Iarnród Éireann
Irish Rail

Rosslare ORE Hub

EIAR Technical Appendices

Technical Appendix 7:

Soils, Geology, Hydrogeology and Contamination

Appendix B: Bathymetry

1. HSL Survey CAD Drawings

2. Hydromaster Survey Report

venterra | GDG

NICHOLAS O'DWYER
an RSK company

Co-funded by the European Union

VOLUME CALC EXTENTS

SURVEY AREA EXTENTS

D01

D02

D03

Navigation Buoy

Lighthouse (Flashing Green White & Red)

Rosslare Pier

BERTH NO. 4

BERTH NO. 3

BERTH NO. 2

ROSSLARE HARBOUR

Mooring Posts

HWM

R.N.L.I.

Breakwater

Ferry Terminal

Level Crossing

Platform

Car Park

Sand

GREENDRE PARK

Mary's Tce

Ard na Mara

Church (Cath)

Bank

Hotel

PO

Weather Station

St MARTIN'S ROAD

Reservoir (Covered)

GOULDING STREET

St CAWDOR

Tuskarmore

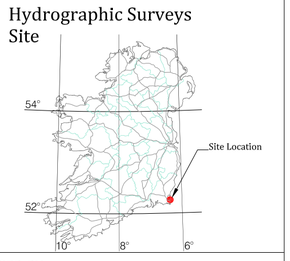
RB01 RB02 RB03 RB04 RB05 RB06 RB07 RB08 RB09

P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11

SITE: Overview Map at Rosslare Europort	
SHEET TITLE: Hydrographic Survey Results - Overview Map	
CLIENT: Iarnród Éireann	
SURVEYED BY: HYDROGRAPHIC SURVEYS LTD. The Cobbles Crosshaven Co. Cork tel: +353 21 4831184	
JOB NUMBER: HS23007B	
DRAWN BY: Robert Cahill	DRAWING NUMBER: HS23007B_D00
SCALE: 1:2500 ON A1	APPROVED: J.B.J.
REVISION: Rev.00	SURVEY DATE: 09/05/2023
COORDINATE SYSTEM: ING	DATUM: Chart Datum

SURVEY NOTES:
1. Surveyed in Irish National Grid.
2. Horizontal control by RTK GPS.
3. Soundings in metres and decimetres reduced to Chart Datum taken as being 1.69m below OD Malin. Positive soundings indicate depths below datum.

Hydrographic Surveys Site



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HYDRO SURVEY EST. 1979

113300

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313200

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Navigation Buoy

FISHERMANS QUAY

SITE:
Rosslare Europort - Monitoring
Hydrographic Surveys

SHEET TITLE:
Hydrographic Survey Results

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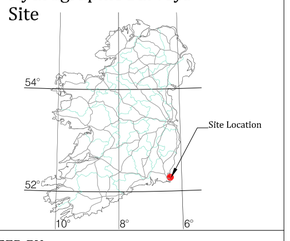

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112900

Lighthouse
(Flashing Green
White & Red)

Rosslare
Pier

Mooring Posts

HWM

BERTH NO. 1

BERTH NO. 2

BERTH NO. 3

RNLI

FISHERMAN'S QUAY

Level Crossing

Ferry Terminal

313400

313500

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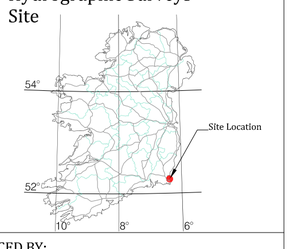

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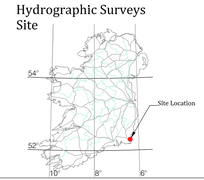

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Navigation Buoy

313100

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313300

FISHERMANS QUAY

BERTH

SITE:
Rosslare Europort - Monitoring Hydrographic Surveys

SHEET TITLE:
Hydrographic Survey Results Difference Map - difference between 9th May 2023 and 23rd Jan 2023.

CLIENT:
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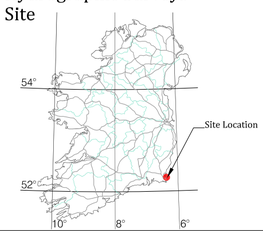
< -1.00	Shallower in current survey
-1.00 - -0.91	
-0.90 - -0.81	
-0.80 - -0.71	
-0.70 - -0.61	
-0.60 - -0.51	
-0.50 - -0.41	
-0.40 - -0.31	
-0.30 - -0.21	
-0.20 - -0.11	
-0.10 - -0.01	
0.00 - 0.09	No difference between current and previous survey
0.10 - 0.19	
0.20 - 0.29	
0.30 - 0.39	
0.40 - 0.49	
0.50 - 0.59	
0.60 - 0.69	
0.70 - 0.79	
0.80 - 0.89	
>= 0.90	Deeper in current survey

Hydrographic Surveys Site



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Lighthouse
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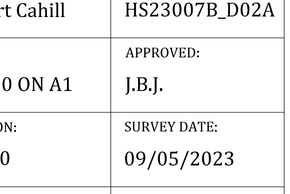

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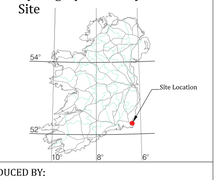

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Rosslare Europort Offshore Wind Hub
Geophysical Survey
Survey Report

Survey date	26th , 27th, 29th October 2023 & 07th November 2023 20th and 21st May 2024
Report date	29th May 2024
Location	Rosslare Europort, County Wexford
Coordinate system	Irish Transverse Mercator
Report Revision	0
Prepared by	MTAL
Checked by	BSMI

Hydromaster Ltd.
7 Howley Court,
Dublin Road
Oranmore
Co. Galway, Ireland

Tel: +353-86-0891047
E-mail: bsmith@hydromaster.ie

Report date	Report revision	Prepared by
21/06/2024	Rev 0 - First Draft for Client Review	MTAL

Table of Contents

List of Figures

List of Tables

Glossary of Definitions

BU	Bow Up	**MF**	Medium Frequency
CRS	Coordinate Reference System	**MBES**	Multi Beam Echo Sounder
ETRS89	European Terrestrial Reference System 1989	**NM**	Nautical Mile
GAMS	GPS Azimuth Measurement SubSystem	**OSGM**	Ordance Survey Geoid Model
GNSS	Global Navigation Satellite System	**PU**	Port Up
HF	High Frequency	**SBP**	Sub-Bottom Profiler
HP	Horsepower	**SBP-HF**	Sub-Bottom Profiler High Frequency
IMU	Inertial Measurement Unit	**SBP-MF**	Sub-Bottom Profiler Medium Frequency
ITM	Irish Transverse Mercator	**SSS**	Sidescan-sonar
LAT	Lowest Astronomical Tide	**WGS84**	World Geodetic System 1984

1. Introduction

Hydromaster were contracted by Causeway Geotech to carry out a marine geophysical survey for the Rosslare Europort Offshore Wind Hub project. The following report details the mobilisation and calibration activities, the survey operations and the results.

The scope of work for this project was to acquire, process and interpret marine geophysical data within the Rosslare ORE Hub Area if interest up to 2m LAT.

The survey was carried on 27th and 28th of October, on the 07th of November 2023 and on the 21st May 2024. The survey area presented some access difficulties relating shipping traffic. Further challenges relating to fishing gear on site and from difficulty in manoeuvring around the quay and marina structures with towed sensors and the effect of ferrous structures on magnetometer data.

2. Location

The survey area is located in the south-western area of the Irish Sea, in Rosslare Europort, County Wexford, as shown below with the red polygon. The white line represents the 2m LAT contours line.

Figure 1: Survey area (red polygon)

3. Survey methodology

3.1 General methodology

The geophysical survey was carried out to ensure a full seabed coverage up to 2m LAT when feasible, within the whole area (magenta polygon- figure 2).

The multibeam echosounder (MBES), the marine magnetometer, the sidescan sonar (SSS) and the sub-bottom profiler (SBP) surveys were conducted simultaneously at slow speed to ensure optimum quality data.

The boomer seismic survey was conducted within a specific area (cyan polygon – figure 2) and with a 50 meters line spacing.

Figure 2: Survey areas showing the boomer survey area in cyan.

The multibeam sonar transducer, IMU and Primary antenna were securely pole mounted. The sub-bottom profiler will also be pole mounted. The sidescan sonar was towed in water deeper than 6 m LAT, and a vessel mounted side-scan sonar was used in shallower water than 6m LAT. The sidescan sonar was towed at an altitude of about 10-15% of the range. The magnetometer was flown on the other side of the vessel, at an altitude of approximately 3-5 meters above the seabed.

A surface-towed Applied Acoustics AA200 Boomer with an 8-channel mini-streamer hydrophone system that acquires full waveform seismic data was mobilised. The boomer was towed from the stern of the vessel.

3.2 Survey tracklines

Figure 3 shows the geophysical survey tracklines. Some of the towed magnetometer survey lines were missed due to difficulty to manoeuvre around jetties and ships and due to fishing gears (figure 3) present on the shallow part of the site (SW).

Figure 3: Picture of some of the fishing gear present on site

Figure 4 shows the survey vessels tracklines per sensor.

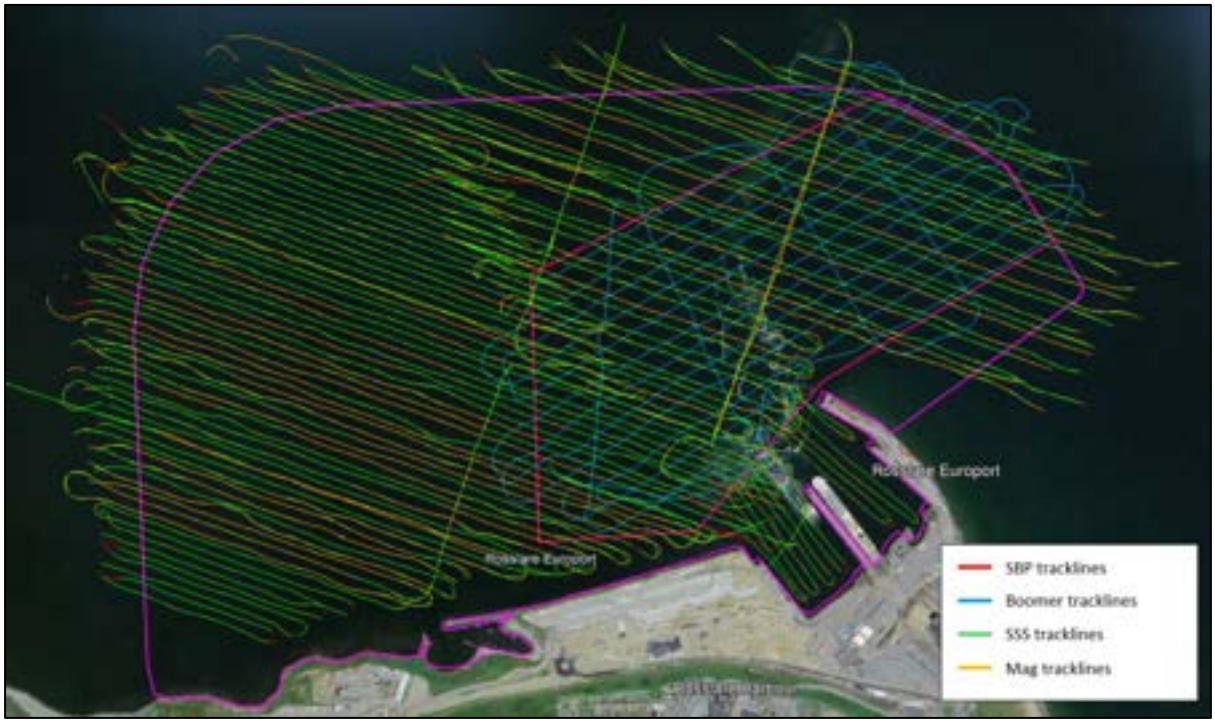


Figure 4: Geophysic and boomer survey tracklines

3.3 Geodetic parameters and vertical datum

All data were acquired in the Irish Transverse Mercator coordinate reference system.

Table 1. Project CRS parameters.

Local Datum Geodetic Parameters	
Datum:	ETRS89
Spheroid:	GRS80
Semi-Major Axis, a:	6,378,137 m
Inverse Flattening, 1/f:	298.257,222,101
Projection	
Projection Zone:	Irish Transverse Mercator
Central Meridian:	8°00’00.00”W
Latitude Of Origin:	53°30’00.00”N
False Easting:	600000 m
False Northing:	750000 m
Scale Factor:	0.99982
Units:	m
EPSG:	2157

Depth soundings values were reduced to Lowest Astronomical Tide (LAT) datum using the Vertical Offshore Reference Frame (VORF) model (LAT/WGS84 separation).

3.4 Survey Vessels

The vessel used for the geophysical survey was the Ros Aine (Figure 5). Summary specifications are listed in Table 2.

Figure 5: Ros Aine, survey vessel.

Table 2. Ros Aine specifications summary.

Vessel Specifications	
Length	13m
Beam	4m
Draft	0.8m
Coding	Irish P5 license 30NM offshore
Propulsion	2 x OXE 200HP outboards
Max Speed	25 knots

For the MF seismic survey, the Manannan vessel was used (figure 6). Summary specifications are listed in Table 3.

Figure 6: Manannan survey vessel

Table 3. Manannan specifications summary.

Vessel Specifications	
Length	11.4m
Beam	4.4m
Draft	0.8m
Coding	Irish P5 license 30NM offshore
Propulsion	2 x 420hp Iveco FPT NEF67 engines
Max Speed	28 knots

3.5 Survey equipment

Hydromaster Ltd. equipment mobilised on the vessel is detailed table 4.

Table 4. Equipment list.

Equipment list	
Sensor	**Make/Model**
GNSS positioning	Applanix Oceanmaster PosMV
Motion Reference Unit	Applanix Oceanmaster PosMV
Multibeam Echosounder	Teledyne T51
Sound Velocity Probe	Teledyne SVP 70
Sound Velocity Profiler	Valeport SWIFT
GNSS Rover	Carlson Brx6
Side Scan Sonar	Edgetech 4125
Magnetometer	Geometrics G882
Sub-bottom Profiler (SBP)	Innomar SES-2000
Boomer (BOOMER)	Applied Acoustic CSP-D 1200

The following frequencies were used during the survey:

Table 5. Sensor frequencies

System	Acquisition settings
MBES	Frequency: 800 kHz
SSS	Frequency 400/900 kHz
SBP	Frequency 12kHz/5 kHz
Boomer	Sample Frequency: 10 kHZ

3.6 Personnel

The following personnel were deployed on the project.

Table 6. Personnel on site

Name	Function
Thomas Devaux	Surveyor
Laura Fitzgerald	Geophysicist
Brian Smith	Senior Surveyor
Alyson Le Quilleuc	Surveyor
Adam Gould	Geophysicist

4. Vessel Geometry and Lever Arms

4.1 Ros Aine vessel geometry

All survey sensors were mounted according to the images shown below. The multibeam sonar, the sub-bottom profiler and one of the side-scan sonars were pole-mounted on the port side of the vessel. Offsets from primary GNSS antenna, sub-bottom profiler and side-scan sonar pole and suitable tow points for the side-scan sonar and magnetometer were measured from the central reference point using a steel tape measure. The central reference point is identified as the reference point on the top of the IMU.

Figure 7: SBP and MBES poles (top left), primary and heading GNSS antennas (top right) and mounting for IMU and MBES (bottom).

The multibeam sonar and IMU are mounted securely together on the same mounting bracket which is fixed to the same pole as the primary GNSS antenna. In essence, the pole becomes the traditional survey vessel in all aspects except for heading. This removes the need for a gyro calibration for the MBES. The remaining heading antenna offsets are determined with a “GAMS” calibration. Note that the heading offsets are related to the primary GNSS antenna and not the IMU reference point in the GAMS calibration.

The local grid is defined as follows:

- X-axis is positive forward and parallel to the ship centreline
- Y-axis is positive starboard and perpendicular to the ship centreline
- Z-axis is positive down

All offset measurements are shown in Table 8 below.

Table 7. Ros Aine sensor offsets.

Reference	X (m)	Y (m)	Z (m)
IMU reference point	0.000	0.000	0.000
Primary GNSS	0.154	0.000	-4.184
Secondary/heading GNSS antenna*	-4.879	2.855	0.147
MBES echosounder	0.105	0.000	0.232
Sub-bottom Profiler	2.27	0.000	- 0.36
Sidescan sonar (pole-mounted)	2.27	4.1	
Sidescan sonar tow point	-6.6	4.1	
Magnetometer tow point	-6.6	1.3	

*reference IMU reference point.

4.2 Manannan survey vessel geometry

A surface-towed Applied Acoustics AA200 Boomer with an 8-channel mini-streamer hydrophone system that acquires full waveform seismic data was mobilised to meet the requirement of greater depth of penetration. This system was interfaced to SonarWiz acquisition software which combines the seismic data with a ZDA time stamp from the vessels ZDA source, survey information and positional data from the PDS navigation software. The boomer was towed from the stern of the vessel.
The positional data were coming from the GNSS system Hemisphere RS330, which is the central reference point of the survey vessel.

The local grid is defined as follows:

- X-axis is positive forward and parallel to the ship centreline
- Y-axis is positive starboard and perpendicular to the ship centreline
- Z-axis is positive down

All offset measurements are shown in Table 9.

Table 8: Manannan survey vessel offsets

Reference	X (m)	Y (m)
RS330 Primary GNSS	0.0	0.0
Streamer tow point (Stern)	-4.1	0.0
Layback	21 m	

5. Sensor Mobilisation and Calibrations

5.1 Mobilisation and Calibration Summary

The Ros Aine survey vessel mobilisation took place in Malahide on 26th October 2024. The Manannan survey vessel mobilisation took place on 20th May 2024 in Rosslare harbour.
The mobilisation and calibration consisted of the following activities:

- Installation and calibration of:
  - GNSS, heading and motion sensors
  - Multibeam sonar
  - Sub-bottom profiler
  - Side-scan sonar
  - Magnetometer
  - Boomer

Sensor calibrations and checks are detailed below.

5.2 GNSS Verification

A position check of the vessel survey system was completed on 26th October 2023 with the vessel alongside the quay wall in Malahide marina, using a GNSS rover connected to RTK corrections. For the verifications, Trimble VRSNow network RTK corrections were used.
The GNSS rover was positioned 0.17m aft of the primary GNSS antenna as shown in Figure 8 and position of both antennas was logged for 300 seconds. The results are shown in Table 10.

Figure 8: GNSS Rover location (left picture) and offset from primary GNSS antenna and average results (right picture).

Table 9: GNSS position check results.

System	Easting (m)	Northing (m)	
ROVER position calculated from position offset and heading	722615.41	746615.82	1.02
Primary GNSS Antenna	722615.43	746615.79	1.04
Difference	**0.02**	**0.03**	**0.02**

5.3 Vessel Gyro Calibration

GNSS Azimuth Measurement System (GAMS) is a system that determines the geographic vector between two GNSS antennas fixed to the vessel. The GAMS use two GNSS receivers to determine a GNSS-based heading that is accurate to ±0.02° when blended with the inertial navigation solution. POS MV (navigation software) uses this heading information as aiding data together with the position, velocity and raw observations information supplied by the primary GNSS receiver. During a GAMS calibration, the vessel executes a series of dynamic manoeuvres (commonly called the figure of eight), during which an accurate GAMS solution is computed.

The local grid is defined as follows:

- X-axis is positive forward and parallel to the vessel centreline.
- Y-axis is positive starboard and perpendicular to the vessel centreline.
- Z-axis is positive down.

The GAMS calibration took place on 26th October 2023. Computed values are shown in Table 11.

Table 10. Results of GAMS calibration.

GAMS computed results	
X	-2.081m
Y	0.259m
Z	0.206m

5.4 MBES Patch Test

A patch test was completed before the survey. The patch test was conducted in a suitable area of similar water depths expected on site, north-east of Port Oriel, Ireland (figure 9).

Figure 9: MBES Patch Test Location.

A sound velocity profile was taken on the deepest part of the patch test area prior to run the calibration lines. Following that, the patch test lines were surveyed as follows:

- **Roll:** Two lines over a flat deep area in opposite direction, at the same speed and with 100% overlap
- **Pitch:** Two lines over an area with slope in opposite direction, at the same speed and with 100% overlap
- **Yaw:** Two lines over an area with slope or feature in the same direction, at the same speed and with 50% overlap

The patch test calibration was computed in PDS, and the results are shown below in Figure 10 and in Table 12.

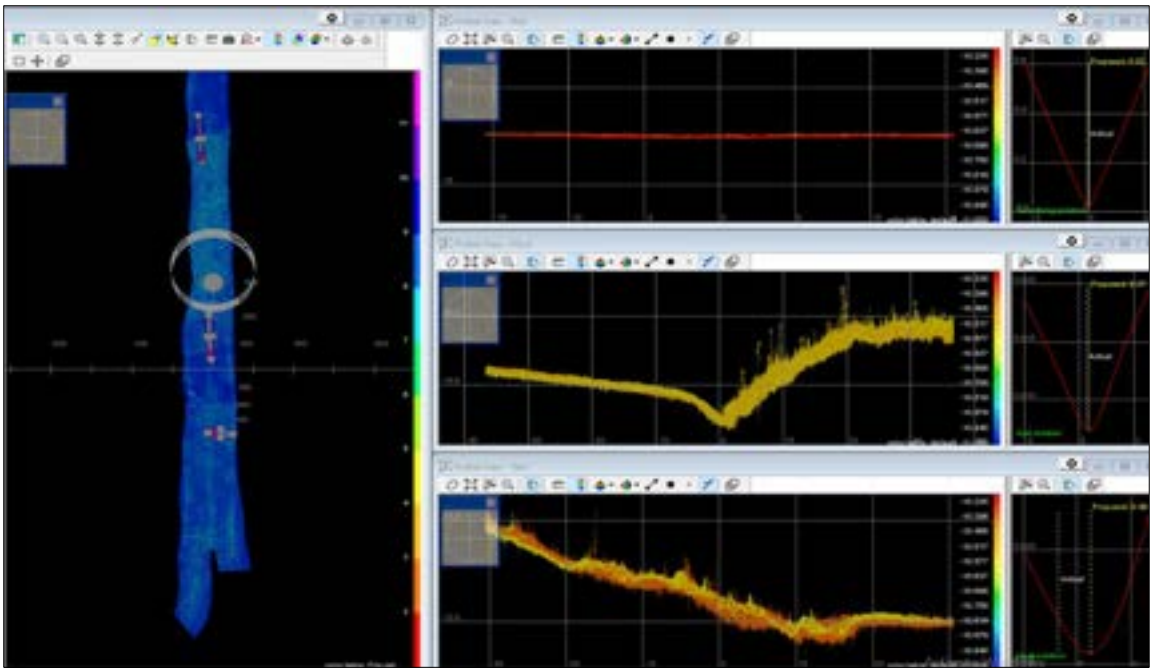


Figure 10: Patch Test calibration in Teledyne PDS software for Ros Aine Survey Vessel

The resulting mounting offsets from the patch test are shown in the table below.

Table 11. Patch test results.

Patch Test Results	
Roll	0.01° PU+
Pitch	0.28° BU+
Yaw	-0.69°

5.5 Magnetometer Position Verification

The magnetometer system was verified using two metallic seabed objects. The data were recorded simultaneously by the multibeam echosounder and the magnetometer in order to verify that the target is identified at the same location by the two systems.
A fishing pots has been identified and used for this purpose (figure 11), and has been marked as AT_07 in the multibeam target list, and as MT_253 (detected with an amplitude of 39 nT) in the Magnetometer anomalies list.

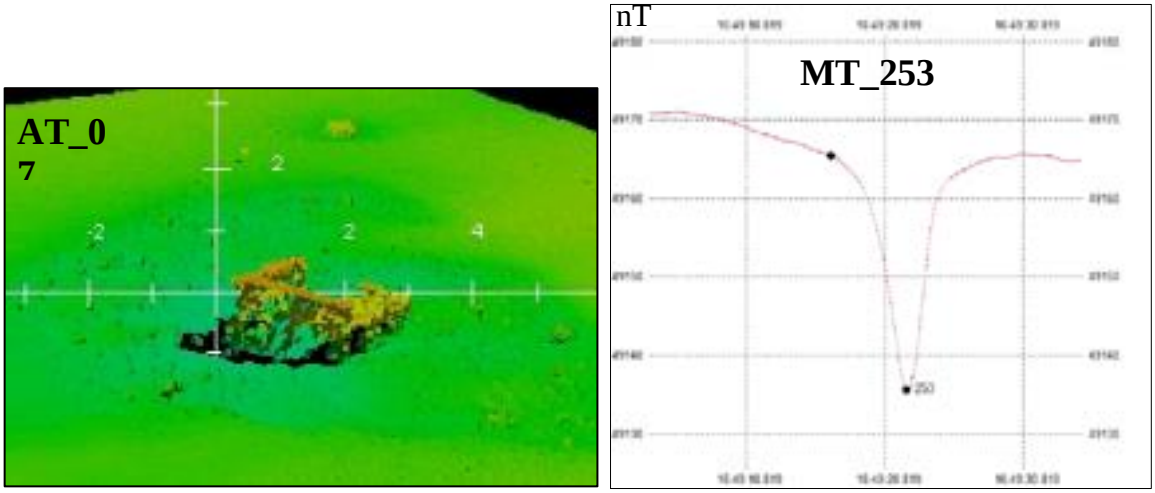


Figure 11: Fishing pot identified in the MBES data (left) and Magnetometer data (right).

Table 13 gives the position of the object identified in the multibeam echosounder and magnetometer data.

Table 12: Fishing pot target position detected by the MBES and the Magnetometer

Target label	Device type	Easting	Northing
AT_07	Multibeam Echosounder	712351.3 E	612812.9 N
MT_253	Magnetometer	712349.0 E	612815.4 N
Difference (m)		2.3	2.5

A mooring block with a chain has been identified at 10 m LAT and used for this purpose (figure 12), and has been marked as AT_18 in the multibeam sonar target list, and as MT_101 (detected with an amplitude of 7 nT) in the Magnetometer anomalies list.

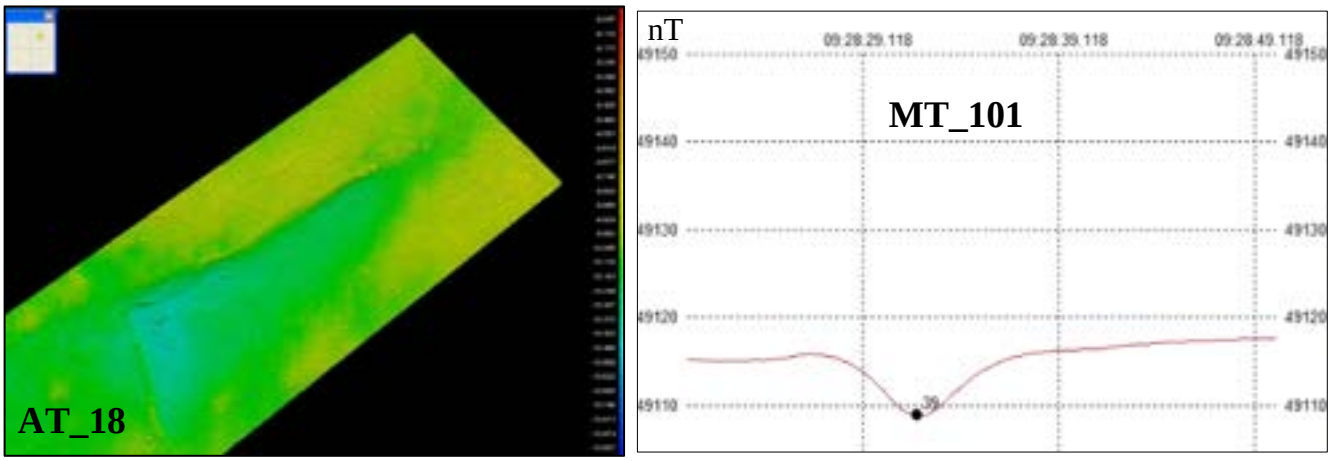


Table 14 gives the position of the object identified in the MBES and Magnetometer data.

Table 13: Mooring target position detected by the MBES and the Magnetometer

Target label	Device type	Easting	Northing
AT_18	Multibeam Echosounder	713554.7	613478.4
MT_101	Magnetometer	713554.4	613475.7
Difference (m)		0.3	2.7

5.6 Side-scan Sonar Position Verification and Acceptance Line

The Side-scan Sonar system was verified using objects on the seabed within the survey area. A line were run over the objects, which was simultaneously surveyed with the multibeam echosounder. The position of the objects were checked in the sidescan-sonar data and compared with the position from the multibeam echosounder data. The results are shown table 15.

The objects picked for the magnetometer position verification have been detected by the sidescan-sonar and labelled as SSS_139 for the fishing pots, and as SSS_11 for the mooring (figure 12).

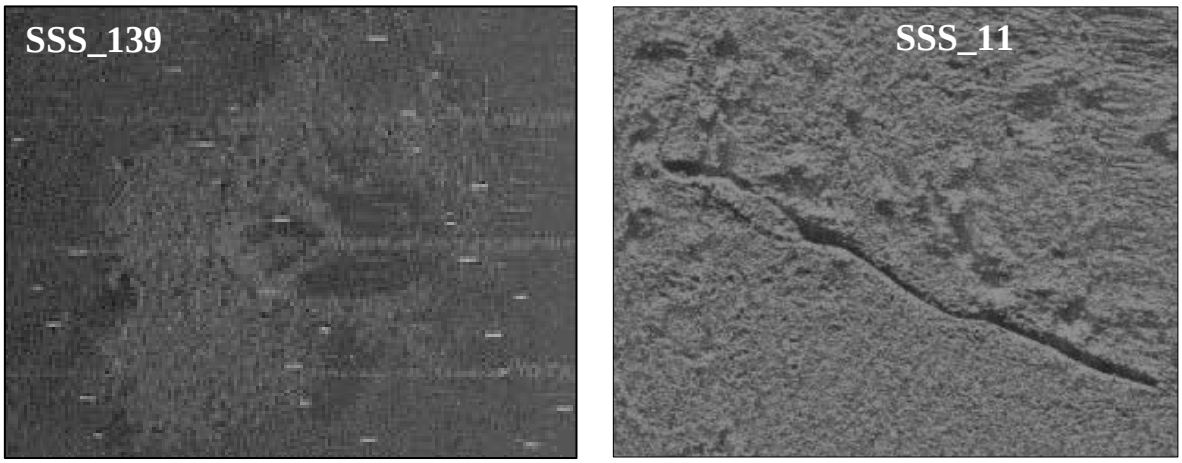


Figure 12: Sidescan data showing the fishing pots on the left, and the mooring on the right .

