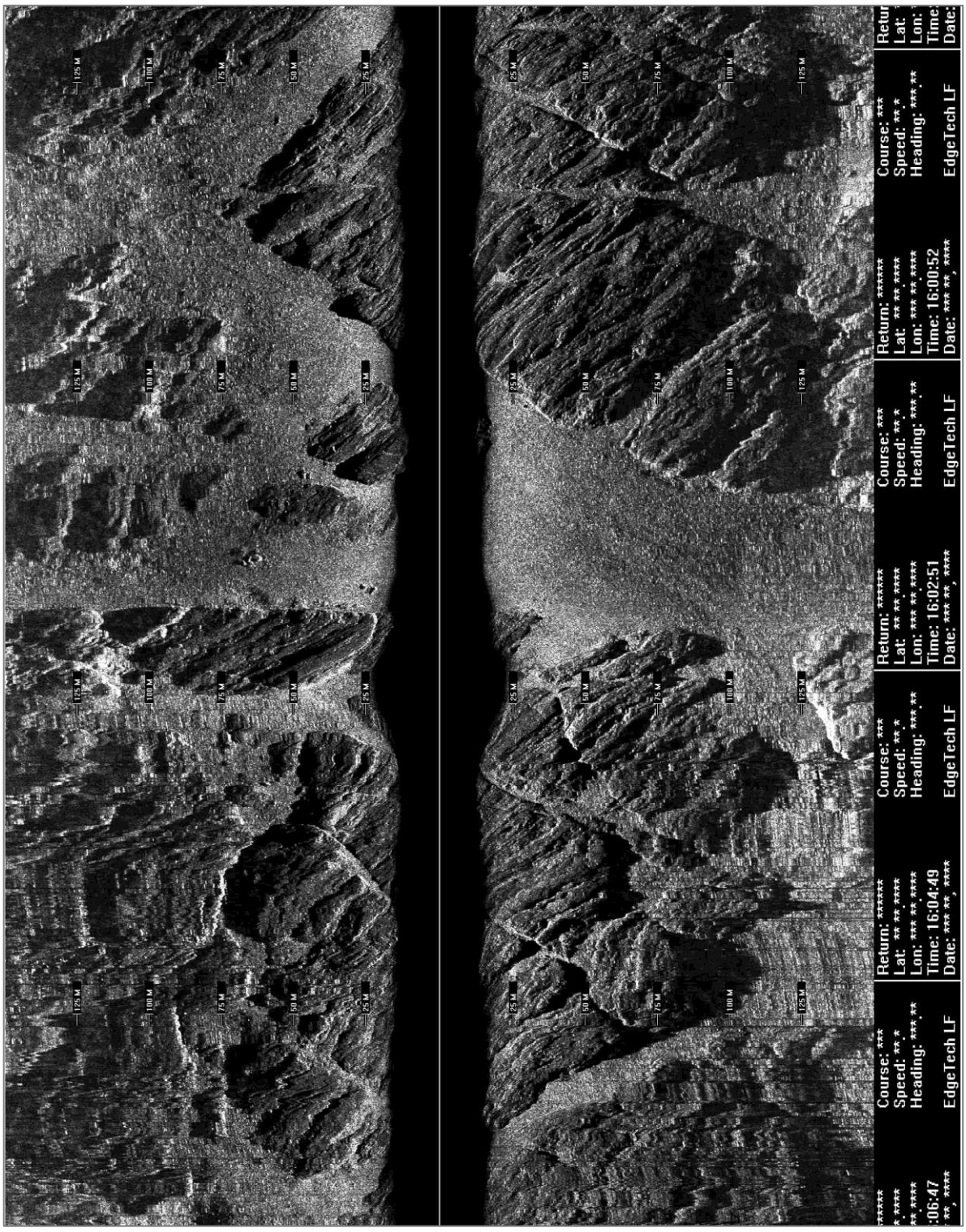


Figure 14 Low frequency (100kHz) Side Scan Sonar Data Example

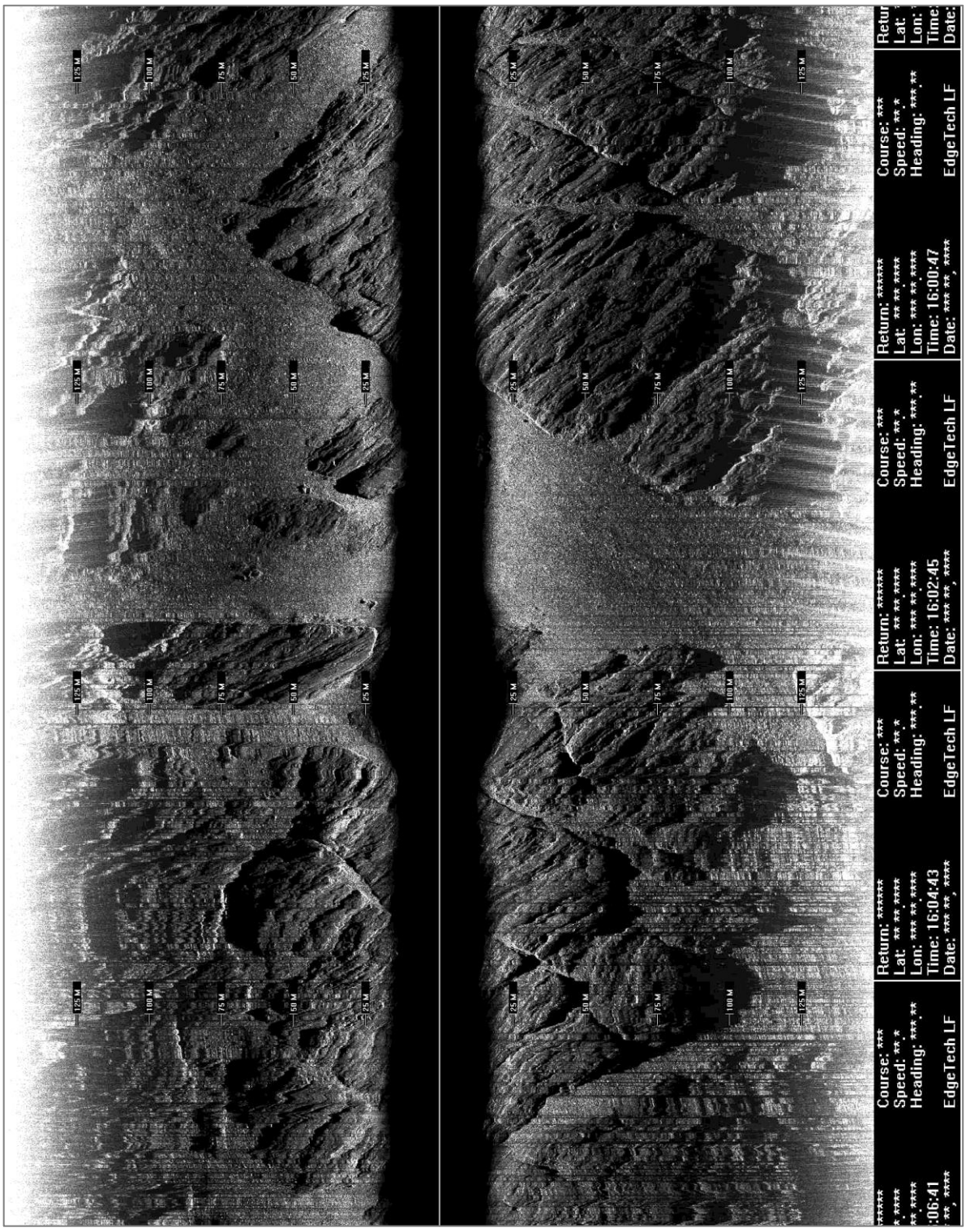


Figure 15 High frequency (400kHz) Side Scan Sonar Data Example

3.4 Sub Bottom Profiler

A Boomer sub bottom profiling system comprising an Applied Acoustics CSP-P300 power supply, AAE AA200 Boomer plate & SES 8 element single channel hydrophone was utilised for this element of the survey.

The SBP was towed 25m behind the vessel with the source and hydrophone towed from opposite sides of the vessel stern. The data was recorded in CodaOctopus acquisition software and positioning derived from QINSy.

Power Setting	100 J
Ping Rate	200 ms
Central Frequency	1800

Table 10 SBP Online Settings

Data quality was monitored both in real-time and in the office and any lines not meeting the required standard were marked for rerun. Whilst remaining of an acceptable standard, the quality of the survey lines acquired into the tidal flow were reduced in comparison to those acquired running with the tidal flow.

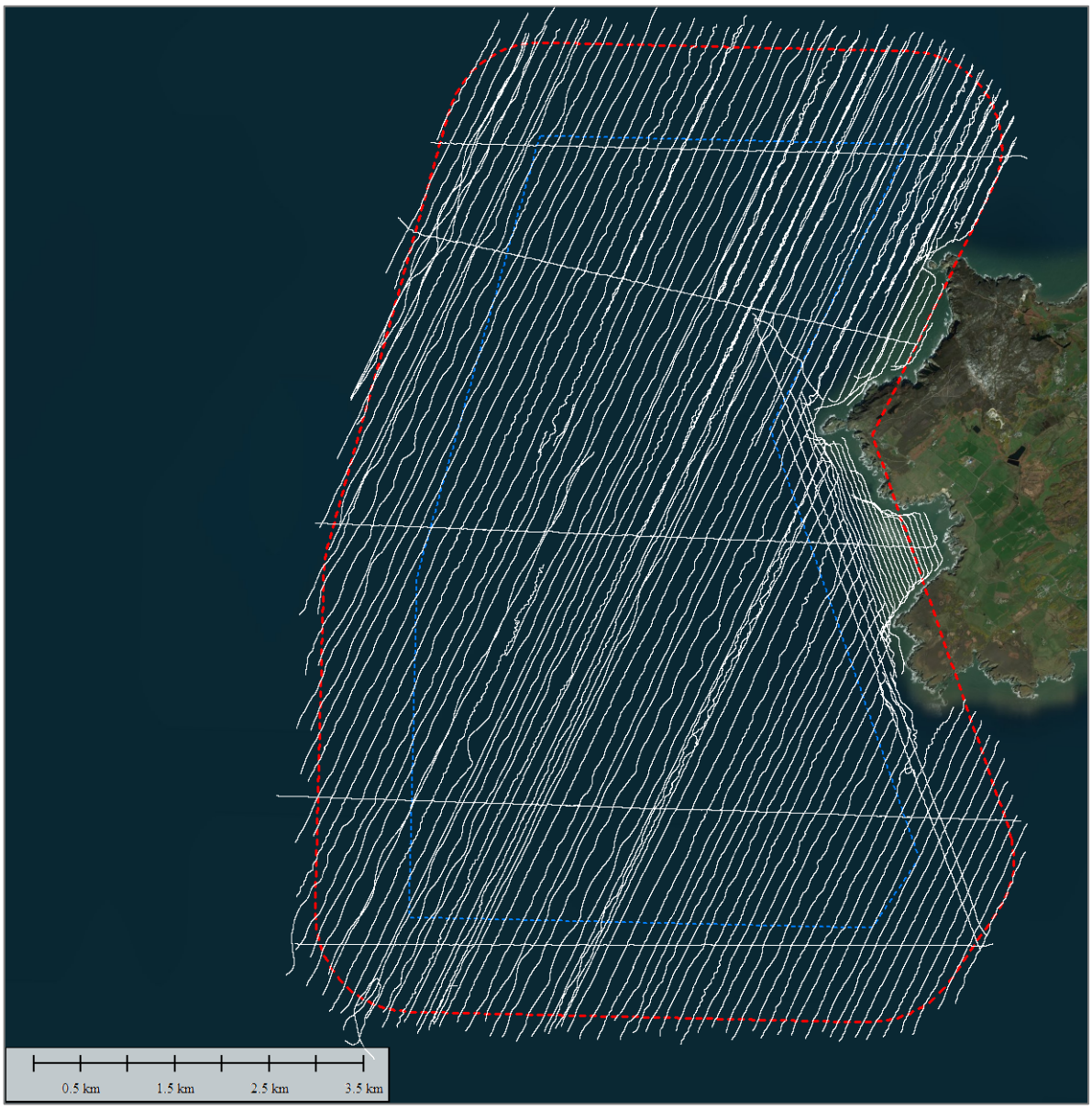


Figure 16 SBP (Boomer) Track Plot

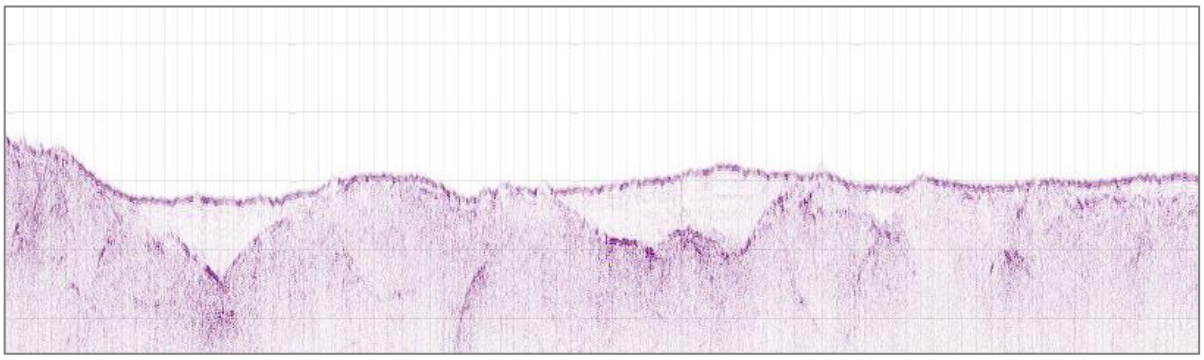


Figure 17 Accepted SBP Data Example

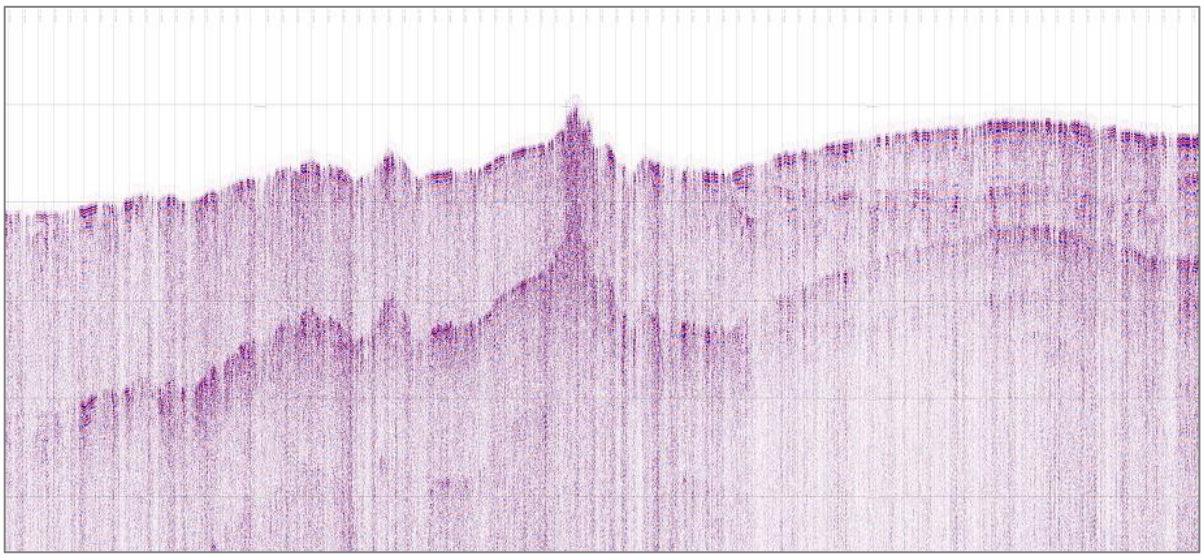


Figure 18 Rejected SBP Data Example

3.5 Magnetometer

The magnetometer utilised throughout this survey was the Geometrics G882. The towfish was piggy-backed to the side scan sonar towfish on an 11m umbilical cable. The data was recorded in QINSy at a rate of 10Hz and was QC'd online. The acquired magnetometer data was generally of good high quality. As magnetometer was towed behind the side scan sonar, see Figure 13 for track plot and coverage

APPENDIX 1 – DAILY PROGRESS REPORTS

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	17/04/2018	Tue
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	01	

Times (Local) From - To	DIARY OF OPERATIONS	Status
08:30 - 09:45	(Pre 08:30 team travel) Project start-up meeting	M
09:45 - 10:00	Vessel induction carried out	M
10:00 - 10:20	Transit to Holyhead Towing yard	M
10:20 - 12:45	Survey equipment loaded onto vessel	M
12:45 - 13:05	Transit back to berth for continuation of mobilisation	M
13:05 - 20:30	Mobilising vessel	M
20:30 -	End of day	
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	12:00	12:00
Transit	Tr	00:00	00:00
Working	WK	00:00	00:00
Breakdown	B	00:00	00:00
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:00	12:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
		Force	Wind	Swell	
00:00					
04:00					
08:00					
16:00					
20:00					

Forecast

Personnel on board

Contractor	GP, PC, NM, GT, VN, JB	Client:	

Comments

Plan for next 24Hrs:

Continue with mobilisation and carry out alongside calibrations/verifications

Signatures	PC:	Client Rep:
	17/04/2018	17/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	17/04/2018	Tue
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	01	

Health Safety Environment records

Today	Total	Type	Comment
84:00	84:00	Man Hours Worked (hh:mm)	
1	1	Toolbox Talk	Mobilisation toolbox talk & project outline
0	0	Safety Drills	
1	1	Safety Inductions	Vessel induction
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Vessel induction carried out for all survey crew. Safety talk for mobilisation carried out. Good use of PPE (pulling up/stopping access & egress without lifejackets etc)

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	0.00	1.00	0.0%	
Side Scan Sonar	0.00	0.00	1.00	0.0%	
Single Channel SBP	0.00	0.00	1.00	0.0%	
Magnetometer	0.00	0.00	1.00	0.0%	
SVP (m/s)	n/a				

Data Observations:

Signatures	PC:	Client Rep:
	17/04/2018	17/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	18/04/2018	Wed
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	02	

Times (Local) From	To	DIARY OF OPERATIONS	Status
07:30	17:30	Mobilisation and system integration	M
17:30	19:30	Project briefing with full team and HIRA/RAMS review	M
19:30		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	12:00	24:00
Transit	Tr	00:00	00:00
Working	WK	00:00	00:00
Breakdown	B	00:00	00:00
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:00	24:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
		Force	Wind	Swell	
00:00					
04:00					
08:00					
16:00					
20:00					
Forecast					

Personnel on board

Contractor	GP, PC, NM, GT, VN, JB	Client:	PD

Comments

Plan for next 24Hrs:

Undertake navigational checks and wet tests/calibrations

Signatures	PC:	Client Rep:
	18/04/2018	18/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	18/04/2018	Wed
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	02	

Health Safety Environment records

Today	Total	Type	Comment
84:00	168:00	Man Hours Worked (hh:mm)	
0	1	Toolbox Talk	
0	0	Safety Drills	
1	2	Safety Inductions	Vessel induction for client
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	0.00	1.00	0.0%	
Side Scan Sonar	0.00	0.00	1.00	0.0%	
Single Channel SBP	0.00	0.00	1.00	0.0%	
Magnetometer	0.00	0.00	1.00	0.0%	
SVP (m/s)	n/a				

Data Observations:

Signatures	PC:	Client Rep:
	18/04/2018	18/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	19/04/2018	Thu
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	03	

Times (Local) From	To	DIARY OF OPERATIONS	Status
07:30	11:10	Mobilisation and system integration. GPS verification carried out.	M
11:10	11:20	Transit for heading alignment	M
11:20	11:55	Carry out heading alignment calibration	M
11:55	12:15	Transit back to Holyhead	M
12:15	17:55	Carry on mobilisation and system integration. Heading verification carried out.	M
17:55	18:20	Depart and transit to area for multibeam calibration	M
18:20	19:15	Multibeam calibration carried out and SVP collected	M
19:15	20:00	Trial deployment of the side scan sonar	M
20:00	20:10	Transit back to Holyhead berth	M
20:10		Alongside and end of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	12:40	36:40
Transit	Tr	00:00	00:00
Working	WK	00:00	00:00
Breakdown	B	00:00	00:00
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:40	36:40

Weather Conditions

Time	Wind		Sea state (m)		Vis
		Force	Wind	Swell	
00:00					
04:00					
08:00					
16:00	SW	3-4	0.5		
20:00	SW	3-4	0.5		
Forecast					

Personnel on board

Contractor	GP, PC, NM, GT, VN, JB	Client:	

Comments

Plan for next 24Hrs:

Complete final configuration and carry out USBL calibration. Start collecting data on site.

Signatures	PC:	Client Rep:
	19/04/2018	19/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	19/04/2018	Thu
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	03	

Health Safety Environment records

Today	Total	Type	Comment
88:40	256:40	Man Hours Worked (hh:mm)	
2	3	Toolbox Talk	Deployment methods reviewed, modified (udated RASMS) & trialled in
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	0.00	1.00	0.0%	
Side Scan Sonar	0.00	0.00	1.00	0.0%	
Single Channel SBP	0.00	0.00	1.00	0.0%	
Magnetometer	0.00	0.00	1.00	0.0%	
SVP (m/s)	n/a				

Data Observations:

Signatures	PC:	Client Rep:
	19/04/2018	19/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	20/04/2018	Fri
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	04	

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	12:40	Mobilisation and system integration	M
12:40	13:55	Depart Holyhead berth and transit to survey site	M
13:55	14:05	Toolbox talk for USBL beacon and calibration frame deployment	M
14:05	14:35	Beacon and frame deployed for USBL calibration	M
14:35	15:30	Issues with reception for GNSS corrections. Trying to resolve issue	M
15:30	16:30	Attempt to recover beacon, to move North for better reception, but not possible due to strong	M
16:30	17:05	Waiting on slacker currents	M
17:05	17:20	Currents slacker and suitable for USBL calibration with SBAS corrections. SVP collected for USBL	M
17:05	18:45	Running USBL calibration lines.	M
18:45	19:10	USBL calibration aborted due to time constraints and suitable conditions to recover frame. Recoverin	M
19:10	20:08	Transiting to Holyhead Harbour	M
20:08	20:30	Alongside in Holyhead	M
20:30		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	12:45	49:25
Transit	Tr	00:00	00:00
Working	WK	00:00	00:00
Breakdown	B	00:00	00:00
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:45	49:25

Weather Conditions

Time	Wind		Sea state (m)		Vis
		Force	Wind	Swell	
00:00					
04:00					
13:00	SSW	2-3	0.7		Misty
16:00	SW	2	0.2		Clear
20:00	SW	3-4	0.2		Clear

Forecast

Personnel on board

Contractor	GP, PC, NM, GT, VN, JB	Client:	

Comments

Due to unforeseen issues with reception for GNSS corrections on site (reported GSM coverage on site incorrect), another corrections service has been organised. The satellite based correction service will be activate in the morning before sailing.

Plan for next 24Hrs:

Carry out the USBL calibration first thing in the morning and then proceed to site to start survey operations.

Signatures

PC: 20/04/2018

Client Rep: 20/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	20/04/2018	Fri
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	04	

Health Safety Environment records

Today	Total	Type	Comment
89:15	345:55	Man Hours Worked (hh:mm)	
3	6	Toolbox Talk	
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	0.00	1.00	0.0%	
Side Scan Sonar	0.00	0.00	1.00	0.0%	
Single Channel SBP	0.00	0.00	1.00	0.0%	
Magnetometer	0.00	0.00	1.00	0.0%	
SVP (m/s)	1484.6				

Data Observations:

Signatures	PC:  20/04/2018	Client Rep: 20/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	21/04/2018	Sat
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	05	

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:15	Alongside in Holyhead	M
06:15	06:55	Depart Holyhead and transit to location for USBL calibration North of Holyhead	M
06:55	08:00	Deploying USBL calibration frame	M
08:00	08:08	Sound velocity profile collected	M
08:08	10:40	Running USBL calibration lines. USBL calibration frame left, due to strong currents (Will recover	M
10:40	11:20	Transit to site	M
11:20	11:59	Preparation for deployment. Sound velocity profile collected	M
11:59	12:45	Boomer deployed. Tweaking settings	M
12:45	15:20	Issues with interference, which was traced to boomer. Moving and reconfiguring boomer top end.	M
15:20	18:15	Deployed SSS and magnetometer. Intermittent communication with magnetometer. Solved	M
18:15	18:55	Transit to Holyhead	M
18:55	19:30	Alongside in Holyhead	M
19:30		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	13:30	62:55
Transit	Tr	00:00	00:00
Working	WK	00:00	00:00
Breakdown	B	00:00	00:00
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		13:30	62:55

Weather Conditions

Time	Wind	Force	Sea state (m) Wind	Swell	Vis
09:00	Var	1	Slight	0.3	Clear
12:00	Var	1	Slight	0.3	Clear
15:00	Var	1	Slight	0.2	Clear
18:00	Var	1	Slight	0.2	Clear
Forecast					

Personnel on board

Contractor	GP, NM, GT, VN, JB	Client:	

Comments

USBL calibration successfully completed. USBL calibration frame was left, as the currents had become too strong and therefore not safe to recover. Will recover at a later. Some survey equipment was found to be suffering from interference, which was traced to the boomer top end box. It was moved to below deck and was reconfigured, which solved the issue. The magnetometer suffered intermittent communications,

Plan for next 24Hrs:

Start survey operations.

Signatures

PC: 21/04/2018

Client Rep: 21/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	21/04/2018	Sat
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	05	

Health Safety Environment records

Today	Total	Type	Comment
81:00	426:55	Man Hours Worked (hh:mm)	
3	9	Toolbox Talk	
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	0.00	1.00	0.0%	
Side Scan Sonar	0.00	0.00	1.00	0.0%	
Single Channel SBP	0.00	0.00	1.00	0.0%	
Magnetometer	0.00	0.00	1.00	0.0%	
SVP (m/s)	1481.0				

Data Observations:

Signatures	PC:	Client Rep:
	21/04/2018	21/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	22/04/2018	Sun
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	06	

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:35	Alongside in Holyhead	M
06:35	08:16	Depart Holyhead and transit to site	M
08:16	08:27	Sound velocity profile collected (1482.79 m/s)	M
08:27	09:35	Deploying equipment	M
09:35	10:05	Earth cable for boomer broke and was fixed	B
10:05	10:20	Remaining equipment deployed	M
10:20	11:38	Running M_125m_28 & 29 lines in the northern part of the site	WK
11:38	14:23	Running M_125m_N01 to N07 lines in the north east part of the site	WK
14:23	18:36	Running M_125m_28, 29 & 36 lines	WK
18:36	19:08	Transit towards Holyhead with equipment out	WK
19:08	19:18	Recovering equipment	WK
19:18	19:30	Continue transit to Holyhead	WK
19:30	19:45	Alongside in Holyhead	WK
19:45		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	03:50	66:45
Transit	Tr	00:00	00:00
Working	WK	09:25	09:25
Breakdown	B	00:30	00:30
Standby Offshore	ST-Off	00:00	00:00
Standby Port < 8 days	ST-P1	00:00	00:00
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		13:45	76:40

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
08:30	SW W	3	0.5	-	Rain
09:15	SW W	3-4	0.5	-	Fog
10:30	SW	4	0.75	0.5	Fog
13:00	SW	3-4	0.5	0.5	Fog
18:00	SW	4	0.5	0.5	-
Forecast					

Personnel on board

Contractor	GP, NM, GT, VN, JB	Client:	

Comments

Data collection was started successfully. See 'Data Observations' for further information.

Plan for next 24Hrs:

Collect the USBL calibration frame in the morning at the safest time for recovery and before the poor weather. Carry on survey operations until it is not possible due to the forecasted weather.

Signatures

PC: 22/04/2018

Client Rep: 22/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	22/04/2018	Sun
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	06	

Health Safety Environment records

Today	Total	Type	Comment
82:30	509:25	Man Hours Worked (hh:mm)	
2	11	Toolbox Talk	
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	36.51	36.51	557.89	6.5%	
Side Scan Sonar	36.51	36.51	557.89	6.5%	
Single Channel SBP	36.51	36.51	557.89	6.5%	
Magnetometer	36.51	36.51	557.89	6.5%	
SVP (m/s)	1481.0				

Data Observations:

Very good data was collected today, but there has been some poorer data collected as well, due to a combination of wind and currents in certain parts of the site (Northern part). Wind in the same orientation, as the tidal flow, caused exaggerated issues in certain areas (Poor data, unfit for use, will be rerun). Currently, it has been observed, that the greatest issues with the current is going to be in the northern part of the site. Currently, no issues was seen in 2/3 of the site (bottom half) The knowledge of the site conditions will continue to grow as we progress.

Note - Line totals above does not include the very close inshore data collection.

PC:  22/04/2018

Client Rep: 22/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	23/04/2018	Mon
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	07	

Times (Local) From - To	DIARY OF OPERATIONS	Status
07:00 - 08:55	Alongside in Holyhead	WK
08:55 - 09:45	Depart Holyhead and transit to pickup USBL calibration frame	M
09:45 - 10:05	At USBL calibration frame. Conditions unsuitable for safe recovery.	M
10:05 - 10:35	Transit to site	WK
10:35 - 10:45	On site - Not workable	ST-Off
10:45 - 11:30	Transit to Holyhead	ST-Off
11:30 - 19:00	Alongside in Holyhead	ST-P1
19:00 -	End of day	
-		
-		
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-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	01:10	67:55
Transit	Tr	00:00	00:00
Working	WK	02:25	11:50
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:55	00:55
Standby Port < 8 days	ST-P1	07:30	07:30
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:00	88:40

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
10:00	SW	F5	Mod	1.5	Clear
10:40	W SW	F5	Mod	1.5+	Clear
15:45	SSW	F6 (GF7)	-	-	-
Forecast					

Personnel on board

Contractor	GP, NM, GT, VN, JB	Client:	

Comments

Conditions worse than forecasted and was unsuitable for USBL calibration frame recovery and survey operations.

Plan for next 24Hrs:

Improved weather forecast, so continue surveying, when weather allows, and collect USBL calibration frame

Signatures		
PC:		Client Rep:
	23/04/2018	23/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	23/04/2018	Mon
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	07	

Health Safety Environment records

Today	Total	Type	Comment
60:00	569:25	Man Hours Worked (hh:mm)	
1	12	Toolbox Talk	
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	36.51	557.89	6.5%	
Side Scan Sonar	0.00	36.51	557.89	6.5%	
Single Channel SBP	0.00	36.51	557.89	6.5%	
Magnetometer	0.00	36.51	557.89	6.5%	
SVP (m/s)	-				

Data Observations:

Note - Line totals above does not include the very close inshore data collection.

PC:  23/04/2018

Client Rep: 23/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	24/04/2018	Tue
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	08	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:20	Alongside in Holyhead	ST-P1
06:20 - 07:05	Transit to site	ST-Off
07:05 - 10:50	Waiting on weather on site.	ST-Off
10:50 - 11:30	Still unworkable. Transiting to USBL frame location for recovery.	Tr
11:30 - 12:00	Conditions suitable for recovery. Recovering USBL frame.	M
12:00 - 12:35	Transit back to site	Tr
12:35 - 13:10	On site waiting on weather	ST-Off
13:10 - 13:20	Sound velocity profile collected - 1482.70 m/s	WK
13:20 - 13:35	SSS and boomer deployed	WK
13:35 - 17:05	Running survey line M_125m_18, 19 & 20	WK
17:05 - 17:25	Adjusting hydrophone	WK
17:25 - 17:50	Recovering survey equipment	WK
17:50 - 18:30	Sound velocity profile collected - 1485.09 m/s	WK
18:30 - 19:15	Transiting to Holyhead	WK
19:15 - 19:35	Alongside in Holyhead	WK
19:35 -	End of day	
-		
-		
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-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:30	68:25
Transit	Tr	01:15	01:15
Working	WK	06:25	18:15
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	05:05	06:00
Standby Port < 8 days	ST-P1	00:20	07:50
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		13:35	102:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:05	SW	F4-5			
07:25	SW	F4-5	Mod	1 to 1.5	Clear
10:45	SW	F4	Mod	1+	Clear
15:00	SW	F3	Slight/M	0.7	Clear
17:25	SW	F4	Slight/M	0.5	Clear

Forecast

Personnel on board

Contractor	GP, NM, GT, VN, JB	Client:	

Comments

Conditions unsuitable for survey operations in the morning. Opportunity was taken to recover the USBL frame during this time, which was recovered safely. Conditions improved in the afternoon and good quality data was collected.

Plan for next 24Hrs:

Continue survey operations in the morning. Forecast does not look good for later in the day, but there might be a window at the start of the day.

Signatures

PC: 24/04/2018

Client Rep: 24/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	24/04/2018	Tue
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	08	

Health Safety Environment records

Today	Total	Type	Comment
67:55	637:20	Man Hours Worked (hh:mm)	
3	15	Toolbox Talk	
0	0	Safety Drills	
0	2	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	22.52	59.03	557.89	10.6%	
Side Scan Sonar	22.52	59.03	557.89	10.6%	
Single Channel SBP	22.52	59.03	557.89	10.6%	
Magnetometer	22.52	59.03	557.89	10.6%	
SVP (m/s)	1485.1				

Data Observations:

Good quality data for the first 2 full lines. Boomer data needs to be check for the last partial line run due to tidal flow..

Note - Line totals above does not include the very close inshore data collection.

PC:  24/04/2018

Client Rep: 24/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	25/04/2018	Wed
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	09	

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:10	Alongside in Holyhead	ST-P1
06:10	07:05	Transit to site	Tr
07:05	07:10	Conditions unsuitable for survey operations with a worsening forecast	ST-Off
07:10	07:55	Transit to Holyhead	Tr
07:55	18:00	Alongside in Holyhead	ST-P1
18:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	01:40	02:55
Working	WK	00:00	18:15
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:05	06:05
Standby Port < 8 days	ST-P1	10:15	18:05
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:00	114:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:05	SW	F4-5	Mod	1+	Clear
Forecast					

Personnel on board

Contractor	GP, NM, GT, VN, JO	Client:	

Comments

Transited to site, but unfortunately conditions was not suitable for survey operations.
James Owen (Vessel engineer and deckhand) onboard to replace James Brady. NOK form filled in and sent. Project induction carried out.

Plan for next 24Hrs:

Waiting on weather, but keeping an eye out for a change in weather

Signatures

PC: 25/04/2018

Client Rep: 25/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	25/04/2018	Wed
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	09	

Health Safety Environment records

Today	Total	Type	Comment
60:00	697:20	Man Hours Worked (hh:mm)	
0	15	Toolbox Talk	
0	0	Safety Drills	
1	3	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	59.03	557.89	10.6%	
Side Scan Sonar	0.00	59.03	557.89	10.6%	
Single Channel SBP	0.00	59.03	557.89	10.6%	
Magnetometer	0.00	59.03	557.89	10.6%	
SVP (m/s)	1485.1				

Data Observations:

Note - Line totals above does not include the very close inshore data collection.

PC:  25/04/2018

Client Rep: 25/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	26/04/2018	Thu
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	10	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 14:30	Vessel alongside in Holyhead	ST-P1
14:30 - 16:30	Reconnaissance on foot to Abraham's Bosom nearshore survey area. LW 14:49, 1.0m CD.	ST-P1
16:30 - 18:00	Vessel alongside in Holyhead	ST-P1
18:00 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	00:00	18:15
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	06:05
Standby Port < 8 days	ST-P1	12:00	30:05
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	00:00
Total		12:00	126:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
13:30	SW	F6-7	Rough	1.5+	Good

Forecast: Improving overnight

Personnel on board

Contractor	NM, GT, VN, JO	Client:	

Comments

Conditions unsuitable for survey operations. Weather conditions reported above are from the Port of Holyhead. Similar conditions were observed on the work site during reconnaissance walk along the cliffs overlooking the nearshore survey area at Abraham's Bosom over low water (14:30-16:30).

Plan for next 24Hrs:

Survey operations.

Signatures

PC: Graham Tattersall — 26/04/2018

Client Rep: — 26/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	26/04/2018	Thu
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	10	

Health Safety Environment records

Today	Total	Type	Comment
48:00	745:20	Man Hours Worked (hh:mm)	
1	16	Toolbox Talk	
0	0	Safety Drills	
0	3	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	59.03	557.89	10.6%	
Side Scan Sonar	0.00	59.03	557.89	10.6%	
Single Channel SBP	0.00	59.03	557.89	10.6%	
Magnetometer	0.00	59.03	557.89	10.6%	
SVP (m/s)					

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

26/04/2018

Client Rep:

26/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	27/04/2018	Fri
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	11	

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:20	Project crew on board	WK
06:20	07:15	Transit to site	WK
07:15	07:36	Sound velocity profile - 1485.09 m/s	WK
07:36	13:58	Running survey lines in Abraham's Bosom	WK
13:58	14:53	Snagged old fishing gear with SSS - recovered all towed survey equipment to deck	O
14:53	15:10	Transit back to port following entanglement with old fishing gear	WK
15:10	15:15	Sound velocity profile - 1486.29 m/s	WK
15:15	16:25	Transit back to port following entanglement with old fishing gear	WK
16:25	18:00	Vessel alongside for repairs to survey equipment following fishing gear entanglement	O
18:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	09:30	27:45
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	06:05
Standby Port < 8 days	ST-P1	00:00	30:05
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	02:30	02:30
Total		12:00	138:15

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
07:15	NE	F1	Slight	<0.5	Good
11:15	NE	F1	Slight	<0.5	Good
15:15	NNE	F4	Mod	0.5	Good
Forecast	Improving tomorrow afternoon				

Personnel on board

Contractor	NM, GT, VN, JO	Client:	

Comments

Good conditions for survey operations. Surveyed Abraham's Bosom in the morning over high water and on the ebb tide. Planned to survey offshore survey lines running south from South Stack over slack water in the afternoon. Snagged some old fishing gear close to South Stack in about 30m water depth, just before the start of the first offshore line.

Plan for next 24Hrs:

Testing sidescan sonar equipment in port, followed by survey operations.
There is some swell forecast overnight that drops off late morning. We plan to be on site as early as possible to utilise the good weather forecast for the afternoon.

Signatures

PC: Graham Tattersall — 27/04/2018

Client Rep: — 27/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	27/04/2018	Fri
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	11	

Health Safety Environment records

Today	Total	Type	Comment
48:00	793:20	Man Hours Worked (hh:mm)	
3	19	Toolbox Talk	
0	0	Safety Drills	
0	3	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	30.84	89.87	557.89	16.1%	
Side Scan Sonar	30.84	89.87	557.89	16.1%	
Single Channel SBP	30.84	89.87	557.89	16.1%	
Magnetometer	30.84	89.87	557.89	16.1%	
SVP (m/s)	1485.1	1486.3			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

27/04/2018

Client Rep:

27/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	28/04/2018	Sat
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	12	

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	11:13	Reparing and testing survey equipment following fishing gear entanglement	O
11:13	11:54	Transit to site after entanglement with old fishing gear	WK
11:54	12:05	Sound velocity profile - 1484.73 m/s	WK
12:05	12:44	Deploying towed survey equipment	WK
12:44	19:43	Running survey lines	WK
19:43	20:00	Recover towed survey equipment	WK
20:00	20:05	Sound velocity profile - 1485.13 m/s	WK
20:05	20:35	Transit back to port	WK
20:35	20:45	Vessel alongside in Holyhead	WK
20:45		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	09:32	37:17
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	06:05
Standby Port < 8 days	ST-P1	00:00	30:05
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	03:13	05:43
Total		12:45	151:00

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
11:30	N	F1	Slight	<0.5	Good
15:30	N	F1	Slight	0.5	Good
19:30	NNE	F1-2	Slight	0.5	Good
Forecast	Good conditions for survey tomorrow				

Personnel on board

Contractor	GT, VN, JO, RV	Client:	

Comments

Russell Venning (Geophysicist) onboard to replace Norman MacDonald for today. Project induction and NOK form completed. A productive day of survey followed repair and testing of the snagged survey equipment after entanglement with old fishing gear.

Plan for next 24Hrs:

The forecast for tomorrow is good so expecting another productive day of survey.