Table 14: Mooring target position detected by the MBES and the Sidescan-sonar

Target label	Device type	Easting	Northing
AT_07	Multibeam Echosounder	712351.3	612812.9
SSS_139	Sidescan-sonar	712352.5	612815.0
Difference (m)		1.2	2.1
Target label	**Device type**	**Easting**	**Northing**
AT_18	Multibeam Echosounder	713554.7	613478.4
SSS_11	Sidescan-sonar	713555.8	613476.4
Difference (m)		1.1	2.0

5.1 Sub-Bottom Profiler Position Verification

The Sub-bottom profiling system was verified on over an area of rocky reef to provide a clear feature for comparison with MBES data.

The position of the start (A) and end (B) of the rocky area was checked in the SBP data and compared with the position from the MBES data.

Figure 13 (top part) shows the SBP profile of the survey line 20231028_110052 with a rock on the seabed (yellow circle), with the starting position of the rock (coordinates of 1: 52.26205°N, 6.33665 °W) and the ending position of the rock (coordinates of 2: 52.2619°N, 6.3363 °W).

A rock can been clearly identified for those exact coordinates in the MBES data, between Point 1 and 2, as shown figure 12 (bottom part).

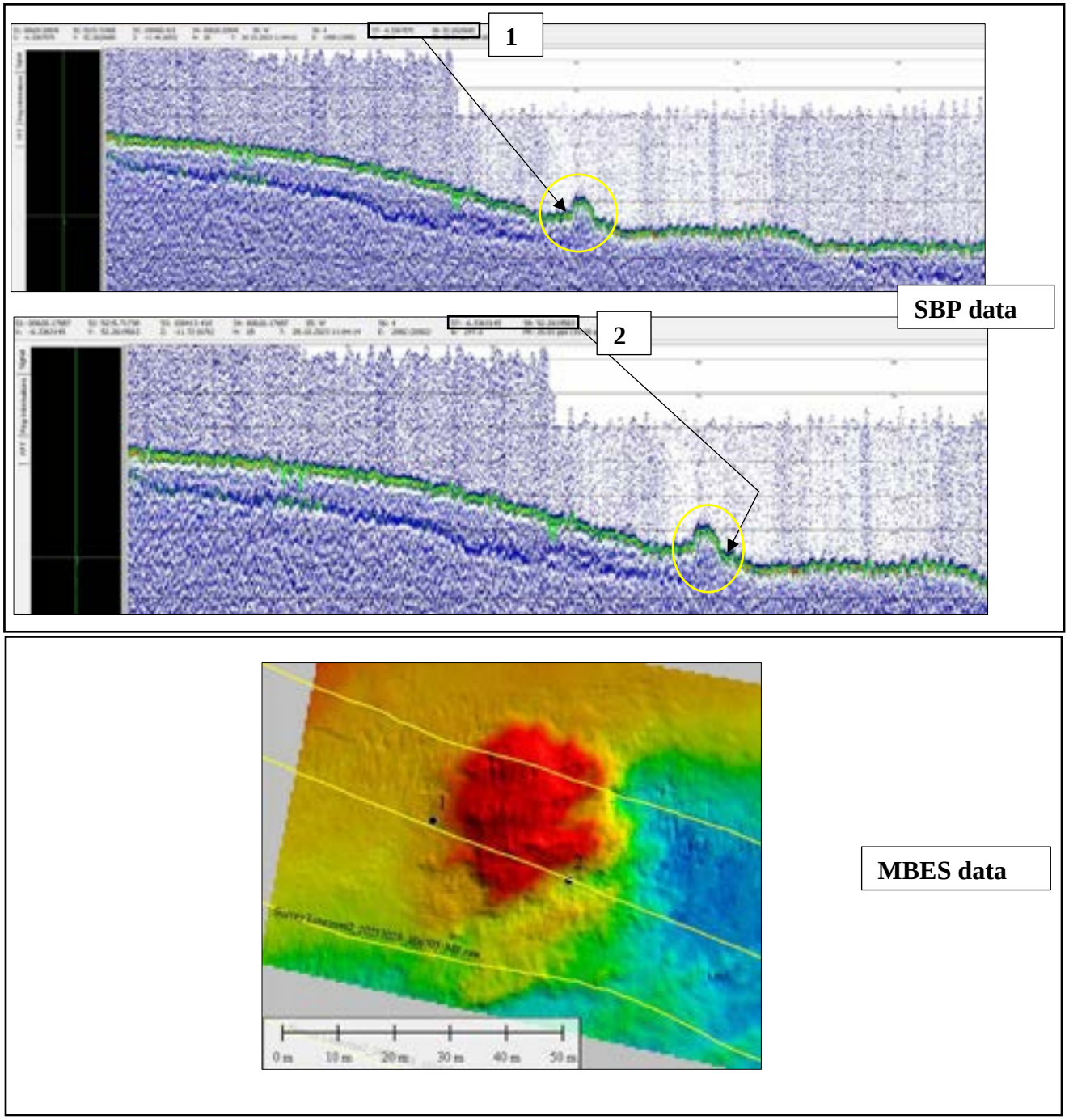


Figure 13: SBP position verification showing SBP data (top) and the MBES data with location of Point 1 and Point 2.

6. Survey operations

The Ros Aine vessel mobilisation was completed in Malahide Marina, County Dublin on 26th October 2023. Survey operations commenced on 27th October 2023. The Sidescan-sonar, the HF Sub Bottom Profiler and the marine magnetometer surveys were completed on 28th October 2023. The MBES survey was completed on 07th November 2023.

The Manannan vessel mobilisation was completed in Rosslare Harbour, County Wexford on 20th May 2024. The seismic survey operations commenced on 21st May 2024 and were completed on the same day.

No HSE incidents, near misses or non-conformities were noted during the survey. A summary of operations per day is found in table 16.

Table 15: Survey operations summary

Date	Description
26/10/2023	Ros Aine Mobilisation, Malahide Marina. Installation and interfacing of all survey sensors. Equipment calibrations.
26/10/2023	Transit to site, commence survey with MBES, SSS, SBP and magnetometer.
27/10/2023	Continue survey operations with MBES, SSS, SBP and magnetometer.
28/10/2023	Continue survey operations with MBES, SSS, SBP and magnetometer. SSS, SBP and magnetometer demobilisation
07/11/2023	Complete MBES survey operations MBES demobilisation
20/05/2024	Manannan Mobilisation, Rosslare Harbour. Installation and interfacing of all boomer survey sensors. Equipment calibrations.
21/05/2024	Complete seismic survey operations. Vessel demobilisation.

The Ros Aine survey vessel followed the planned survey lines, with a spacing of 20 or 40 m with lines running parallel to the shore. Crosslines were acquired approximately every 500 m. The Boomer was utilised on all planned survey lines. Boomer lines spacing was 50 m with lines running parallel to the shore. Boomer crosslines were acquired approximately every 250 m.

7. Data processing

All data was quality checked during operations and samples of data quality were sent to our office to ensure preliminary agreement on coverage and quality prior to vessel demobilisation.
Following data acquisition, data was processed according to Hydromaster's internal standards.
Table 17 shows software used to process data from each sensor.

Table 16: Data processing software used.

System	Software
MBES	Teledyne PDS
SSS	Sonarwiz 7
SBP	ISE, Sonarwiz 7
Marine Magnetometer	Magpick
Boomer	SonarWiz and CodaOctopus Survey Engine
Navigation data	POSPac MMS

7.1.1 Multibeam echosounder

A total of 138 survey lines were acquire including crosslines.
Data was acquired and processed using Teledyne PDS. Coverage and quality statistics were monitored in real-time during the surveys and prior to demobilisation to ensure the data was sufficient to satisfy requirements for both.
Data was processed using cleaned and processed using Teledyne PDS 3D editor, where obvious spike are first removed from the data after which data is analysed in a swath profile viewer to strip out less obvious noise and fully clean the 3D surface. The processed 3D surface was then exported in the required format.

7.1.2 Sidescan-Sonar

A total of 118 survey lines were acquired including crosslines.
SSS data were loaded into SonarWiz for post-processing and interpretation. The data were bottom tracked and gains applied. Corrected navigation was applied to ensure contacts were within positional accuracy specifications.
After processing, merged mosaic was exported along with identified seabed contacts, which were analysed against the MBES and magnetometer data.

7.1.3 Marine Magnetometer

A total of 136 survey lines were acquired including crosslines.
Data were replayed and interpreted using Magpick software. Magnetic anomalies were manually picked from the analytical signal grid. Targets were attributed a unique ID, position (Easting and Northing), and as grid value at the target position.
Targets were exported to provide a list of significant targets, which were analysed against MBES and SSS data.

7.1.4 Sub Bottom Profiler HF-SBP

A total of 120 survey lines were acquired including crosslines.
Penetration achieved was according to requirements. The SBP data were acquired as .raw files and processed using ISE software. Data were bottom tracked. The seabed was picked allowing for accurate application of gain filters and removal of the water column. Relevant reflectors were exported as ASCII XYZ files and as depth below seabed to provide an isopach dataset for charting.

7.1.5 Boomer MF-SBP

A total of 18 survey lines and 4 crosslines were acquired.

The boomer was recorded within the SonarWiz acquisition system and exported to SEG-Y which was then imported into CodaOctopus Survey Engine for processing.

The first processing step consists of a thorough analysis of the seismic data quality, the seabeds were hand-picked on each line. The navigation was then assessed, and any required corrections were applied. A Bandpass filter with a low cut of 500Hz and a high cut of 1500Hz was applied to remove some of the lower frequency noise typically outside of the dominant frequency range. A Digital Base Gain of 6.12dB was also applied to the data.

Horizons below the seabed are picked by identifying strong reflectors and tracing them along each survey line. These reflectors indicate changes in the geology, allowing us to identify the

different layers within the substrata. For this project, the Top of Mudstone was tracked across the site and the depth of this horizon was measured.

8. Survey results

Survey results are described below, based on the interpretation of the multibeam echosounder, the sidecan-sonar, the Magnetometer, Sub bottom profiler and boomer datasets.

8.1 Multibeam echosounder (MBES)

8.1.1 Bathymetry and seabed type

Water depths range from 0 m LAT to 11 m LAT, with deeper water depths within the harbour and on the west part of the site.

A few boulders and outcrops/reefs can be identified. The harbour seabed is dominated by scours created by prop wash from large vessels, and with some sediment deposition.

Figure 14 shows the shaded bathymetry of the site.

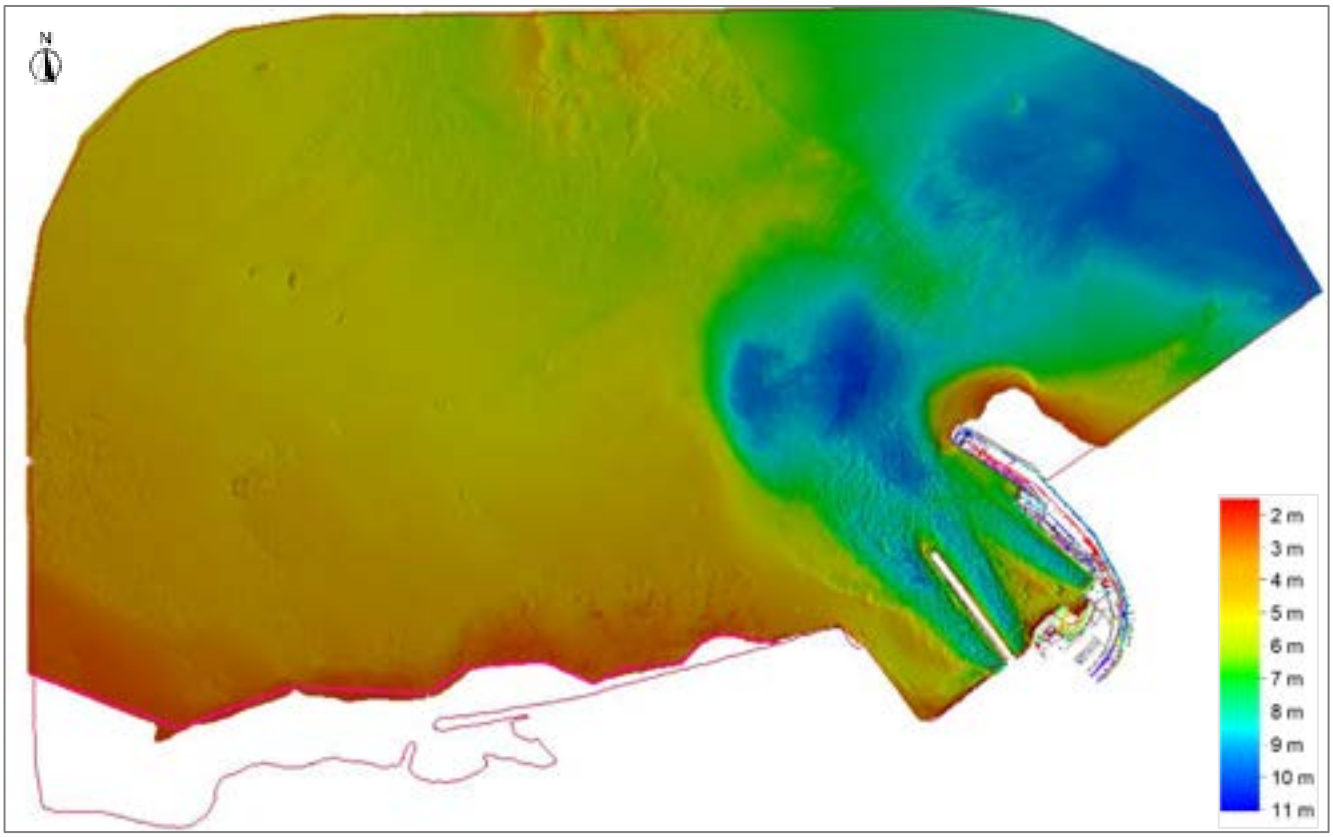


Figure 14: shaded bathymetric data from MBES

Figure 15 shows examples of the multibeam data corresponding to different type of seabed present onsite.

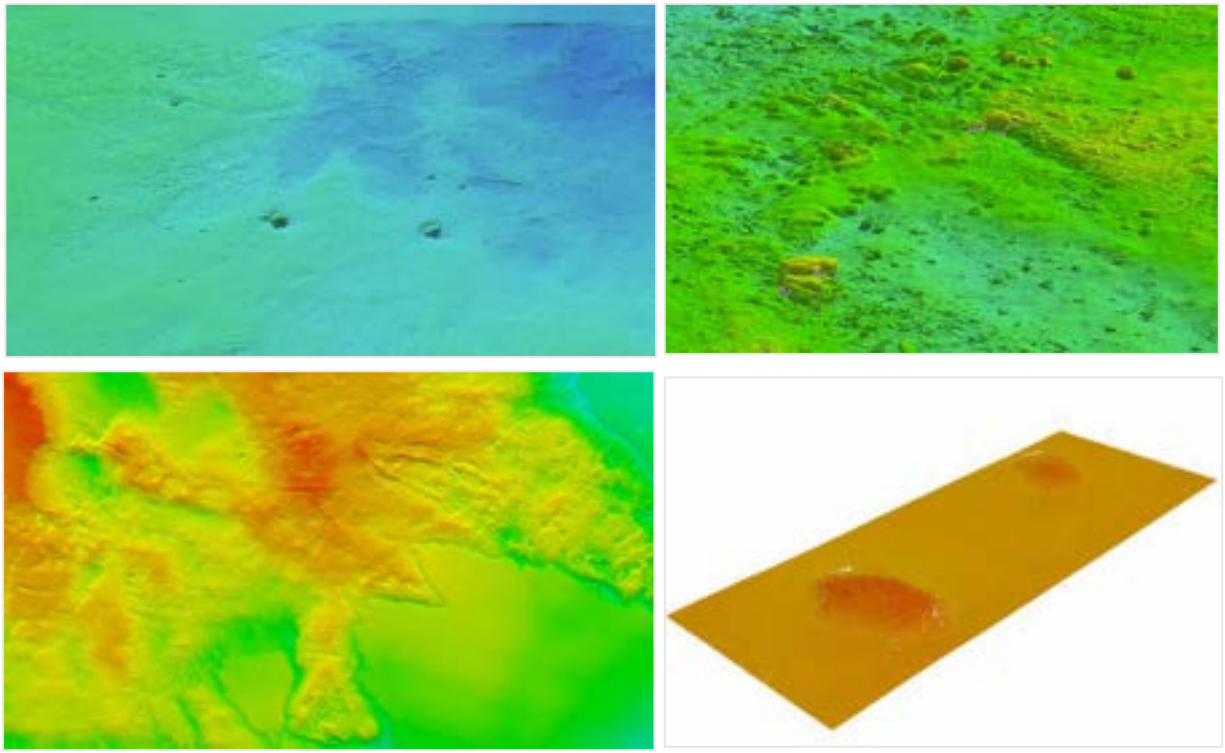


Figure 15: MBES data example showing different seabed type

8.1.2 Debris list

29 debris were located on the MBES data as shown in figure 16 and table 18.

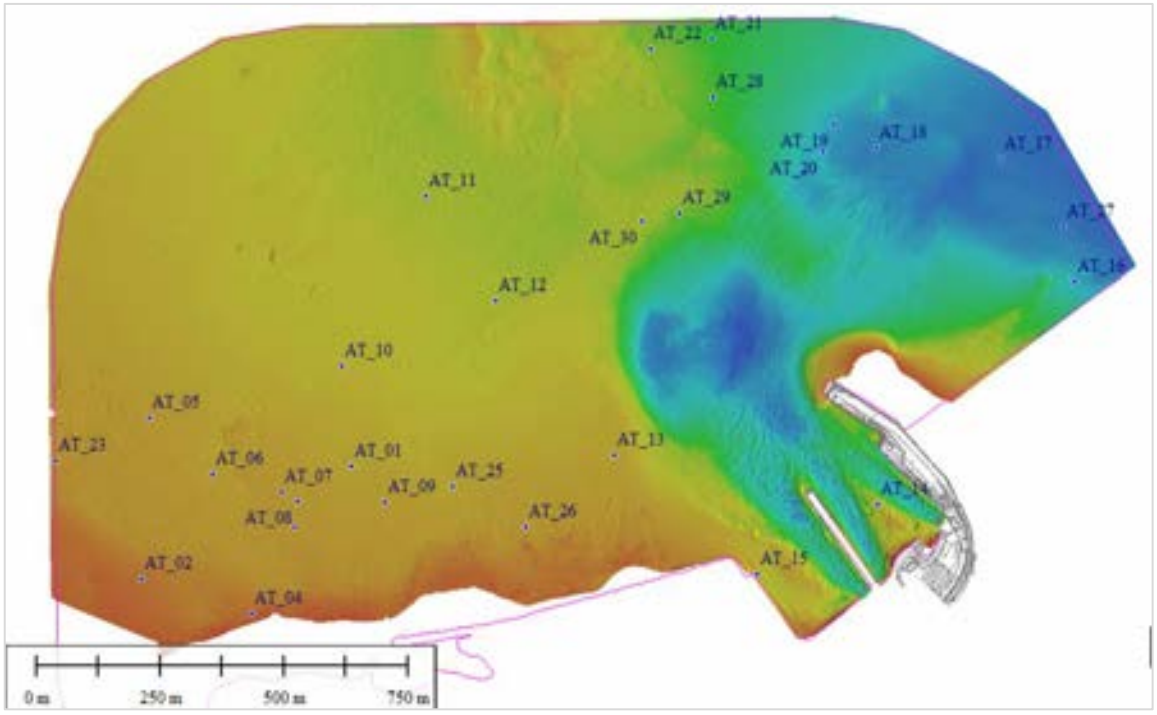


Figure 16: MBES Debris location

Figure 19 shows examples of debris, showing wrecks (top), a fishing pots on the bottom left, and an anchor block on the bottom right. Appendix 1 detailed all the MBES debris pictures.

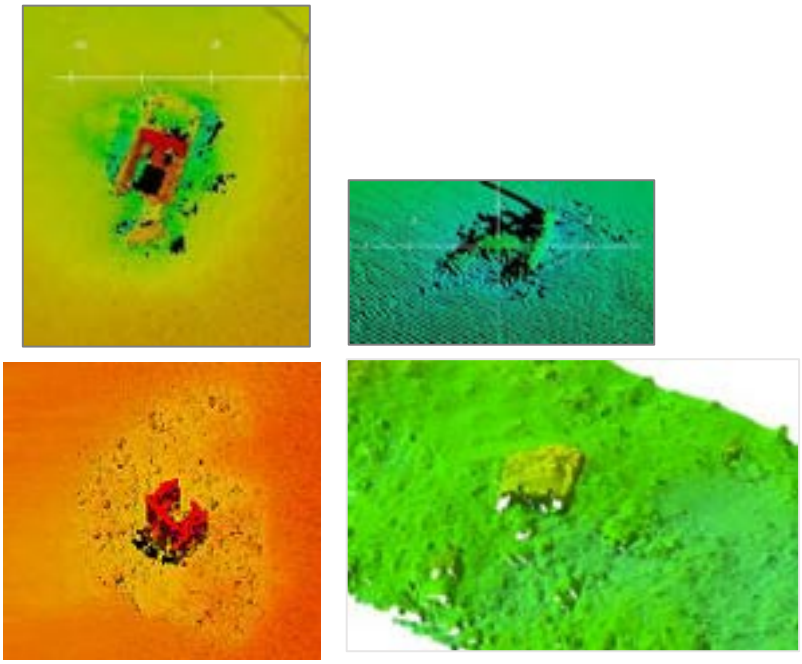


Figure 17: MBES data showing debris located in the Harbour.

29 targets have been listed from the MBES dataset, see table 18.

Table 17: MBES Target list (ITM coordinates)

Target ID	Easting*	Northing*	Description
AT_01	712492.5	612864.3	2 blocks
AT_02	712070.0	612646.3	2 boulders or blocks
AT_04	712290.9	612578.5	1 block and boulders
AT_05	712084.1	612956.3	NI ** debris - possible wreck
AT_06	712214.0	612848.5	NI ** debris possible buried wreck
AT_07	712351.3	612812.9	Fishing pot
AT_08	712384.2	612796.1	NI ** debris
AT_09	712560.0	612794.5	Mooring with rope
AT_10	712474.8	613057.2	Mooring block
AT_11	712642.8	613384.4	Possible Boulder
AT_12	712784.3	613182.6	Tyre
AT_13	713023.3	612885.1	Mooring and rope
AT_14	713557.1	612788.8	NI ** long debris
AT_15	713313.1	612655.8	NI ** debris
AT_16	713953.2	613220.5	Long thin scour
AT_17	713805.2	613456.5	Little boulder

AT_18	713554.7	613478.4	Mooring with rope or chain
AT_19	713467.3	613524.4	Possible rope
AT_20	713446.1	613473.1	NI ** debris - possible mooring with rope or chain
AT_21	713221.2	613688.5	Tyre
AT_22	713097.5	613669.6	Possible mooring block or boulder
AT_23	711895.8	612874.0	NI ** debris - possible boulder
AT_24	712377.3	612746.7	Mooring with chain or rope
AT_25	712697.5	612825.0	NI ** debris - possible buried mooring with rope
AT_26	712845.4	612746.5	Mooring with chain or rope
AT_27	713932.6	613327.3	Possible scours on the seabed
AT_28	713223.1	613575.9	NI ** debris
AT_29	713155.5	613353.4	Block - possible former mooring
AT_30	713080.8	613336.9	Block

**Coordinates in Irish Transverse Mercator (ITM)*

*** NI: Not Identified*

8.2 Sidescan-sonar (SSS)

8.2.1 Seabed contacts

In total, 187 contacts were identified in the side-scan sonar within the survey site. The sonar contacts are listed in table 19 and figure 18 & 19 show their location.

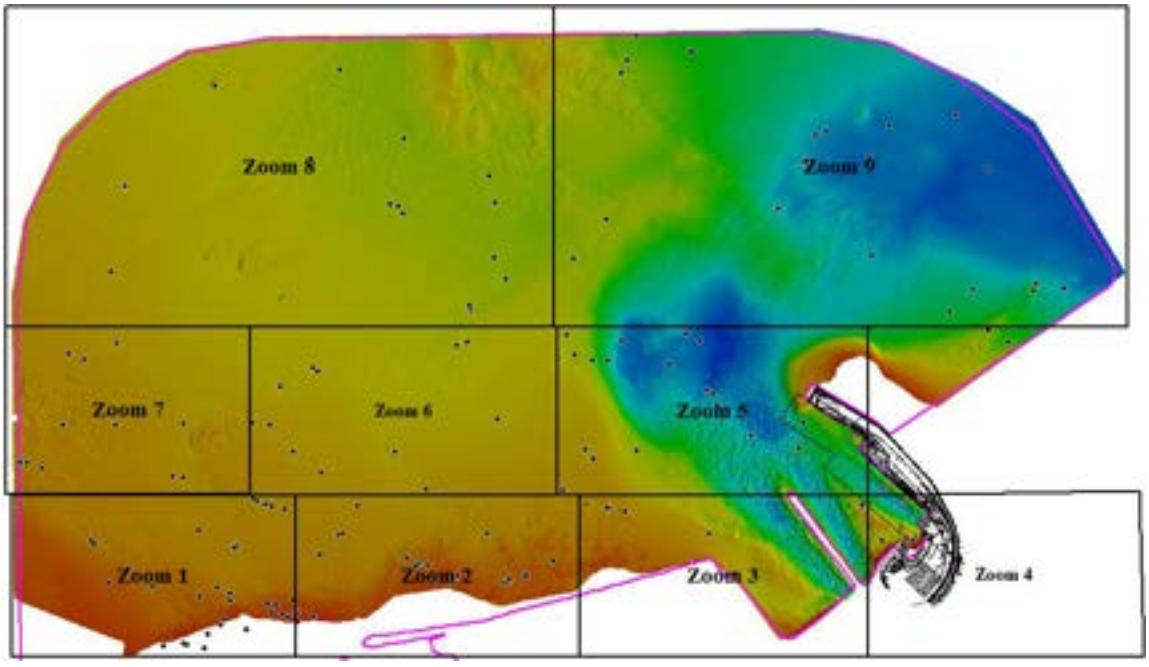
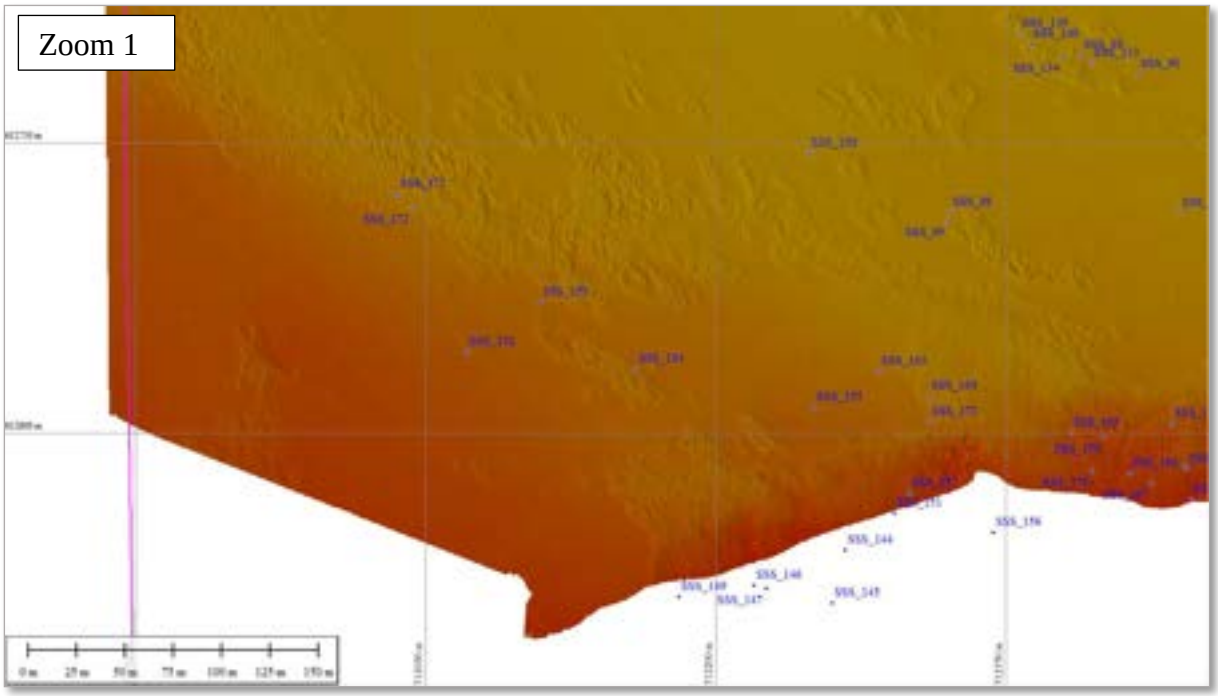
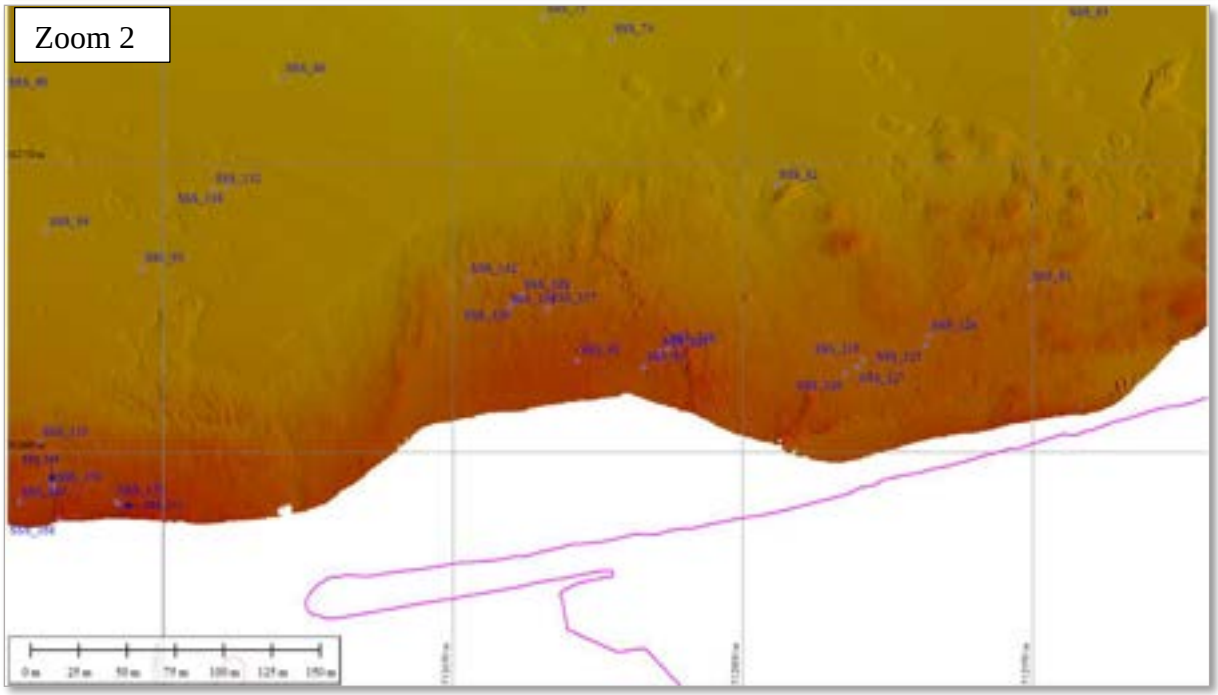
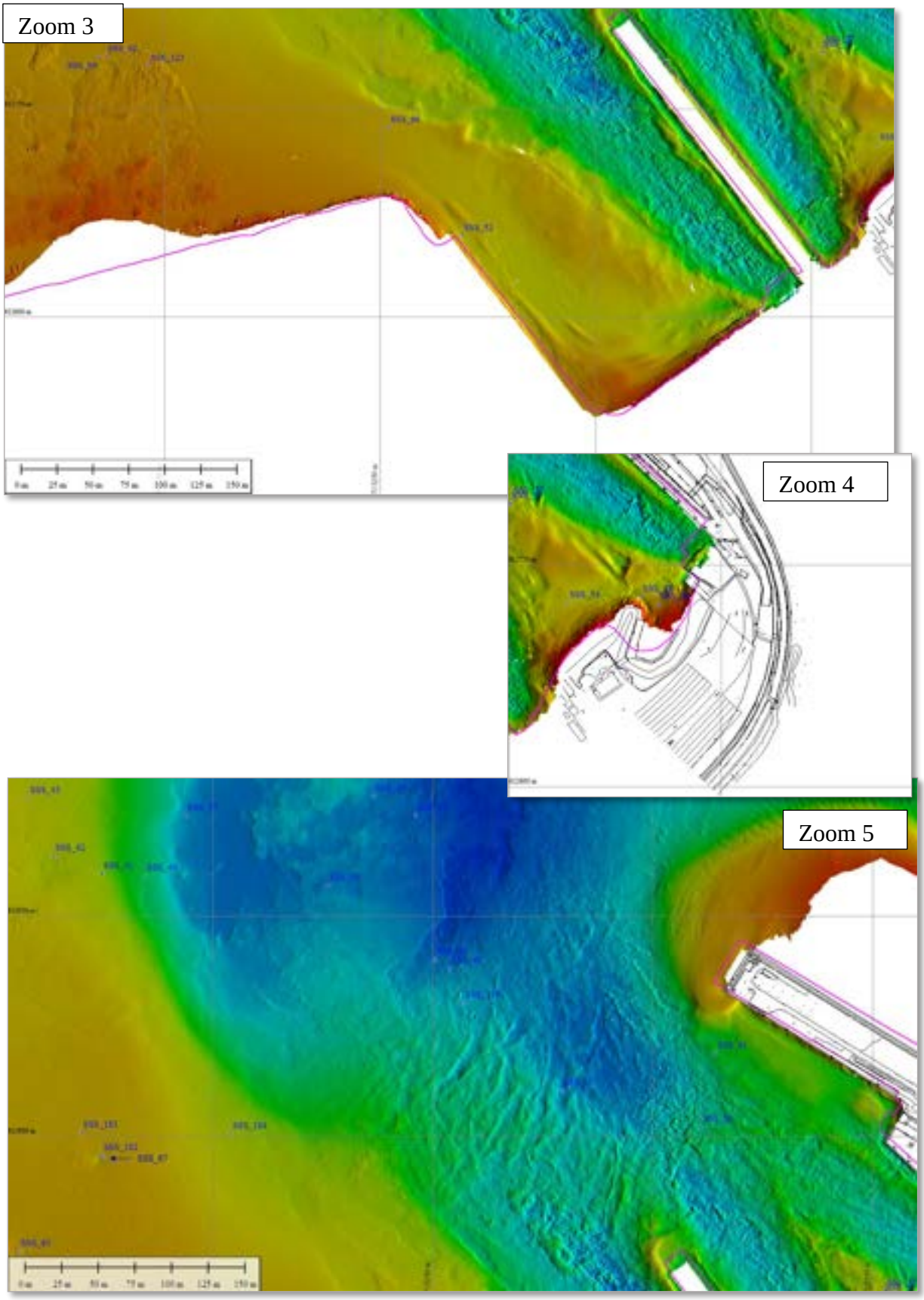
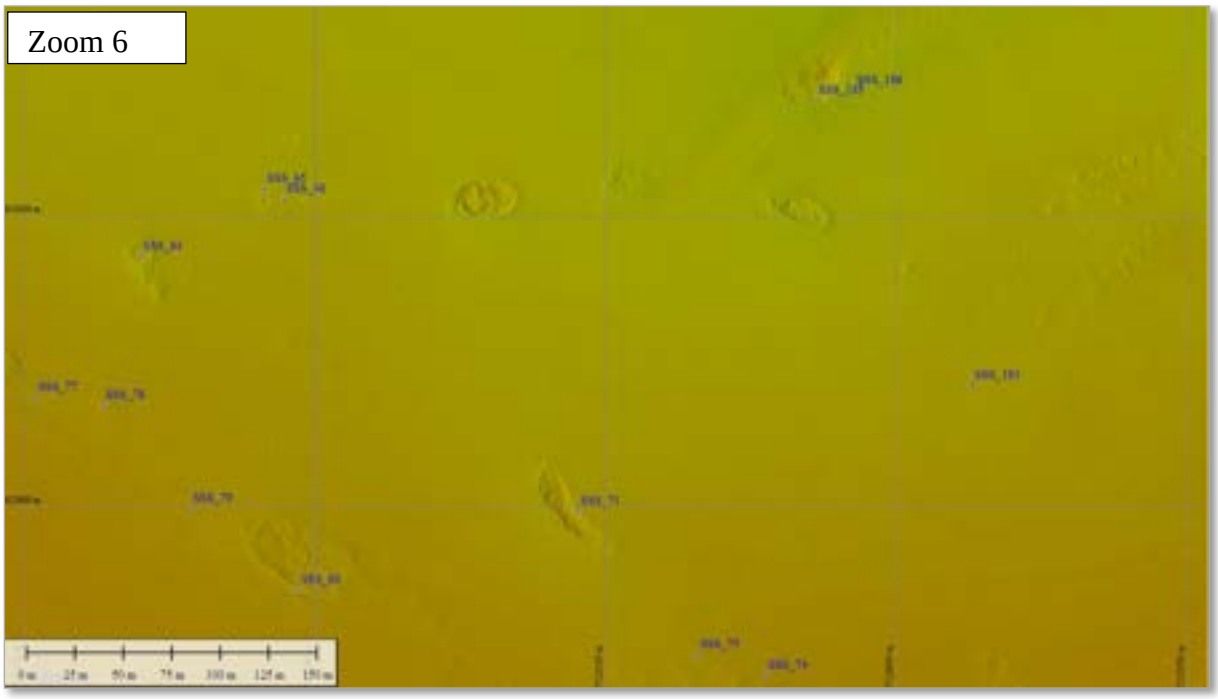


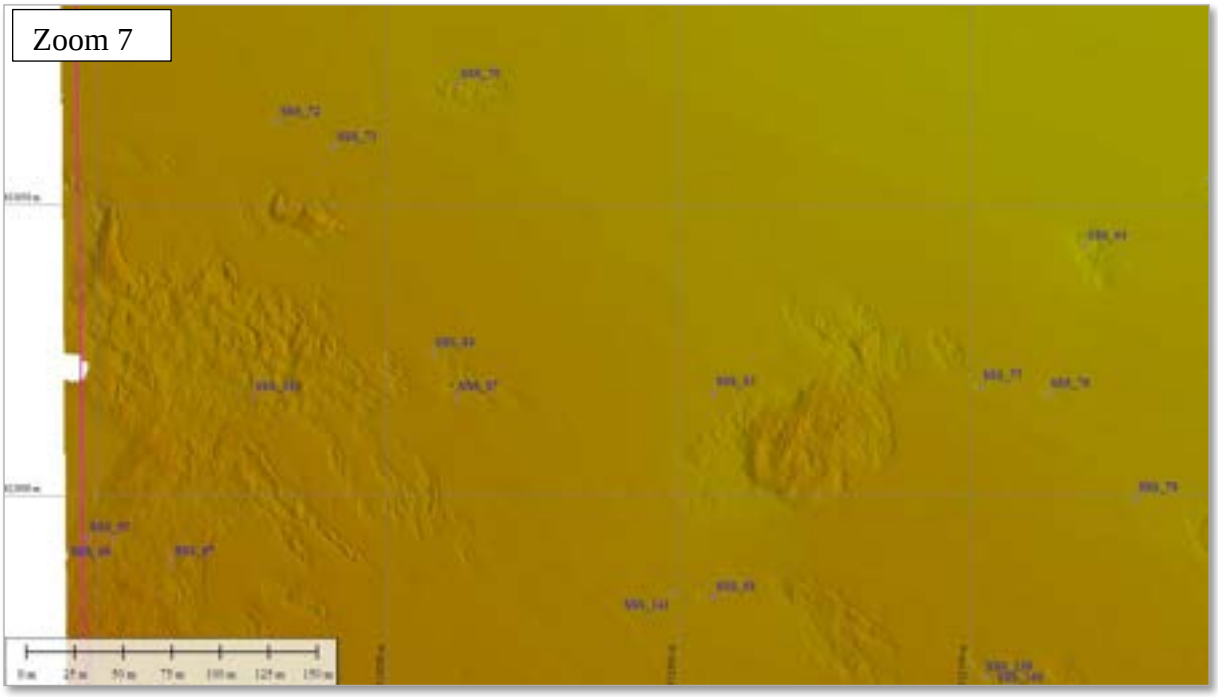
Figure 18: Sidescan sonar contacts location Keyplan and zoomed view


Zoom 1


Zoom 2


Zoom 3
Zoom 4
Zoom 5


Zoom 6


Zoom 7

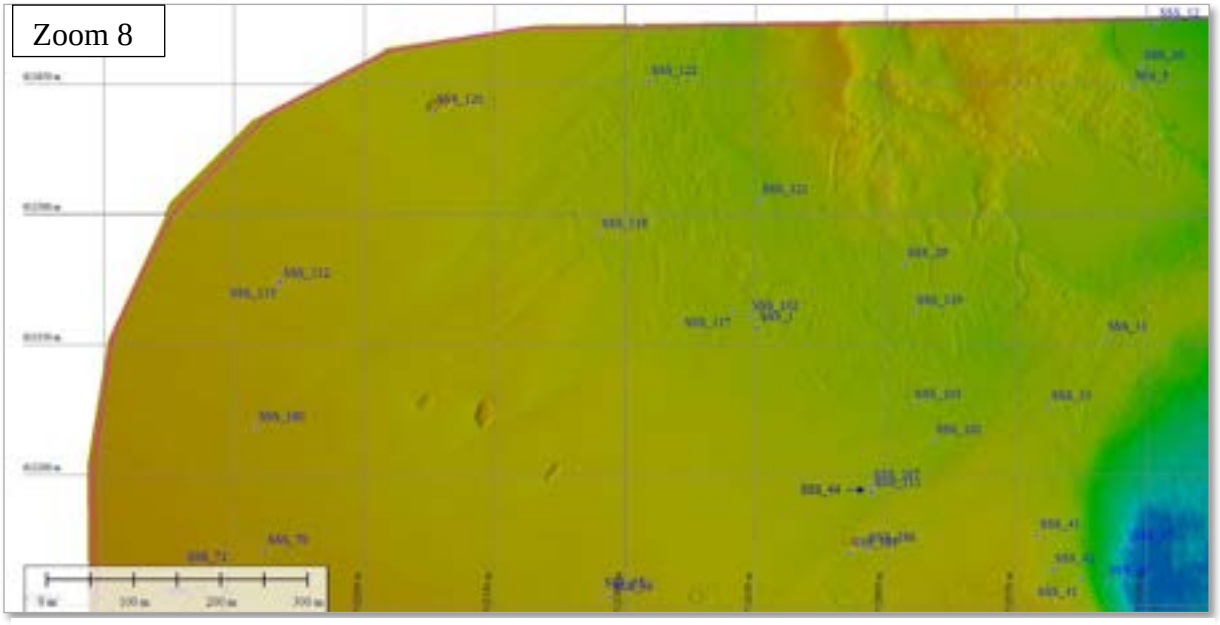


Figure 19: Zoomed views of SSS target location

Table 18: Sidescan sonar contact list (unit in metre)

Target ID	Easting*	Northing*	Height	Length	Width	Description
SSS_1	712652.1	613369.3	0.2	13.0	1.0	NI** debris
SSS_2	713955.7	613220.5	0.4	6.4	0.3	NI** linear debris
SSS_5	713083.8	613646.0	0.0	8.4	0.8	NI** linear debris
SSS_6	713446.2	613466.1	0.2	3.6	0.6	NI ** debris - possible mooring with rope or chain
SSS_8	713465.6	613524.1	0.2	2.9	0.5	NI** debris
SSS_9	713485.6	613530.1	0.4	1.3	1.1	boulders
SSS_10	713094.0	613670.0	0.5	1.7	1.0	boulders
SSS_11	713555.8	613476.4	0.2	36.1	0.2	Possible mooring rope/chain
SSS_12	713112.1	613718.6	0.6	1.7	0.5	boulders
SSS_13	713217.8	613687.4	0.2	1.2	1.1	tyre
SSS_14	713806.2	613456.3	0.1	4.0	0.6	NI** debris
SSS_15	713224.1	613685.6	0.5	1.1	0.9	tyre
SSS_16	713610.1	613542.2	0.5	1.1	0.5	boulders
SSS_18	713742.6	613562.3	0.4	1.3	0.5	boulders
SSS_22	713846.8	613115.5	0.3	6.7	1.8	Possible mooring block or boulder
SSS_23	713806.7	613137.6	0.0	51.5	37.9	boulder patch
SSS_24	713731.4	613175.8	0.2	3.4	0.8	boulders

SSS_29	712822.4	613442.6	0.8	1.5	1.2	boulders
SSS_31	713052.7	613358.2	0.2	27.0	2.9	sand waves/ripples
SSS_33	712987.7	613278.2	0.3	1.8	0.8	boulders
SSS_34	713210.3	613131.6	0.8	2.5	1.0	boulders
SSS_37	713081.9	613117.9	0.9	1.4	0.8	boulders
SSS_39	713178.2	613070.3	0.6	2.9	2.1	boulders
SSS_40	713054.2	613077.2	0.5	2.5	0.7	boulders
SSS_41	713024.5	613078.4	0.5	3.5	0.6	boulders
SSS_42	712991.3	613090.7	0.0	54.3	41.9	outcropping
SSS_43	712974.6	613130.1	0.5	2.3	0.8	boulders
SSS_44	712782.4	613182.0	0.3	1.6	1.1	tyre
SSS_45	713446.9	613475.3	0.2	16.7	0.4	NI ** debris - possible mooring with rope or chain
SSS_46	713392.7	613377.5	0.3	0.8	0.6	boulders
SSS_47	713238.2	613118.6	0.5	1.6	0.7	boulders
SSS_48	713261.8	613014.3	0.0	47.9	29.0	boulder patch
SSS_49	713251.7	613020.1	1.0	1.9	0.9	boulders
SSS_50	713444.4	613469.8	0.3	8.6	0.4	NI ** debris - possible mooring with rope or chain
SSS_52	713307.5	612658.7	1.9	27.7	1.4	NI** debris
SSS_53	713337.7	612931.0	1.2	2.4	1.8	boulders
SSS_54	713596.5	612723.9	0.8	1.3	0.6	boulders
SSS_55	713557.6	612791.3	1.1	8.2	1.9	linear NI** debris
SSS_56	713433.2	612906.3	1.6	1.6	1.3	boulders
SSS_57	713558.8	612794.6	0.3	7.1	0.3	linear NI** debris
SSS_59	713657.6	612722.8	0.1	13.7	0.2	rope
SSS_61	713443.3	612956.0	0.7	1.1	0.7	boulders
SSS_62	713059.5	612787.9	0.0	2.3	0.2	boulders
SSS_63	712967.9	612821.6	1.9	12.0	8.3	outcrop
SSS_64	712409.7	613028.7	1.5	14.6	17.4	outcrop
SSS_65	712473.6	613063.7	1.1	3.1	2.6	block
SSS_66	713256.5	612736.6	0.2	2.8	0.3	linear NI** debris
SSS_67	713026.6	612885.0	0.1	7.5	0.2	rope
SSS_68	712483.7	613058.7	0.1	2.7	0.3	NI** debris
SSS_69	713054.8	612787.3	0.5	2.1	0.6	boulders
SSS_70	712086.5	613112.0	2.1	28.6	12.0	outcrop
SSS_71	712635.7	612897.7	1.6	47.4	16.7	outcrop
SSS_72	711993.8	613092.6	0.8	1.4	1.1	boulders
SSS_73	712023.1	613079.5	0.3	1.3	0.7	boulders
SSS_74	712732.4	612812.8	1.5	2.5	2.0	boulders
SSS_75	712697.4	612823.8	0.8	1.8	0.5	Possible mooring
SSS_76	712390.3	612952.3	0.5	1.9	1.2	boulders

SSS_77	712355.6	612956.4	0.6	1.0	0.9	boulders
SSS_79	712435.7	612899.0	1.2	1.2	0.7	boulders
SSS_80	712491.3	612857.1	0.6	1.6	1.7	block
SSS_81	712948.8	612685.1	0.9	1.3	0.9	boulders
SSS_82	712817.6	612737.7	0.9	1.5	0.8	boulders
SSS_83	712218.3	612953.2	1.8	1.9	0.9	boulders
SSS_84	712073.3	612973.4	0.7	2.8	0.9	NI** debris
SSS_86	712562.1	612792.6	1.2	2.6	2.5	Mooring with rope/chain
SSS_87	712085.7	612950.8	0.5	5.9	2.7	NI** debris
SSS_88	712218.3	612847.7	1.0	4.0	0.4	NI* debris - possible wreck
SSS_89	712389.0	612795.1	0.4	1.2	1.0	boulders
SSS_90	712418.6	612785.2	0.5	1.2	0.7	boulders
SSS_91	712749.2	612643.6	0.6	2.1	0.8	boulders
SSS_92	712714.5	612647.2	0.7	2.3	1.6	boulders
SSS_93	712489.0	612694.7	0.3	1.3	0.6	boulders
SSS_94	712440.0	612713.5	0.3	1.4	1.0	boulders
SSS_95	711895.8	612878.2	0.5	1.6	0.9	boulders
SSS_96	711909.2	612876.9	0.3	1.1	1.1	boulders
SSS_97	711939.2	612865.8	0.6	1.4	1.2	boulders
SSS_98	712321.5	612713.7	0.8	1.4	0.9	boulders
SSS_99	712320.2	612709.5	0.4	1.2	0.8	boulders
SSS_100	712248.2	612744.4	0.7	1.0	0.7	boulders
SSS_101	712854.6	613239.5	0.2	39.1	5.9	sand waves/ripples
SSS_102	712643.2	613382.4	0.4	0.9	0.4	boulders
SSS_103	712830.7	613280.2	0.2	1.1	0.6	boulders
SSS_104	713776.0	613219.6	0.6	2.7	0.5	boulders
SSS_105	713577.1	613286.2	0.2	2.1	1.5	boulders
SSS_107	713896.5	613217.4	2.5	3.4	1.5	boulders
SSS_108	713901.4	613229.7	0.0	47.4	36.9	boulder patch
SSS_110	712436.2	612604.8	0.5	2.0	1.3	boulders
SSS_111	712784.9	613178.2	0.2	1.2	1.1	Tyre
SSS_112	712104.6	613419.7	0.4	1.4	0.6	boulders
SSS_113	712102.4	613421.9	0.6	1.1	0.7	boulders
SSS_115	713271.0	612990.9	1.3	2.3	0.9	boulders
SSS_117	712626.0	613388.3	0.5	1.6	0.6	boulders
SSS_118	712470.3	613476.2	0.4	1.1	0.4	boulders
SSS_119	712833.1	613388.6	0.4	0.9	0.5	boulders
SSS_120	712281.2	613619.5	0.0	35.0	20.2	Possible outcrop
SSS_121	712655.2	613516.2	0.5	3.9	0.2	linear NI** debris
SSS_122	712527.3	613652.3	0.4	0.9	0.4	boulders
SSS_123	713089.4	612781.1	0.0	22.8	11.3	boulder patch

SSS_124	712896.4	612659.9	0.9	1.2	0.2	boulders
SSS_125	712894.6	612654.9	1.5	0.8	0.9	boulders
SSS_126	712853.3	612640.3	0.6	1.3	0.8	boulders
SSS_127	712859.5	612643.8	0.9	0.9	0.5	boulders
SSS_128	712757.3	612651.1	0.0	21.2	10.6	boulder patch
SSS_129	712686.9	612677.7	0.4	1.6	0.6	boulders
SSS_130	712681.2	612676.4	0.6	1.8	0.7	boulders
SSS_131	712678.3	612673.3	1.2	2.0	0.8	boulders
SSS_132	712525.9	612735.8	0.3	0.7	0.5	boulders
SSS_133	712394.4	612790.8	0.3	2.8	0.5	mooring and rope
SSS_134	712379.2	612794.4	0.3	0.8	0.8	boulders
SSS_135	712862.5	612647.7	0.8	1.3	0.8	boulders
SSS_136	712761.4	612653.5	0.3	0.8	0.6	boulders
SSS_137	712699.6	612674.0	0.0	13.3	8.7	boulder patch
SSS_138	712532.6	612736.9	0.3	0.6	0.5	boulders
SSS_139	712352.5	612815.0	0.9	2.3	2.7	Fishing pot
SSS_140	712363.1	612800.8	0.3	0.8	0.6	boulders
SSS_141	712197.4	612849.8	1.0	1.7	0.0	NI** debris
SSS_142	712658.4	612689.1	0.5	1.9	1.0	boulders
SSS_143	711980.7	612950.8	0.4	0.6	0.5	boulders
SSS_144	712267.0	612539.4	0.5	1.4	0.4	boulders
SSS_145	712260.3	612511.9	0.0	22.8	24.7	boulder patch
SSS_146	712219.9	612521.1	0.4	1.4	1.5	boulders
SSS_147	712226.1	612519.3	0.8	0.7	1.3	boulders
SSS_149	712180.7	612515.1	0.0	19.8	19.2	boulder patch
SSS_151	712292.3	612558.3	0.4	1.2	0.5	boulders
SSS_152	712071.4	612641.6	0.1	0.7	0.2	two boulders or blocks
SSS_153	712109.6	612667.5	0.4	0.8	0.3	boulders
SSS_154	712158.9	612632.8	0.6	2.1	0.9	boulders
SSS_155	712251.1	612612.9	0.3	1.0	0.3	boulders
SSS_156	712343.5	612548.5	0.0	26.0	24.5	boulder patch
SSS_157	712300.4	612568.6	0.1	16.1	0.2	long linear NI* debris - possible rope or chain
SSS_163	712284.6	612631.8	0.3	1.3	1.0	boulders
SSS_164	712310.0	612619.0	0.4	1.5	0.6	boulders
SSS_165	712383.9	612600.0	1.4	2.4	1.6	boulders
SSS_166	712414.2	612579.0	0.1	1.2	0.3	boulders
SSS_167	712425.1	612573.9	0.2	1.4	0.7	boulders
SSS_168	712445.7	612565.5	0.4	0.9	0.5	boulders
SSS_169	712442.5	612582.7	0.3	0.6	0.2	boulders
SSS_171	712035.7	612723.4	0.3	0.7	0.4	boulders
SSS_172	712043.2	612716.3	0.4	0.7	0.4	boulders

SSS_173	712310.6	612605.3	0.6	1.8	1.8	boulders
SSS_174	712443.3	612581.4	0.7	1.8	1.6	boulders
SSS_175	712476.8	612572.5	0.7	1.2	0.7	boulders
SSS_176	712475.5	612574.5	0.2	1.4	1.1	boulders
SSS_178	712394.7	612580.0	0.5	1.2	1.0	boulders
SSS_179	712400.5	612597.6	0.4	0.7	0.5	boulders
SSS_180	712075.5	613254.3	0.4	1.8	1.2	boulders
SSS_181	712839.1	612962.5	0.1	0.6	0.6	boulders
SSS_182	713024.4	612886.7	0.3	8.4	0.2	mooring and rope
SSS_183	713010.7	612902.3	0.5	0.9	0.4	boulders
SSS_184	713112.5	612901.6	0.4	0.9	0.5	boulders
SSS_185	712758.7	613109.2	0.8	1.2	0.7	boulders
SSS_186	712778.4	613114.7	0.5	0.7	0.2	boulders
SSS_187	712783.5	613187.7	0.5	1.1	1.2	tyre

**Coordinates in Irish Transverse Mercator (ITM)*

*** NI: Not Identified*

Figure 20 below is showing a few of the identified contacts. Appendix 2 shows all the sonar contacts.

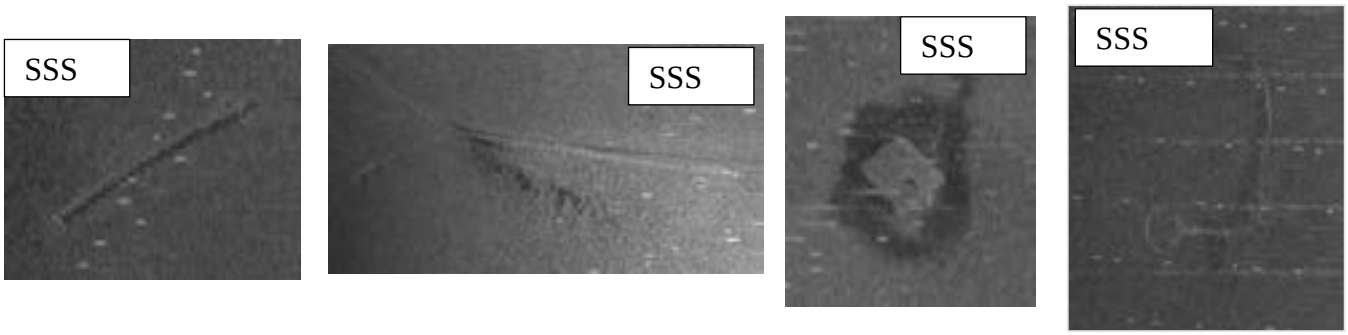


Figure 20: Sidescan sonar contact examples

8.3 Marine Magnetometer targets

In total, 286 magnetometer anomalies were identified. The magnetic anomalies are listed in table 20 and figure 21 and 22 show their location.