Signatures

PC: Graham Tattersall — 28/04/2018

Client Rep: — 28/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	28/04/2018	Sat
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	12	

Health Safety Environment records

Today	Total	Type	Comment
51:00	844:20	Man Hours Worked (hh:mm)	
2	21	Toolbox Talk	
0	0	Safety Drills	
1	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	58.79	148.66	557.89	26.6%	
Side Scan Sonar	58.79	148.66	557.89	26.6%	
Single Channel SBP	58.79	148.66	557.89	26.6%	
Magnetometer	58.79	148.66	557.89	26.6%	
SVP (m/s)	1484.7	1485.1			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

28/04/2018

Client Rep:

28/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	29/04/2018	Sun
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	13	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:10	Vessel alongside in Holyhead	WK
06:10 - 06:55	Transit to site	WK
06:55 - 07:05	Sound velocity profile - 1484.23 m/s	WK
07:05 - 07:30	Deploying towed survey equipment	WK
07:30 - 12:49	Running survey lines	WK
12:49 - 13:54	Tide too strong for survey; transit to N end of work site to run with the tide.	ST-Off
13:54 - 15:34	Running survey lines	WK
15:34 - 15:59	Tide too strong for survey; transit inshore to SE corner of the work site.	ST-Off
15:59 - 19:18	Running survey lines	WK
19:18 - 19:40	Transit back to port	WK
19:40 - 19:50	Recovered towed survey equipment in Holyhead harbour due to worsening conditions on site	WK
19:50 - 20:00	Vessel alongside in Holyhead	WK
20:00 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	12:30	49:47
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	01:30	07:35
Standby Port < 8 days	ST-P1	00:00	30:05
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	05:43
Total		14:00	165:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:30	NNE	F1	Slight	0.5	Good
11:30	NNE	F1-2	Slight	0.5	Good
15:30	N	F3	Mod	<0.5	Good
19:30	N	F4-5	Mod	1.0	Good
Forecast	Conditions improving tomorrow PM				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Norman MacDonald (Survey Engineer) back on board. A productive day of survey.

Plan for next 24Hrs:

Forecast for tomorrow morning is poor, improving in the afternoon. A northerly wind is forecast so we plan to survey the SE corner of the work site, which may be more sheltered.

Signatures

PC: Graham Tattersall — 29/04/2018

Client Rep: — 29/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	29/04/2018	Sun
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	13	

Health Safety Environment records

Today	Total	Type	Comment
56:00	900:20	Man Hours Worked (hh:mm)	
2	23	Toolbox Talk	
0	0	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	75.34	223.99	557.89	40.2%	
Side Scan Sonar	75.34	223.99	557.89	40.2%	
Single Channel SBP	75.34	223.99	557.89	40.2%	
Magnetometer	75.34	223.99	557.89	40.2%	
SVP (m/s)	1484.2				

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

29/04/2018

Client Rep:

29/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	30/04/2018	Mon
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	14	

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	08:45	Waiting on weather - vessel alongside in Holyhead	ST-P1
08:45	09:15	Reconnaissance by car to observe work site from South Stack	ST-P1
09:15	09:45	Waiting on vessel movements to depart Holyhead	O
09:45	10:40	Transit to SE corner of work site	WK
10:40	10:59	Sound velocity profile - 1486.45 m/s	WK
10:59	11:39	Running MBES survey lines along coast over HW springs (maximum available depth)	WK
11:39	12:24	Deploying towed survey equipment	WK
12:24	15:18	Running survey lines	WK
15:18	15:52	Coastguard helicopter exercise - requested to winch person onto deck. Cancelled due to wind	O
15:52	18:48	Running survey lines	WK
18:48	19:00	Recovered towed survey equipment	WK
19:00	19:05	Sound velocity profile - 1485.21 m/s	WK
19:05	19:55	Transit back to port	WK
19:55	20:00	Vessel alongside in Holyhead	WK
20:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	09:41	59:28
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	07:35
Standby Port < 8 days	ST-P1	01:15	31:20
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	01:04	06:47
Total		12:00	177:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
08:30	N	F4-5	Mod	1.0	Good
12:30	N	F3	Slight	0.5	Good
16:30	NW	F3	Slight	<0.5	Good
19:30	NNE	F3-4	Mod	0.7	Good

Forecast: Conditions deteriorating tomorrow PM

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Surveyed the SE corner of the work site, which was sheltered from the northerly wind and the maximum spring tide currents. Took advantage of the HW spring tide and offshore wind to map coastline from Abraham's Bosom to SE corner of work site. Coastguard helicopter asked to winch person onto deck but cancelled due to windy conditions.

Plan for next 24Hrs:

Forecast for tomorrow morning is OK but deteriorates in the afternoon. The wind backs to the W, leaving the whole site exposed.

Signatures

PC: Graham Tattersall — 30/04/2018

Client Rep: — 30/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	30/04/2018	Mon
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	14	

Health Safety Environment records

Today	Total	Type	Comment
48:00	948:20	Man Hours Worked (hh:mm)	
3	26	Toolbox Talk	
0	0	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	40.35	264.34	557.89	47.4%	
Side Scan Sonar	40.35	264.34	557.89	47.4%	
Single Channel SBP	40.35	264.34	557.89	47.4%	
Magnetometer	40.35	264.34	557.89	47.4%	
SVP (m/s)	1486.5	1485.2			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

30/04/2018

Client Rep:

30/04/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.

Report Date: 01/05/2018 Tue
Partrac Project No. P1830
Daily Report No. 15

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:15	Vessel alongside in Holyhead	ST-P1
06:15	07:15	Transit to SE corner of work site	ST-Off
07:15	08:30	Spring tidal current too strong - transit to SW corner of work site	ST-Off
08:30	09:20	Conditions unsuitable for survey operations - transit to the N end of site	ST-Off
09:20	09:40	Conditions unsuitable for survey operations with a worsening forecast - return to port	ST-Off
09:40	09:50	Man overboard drill	ST-Off
09:50	10:10	Transit to port	ST-Off
10:10	18:00	Vessel alongside in Holyhead	ST-P1
18:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	00:00	59:28
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	03:55	11:30
Standby Port < 8 days	ST-P1	08:05	39:25
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:00	189:00

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
06:30	S	F3-4	Slight	0.2	Good
07:45	S	F4-5	Mod	1.0	Good
12:00	S	F5-6	Mod	1.5	Good
16:00	S	F7-8	Rough	1.5+	Mod

Forecast: Conditions improving slightly tomorrow

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Transit to the SE corner of the work site, however, the site was exposed to the southerly wind and spring tide currents (top of springs today). Transit to SW corner to run with the tide but conditions were too rough to deploy the survey equipment. Transit to the N end ot the site but conditions were unworkable with a worsening forecast. Return to port.

Plan for next 24Hrs:

Windy conditions persist tomorrow morning with a slight improvement forecast for late afternoon. At present, tomorrow looks unworkable; however, we continue to monitor the forecast and conditions on site.

Signatures

PC: Graham Tattersall 01/05/2018

Client Rep: 01/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	01/05/2018	Tue
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	15	

Health Safety Environment records

Today	Total	Type	Comment
48:00	996:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
1	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

The vessel crew undertook a man overboard drill in sheltered conditions outside of Holyhead harbour, on the return transit to port.

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	264.34	557.89	47.4%	
Side Scan Sonar	0.00	264.34	557.89	47.4%	
Single Channel SBP	0.00	264.34	557.89	47.4%	
Magnetometer	0.00	264.34	557.89	47.4%	
SVP (m/s)					

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 01/05/2018

Client Rep: 01/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.
Report Date: 02/05/2018 Wed
Partrac Project No. P1830
Daily Report No. 16

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 12:10	Waiting on Weather - Vessel alongside in Holyhead	ST-P1
12:10 - 13:20	Reconnaissance by car to Holyhead breakwater and South Stack to view conditions on site	ST-P1
13:20 - 18:00	Waiting on Weather - Vessel alongside in Holyhead	ST-P1
18:00 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	00:00	59:28
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	11:30
Standby Port < 8 days	ST-P1	12:00	51:25
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:00	201:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
08:00	NW	F5	Mod	1.5	Mod
12:00	NW	F5-6	Rough	1.5+	Mod
16:00	WNW	F4-5	Mod	1.0	Good

Forecast: Conditions improving overnight

Personnel on board

Contractor: GT, VN, JO, NM
Client:

Comments

Vessel waiting on weather in Holyhead and receiving regular updates on wind speed and direction from the port authority. Reconnaissance trip to look at sea state confirmed that conditions on site were unsuitable for survey.

Plan for next 24Hrs:

Conditions are forecast to improve overnight before the wind speed increases again late afternoon tomorrow.

Signatures

PC: Graham Tattersall 02/05/2018

Client Rep: 02/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	02/05/2018	Wed
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	16	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1044:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	264.34	557.89	47.4%	
Side Scan Sonar	0.00	264.34	557.89	47.4%	
Single Channel SBP	0.00	264.34	557.89	47.4%	
Magnetometer	0.00	264.34	557.89	47.4%	
SVP (m/s)					

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

02/05/2018

Client Rep:

02/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	03/05/2018	Thu
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	17	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:20	Vessel alongside in Holyhead	WK
06:20 - 07:05	Transit to site	WK
07:05 - 07:15	Sound velocity profile - 1484.14 m/s	WK
07:15 - 07:47	Deployed towed survey equipment	WK
07:47 - 15:29	Running survey lines	WK
15:29 - 16:00	Transit back to port due to worsening conditions on site	ST-Off
16:00 - 16:20	Recovered towed survey equipment in Holyhead harbour due to worsening conditions on site	WK
16:20 - 16:30	Transit back to port due to worsening conditions on site	ST-Off
16:30 - 18:00	Waiting on Weather - Vessel alongside in Holyhead	ST-P1
18:00 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	09:49	69:17
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:41	12:11
Standby Port < 8 days	ST-P1	01:30	52:55
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:00	213:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:15	SW	F4	Slight	0.8	Good
10:10	S	F5	Slight	0.8	Good
13:15	S	F4	Slight	0.8	Mod
16:00	S	F5-6	Mod	1.0+	Mod
Forecast	Conditions improving tomorrow				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Conditions on site were marginal today with 0.8m westerly swell in the morning, which backed south and increased by mid afternoon, in agreement with the StormGeo weather forecast. Completed 6 survey lines from N to SW across the site.

Plan for next 24Hrs:

Conditions are forecast to improve overnight and into tomorrow. Plan to finish the SE corner of the site if conditions allow, otherwise continue with the offshore lines in the NW corner of the site.

Signatures

PC: Graham Tattersall — 03/05/2018

Client Rep: — 03/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	03/05/2018	Thu
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	17	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1092:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	56.07	320.42	557.89	57.4%	
Side Scan Sonar	56.07	320.42	557.89	57.4%	
Single Channel SBP	56.07	320.42	557.89	57.4%	
Magnetometer	56.07	320.42	557.89	57.4%	
SVP (m/s)	1484.1				

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall

03/05/2018

Client Rep:

03/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	04/05/2018	Fri
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	18	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:20	Vessel alongside in Holyhead	WK
06:20 - 07:27	Transit to SE corner of site	WK
07:27 - 07:37	Sound velocity profile - 1486.65 m/s	WK
07:37 - 08:00	Deployed towed survey equipment	WK
08:00 - 16:44	Running survey lines	WK
16:44 - 17:05	Recovered towed survey equipment	WK
17:05 - 17:15	Sound velocity profile - 1486.46 m/s	WK
17:15 - 18:05	Transit back to port	WK
18:05 - 18:15	Vessel alongside in Holyhead	WK
18:15 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	12:15	81:32
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	12:11
Standby Port < 8 days	ST-P1	00:00	52:55
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:15	225:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:15	S	F3	Slight	0.5	Mod
10:15	S	F3	Slight	0.5	Mod
14:15	SW	F3	Slight	<0.5	Good
17:15	S	F4-5	Mod	0.7	Good

Forecast: Swell increasing slightly tomorrow

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Completed 15 shorter survey lines in SE corner of the site. Total km less than yesterday due to the number of line turns. The area south of Abraham's Bosom is now complete, barring reruns and bathymetry infill.

Plan for next 24Hrs:

Similar conditions to today are forecast for tomorrow, with a slightly larger swell from the south. Plan to survey area between North and South Stack if conditions allow, otherwise continue with the offshore lines in the NW corner of the site.

Signatures

PC: Graham Tattersall — 04/05/2018

Client Rep: — 04/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	04/05/2018	Fri
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	18	

Health Safety Environment records

Today	Total	Type	Comment
49:00	1141:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	54.55	374.97	557.89	67.2%	
Side Scan Sonar	54.55	374.97	557.89	67.2%	
Single Channel SBP	54.55	374.97	557.89	67.2%	
Magnetometer	54.55	374.97	557.89	67.2%	
SVP (m/s)	1486.7	1486.5			

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall 04/05/2018

Client Rep: 04/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.

Report Date: 05/05/2018 Sat
Partrac Project No. P1830
Daily Report No. 19

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:20	Vessel alongside in Holyhead	WK
06:20	06:50	Transit to NE corner of site	WK
06:50	07:09	Sound velocity profile - 1486.22 m/s	WK
07:09	08:34	Bathymetry survey of Gogarth Bay over slack water.	WK
08:34	09:09	Deployed towed survey equipment	WK
09:09	10:54	Running survey lines in Gogarth Bay	WK
10:54	11:45	Conditions unsuitable for survey operations inshore - transit to the NW corner of site	ST-Off
11:45	12:25	Conditions unsuitable for survey operations with a worsening forecast - return to port	ST-Off
12:25	12:35	Recovered towed survey equipment in Holyhead harbour due to worsening conditions on site	WK
12:35	12:45	Transit back to port due to worsening conditions on site	ST-Off
12:45	18:00	Vessel alongside in Holyhead	ST-P1
18:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	05:04	86:36
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	01:41	13:52
Standby Port < 8 days	ST-P1	05:15	58:10
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:00	237:15

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
06:15	S	F4	Slight	0.5	Poor
09:55	S	F5	Mod	0.8	Poor
10:45	S	F5-6	Mod	1.0+	Mod
12:45	S	F5-6	Mod	1.0+	Mod
Forecast	Swell decreasing overnight				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Weather on site worse than forecast. Completed survey of Gogarth Bay between North and South Stack. Transitted offshore to see if running survey lines with tide and wind was possible. Conditions unsuitable for survey.

Plan for next 24Hrs:

Forecast improves overnight and swell drops. Plan to survey NW corner of site and run survey lines past South Stack over slack water.

Signatures

PC: Graham Tattersall 05/05/2018

Client Rep: 05/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	05/05/2018	Sat
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	19	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1189:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	9.50	384.47	557.89	68.9%	
Side Scan Sonar	9.50	384.47	557.89	68.9%	
Single Channel SBP	9.50	384.47	557.89	68.9%	
Magnetometer	9.50	384.47	557.89	68.9%	
SVP (m/s)	1486.2				

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall

05/05/2018

Client Rep:

05/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	06/05/2018	Sun
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	20	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:30	Vessel alongside in Holyhead	WK
06:30 - 07:05	Transit to N edge of site	WK
07:05 - 07:15	Sound velocity profile - 1486.00 m/s	WK
07:15 - 07:41	Deployed towed survey equipment	WK
07:41 - 16:56	Running survey lines	WK
16:56 - 17:06	Recovered towed survey equipment	WK
17:06 - 17:15	Sound velocity profile - 1486.89 m/s	WK
17:15 - 17:45	Transit back to port	WK
17:45 - 18:00	Vessel alongside in Holyhead	WK
18:00 -	End of day	
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Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	12:00	98:36
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	13:52
Standby Port < 8 days	ST-P1	00:00	58:10
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		12:00	249:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:15	W	F1	Slight	0.4	V. Poor
10:15	NW	F1	Slight	0.2	V. Poor
14:30	SSW	F1	Slight	0.3	Good
17:15	S	F2	Slight	0.2	Good
Forecast	Similar to today. Good survey conditions				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Completed survey lines north and south of South Stack, taking advantage of good weather conditions and weaker currents over neap tides.

Plan for next 24Hrs:

Plan to survey NW corner of site. No weather forecast received since 18:00 on 05/05/2018.

Signatures

PC: Graham Tattersall — 06/05/2018

Client Rep: — 06/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	06/05/2018	Sun
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	20	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1237:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	61.40	445.87	557.89	79.9%	
Side Scan Sonar	61.40	445.87	557.89	79.9%	
Single Channel SBP	61.40	445.87	557.89	79.9%	
Magnetometer	61.40	445.87	557.89	79.9%	
SVP (m/s)	1486.0	1486.9			

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall

06/05/2018

Client Rep:

06/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.

Report Date: 07/05/2018 Mon
Partrac Project No. P1830
Daily Report No. 21

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	06:20	Vessel alongside in Holyhead	WK
06:20	07:05	Transit to N edge of site	WK
07:05	07:15	Sound velocity profile - 1486.07 m/s	WK
07:15	07:38	Deployed towed survey equipment	WK
07:38	19:29	Running survey lines	WK
19:29	19:45	Recovered towed survey equipment	WK
19:45	19:55	Sound velocity profile - 1487.20 m/s	WK
19:55	20:40	Transit back to port	WK
20:40	20:45	Vessel alongside in Holyhead	WK
20:45		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	14:45	113:21
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	13:52
Standby Port < 8 days	ST-P1	00:00	58:10
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Other	O	00:00	06:47
Total		14:45	264:00

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
07:00	S	F3-4	Mod	0.8	Good
11:00	SSW	F3-4	Slight	0.5	Good
15:15	SW	F1-2	Slight	0.3	Good
19:15	S	F3	Slight	0.2	Good
20:00	S	F4	Mod	0.4	Good

Forecast: Poor survey conditions tomorrow AM

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Completed the NW corner of the site (deep water area 50m-70m depth), taking advantage of good weather conditions and weaker currents over neap tides.

Plan for next 24Hrs:

Poor survey conditions forecast for tomorrow morning, improving by late afternoon.

Signatures

PC: Graham Tattersall 07/05/2018

Client Rep: 07/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	07/05/2018	Mon
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	21	

Health Safety Environment records

Today	Total	Type	Comment
59:00	1296:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	80.40	526.26	557.89	94.3%	
Side Scan Sonar	80.40	526.26	557.89	94.3%	
Single Channel SBP	80.40	526.26	557.89	94.3%	
Magnetometer	80.40	526.26	557.89	94.3%	
SVP (m/s)	1486.1	1487.2			

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall 07/05/2018

Client Rep: 07/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Report Date:**	08/05/2018	Tue
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	22	

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	14:00	Waitiing on weather in port - Vessel alongside in Holyhead	ST-P1
14:00	14:30	Reconnaissance by car to observe work site from South Stack and Holyhead Breakwater	ST-P1
14:30	14:45	Waiting on weather in port - Vessel alongside in Holyhead	ST-P1
14:45	15:15	Transit to NE corner of site	WK
15:15	15:25	Sound velocity profile - 1488.09 m/s	WK
15:25	16:01	Deployed towed survey equipment	WK
16:01	16:59	Re-running survey lines for MBES and SBP due to poor conditions during initial survey	ER
16:59	17:10	Waiting on ferry passage	O
17:10	18:05	Re-running survey lines for MBES and SBP due to poor conditions during initial survey	ER
18:05	18:18	Waiting on ferry passage	O
18:18	18:45	Re-running survey lines for MBES and SBP due to poor conditions during initial survey	ER
18:45	18:55	Recover towed survey equipment	WK
18:55	19:05	Sound velocity profile - 1487.74 m/s	WK
19:05	19:30	Transit back to port	WK
19:30	20:00	Vessel alongside in Holyhead	WK
20:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	02:31	115:52
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	13:52
Standby Port < 8 days	ST-P1	06:45	64:55
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	02:20	02:20
Other	O	00:24	07:11
Total		12:00	276:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
08:00	S	F5-6	Mod	1.0+	Mod
10:00	S	F6	Mod	1.0+	Mod
14:30	S	F5	Slight	1.0	Mod
19:15	SW	F3	Slight	0.7	Good
Forecast	Deteriorating late morning tomorrow				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Re-ran survey lines M_125m_N01 to M_125m_N07 to collect bathymetry and sub-bottom data that failed QC due to environmental conditions (wind and waves). Original SSS data passed QC due to sidescan fish below the surface.

Plan for next 24Hrs:

Good survey conditions early morning deteriorating later. Aim to work in sheltered parts of the site.

Signatures

PC: Graham Tattersall

08/05/2018

Client Rep:

08/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	08/05/2018	Tue
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	22	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1344:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	526.26	557.89	94.3%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Re-run survey lines	11.88	11.88			Environmental Re-run
SVP (m/s)	1488.1	1487.7			

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall 08/05/2018

Client Rep: 08/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.
Report Date: 09/05/2018 Wed
Partrac Project No. P1830
Daily Report No. 23

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:20	Vessel alongside in Holyhead	WK
06:20 - 06:50	Transit to NE corner of site	WK
06:50 - 07:00	Sound velocity profile - 1487.38 m/s	WK
07:00 - 07:22	Deployed sidescan sonar and magnetometer	WK
07:22 - 09:56	Re-ran survey lines due to poor positioning during initial survey	WK
09:56 - 10:10	Recover sidescan sonar and magnetometer	WK
10:10 - 10:36	Transit back to south to run with the weather	ST-Off
10:36 - 10:44	Running survey line north from North Stack	WK
10:44 - 10:54	Transit back to south to run with the weather	ST-Off
10:54 - 11:03	Running survey line north from North Stack	WK
11:03 - 11:12	Transit back to south to run with the weather	ST-Off
11:12 - 11:19	Running survey line north from North Stack	WK
11:19 - 11:26	Transit back to south to run with the weather	ST-Off
11:26 - 11:32	Running survey line north from North Stack	WK
11:32 - 11:40	Transit back to port due to worsening conditions on site	ST-Off
11:40 - 11:50	Sound velocity profile - 1487.35 m/s	WK
11:50 - 12:30	Transit back to port due to worsening conditions on site	ST-Off
12:30 - 18:00	Waiting on weather - Vessel alongside in Holyhead	ST-P1
18:00 -	End of day	
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	Tr	00:00	02:55
Working	WK	04:50	120:42
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	01:40	15:32
Standby Port < 8 days	ST-P1	05:30	70:25
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	02:20
Other	O	00:00	07:11
Total		12:00	288:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:00	S	F3-4	Slight	0.5	Good
10:00	S	F5-6	Mod	0.8	Good
11:30	S	F6-7	Mod	1.0	Good
14:30	S	F6-7	Rough	1.0+	Good
Forecast	Conditions improving tomorrow PM				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Re-ran survey lines M_125m_34 and M_125m_35 due to poor positioning. Then moved to NE corner of work site, where some shelter was afforded by North Stack. Able to run 4 lines from S to N, with transit back to start of line, before conditions deteriorated.

Plan for next 24Hrs:

Poor survey conditions tomorrow morning improving slightly in the afternoon. Aim to work in sheltered parts of the site.

Signatures

PC: Graham Tattersall 09/05/2018

Client Rep: 09/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	09/05/2018	Wed
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	23	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1392:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	1.95	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	0.00	11.88			
Other Re-run	11.74	11.74			
Infill		0.00			
SVP (m/s)	1487.4	1487.4			

Data Observations:

Note - Line totals above do not include the very close inshore data collection or infills.

PC: Graham Tattersall 09/05/2018

Client Rep: 09/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.

Report Date: 10/05/2018 Thu
Partrac Project No. P1830
Daily Report No. 24

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 12:00	Waiting on weather - Vessel alongside in Holyhead	ST-P1
12:00 - 12:30	Reconnaissance by car to observe work site from South Stack	ST-P1
12:30 - 18:00	Waiting on weather - Vessel alongside in Holyhead	ST-P1
18:00 -	End of day	
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	00:00	120:42
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	15:32
Standby Port < 8 days	ST-P1	12:00	82:25
Standby Port 8 - 14 days	ST-P2	00:00	00:00
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	02:20
Other	O	00:00	07:11
Total		12:00	300:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:30	SW	F4	Mod	1.0+	Good
09:30	SW	F4	Mod	1.0+	Good
12:30	SW	F4-5	Mod	1.0+	Good
16:00	SW	F4-5	Mod	1.0+	Good

Forecast: Tomorrow unworkable all day.

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Wind speed increased throughout the day from the SW. Swell didn't decrease and no part of the site was sheltered. Conditions unsuitable for survey.

Plan for next 24Hrs:

Forecast for tomorrow is unsuitable for survey all day. Wind and swell coming down early hours of Saturday morning.

Signatures

PC: Graham Tattersall 10/05/2018

Client Rep: 10/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	10/05/2018	Thu
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	24	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1440:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	0.00	11.88			
Other Re-run	0.00	11.74			
Infill	0.00	0.00			
SVP (m/s)					

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

10/05/2018

Client Rep:

10/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mor
Vessel: Norse
Client Project No.

Report Date: 11/05/2018 Fri
Partrac Project No. P1830
Daily Report No. 25

Times (Local) From	To	DIARY OF OPERATIONS	Status
06:00	07:35	Waiting on weather - Vessel alongside in Holyhead	ST-P1
07:35	18:00	Waiting on weather - Vessel alongside in Holyhead	ST-P2
18:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	00:00	120:42
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	15:32
Standby Port < 8 days	ST-P1	01:35	84:00
Standby Port 8 - 14 days	ST-P2	10:25	10:25
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	02:20
Other	O	00:00	07:11
Total		12:00	312:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:00	SSE	F5-6	Rough	1.2	Good
10:00	S	F6-7	Rough	1.5+	Mod
13:00	S	F6-7	Rough	1.5+	Mod
16:00	SSW	F5-6	Rough	1.5+	Good
Forecast	Swell coming down early tomorrow AM				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Conditions unsuitable for survey today. Wind and swell coming down tomorrow morning.

Plan for next 24Hrs:

Start rerunning survey lines with poor data quality due to environmental conditions during initial data collection.

Signatures

PC: Graham Tattersall 11/05/2018

Client Rep: 11/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mor	**Date:**	11/05/2018	Fri
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	25	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1488:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	0.00	11.88			
Other Re-run	0.00	11.74			
Infill	0.00	0.00			
SVP (m/s)					

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 11/05/2018

Client Rep: 11/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	12/05/2018	Sat
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	26	

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	08:45	Waiting on weather - Vessel alongside in Holyhead	ST-P2
08:45	09:15	Transit to NE corner of work site. Swell too high to deploy towed survey equipment.	ST-Off
09:15	09:55	Transit to SE corner of work site	ST-Off
09:55	10:12	Sound velocity profile - 1490.16 m/s	WK
10:12	15:26	Run MBES infill lines	WK
15:26	15:40	Sound velocity profile - 1488.08 m/s	WK
15:40	18:56	Run MBES infill lines	WK
18:56	19:05	Sound velocity profile - 1490.79 m/s	WK
19:05	19:55	Transit back to port	WK
19:55	20:00	Vessel alongside in Holyhead	WK
20:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	10:05	130:47
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	01:10	16:42
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:45	11:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	02:20
Other	O	00:00	07:11
Total		12:00	324:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
09:15	S	F2-3	Mod	1.5	Good
12:00	S	F2	Mod	1.0	Good
16:00	SW	F1	Slight	0.8	Good
19:30	Light airs	F0	Slight	0.5	Good
Forecast	Swell decreasing further overnight				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Conditions initially unsuitable to deploy towed survey equipment due to long period swell. Transited to SE corner of the work site to start MBES infill.

Plan for next 24Hrs:

Start surveying cross lines and rerunning survey lines with poor data quality due to environmental conditions during initial data collection

Signatures

PC: Graham Tattersall — 12/05/2018

Client Rep: — 12/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	12/05/2018	Sat
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	26	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1536:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	0.00	11.88			
Other Re-run	0.00	11.74			
Infill	67.65	67.65			
SVP (m/s)	1490.2	1488.1	1490.8		

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 12/05/2018

Client Rep: 12/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	13/05/2018	Sun
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	27	

Times (Local) From	To	DIARY OF OPERATIONS	Status
07:00	07:15	Vessel alongside in Holyhead	WK
07:15	07:40	Transit to NE corner of work site	WK
07:40	07:50	Sound velocity profile - 1489.44 m/s	WK
07:50	08:11	Deployed towed survey equipment	WK
08:11	10:34	Run crosslines XL5, XL4, XL3 over HW slack.	WK
10:34	15:33	Rerun lines M_125m_04 and M_125m_05 due to environmental conditions during first survey	ER
15:33	17:29	Run crosslines XL2, XL1 over LW slack.	WK
17:29	18:20	Rerun line M_125m_27 due to environmental conditions during first survey	ER
18:20	18:30	Recover towed survey equipment	WK
18:30	18:40	Sound velocity profile - 1489.38 m/s	WK
18:40	19:10	Transit back to port	WK
19:10	19:15	Vessel alongside in Holyhead	WK
19:15		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	06:25	137:12
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	16:42
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	11:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	05:50	08:10
Other	O	00:00	07:11
Total		12:15	336:15

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:15	W	F2-3	Slight	0.5	Good
10:30	W	F2	Slight	0.5	Good
15:30	S	F1	Slight	0.3	Good
19:00	S	F2	Slight	0.2	Good
Forecast	Good survey conditions tomorrow				

Personnel on board

Contractor	GT, VN, JO, NM	Client:	

Comments

Completed cross lines and started rerunning survey lines with poor data quality due to environmental conditions during initial data collection.

Plan for next 24Hrs:

Continue rerunning survey lines with poor data quality due to environmental conditions during initial data collection.

Signatures

PC: Graham Tattersall — 13/05/2018

Client Rep: — 13/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	13/05/2018	Sun
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	27	

Health Safety Environment records

Today	Total	Type	Comment
49:00	1585:20	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	18.28	30.17			
Other Re-run	0.00	11.74			
Infill	0.00	67.65			
Cross Lines	32.90	32.90	32.90	100%	
SVP (m/s)	1489.4	1489.4			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall  13/05/2018

Client Rep: 13/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	14/05/2018	Mon
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	28	

Times (Local) From	To	DIARY OF OPERATIONS	Status
07:00	07:20	Vessel alongside in Holyhead	WK
07:20	08:10	Transit to NE corner of work site	WK
08:10	08:20	Sound velocity profile - 1488.11 m/s	WK
08:20	09:35	Transit to SW corner of work site to run with the tide	ST-Off
09:35	09:45	Sound velocity profile - 1488.89 m/s	WK
09:45	10:04	Deploy towed survey equipment	WK
10:04	18:24	Rerun boomer survey lines due to environmental conditions during first survey	ER
18:24	18:34	Recover towed survey equipment	WK
18:34	18:45	Sound velocity profile - 1488.54 m/s	WK
18:45	19:10	Transit back to port	WK
19:10	19:15	Vessel alongside in Holyhead	WK
19:15		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	02:40	139:52
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	01:15	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	11:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	08:20	16:30
Other	O	00:00	07:11
Total		12:15	348:30

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:15	S	F2-3	Slight	0.5	Good
12:30	S	F4	Mod	0.5	Good
17:15	S	F2	Slight	0.2	Good
18:45	Light airs	F0	Slight	0.0	Good
Forecast	Good survey conditions tomorrow				

Personnel on board

Contractor	GT, VN, JO, NM, GP	Client:	

Comments

Completed rerunning survey lines with poor data quality due to environmental conditions during initial data collection. Gustav Pettersson on board today.

Plan for next 24Hrs:

Bathymetry (MBES) infill.

Signatures

PC: Graham Tattersall

14/05/2018

Client Rep:

14/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	14/05/2018	Mon
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	28	

Health Safety Environment records

Today	Total	Type	Comment
61:15	1646:35	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	528.22	557.89	94.7%	
Side Scan Sonar	0.00	526.26	557.89	94.3%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	526.26	557.89	94.3%	
Environmental Re-run	46.56	76.73			
Other Re-run	0.00	11.74			
Infill	0.00	67.65			
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1488.1	1488.9	1488.5		

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall

14/05/2018

Client Rep:

14/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	15/05/2018	Tue
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	29	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:20	Vessel alongside in Holyhead	WK
06:20 - 07:05	Transit to Gogarth Bay	WK
07:05 - 07:15	Sound velocity profile - 1489.92 m/s	WK
07:15 - 07:30	Deploy SSS and magnetometer	WK
07:30 - 07:31	No SSS data - reason unknown	WK
07:31 - 07:50	Recover SSS and magnetometer	WK
07:50 - 08:48	Running MBES survey lines in Gogarth Bay	WK
08:48 - 09:01	Redeploy SSS and magnetometer	WK
09:01 - 10:33	Running SSS and MBES survey lines in Gogarth Bay	WK
10:33 - 10:48	Recover SSS and magnetometer	WK
10:48 - 11:17	MBES infill	WK
11:17 - 11:25	Waiting on ferry passage	O
11:25 - 17:33	MBES infill	WK
17:33 - 17:45	Sound velocity profile - 1487.79 m/s	WK
17:45 - 18:20	Transit back to port	WK
18:20 - 18:30	Vessel alongside in Holyhead	WK
18:30 -	End of day	
-		
-		
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	12:22	152:14
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	11:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	16:30
Other	O	00:08	07:19
Total		12:30	361:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:45	S	F2	Slight	0.0	Good
11:20	S	F2	Slight	0.2	Good
17:55	WSW	F2	Slight	0.0	Good

Forecast: Poor conditions for survey tomorrow

Personnel on board

Contractor	GT, VN, JO, NM, GP	Client:	

Comments

Survey of Gogarth Bay completed. Bathymetry (MBES) infill.

Plan for next 24Hrs:

Bathymetry (MBES) infill, weather permitting.

Signatures

PC: Graham Tattersall — 15/05/2018

Client Rep: — 15/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	15/05/2018	Tue
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	29	

Health Safety Environment records

Today	Total	Type	Comment
62:30	1709:05	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	0	Safety Incident	
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	22.81	551.03	557.89	98.8%	
Side Scan Sonar	9.98	536.24	557.89	96.1%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	9.98	536.24	557.89	96.1%	
Environmental Re-run	0.00	76.73			
Other Re-run	0.00	11.74			
Infill	57.65	125.30			
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1489.9	1487.8			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 15/05/2018

Client Rep: 15/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client: Menter Mon
Vessel: Norse
Client Project No.
Report Date: 16/05/2018 Wed
Partrac Project No. P1830
Daily Report No. 30

Times (Local) From	To	DIARY OF OPERATIONS	Status
08:00	20:00	Vessel alongside in Holyhead - waiting on weather	ST-P2
20:00		End of day	

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	00:00	152:14
Breakdown	B	00:00	00:30
Standby Offshore	ST-Off	00:00	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	12:00	23:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	00:00	16:30
Other	O	00:00	07:19
Total		12:00	373:00

Weather Conditions

Time	Wind Direction	Wind Force	Sea state (m) Wind	Sea state (m) Swell	Vis
08:30	N	F5-6	Mod	1.0+	Good
11:30	N	F5	Mod	1.0+	Poor
15:00	N	F5	Mod	1.0+	Good
20:00	N	F3-4	Slight	<1.0	Good

Forecast: Conditions improving overnight

Personnel on board

Contractor: GT, VN, JO, NM, GP
Client:

Comments

Waiting on weather

Plan for next 24Hrs:

Bathymetry (MBES) infill.

Signatures

PC: Graham Tattersall 16/05/2018
Client Rep: 16/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	16/05/2018	Wed
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	30	

Health Safety Environment records

Today	Total	Type	Comment
60:00	1769:05	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	2	Safety Incident	SSS incidents on 27/04/2018 and 15/05/2018
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	551.03	557.89	98.8%	
Side Scan Sonar	0.00	536.24	557.89	96.1%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	536.24	557.89	96.1%	
Environmental Re-run	0.00	76.73			
Other Re-run	0.00	11.74			
Infill	0.00	125.30			
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1489.9	1487.8			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 16/05/2018

Client Rep: 16/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	17/05/2018	Thu
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	31	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:30	Vessel alongside in Holyhead	WK
06:30 - 06:45	Vessel breakdown - port engine not starting - charge battery	B
06:45 - 07:45	Transit to work site	ER
07:45 - 07:58	Sound velocity profile - 1487.78 m/s	ER
07:58 - 08:08	Rerun MBES survey lines due to environmental conditions during first survey	ER
08:08 - 08:14	Issue with MBES	B
08:14 - 08:19	Rerun MBES survey lines due to environmental conditions during first survey	ER
08:19 - 08:30	Issue with MBES	B
08:30 - 09:51	Rerun MBES survey lines due to environmental conditions during first survey	ER
09:51 - 10:25	Issue with MBES	B
10:25 - 10:57	Rerun MBES survey lines due to environmental conditions during first survey	ER
10:57 - 11:23	Issue with MBES	B
11:23 - 11:54	Rerun MBES survey lines due to environmental conditions during first survey	ER
11:54 - 12:05	Issue with MBES resolved	B
12:05 - 16:13	Rerun MBES survey lines due to environmental conditions during first survey	ER
16:13 - 16:16	Restart POS MV	B
16:16 - 18:47	Rerun MBES survey lines due to environmental conditions during first survey	ER
18:47 - 18:53	Restart POS MV	B
18:53 - 19:12	Rerun MBES survey lines due to environmental conditions during first survey	ER
19:12 - 19:27	Sound velocity profile - 1488.53 m/s	ER
19:27 - 20:07	Rerun MBES survey lines due to environmental conditions during first survey	ER
20:07 - 20:50	Transit back to port	ER
20:50 - 21:00	Vessel alongside in Holyhead	WK
21:00 -	End of day	
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	00:40	152:54
Breakdown	B	01:52	02:22
Standby Offshore	ST-Off	00:00	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	23:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	12:28	28:58
Other	O	00:00	07:19
Total		15:00	388:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:30	NE	F3-4	Mod	<0.5	Good
11:30	NNE	F5	Mod	0.5	Good
16:10	N	F3-4	Slight	0.3	Good
20:30	NNE	F4	Slight	0.2	Good

Forecast: V. good conditions for survey tomorrow

Personnel on board

Contractor	GT, VN, JO, GP	Client:	

Comments

Rerun MBES survey lines due to environmental conditions during first survey. A timing issue with the MBES occurred several times in the morning but a solution was found and the issue resolved.

Plan for next 24Hrs:

Bathymetry (MBES) infill.

Signatures

PC: Graham Tattersall — 17/05/2018

Client Rep: — 17/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	17/05/2018	Thu
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	31	

Health Safety Environment records

Today	Total	Type	Comment
60:00	1829:05	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	2	Safety Incident	SSS incidents on 27/04/2018 and 15/05/2018
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	551.03	557.89	98.8%	
Side Scan Sonar	0.00	536.24	557.89	96.1%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	536.24	557.89	96.1%	
Environmental Re-run	103.07	179.80			
Other Re-run	0.00	11.74			
Infill	0.00	125.30			
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1487.8	1488.5			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall  17/05/2018

Client Rep: 17/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	18/05/2018	Fri
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	32	

Times (Local) From - To	DIARY OF OPERATIONS	Status
06:00 - 06:15	Vessel alongside in Holyhead	WK
06:15 - 06:55	Transit to work site	WK
06:55 - 07:15	Sound velocity profile - 1488.24 m/s	WK
07:15 - 07:45	GPS not receiving corrections - issue resolved	B
07:45 - 12:29	Rerun MBES survey lines due to environmental conditions during first survey	ER
12:29 - 15:47	MBES infill - Abraham's Bosom	WK
15:47 - 16:20	Rerun MBES survey lines due to environmental conditions during first survey	ER
16:20 - 16:53	MBES rerun due to motion error in initial data - line M_125m_48	WK
16:53 - 17:23	Rerun MBES survey lines due to environmental conditions during first survey	ER
17:23 - 17:55	MBES rerun due to motion error in initial data - line M_125m_51	WK
17:55 - 18:14	Rerun MBES survey lines due to environmental conditions during first survey	ER
18:14 - 19:58	MBES rerun due to motion error in initial data - lines M_125m_50 and M_125m_49	WK
19:58 - 20:21	Rerun MBES survey lines due to environmental conditions during first survey	ER
20:21 - 20:30	Sound velocity profile - 1488.87 m/s	WK
20:30 - 20:50	Transit back to port	WK
20:50 - 21:00	Vessel alongside in Holyhead	WK
21:00 -	End of day	
-		
-		
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	00:00	68:25
Transit	TR	00:00	02:55
Working	WK	08:01	160:55
Breakdown	B	00:30	02:52
Standby Offshore	ST-Off	00:00	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	23:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	06:29	35:27
Other	O	00:00	07:19
Total		15:00	403:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
06:30	Light airs	F0	Calm	0.0	Good
11:00	Light airs	F0	Calm	0.0	Good
16:00	Light airs	F0	Calm	0.0	Good
20:30	Light airs	F0	Calm	0.0	Good

Forecast: V. good conditions for survey tomorrow

Personnel on board

Contractor	GT, VN, JO, GP	Client:	

Comments

Rerun MBES survey lines due to motion error and environmental conditions during initial survey.
Completed MBES infill in Abraham's Bosom.

Plan for next 24Hrs:

Complete bathymetry (MBES) survey - approximately 50 km remaining.