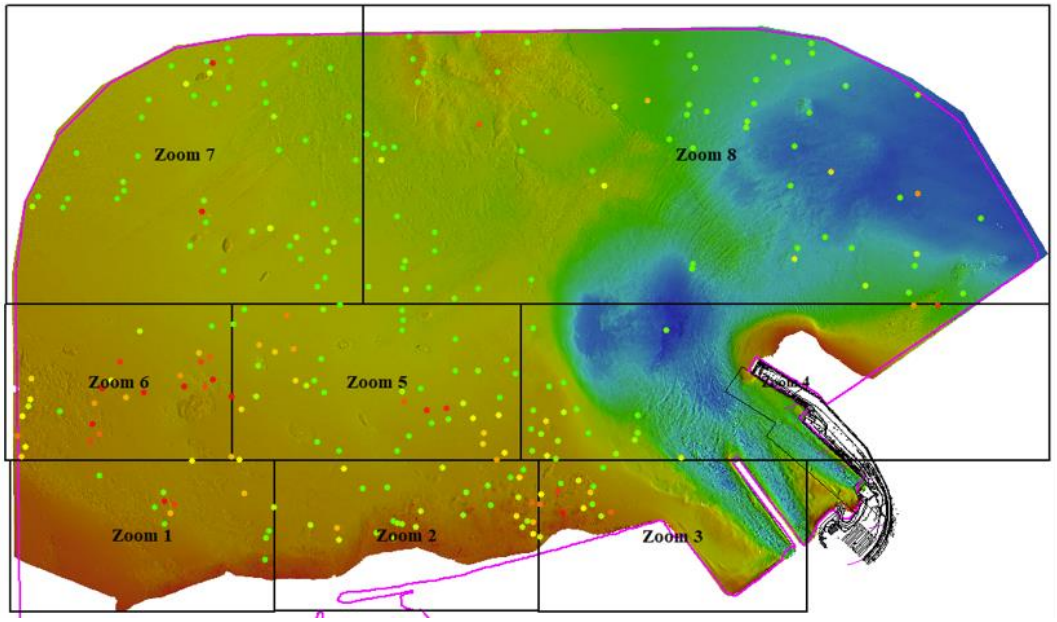
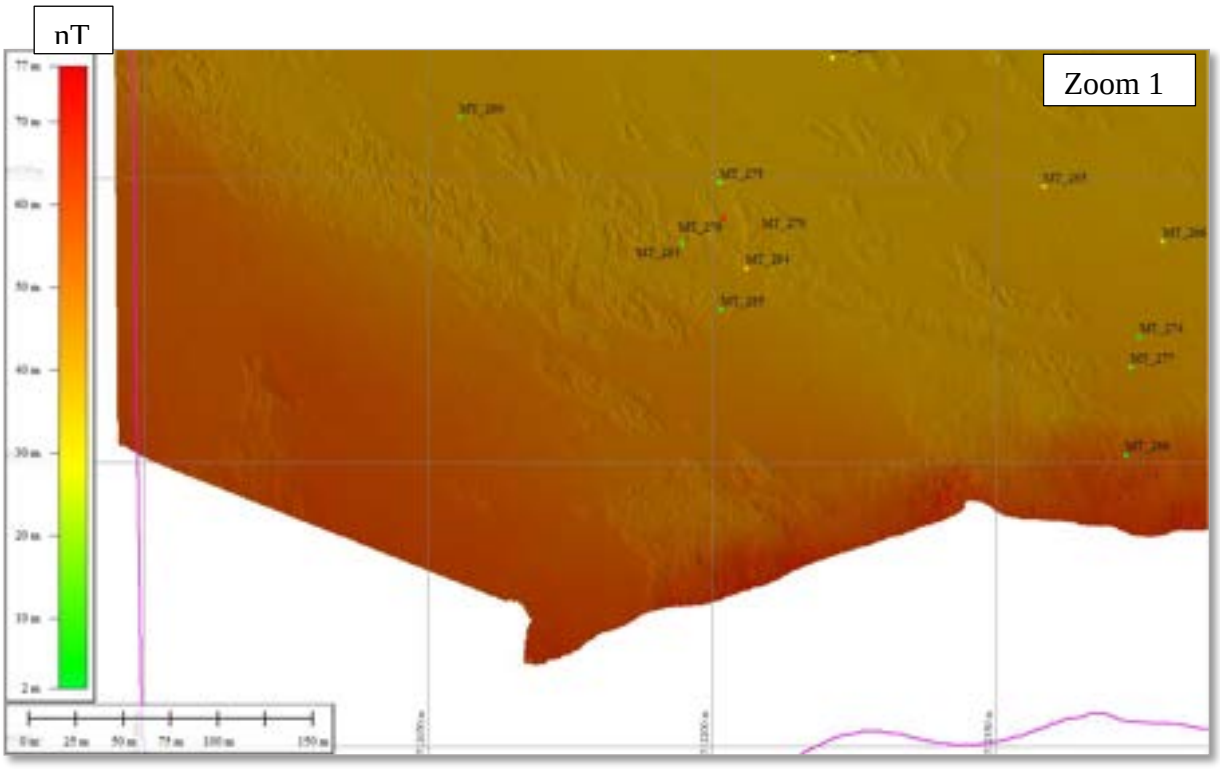
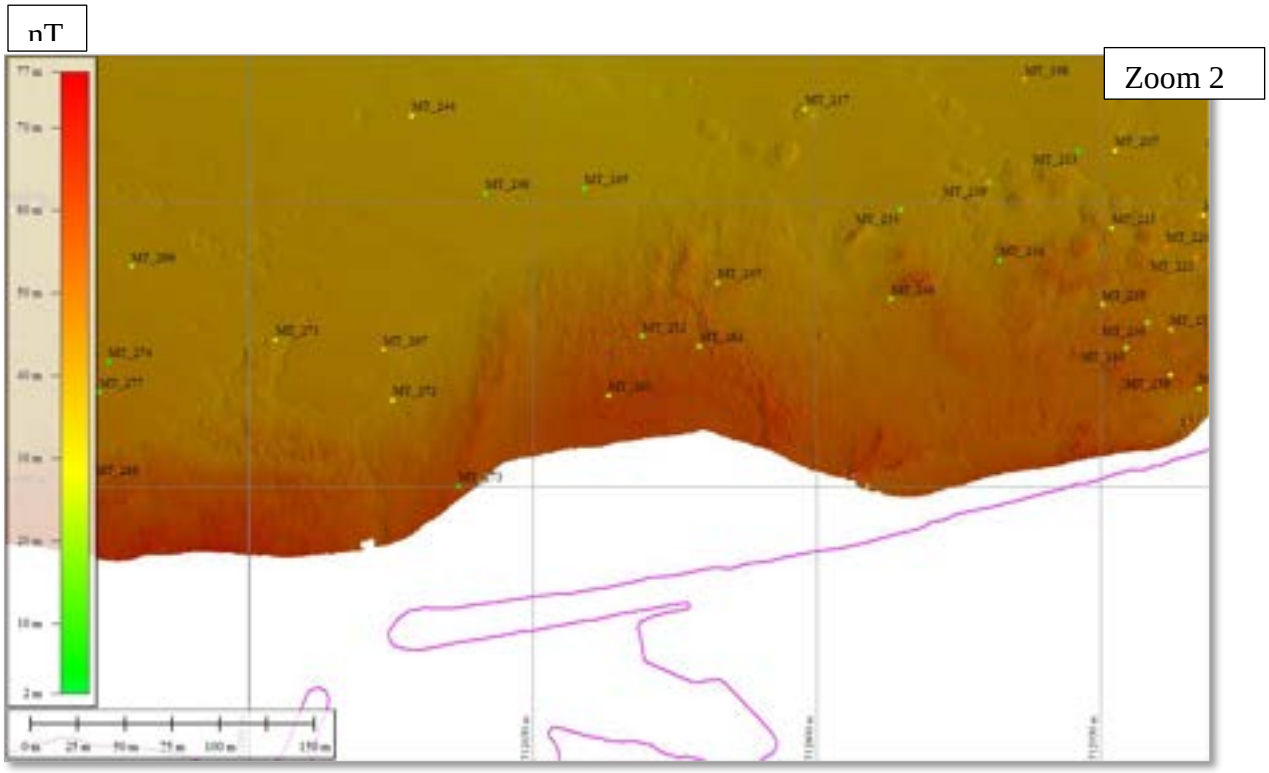
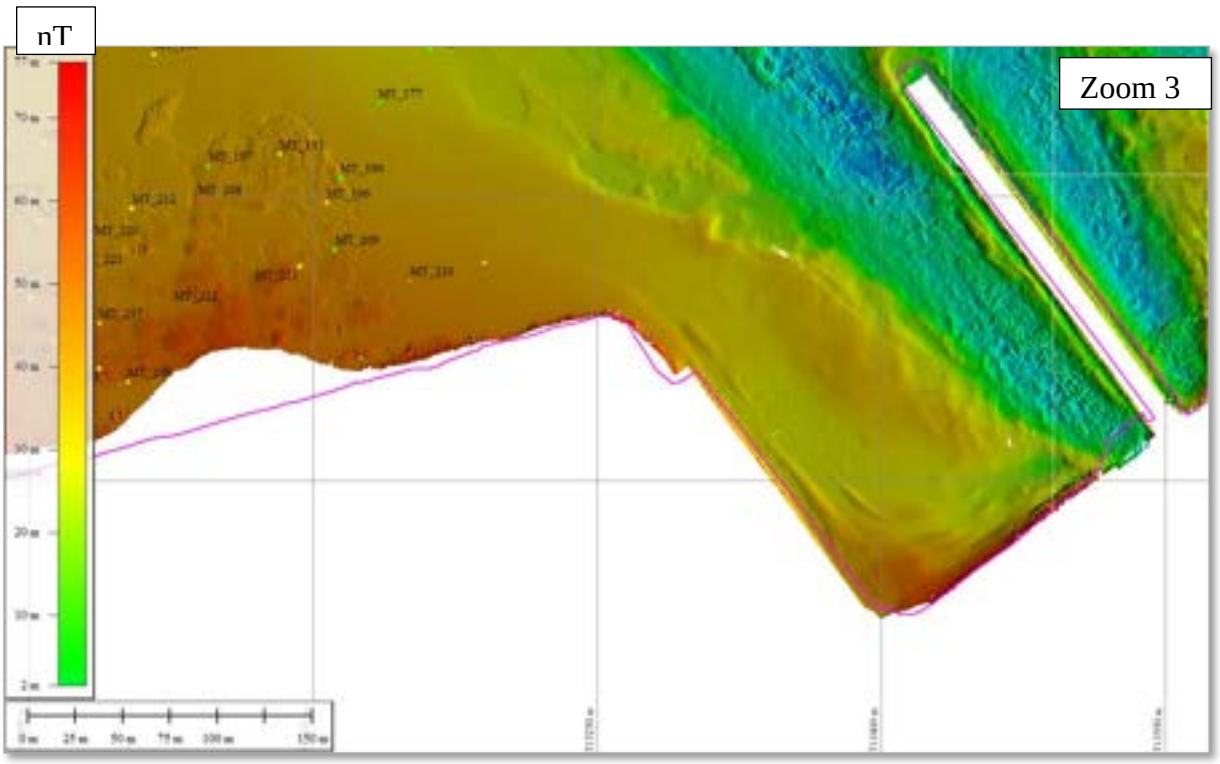


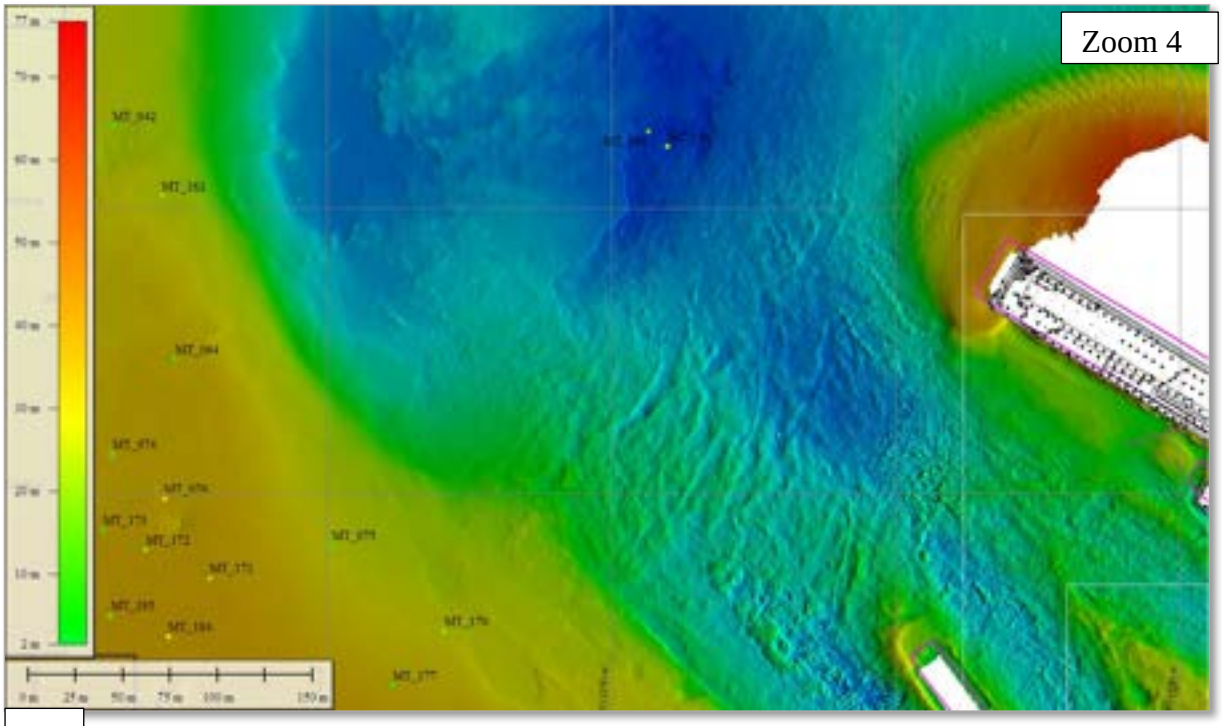
Figure 21: Magnetometer anomalies location and key plan and zoomed view.



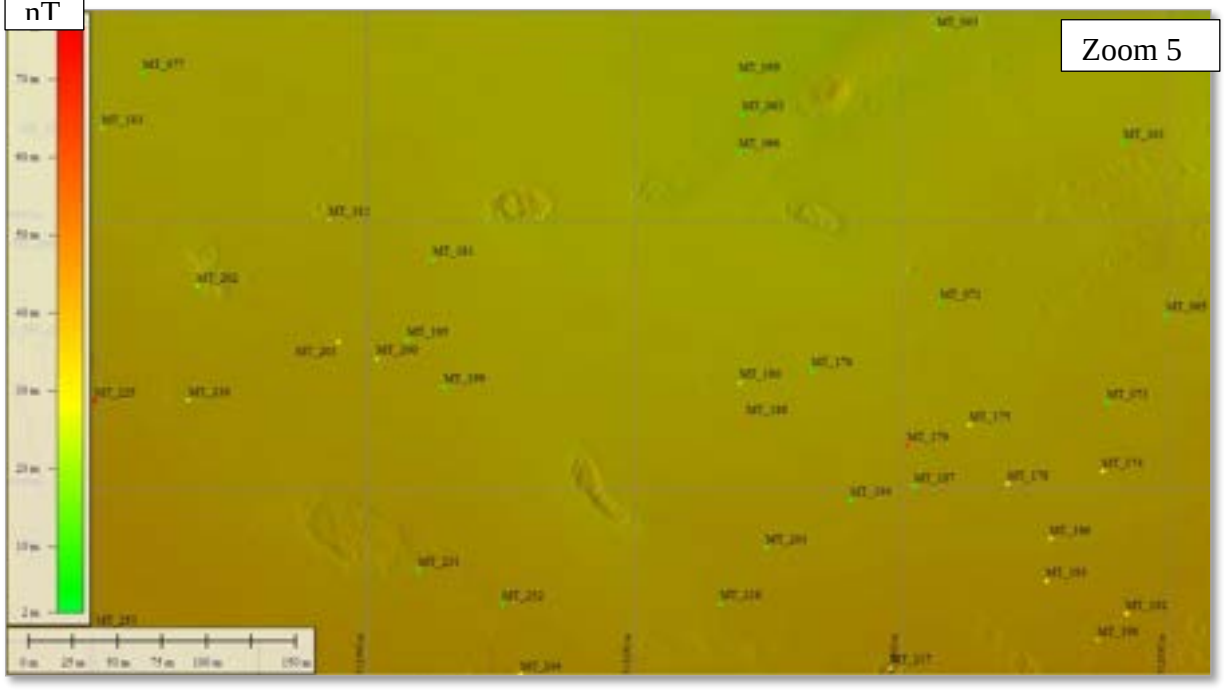

nT
Zoom 2


nT
Zoom 3

nT

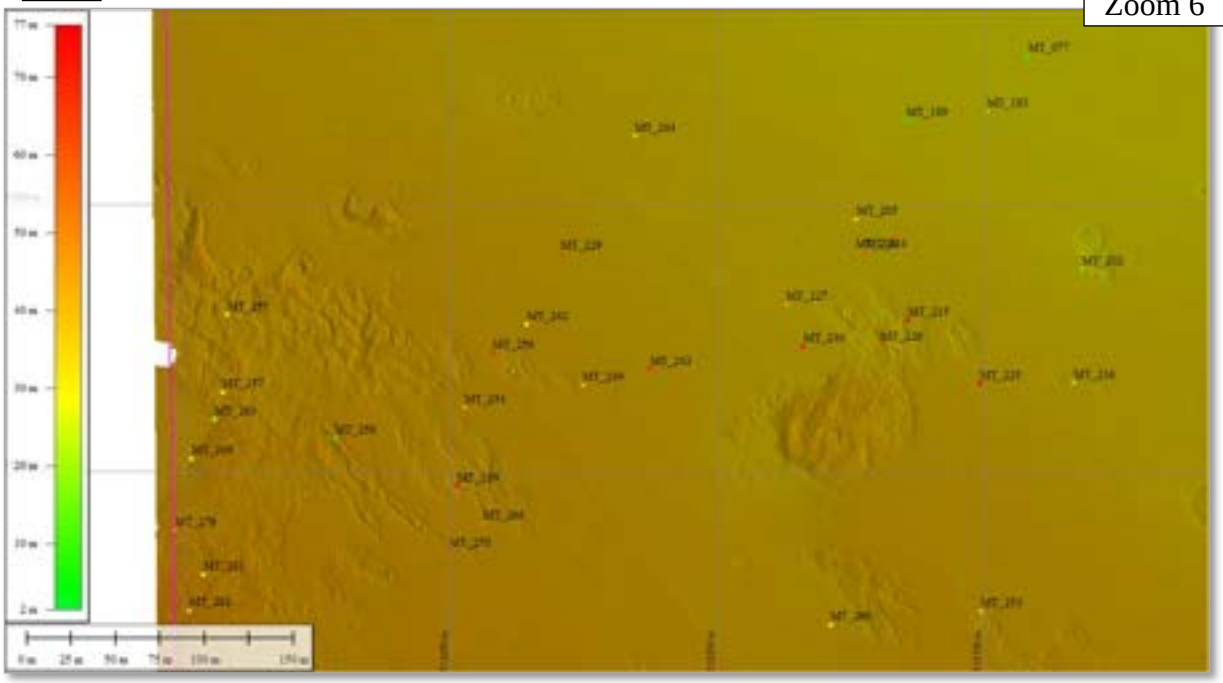


nT



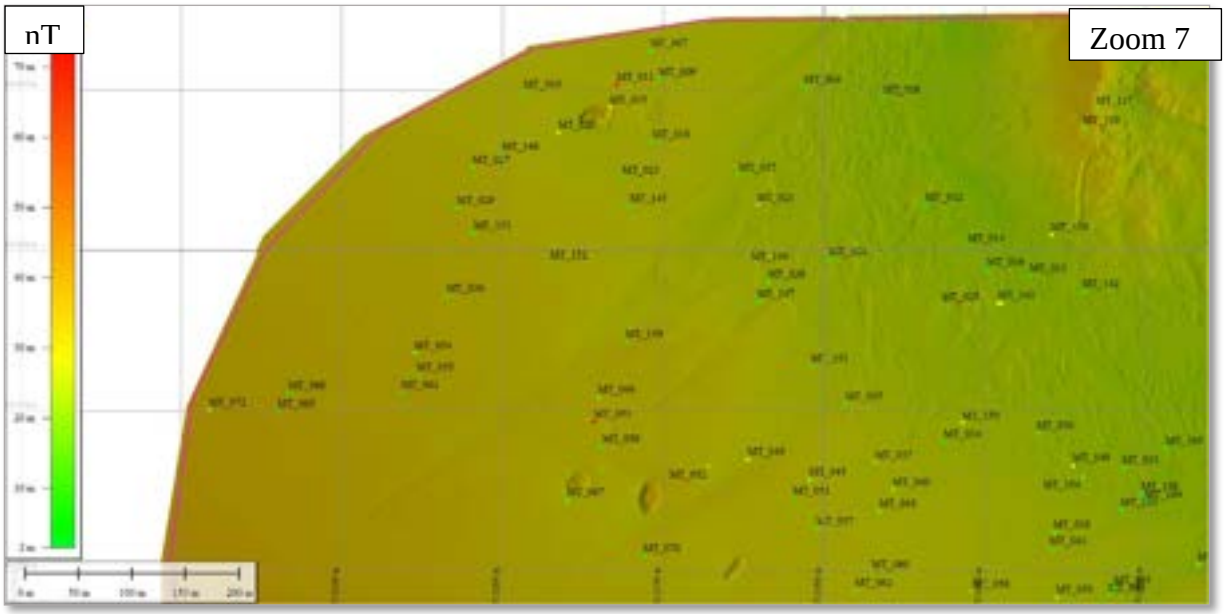
nT

Zoom 6



nT

Zoom 7



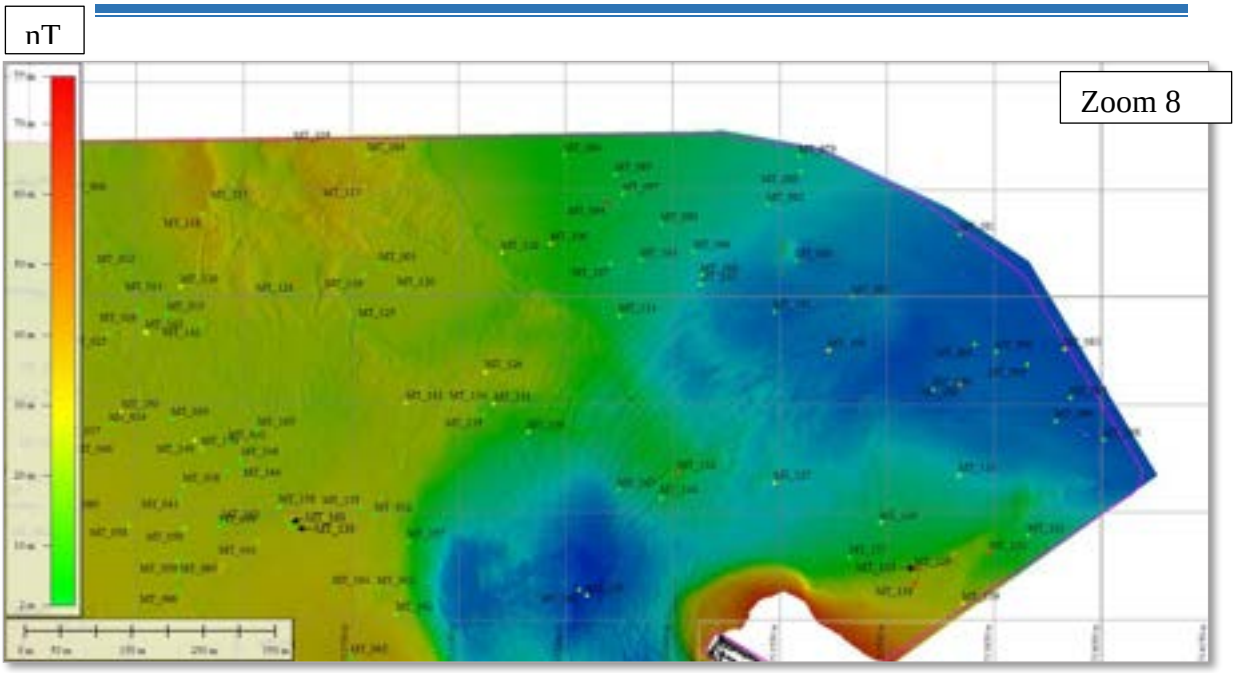


Figure 22: Zoomed views of Magnetic target location

Table 20 is listing the 286 magnetic anomalies identified within the survey site.

Table 19: Magnetic anomalies (nT)

ID	Easting *	Northing*	Amplitude (nT)
MT_001	712989.9	613546.0	2.3
MT_004	712481.9	613652.2	4.0
MT_006	712555.9	613642.9	3.0
MT_007	712338.1	613686.1	6.3
MT_009	712346.1	613659.4	2.3
MT_011	712307.0	613655.0	107.5
MT_012	712595.3	613542.4	1.9
MT_013	712692.7	613476.6	1.6
MT_014	712634.1	613504.5	5.2
MT_015	712300.8	613633.4	21.6
MT_016	712652.4	613482.0	2.3
MT_017	712420.9	613570.2	3.9
MT_018	712340.2	613601.1	6.7
MT_019	712219.7	613647.6	6.3
MT_020	712252.2	613609.9	23.7
MT_021	712438.1	613542.2	17.0
MT_022	712665.5	613450.2	24.3
MT_023	712311.7	613568.1	6.0
MT_024	712505.3	613491.6	6.4
MT_025	712610.6	613449.4	9.1
MT_026	712448.1	613471.0	8.1
MT_027	712172.2	613577.4	9.8
MT_029	712157.3	613539.4	4.6

MT_030	712698.8	613329.4	7.7
MT_031	712778.9	613297.4	5.4
MT_032	712983.4	613196.5	5.7
MT_033	712777.6	613258.1	2.2
MT_034	712612.1	613321.8	5.5
MT_035	712520.4	613357.0	3.4
MT_036	712148.3	613457.3	7.4
MT_037	712547.8	613302.1	13.6
MT_038	712714.7	613236.9	12.7
MT_039	712869.6	613177.8	5.6
MT_040	712564.4	613276.9	16.4
MT_041	712710.8	613221.8	2.2
MT_042	712987.0	613093.6	6.9
MT_043	712820.1	613157.1	10.6
MT_044	712765.4	613178.7	6.8
MT_045	712486.4	613286.1	16.4
MT_046	712288.9	613362.9	14.1
MT_048	712551.7	613256.6	13.1
MT_049	712429.1	613304.9	23.3
MT_050	712717.1	613176.3	17.0
MT_051	712471.6	613268.4	5.2
MT_052	712391.9	613298.4	13.3
MT_053	712285.1	613340.4	151.5
MT_054	712117.8	613404.1	12.4
MT_055	712119.6	613384.1	6.0
MT_056	712293.7	613317.1	6.2
MT_057	712493.5	613240.5	8.0
MT_058	712638.8	613181.8	12.2
MT_059	712708.8	613131.4	8.3
MT_060	712545.1	613199.6	5.1
MT_061	712105.9	613367.4	4.6
MT_062	712529.5	613182.8	9.6
MT_063	712710.9	613110.3	4.4
MT_064	713019.8	612970.8	7.4
MT_065	712948.8	612997.6	4.9
MT_066	712708.9	613089.1	6.0
MT_067	712260.4	613267.3	11.0
MT_068	712000.0	613366.9	3.6
MT_069	711989.8	613349.7	3.6
MT_070	712331.7	613215.2	3.5
MT_071	712821.9	613004.3	6.4
MT_072	711925.6	613351.1	17.5
MT_073	712915.6	612948.6	5.2

MT_074	712986.7	612920.7	11.8
MT_075	713102.9	612872.9	6.5
MT_076	713019.6	612888.5	32.9
MT_077	712374.8	613133.2	7.8
MT_079	713576.4	613696.4	3.5
MT_080	713578.4	613675.9	8.8
MT_081	713801.3	613588.3	10.4
MT_082	713532.2	613629.3	5.7
MT_083	713947.6	613426.8	26.4
MT_084	713248.5	613698.3	4.0
MT_085	713319.8	613671.1	3.2
MT_087	713329.8	613643.4	9.3
MT_088	713571.6	613550.6	2.5
MT_089	713895.9	613405.7	9.9
MT_090	713852.1	613422.9	3.9
MT_091	713822.4	613433.3	9.3
MT_092	713651.4	613499.5	5.0
MT_093	713383.6	613601.9	3.8
MT_094	713308.3	613632.1	74.6
MT_095	713956.5	613358.8	11.7
MT_096	713429.1	613562.9	1.9
MT_098	714002.8	613300.1	3.2
MT_099	713935.7	613326.1	6.7
MT_100	713801.6	613378.3	47.8
MT_101	713554.4	613475.7	6.9
MT_102	713438.1	613517.6	12.2
MT_103	713354.7	613551.4	5.7
MT_104	712973.7	613698.9	12.4
MT_105	712869.5	613714.5	7.9
MT_106	713228.6	613574.4	40.4
MT_107	713313.1	613546.0	5.3
MT_108	713617.9	613425.0	34.0
MT_109	713764.9	613370.8	8.2
MT_110	713161.1	613561.5	20.6
MT_113	712911.4	613635.3	7.1
MT_114	713325.7	613473.8	10.4
MT_116	713800.5	613250.6	21.2
MT_117	712753.9	613632.9	7.8
MT_118	712742.3	613614.8	11.1
MT_119	712967.6	613529.8	10.6
MT_120	713015.3	613510.9	4.1
MT_121	713897.1	613167.1	9.7
MT_123	713842.9	613142.4	64.9

MT_124	712871.8	613523.8	59.2
MT_125	712960.8	613467.4	6.0
MT_126	713137.8	613395.2	25.7
MT_127	713541.6	613240.2	24.3
MT_128	713690.5	613184.9	21.2
MT_129	713792.6	613141.2	47.0
MT_130	712712.3	613514.6	24.5
MT_131	713150.0	613350.4	25.8
MT_132	713407.5	613254.4	58.1
MT_133	713742.6	613120.9	92.9
MT_134	713088.5	613351.6	4.3
MT_135	713136.1	613334.6	4.7
MT_136	713197.6	613311.0	16.7
MT_137	713647.6	613136.2	5.5
MT_138	713738.1	613099.3	83.7
MT_139	713805.0	613071.4	35.2
MT_140	713383.1	613219.4	11.1
MT_141	713026.8	613351.8	35.3
MT_142	712741.6	613461.8	6.8
MT_143	712662.6	613451.1	28.3
MT_144	712468.2	613487.0	57.1
MT_145	712319.1	613541.2	5.8
MT_146	712199.2	613589.8	3.8
MT_147	712437.9	613452.8	4.6
MT_148	712796.6	613273.3	3.0
MT_149	712732.5	613299.2	27.4
MT_150	712629.3	613339.4	23.8
MT_151	712488.2	613391.9	5.7
MT_152	712244.7	613488.2	4.1
MT_153	712173.3	613516.4	6.4
MT_154	712741.1	613288.8	14.8
MT_155	712964.1	613205.1	5.4
MT_156	713279.6	613082.8	21.5
MT_157	713029.8	613158.1	6.4
MT_158	712849.3	613207.1	11.1
MT_159	712315.3	613414.8	6.4
MT_160	712862.9	613183.6	5.0
MT_161	712924.8	613094.3	5.6
MT_162	713013.0	613057.0	14.6
MT_163	712770.9	613185.3	4.0
MT_164	712800.1	613265.7	3.0
MT_165	712819.6	613315.1	6.2
MT_166	713269.9	613090.5	11.6

MT_167	713324.4	613230.4	4.9
MT_169	713440.1	613530.0	13.8
MT_170	713161.9	612827.4	14.4
MT_171	713038.2	612855.4	16.6
MT_172	713004.4	612870.4	16.3
MT_173	712981.9	612880.8	7.2
MT_174	712912.9	612909.9	25.9
MT_175	712838.1	612935.9	21.6
MT_176	712749.5	612966.6	5.7
MT_177	713134.5	612799.1	5.8
MT_178	712859.8	612902.7	26.1
MT_179	712803.4	612924.6	68.4
MT_180	712709.3	612959.6	16.9
MT_181	712537.1	613028.4	9.1
MT_182	712477.5	613054.4	44.3
MT_183	712351.7	613102.3	11.0
MT_184	713016.3	612824.7	25.4
MT_185	712985.8	612835.7	10.6
MT_186	712883.4	612872.1	36.6
MT_187	712807.2	612901.4	11.3
MT_188	712713.1	612939.6	58.5
MT_189	712306.3	613097.3	6.1
MT_190	713114.4	612759.5	8.8
MT_191	713082.6	612772.0	23.1
MT_192	712926.3	612830.0	29.2
MT_193	712881.3	612848.4	34.9
MT_194	712771.6	612893.8	6.3
MT_195	712522.8	612983.4	10.2
MT_196	713107.1	612746.3	37.0
MT_197	713044.8	612765.9	9.6
MT_198	712910.1	612815.3	44.9
MT_199	712543.6	612957.1	8.2
MT_200	712505.7	612973.2	18.8
MT_201	712484.3	612982.2	34.9
MT_202	712404.9	613013.6	12.8
MT_203	712724.3	612866.9	8.4
MT_204	712153.3	613088.4	19.7
MT_205	712277.8	613041.5	38.4
MT_206	712301.4	613032.9	57.8
MT_207	712957.8	612777.6	31.1
MT_208	713039.3	612748.2	65.1
MT_209	713111.6	612721.8	12.5
MT_210	713151.0	612705.4	56.3

MT_211	713093.1	612712.9	26.1
MT_212	713004.4	612743.7	27.8
MT_213	712938.6	612777.7	6.8
MT_214	712282.9	613023.3	63.1
MT_215	712306.9	612985.0	83.6
MT_216	712400.1	612949.9	18.3
MT_217	712794.0	612799.6	22.0
MT_218	712698.3	612829.6	7.2
MT_219	712890.9	612760.8	12.7
MT_220	712984.7	612727.0	55.6
MT_221	713000.6	612721.3	53.3
MT_222	713050.5	612702.1	107.3
MT_223	712956.1	612736.8	20.2
MT_225	712347.4	612949.4	81.2
MT_226	712292.0	612970.9	60.7
MT_227	712238.6	612993.6	46.5
MT_229	712111.7	613022.2	65.5
MT_230	712248.1	612970.3	77.6
MT_231	712529.2	612854.5	8.7
MT_232	712576.3	612835.6	4.5
MT_233	712844.4	612746.3	13.7
MT_234	712897.0	612719.6	8.9
MT_235	712950.9	612696.4	30.9
MT_236	712974.9	612686.9	16.0
MT_237	712987.0	612683.2	39.7
MT_238	713002.1	612652.0	20.5
MT_239	712987.3	612659.1	28.6
MT_240	712963.6	612673.4	18.4
MT_242	712092.6	612982.5	27.6
MT_243	712162.0	612957.4	71.4
MT_244	712568.3	612794.2	26.2
MT_245	712677.3	612757.6	9.6
MT_246	712839.5	612699.3	16.5
MT_247	712747.8	612707.9	21.2
MT_248	712625.1	612754.9	10.2
MT_249	712123.9	612948.4	40.9
MT_250	712078.2	612961.0	71.6
MT_252	712708.0	612679.5	15.7
MT_253	712340.0	612815.4	39.3
MT_254	712057.6	612936.0	45.7
MT_255	711924.2	612987.9	34.0
MT_257	711921.6	612944.4	28.1
MT_258	711984.7	612918.8	5.4

MT_259	712053.6	612891.8	77.3
MT_260	712263.5	612813.8	29.5
MT_261	712690.0	612648.3	21.2
MT_262	712738.3	612674.4	21.0
MT_263	711917.1	612929.3	21.3
MT_264	712067.9	612870.6	55.5
MT_265	712375.3	612745.5	40.1
MT_266	712438.1	612716.5	19.8
MT_267	712571.3	612672.4	40.0
MT_269	711904.0	612907.3	27.4
MT_270	712048.9	612855.3	62.6
MT_271	712514.4	612677.6	19.7
MT_272	712576.1	612645.8	23.2
MT_273	712610.9	612600.4	4.6
MT_274	712425.9	612666.2	5.0
MT_275	712204.0	612747.7	12.1
MT_276	711894.9	612867.0	52.6
MT_277	712421.0	612650.1	10.5
MT_278	712226.4	612721.3	63.3
MT_279	712206.3	612728.9	282.9
MT_280	712066.9	612782.0	7.6
MT_281	711910.8	612842.1	26.7
MT_282	711902.8	612821.9	34.4
MT_283	712184.2	612715.6	6.8
MT_284	712218.1	612702.4	40.2
MT_285	712204.8	612680.4	6.4
MT_286	712418.6	612603.8	3.4

**Coordinates in Geographic WGS84 and Irish Transverse Mercator (ITM)*

Figure 23 shows two magnetic anomalies of 151 nT and 283 nT recorded for MT_53 and MT_279. The vertical axis corresponds to the magnetic Amplitude in nT.

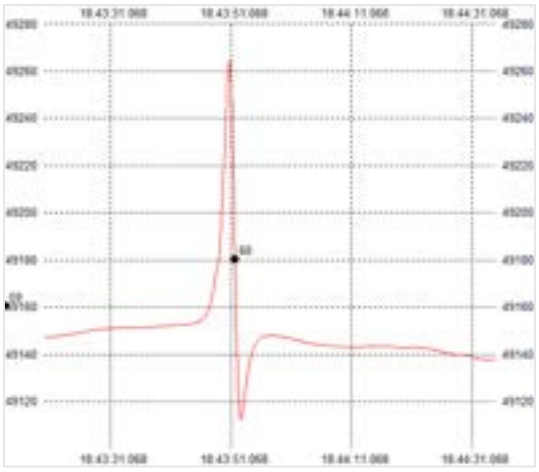
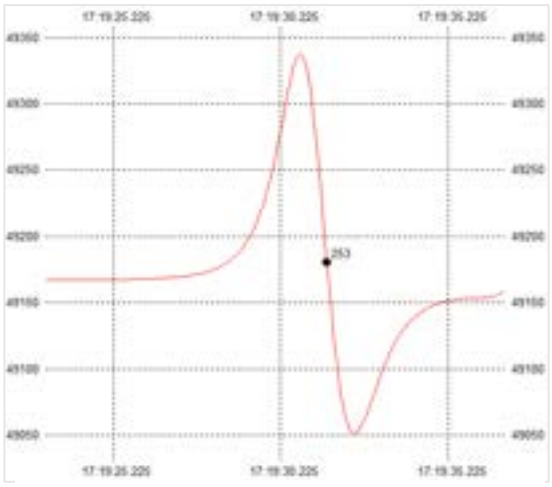


Figure 23: Magnetic anomalies of 151 nT (MT_53)



Magnetic anomalies of 283 nT (MT_279)

8.4 Target correlation

Table 21 shows if the MBES targets are related to a SSS contacts and/or to a magnetic anomalies.

Table 20: MBES target correlations with SSS and magnetic targets

Target ID	Easting*	Northing*	Description	SSS targets ID	Magnetometer target ID
AT_01	712492.5	612864.3	2 blocks	SSS_80	MT_231
AT_02	712070.0	612646.3	2 boulders or blocks	SSS_152	NA
AT_04	712290.9	612578.5	1 block and boulders	SSS_157	NA
AT_05	712084.1	612956.3	**NI ** debris - possible wreck**	SSS_84 & SSS_87	MT_250
AT_06	712214.0	612848.5	**NI ** debris possible buried wreck**	SSS_88	NA
AT_07	712351.3	612812.9	Fishing pot	SSS_139	MT_253
AT_08	712384.2	612796.1	NI ** debris possible mooring block	SSS_133	NA
AT_09	712560.0	612794.5	Mooring with rope	SSS_86	MT_244
AT_10	712474.8	613057.2	Mooring block	SSS_65 & SSS_68	MT_182
AT_11	712642.8	613384.4	Possible Boulder	SSS_1	NA
AT_12	712784.3	613182.6	Tyre	SSS_44, SSS111, SSS_187	NA
AT_13	713023.3	612885.1	Mooring and rope	SSS_67, SSS_182	MT_076
AT_14	713557.1	612788.8	NI ** long debris	SSS_55, SSS_57	NA
AT_15	713313.1	612655.8	NI ** debris	SSS_52	NA
AT_16	713953.2	613220.5	Long thin scour	SSS_2	NA
AT_17	713805.2	613456.5	Little boulder	SSS_14	NA
AT_18	713554.7	613478.4	Mooring with rope or chain	SSS_11	MT_101
AT_19	713467.3	613524.4	Possible rope	SSS_8	NA
AT_20	713446.1	613473.1	NI ** debris - possible mooring with rope or chain	SSS_6,SSS_45, SSS_50	NA
AT_21	713221.2	613688.5	Tyre	SSS_13, SSS_15	NA
AT_22	713097.5	613669.6	Possible mooring block or boulder	SSS_5	NA
AT_23	711895.8	612874.0	NI ** debris - possible boulder	NA	MT_276
AT_24	712377.3	612746.7	Mooring with chain or rope	NA	MT_265
AT_25	712697.5	612825.0	NI ** debris - possible buried mooring with rope	SSS_75	MT_218
AT_26	712845.4	612746.5	Mooring with chain or rope	NA	MT_223
AT_27	713932.6	613327.3	Possible scours on the seabed	NA	MT_99
AT_28	713223.1	613575.9	NI ** debris	NA	MT_106
AT_29	713155.5	613353.4	Block - possible former mooring	NA	MT_131
AT_30	713080.8	613336.9	Block	NA	MT_134

* Coordinates in ITM

** NI: Non-identified

Table 22 shows if the SSS contacts are related to a MBES targets and/or to a magnetic anomalies.

Table 21: SSS Targets correlation with MBES and Magnetic targets

Target ID	Easting*	Northing*	Description	Magnetometer target ID	MBES target ID
SSS_1	712652.1	613369.3	NI** debris	NA	AT_11
SSS_2	713955.7	613220.5	NI** linear debris	NA	AT_16
SSS_5	713083.8	613646.0	NI** linear debris	NA	AT_22
SSS_6&45&50	713446.2	613466.1	NI** debris - possible mooring with rope or chain	NA	AT_20
SSS_8	713465.6	613524.1	NI** debris	NA	AT_19
SSS_11	713555.8	613476.4	Possible mooring rope/chain	MT_101	AT_18
SSS_13&15	713217.8	613687.4	tyre	NA	AT_21
SSS_14	713806.2	613456.3	NI** debris	NA	AT_17
SSS_22&23	713846.8	613115.5	Possible mooring block or boulder	MT_123	NA
SSS_24	713731.4	613175.8	boulders	MT_128	NA
SSS_31	713052.7	613358.2	sand waves/ripples	MT_141	NA
SSS_41	713024.5	613078.4	boulders	MT_162	NA
SSS_42	712991.3	613090.7	outcropping	MT_042	NA
SSS_44&111&187	712782.4	613182.0	tyre	NA	AT_12
SSS_52	713307.5	612658.7	NI** debris	NA	AT_15
SSS_55&57	713557.6	612791.3	linear NI** debris	NA	AT_14
SSS_63	712967.9	612821.6	outcrop	MT_185	NA
SSS_64	712409.7	613028.7	outcrop	MT_202	NA
SSS_65&68	712473.6	613063.7	Mooring block	MT_182	AT_10
SSS_67&182	713026.6	612885.0	Mooring with rope/chain	MT_076	AT_13
SSS_69	713054.8	612787.3	boulders	MT_197	NA
SSS_75	712697.4	612823.8	Possible mooring	MT_218	AT_25
SSS_76	712390.3	612952.3	boulders	MT_216	NA
SSS_77	712355.6	612956.4	boulders	MT_225	NA
SSS_80	712491.3	612857.1	block	MT_231	AT_01
SSS_81	712948.8	612685.1	boulders	MT_235	NA
SSS_84&87	712073.3	612973.4	NI* debris	MT_250	AT_05
SSS_86	712562.1	612792.6	Mooring with rope/chain	MT_244	AT_09
SSS_88	712218.3	612847.7	NI* debris - possible wreck	NA	AT_06
SSS_93	712489.0	612694.7	boulders	MT_271	NA
SSS_94	712440.0	612713.5	boulders	MT_266	NA
SSS_95	711895.8	612878.2	boulders	MT_276	AT_23
SSS_101	712854.6	613239.5	sand waves/ripples	MT_158	NA
SSS_103	712830.7	613280.2	boulders	MT_148, MT_164	NA
SSS_104	713776.0	613219.6	boulders	MT_116	NA
SSS_110	712436.2	612604.8	boulders	MT_286	NA
SSS_112&113	712104.6	613419.7	boulders	MT054	NA
SSS_118	712470.3	613476.2	boulders	MT_144	NA

SSS_120	712281.2	613619.5	Possible outcrop	MT020, MT015	NA
SSS_121	712655.2	613516.2	linear NI* debris	MT_014	NA
SSS_122	712527.3	613652.3	boulders	MT004, MT006	NA
SSS_123	713089.4	612781.1	boulder patch	MT_191	NA
SSS_133	712394.4	612790.8	mooring with rope	NA	AT_08
SSS_152	712071.4	612641.6	two boulders or blocks	NA	AT_02
SSS_157	712300.4	612568.6	long linear NI* debris - possible rope or chain	NA	AT_04
SSS_181	712839.1	612962.5	boulders	MT_175	NA
SSS_183	713010.7	612902.3	boulders	MT_076	NA
SSS_184	713112.5	612901.6	boulders	MT_075	NA

* Coordinates in ITM

** NI: Non-identified

Figures 24 to 27 shows the multibeam echosounder, the sidescan sonar and the magnetometer target location. A1 detailed charts are included in Appendix 3.

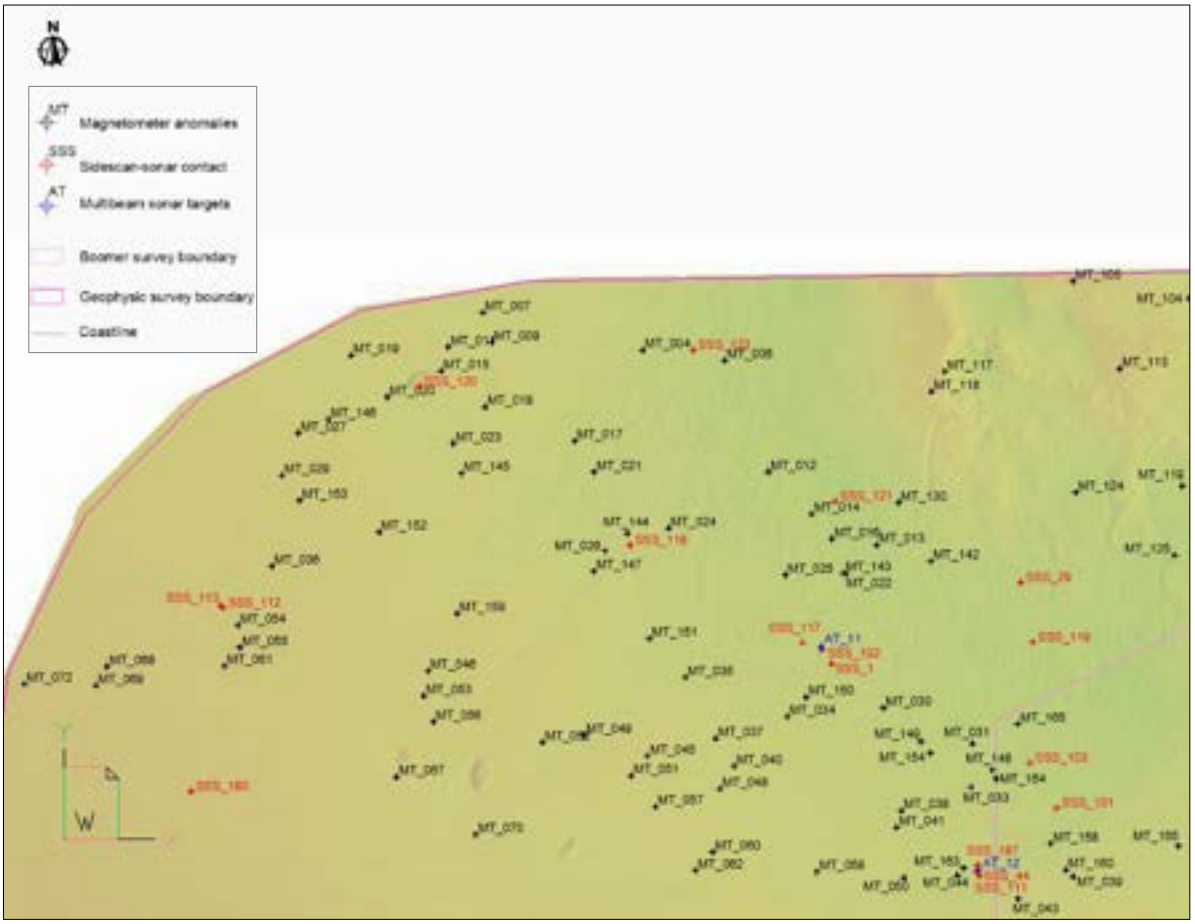


Figure 24: MBES, SSS and Magnetic target location - Chart 01

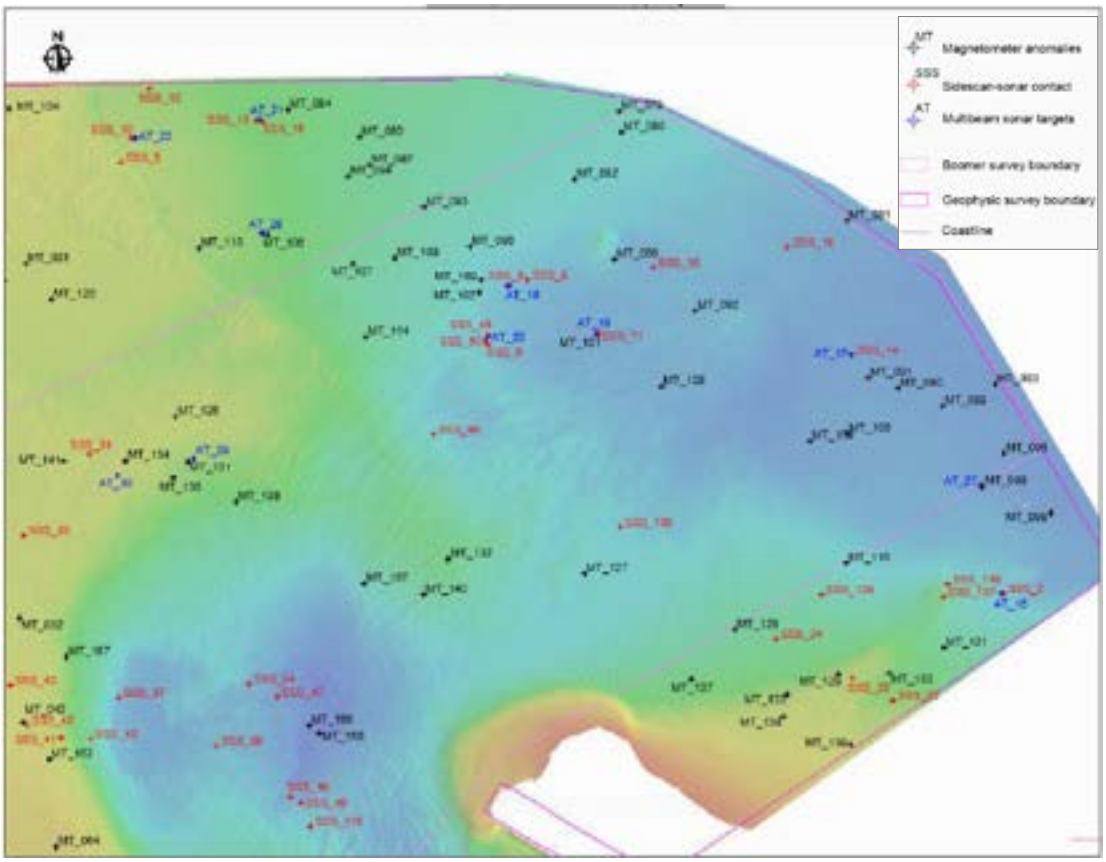


Figure 26: MBES, SSS and Magnetic target location - Chart 02

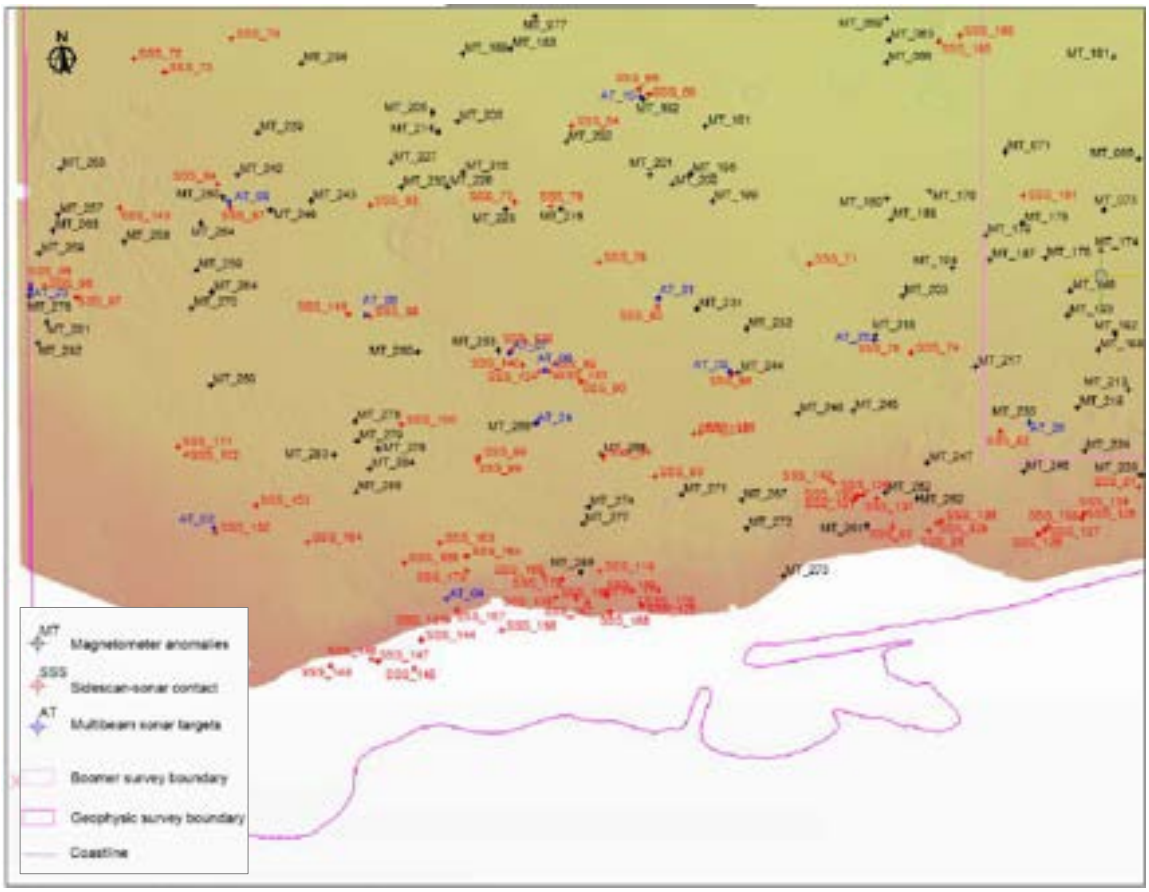


Figure 25: MBES, SSS and Magnetic target location - Chart 03

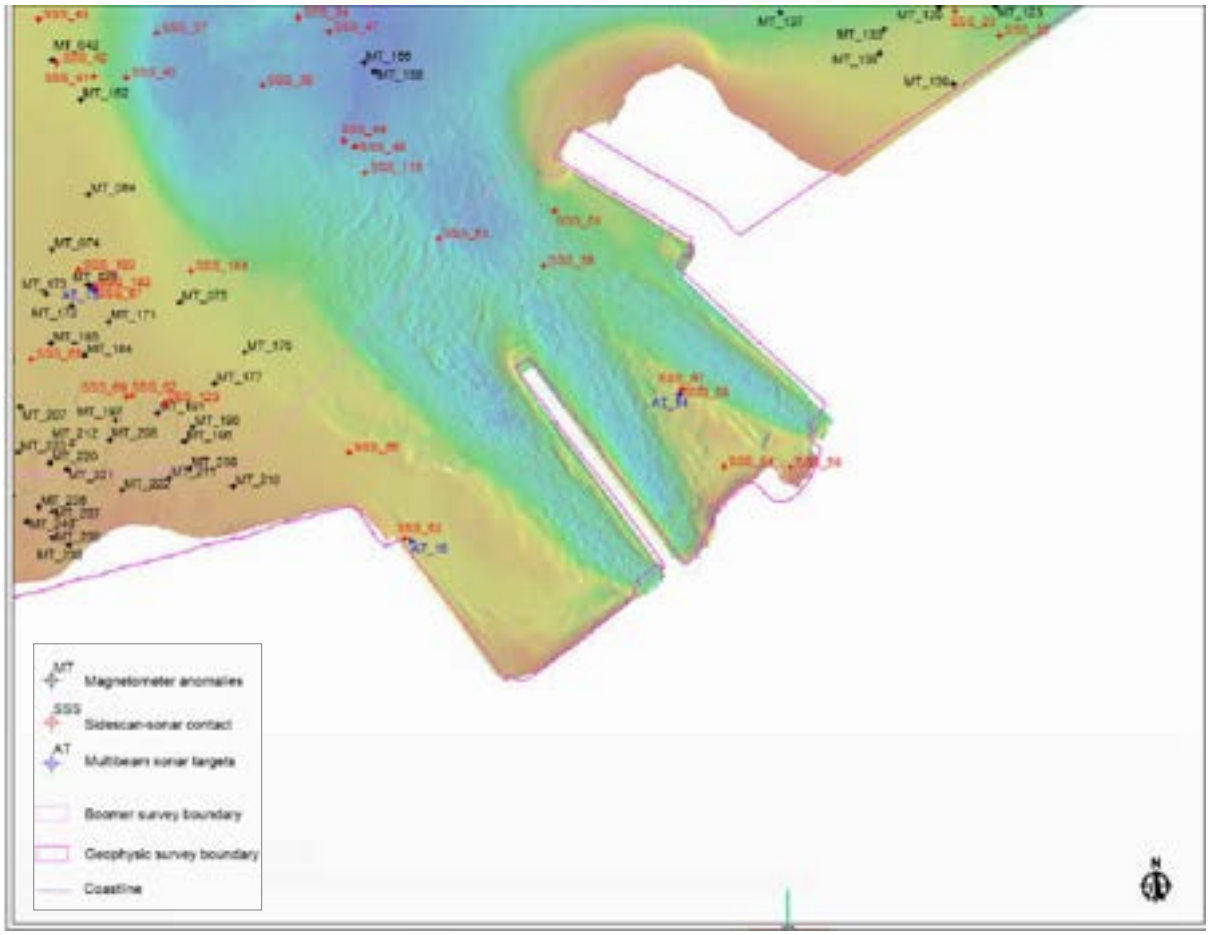


Figure 27: MBES, SSS and Magnetic target location - Chart 04

8.5 High Frequency Sub-Bottom-Profiler (HF-SBP)

A total of 120 raw data files were interpreted across the worksite to generate isopaches. Data quality is good overall. Signal penetration was limited by sediment type below the seabed but overall achieving good penetration on most areas. Figure 28 shows an example of one the seismic profile.

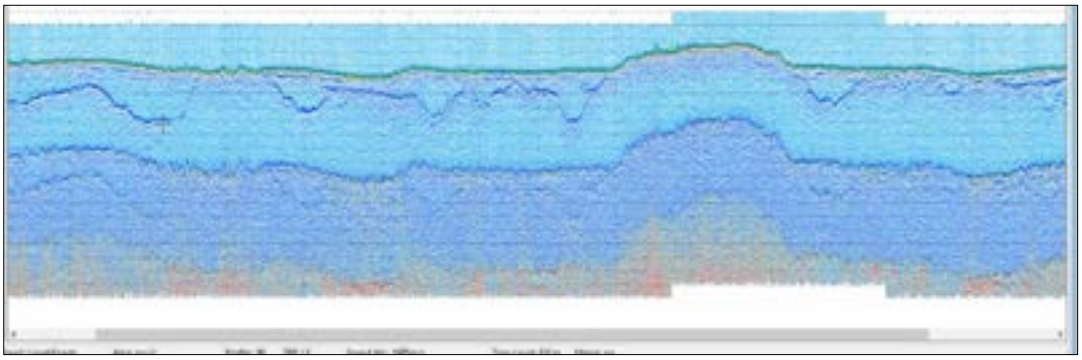


Figure 28: HF-SBP seismic profile example

The isopach (figure 29) is contoured at 1 metre intervals and detailed in charts supplied in Appendix 3. Relevant reflectors were exported as ASCII XYZ files and as depth below seabed to provide an isopach dataset for charting.

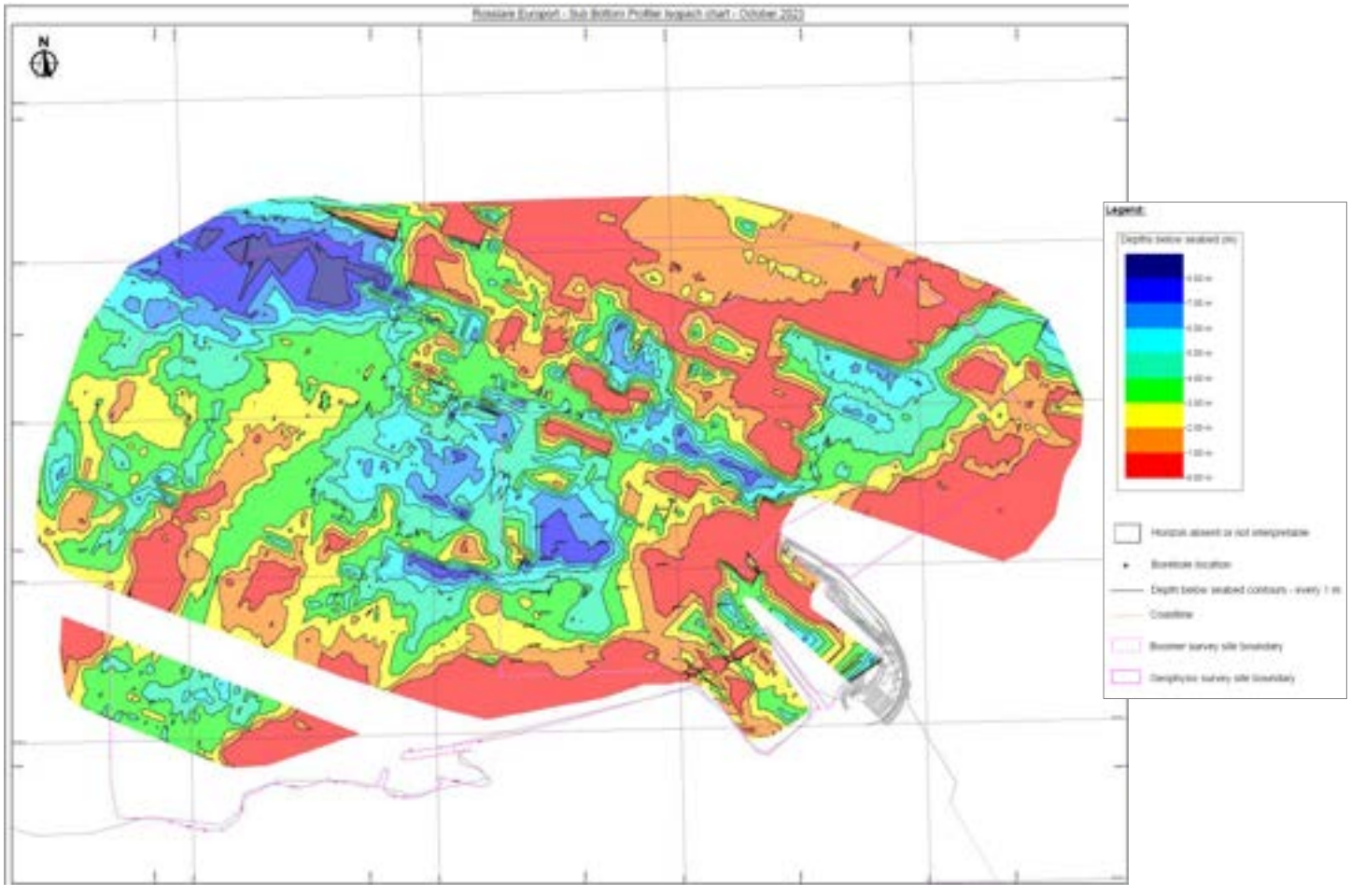


Figure 29: HF-SBP Isopach map

8.6 Medium Frequency Sub-Bottom Profiler (MF-SBP)

The Boomer data was of good quality throughout the survey and achieved >10m penetration over the majority of the survey area. Penetration was limited in the shallow water areas due to the reverberation from the seabed masking the sub bottom data. Due to the limitations of the system, the deep penetration comes at the cost of lower resolution. This lower resolution is apparent in the top 10 m of the data, where it is difficult to distinguish between different horizons which are known to be present, such as the top of clay. However, the data from the Innomar was used to interpret the areas of shallow sediment and bedrock as the Innomar is a high-resolution system.

Horizons below the seabed are picked by identifying strong reflectors and tracing them along each survey line. These reflectors indicate changes in the geology, allowing us to identify the different layers within the substrata.