Signatures

PC: Graham Tattersall

18/05/2018

Client Rep:

18/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	18/05/2018	Fri
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	32	

Health Safety Environment records

Today	Total	Type	Comment
60:00	1889:05	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	2	Safety Incident	SSS incidents on 27/04/2018 and 15/05/2018
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	551.03	557.89	98.8%	
Side Scan Sonar	0.00	536.24	557.89	96.1%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	536.24	557.89	96.1%	
Environmental Re-run	63.88	243.68			
Other Re-run	25.43	37.17			
Infill	19.96	145.26			
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1488.2	1488.9			

Data Observations:

Note - Line totals above do not include the very close inshore data collection.

PC: Graham Tattersall 18/05/2018

Client Rep: 18/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Report Date:**	19/05/2018	Sat
Vessel:	Norse	**Partrac Project No.**	P1830	
Client Project No.		**Daily Report No.**	33	

Times (Local) From - To	DIARY OF OPERATIONS	Status
07:00 - 07:10	Vessel alongside in Holyhead	WK
07:10 - 07:45	Transit to work site	WK
07:45 - 07:56	Sound velocity profile - 1488.75 m/s	WK
07:56 - 12:10	Rerun MBES survey lines due to environmental conditions during first survey	ER
12:10 - 13:57	Rerun MBES survey lines due to POS MV timing issue on 17/05/18	WK
13:57 - 14:30	Rerun MBES survey lines due to environmental conditions during first survey	ER
14:30 - 14:40	Sound velocity profile - 1489.75 m/s	WK
14:40 - 15:10	Transit back to port	WK
15:10 - 19:00	Vessel alongside in Holyhead - Demobilisation	M
19:00 -	End of day	
-		
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-		
-		
-		
-		
-		
-		
-		
-		

Summary of Times

	Status	Today	Cumulative
Mob/Demob	M	03:50	72:15
Transit	TR	00:00	02:55
Working	WK	03:23	164:18
Breakdown	B	00:00	02:52
Standby Offshore	ST-Off	00:00	17:57
Standby Port < 8 days	ST-P1	00:00	84:00
Standby Port 8 - 14 days	ST-P2	00:00	23:10
Standby Port >14 days	ST-P3	00:00	00:00
Stand Down	ST-Down	00:00	00:00
Environmental Re-run	ER	04:47	40:14
Other	O	00:00	07:19
Total		12:00	415:00

Weather Conditions

Time	Wind		Sea state (m)		Vis
	Direction	Force	Wind	Swell	
07:30	S	F3-4	Slight	0.3	Good
15:00	S	F4	Mod	0.5	Good

Forecast: Good conditions for foreseeable future

Personnel on board

Contractor	GT, VN, JO, GP	Client:	

Comments

Rerun MBES survey lines due to environmental conditions during initial survey and POS MV timing issue on 17/05/2018.
Completed MBES survey.
Demobilisation MV Norse complete.

Plan for next 24Hrs:

Signatures

PC: Graham Tattersall — 19/05/2018

Client Rep: — 19/05/2018

PARTRAC

Morlais Geophysical Survey

DAILY PROGRESS REPORT

Client:	Menter Mon	**Date:**	19/05/2018	Sat
Vessel:	Norse	**HSL Project No.**	P1830	
Client Project No.		**Report No.**	33	

Health Safety Environment records

Today	Total	Type	Comment
48:00	1937:05	Man Hours Worked (hh:mm)	
0	26	Toolbox Talk	
0	1	Safety Drills	
0	4	Safety Inductions	
0	0	Safety Observations	
0	0	Near Miss	
0	2	Safety Incident	SSS incidents on 27/04/2018 and 15/05/2018
0	0	Lost Time Incident	
0	0	Other	

HSE Comments:

Data Collected

Technique	No. of Km Today	No. of Km Total	Total to be surveyed	% Completed	Comment
Bathymetry	0.00	551.03	557.89	98.8%	
Side Scan Sonar	0.00	536.24	557.89	96.1%	
Single Channel SBP	0.00	526.26	557.89	94.3%	
Magnetometer	0.00	536.24	557.89	96.1%	
Environmental Re-run	39.08	282.76	282.76	100%	
Other Re-run	17.05	54.22	54.22	100%	
Infill	0.00	145.26	145.26	100%	
Cross Lines	0.00	32.90	32.90	100%	
SVP (m/s)	1488.8	1489.8			

Data Observations:

PC: Graham Tattersall 19/05/2018

Client Rep: 19/05/2018

APPENDIX 2 – SITE PHOTOGRAPHS

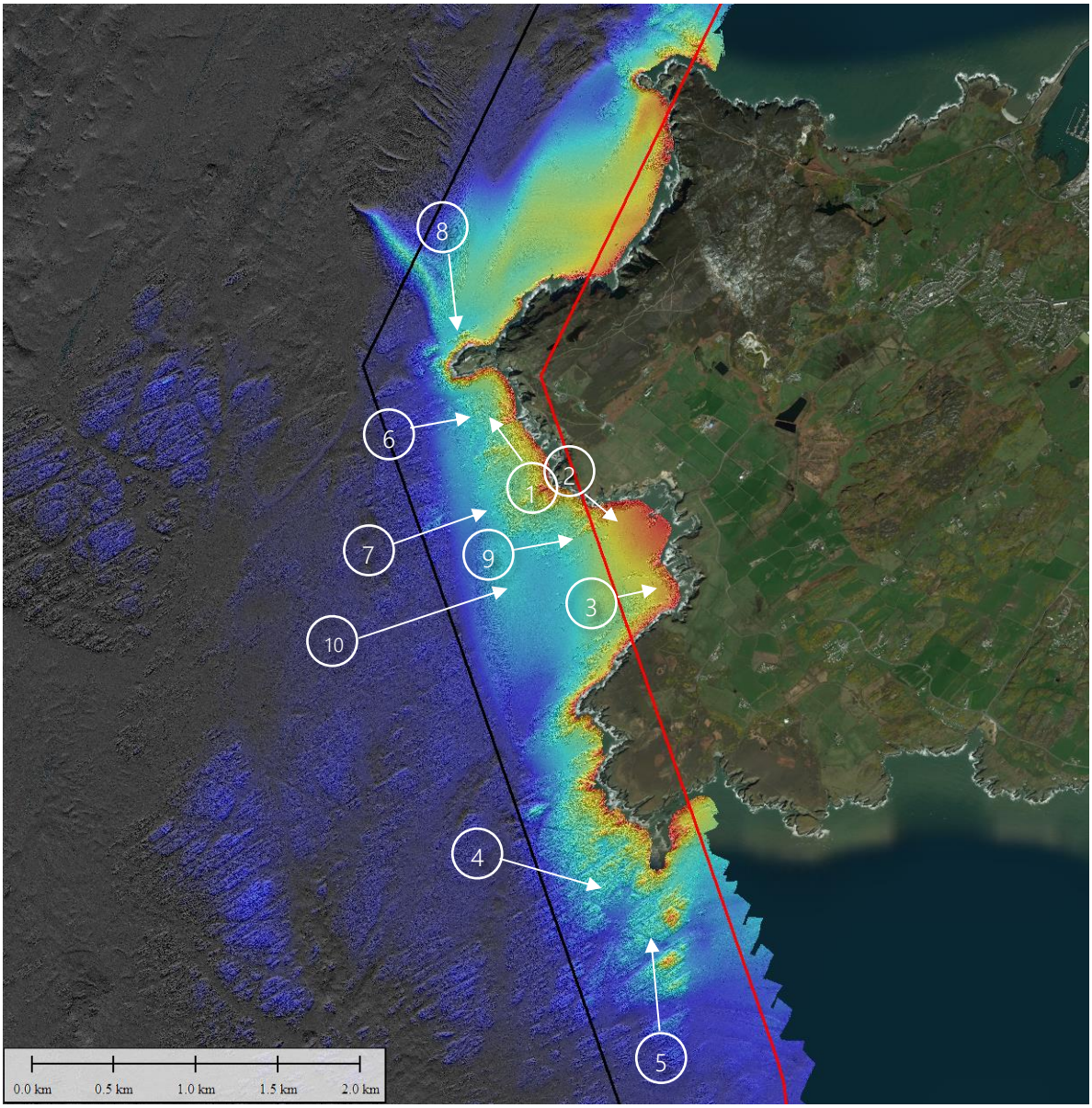


Photo Locations

(Number in circle refers to Photo id and arrow refers to direction photo was taken)

Photo 1 at low water from top of cliff

Photo 2 at low water from top of cliff

Panoramic photo from Photo 1 location

Photo 3 (From vessel)

Photo 4 (From vessel)

Photo 5 (From vessel)

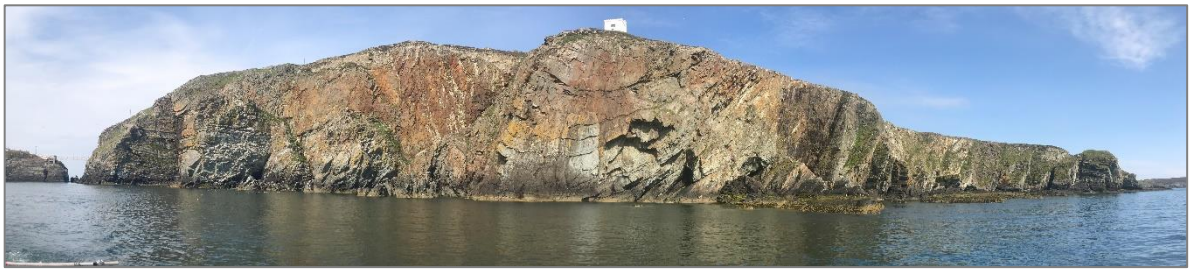


Photo 6 (From vessel)

Photo 7 (From vessel)

Photo 8 (From vessel)

Photo 9 (From vessel)

Photo 10 (From vessel)

APPENDIX 3 – SOUND VELOCITY PROFILES

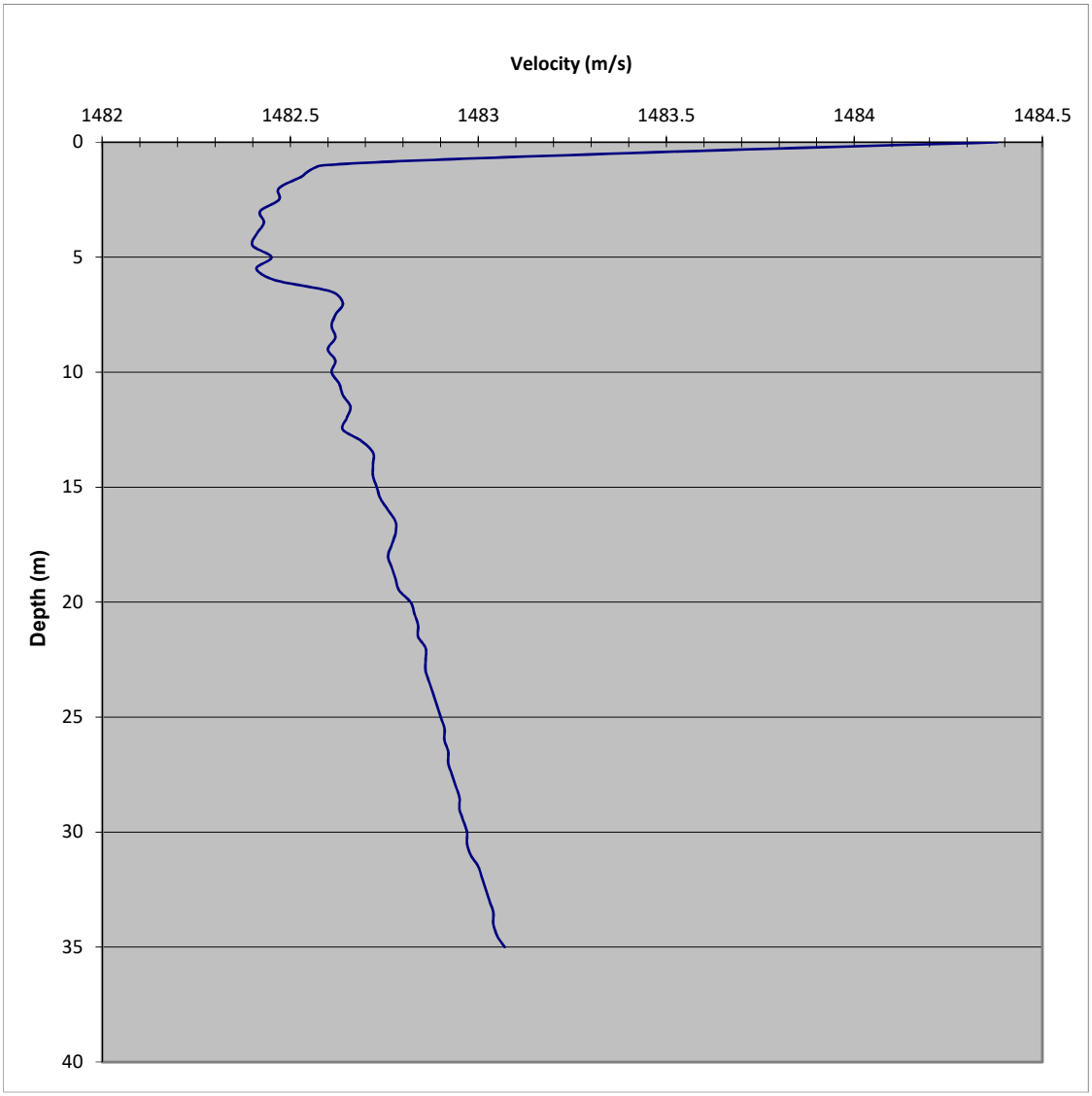
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	22 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;59N	
Longitude	4;41;53W	

Summary Statistics	SVP 1	SVP 2
Time	07:19	
Mean	1482.80	
Minimum	1482.40	
Maximum	1484.38	
Count	71.00	



Mean Velocity - SVP 1 = 1482.8 m/s

Mean Velocity - SVP 2 = m/s

Difference = 1482.8 m/s

Calculated: *GP*

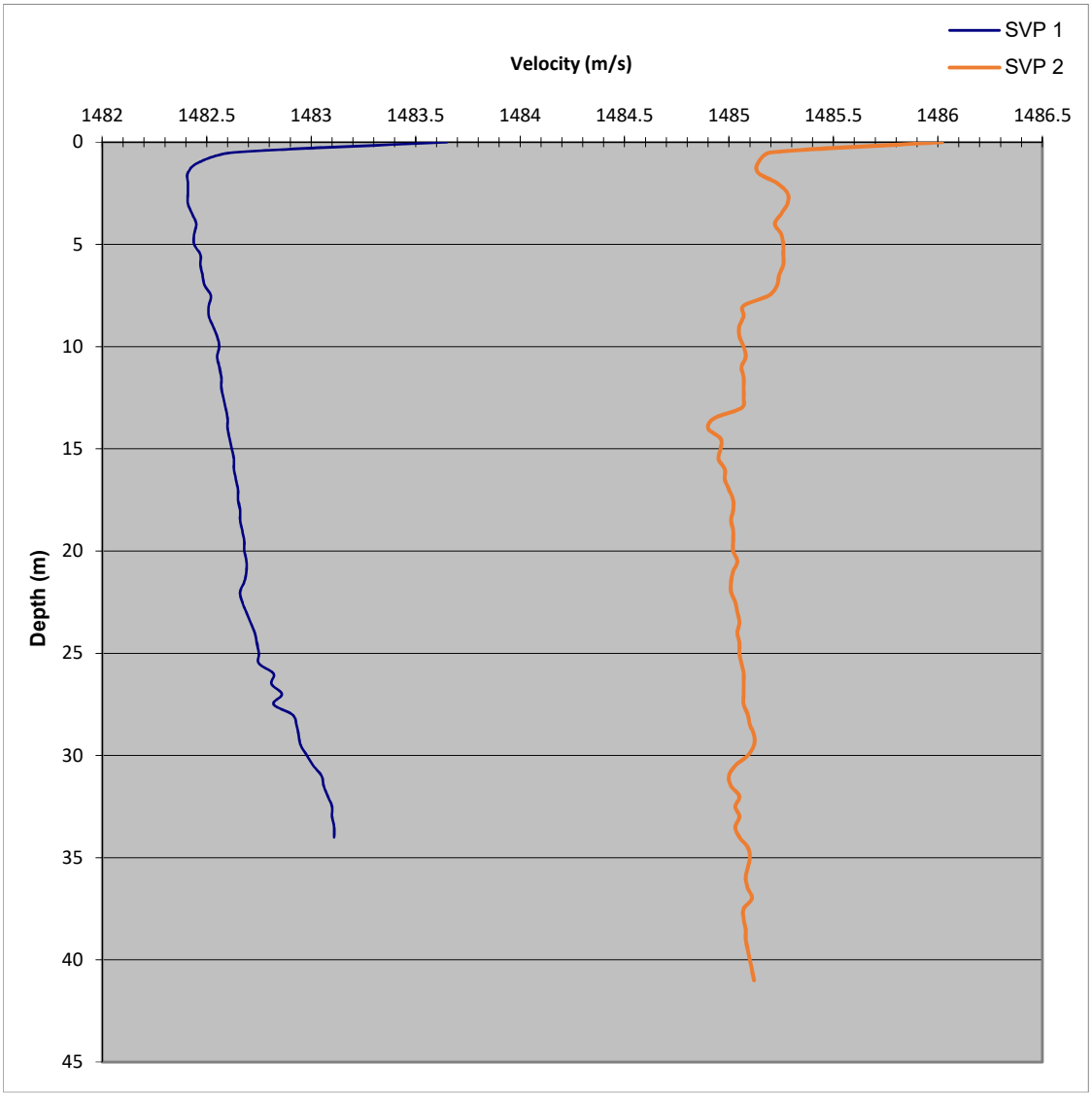
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	24 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;21;39N	53;21;10N
Longitude	4;42;26W	4;42;23W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1482.70	1485.09
Minimum	1482.41	1484.90
Maximum	1483.65	1486.02
Count	69.00	83.00



Mean Velocity - SVP 1 = **1482.7 m/s**

Mean Velocity - SVP 2 = **1485.1 m/s**

Difference = **-2.4 m/s**

Calculated: *GP*

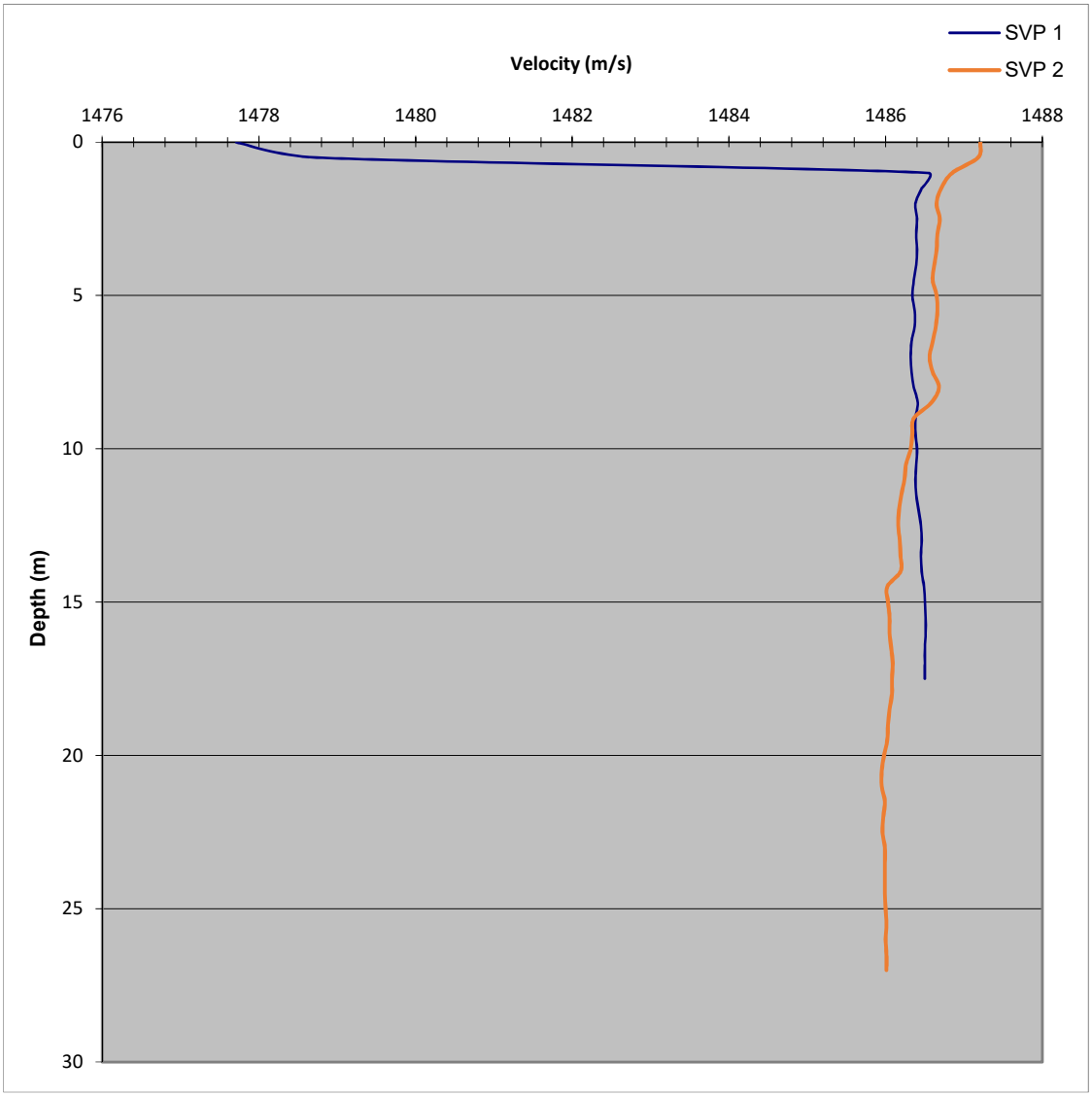
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	27 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;17;44N	53;17;36N
Longitude	4;41;10W	4;41;55W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1485.96	1486.29
Minimum	1477.71	1485.95
Maximum	1486.54	1487.21
Count	36.00	55.00



Mean Velocity - SVP 1 = **1486.0 m/s**

Mean Velocity - SVP 2 = **1486.3 m/s**

Difference = **-0.3 m/s**

Calculated: *GP*

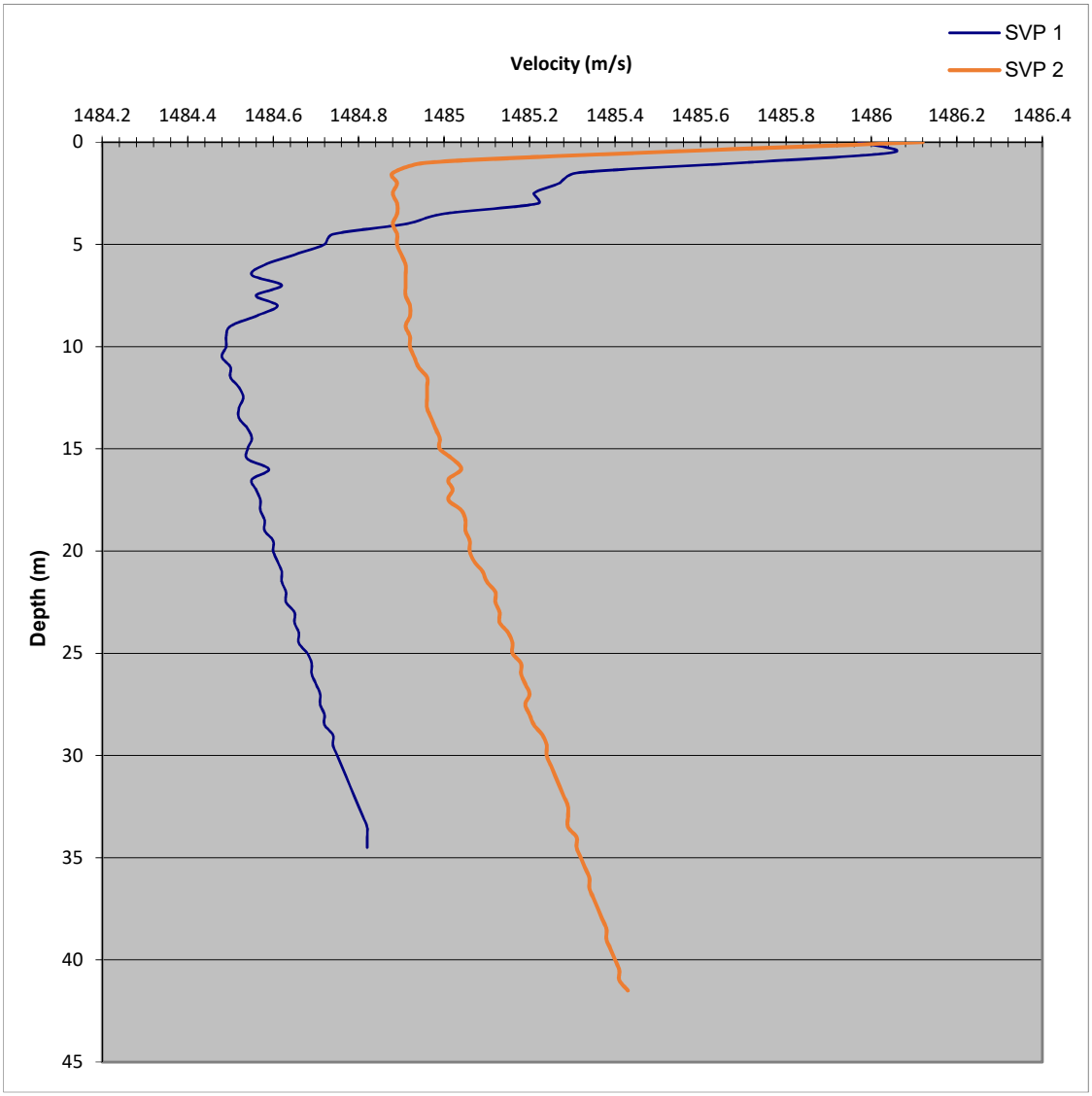
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	28 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;42N	53;21;02N
Longitude	4;42;00W	4;41;37W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1484.73	1485.13
Minimum	1484.48	1484.88
Maximum	1486.05	1486.12
Count	70.00	84.00



Mean Velocity - SVP 1 = **1484.7 m/s**

Mean Velocity - SVP 2 = **1485.1 m/s**

Difference = **-0.4 m/s**

Calculated: *GP*

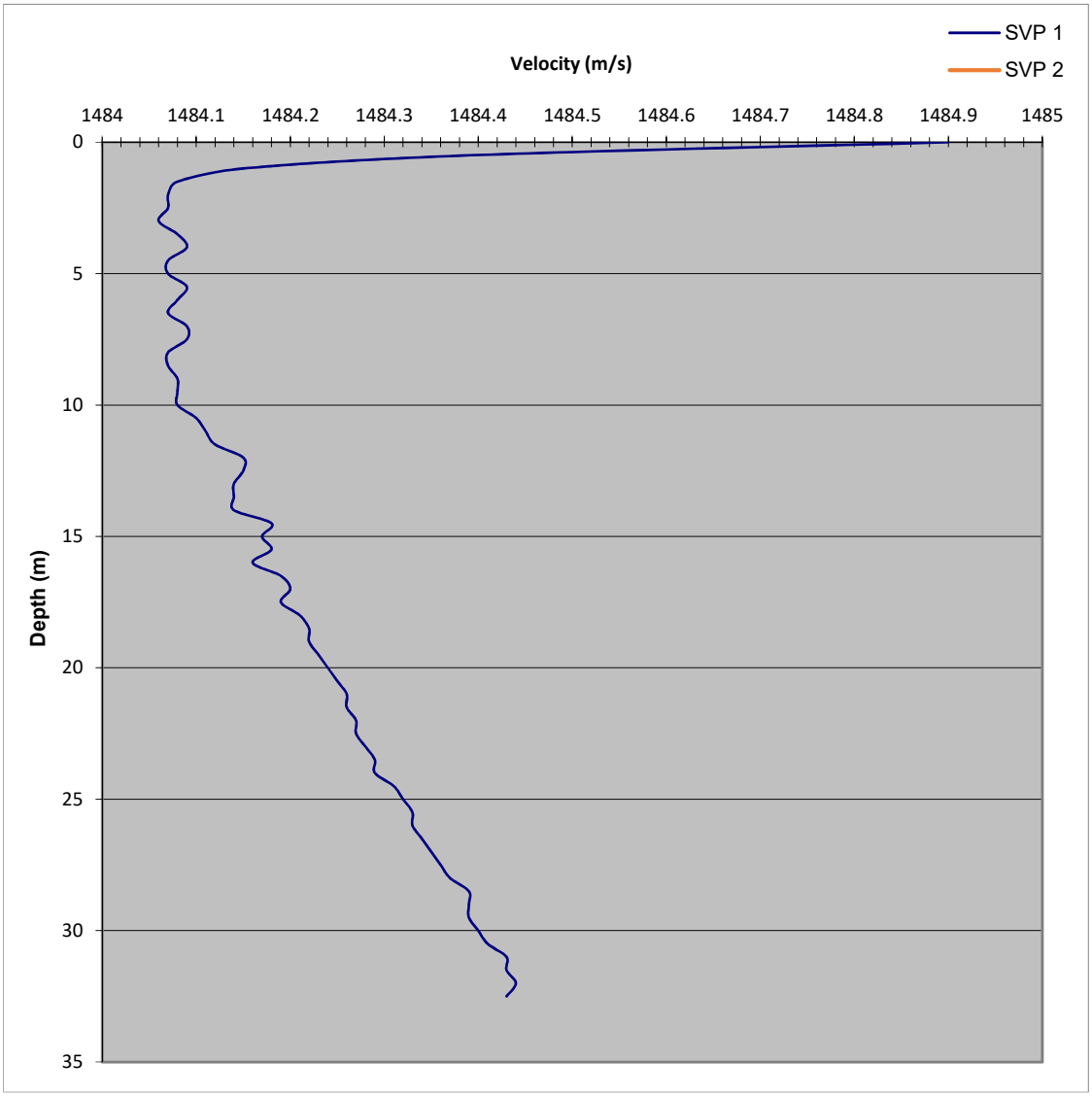
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	29 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;21;11N	
Longitude	4;40;45W	

Summary Statistics	SVP 1	SVP 2
Time	07:19	
Mean	1484.23	
Minimum	1484.06	
Maximum	1484.90	
Count	66.00	



Mean Velocity - SVP 1 = 1484.2 m/s

Mean Velocity - SVP 2 = m/s

Difference = 1484.2 m/s

Calculated: *GP*

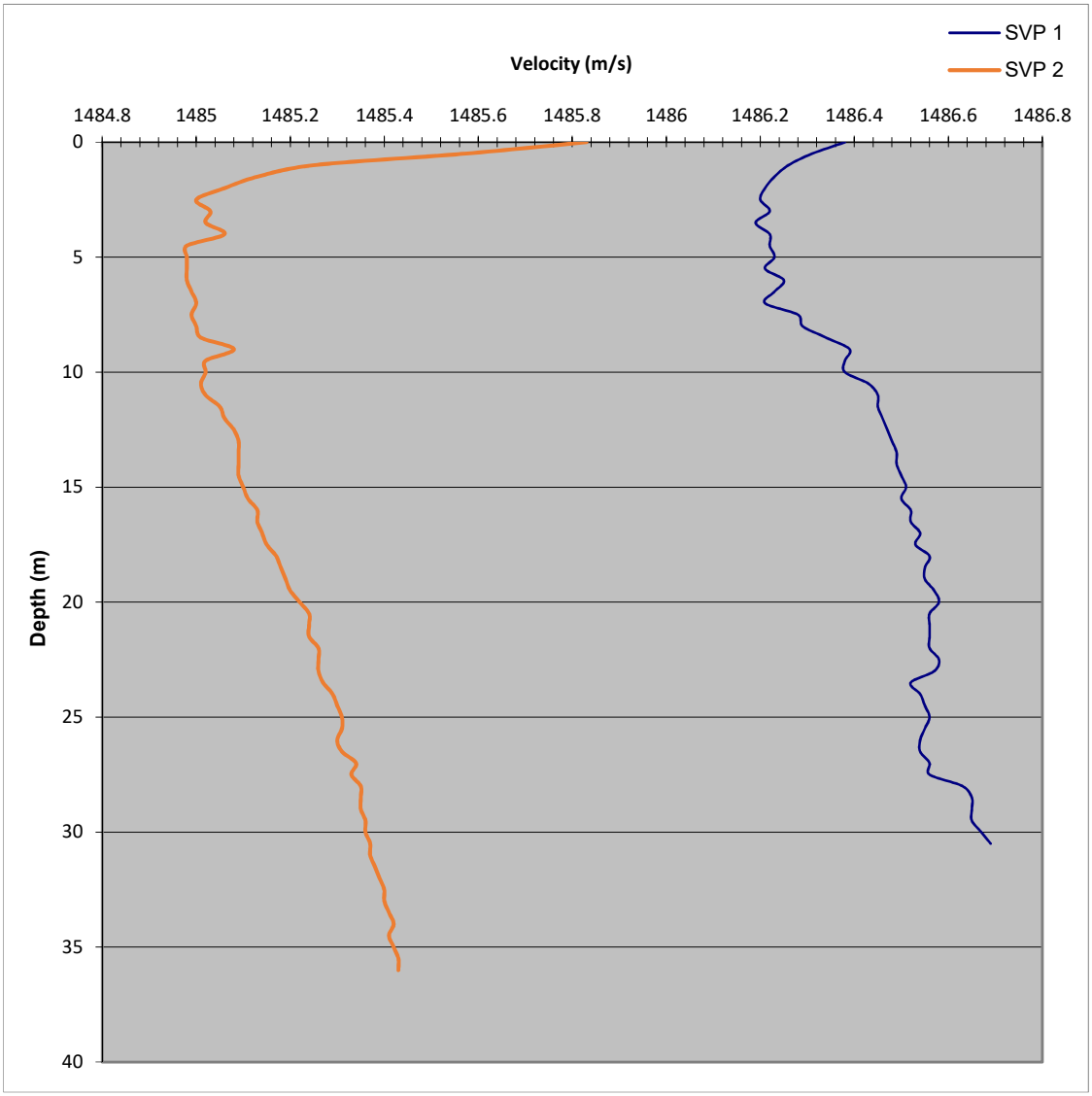
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	30 April 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;17;10N	53;15;24N
Longitude	4;41;44W	4;42;31W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1486.45	1485.21
Minimum	1486.19	1484.98
Maximum	1486.69	1485.83
Count	62.00	73.00



Mean Velocity - SVP 1 = **1486.5 m/s**

Mean Velocity - SVP 2 = **1485.2 m/s**

Difference = **1.2 m/s**

Calculated: *GP*

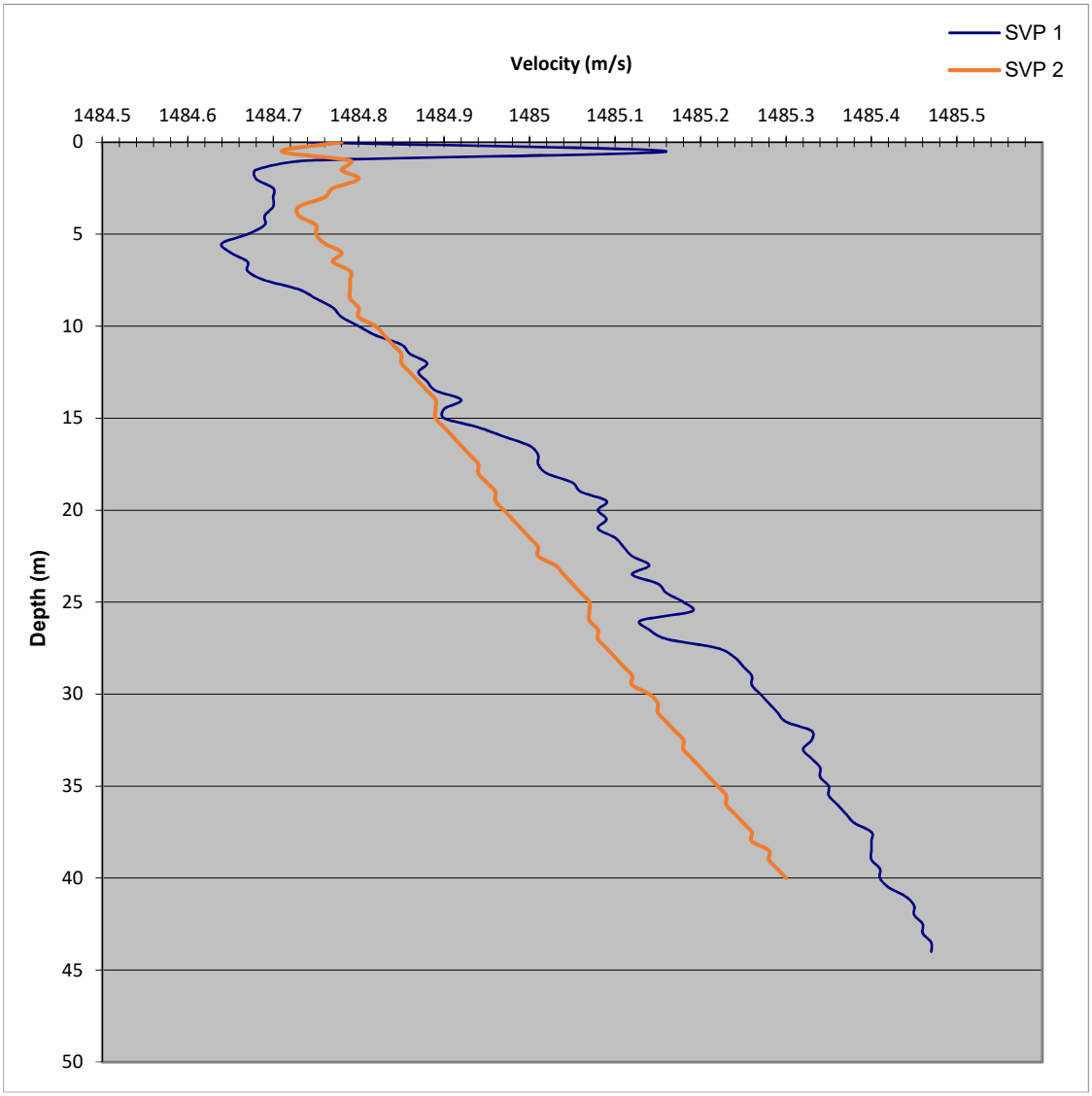
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	01 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;15;13N	53;20;38N
Longitude	4;46;12W	4;41;51W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1485.08	1484.99
Minimum	1484.64	1484.71
Maximum	1485.47	1485.30
Count	89.00	81.00



Mean Velocity - SVP 1 = **1485.1 m/s**

Mean Velocity - SVP 2 = **1485.0 m/s**

Difference = **0.1 m/s**

Calculated: *GP*

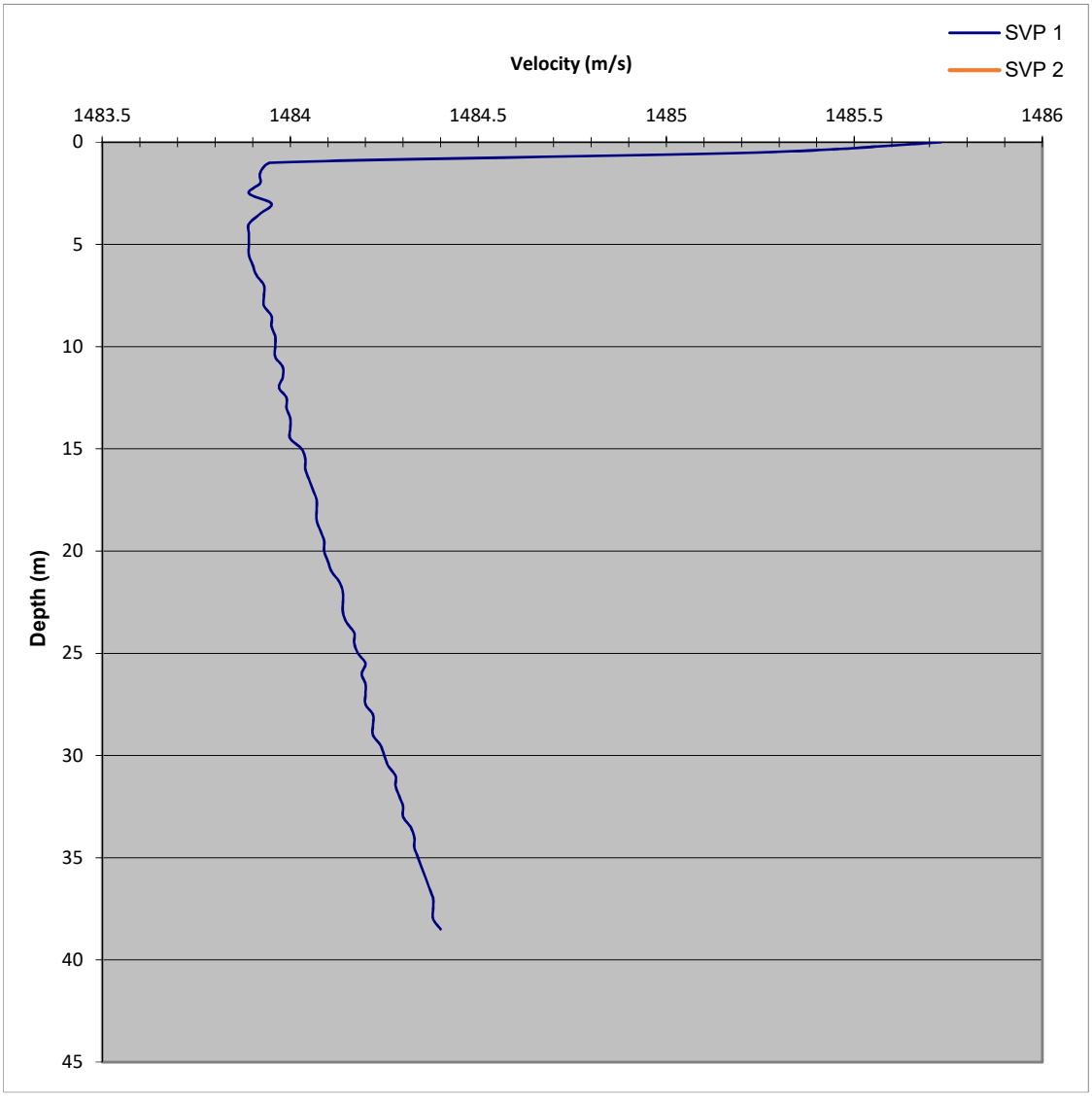
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	03 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;21;13N	
Longitude	4;42;17W	

Summary Statistics	SVP 1	SVP 2
Time	07:19	
Mean	1484.14	
Minimum	1483.89	
Maximum	1485.73	
Count	78.00	



Mean Velocity - SVP 1 = **1484.1** **m/s**

Mean Velocity - SVP 2 = **m/s**

Difference = **1484.1** **m/s**

Calculated: *GP*

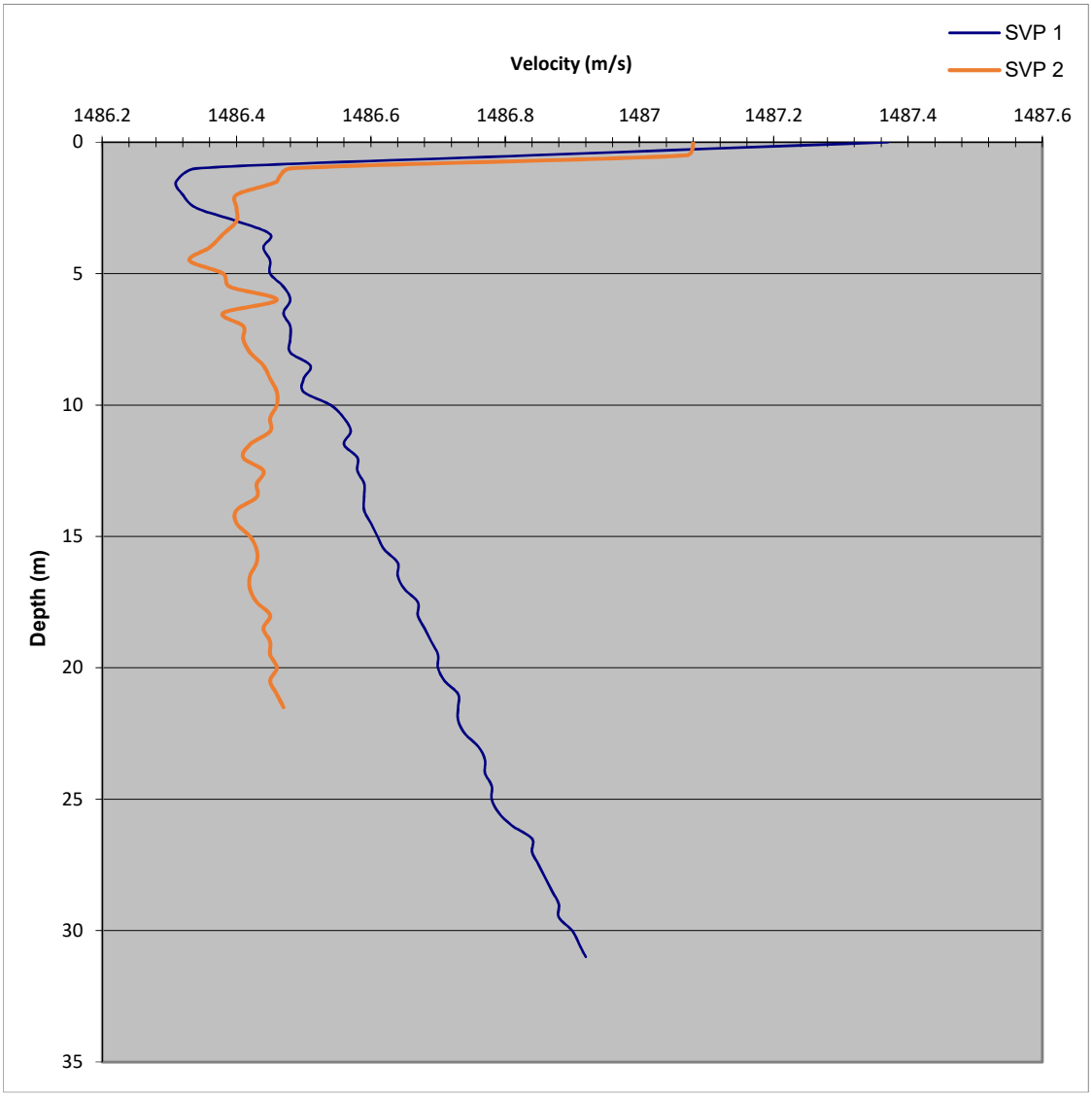
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	04 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;15;16N	53;18;36N
Longitude	4;41;09W	4;42;05W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1486.65	1486.46
Minimum	1486.31	1486.33
Maximum	1487.37	1487.08
Count	63.00	44.00



Mean Velocity - SVP 1 = 1486.7 m/s

Mean Velocity - SVP 2 = 1486.5 m/s

Difference = 0.2 m/s

Calculated: *GP*

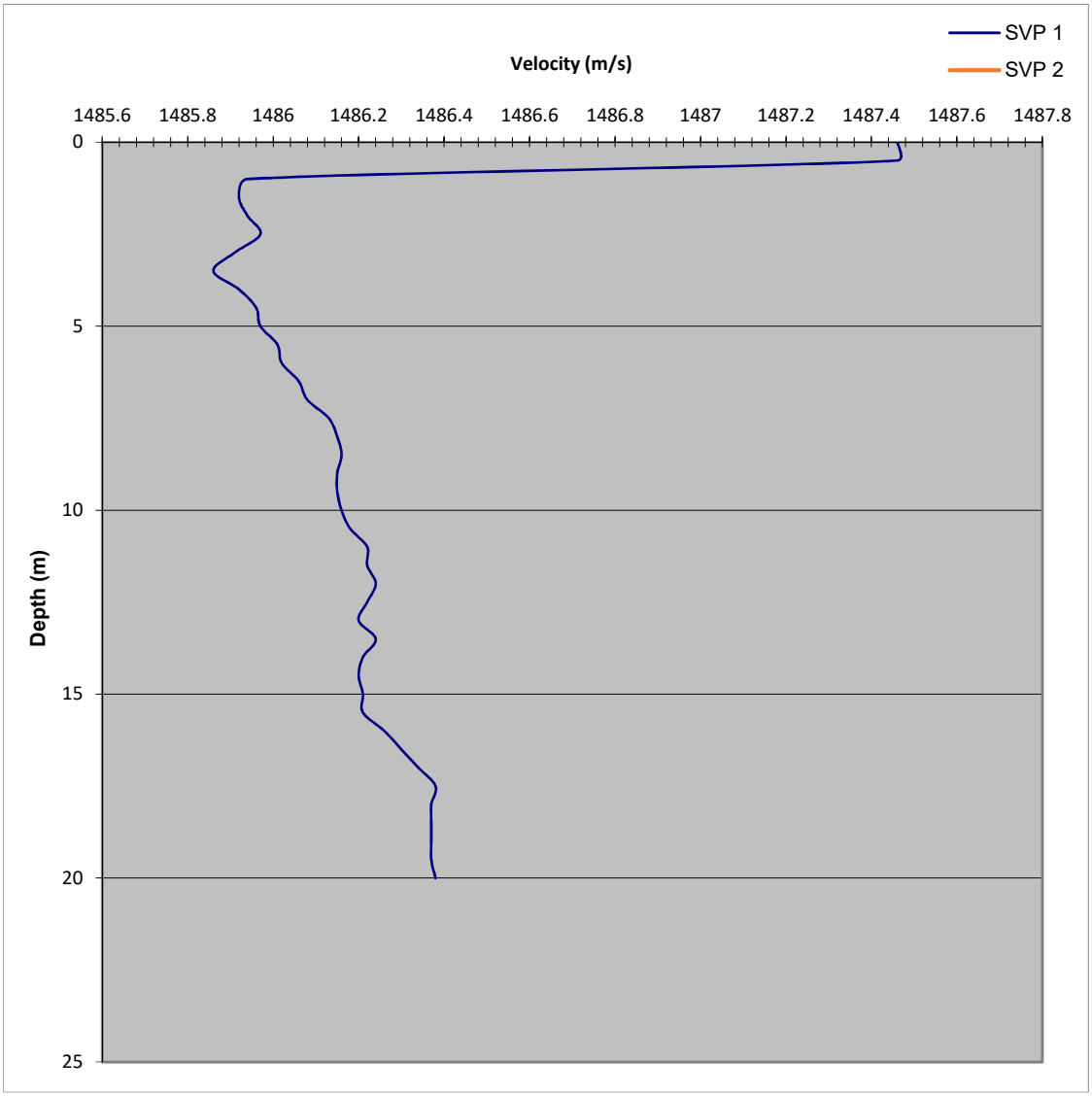
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	05 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;19;32N	
Longitude	4;40;21W	

Summary Statistics	SVP 1	SVP 2
Time	07:19	
Mean	1486.22	
Minimum	1485.86	
Maximum	1487.46	
Count	41.00	



Mean Velocity - SVP 1 = **1486.2** **m/s**

Mean Velocity - SVP 2 = **m/s**

Difference = **1486.2** **m/s**

Calculated: *GP*

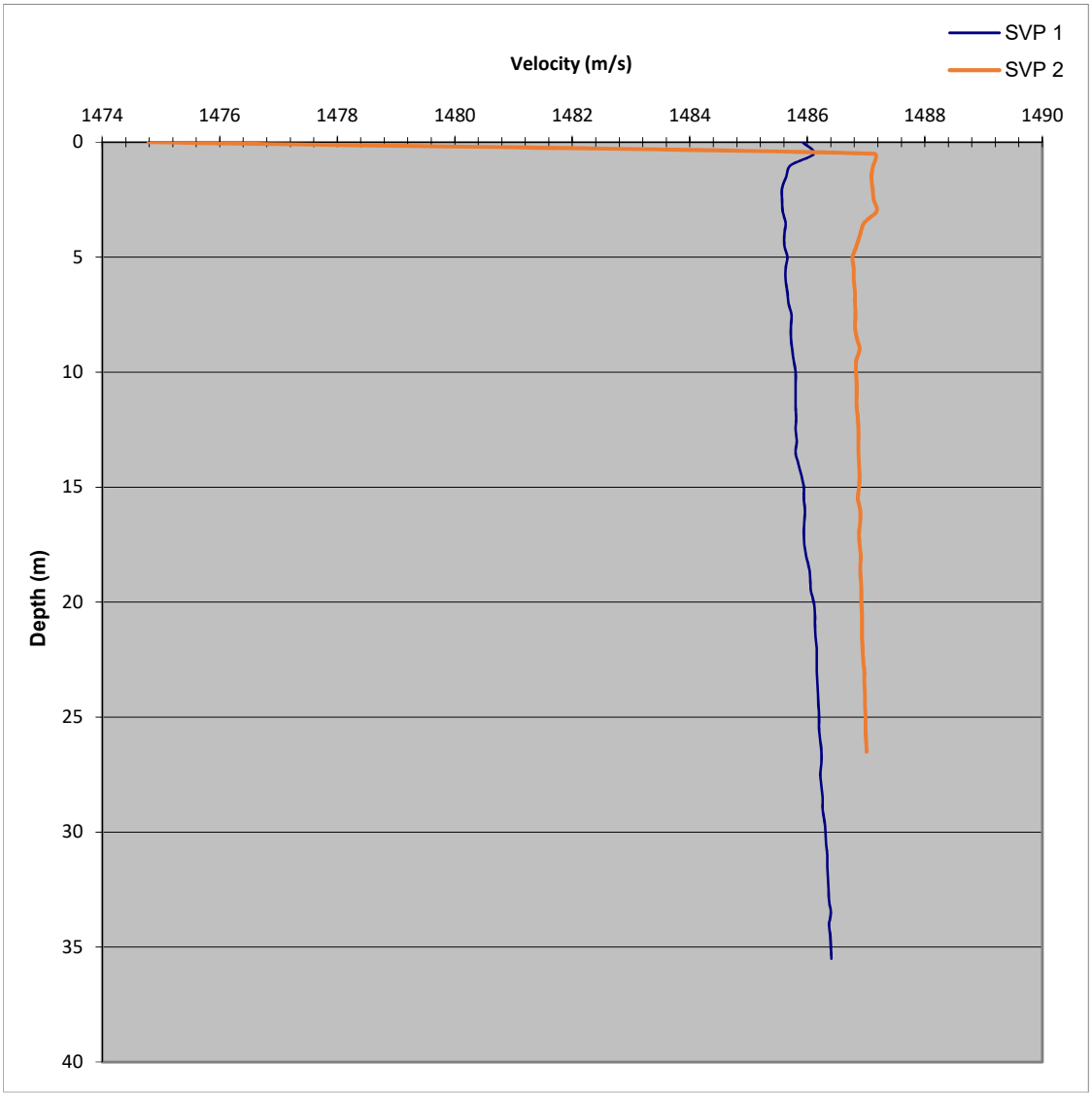
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	06 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;37N	53;19;34N
Longitude	4;41;18W	4;41;32W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1486.00	1486.69
Minimum	1485.57	1474.79
Maximum	1486.41	1487.18
Count	72.00	54.00



Mean Velocity - SVP 1 = **1486.0 m/s**

Mean Velocity - SVP 2 = **1486.7 m/s**

Difference = **-0.7 m/s**

Calculated: *GP*

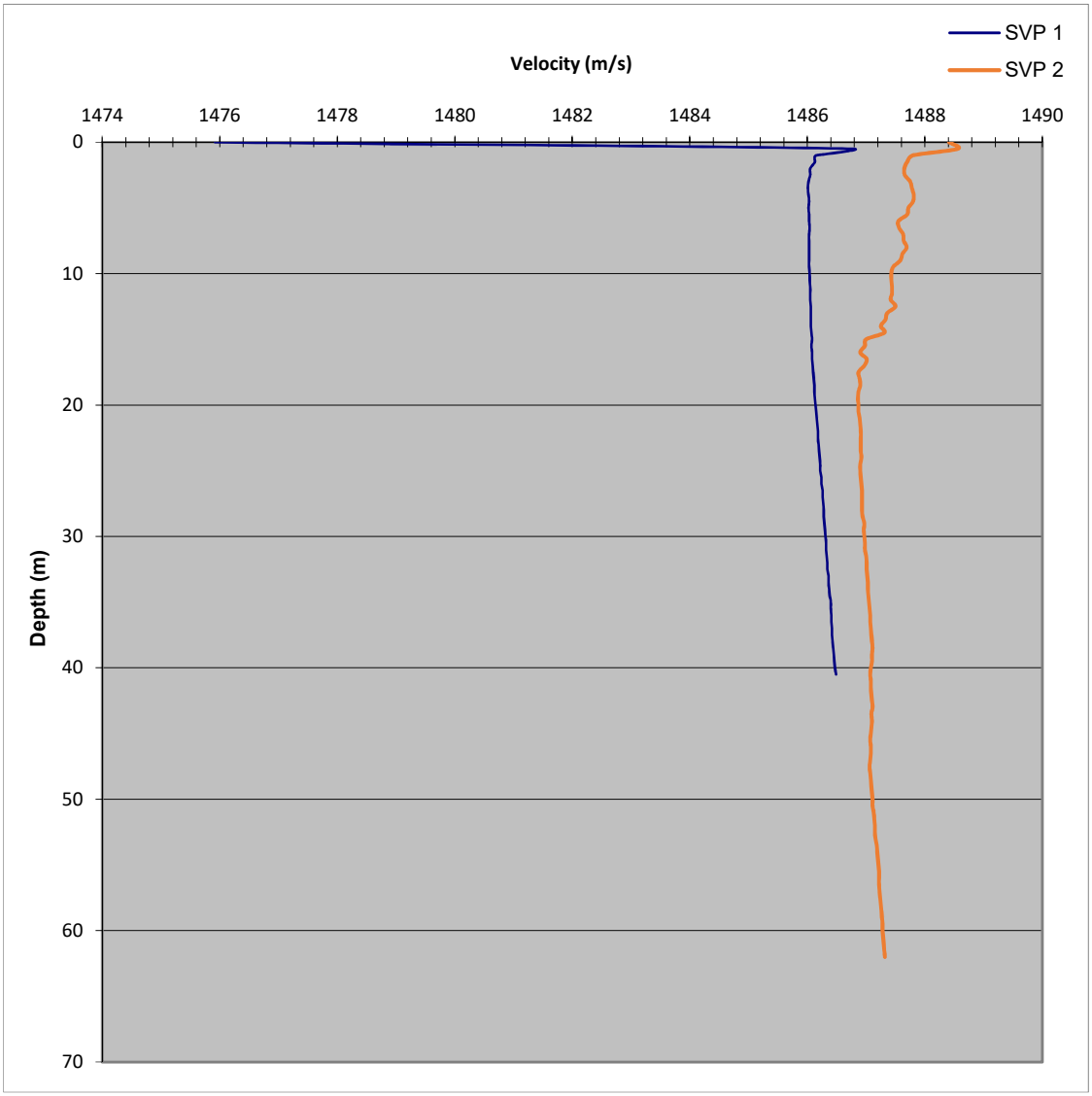
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	07 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;42N	53;20;38N
Longitude	4;43;48W	4;45;34W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1486.07	1487.20
Minimum	1475.92	1486.86
Maximum	1486.76	1488.56
Count	82.00	125.00



Mean Velocity - SVP 1 = **1486.1 m/s**

Mean Velocity - SVP 2 = **1487.2 m/s**

Difference = **-1.1 m/s**

Calculated: *GP*

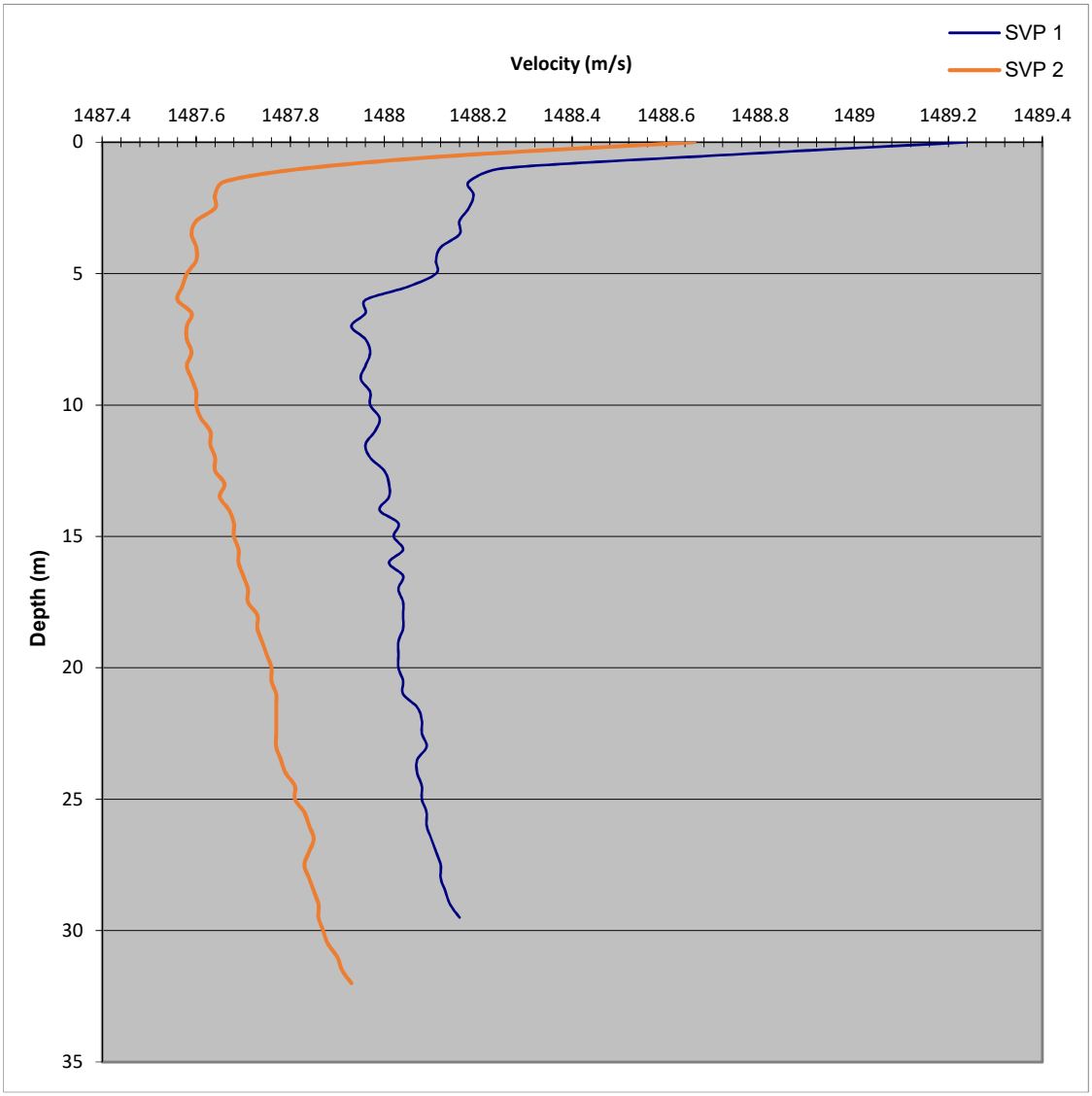
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	08 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;04N	53;19;54N
Longitude	4;40;04W	4;40;41W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1488.09	1487.74
Minimum	1487.93	1487.56
Maximum	1489.24	1488.66
Count	60.00	65.00



Mean Velocity - SVP 1 = **1488.1 m/s**

Mean Velocity - SVP 2 = **1487.7 m/s**

Difference = **0.3 m/s**

Calculated: *GP*

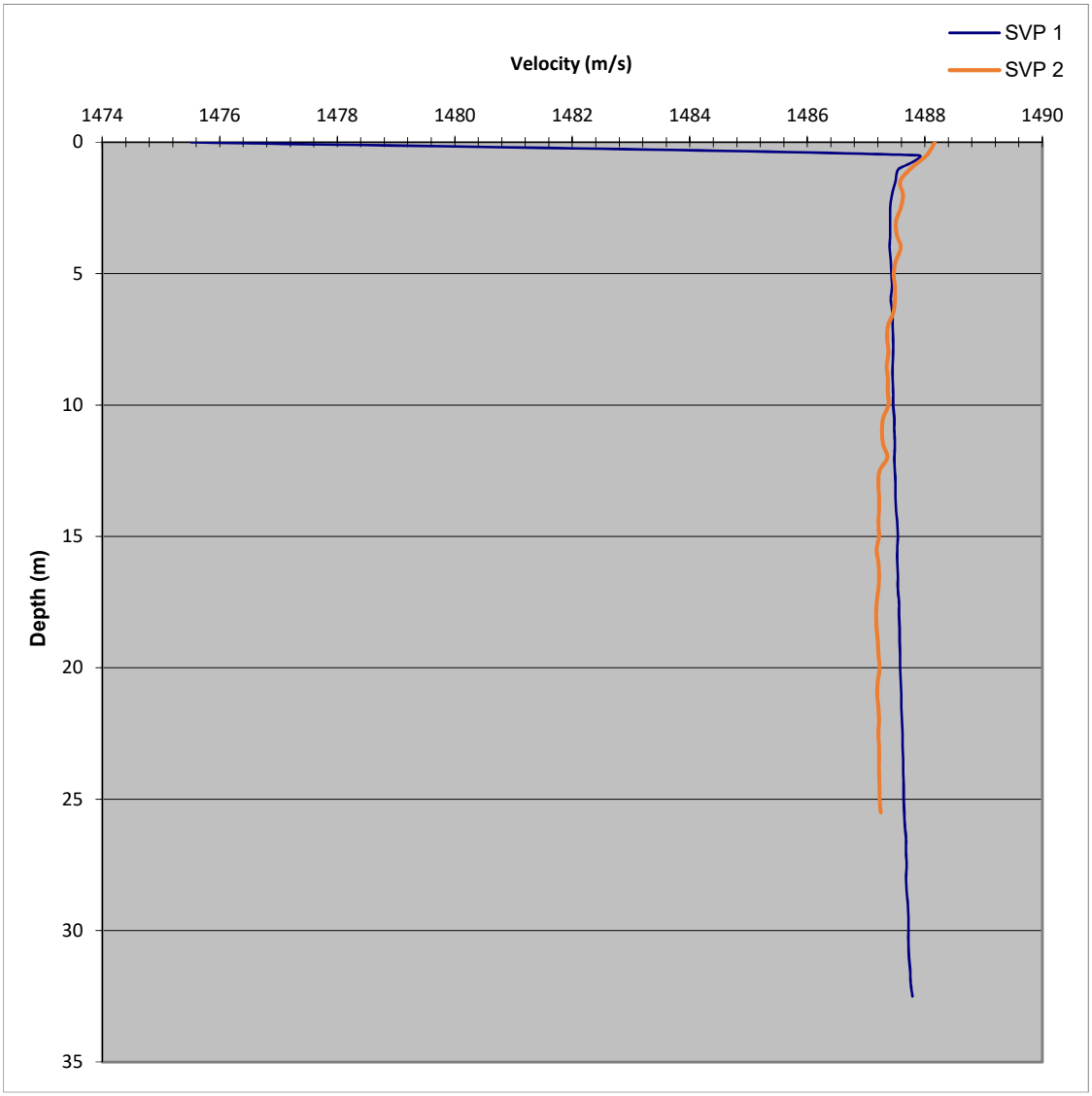
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	09 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;53N	53;19;38N
Longitude	4;40;48W	4;40;36W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1487.38	1487.35
Minimum	1475.51	1487.17
Maximum	1487.88	1488.17
Count	66.00	52.00



Mean Velocity - SVP 1 = **1487.4** **m/s**

Mean Velocity - SVP 2 = **1487.4** **m/s**

Difference = **0.0** **m/s**

Calculated: *GP*

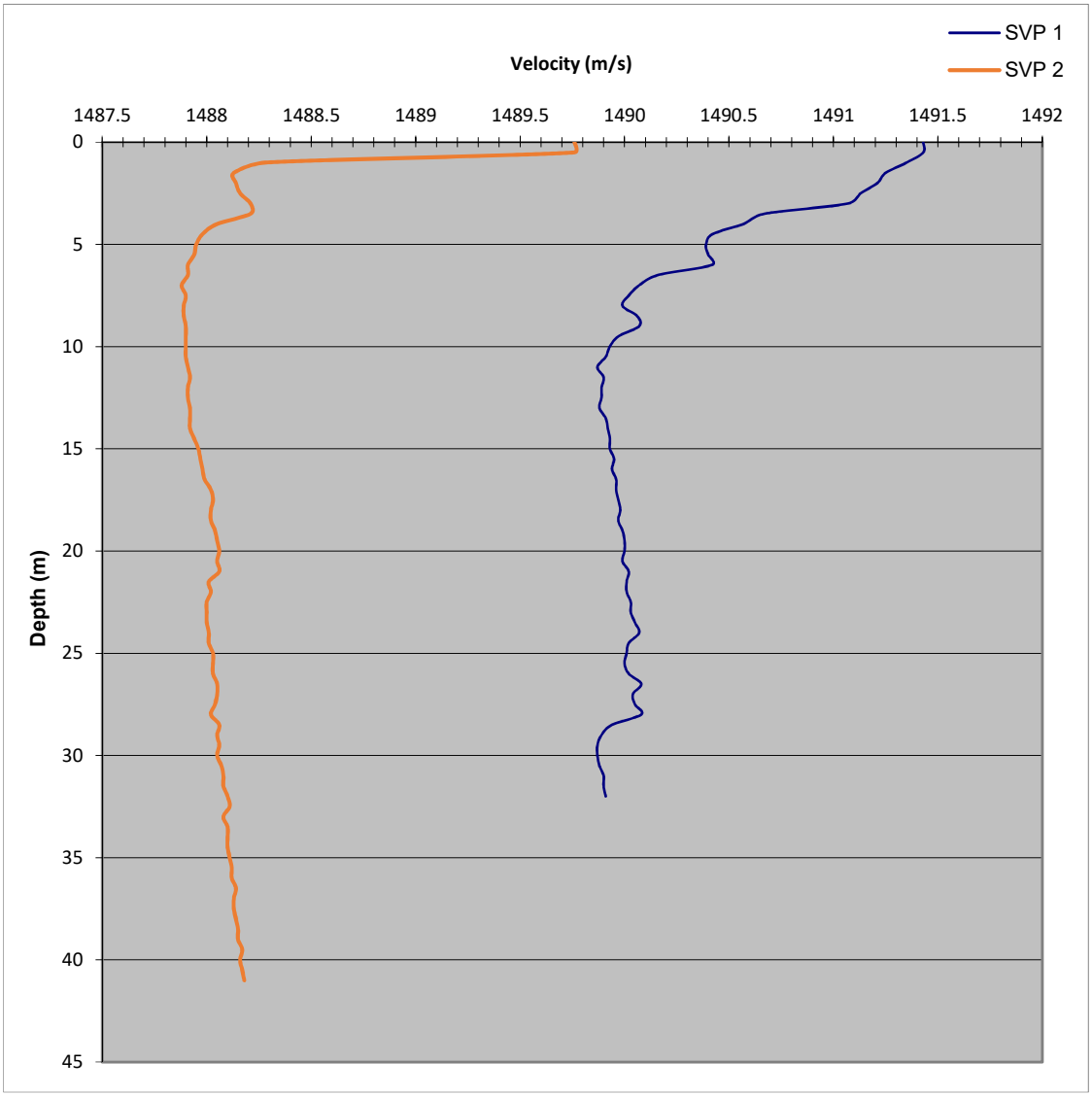
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	12 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;16;02N	53;14;52N
Longitude	4;40;04W	4;42;25W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1490.16	1488.08
Minimum	1489.87	1487.88
Maximum	1491.43	1489.76
Count	65.00	83.00



Mean Velocity - SVP 1 = **1490.2 m/s**

Mean Velocity - SVP 2 = **1488.1 m/s**

Difference = **2.1 m/s**

Calculated: *GP*

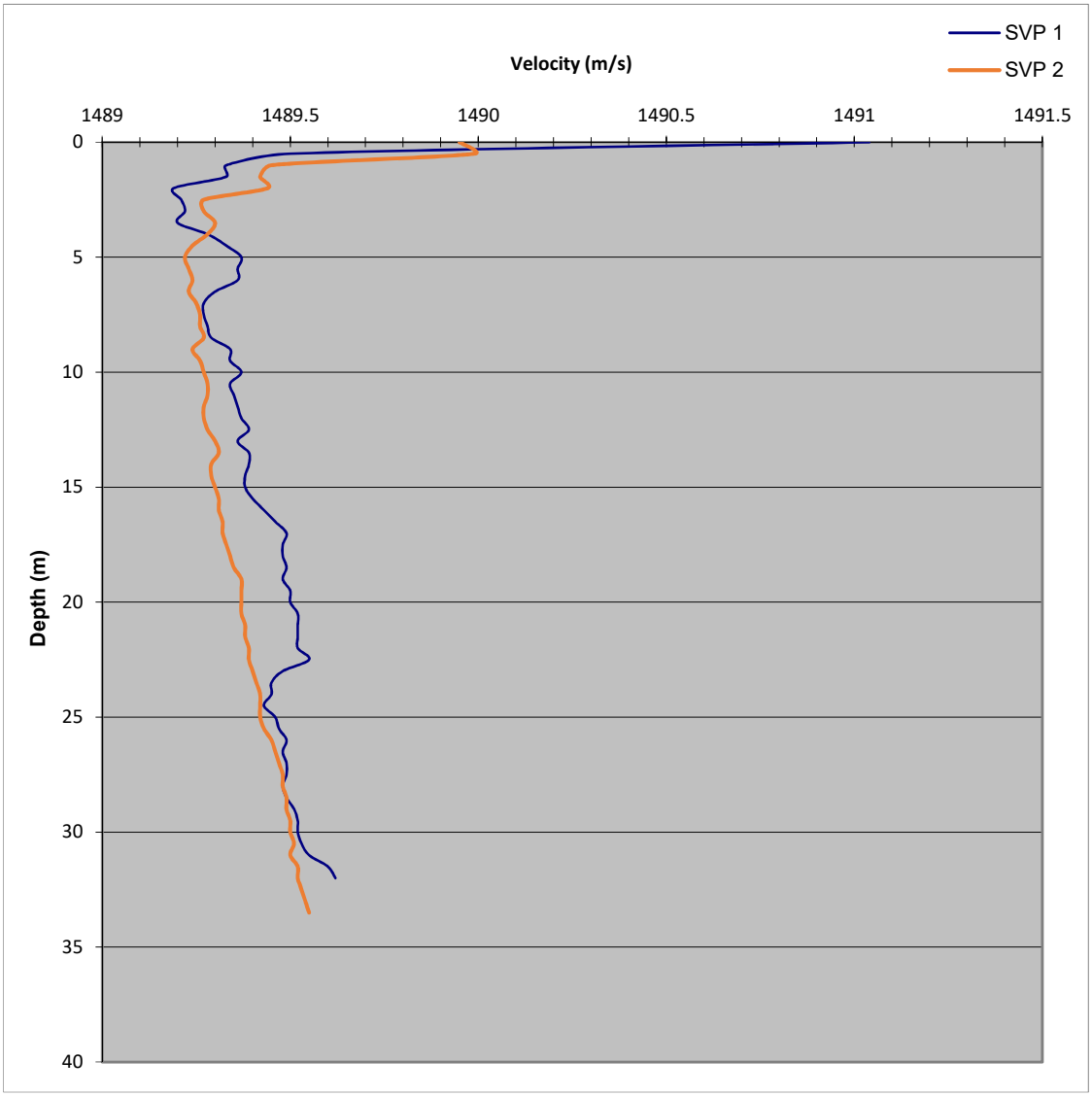
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	13 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;19;59N	53;20;41N
Longitude	4;40;13W	4;40;34W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1489.44	1489.38
Minimum	1489.19	1489.22
Maximum	1491.04	1489.99
Count	65.00	68.00



Mean Velocity - SVP 1 = **1489.4** **m/s**

Mean Velocity - SVP 2 = **1489.4** **m/s**

Difference = **0.1** **m/s**

Calculated: *GP*

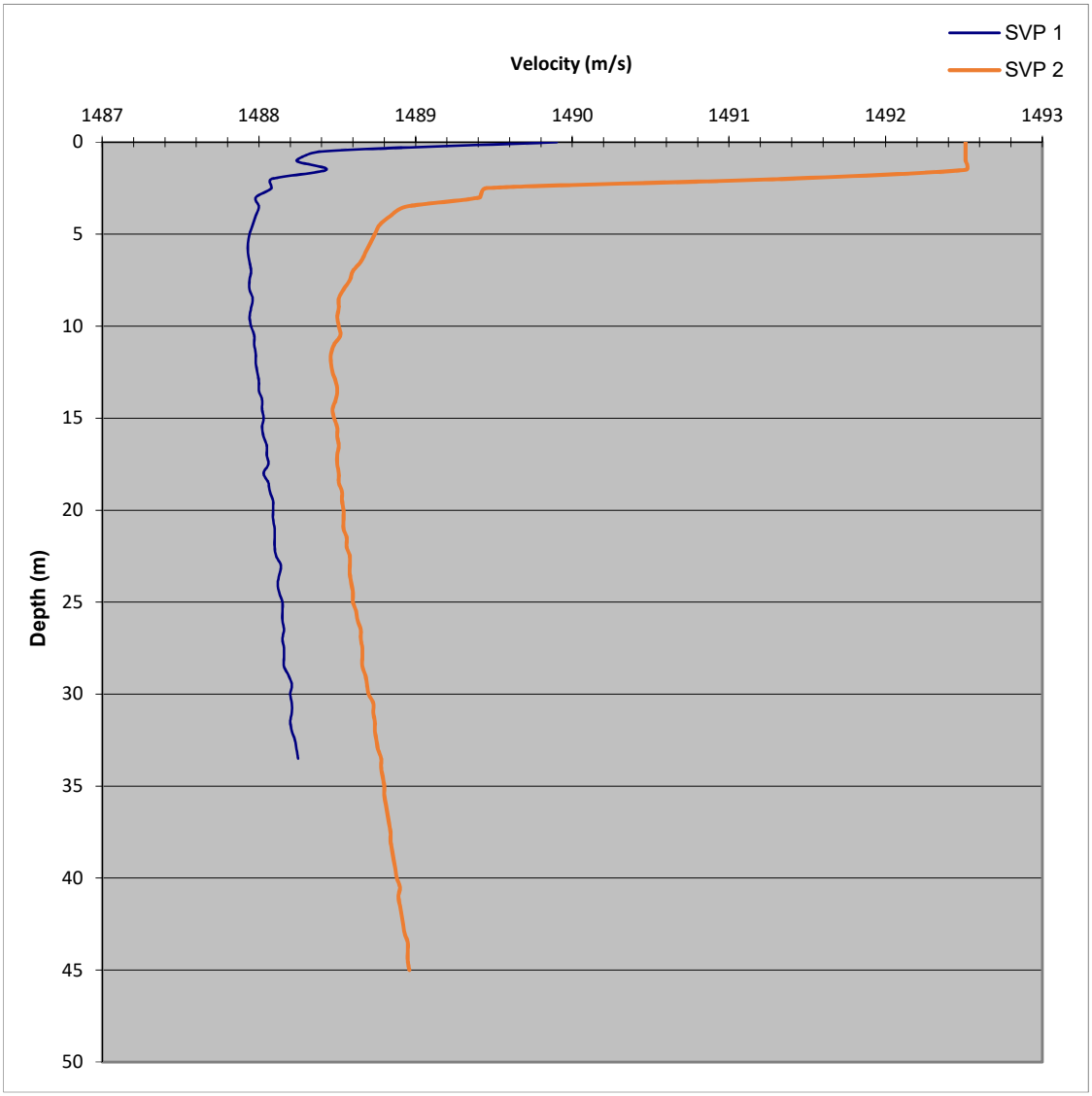
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	14 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;50N	53;15;13N
Longitude	4;42;29W	4;46;46W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1488.11	1488.89
Minimum	1487.93	1488.46
Maximum	1489.90	1492.51
Count	68.00	91.00