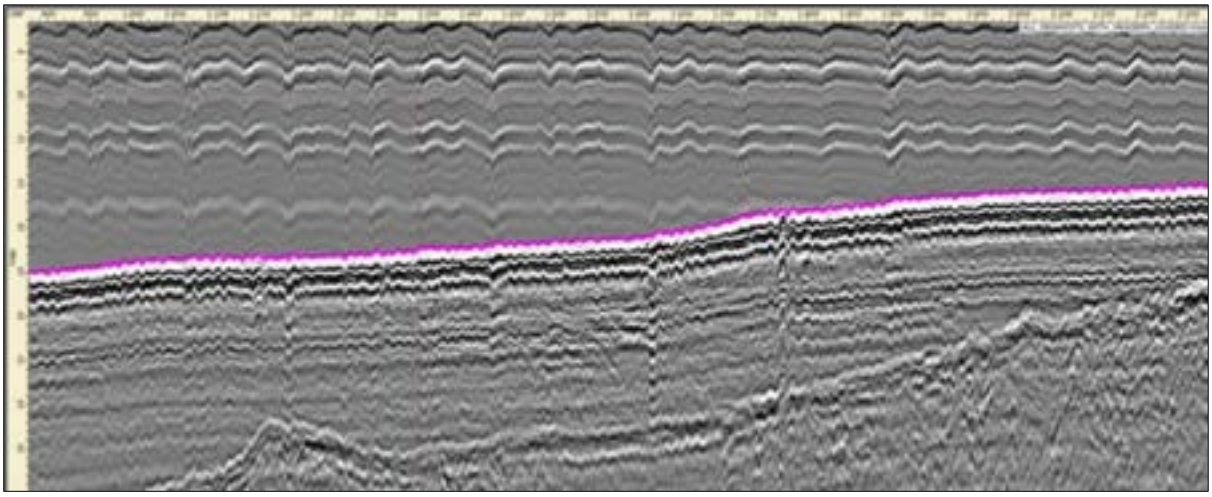


Figure 30: Subsection example of seabed picks.

Relevant reflectors were exported as ASCII XYZ files and as depth below seabed to provide an isopach dataset for charting.

For this project, the Top of Mudstone was tracked across the site and the depth of this horizon was measured. The isopach representing the depths of the mudstone below seabed is shown figure 31 (detailed A1 chart in Appendix 3).

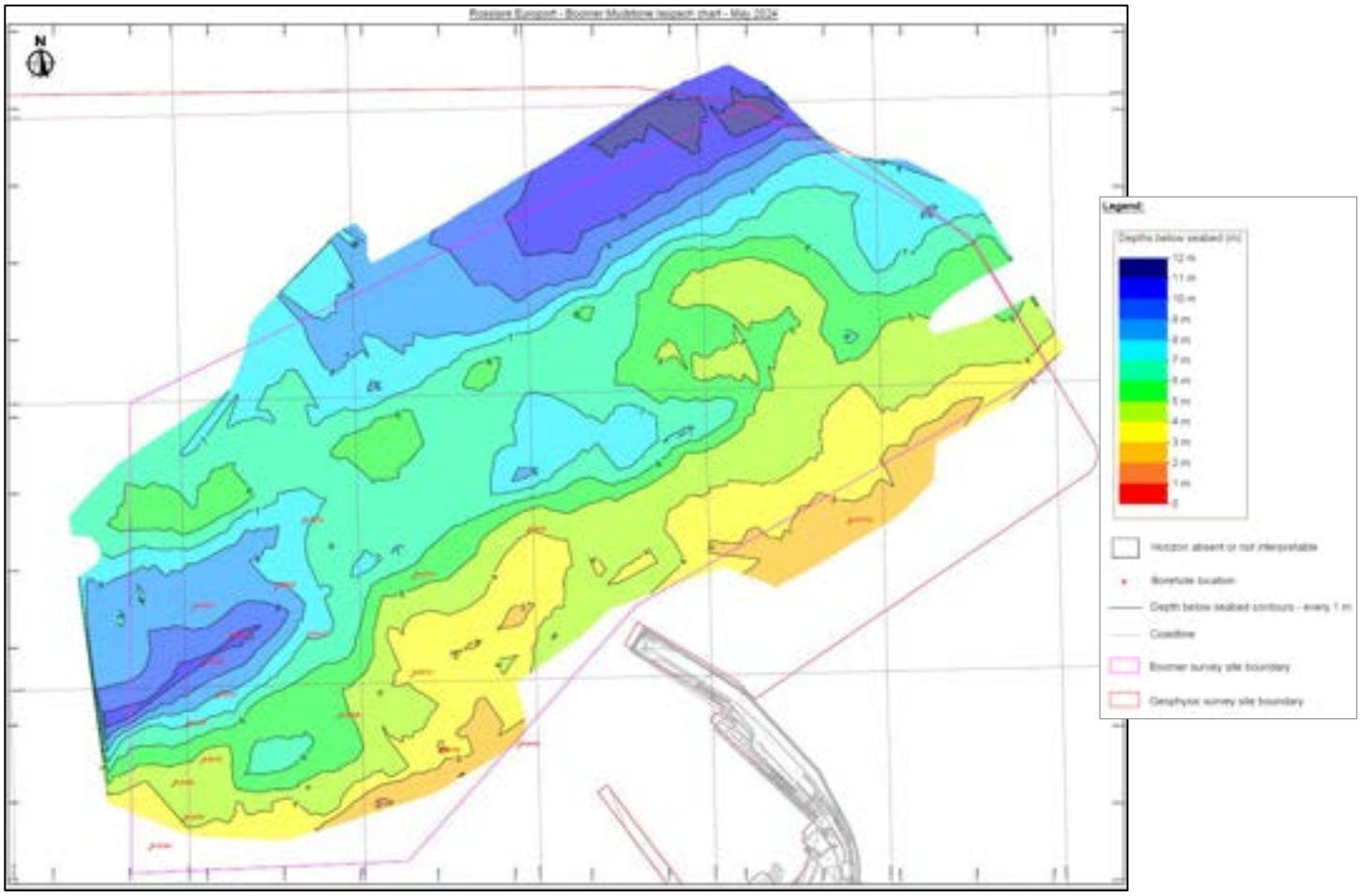


Figure 31: Boomer Mudstone Isopach Chart - May 2024

The Paleo Channels were tracked across the site and the depth of this horizon was measured as well. The isopach representing the depths of the mudstone below seabed is shown figure 32 (detailed A1 chart in Appendix 3).

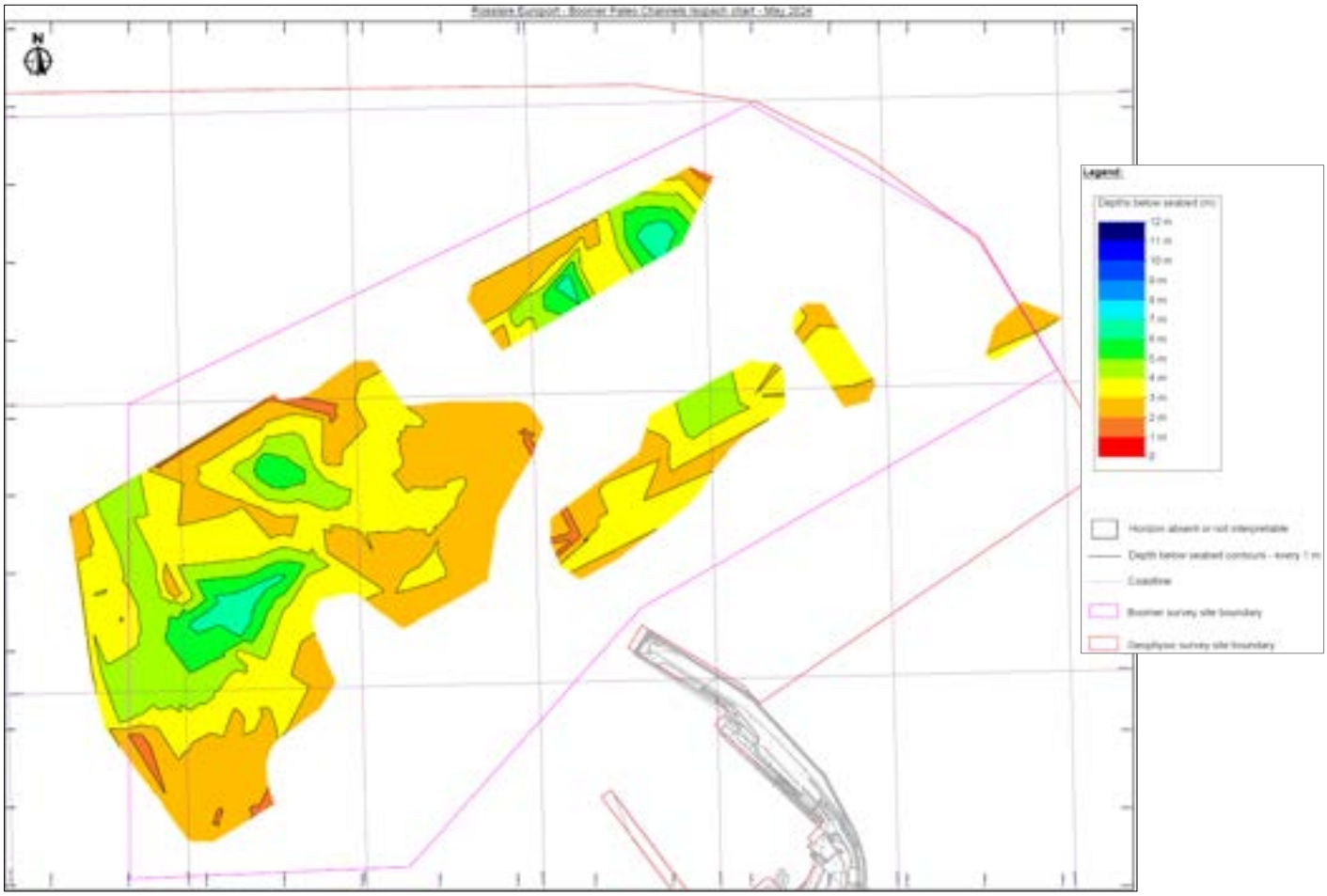


Figure 32: Boomer Paleo Channels Isopach Chart - May 2024

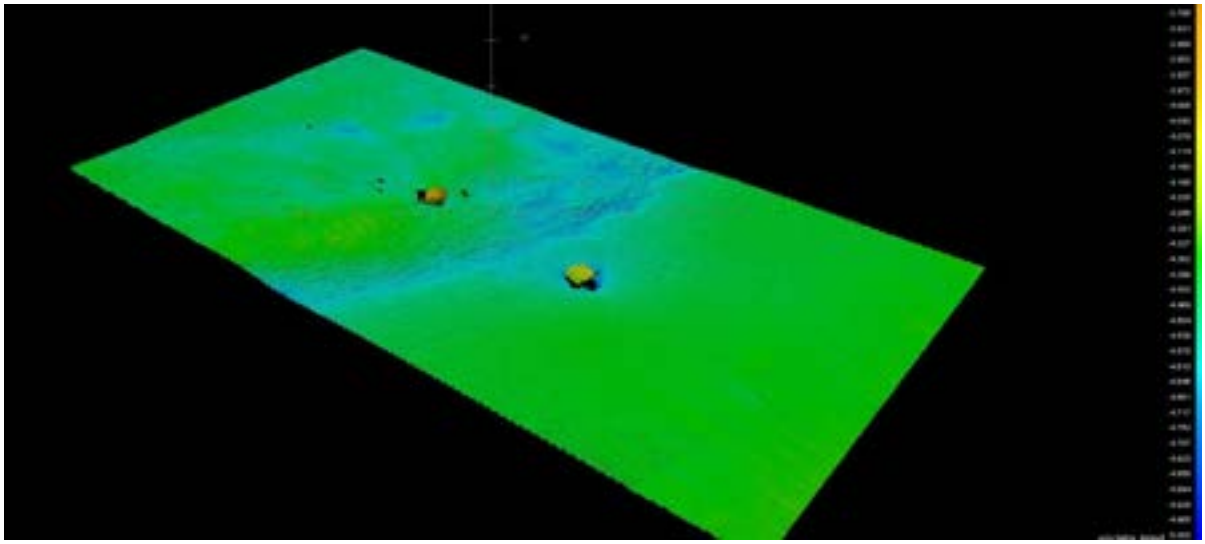
9. Appendices

9.1 Appendix 1 - MBES TARGET PICTURES

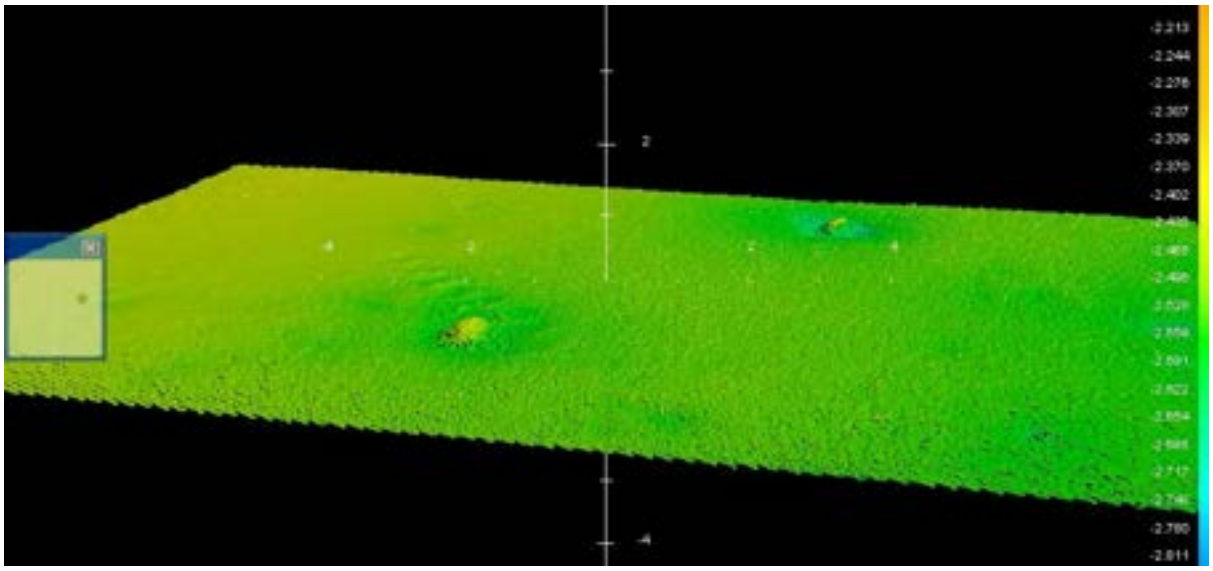
9.2 Appendix 2 - SSS CONTACTS PICTURES

9.3 Appendix 3- Charts

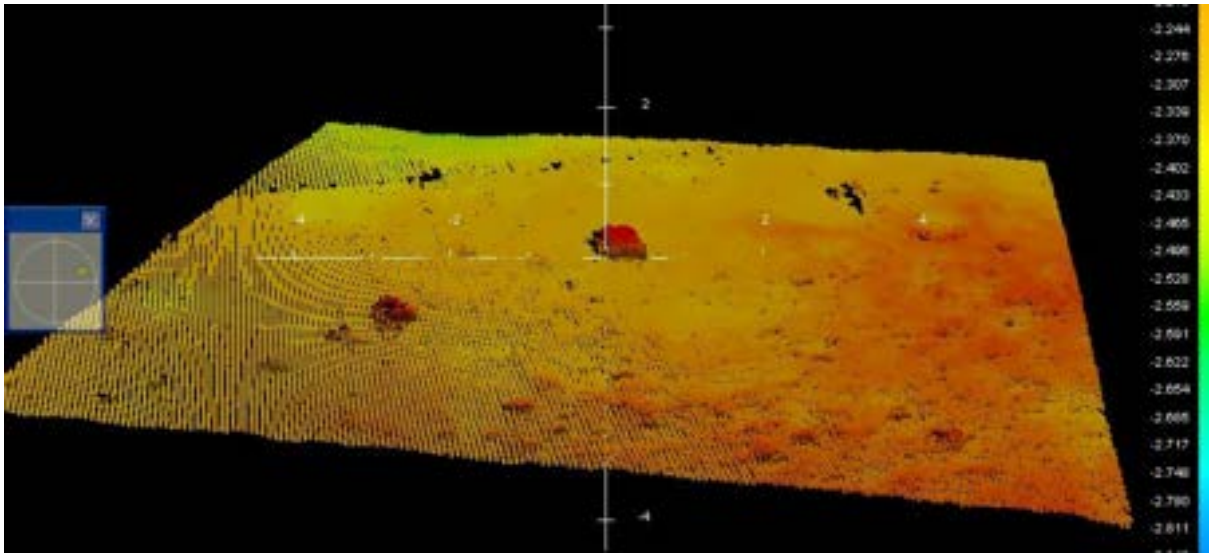
MBES TARGET 1



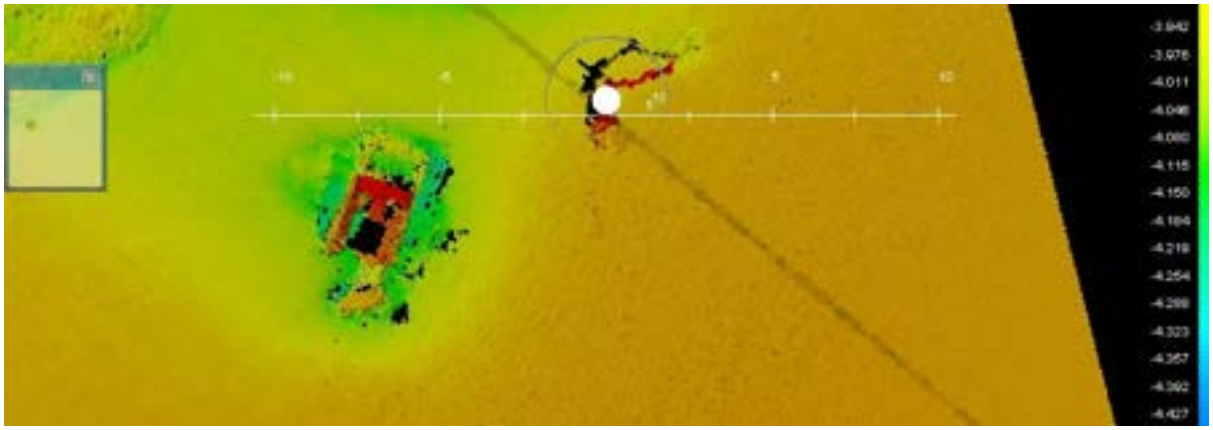
MBES TARGET 2



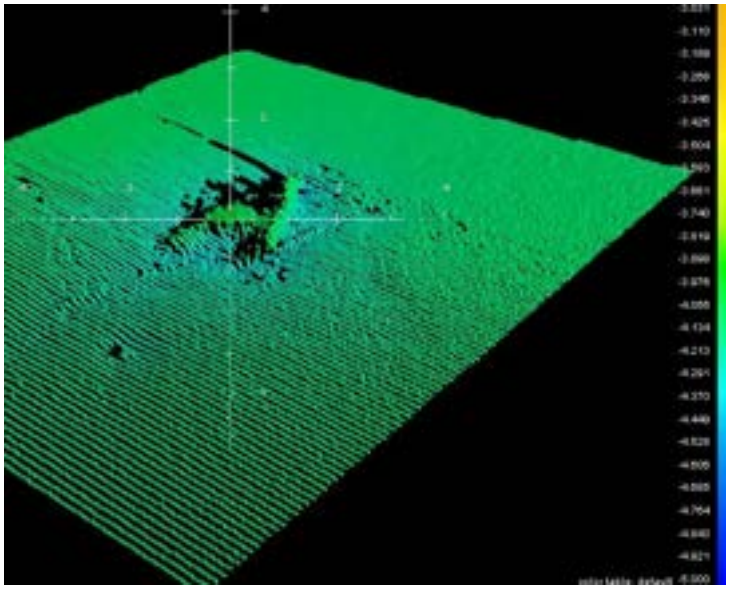
MBES TARGET 4



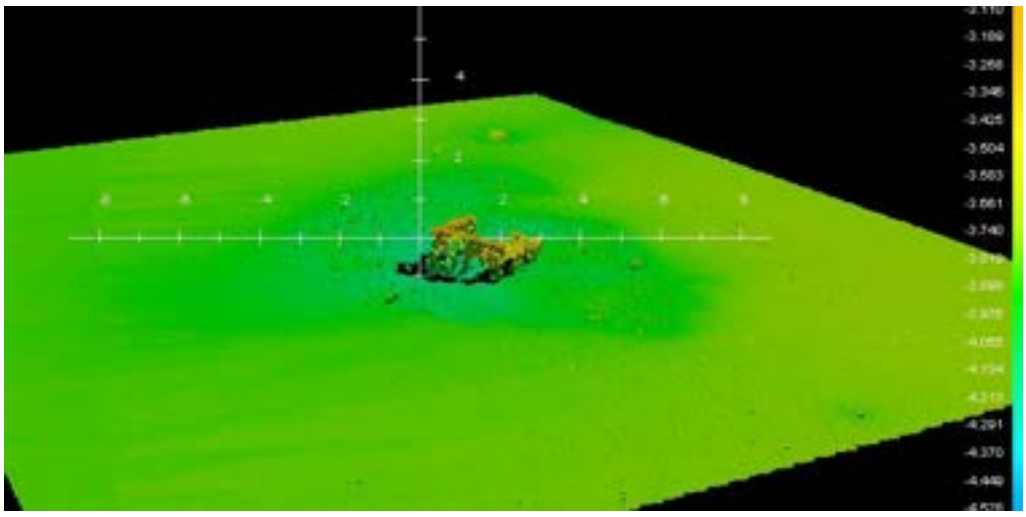
MBES TARGET 5



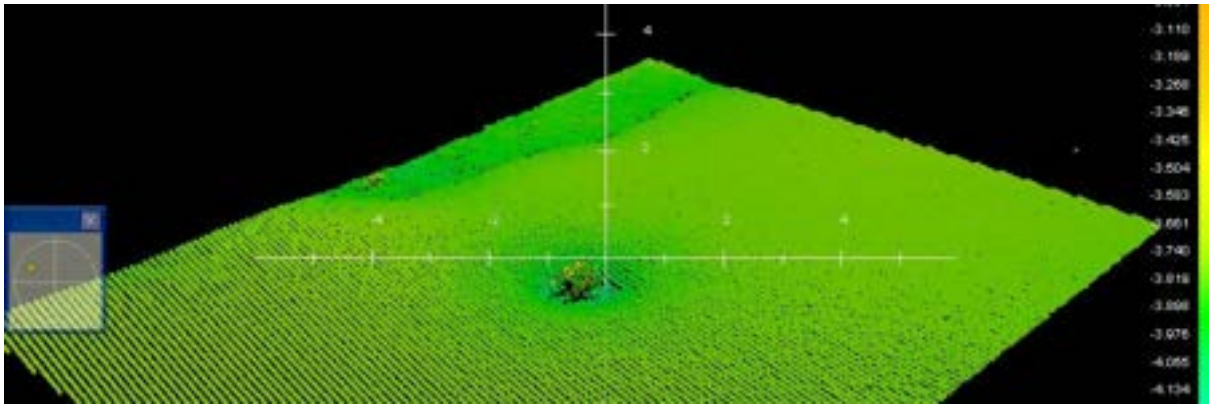
MBES TARGET 6



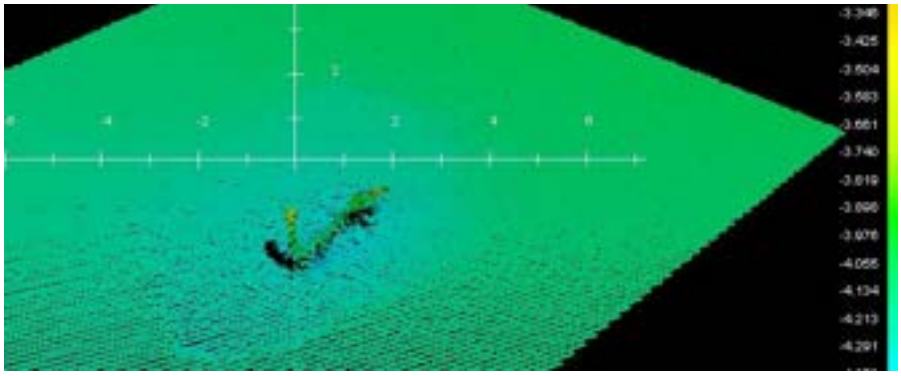
MBES TARGET 7



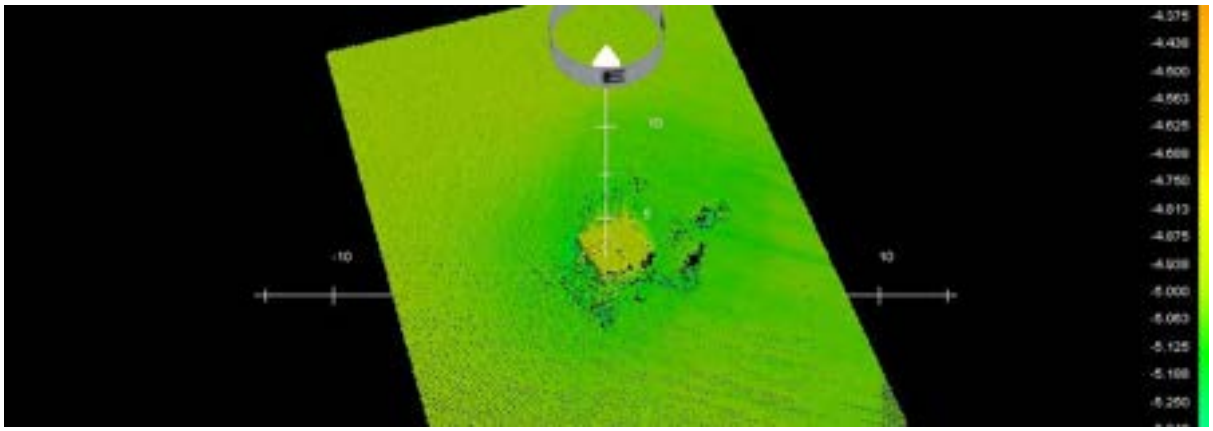
MBES TARGET 8



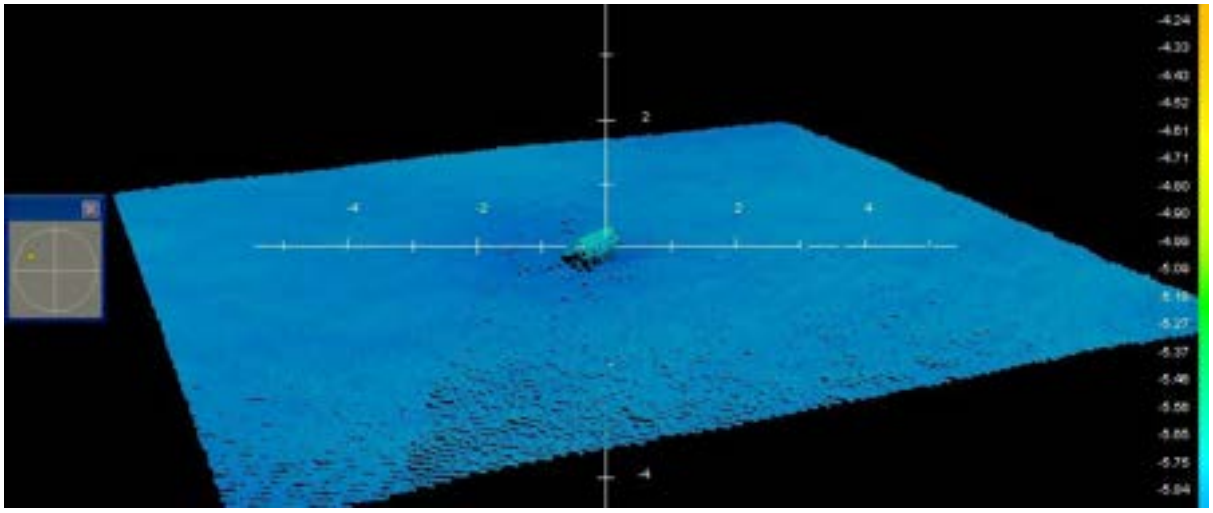
MBES TARGET 9



MBES TARGET 10

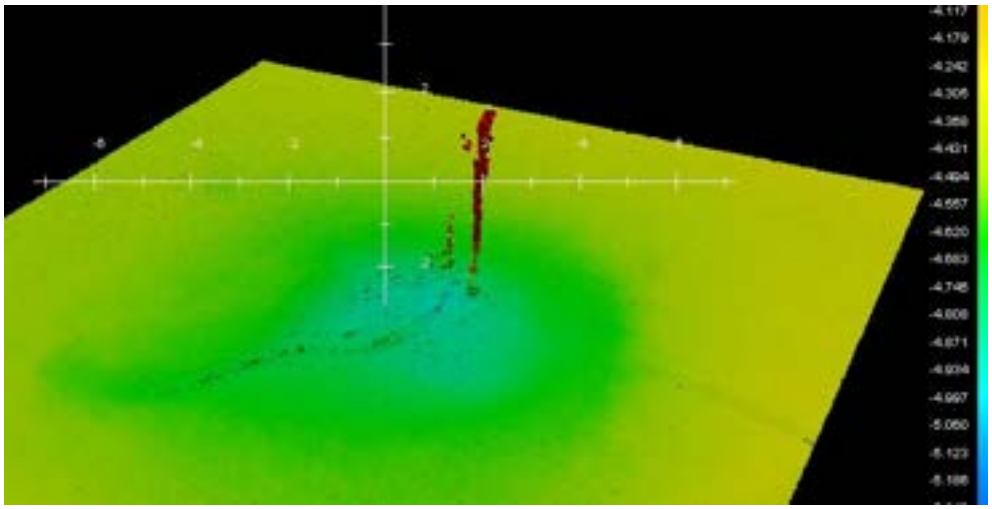


MBES TARGET 11

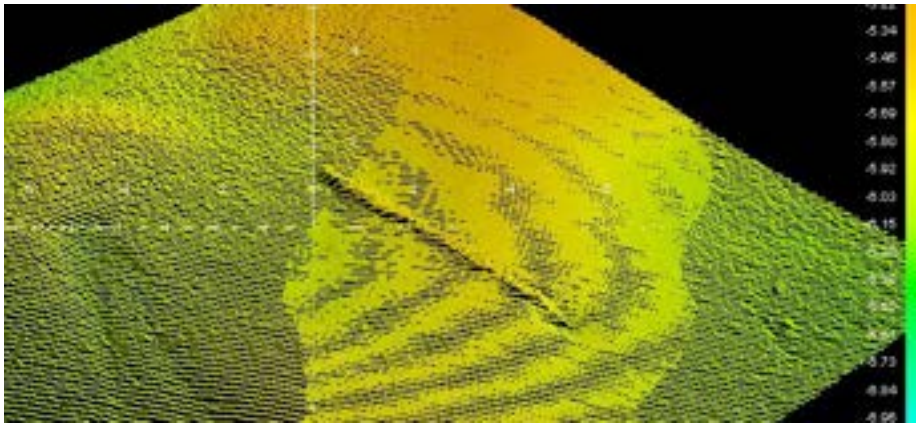


MBES TARGET 12

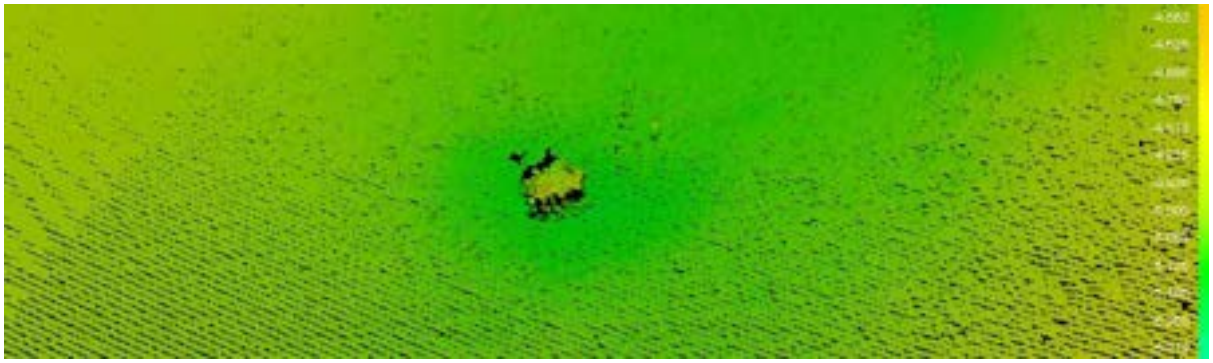
MBES TARGET 13



MBES TARGET 14



MBES TARGET 15



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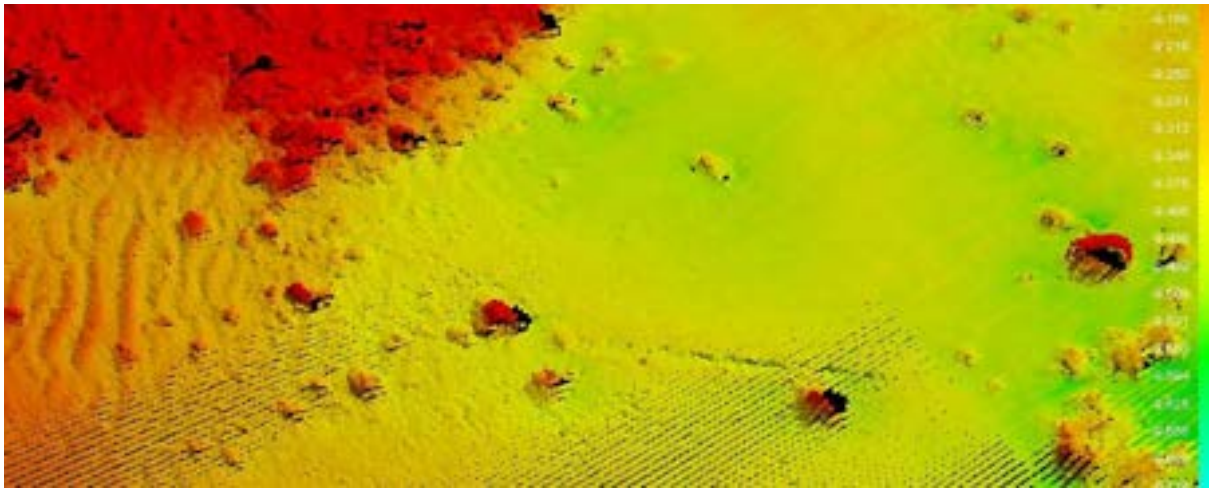