Mean Velocity - SVP 1 = **1488.1 m/s**

Mean Velocity - SVP 2 = **1488.9 m/s**

Difference = **-0.8 m/s**

Calculated: *GP*

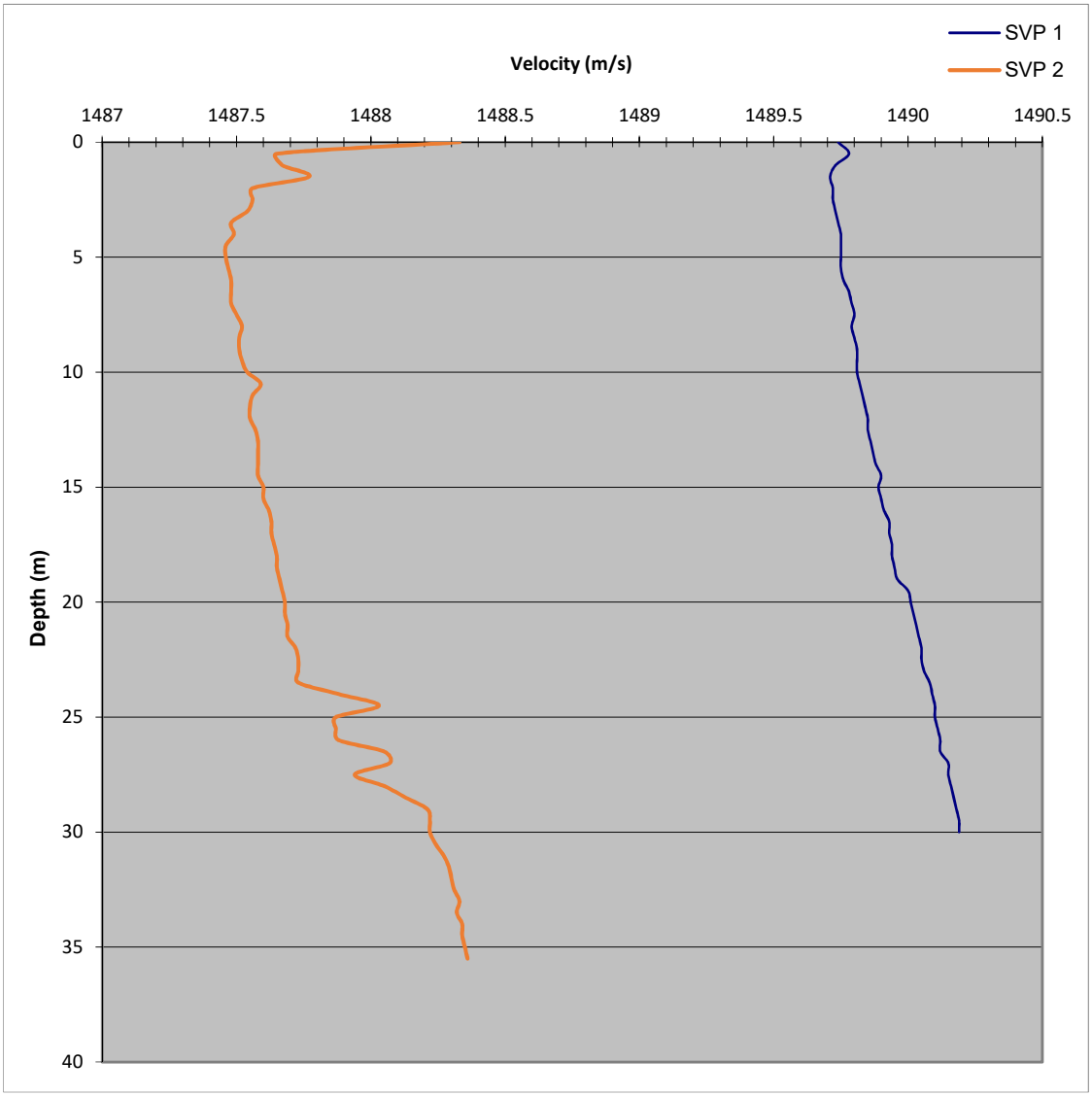
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	15 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;18;59N	53;20;24N
Longitude	4;41;46W	4;42;47W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1489.92	1487.79
Minimum	1489.71	1487.46
Maximum	1490.19	1488.36
Count	61.00	72.00



Mean Velocity - SVP 1 = **1489.9** **m/s**

Mean Velocity - SVP 2 = **1487.8** **m/s**

Difference = **2.1** **m/s**

Calculated: *GP*

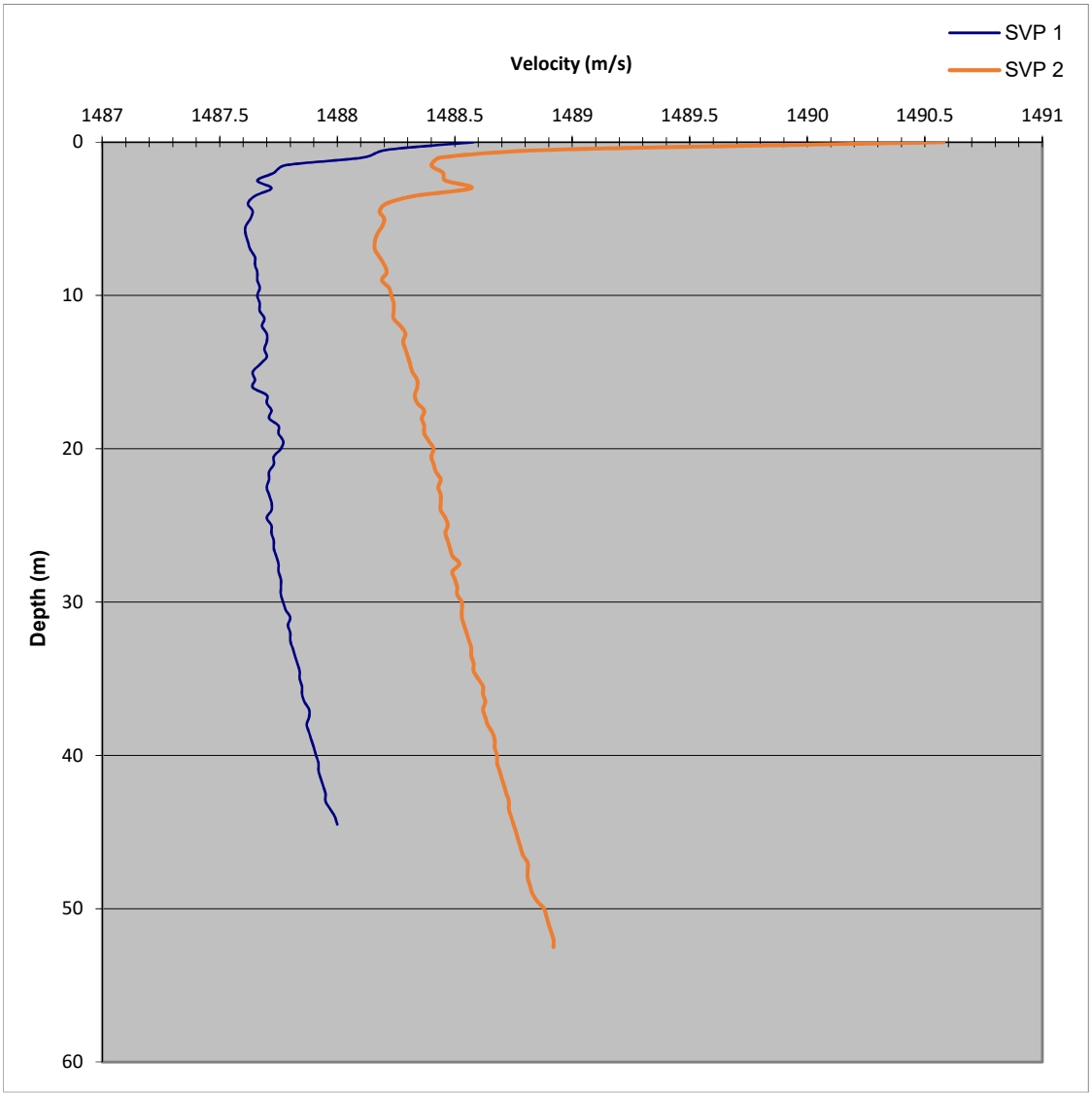
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	17 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;43N	53;15;36N
Longitude	4;44;06W	4;46;49W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1487.78	1488.53
Minimum	1487.61	1488.16
Maximum	1488.58	1490.58
Count	90.00	106.00



Mean Velocity - SVP 1 = **1487.8 m/s**

Mean Velocity - SVP 2 = **1488.5 m/s**

Difference = **-0.8 m/s**

Calculated: *GP*

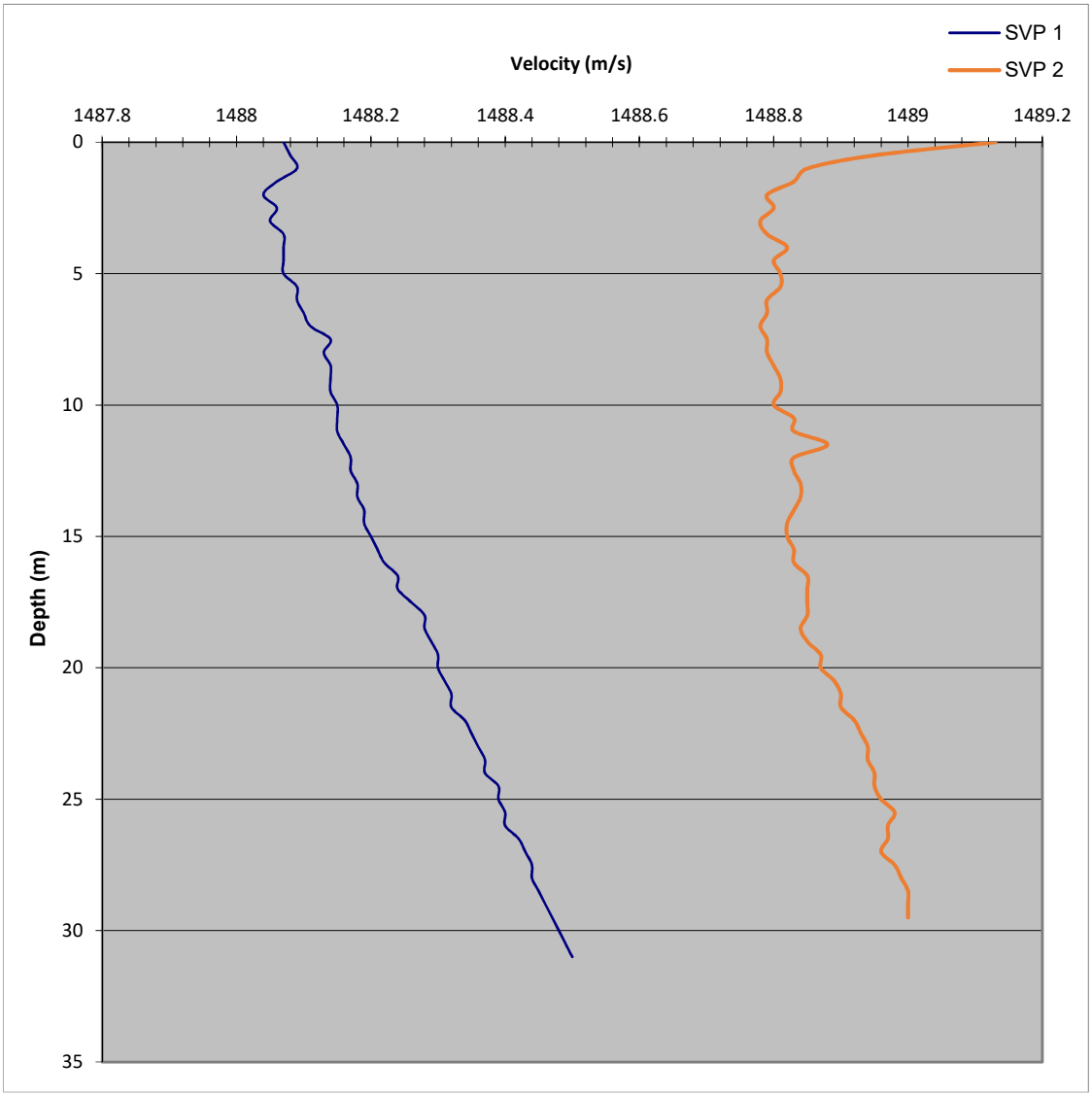
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	18 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;46N	53;20;31N
Longitude	4;40;58W	4;40;46W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1488.24	1488.87
Minimum	1488.04	1488.78
Maximum	1488.50	1489.13
Count	63.00	60.00



Mean Velocity - SVP 1 = **1488.2 m/s**

Mean Velocity - SVP 2 = **1488.9 m/s**

Difference = **-0.6 m/s**

Calculated: *GP*

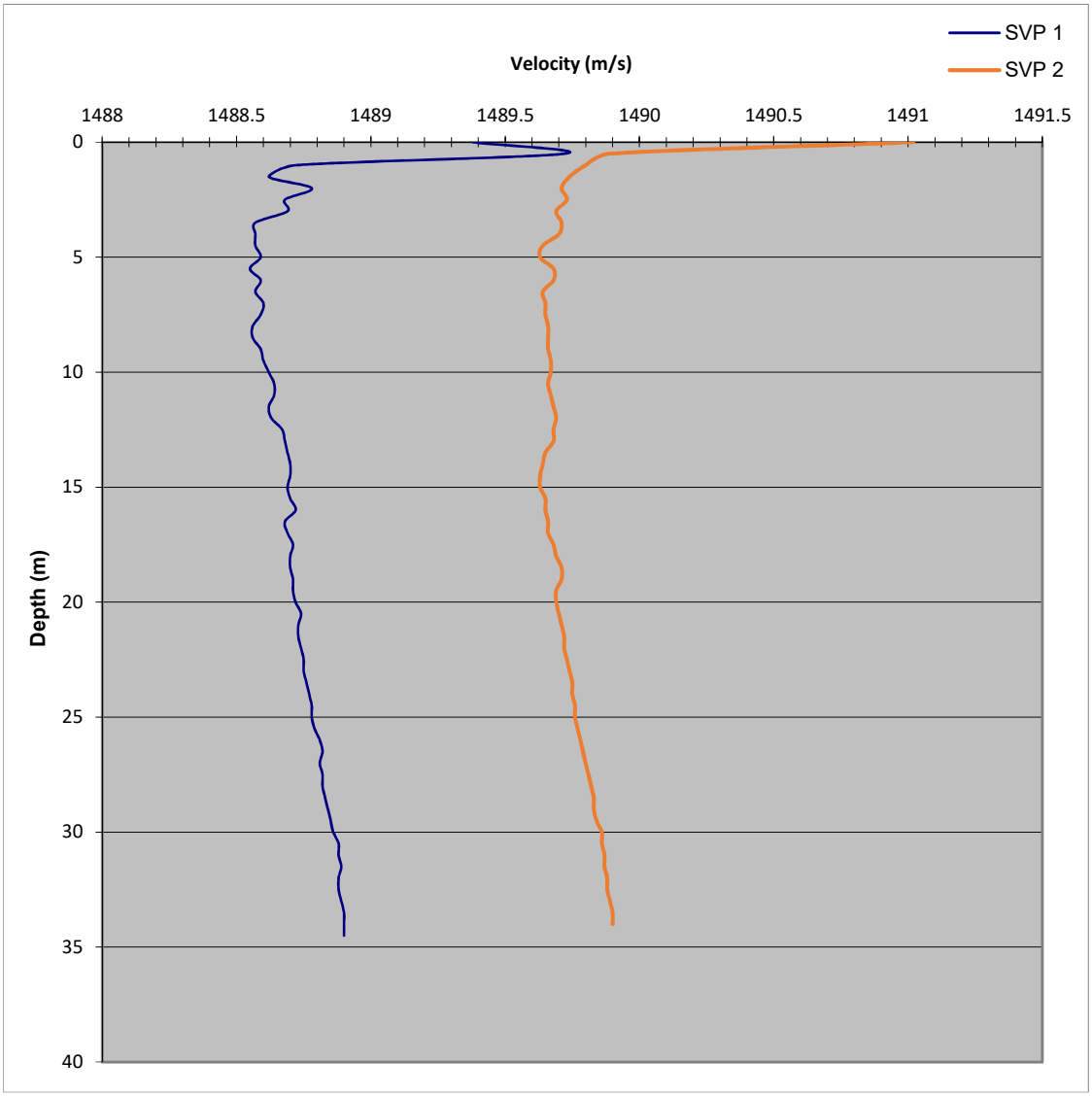
Sound Velocity Profile

PARTRAC

Client:	Mentor Môn	Date:	18 May 2018
Job Number:	P1830	Location:	West of Holy Island
Job Description:	MDZ Hydrographic & Geophysical Survey		
Vessel:	Norse		
Probe type:	SVP Serial No. 63615		
Serial No.	63615		

	SVP 1	SVP 2
Latitude	53;20;38N	53;19;39N
Longitude	4;41;43W	4;41;36W

Summary Statistics	SVP 1	SVP 2
Time	07:19	17:33
Mean	1488.75	1489.75
Minimum	1488.55	1489.63
Maximum	1489.72	1491.02
Count	70.00	69.00



Mean Velocity - SVP 1 = **1488.7 m/s**

Mean Velocity - SVP 2 = **1489.8 m/s**

Difference = **-1.0 m/s**

Calculated: *GP*

APPENDIX 4 – MOBILISATION REPORT

Marine Geophysical Surveys for the Morlais Demo Zone (MDZ)

P1830

Mobilisation Report

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DOCUMENT CONTROL

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V01	Minor format changes and update to Final

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Phil Durrant		x	
Holders of controlled copies will automatically be provided with subsequent approved versions of this document when they become available.			

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Abbreviations

AUV	Autonomous Underwater Vehicle
CD	Chart Datum
CPS	Cable Protection System
CTV	Crew Transfer Vessel
dGPS	Differential Global Positioning System
DTM	Digital Terrain Model
DVL	Doppler Velocity Log
ETRS	European Terrestrial Reference System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IAC	Inter Array Cable
IHO	International Hydrographic Organisation
INS	Inertial Navigation System
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LAT	Lowest Astronomical Tide
MBES	Multi-Beam Echo Sounder
MRU	Motion Reference Unit
MSL	Mean Sea Level
OD	Ordnance Datum
OSP	Offshore Substation
OWF	Offshore Wind Farm
QC	Quality Control
RAMS	Risk Assessed Method Statement
RTCM	Radio Technical Commission for Maritime Services
RTK	Real Time Kinematic
SBAS	Satellite-based augmentation systems
SD	Standard Deviation
THU	Total Horizontal Uncertainty
TVU	Total Vertical Uncertainty
USBL	Ultra-Short Baseline (underwater positioning)
UTM	Universal Transverse Mercator
VME	Vessel Mounted Echo sounder
VORF	Vertical Offshore Reference Frame
WGS	World Geodetic System
WTG	Wind Turbine Generator

1. INTRODUCTION

This mobilisation report covers the mobilisation of the survey equipment on the Survey Vessel Norse for the Morlais Geophysical Survey campaign. The mobilisation was carried out in Holyhead between the 17th and 21st of April, with the dynamic calibrations being carried out in Holyhead Bay.

2. VESSEL

Partrac mobilised a local MCA category 2 coded workboat for this campaign. “MV Norse” based in and operated from Holyhead, Anglesey, is a 23.3 m “Schottel” survey vessel, with a 60mile operating limit. Offering a fast transit speed, of over 13 knots, and the capability to work consistently at slow speeds the vessel provided an ideal platform for survey at this site. The vessel operated on a nominal 12-hour quayside to quayside working basis from her home port.

Figure 1 Survey Vessel "Norse"

Built	Schottel, Holland 1983 - Rebuilt and re-engined 2010
Classification	Bureau Veritas1 - Hull - Mach. Special Service 'Coastal Area' UK MCA Workboat Code of Practice - Category 2 - up to 60 miles from safe haven.
Dimensions	LOA 23.3m Beam 5.1m Depth 2.9m Draft aft 1.4m
Main Engines	2 x Scania 430 BHP Engines, total 860 BHP, @ 2,200 RPM, each driving twin open propellers through twin disc reverse reduction gearboxes.
Speed	13 knots
Fuel Capacity	5,000 litres
Navigation Aids	Kelvin Hughes RSR 1000 sea radar with electronic chart display, Nucleus 5000R river radar, GPS compass, echo sounder, Fluxgate compass, Navtex receiver, D/F, 3 x VHF radios including GMDSS set, telephone, searchlight.
Accommodation	For four crew
Included Equipment	2 x 16/20 kva silenced gensets, Electric bowthruster, domestic boiler, 24v - 220v invertors, spacious wheelhouse with dinette, survey desk, spacious interior below with large galley / messroom and seating, large clear aft deck. 660mm x 350mm, plus 350mm x 250mm moonpools.

Table 1 Norse vessel specifications

3. EQUIPMENT

3.1 Equipment List

The following equipment was mobilised aboard the vessel to complete the survey scope of works.

- Hydrofix NaviSTAK compact modular survey system comprising:
- Primary Positioning – "Trimble" SP855 GNSS RTK Rover with Marinestar G2+ corrections;
- Secondary Positioning & Vertical Control – "Applanix" WaveMaster GPS with real-time Marinestar G2+ corrections, logged for Post Processing Solution;
- Multibeam Echo Sounder – "Norbit" 0.9ºx0.9º, 512 beam system, with integrated INS and sound velocity correction;
- SVS – AML Mini SVS;
- Inertial Navigation System (INS) (Motion Reference) – "Applanix" WaveMaster INS;
- Navigational Software – "QPS" QINSy;
- Sound Velocity 1 – Valeport Swift SVP;
- Sound Velocity 2 – Valeport Monitor SVP (Spare);
- Edgetech – 100 & 400 kHz digital dual frequency (Inc. 1 spare towfish);
- Sheave block -- Hytech T-count;
- Winch – AGO CSW-7V;
- Magnetometer – "Geometrics" G882 caesium vapour (Inc. 1 spare towfish);
- Seismic – Applied Acoustics CSP-P300 (AAE AA200 Boomer plate & SES Hydrophone); and
- Sub-surface positioning – "Sonardyne" Scout ultra-short baseline (USBL).

3.2 Equipment Locations

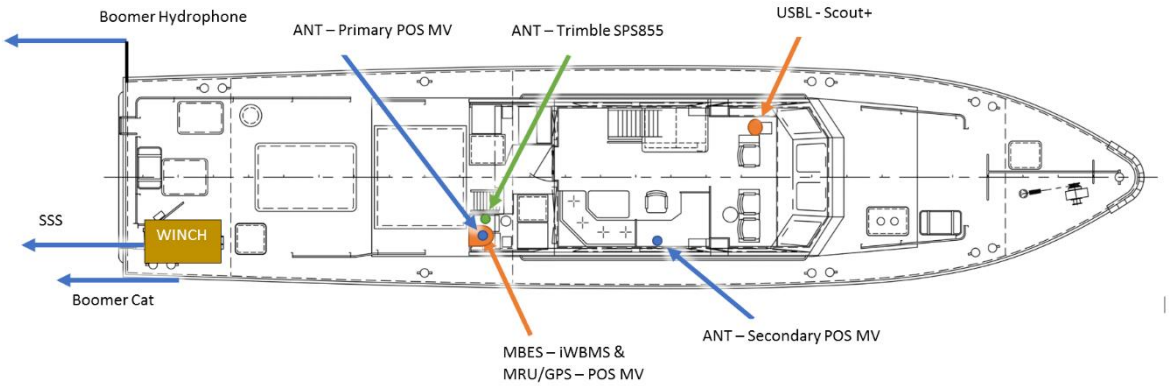


Figure 2 Position of survey equipment on the Norse

Figure 3 Position of GNSS antennas and iWBMS

4. OFFSETS

4.1 QINSy Offsets

	X	Y	Z	Notes
COG	0.000	0.000	0.000	Z = waterline
iWBMS	1.100	-0.122	-1.132	Sonar ref point
POS MV	1.100	-0.122	-1.132	Sonar ref point
USBL	-1.239	6.160	-1.480	Scout head
SSS Tow point	1.203	-7.960	0.000	Sheave wheel
Boomer Tow point	2.035	-6.880	0.000	STBD aft bollard
Trimble Primary Ant	0.694	0.046	5.250	

Table 2 QINSy offsets

4.2 iWBMS Offsets

	POS FWD	POS STB	POS Down
WBMS Ref. Point to IMU Ref. Point	0.248	0.000	0.079
WBMS Ref. Point to Measure Point	0.122	0.000	-0.078
Measure Point to Antenna Bottom	-0.005	0.000	-6.748
Antenna Bottom to Phase Centre			0.058
Primary to Secondary Antenna Baseline Vector	3.135	0.493	-0.046

Table 3 iWBMS & POS MV offsets

4.3 Sonardyne Scout Offsets

	X	Y	Z	Notes
COG	0.00	0.00	0.00	Z = waterline
USBL	-1.24	6.16	-1.48	
Trimble Primary Ant	0.69	0.05	5.25	

Table 4 Sonardyne Scout offsets

5. PROJECT GEODETICS

Both GNSS output an WGS84 position in geodetic coordinates to the navigation software, which projects to the Cartesian coordinate system of UTM30N using the following geodetic projection parameters:

	Value
Datum	World Geodetic System 1984
Spheroid	WGS84
Semi-major axis	6378137.000000
Semi-minor axis	6356752.314245
Inverse Flattening (I/F)	298.2572236
Projection	Universal Transverse Mercator
False Easting	500000 m
False Northing	0 m
Latitude of Origin	0°
Central Meridian	3° W
Central Scale Factor	0.9996
UTM Zone	30 North
Scale Factor on CM	0.9996
Units	Metres

Table 5 Project Geodetics

For this project, the UKHO Vertical Offshore Reference Frame (VORF) model is being used online in the acquisition software to apply a Datum separation to the GNSS antenna height to reduce the accurate height component of the GNSS solution to Chart Datum (CD) at the survey site. The separation between the Ellipsoidal height and CD at the centre of the site is 51.91 metres.

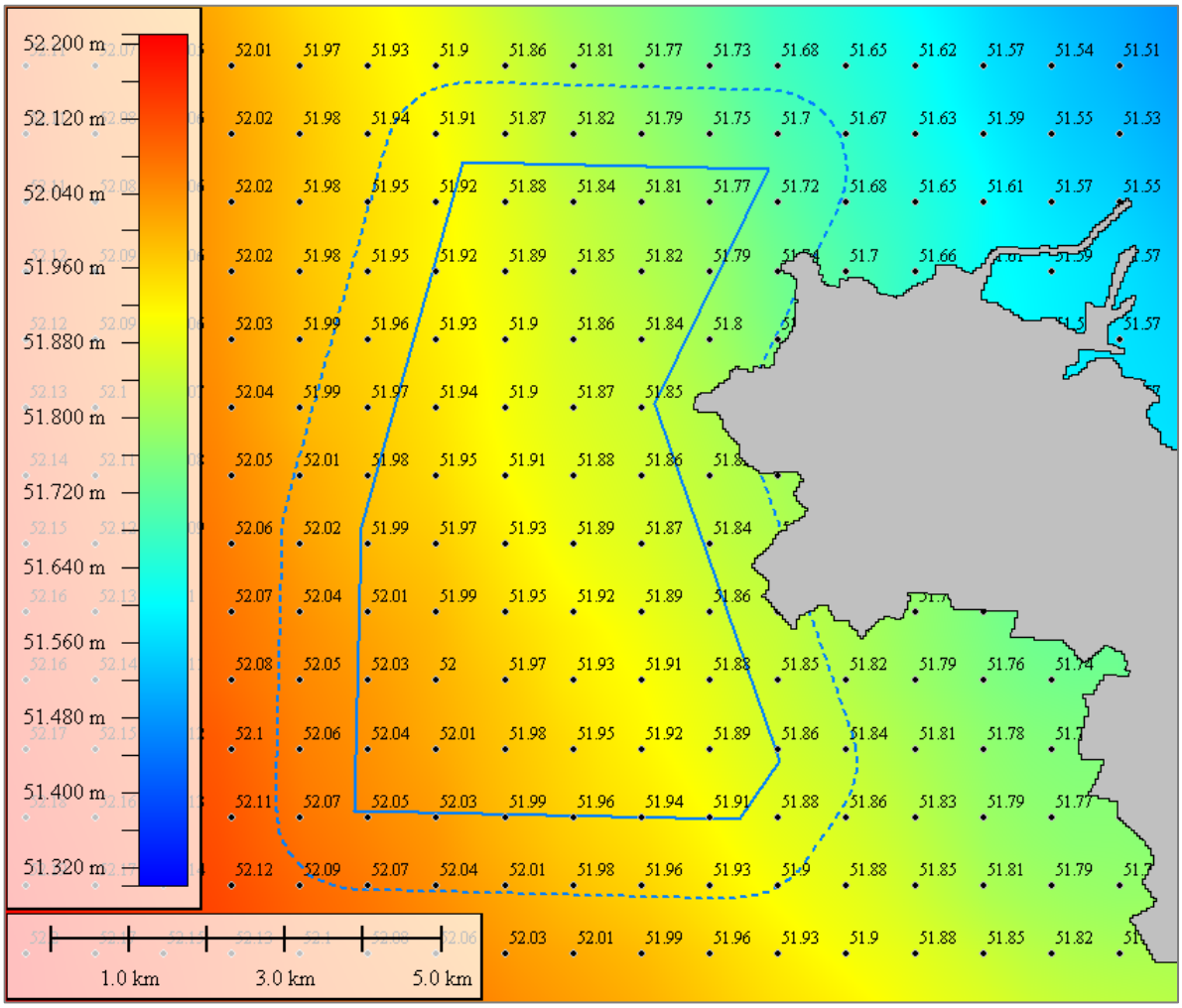


Figure 4 UKHO VORF model

6. ALONGSIDE VERIFICATIONS AND CALIBRATIONS

6.1 GNSS Verifications

6.1.1 Introduction

Primary GNSS system was verified over an OS passive station (Porth Eilian C1SH4793). However, a change in correction service was necessary as it was found that there was no GSM reception on site despite having a hi-gain GSM antenna on the wheelhouse roof. The corrections service was changed from Trimble VRS RTK (GSM) corrections to Fugro 'Marinestar G2' corrections (SBAS).

A second verification over the Holyhead H1SH2482 OS passive station was completed with the Marinestar corrections. The VRS corrections were used for the mobilisation and Marinestar G2 corrections were used for the survey operations.

6.1.2 GNSS Systems

Primary horizontal and vertical control was provided by a Trimble SPS855 GNSS receiver. The Trimble SPS855 GNSS, is a 440 channel receiver, capable of on-the-fly Real Time Gypsy (RTG) or Real Time Kinematic (RTK) ambiguity resolution on satellite carriers L1, L2, L2C and L5 as well as GLONASS and Galileo services.

The SPS855 was initially setup with Trimble VRS Now corrections, but was switched to Marinestar G2 corrections at the start of the survey operations, due to poor GSM reception in the survey area. Marinestar G2 RTG corrections were received via the SBAS service to provide a real time positional accuracy of up to 0.03 metres.

Secondary horizontal and vertical control was provided by an Applanix PosMV Wavemaster. This system provided position from the intergrated inertial measurement unit (IMU) which is aided by GNSS.

Raw GNSS observations were recorded to enable the data to be post processed within Applanix's PosPAC MMS to provide a Post Processed Kinematic (PPK) position solution to be applied to the data. The PPK solution would provide, if required, horizonal and vertical accuarices of 0.02 m and 0.03 m respectively.

Vessel heading and motion were also provided by the WaveMaster

6.1.3 GNSS Verification 1

The Trimble SPS855 GNSS system first underwent a static observation at the Ordnance Survey Passive Station "Porth Eilian C1SH4793" on 20th April 2018 over a 25-minute period (Figure 6). The Trimble SPS855 and QPS QINSy acquisition survey software were used for the verification.

Figure 5 Position verification at Porth Eilian C1SH4793

Figure 6 1st RTK GNSS verification Scatterplot (Porth Eilian C1SH4793)

	Easting	Northing	Height
Mean	414309.36	5918889.17	79.73
Passive Station	414309.35	5918889.16	79.71

Difference	0.01	0.01	0.02

Table 6 1st Positioning QC (Porth Eilian C1SH4793)

6.1.4 GNSS Verification 2

The Trimble SPS855 GNSS system underwent a second static observation at the Ordnance Survey Passive Station "Holyhead H1SH2482" on 25th April 2018 over a 30-minute period (Figure 6). The Trimble SPS855 and QPS QINSy acquisition survey software were used for the verification.

Figure 7 Position verification at Holyhead H1SH2482

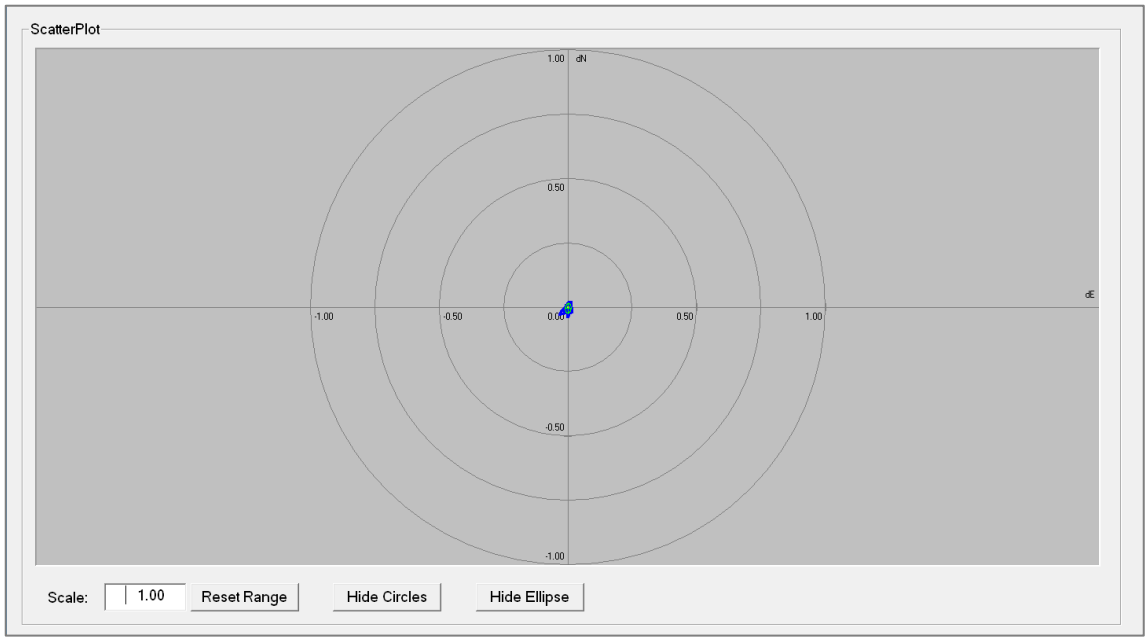
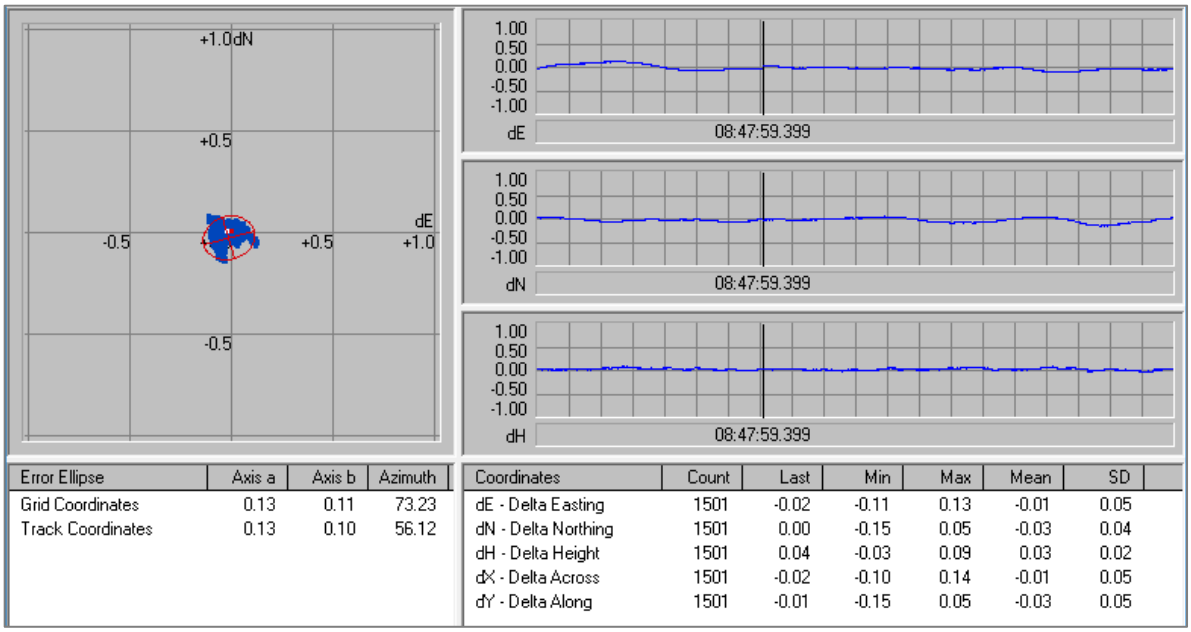


Figure 8 2nd RTG GNSS verification Scatterplot (Holyhead H1SH2482)

	Easting	Northing	Height
Mean	390629.24	5908360.20	90.86
Passive Station	390629.24	5908360.20	90.84
Difference	0.00	0.00	0.02

Table 7 2nd Positioning QC (Holyhead H1SH2482)

Following installation of the primary and secondary GNSS onboard the vessel, a comparison of the Applanix POS MV WaveMaster system was completed against the previously verified 'mobile' system. This check was completed with the vessel moored and stationary in harbour and demonstrated the POS MV WaveMaster position to be within acceptable limits (Figure 9).



Error Ellipse	Axis a	Axis b	Azimuth
Grid Coordinates	0.13	0.11	73.23
Track Coordinates	0.13	0.10	56.12

Coordinates	Count	Last	Min	Max	Mean	SD
dE - Delta Easting	1501	-0.02	-0.11	0.13	-0.01	0.05
dN - Delta Northing	1501	0.00	-0.15	0.05	-0.03	0.04
dH - Delta Height	1501	0.04	-0.03	0.09	0.03	0.02
dX - Delta Across	1501	-0.02	-0.10	0.14	-0.01	0.05
dY - Delta Along	1501	-0.01	-0.15	0.05	-0.03	0.05

Figure 9 Primary and Secondary GNSS system comparison verification

6.2 Heading Verification

Heading verifications were completed on the using the Trimble SPS855 & 555H, with “VRS Now” RTK corrections to confirm the vessel centreline heading. This verification was conducted after the completion of the GAMS calibration on the 19th April 2018 (See section 7.1).

One antenna was placed on the centreline of the bow and one on the stern. Both the Trimble heading, and the POS MV heading were recorded simultaneously for a period of 15 minutes and the C-O value was compared. The difference between the Trimble and POS MV was 0.06°.

Primary Trimble antenna on the bow

Secondary Trimble antenna on the stern

Figure 10 Trimble GNSS antennae positions during heading verification

Collecting Statistics... 00:15:27

	POS MV [Gyro Com	Gyro - SPS555H
Time:	13:46:32.653	13:46:32.462
Count:	46359	4638
Last:	213.59	213.52
Mean:	**212.91**	**212.85**
Sd:	1.12	1.12
Sd (95%):	2.19	2.19

Comparison Matrix

	POS MV [Gyro Com	Gyro - SPS555H
POS MV [Gyro Com		-0.06
Gyro - SPS555H	0.06	

Figure 11 Heading verification

7. DYNAMIC VERIFICATIONS AND CALIBRATIONS

7.1 GNSS Azimuth Measurement Subsystem (GAMS) Calibration

To confirm the measured baseline between the Applanix POS MV WaveMaster IMU and GNSS antennae, a GNSS Azimuth Measurement Subsystem (GAMS) calibration was completed in accordance with the manufacturer's procedure. The GAMS was run 3 times with VRS Now RTK corrections.

The GAMS calibration was carried out on the 19th April 2018, North of Holyhead, and the results were:

Measurement	Value
X (Fore/Aft)	3.135 m
Y (Port/Stb)	0.493 m
Z (Vertical)	-0.046 m

Table 8 GAMS calibration results.

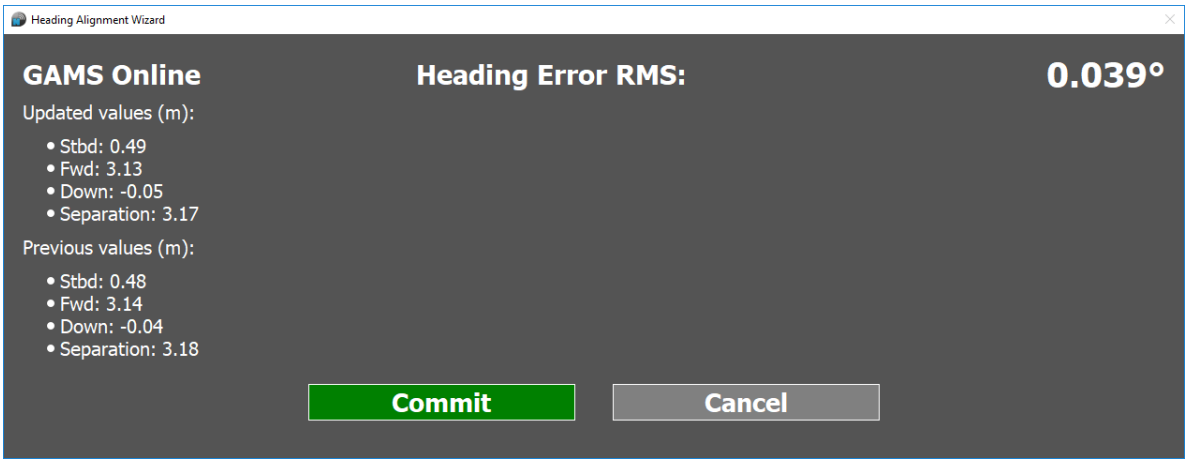
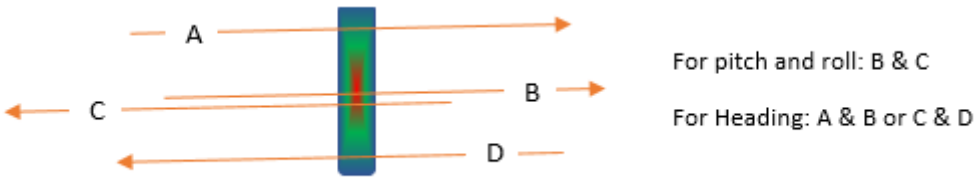


Figure 12 GAMS heading alignment results (3rd run)

7.2 Multibeam Echo Sounder Calibration

During the mobilisation, the echo sounder underwent an industry standard Patch Test over a wreck in Holyhead Bay. This involves running the following set of lines over an object with a distinct relief:



The Norbit iWBMS multibeam echo sounder was mounted on in a moonpool on the starboard side behind the wheelhouse. The iWBMS has an integrated Applanix Pos MV WaveMaster within the transducer head, which gives it robust repeatability and data quality

due to tight coupling with motion sensor and RTK GPS. The system was calibrated on 19th April 2018 (See Appendix 3). The results of the 19th April 2018 Calibration were:

Angle	Value
Roll	-0.22°
Pitch	-1.31°
Heading	-0.11°

Table 9 Multibeam calibration results.