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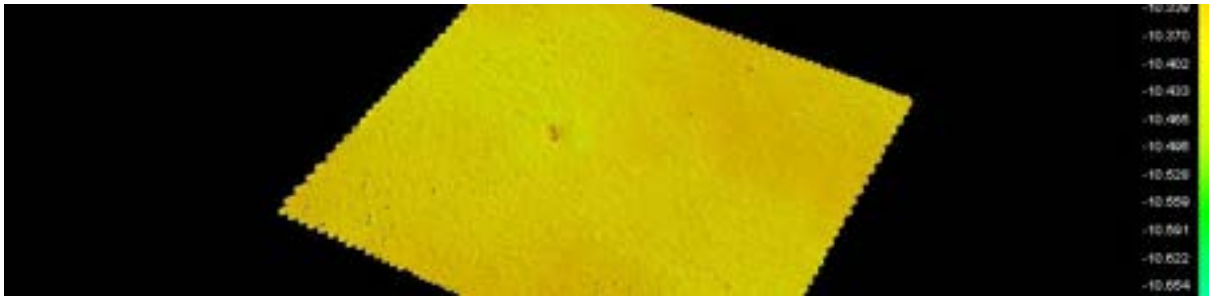

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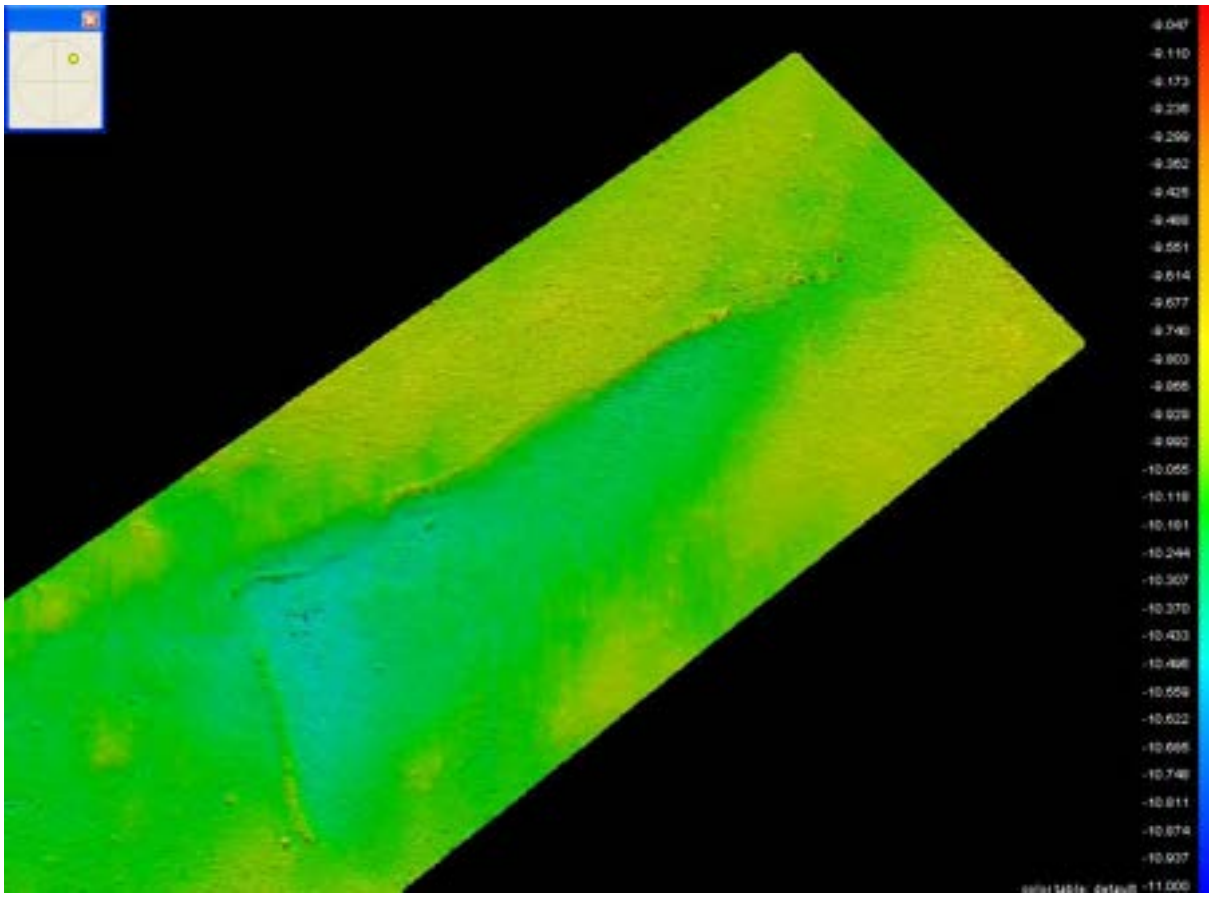

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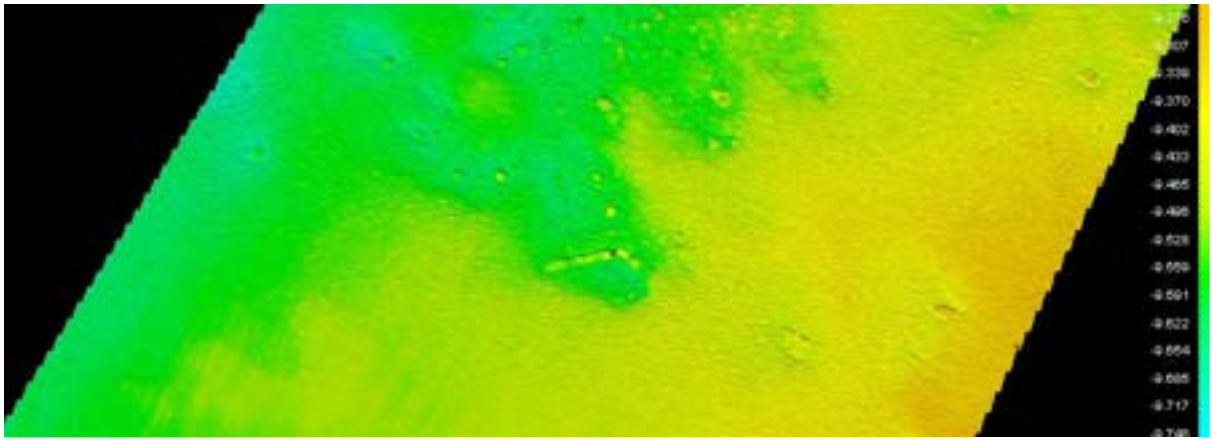

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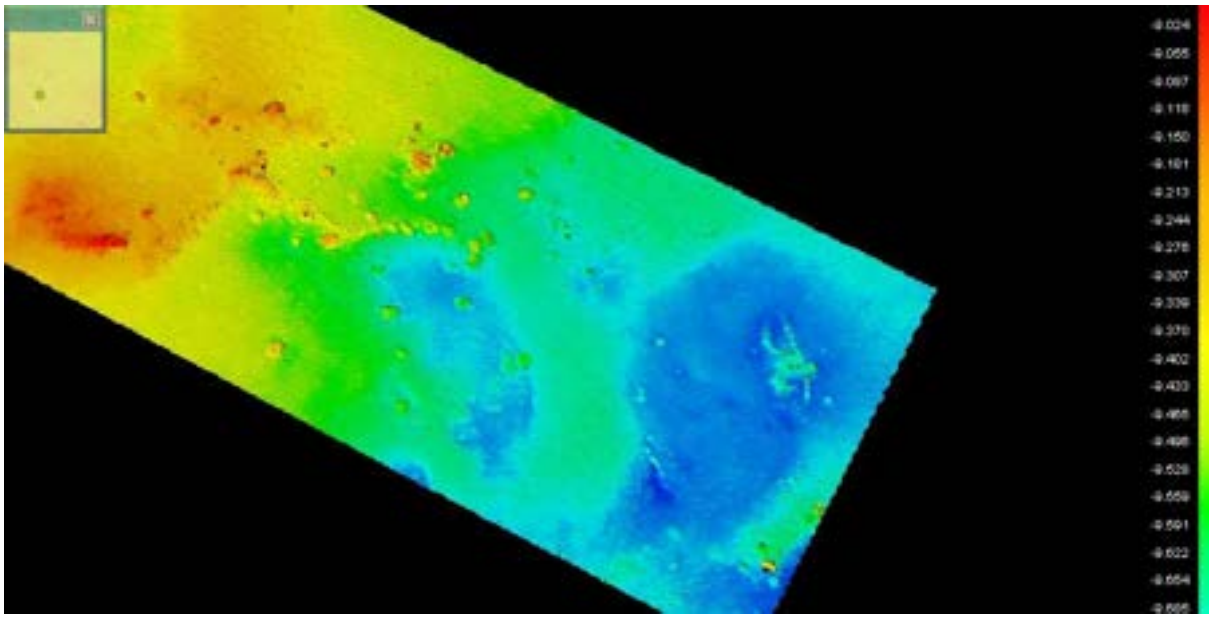

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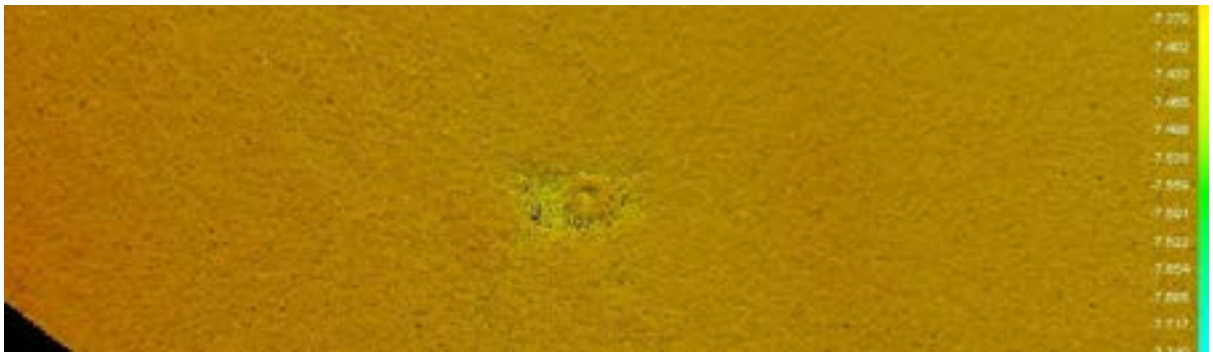

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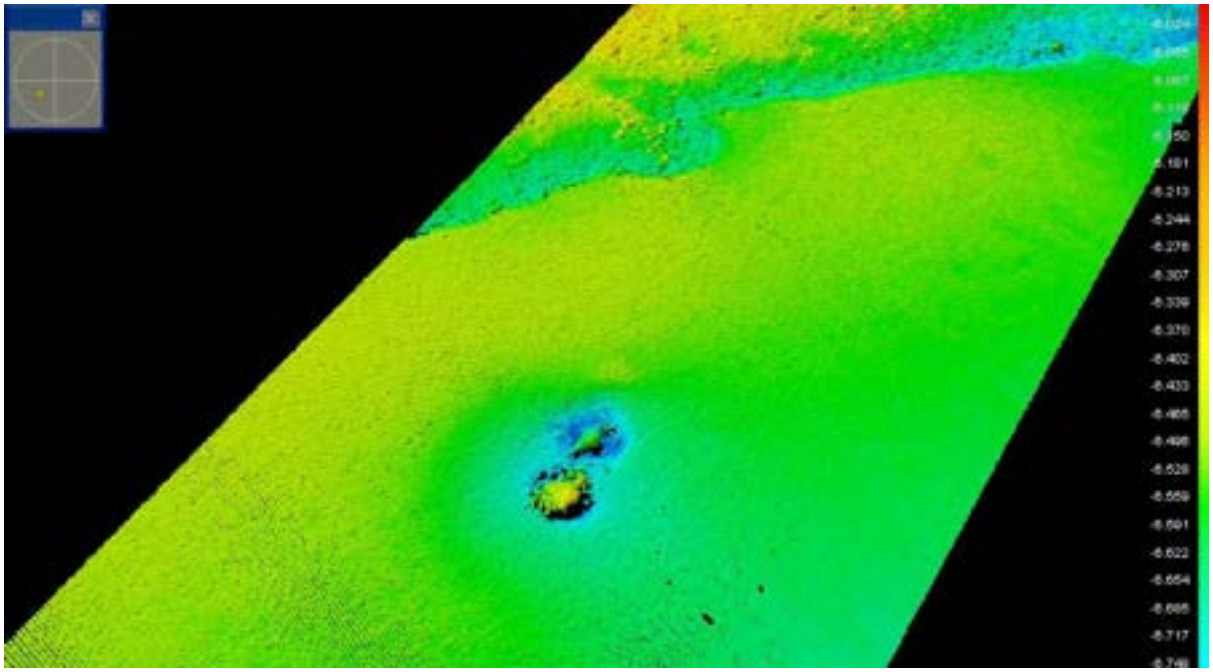

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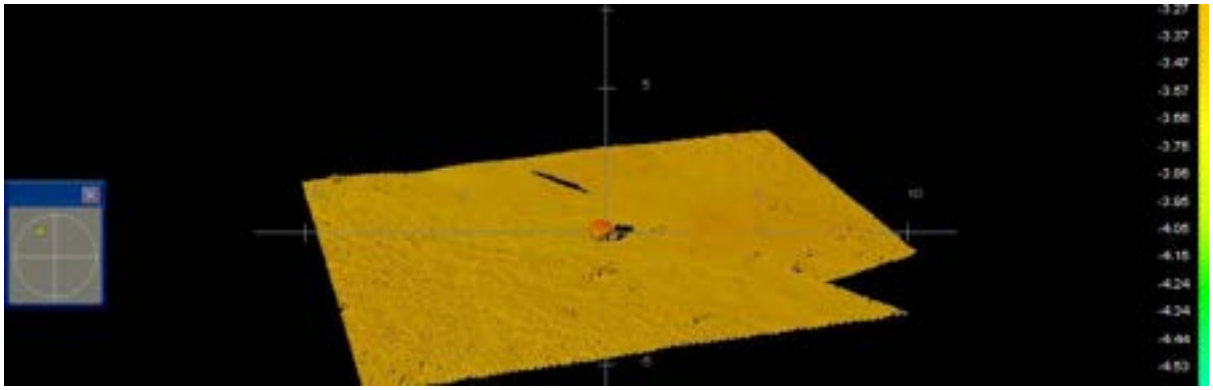

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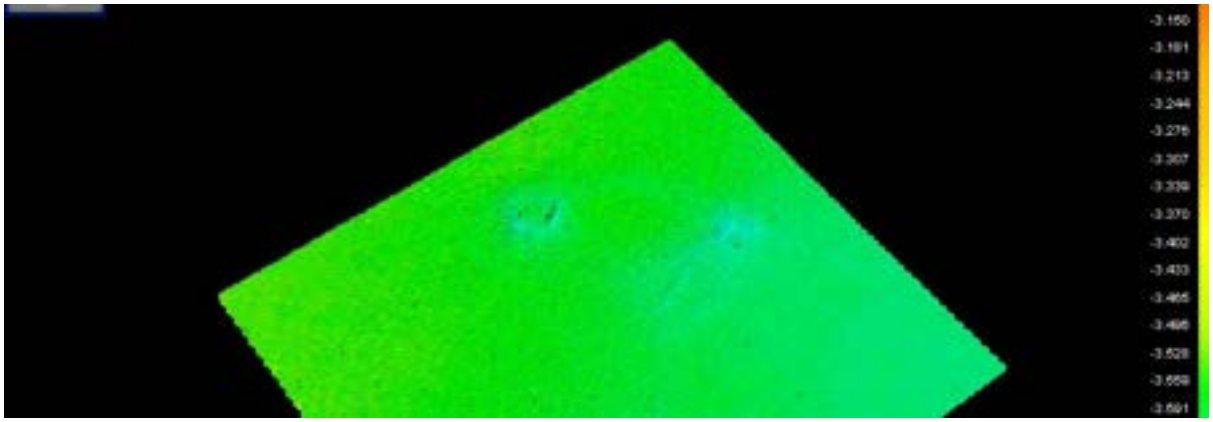

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MBES TARGET 26

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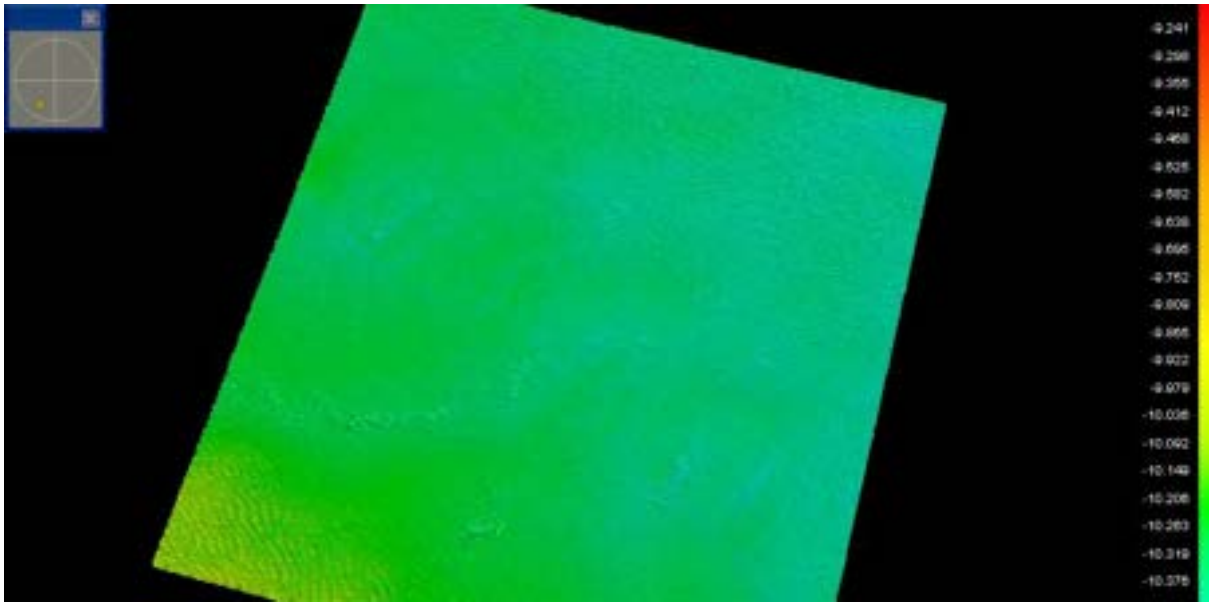

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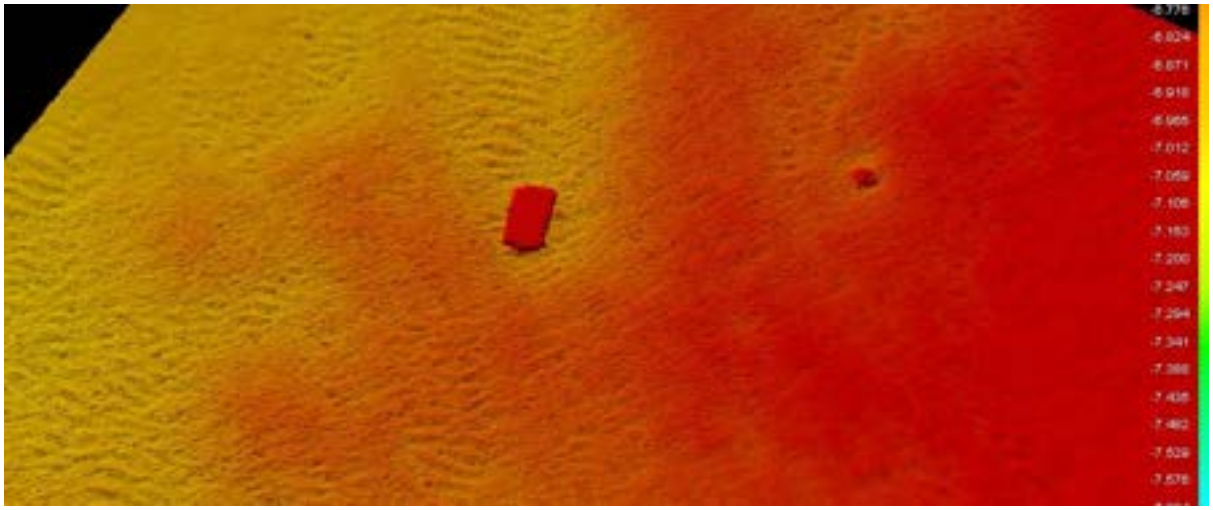

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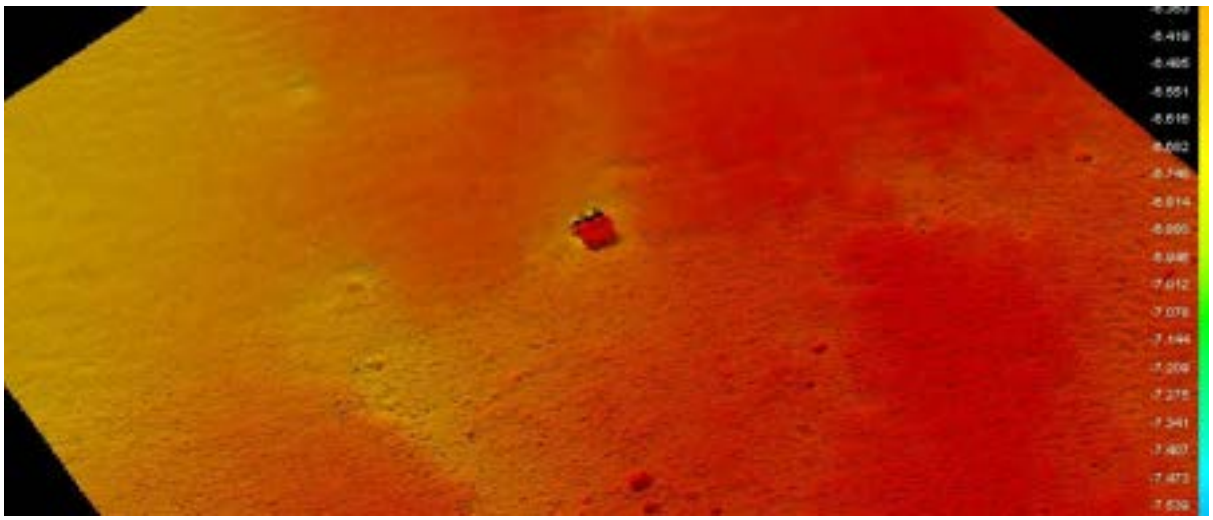

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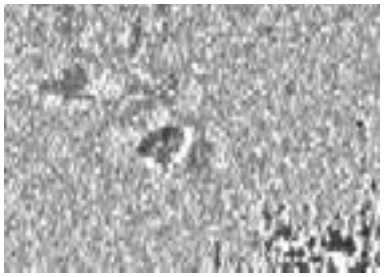

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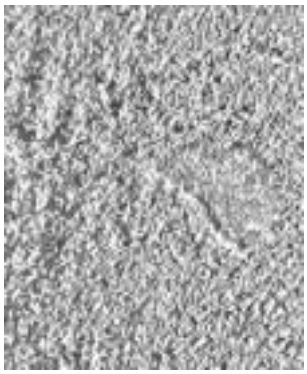

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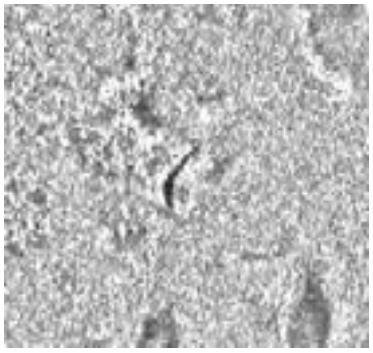
C 8



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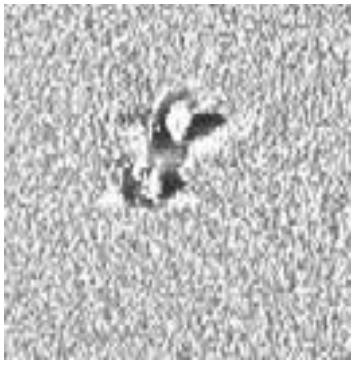

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C 12

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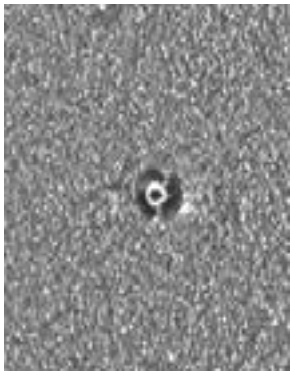

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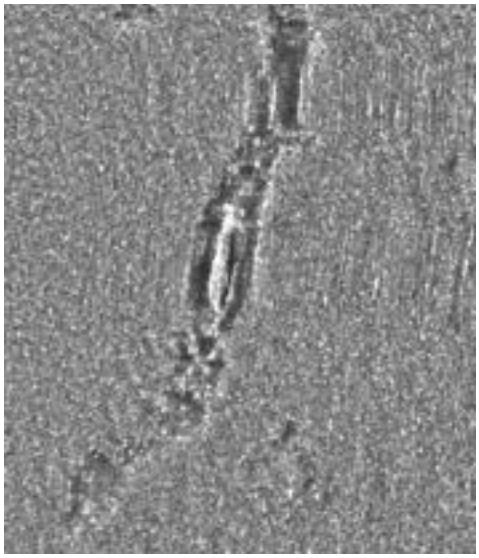

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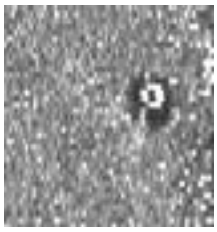

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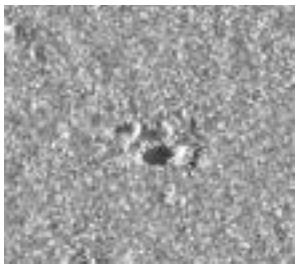

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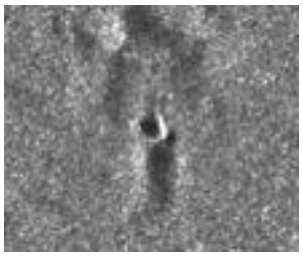

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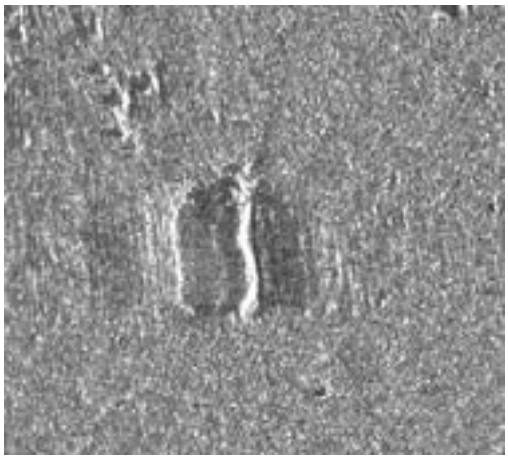