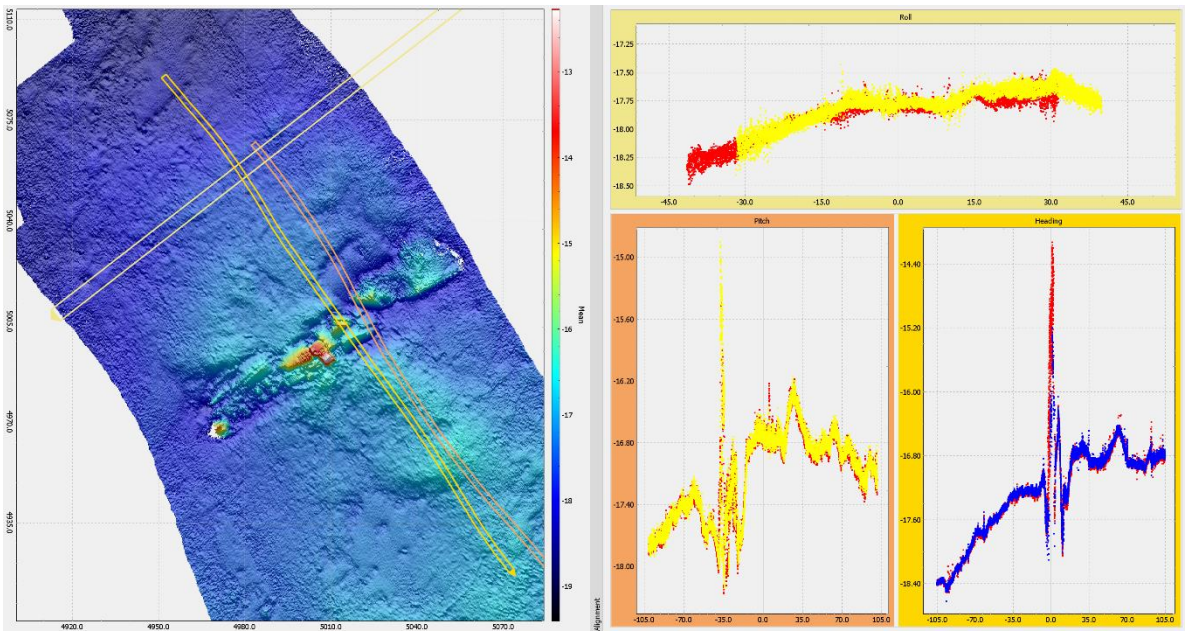


Figure 13 Bathymetry surface with calibration value results applied with profiles as indicated on the surface

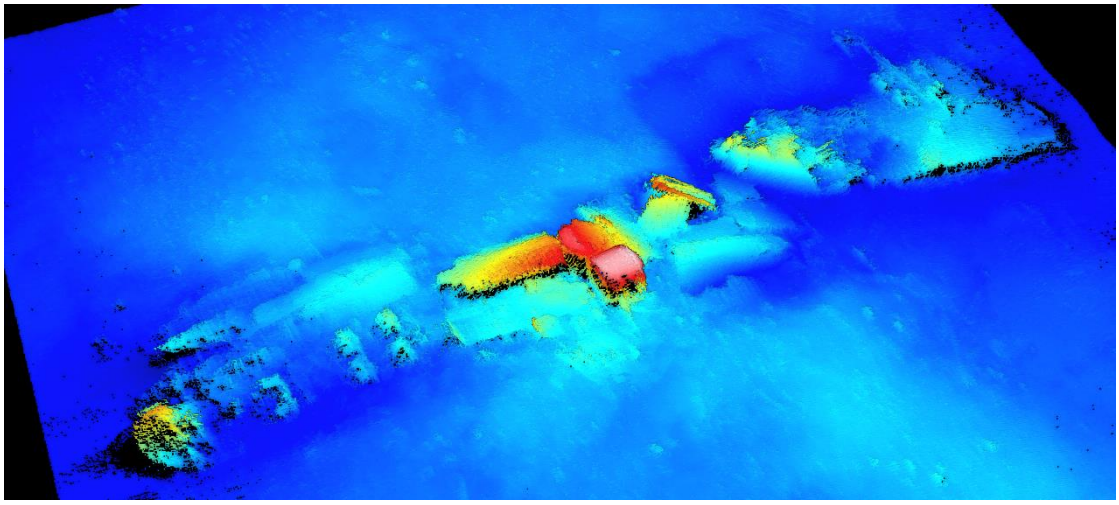


Figure 14 3D Bathymetry surface with calibration value results applied

7.2.1 SVS vs SVP comparison

SVS comparison with sound velocity profile taken during multibeam calibration is as follows:

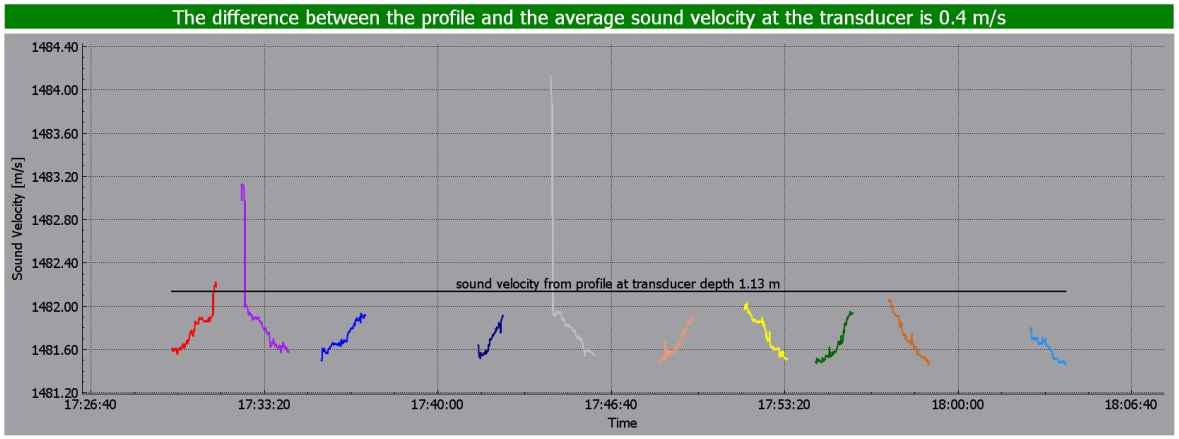


Figure 7. Sound Velocity Check (SVP vs SVS at transducer).

7.3 USBL Calibration

During the mobilisation, the Sonardyne Scout+ USBL was calibrated in accordance with standard industry practice. The calibration was completed in approximately 32 metres of water within Holyhead Bay on 21st April 2017.

Vessel motion and heading from the Applanix POS MV WaveMaster was interfaced into the Scout+. The results of the calibration were:

Angle	Value
Roll	-0.18°
Pitch	-2.00°
Heading	-4.03°

	Before CASIUS (distance)	After CASIUS (distance)	Before CASIUS (% depth)	After CASIUS (% depth)
39.4% Beacon Positions (1 sigma)	1.7m	0.4m	5.43	1.37
50.0% Beacon Positions (CEP)	2.1m	0.5m	6.53	1.61
63.2% Beacon Positions (1 Drms)	2.4m	0.6m	7.55	1.89
86.5% Beacon Positions (2 sigma)	3.7m	0.9m	11.59	2.77
98.2% Beacon Positions (2 Drms)	7.5m	2.2m	23.35	6.74

Table 10 USBL calibration results.

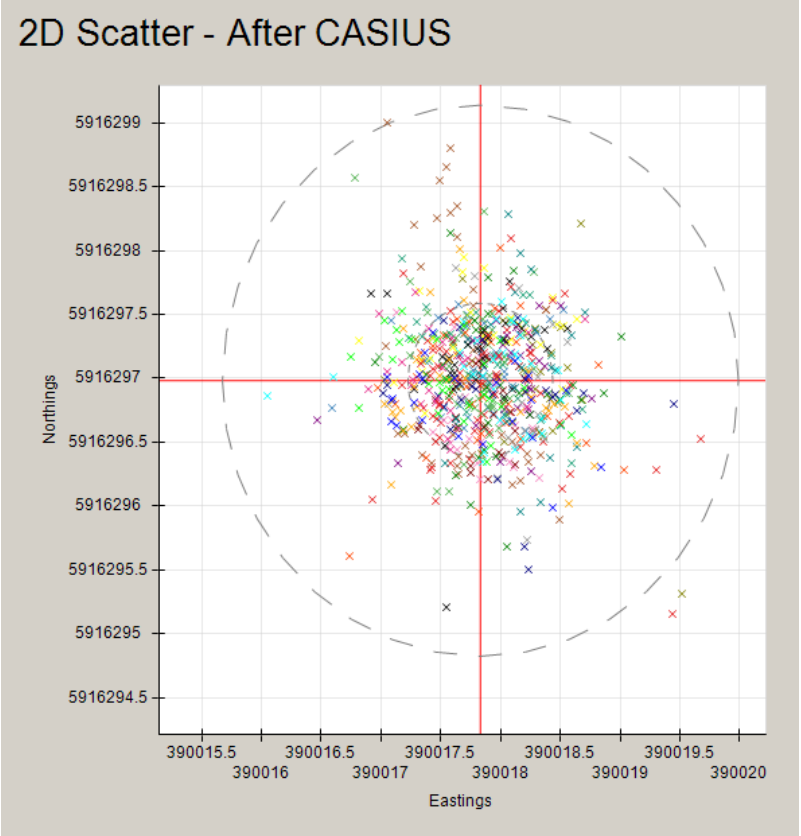


Figure 15 Scatterplot after USBL calibration

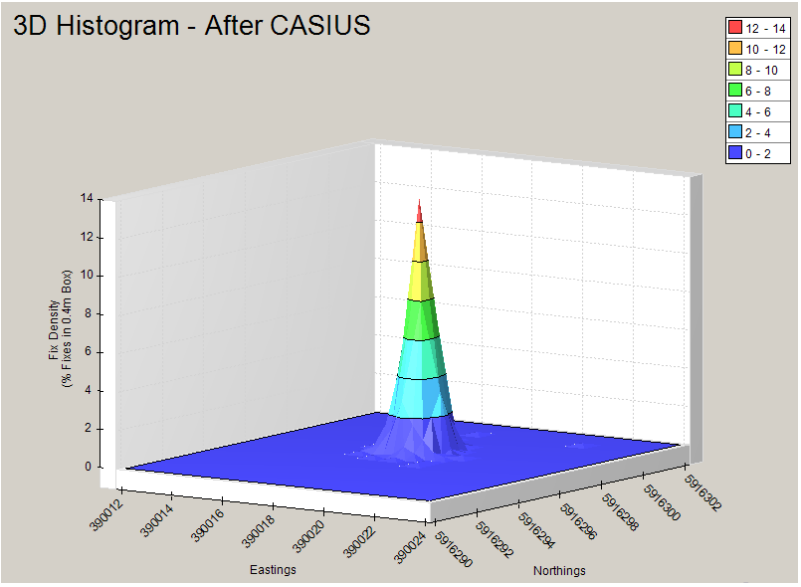


Figure 16 3D histogram after USBL calibration

7.4 Geophysical Data Examples

7.4.1 Side Scan Sonar Data Example

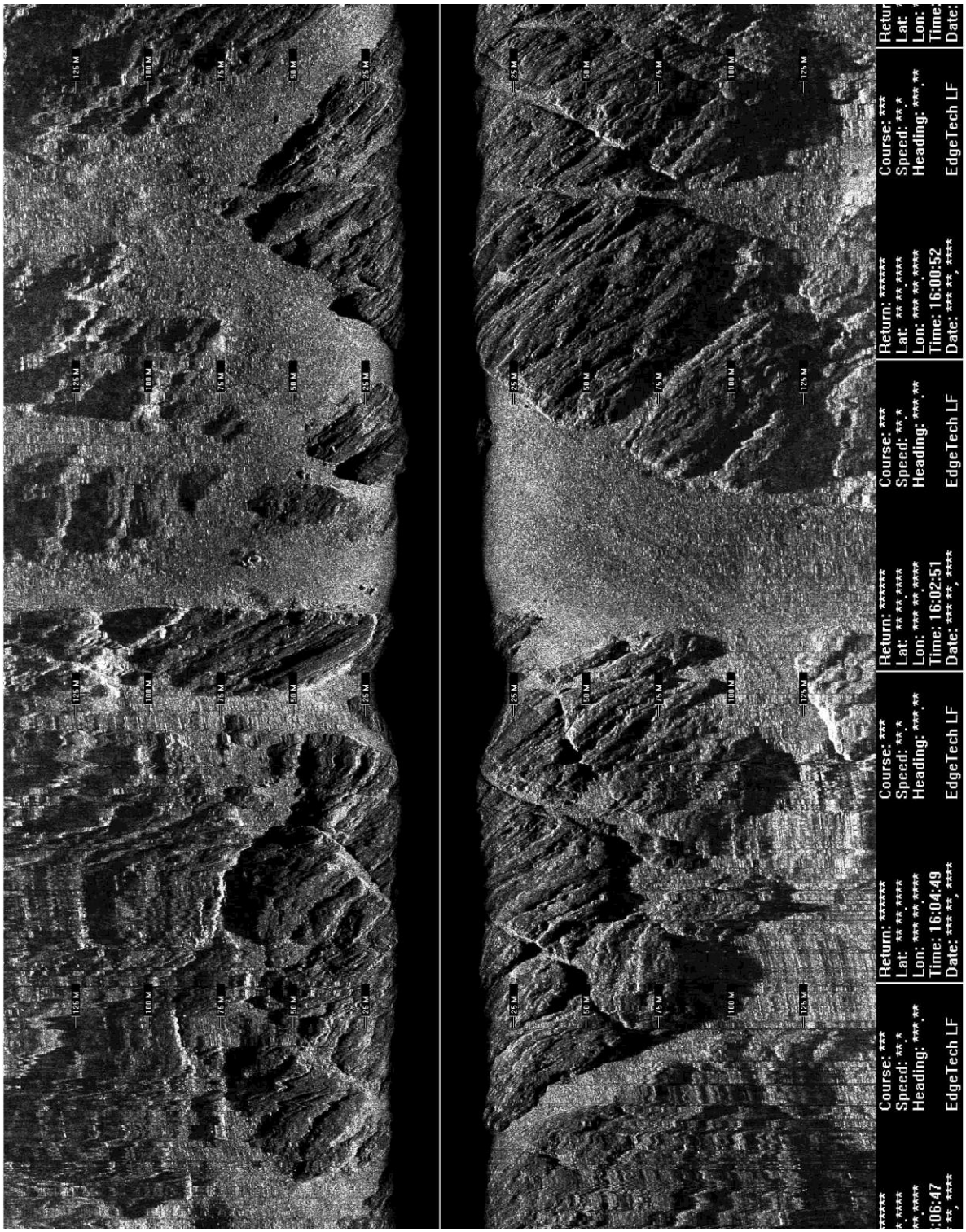


Figure 17 Low frequency (100kHz) side scan sonar data example

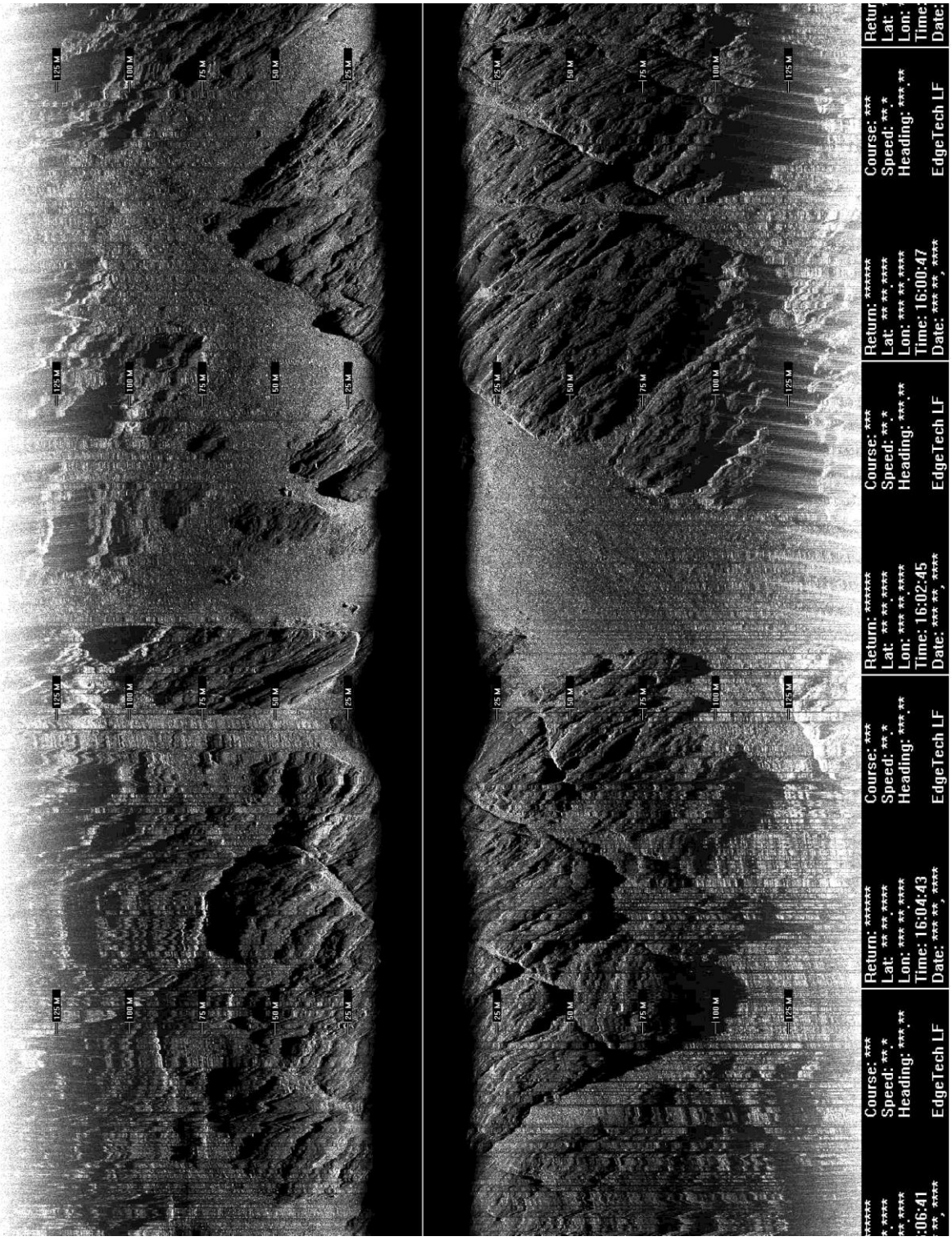


Figure 18 High frequency (400kHz) side scan sonar data example

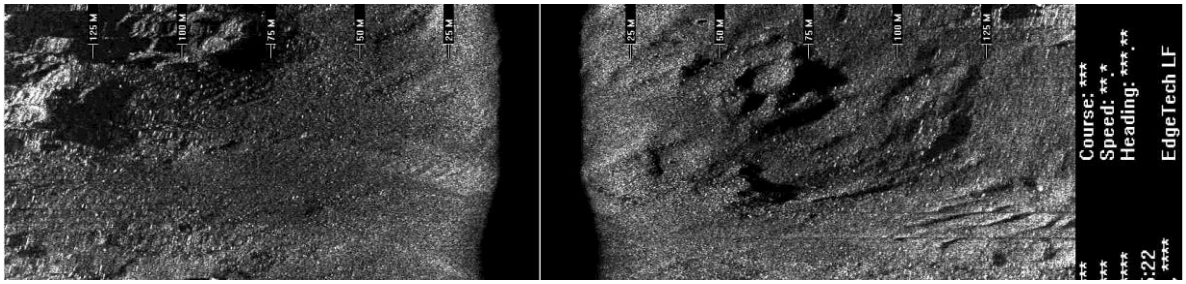


Figure 19 Low frequency (100kHz) side scan sonar data example from site

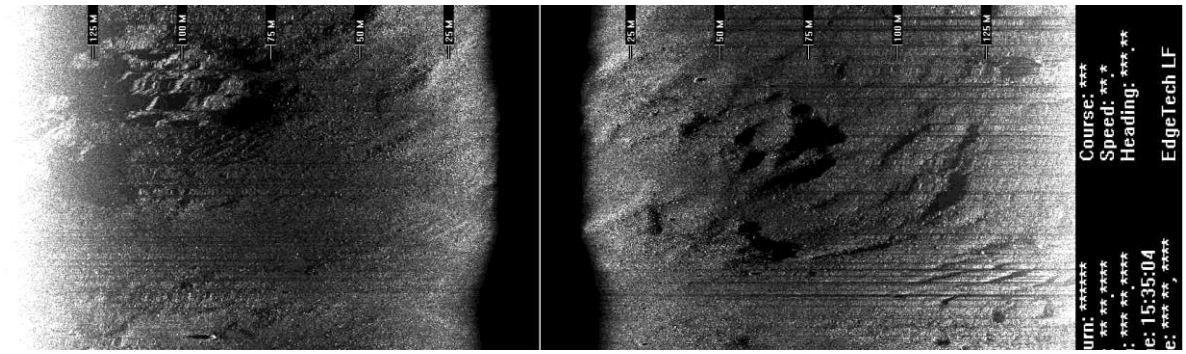


Figure 20 High frequency (400kHz) side scan sonar data example

7.4.2 Boomer Data Example

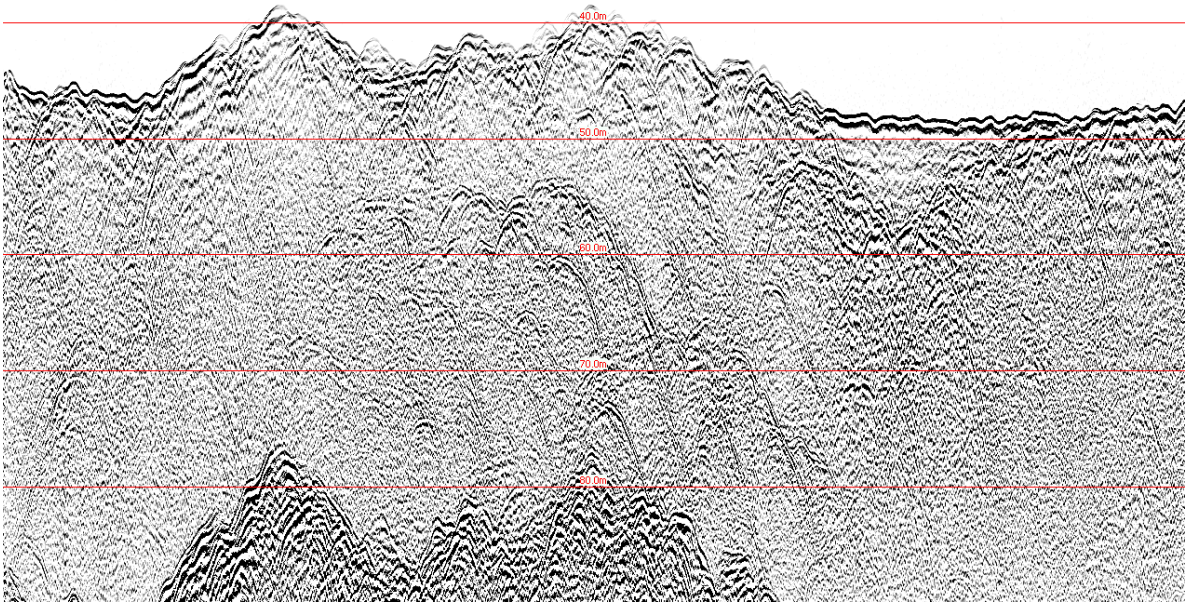


Figure 21 Boomer data example from site

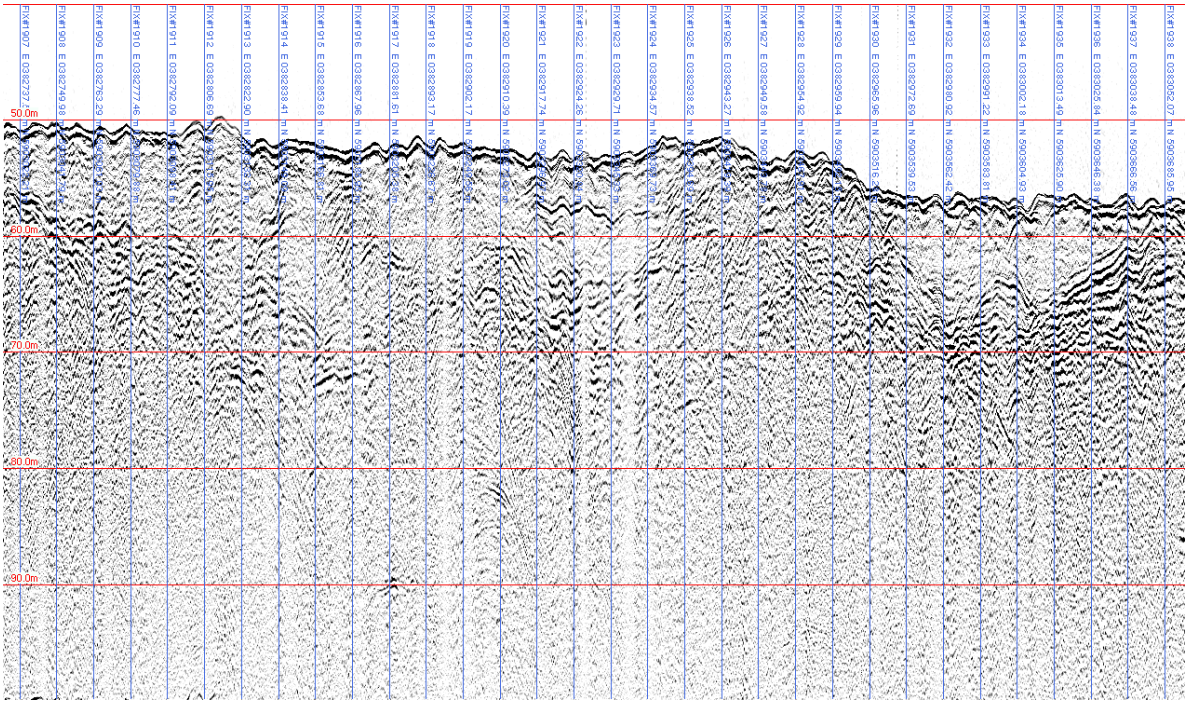


Figure 22 Boomer data example from site (with fixes)

APPENDIX 1 - SURVEY CONTROL INFORMATION

Passive station: Porth Eilian - C1SH4793

Overview

Type of mark:
Bolt
Flush bracket:
Not Available
Grid reference:
SH479931
Access to mark:
foot
Keys required:
No

On Landranger sheet:
114
Click to buy
On Explorer sheet:
263
Click to buy
Permission required:
No

Coordinates of this station

ETRS89 CARTESIAN

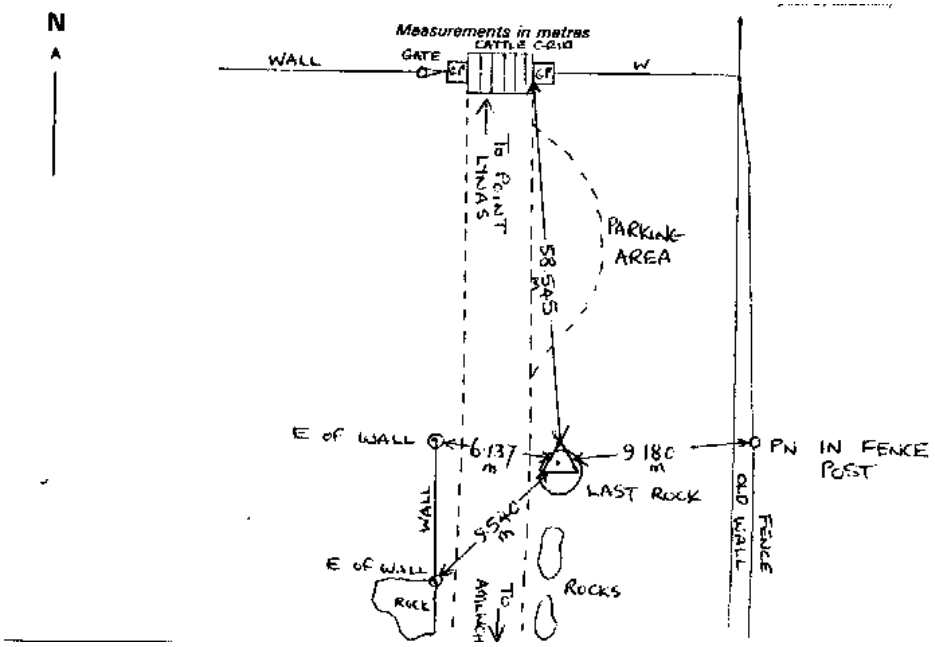
X:
3799329.731
Y:
-284952.937
Z:
5098076.494

ETRS89 GEODETIC

Latitude:
N 53 ° 24' 43.565669"
Longitude:
W 4 ° 17' 21.125122"
Ellipsoid height:
79.712

NATIONAL GRID (TRANSFORMED BY OSTN15/OSGM15)

Eastings:
247942.660
Northings:
393027.622
Height:
25.263



Passive station: Holyhead FBM - H1SH2482

Overview

Type of mark:
FBM
Flush bracket:
Not Available
Grid reference:
SH241828
Access to mark:
foot
Keys required:
No

On Landranger sheet:
114
Click to buy
On Explorer sheet:
262
Click to buy
Permission required:
No

Coordinates of this station

ETRS89 CARTESIAN

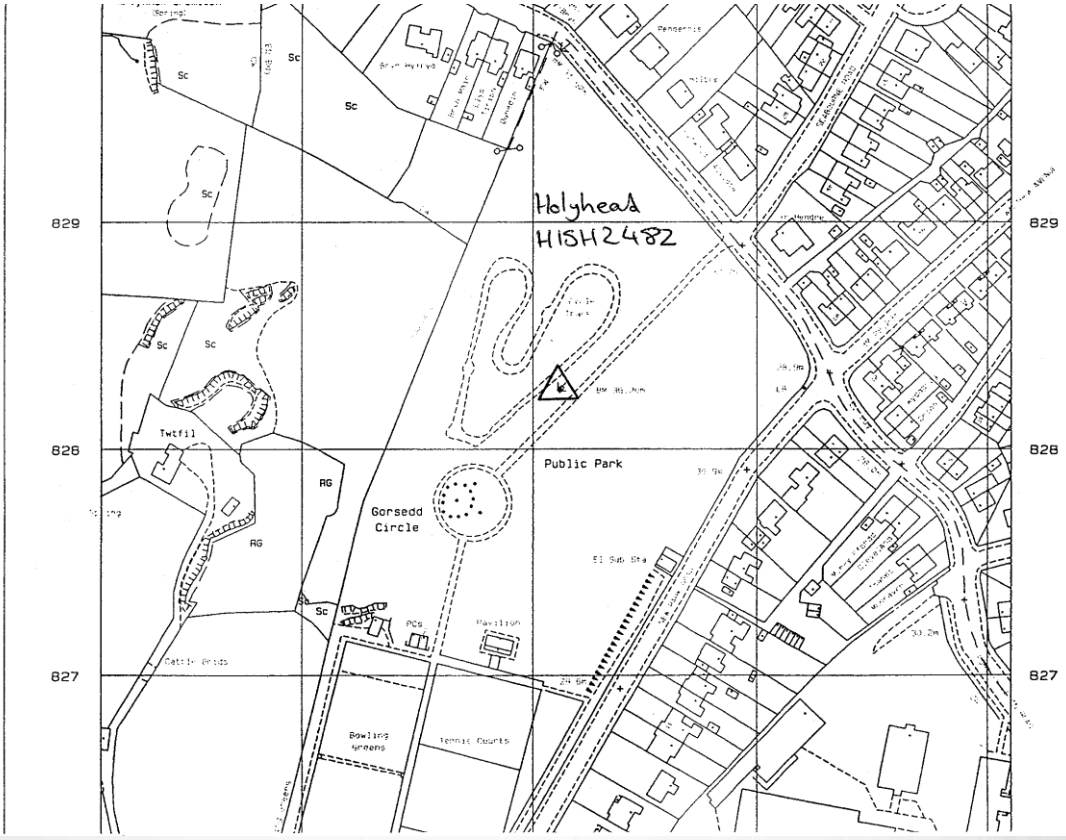
X:
3806322.430
Y:
-309036.842
Z:
5091511.278

ETRS89 GEODETIC

Latitude:
N 53 ° 18' 47.21704"
Longitude:
W 4 ° 38' 30.069568"
Ellipsoid height:
90.815

NATIONAL GRID (TRANSFORMED BY OSTN15/OSGM15)

Eastings:
224110.985
Northings:
382828.658
Height:
36.202


Holyhead
HISH2482
829
826
827
Public Park
Gorsedd
Circle
Twtfil
RG
Sc
Bowling
Greens
Tennis Courts
Pavilion
PCs

APPENDIX 2 – MULTIBEAM CALIBRATION REPORT

AutoPatch (V2018.1.0.0) Calibration Report - 23 - 04 - 2018 16:31:46

TRANSDUCER ALIGNMENT CALIBRATION	
Current User	thecr
Project Folder	C:/Projects/H18012 - Morlais/BeamworX/MBES Cal/POS MV
Number of Raw Files	12

RAW FILE LIST					
Date	**Start**	**End**	**Heading**	**Speed**	**File Name**
19 - 04 - 2018	17:29:46	17:31:28	143.7°	2.6	0013 - W01 - 0001.xtf
19 - 04 - 2018	17:32:26	17:34:15	323.1°	2.5	0014 - W01 - 0001.xtf
19 - 04 - 2018	17:35:31	17:37:12	144.8°	2.5	0015 - W01 - 0001.xtf
19 - 04 - 2018	17:38:57	17:40:09	331.2°	3.7	**0016 - W01 - 0001.xtf - NOT USED**
19 - 04 - 2018	17:41:32	17:42:30	144.7°	3.9	0017 - W01 - 0001.xtf
19 - 04 - 2018	17:44:19	17:46:01	324.0°	2.5	0018 - W02 - 0001.xtf
19 - 04 - 2018	17:48:31	17:49:49	147.9°	2.7	0019 - W03 - 0001.xtf
19 - 04 - 2018	17:51:46	17:53:25	325.2°	2.4	0020 - W04 - 0001.xtf
19 - 04 - 2018	17:54:30	17:55:56	150.6°	3.2	0021 - W04 - 0001.xtf
19 - 04 - 2018	17:57:18	17:58:52	325.8°	2.4	0022 - W01 - 0001.xtf
19 - 04 - 2018	18:00:03	18:00:34	133.8°	2.9	**0023 - W01 - 0001.xtf - NOT USED**
19 - 04 - 2018	18:02:46	18:04:07	327.6°	2.5	0024 - W01 - 0001.xtf

Post-Processing Trajectory	
File:	Not Used

OFFSET LOCATIONS			
Description	**Starboard[m]**	**Forward[m]**	**Up[m]**
COG	0.000	0.000	0.000
Xtf-Pos	1.100	-0.122	-1.132

COMPUTATION SETTINGS	
Positioning System	XTF-Position
Heading System	XTF-Motion
Pitch/Roll/Heave System	XTF-Motion
Height Mode	Use Only Position

SOUND VELOCITY PROFILE		
C:/Projects/H18012 - Morlais/BeamworX/MBES Cal/POS MV/SVP.txt		
29 records		
Min Speed = 1482.13m/s	Min Cast Depth = 0.50m	Min Survey Depth = 11.80m
Max Speed = 1483.49m/s	Max Cast Depth = 14.50m	Max Survey Depth = 19.40m

MRU ALIGNMENT			
Name	**Roll**	**Pitch**	**Heading**
XTF-Motion	0.000 °	0.000 °	0.000 °

VALID DATA GATES		
	Minimum	**Maximum**
Depth	11.80	19.50
Sector	-65.20°	65.20°

ADJUSTMENTS
No Adjustments were made

DATA PAIRING & ROLL AREA SETTINGS	
Parameter	**Value**
Min. Roll-Pitch Overlap	80

1

Max. Heading Overlap	60
Line Heading Margin	20
Line Speed Margin	1
Roll Calibration Area Placement	Automatically, based on seabed features

CALIBRATION OFFSET RESULTS

Roll-Pitch	Hdg	Roll	Pitch	Heading	
1 - 8	1 - 3	-0.257°	-0.665°	0.075°	
1 - 8	1 - 5	-0.239°	-0.685°	-0.240°	
1 - 8	1 - 7	-0.247°	-0.795°	-0.030°	
1 - 8	2 - 6	-0.247°	-0.705°	0.045°	
1 - 8	6 - 10	-0.249°	-0.775°	-0.235°	
1 - 8	6 - 12	-0.246°	-0.855°	-0.075°	
1 - 8	7 - 9	-0.246°	-0.705°	0.385°	
2 - 3	1 - 3	-0.204°	-0.860°	-0.125°	
2 - 3	1 - 5	-0.202°	-0.915°	-0.455°	
2 - 3	1 - 7	-0.207°	-0.835°	0.005°	
2 - 3	2 - 6	-0.200°	-0.925°	-0.430°	
2 - 3	6 - 10	-0.200°	-0.925°	-0.285°	
2 - 3	6 - 12	-0.198°	-0.945°	-0.590°	
2 - 3	7 - 9	-0.208°	-0.830°	0.045°	
2 - 5	1 - 3	-0.209°	-0.450°	0.305°	
2 - 5	1 - 5	-0.207°	-0.400°	-0.315°	
2 - 5	1 - 7	-0.207°	-0.515°	-0.015°	
2 - 5	2 - 6	-0.204°	-0.570°	-0.235°	
2 - 5	6 - 10	-0.204°	-0.490°	-0.675°	
2 - 5	6 - 12	-0.205°	-0.455°	-0.550°	
2 - 5	7 - 9	-0.210°	-0.350°	0.020°	
3 - 10	1 - 3	-0.222°	-1.965°	-0.255°	
3 - 10	1 - 5	-0.227°	-1.805°	0.095°	
3 - 10	1 - 7	-0.225°	-1.950°	-0.275°	
3 - 10	2 - 6	-0.223°	-1.965°	-0.075°	
3 - 10	6 - 10	-0.228°	-2.015°	0.040°	
3 - 10	6 - 12	-0.218°	-1.935°	-0.425°	
3 - 10	7 - 9	-0.232°	-2.085°	0.065°	
3 - 12	1 - 3	-0.198°	-1.600°	0.125°	
3 - 12	1 - 5	-0.203°	-1.610°	0.310°	
3 - 12	1 - 7	-0.194°	-1.555°	-0.095°	
3 - 12	2 - 6	-0.193°	-1.475°	-0.075°	
3 - 12	6 - 10	-0.188°	-1.470°	-0.435°	
3 - 12	6 - 12	-0.178°	-1.435°	-1.115°	
3 - 12	7 - 9	-0.199°	-1.600°	0.205°	
5 - 10	1 - 3	-0.204°	-2.320°	-0.010°	
5 - 10	1 - 5	-0.199°	-2.295°	-0.390°	
5 - 10	1 - 7	-0.200°	-2.385°	0.265°	
5 - 10	2 - 6	-0.199°	-2.300°	-0.205°	
5 - 10	6 - 10	-0.198°	-2.295°	-0.630°	
5 - 10	6 - 12	-0.198°	-2.225°	-0.660°	
5 - 10	7 - 9	-0.200°	-2.295°	-0.020°	
5 - 12	1 - 3	-0.213°	-2.215°	0.265°	
5 - 12	1 - 5	-0.212°	-2.215°	-0.135°	
5 - 12	1 - 7	-0.218°	-2.240°	0.525°	
5 - 12	2 - 6	-0.213°	-2.220°	-0.095°	
5 - 12	6 - 10	-0.205°	-1.780°	-0.195°	
5 - 12	6 - 12	-0.210°	-2.215°	-0.515°	
5 - 12	7 - 9	-0.216°	-2.240°	0.095°	
8 - 9	1 - 3	-0.237°	-0.390°	0.355°	

2

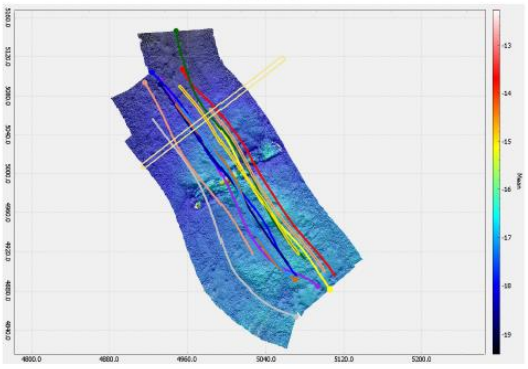
8 - 9	1 - 5	-0.231°	-0.410°	-0.065°	
8 - 9	1 - 7	-0.242°	-0.380°	0.575°	
8 - 9	2 - 6	-0.234°	-0.390°	0.085°	
8 - 9	6 - 10	-0.233°	-0.385°	0.060°	
8 - 9	6 - 12	-0.229°	-0.430°	-0.285°	
8 - 9	7 - 9	-0.234°	-0.400°	0.125°	
	PRESET	**0.00°**	**0.00°**	**0.00°**	
	AVERAGE	**-0.22°**	**-1.31°**	**-0.11°**	**ADVISED MOUNTING ANGLES**
	SDEV	0.02°	0.74°	0.32°	

MOUNTING ANGLE SIGN CONVENTION	
Roll	Positive when Transducer center beam points towards port
Pitch	Positive when Transducer center beam points towards bow
Heading	Positive when Transducer is rotated clockwise around vertical axis of vessel
Note: All angles are absolute w.r.t. the vessel reference frame	

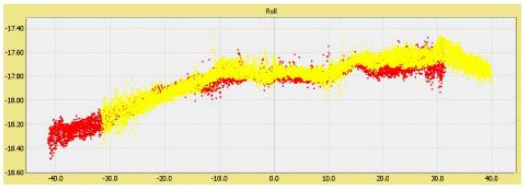
ACCURACY	
Average Error	**4.278 cm/m2**

WARNINGS
There are no warnings to report

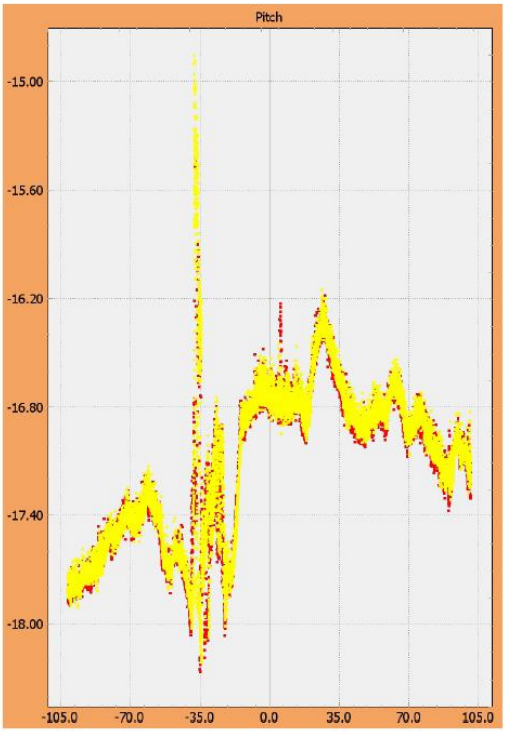
Chart View



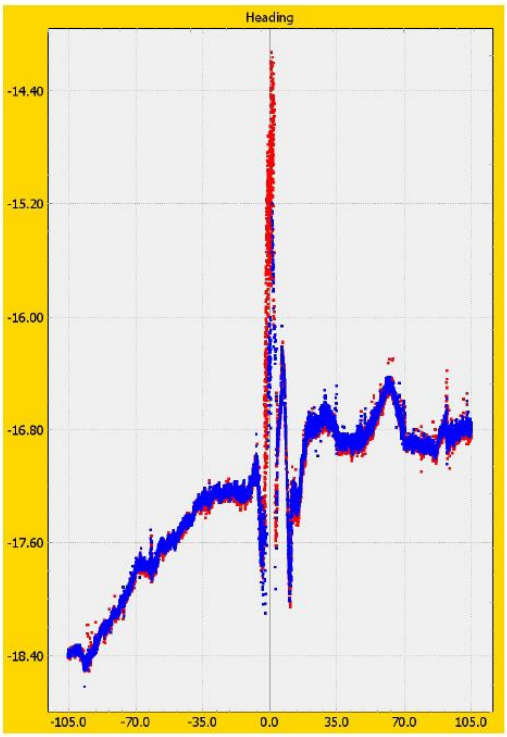
Roll Slice View



Pitch Slice View



Heading Slice View



-- End of Calibration Report --

APPENDIX 3 – USBL CALIBRATION REPORT

CASIUS Calibration Report

Sonardyne SOUND IN DEPTH

Vessel: Norse **Device No:** 5079 **Date/Time:** 21 April 2018 07:28:52

Settings:

Initial Estimates for BoxIn	
Transceiver depth offset	1.480m
Transceiver depth	1.480m
Antenna starboard offset	0.690m
Antenna forward offset	0.050m
Antenna height offset	5.250m

Error Estimates for BoxIn	
DGPS lags USBL	0.00s
Range measurement	0.2m
Range gate	1.0m
DGPS position	2.0m
Beacon position	30.0m
Beacon depth	5.0m
Sound velocity	15.0m/s
Transceiver depth	0.5m
Transceiver offset	1.0m

Transceiver & Beacon	
Transceiver Index	11
Beacon Name	Quickset B1
Turn Around Time	250.0ms

Depth Aiding	
Boresight Angle Limit	22.0°
Depth Difference Limit	1.0m

Transceiver Attitude Calculation Inputs	
Angle Gate	2.0°
Known Heading Correction	n/a

Values Used During Data Collection	
Transceiver Pitch Correction	0.00°
Transceiver Roll Correction	0.00°
Transceiver Heading Correction	0.00°
Sound Velocity	1481.0m/s

Results:

Beacon BoxIn	Beacon Eastings	Beacon Northings	Beacon Depth	Sound Velocity	Transceiver Starboard Offset	Transceiver Forward Offset
Before	390017.30m	5916297.80m	31.50m	1480.98m/s	-1.24m	6.16m
Calculated	390017.83m	5916296.98m	32.01m	1485.50m/s	-1.15m	5.90m
Calculated Accuracy	0.02m	0.01m	0.02m	0.31m/s	0.02m	0.01m

Transceiver Attitude	Pitch Correction	Roll Correction	Heading Correction
Before	0.00°	0.00°	0.00°
Calculated	-2.00°	-0.18°	-4.03°
Calculated Accuracy	0.02°	0.03°	0.05°

Statistics:

	Before CASIUS (distance)	After CASIUS (distance)	Before CASIUS (% depth)	After CASIUS (% depth)
39.4% Beacon Positions (1 sigma)	1.7m	0.4m	5.43	1.37
50.0% Beacon Positions (CEP)	2.1m	0.5m	6.53	1.61
63.2% Beacon Positions (1 Drms)	2.4m	0.6m	7.55	1.89
86.5% Beacon Positions (2 sigma)	3.7m	0.9m	11.59	2.77
98.2% Beacon Positions (2 Drms)	7.5m	2.2m	23.35	6.74

General:

	Beacon BoxIn	Transceiver Attitude
Number of Iterations	3	8
Number of Fixes Used	680	680
Number Depth Aided		118
Average weighted residuals	0.011	0.074

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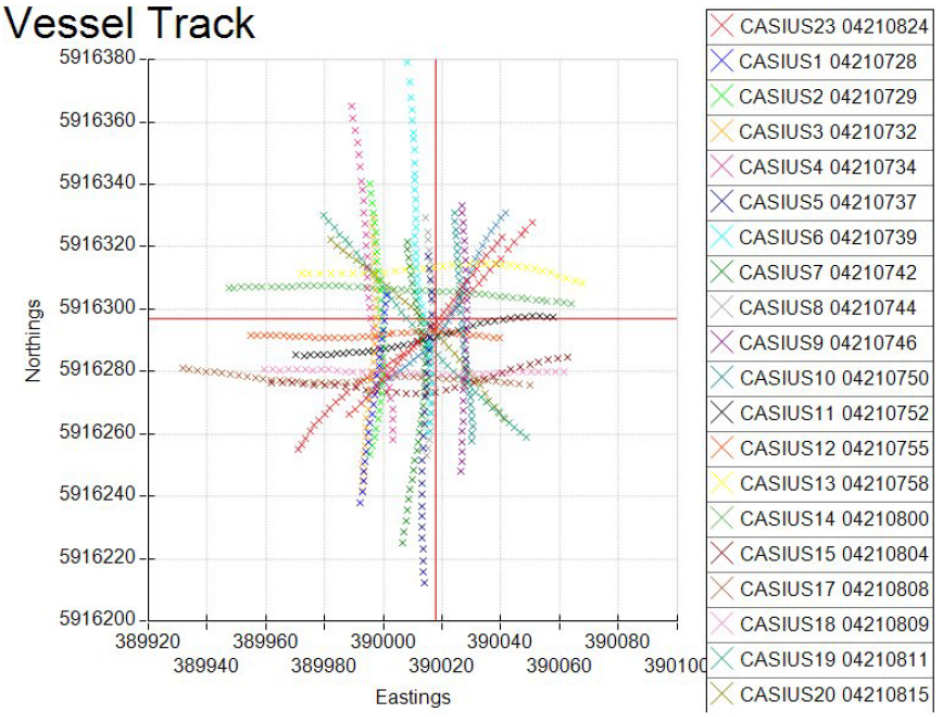
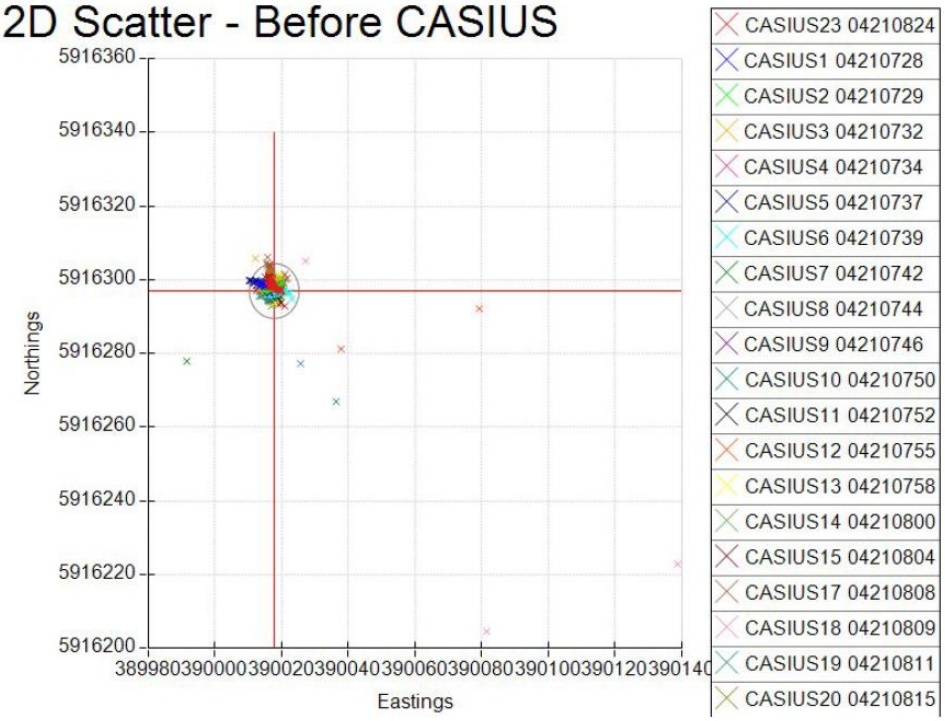
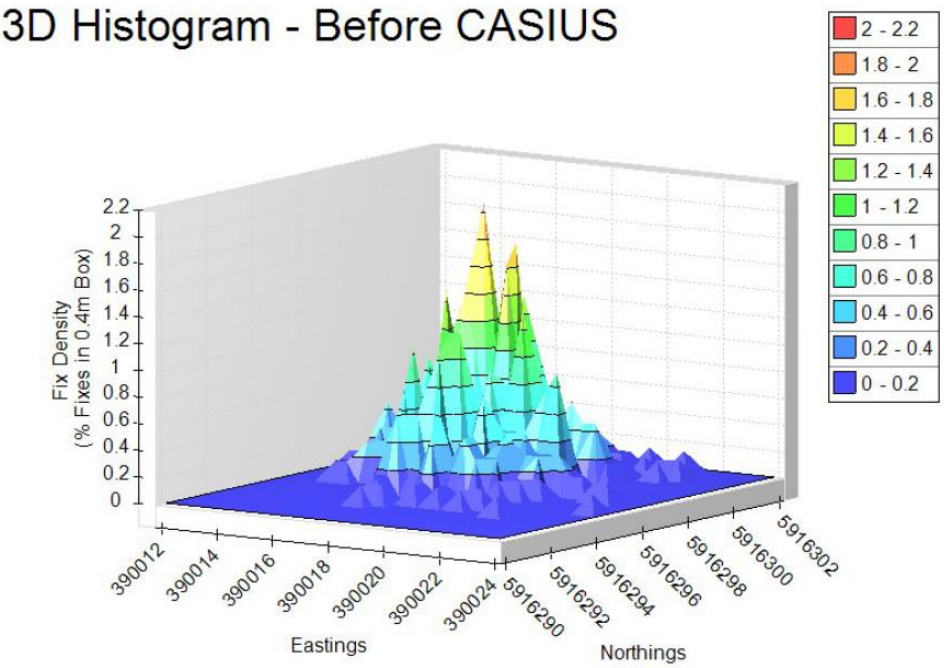


Data used:

Name	Filename	Start	End	#Acoustic	#Position
CASIUS23 04210824	C:\Ranger Files\CASIUS\0421_0728\ CASIUS23 04210824.csv	21/04/2018 08:26:37	21/04/2018 08:27:09	32	54
CASIUS1 04210728	C:\Ranger Files\CASIUS\0421_0728\CASIUS1 04210728.csv	21/04/2018 07:28:52	21/04/2018 07:29:15	24	41
CASIUS2 04210729	C:\Ranger Files\CASIUS\0421_0728\CASIUS2 04210729.csv	21/04/2018 07:31:22	21/04/2018 07:31:52	31	53
CASIUS3 04210732	C:\Ranger Files\CASIUS\0421_0728\CASIUS3 04210732.csv	21/04/2018 07:33:55	21/04/2018 07:34:27	32	54
CASIUS4 04210734	C:\Ranger Files\CASIUS\0421_0728\CASIUS4 04210734.csv	21/04/2018 07:36:41	21/04/2018 07:37:13	32	55
CASIUS5 04210737	C:\Ranger Files\CASIUS\0421_0728\CASIUS5 04210737.csv	21/04/2018 07:38:58	21/04/2018 07:39:27	29	50
CASIUS6 04210739	C:\Ranger Files\CASIUS\0421_0728\CASIUS6 04210739.csv	21/04/2018 07:41:34	21/04/2018 07:42:15	40	72
CASIUS7 04210742	C:\Ranger Files\CASIUS\0421_0728\CASIUS7 04210742.csv	21/04/2018 07:44:00	21/04/2018 07:44:36	36	60
CASIUS8 04210744	C:\Ranger Files\CASIUS\0421_0728\CASIUS8 04210744.csv	21/04/2018 07:46:03	21/04/2018 07:46:28	25	43
CASIUS9 04210746	C:\Ranger Files\CASIUS\0421_0728\CASIUS9 04210746.csv	21/04/2018 07:49:23	21/04/2018 07:49:51	28	47
CASIUS10 04210750	C:\Ranger Files\CASIUS\0421_0728\ CASIUS10 04210750.csv	21/04/2018 07:51:33	21/04/2018 07:52:03	31	54
CASIUS11 04210752	C:\Ranger Files\CASIUS\0421_0728\ CASIUS11 04210752.csv	21/04/2018 07:54:44	21/04/2018 07:55:22	39	67
CASIUS12 04210755	C:\Ranger Files\CASIUS\0421_0728\ CASIUS12 04210755.csv	21/04/2018 07:57:46	21/04/2018 07:58:25	39	67
CASIUS13 04210758	C:\Ranger Files\CASIUS\0421_0728\ CASIUS13 04210758.csv	21/04/2018 08:00:12	21/04/2018 08:00:44	33	54

Name	Filename	Start	End	#Acoustic	#Position
CASIUS14 04210800	C:\Ranger Files\CASIUS\0421_0728\ CASIUS14 04210800.csv	21/04/2018 08:02:58	21/04/2018 08:03:47	49	84
CASIUS15 04210804	C:\Ranger Files\CASIUS\0421_0728\ CASIUS15 04210804.csv	21/04/2018 08:05:37	21/04/2018 08:06:08	32	54
CASIUS17 04210808	C:\Ranger Files\CASIUS\0421_0728\ CASIUS17 04210808.csv	21/04/2018 08:08:15	21/04/2018 08:08:59	44	74
CASIUS18 04210809	C:\Ranger Files\CASIUS\0421_0728\ CASIUS18 04210809.csv	21/04/2018 08:10:52	21/04/2018 08:11:31	39	66
CASIUS19 04210811	C:\Ranger Files\CASIUS\0421_0728\ CASIUS19 04210811.csv	21/04/2018 08:14:43	21/04/2018 08:15:23	40	67
CASIUS20 04210815	C:\Ranger Files\CASIUS\0421_0728\ CASIUS20 04210815.csv	21/04/2018 08:17:13	21/04/2018 08:17:44	32	55
CASIUS21 04210818	C:\Ranger Files\CASIUS\0421_0728\ CASIUS21 04210818.csv	21/04/2018 08:21:03	21/04/2018 08:21:39	37	62
CASIUS22 04210821	C:\Ranger Files\CASIUS\0421_0728\ CASIUS22 04210821.csv	21/04/2018 08:23:55	21/04/2018 08:24:36	42	71





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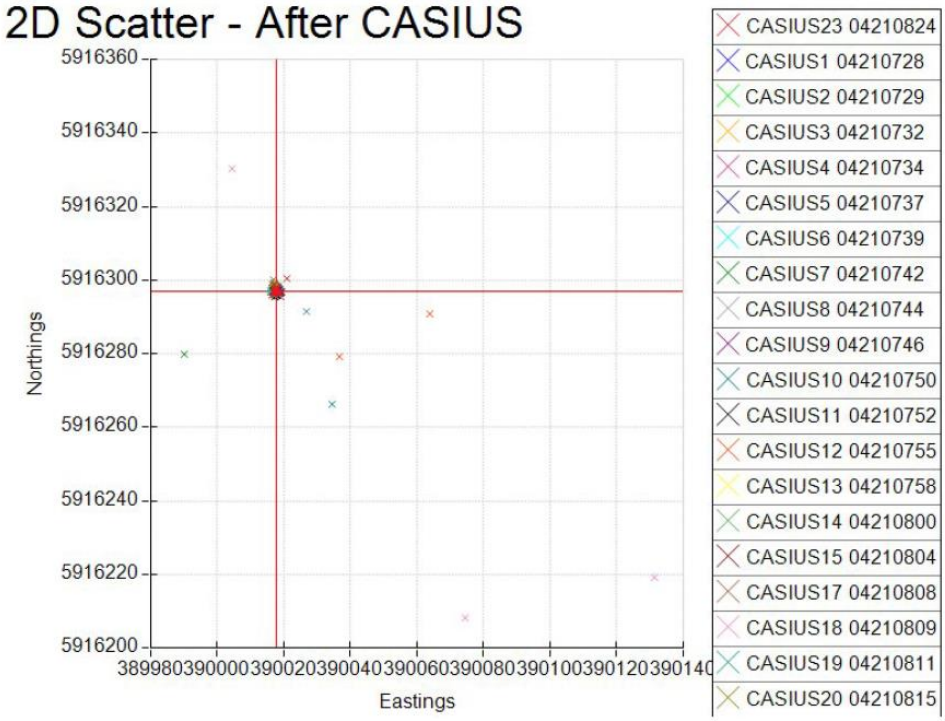

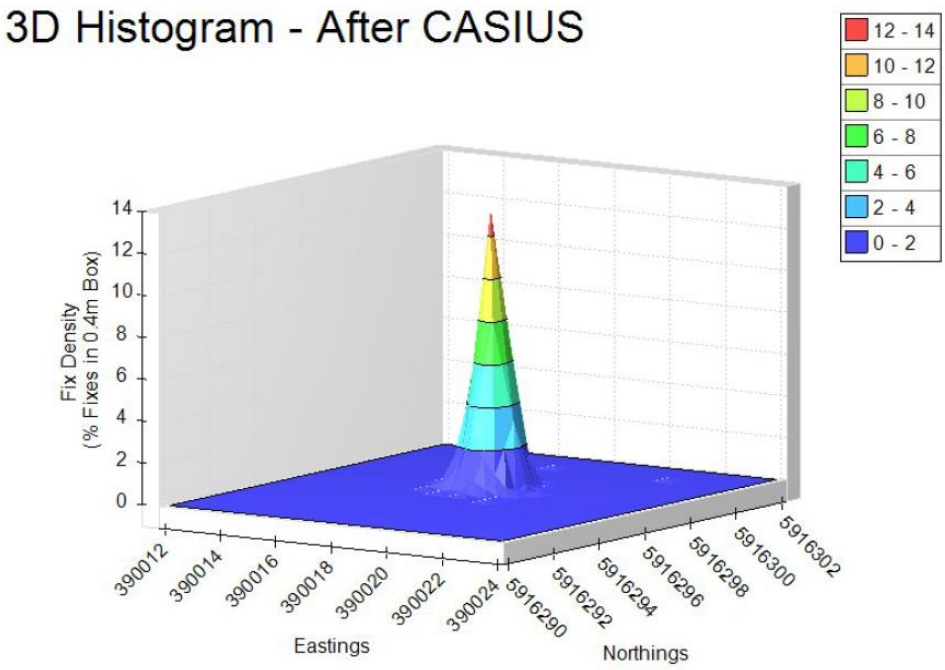

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APPENDIX 4 – SVP CERTIFICATES

Valeport Swift (Primary)

VALEPORT

This document certifies that the instrument detailed below has been calibrated according to Valeport Limited's Standard Procedures, using equipment with calibrations traceable to UKAS or National Standards.

Calibration Certificate Number:	53223
Instrument Type:	Swift SVP
Instrument Serial Number:	63615
Calibrated By:	J.Harper
Date:	23/03/2018
Signed:	

Full details of the results from the calibration procedure applied to each fitted sensor are available, on request, via email. This summary certificate should be kept with the instrument.

Valeport Ltd | St Peter's Quay | Totnes | Devon | TQ9 5EW | UK
T: +44 (0) 1803 869292 | F: +44 (0) 1803 869293
E: sales@valeport.co.uk | www.valeport.co.uk

Sensor Calibration Record - 4008231B **Sound Velocity**

Instrument Serial Number	33550
Transducer Type, mm	50
Transducer Ser No	52169
PCB Part No	0400554
PCB Ser No	50030
SV Firmware Version	04007149B0
FPGA Firmeware Version	0650714C
Module Number	12

Calibration Equipment used		
Instrument	Type	Serial No
Temp Bridge	MICRO K	311063/1
PRT	909L	63

Fresh	1412.693	1412.615	0.078
Saline	#	#	#VALUE!

Stage 1: First order fit

Temp °C90	SoS from Bilaniuk & Wong m/s	Measured ToF nsec*100	Coefficients	Calc SoS from coefficients m/s	Error (Calc - True) m/s	Acceptable Error m/s	Pass/Fail
2.0797	1412.617	7444852	3.875720E+05	1412.617	0.000	±0.001	Pass
16.1130	1469.785	7170357	1.003086E+07	1469.785	0.000	±0.001	Pass

Stage 2: Enter calibration string

#024;12;1;15;0;0;0;0;1.003086E+07;3.875720E+05

Stage 3: Check point

Temp °C90	Actual SoS m/s	Measured SoS m/s	Error SoS Reading-Actual m/s	Acceptable Error m/s	Pass/Fail
16.1139	1469.788	1469.787	-0.001	±0.005	Pass

Name:	N.Paddon
Date:	08/03/2018
Signature:	

Calibrated to Valeport's procedures using test equipment with calibrations traceable to UKAS or national standards

AML OCEANOGRAPHIC
Xchange your old ideas

Certificate of Calibration

Customer:	Norbit Subsea, Group : Norbit EMS AS Selbu
Asset Serial Number:	206001
Asset Product Type:	SV•Xchange™ Calibrated Sensor
Calibration Type:	Sound Velocity
Calibration Range:	1375 to 1625 m/s
Calibration RMS Error:	.011
Calibration ID:	206001 999999 206001 070317 090934
Installed On:	011581

Coefficient A:	0.000000E+0	Coefficient H:	1.948303E-7
Coefficient B:	0.000000E+0	Coefficient I:	0.000000E+0
Coefficient C:	1.804456E-7	Coefficient J:	0.000000E+0
Coefficient D:	1.948674E-7	Coefficient K:	0.000000E+0
Coefficient E:	-1.793870E-5	Coefficient L:	0.000000E+0
Coefficient F:	1.954814E-7	Coefficient M:	0.000000E+0
Coefficient G:	3.458695E-7	Coefficient N:	0.000000E+0

Calibration Date (dd/mm/yyyy): 7/3/2017

Certified By:

AML Oceanographic

Robert Haydock
President, AML Oceanographic

AML Oceanographic certifies that the asset described above has been calibrated or recalibrated with equipment referenced to traceable standards. Please note that Xchange™ sensor-heads may be installed on assets other than the one listed above; this calibration certificate will still be valid when used on other such assets. If this instrument or sensor has been recalibrated, please be sure to update your records. Please also ensure that you update the instrument's coefficient values in any post-processing software that you use, if necessary. Older generation instruments may require configuration files, which are available for download at our Customer Centre at www.AMLoceanographic.com/support

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APPENDIX 5 - EQUIPMENT SPECIFICATIONS

Trimble SPS855

DATASHEET

SPS855

GNSS MODULAR RECEIVER

FLEXIBLE RECEIVER FOR JOBSITE MEASUREMENT

Whether you need a reliable GNSS base station or a rugged rover, the Trimble® SPS855 GNSS Modular Receiver gives you the flexibility to perform all of your construction site measurements. As a permanent or semi-permanent base station, it provides GNSS corrections for site measurements and machine control. As a rover, it can move easily from a site supervisor truck to a pole mount for grade checking, site measurement and stakeout.

The versatile SPS855 receiver is available in a range of options to suit your jobsite or marine construction performance requirements. Simply purchase the receiver that you need today, and upgrade as your needs change.

Key Features

Secure and Easy to Use

The Trimble SPS855 is comprised of an integrated GNSS receiver and radio plus a choice of external antenna. The receiver can be placed in a secure environment such as the job trailer or boat cabin where it is protected from theft and weather. The less expensive antenna can be placed in a location with clear visibility to the sky and maximum radio coverage.

You don't have to be a GNSS expert to use the SPS855. Integrated 450 or 900 MHz license-free radio and interface with Trimble SCS900 Site Controller Software make the SPS855 easy to use, fast to setup and more productive on the job. Trimble Autobase™ technology means anyone on the jobsite can perform daily base station set up with one button push.

For more advanced troubleshooting, the receiver's web interface allows your GNSS manager to remotely monitor base station performance, availability, and configuration. No need for time-consuming and costly visits to the base station to set up each day or diagnose issues that may arise.

The fully upgradable SPS855 GNSS Modular Receiver can be configured in a variety of ways. For example:

- As a base station only
- As a rover only with SBAS, Location, or Precision Real-Time Kinematic (RTK) accuracy
- As a flexible base or rover with Precision RTK accuracy

The SPS855 can be combined with the Trimble SPS555H Heading Add-on Receiver, for applications on cranes, construction vessels, and dredges where real-time position and orientation are important.

TRANSFORMING THE WAY THE WORLD WORKS

Trimble.

DATASHEET

SPS855 GNSS Modular Receiver

GENERAL

Keyboard and display	Vacuum fluorescent display 16 characters by 2 rows Dimmable. On/Off key for one-button startup
Dimensions (L × W × D)	24 cm × 12 cm × 5 cm (9.4 in x 4.7 in x 1.9 in)
Weight	1.65 kg (3.64 lb) receiver with internal battery and radio 1.55 kg (3.42 lb) receiver with internal battery and no radio

ANTENNA OPTIONS

Zephyr™ 2 Models	Triple frequency GNSS (GPS, GLONASS, Galileo, BeiDou), MSS (CenterPoint RTX, OmniSTAR™, L1 SBAS)
GA830	Triple frequency GNSS (GPS, GLONASS, Galileo, BeiDou), MSS (CenterPoint RTX, OmniSTAR, L1 SBAS)
GA530	L1/L2/L2C GPS, SBAS, RTX and OmniSTAR

ENVIRONMENT

Operating[1]	−40 °C to +65 °C (−40 °F to +149 °F)
Storage	−40 °C to +80 °C (−40 °F to +176 °F)
Humidity	MIL-STD 810F, Method 507.4
Waterproof	IP67 for submersion to depth of 1 m (3.3 ft), dustproof
Pole drop	Designed to survive a 1 m (3.3 ft) pole drop onto a hard surface

MEASUREMENTS[2]

- 440-channel L1C/A, L1/L2/L2C GPS and QZSS.
- Upgradable to L5 and GLONASS L1/L2C/A, L1/L2P Full Cycle Carrier
- Galileo
- BeiDou
- CenterPoint™ RTX™ Correction Service
- OmniSTAR
- Trimble EVEREST™ multipath signal rejection
- 4-channel SBAS (WAAS/EGNOS/MSAS/QZSS)

CODE DIFFERENTIAL GPS POSITIONING[3]

Horizontal accuracy	0.25 m + 1 ppm RMS (0.8 ft + 1 ppm RMS)
Vertical accuracy	0.50 m + 1 ppm RMS (1.6 ft + 1 ppm RMS)

REAL-TIME KINEMATIC (RTK UP TO 30 KM) POSITIONING[3]

Horizontal accuracy	8 mm + 1 ppm RMS (0.026 ft + 1 ppm RMS)
Vertical accuracy	15 mm + 1 ppm RMS (0.05 ft +1 ppm RMS)

TRIMBLE XFILL

Horizontal accuracy	RTK[4] + 10mm/minute RMS
Vertical accuracy	RTK + 20mm/minute RMS

TRIMBLE CENTERPOINT RTX

Horizontal accuracy	4cm (0.13 ft) RMS
Vertical accuracy	9cm (0.30 ft) RMS

INITIALIZATION TIME

Initialization reliability[5]	> 99.9%

OPERATION TIME ON INTERNAL BATTERY

Rover	13 hours; varies with temperature
Base station	
450 MHz systems	Approximately 11 hours; varies with temperature[6]
900 MHz systems	Approximately 9 hours; varies with temperature
220 MHz systems	Approximately 9 hours; varies with temperature

POWER

Internal	Integrated internal battery 7.2 V, 7800 mA-hr, Lithium-ion
External	Power input on 7-pin 0-shell Lemo connector is optimized for lead acid batteries with a cut-off threshold of 11.5 V Power input on the 26-pin D-sub connector is optimized for Trimble Lithium-ion battery input with a cut-off threshold of 10.5 V
Power consumption	6.0 W in rover mode with internal receive radio 8.0 W in base mode with internal transmit radio

REGULATORY APPROVALS

- FCC: Part 15 Subpart B (Class B Device) and Subpart C, Part 90
- Canadian ICES-003. Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
- Canadian RSS-310, RSS-210, and RSS-119. Cet appareil est conforme à la norme CNR-310, CNR-210, et CNR-119 du Canada.
- ACMA: AS/NZS 4295 approval
- CE mark compliance
- C-tick mark compliance
- UN ST/SG/AC.10.11/Rev. 3, Amend. 1 (Lithium-ion Battery)
- UN ST/SG/AC. 10/27/Add. 2 (Lithium-ion Battery)
- RoHS compliant
- WEEE compliant
- China CRRC - 220 MHz

COMMUNICATIONS

Lemo (Serial)	7-pin OS Lemo, Serial 1, 3-wire RS-232
Modem 1 (Serial)	26-pin D-sub, Serial 2, Full 9-wire RS232, using adaptor cable
Modem 2 (Serial)	26-pin D-sub, Serial 3, 3 wire RS-232, using adaptor cable
1PPS (1 Pulse-per-second)	Available on Marine versions
Ethernet	Through a multi-port adaptor
Bluetooth wireless technology	Fully-integrated, fully-sealed 2.4 GHz Bluetooth module[7]
Integrated radios (optional)	Fully-integrated, fully-sealed internal 450 MHz (UHF) Tx/Rx; internal 900 MHz Tx/Rx; internal 220 MHz Tx/Rx
External GSM/GPRS, cell phone support	For Internet-based correction streams
Receiver position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz positioning
Correction data input/output	CMR™, CMR+™, CMRx, RTCM v 2.x & 3.x
Data outputs	NMEA, GSOF, 1PPS Time Tags (Marine version)

1 Receiver will operate normally to −40 °C. Internal batteries are rated to −20 °C.
2 The Trimble SPS855 GNSS Modular Receiver is capable of supporting existing and planned GNSS satellite signals, including GPS, GLONASS, Galileo, CenterPoint RTX, Quasi Zenith Satellite System and BeiDou, and existing and planned augmentations to these GNSS systems. Support for the Galileo system is developed under a license of the European Union and the European Space Agency.
3 Accuracy and reliability may be subject to anomalies such as multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended practices. 4 RTK refers to the last reported precision before the correction source was lost and xFill started.
5 May be affected by atmospheric conditions, signal multipath, and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
6 For receivers with the 2.0W upgrade, reduced battery performance should be expected compared to the 0.5W solution.
7 Bluetooth type approvals are country specific. For more information, contact your local Trimble office or representative.

Specifications subject to change without notice.

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Sonardyne Scout USBL

Sonardyne
SOUND IN DEPTH

SCOUT USBL

SHALLOW WATER SUBSEA TARGET TRACKING SYSTEM

Scout USBL is a complete vessel based acoustic positioning system designed for tracking divers, ROVs and towfish in waters up to 1,000 metres. The system calculates the position of a subsea target by measuring the range (distance) and bearing (heading) from a vessel mounted transceiver to a small acoustic transponder fitted to the target; a technique known as Ultra-Short BaseLine (USBL) positioning. USBL is widely used by the offshore survey and ocean scientific industries as it offers high accuracy performance combined with efficient subsea tracking operations.

Fast and Efficient Operations

One of the main advantages of the USBL technique is that no other in-water acoustic equipment has to be deployed before underwater operations can commence. Only the targets being tracked need to be equipped with a transponder.

With Scout, a boat can arrive on location and begin tracking straight away. This has particular benefits for search and salvage applications when search times are critical.

Scout Product Family

Three versions of Scout USBL are available: Scout, Scout Plus and Scout Pro.

Scout and Scout Plus are entry level systems designed for general target tracking applications at ranges up to 500 metres. Scout can track one surface vessel and four subsea targets whilst Scout Plus can track six targets and incorporates a Responder mode. This enables the system to calculate a target's position at a much higher update rate, ideal for fast moving vehicles such as ROVs and towfish.

With both versions, all sensors and hardware are provided whilst the software is simple to learn and intuitive to use. These features make Scout and Scout Plus the ideal solution for users with little or no prior experience of acoustic systems.

Scout USBL at a glance

- Affordable and high accuracy tracking system for divers, ROV and towfish
- Easy to install and use; no prior USBL experience required
- Supports simple through to complex subsea positioning operations
- Up to 1,000 metres slant range
- All sensors, software and hardware provided
- Portable; can be operated from almost any size boat including RIBs
- Equipment upgrade path to Sonardyne's deep water USBL system - Ranger

SCOUT USBL

SHALLOW WATER SUBSEA TARGET TRACKING SYSTEM

Scout Pro is designed to support complex construction survey applications through its fully featured software. It provides greater accuracy, tracking for up to 10 subsea targets and a 1,000 metre design slant range.

The advanced topside control hardware supplied with Scout Pro systems enables experienced users to operate using Sonardyne's Wideband digital acoustic signal technology. The benefits of using Wideband include greater immunity to noise interference and a ten fold improvement in measurement repeatability.

System Overview

A Scout USBL system comprises four main components: control software, vessel based interface unit, acoustic transceiver and transponders.

Software

Scout and Scout Plus software is easy to use and intuitive to operate. It is designed to appeal to users who wish to arrive on location and begin tracking a target immediately. Features include clear and simple configuration tables as well as diagnostic tools to assist an operator in preparing the system for tracking an underwater target.

Scout Pro software shares a common look and feel with Sonardyne's survey-grade platform, Fusion. It offers the user a complete range of tools that include: chart backdrops, industry standard output telegrams and configurable sensor displays.

Interface Unit

As standard Scout and Scout Plus systems are supplied with a rack-mountable Surface Interface Unit (SIU). This supplies power and communications to the transceiver and is connected to the user's own computer via a serial or USB link.

For complete system portability and operation from almost any size of boat, Scout and Scout Plus systems can be commanded using the Surface Command Unit (SCU).

The SCU incorporates all the features of a rack mounted Surface Interface Unit (SIU), supplying power and communications to the acoustic transceiver. Being completely portable enables operation of Scout USBL systems independently from almost any type of boat, including small RIBs, and in any climate: rain, tropical heat and snow.

The latest version, SCU 2, has been upgraded with a faster processor, more memory, solid state hard drive, a heat exchanger, rechargeable Li-ion battery packs, robust mechanics, a 12" LED backlit screen providing a bright and crisp display that is viewable in direct sunlight and all incorporated in a ruggedized splash-proof case.

The SCU 2 can also be used with Sonardyne's 6G® autonomous monitoring product range (Fetch, PIES and AMT) for fast and efficient retrieval of logged subsea data.

Scout Pro systems are supplied with a rack-mounted Navigation Controller Unit (NCU). In addition to accurately time stamping incoming data from external devices such as GPS, gyros and VRU's, the NCU also provides power and communications for the Scout USBL transceiver.

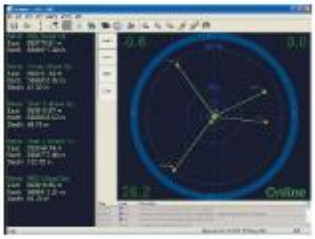
A range of hardware interface cards are available for interfacing external sensors and transceivers other than the standard Scout transceiver. By simply plugging these cards into the rear of the unit, the role of the Navigation Controller Unit can be transformed from supporting simple to complex acoustic operations.

Acoustic Transceiver

The USBL acoustic transceiver designed for use with Scout systems provides a hemispherical pattern of acoustic coverage underneath a surface vessel. It is suitable for a wide variety of underwater positioning tasks as it enables targets to be tracked from far below through to near surface.

Software

Scout software has been designed to be very easy and intuitive to operate with no previous experience of acoustic positioning systems required.



Surface Command Unit

The SCU is a portable computer and control unit that enables Scout USBL to be operated independently from almost any type of boat and in any climate.

Scout USBL Transceiver

Scout transceivers are typically deployed from a rigid pole mounted to the side of the vessel. When a permanent installation is required, the transceiver can be fitted to a through-hull deployment machine. The integrated heading, pitch and roll sensor simplifies setup.

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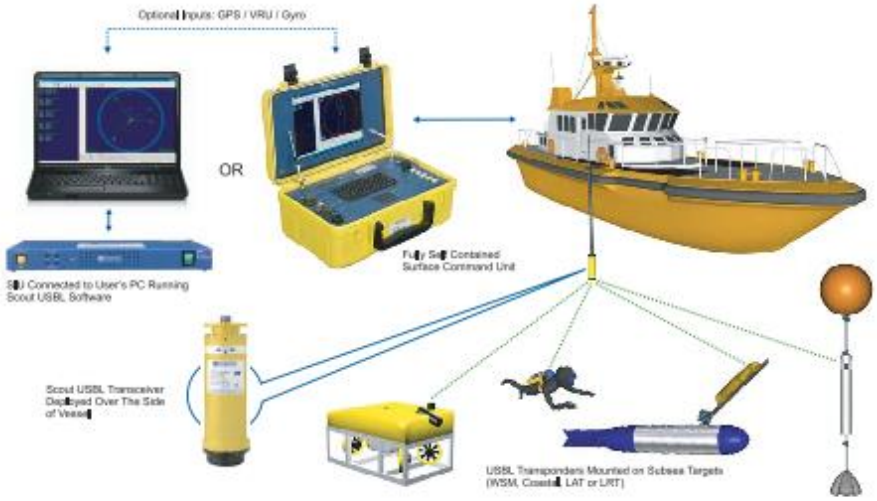

The compact design of the transceiver makes it easy to install on a simple over-the-side mount or through a gate valve. Sonardyne can supply an easy-to-assemble pole, complete with fittings and advice on installation, if required. This ensures the performance of Scout can be optimised for the vessel it is operating from.

To simplify set-up, Scout transceivers are equipped with an integrated motion sensor that automatically compensates for the motion of the vessel. For higher accuracy applications, external reference sensors can be used with Scout Plus and Scout Pro.

When tracking targets far behind a vessel, such as a towed side scan sonar, a tilted transducer array ensures that the target is kept within the transceiver's optimum cone of operation.

Transponders

Scout USBL is compatible with Sonardyne's family of low cost HF frequency transponders; Coastal, LAT and LRT. These have been designed for applications where size and weight are important operational factors, such as installation on the back of a diver or ROV. The transponders are depth rated to 500 metres and use an alkaline battery pack that provides up to 18 months of listening life.

Scout Plus and Scout Pro both offer additional compatibility with the advanced Wideband Sub-Mini (WSM) transponder. WSMs are available with powerful omni or directional transducers, responder mode for fast position updates, depth sensor to aid USBL positioning accuracy and a rechargeable NiMH battery.

ViewPoint Navigation Package

ViewPoint navigation software allows multiple users to explore, visualise and share positioning data from Sonardyne's USBL product family, including Scout (Scout Plus and Pro only) and Ranger. It transforms co-ordinates of surface vessels, subsea vehicles and structures into geographical information that is overlaid on easy-to-use guidance displays. When changes to Scout are made, such as adding a new tracked target, they automatically appear in ViewPoint, ensuring everyone onboard has access to accurate, real-time positioning information.

Tracking Transponders

Scout USBL is compatible with Sonardyne's family of low cost transponders. Scout Plus and Scout Pro both offer additional compatibility with the advanced Wideband Sub-Mini (WSM) transponder. All transponders have been designed for applications where size and weight are important factors.

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Scout Performance Summary

Operating Range	500 metres (Scout, Scout Plus) 1,000 metres (Scout Pro)
System Accuracy	2.75% of Slant Range Using Scout transceiver's internal heading and attitude sensor 0.5% of Slant Range Scout Plus or Scout Pro using external VRU and gyro
Number of Targets Tracked	1 surface, 4 subsea (Scout) 1 surface, 6 subsea (Scout Plus) 1 surface, 10 subsea (Scout Pro)
Output Telegrams	Supports all industry standard survey and DP telegrams

Scout USBL Equipment List

Key: ● = Required ○ = Optional
(Please refer to separate technical datasheets)

● Software Scout (Std, Plus or Pro)
○ Software Viewpoint Navigation
● Type 8038 Surface Interface Unit
○ Type 8039 Surface Command Unit
○ Type 8020 Navigation Command Unit
● Type 8024 Scout USBL Transceiver
● Type 7815 Coastal Transponder
○ Type 7980 LRT Transponder
○ Type 8044 LAT Transponder
○ Type 8070/71 Wideband Sub Mini Transponder

Other Acoustic Positioning Systems from Sonardyne

- Ranger 2 USBL
- Fusion 6G® LBL
- Marksman LUSBL
- Prospector LBL

Scout Key Technology

Multiple Target Tracking
Scout USBL can track up to 10 mobile targets simultaneously up to ranges of 1,000 metres. With the 'ping stacking' software feature enabled in Scout Pro, one second position updates can be achieved.

Quick and Easy to Deploy
As soon as a boat arrives on location and deploys its USBL transceiver, tracking of divers and underwater targets can begin. This makes operations using Scout fast and efficient.

Portable
Scout can be operated from almost any size boat including small RIBs. The transponders designed for use with the system are small and robust, ideal when space on an ROV or towfish is restricted.

Heading Sensor
Scout's transceiver is fitted with an internal motion sensor that automatically compensates for the dynamic motion of the boat. For the highest accuracy, Scout Plus and Pro can be interfaced to external reference sensors such as Sonardyne's Lodestar AHRS can be used.

Support
Need to get in touch? Sonardyne's customer support team are available around the clock to get you the answers you need. From advice on which product to use to operational support, it's all part of the service.

Norbit Multibeam

NORBIT
- explore more -

DATASHEET - PS-120006-12

NORBIT - iWBMS TURNKEY MULTIBEAM SONAR SYSTEM

For High Resolution Bathymetry

Introducing the all-new, compact and high-resolution curved array bathymetric mapping system by NORBIT.

This all-in-one tightly integrated broadband multibeam turnkey solution offers high resolution bathymetry over a wide swath. The high-end sonar with globally leading GNSS/Inertial Navigation System embedded into the unit ensures fast and reliable mobilization and highest quality sounding for installations in all conditions.

The WBMS-series are based on a flexible sonar platform that utilizes the latest in analog and digital signal processing. With broad R&D expertise NORBIT has developed, from the ground-up, exciting new technology that allows existing and new applications to benefit from the advantages offered by a compact wideband curved-array multibeam sonar.

Features

- ✓ State-Of-The-Art Curved Array Multibeam Sonar Tightly Integrated with High-end GNSS-aided Inertial Navigation System
- ✓ 80kHz Bandwidth
- ✓ Side-scan, Water Column, Backscatter, Snippets
- ✓ Simple Ethernet Interface
- ✓ Integrated Sound Velocity Probe
- ✓ Hydrodynamic Fairing
- ✓ Mounting Bracket Included
- ✓ FM & CW Processing
- ✓ Flexible Power
- ✓ Exceeds IHO Special Order, CHS Exclusive Order & USACE New Work

Applications

- ✓ Shallow Water Bathymetry
- ✓ Pipeline Surveys
- ✓ Pond, River and Estuary Surveys
- ✓ Harbor and Lake Surveys
- ✓ USV & UUV
- ✓ MCM & Littoral Combat Zone Surveys
- ✓ Open Ocean Coastal Surveys

Options

- ✓ Senior Hydrographer For Support and Training
- ✓ Sound Velocity Profiler
- ✓ Laptop
- ✓ Turnkey Survey Solutions
- ✓ Permanent Hull Mount Option
- ✓ Pole Mount and Travel Option
- ✓ 200kHz Version
- ✓ Narrow Beam Along Track 0.9°
- ✓ Top-end INS (Roll, Pitch & Heading 0.01degree)
- ✓ Entry level INS
- ✓ Acquisition, Navigation and Post Processing Software
- ✓ Can be Delivered with all Major Software Packages e.g. HYPACK, QINSy, EIVA, CARIS and Others

EXPERTS in sensor equipment providing telemetry and communication solutions for harsh environments.
NORBIT develops and delivers innovative products - allowing you to explore more.

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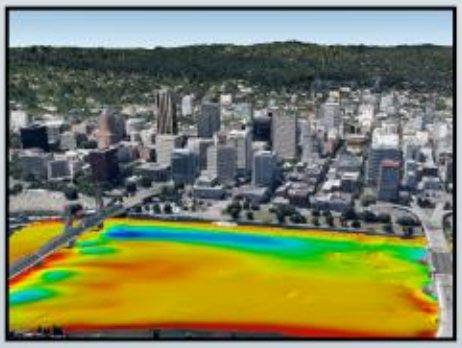
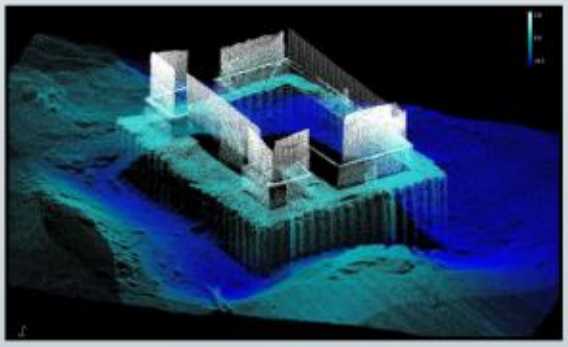
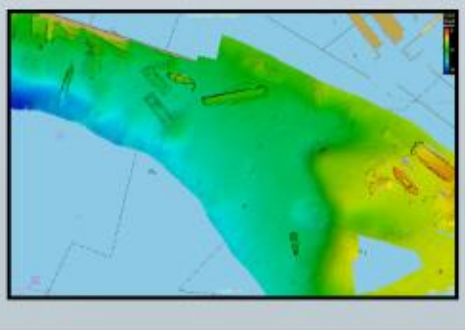
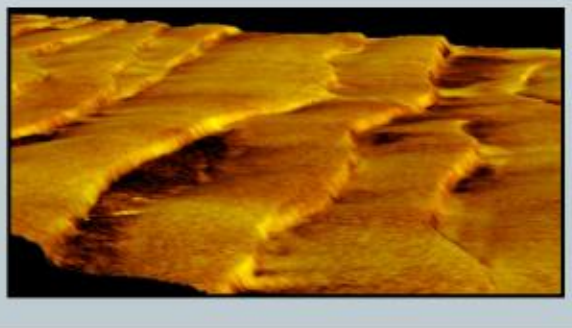
DATASHEET - PS-120006-12

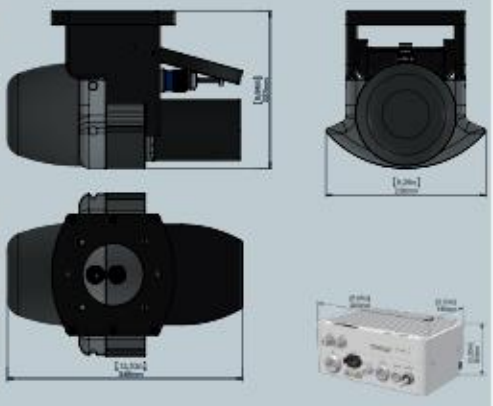
NORBIT iWBMS Wideband Multibeam Sonar

For High Resolution Bathymetry

TECHNICAL SPECIFICATION

SWATH COVERAGE	7-210° (150° NOMINAL)
RANGE RESOLUTION	<10mm (ACOUSTIC)
NUMBER OF BEAMS	256-512 EA & ED
OPERATING FREQUENCY	400kHz w/ 80kHz BANDWIDTH (LOW FREQ MODE AND HIGH RES MODE)
DEPTH RANGE	0.2-275m (160m TYPICAL)
PING RATE	UP TO 50Hz, RANGE DEPENDENT
RESOLUTION	0.9° ACROSS, 1.9° ALONG @400kHz. OPTION: ALONG 0.9°
POSITION	HOR: ±(8MM +1PPM X DISTANCE FROM RTK STATION) VER: ±(15MM +1PPM X DISTANCE FROM RTK STATION) (ASSUMES 1M GNSS SEPARATION)
HEADING ACCURACY	0.03° (RTK) WITH 2m ANTENNA SEPARATION
PITCH/ROLL ACCURACY	0.02° INDEPENDENT OF ANTENNA SEPARATION
HEAVE ACCURACY	5cm or 5% (2cm RTK)
WEIGHT	APPROX. 9.5kg (AIR) LESS THAN 6kg (WATER)
INTERFACE	ETHERNET
CABLE LENGTH	STD 8m, OPTIONS: 20m, PIGTAIL, CUSTOM UP TO 50m
POWER CONSUMPTION	60W (80W MAX) (10-28VDC, 110-240VAC)
OPERATING TEMPERATURE	-4°C to +40°C (TOPSIDE -25°C to +40°C)
STORGAGE TEMPERATURE	-20°C to +60°C
ENVIRONMENTAL	TOPSIDE: IP67: DUST TIGHT, PROTECTED AGAINST THE EFFECT OF IMMERSION UP TO 1m/WET-END: 100m



Part #12004

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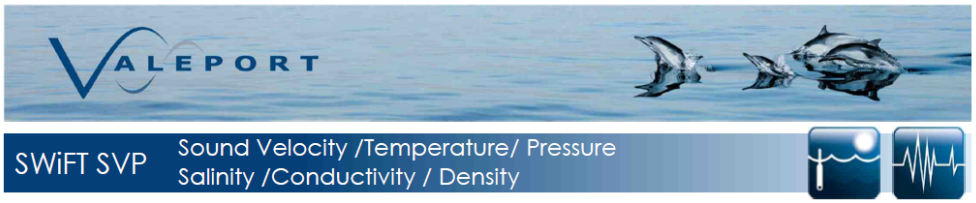
Valeport SVP



Designed from the outset with the intention of a seamless workflow, the SWiFT profiler provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity and rechargeable batteries. An integral GPS module, to geo-locate each profile, completes the package. Data can be easily and quickly downloaded and reviewed wirelessly, via Bluetooth, using the SWiFT App on iOS devices and instantly shared, in industry standard SVP formats through email and cloud services. Using the provided USB adapter or cable, Valeport's DataLog x2 software package provides further tools.

In addition to the directly measured sound speed, temperature and pressure observations, Conductivity, Salinity and Density are calculated using Valeport's proprietary algorithm developed from extensive laboratory and field work.

With an operational battery life of up to 5 days and the convenience of charging via USB, SWiFT is intended for coastal, harbour and inland hydrographic survey use and offers the highest quality sound velocity profiles in a compact, robust and portable package.

Optionally, the supplied deployment weight is available to bolt onto the sensor protection cage to help get the SWiFT to depth in fast flowing currents.

Sensor Specifications
The SWiFT SVP is fitted with Valeport's digital time of flight sound velocity sensor, temperature compensated piezo-resistive pressure transducer and a PRT temperature sensor

Sound Velocity	
Range:	1375 – 1900 m/s
Resolution:	0.001 m/s
Accuracy:	±0.02 m/s
Pressure	
Range:	10 Bar or 20Bar
Resolution:	0.001% FS
Accuracy:	±0.05% FS
Temperature	
Range:	-5°C to +35°C
Resolution:	0.001°C
Accuracy:	±0.01°C
Calculated Accuracies	
Conductivity:	±0.05 mS/cm
Salinity:	±0.05 PSU
Density:	±0.05 kg/m³
Physical	
Materials:	Titanium Stainless Steel deployment weight
Depth Rating:	200m
Dimensions:	Ø78mm x Length 277mm 321mm with deployment weight
Weight:	2.0kg (in air) / 0.9kg (in water) 3.0kg (in air) /1.8kg (in water) with deployment weight

Communications (set up and data offload)
USB Serial
Bluetooth v4 - low energy

Memory
2 GB Internal Flash Card Storage

Electrical

Battery:	Internal Rechargeable Battery Pack
Battery Life:	Up to 5 days of operations
Charging:	USB typically, 1 hour fast charging will give 12 hours operation

Software
iOS App for Bluetooth 4 compatible iPad and iPhone – instrument set up, data offload, display and translation to common SVP formats, Android to follow.
DataLog x2 Windows based PC software, with both USB cable and Bluetooth 4 connectivity, for instrument setup, data extraction, display and translation to common SVP formats.

Ordering

0660047 **XX**	SWIFT SVP Profiler - Titanium housing rated to 200m
Note:	**XX** pressure transducer range - select from 10 or 20 Bar
	Supplied with: • Deployment weight • 20m deployment line • PC Bluetooth adapter • USB interface and charging cable • 1.5 A charger • DataLog x2 software, operating manual • System transit case

Data Sheet Reference: SWiFT SVP - May 2016
As part of our policy of continuing development, we reserve the right to alter at any time, without notice, all specifications, designs, prices and conditions of supply of all equipment
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Valeport Monitor SVP

MONITOR SVP Sound Velocity Profiler

The MONITOR SVP has been developed from Valeport's world leading MIDAS SVP, utilising the exceptional digital time of flight sound velocity sensor and synchronised sampling technique, but packaged as a smaller, lightweight unit to suit small boat or shallow water applications.

Sensors

The MONITOR SVP is fitted with Valeport's digital time of flight sound velocity sensor, a fast response PRT temperature sensor, and strain gauge pressure transducer.

Sound Velocity

Range:	1375 – 1900 m/s
Resolution:	0.001 m/s
Accuracy:	±0.02 m/s

Temperature

Range:	-5°C to +35°C
Resolution:	0.005°C
Accuracy:	±0.01°C

Pressure

Range:	50 Bar standard, others available
Resolution:	0.005% range
Accuracy:	±0.1% range

Data Acquisition

The MONITOR SVP uses the concept of distributed processing, where each sensor has its own microprocessor controlling sampling and calibration of readings. Each of these is then controlled by a central processor, which issues global commands and handles all the data. This means that all data is sampled at precisely the same instant, giving superior quality profile data.

Sampling Modes

Continuous:	Regular output from all sensors at 1, 2, 4 or 8Hz.
Burst:	Regular sampling pattern, where instrument takes a number of readings, then sleeps for a defined time.
Trip/Profile:	Data is output as a chosen parameter changes by a set value, usually Pressure for profiling.
Conditional:	Instrument sleeps until a selected parameter reaches a set value.
Delay:	Instrument sleeps until predefined start time

Communications

The instrument will operate autonomously, with setup and data extraction performed by direct communications with PC before and after deployment. It also operates in real time, with a choice of communication protocols for a variety of cable lengths, all fitted as standard and selected by pin choice on the output connector:

Standard

RS232	Up to 200m cable, direct to serial port via USB adaptor
RS485	Up to 1000m cable, addressable half duplex comms
Baud Rate:	2400 - 115200 (FSK fixed at 19200, USB 460800)
Protocol:	8 data bits, 1 stop bit, No parity, No flow control

Memory

The MONITOR SVP is fitted with 16Mb solid state non-volatile FLASH memory. Total capacity depends on sampling mode; continuous & burst modes have a single time stamp at the start of the file, trip mode (profiling) stores a time stamp with each reading. A single line of SVP data uses 8 bytes, and a time stamp uses 7 bytes.

Continuous:	>1,000,000 data points
Profile:	>500,000 data points (>500 profiles to 500m).

Electrical

Internal:	8 x C cells, 1.5v alkaline or 3.6v lithium
External:	9 - 30vDC
Power:	0.6W (sampling), <1mW (sleeping)
Battery Life:	<100 hours operation (alkaline) <250 hours operation (lithium)
Connector:	Subconn MCBH10F

Physical

Materials:	Acetal housing, polycarbonate and composite sensor components, stainless steel (316) cage
Depth Rating:	500m
Instrument Size:	88mmØ x 540mm long
Cage Size:	640 x 140 x 120mm
Weight (in cage):	7.5kg (in air), 4.5kg (in water)
Shipping:	74 x 35 x 27cm, 17kg

Software

System is supplied with DataLog Express Windows based PC software, for instrument setup, data extraction and display. DataLog Express is license free.

Ordering

0650008-XX	MONITOR SVP Profiler, supplied with deployment cage, Subconn switch plug, 3m communications lead, USB adaptor, DataLog Express software, manual, tool kit and transit case.
Note:	XX denotes pressure transducer range. Select from 10, 20, 30 or 50bar

Datasheet Reference: MONITOR SVP version 2c, Oct 2013

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AML SVS

Xchange™
Field-Swappable Sensors


CT•Xchange™


SV•Xchange™


P•Xchange™


C•Xchange™


T•Xchange™


Tu•Xchange™

Xchange™ is the industry's only family of field-swappable sensor heads. Each sensor head contains its own embedded calibration, and can be moved from instrument to instrument without impacting field accuracy. Changing sensors is easy: simply unscrew one sensor head and replace it with another.

Key Benefits:

- Elimination of instrument downtime - time when the instrument cannot be used because it is en-route from the vessel to recalibration, at the service centre for recalibration, or en-route to the vessel from recalibration. With Xchange™ sensors, recalibrated sensors are sent to the instrument, instead of sending the instrument to the recalibration centre.
- Reduction in transportation and logistics costs - shipping, duties, and brokerage fees - related to shipping large instruments back for recalibration. With Xchange™, small sensor heads are shipped instead of heavy instruments.
- Increased flexibility for service managers, because a recalibration becomes a mobile asset that can be plugged into any X•Series instrument. Field-swappable sensor heads enable any organization - big or small - to become a virtual recalibration centre by stocking spare calibrated sensor heads.
- Multi-range instruments - the ability to change sensor range on any instrument to suit specific deployment requirements. This means instrument duplicates (identical instruments dedicated to different pressure ranges) become a thing of the past.
- Improved absolute pressure accuracy. You may choose the best full scale pressure range to suit your deployment depth.
- Greater system redundancy resulting from the ease of deploying spare sensors into the field.

Xchange™ sensor heads are used exclusively with X•Series instrumentation. Total flexibility of instrument model, sensor type, and sensor range ensures that the right instrument is always available. Please refer to the X•Series brochure for a list of instruments, applications, and specifications.

Sound Velocity / CTD / Multiparameter
Biofouling Control / Deployment Systems

AML OCEANOGRAPHIC
Xchange your old ideas

Available Xchange™ Sensors

	UPC Code	Port Type	Maximum Depth (m)	Range	Precision (+/-)	Accuracy (+/-)	Resolution	Response Time	Notes
C•Xchange™ Conductivity Sensor	XCH-CND-RA002	P	6000	0-2 mS/cm	0.003 mS/cm	0.01 mS/cm [5]	0.001 mS/cm	25 ms [6]	Right Angle Flow
	XCH-CND-RA090			0-90 mS/cm [1]					
	XCH-CND-ST090								Straight Flow
CT•Xchange™ Conductivity Temperature Sensor	XCH-CT-RA-090-n545	P	6000	CND: 0-90 mS/cm [1] TMP: -5-45 °C [2]	CND: 0.003 mS/cm TMP: 0.003 °C	CND: 0.01 mS/cm [5] TMP: 0.005 °C	CND: 0.001 mS/cm TMP: 0.001 °C	CND: 25 ms [6] TMP: 100 ms	Combined Conductivity & Temperature
SV•Xchange™ Sound Velocity Sensor	XCH-SV-STD	P	6000	1375-1625 m/s	0.006 m/s	0.025 m/s	0.001 m/s	20 ms	Typical Oceanographic
	XCH-SV-1120			1100-2000 m/s	0.02 m/s	0.5 m/s			Brine Solutions
	XCH-SV-0520			500-2000 m/s		1.0 m/s			Special fluids
P•Xchange™ Pressure Sensor	XCH-PRS-0050	S	50	0-50 dBar	0.03% FS	0.05% FS	0.02% FS	10 ms	Piezo-Resistive
	XCH-PRS-0100		100	0-100 dBar					
	XCH-PRS-0200		200	0-200 dBar					
	XCH-PRS-0500		500	0-500 dBar					
	XCH-PRS-1000		1000	0-1000 dBar					
	XCH-PRS-2000		2000	0-2000 dBar					
	XCH-PRS-4000		4000	0-4000 dBar					
	XCH-PRS-5000		5000	0-5000 dBar					
	XCH-PRS-6000		6000	0-6000 dBar					
T•Xchange™ Temperature Sensor	XCH-TMP-n545	S	6000	-5-45 °C [2]	0.003 °C	0.005 °C	0.001 °C	100 ms	Extended Oceanographic
Tu•Xchange™ Turbidity Sensor	XCH-TRB-A3000-03	S	300	0-3000 NTU [3]	0.5% reading or 0.1 NTU [4]	2% reading or 0.2 NTU [4]	0.01 NTU	<0.7 s	Auto-ranging
	XCH-TRB-A3000-02W		200						Auto-ranging Wiper-equipped

X•Series instruments and sensor heads must be ordered separately. All specifications subject to change without notice.
[1] Will over-range to 100 mS/cm. Inquire for specifications.
[2] Will over-range to 60 °C. Inquire for specifications.
[3] Digital auto-ranging
[4] Whichever is greater
[5] Stability is +/-0.003 mS/cm/month when combined with UV•Xchange™
[6] At 1 m/s flow

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Mar. 2017

Survey Vessel Norse

Geometrics Magnetometer

GEOMETRICS

G-882 MARINE MAGNETOMETER

- ***CESIUM VAPOR HIGH PERFORMANCE – Highest detection range and probability of detecting all sized ferrous targets***
- ***NEW STREAMLINED DESIGN FOR TOW SAFETY – Low probability of fouling in lines or rocks***
- ***NEW QUICK CONVERSION FROM NOSE TOW TO CG TOW – Simply remove a stainless steel locking pin, move tow point and reinsert. New easy carry handle built in!***
- ***NEW INTERNAL CM-221 COUNTER MODULE – Provides Flash Ram for storage of default parameters set by user***
- ***NEW ECHOSOUNDER / ALTIMETER OPTION***
- ***NEW DEPTH RATING – 4,000 psi !***
- ***HIGHEST SENSITIVITY IN THE INDUSTRY – 0.004 nT/Hz RMS with the internal CM-221 Mini-Counter***
- ***EASY PORTABILITY & HANDLING – no winch required- single man operation, 44 lbs with 200 ft cable (without weights or depressor wing)***
- ***COMBINE TWO SYSTEMS FOR INCREASED COVERAGE – Internal CM-221 Mini-Counter provides multi-sensor data concatenation allowing side by side coverage which maximizes detection of small targets and reduces noise***

G-882 with Weight Collar Depth Option

Very high resolution Cesium Vapor performance is now available has been incorporated into a low cost, small size system for professional surveys in shallow or deep water. High sensitivity and sample rates of total field measurements are maintained for all applications. The well proven Cesium sensor is combined with a unique new CM-221 Larmor counter and ruggedly packaged for small or large boat operation. Use your computer and standard printer with our MagLog Lite™ software to log, display and print GPS position and magnetic field data. Model G–882 is the lowest priced - highest performance fully operational marine mag system ever offered.

The G-882 is flexible for operation in small boat, shallow water surveys as well as deep tow applications (4,000 psi rating, telemetry over steel coax available to 10Km). Being small and lightweight (44 lbs net, no weights) it is easily deployed and operated by one man. But add several no-foul weight collars and the system can quickly weigh in at more than 100 lbs. Power may be supplied from a 24 to 30 VDC battery supply or the included 110/220 VAC power supply. The tow cable uses high strength Kevlar and it's length is standard at 200 ft (61 m) with optional cable up to 500m (no telemetry). The shipboard end of the tow cable is attached to a junction box or on-board cable for quick and simple hookup to power and output of data into any IBM PC computer. A rugged fiber-wound fiberglass housing provides selectable orientation of the sensor and therefore maintains operations throughout the world with only small limitations as to direction of survey in equatorial regions.

The G-882 Cesium magnetometer provides the same operating sensitivity and sample rates as the larger deep tow model G-880. MagLogLite™ Logging Software is offered with each magnetometer and allows recording and display of data and position with Automatic Anomaly Detection! Additional options include: MagMap2000 plotting and contouring software and post acquisition processing software MagPick™ (free from our website.)

The G-882 system is particularly well suited for the detection and mapping of all sizes of ferrous objects. This includes anchors, chains, cables, pipelines, ballast stone and other scattered shipwreck debris, munitions of all sizes, aircraft, engines and any other object with magnetic expression. Objects as small as a 5 inch screwdriver are readily detected provided that the sensor is close to the seafloor and within practical detection range.(Refer to table at right).

The design of this special marine unit is directed toward the largest number of user needs. It is not intended to meet all marine requirements such as deep tow through long cables or monitoring fish altitude. Rugged design with highest performance at lowest cost are the goals.

Typical Detection Range For Common Objects

Ship 1000 tons	0.5 to 1 nT at 800 ft (244 m)
Anchor 20 tons	0.8 to 1.25 nT at 400 ft (120 m)
Automobile	1 to 2 nT at 100 ft (30 m)
Light Aircraft	0.5 to 2 nT at 40 ft (12 m)
Pipeline (12 inch)	1 to 2 nT at 200 ft (60 m)
Pipeline (6 inch)	1 to 2 nT at 100 ft (30 m)
100 KG of iron	1 to 2 nT at 50 ft (15 m)
100 lbs of iron	0.5 to 1 nT at 30 ft (9 m)
10 lbs of iron	0.5 to 1 nT at 20 ft (6 m)
1 lb of iron	0.5 to 1 nT at 10 ft (3 m)
Screwdriver 5 inch	0.5 to 2 nT at 12 ft (4 m)
1000 lb bomb	1 to 5 nT at 100 ft (30 m)
500 lb bomb	0.5 to 5 nT at 50 ft (16 m)
Grenade	0.5 to 2 nT at 10 ft (3 m)
20 mm shell	0.5 to 2 nT at 5 ft (1.8 m)

MODEL G-882 CESIUM MARINE MAGNETOMETER SYSTEM SPECIFICATIONS

OPERATING PRINCIPLE:	Self-oscillating split-beam Cesium Vapor (non-radioactive)
OPERATING RANGE:	20,000 to 100,000 nT
OPERATING ZONES:	The earth's field vector should be at an angle greater than 6° from the sensor's equator and greater than 6° away from the sensor's long axis. Automatic hemisphere switching.
CM-221 COUNTER SENSITIVITY:	<0.004 nT/√Hz rms. Typically 0.02 nT P-P at a 0.1 second sample rate or 0.002 nT at 1 second sample rate. Up to 10 samples per second
HEADING ERROR:	±1 nT (over entire 360° spin and tumble)
ABSOLUTE ACCURACY:	<3 nT throughout range
OUTPUT:	RS-232 at 9600 Baud
MECHANICAL:	
Sensor Fish:	Body 2.75 in. (7 cm) dia., 4.5 ft (1.37 m) long with fin assembly (11 in. cross width), 40 lbs. (18 kg) Includes Sensor and Electronics and 1 main weight. Additional collar weights are 14lbs (6.4kg) each, total of 5 capable
Tow Cable:	Kevlar Reinforced multiconductor tow cable. Breaking strength 3,600 lbs, 0.48 in OD, 200 ft maximum. Weighs 17 lbs (7.7 kg) with terminations.
OPERATING TEMPERATURE:	-30°F to +122°F (-35°C to +50°C)
STORAGE TEMPERATURE:	-48°F to +158°F (-45°C to +70°C)
ALTITUDE:	Up to 30,000 ft (9,000 m)
WATER TIGHT:	O-Ring sealed for up to 9000 ft (2750 m) depth operation
POWER:	24 to 32 VDC, 0.75 amp at turn-on and 0.5 amp thereafter
ACCESSORIES:	
Standard:	CM-201 View Utility Software operation manual and ship case
Optional:	Telemetry to 10Km coax, gradiometer (longitudinal or transverse)
MagLog Lite™ Software:	Logs, displays and prints Mag and GPS data at 10 Hz sample rate. Automatic anomaly detection and single sheet Windows printer support

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE ***4/03***

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GEOMETRICS

NAViSTAK

NAViSTAK

HYDROFIX

Designed by Hydrofix, NAViSTAK is a compact modular survey system, that offers reliability, redundancy, performance, flexibility, and quick mobilisations. The size and weight is a crucial factor with transportation and installation on vessels of all sizes.

The core module is a self-contained system that can be expanded internally or with further modules that can be stacked and locked together (No need for a vessel with their own server cabinet). Further modules can contain for example geophysical equipment, further UPS's and larger MBES systems. The compact core module contains everything needed for a typical hydrographic survey (Positioning, multibeam surveys etc.)

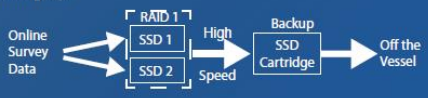
Compact
Multiple Redundancies
Versatile
Expandable
High Performance
Data Safety
Time and Cost Savings

Workstation

The workstations are compact, but at the same time remaining versatile and powerful. They are powered by a 7th generation i7 processor with 16GB of RAM and contain a wide range of inputs and outputs:

4 x gigabit network ports
4 x flexible display outputs (VGA, DVI, HDMI, mDP & DP)
3 x true serial ports (Motherboard - RS232 & RS422)
6 x USB 3.0 ports (2 USB 2.0)

The workstations are equipped exclusively with solid state drives and importantly the data SSD's are raided for redundancy. Backup is carried out by using drive cartridges, available with both standard 2.5" HDD or 2.5" SSDs. They connect straight to SATA6 which enables the fastest regular backups during the day or end of day backups (Over 500MB/s transfer with SSD cartridges).



Core Module - Standard Equipment

2 identical survey workstations (1 for redundancy)
Trimble GNSS and heading
UPS
Serial server (RS232 & RS422)
USB to 8 Port RS232 (Backup)
QPS PPS TTL Adapter
GSM Modem (inc. serial input)
Gigabit switch
Network attached storage

Case

Compact
Shock protection
Waterproof
Stackable and lockable

Length:	58cm
Length inc lids:	78.5cm
Width:	55.5cm
Height:	46cm

www.hydrofix.co.uk

Edgetech 4200

EdgeTech

4200 SERIES

SIDE SCAN SONAR SYSTEM

FEATURES

- Optional Multi-Pulse (MP) technology for high speed surveys
- Crisp, high resolution CHIRP images
- Multiple dual simultaneous frequency sets to choose from
- Stainless steel towfish
- Easily integrates to other 3rd party sensors
- Meets IHO & NOAA Survey Specifications

APPLICATIONS

- Cable & Pipeline Surveys
- Geological/Geophysical Surveys
- Mine Countermeasures (MCM)
- Geohazard Surveys
- Channel Clearance
- Search and Recovery
- Archeological Surveys

The 4200 Series is a versatile side scan sonar system that can be configured for almost any survey application from shallow to deep water operations. The 4200 utilizes EdgeTech's Full Spectrum® CHIRP technology to provide crisp, high resolution imagery at ranges up to 50% greater than non-CHIRP systems; thus allowing customers to cover larger areas and save money spent on costly surveys.

One of the unique features of the 4200 is the optional Multi-Pulse (MP) technology, which places two sound pulses in the water rather than one pulse like conventional side scan sonar systems. This allows the 4200 to be towed at speeds of up to 10 knots while still maintaining 100% bottom coverage. In addition, the MP technology will provide twice the resolution when operating at normal tow speeds, thus allowing for better target detection and classification ability. The addition of the optional MP technology provides the operator with two modes of operation; either High Definition Mode (HDM) or High Speed Mode (HSM). This software-selectable mode of operation provides the operator the ability to select the best configuration for the specific job type.

All EdgeTech 4200 systems are comprised of a topside system and a reliable stainless steel towfish. A choice of dual simultaneous frequency sets are available to the user and topside processors come in a choice of configurations from portable to rack mounted units. In addition, an easy-to-use GUI software is supplied with every unit.

For more information please visit EdgeTech.com

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EdgeTech

4200 SERIES

SIDE SCAN SONAR SYSTEM

KEY SPECIFICATIONS

SONAR SPECIFICATIONS	STANDARD	WITH OPTIONAL MP TECHNOLOGY	
Frequency	Choice of either 100/400, 100/600, 300/600 or 300/900 kHz dual simultaneous		
Operating Range (meters/side)	100 kHz: 500m, 300 kHz: 230m, 400 kHz: 150m, 600 kHz: 120m, 900 kHz: 75m		
Horizontal Beam Width:	100 kHz: 1.5°, 300 kHz: 0.5°, 400 kHz: 0.4°, 600 kHz: 0.26°, 900 kHz: 0.2°	In High Speed Mode: 100 kHz: 1.26°, 300 kHz: 0.54°, 400 kHz: 0.4°, 600 kHz: 0.34°, 900 kHz: 0.3° In High Definition Mode: 100 kHz: 0.64°, 300 kHz: 0.28°, 400 kHz: 0.3°, 600 kHz: 0.26°, 900 kHz: 0.2°	
Resolution Along Track	100 kHz: 5 m @ 200 m 300 kHz: 1.3 m @ 150 m 400 kHz: 0.6 m @ 100 m 600 kHz: 0.45 m @ 100 m 900 kHz: 18 cm @ 50 m	High Definition Mode: 100 kHz: 2.5m @ 200m 300 kHz: 1.0m @ 200m 400 kHz: 0.5m @ 100m 600 kHz: 0.45m @ 100m 900 kHz: 18 cm @ 50m	HIgh Speed Mode: 100 kHz: 4.4m @ 200m 300 kHz: 1.9m @ 200m 400 kHz: 0.7m @ 100m 600 kHz: 0.6m @ 100m 900 kHz: 26 cm @ 50m
Resolution Across Track	100 kHz: 8 cm, 300 kHz: 3 cm, 400 kHz: 2 cm, 600 kHz: 1.5 cm, 900 kHz: 1 cm		
Vertical Beam Width	50°		
Depression Angle	Tilted down 25°		
TOWFISH	**STAINLESS STEEL**		
Diameter	11.4 cm (4.5 inches)		
Length	125.6 cm (49.5 inches)		
Weight in Air/Saltwater	48 / 36 kg (105 / 80 pounds)		
Depth Rating (Max)	2,000m		
Standard Sensors	Heading, pitch & roll		
Optional Sensor Port	(1) Serial – RS 232C, 9600 Baud, Bi-directional & 27 VDC		
Options	Pressure Sensor, Magnetometer, Integrated USBL Acoustic Tracking System, Built-in Responder Nose, Depressor, Power Loss Pinger and Custom Sensors		
TOPSIDE PROCESSOR	**4200-P**	**4200**	**701-DL INTERFACE**
Hardware	Portable splash-proof case	19" rack mount computer	19" rack mount interface
Display & Interface	Laptop Computer (Optional: Splash Proof/Ruggedized Laptop)	23" flat panel monitor, keyboard & trackball	Customer-supplied
Power Input	20-36 VDC or 115/230 VAC	115/230 VAC	115/230 VAC
Operating System	Windows© 7		
File Format	Native JSF or XTF		
Output	Ethernet		
TOW CABLE			
	Coaxial Kevlar or double-armored up to 6,000m, winches available		

For more information please visit EdgeTech.com

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Applied Acoustics CSP-P350

APPLIED ACOUSTICS
Underwater Technology

Applied Acoustic Engineering Ltd
Marine House, Marine Park, Gapton Hall Road, Great Yarmouth, NR31 0NB, United Kingdom

CSP-P Seismic Energy Source

The CSP-P is a small, light 350 Joule power source intended primarily as a boomer power supply but it can be used with small sparkers.

Recently upgraded, the CSP-P now incorporates dual-voltage technology that allows the operator to tune the sound source to a particular application for improved data quality.

Key Features

- **Incorporates dual-voltage technology for exceptional versatility**
- **Variable Input Power Circuitry for 'soft start'**
- **Proprietary pulse shaping circuitry for high resolution data**
- **Additional safety/protection features**
- **All settings externally selectable**
- **LED fault indicators**
- **High current and voltage solid state (semi-conductor) discharge method**
- **Meets EC emissions regulations enabling interference-free field use**
- **Supplied in robust transit case, with HV junction box (HVJ2000), mains lead and HV connector plug**

Technical Specification

PHYSICAL

Size	Transit Case (4U) with cover in place and handles flat: 29cm(H) x 56cm(W) x 56cm(D)
Weight	CSP-P, case and cover: 35kg

ELECTRICAL SPECIFICATION

Mains Input	110 or 240Vac (fixed) 45-65Hz@2.0kVA single phase. 3 pin connector Variable Input Power Circuitry (AVIP) 'soft start' circuitry
Voltage Output	2500 to 3950 Vdc, 4 pin interlocked connector Solid state semi-conductor discharge method
Output Energy	Easy switch selectable in increments 50,100,150,200,300 and 350 Joules
Charging Rate	1500J/second for continuous operation at 0-45°C ambient

APPLIED ACOUSTICS
Underwater Technology

CSP-P Technical Specification continued...

Capacitance	48µF at 10^8 shot life
Trigger	+ve key opto isolated or isolated closure set by front panel switch BNC connector on front panel and remote box (optional)
Repetition rate	6pps max Limited by charge rate, energy level and sound source rating
Earth	M8 stainless steel stud on front panel

SAFETY FEATURES

Main electronic control circuits and secondary layer of safety circuitry
Specially designed HV connector with interlock
High speed dump resistors for high voltage components
Capacitor bleed resistors
Open circuit shutdown
Timer shutdown
Output current monitor and shutdown
Over temperature shut-down
Cover and connector interlocks
HV fault indicator for internal temperature, low input voltage or capacitor fault
Remote control available for triggering and operation

The unit's internal design has a modular construction for ease of servicing and capacitor replacement. However, for safety reasons, only Applied Acoustics trained engineers should attempt a repair.

COMPATIBLE SOUND SOURCES

AA201, AA251 and AA301 Boomer plates
Squid 501 Sparker

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