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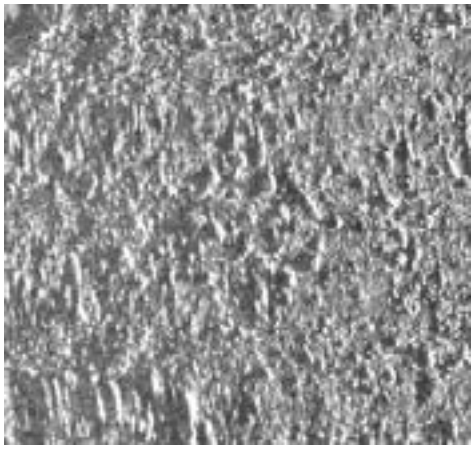

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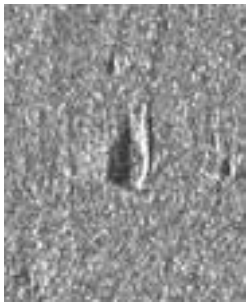

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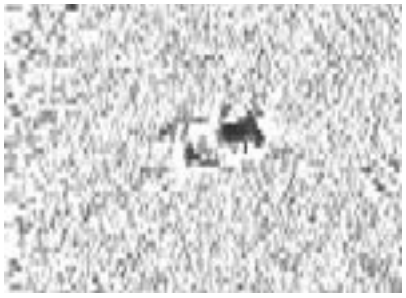

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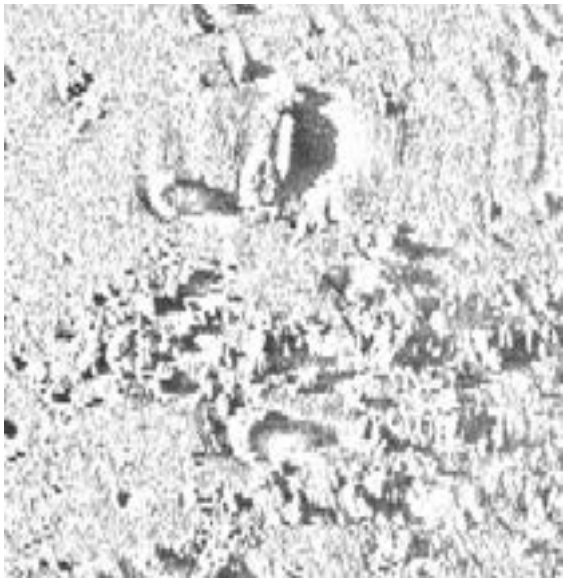

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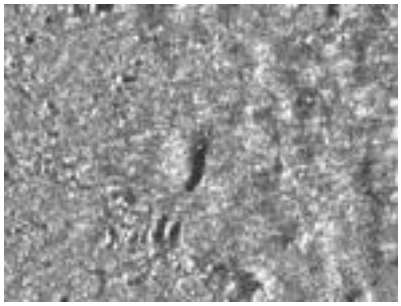

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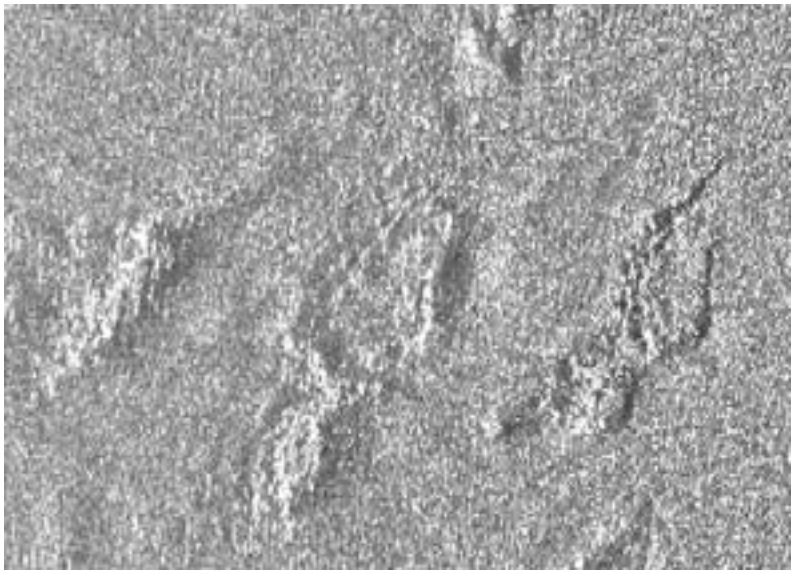
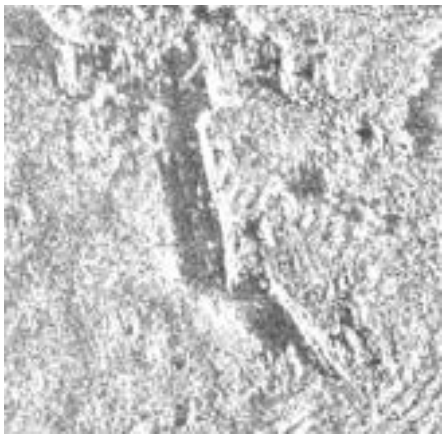
C 41

C 42



C 44

C 45



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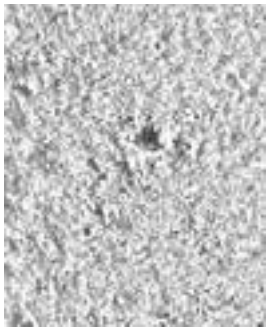

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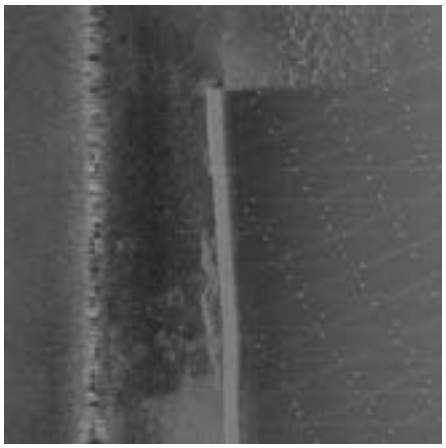
C 50

C 52



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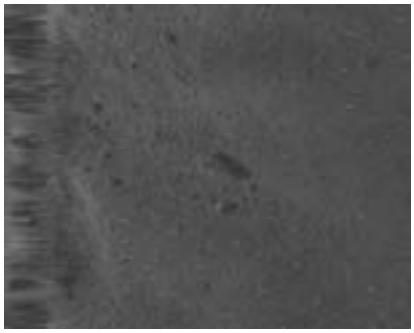
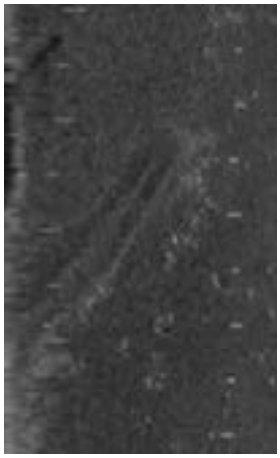


C 54

C 55



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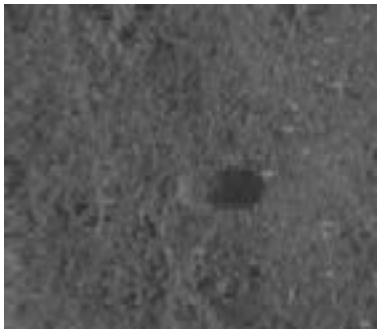

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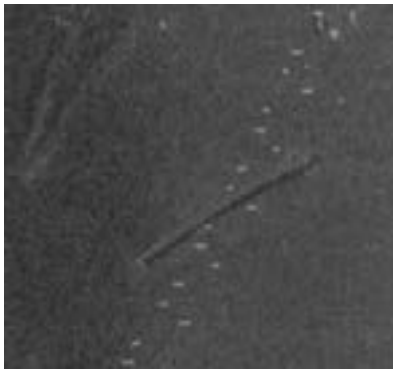

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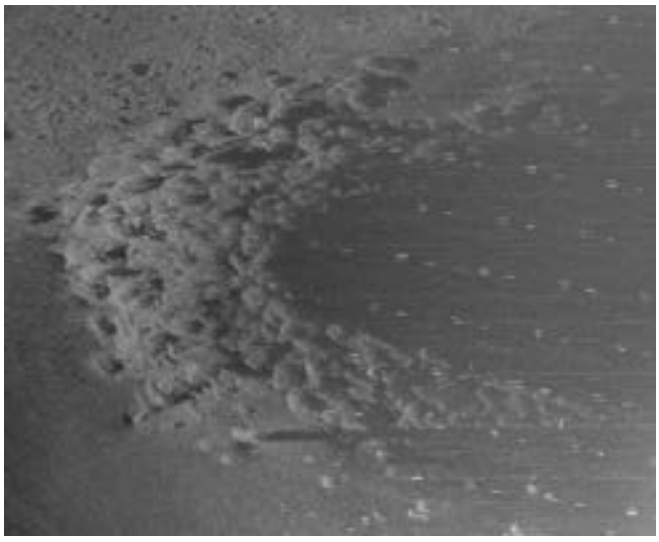
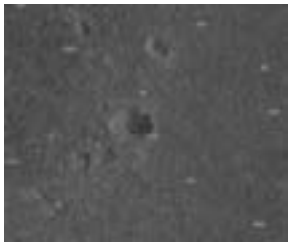


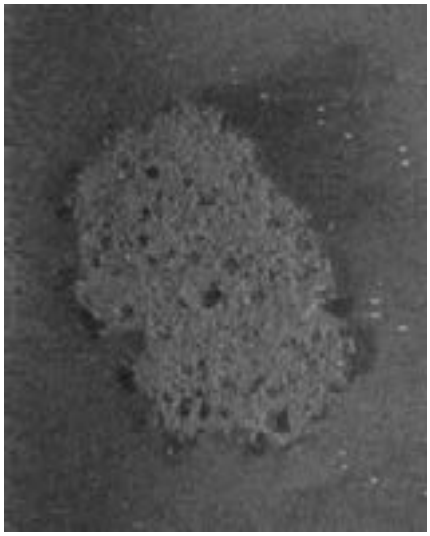
C 59

C 61



C 62

C 63



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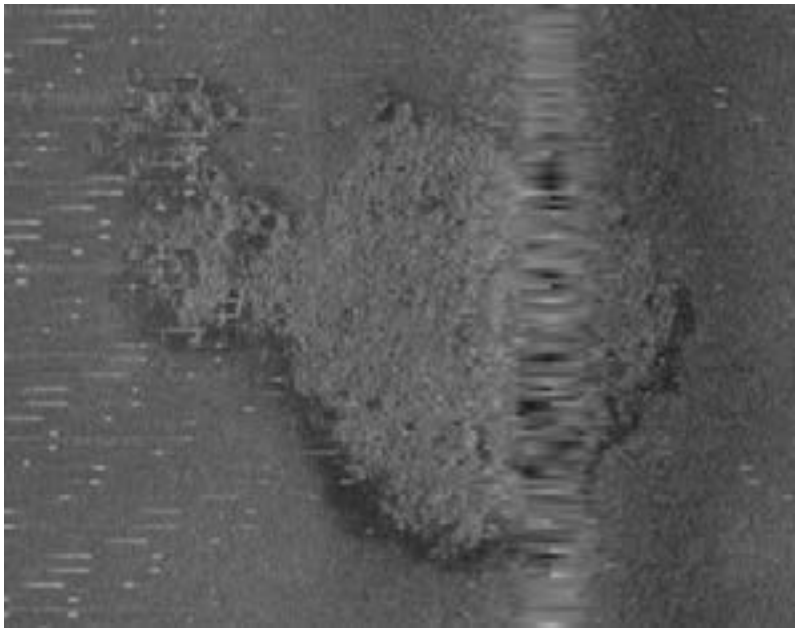

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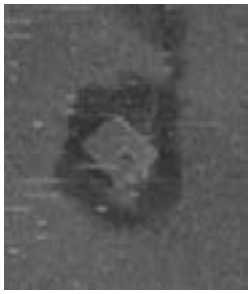

C 66

C 69

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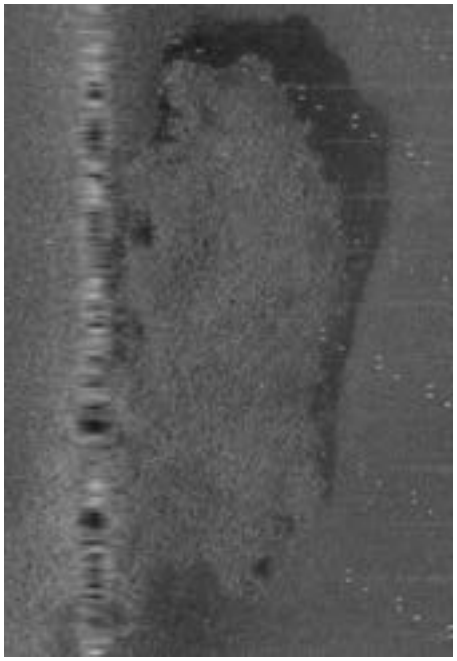

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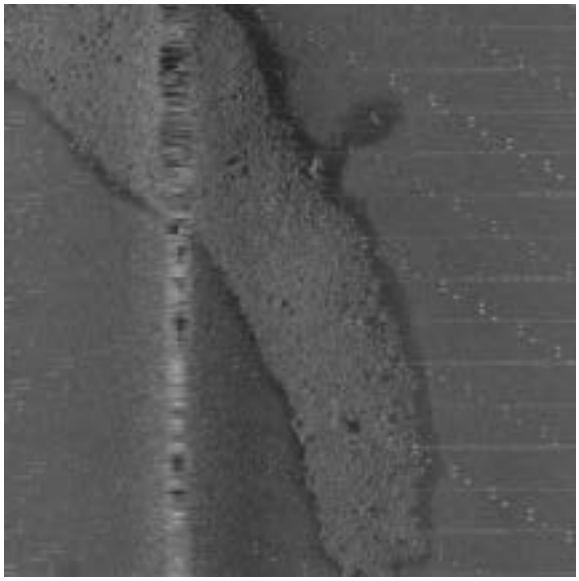

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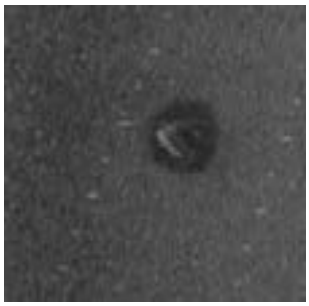

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C 81

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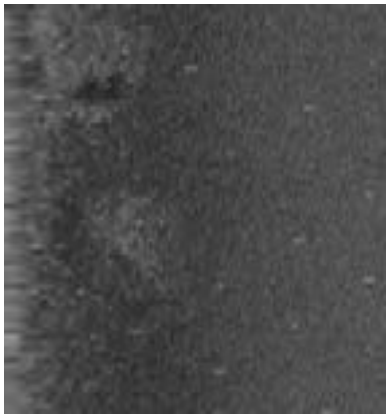

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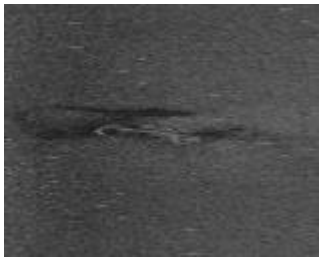

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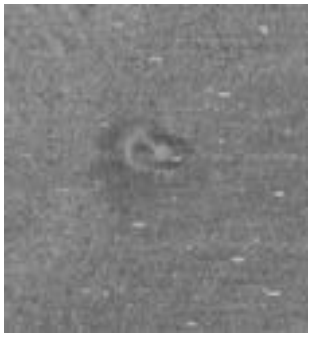

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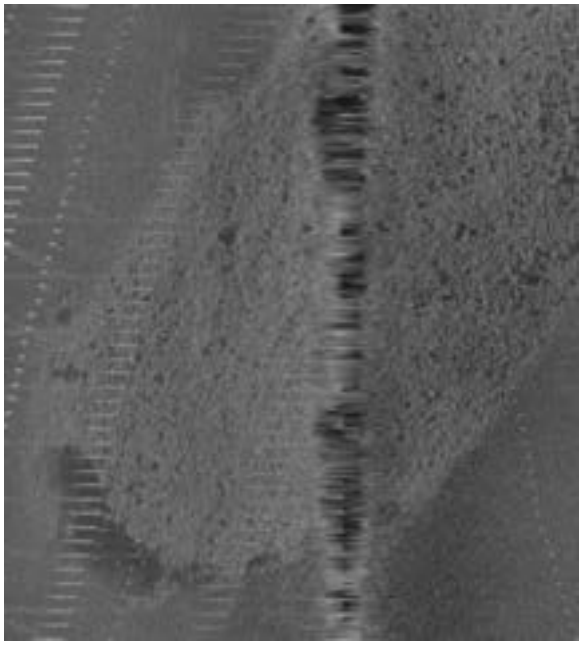

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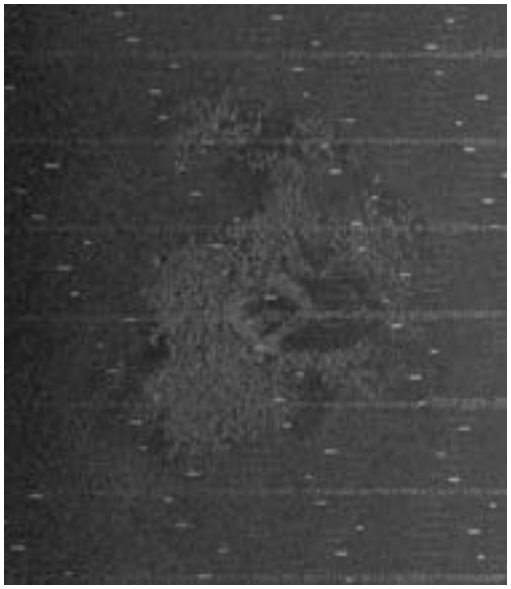
C 133

C 139



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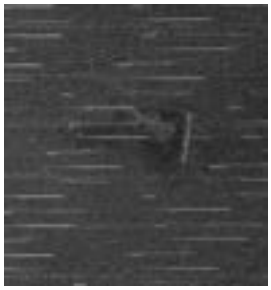

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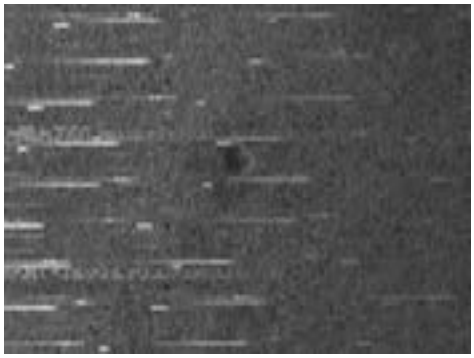

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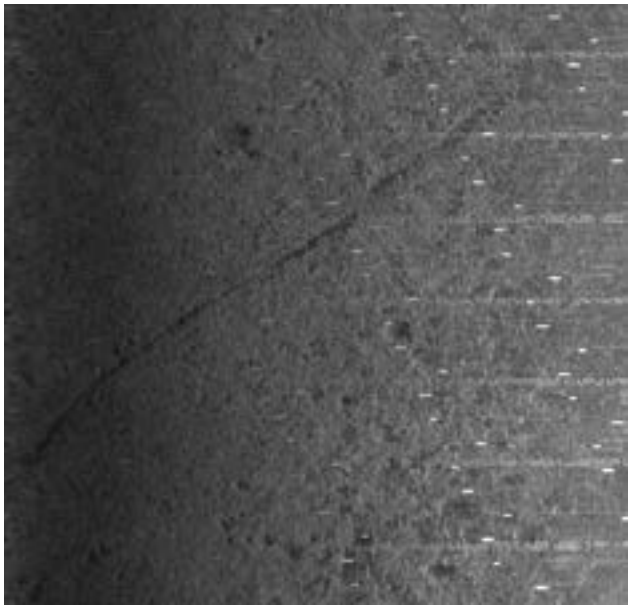
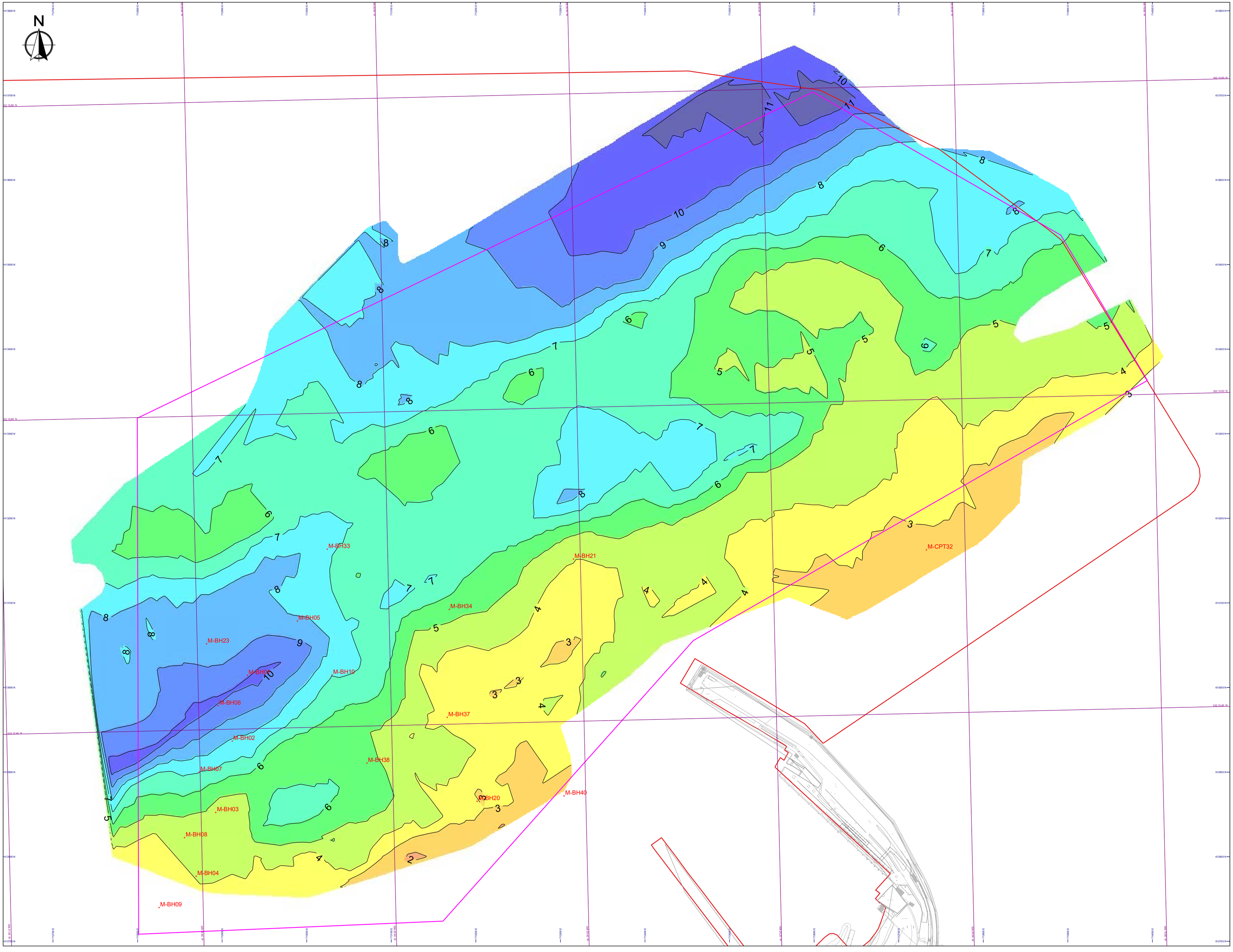
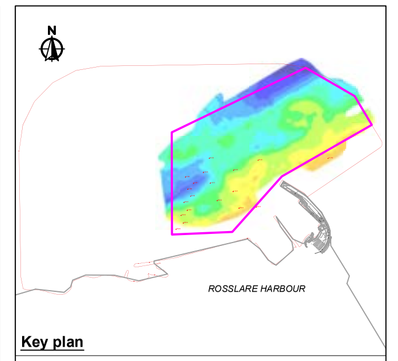


C 182

C 187

Rosslare Europort - Boomer Mudstone Isopach chart - May 2024





Key plan

Legend:

Depths below seabed (m)
- 12 m
- 11 m
- 10 m
- 9 m
- 8 m
- 7 m
- 6 m
- 5 m
- 4 m
- 3 m
- 2 m
- 1 m
- 0

Horizon absent or not interpretable

Borehole location

Depth below seabed contours - every 1 m

Coastline

Boomer survey site boundary

Geophysic survey site boundary

0 20.0 80.0 160.0 m

General Notes:

Unit: Metre

Projection: Geographic - WGS84
Irish Transverse Mercator

Survey Location: Rosslare Europort
Co. Wexford, IRELAND

Survey method: Boomer

Survey Date: 21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
17/06/2024	0	Draft	MTAL

Contractor:

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7 Hawley court, Dublin Road
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Client:

CAUSEWAY GEOTECH

Iarnród Éireann Irish Rail

GDG GEOTECHNICAL & ENVIRONMENTAL GEOSOLUTIONS

Project: Rosslare Europort Offshore Wind Hub

Drawing Title: Rosslare Europort - Boomer Mudstone Isopach chart - May 2024

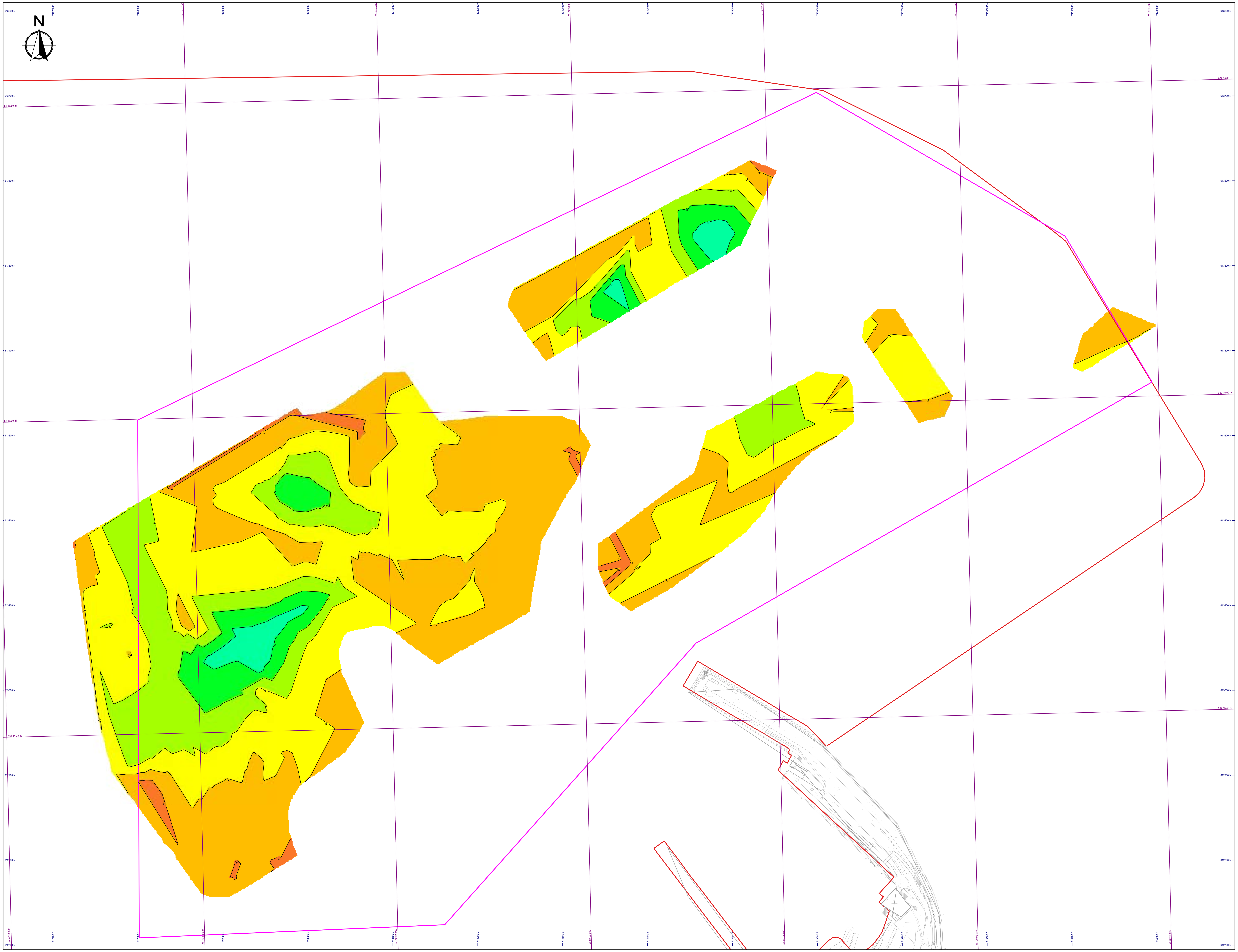
Drawing Status: Draft **Rev:** 0

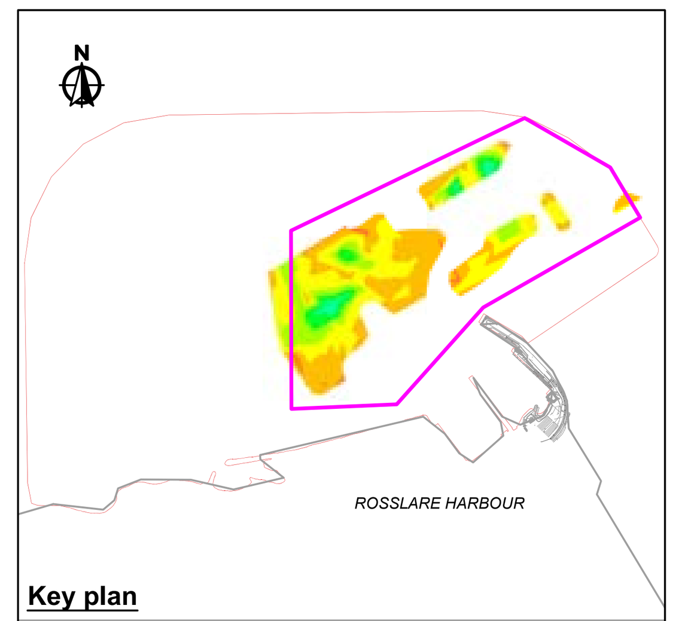
Paper size and scale: 1:2000 @ A1

Job Number: 2405_CG_RG_01 **Date:** 17/06/2024

Drawn By: MTAL **Checked By:** BSMI

Rosslare Europort - Boomer Paleo Channels Isopach chart - May 2024





Key plan

Legend:

Depths below seabed (m)

12 m
11 m
10 m
9 m
8 m
7 m
6 m
5 m
4 m
3 m
2 m
1 m
0

Horizon absent or not interpretable

Depth below seabed contours - every 1 m

Coastline

Boomer survey site boundary

Geophysic survey site boundary

0 20.0 80.0 160.0 m

General Notes:

Unit:	Metre
Projection:	Geographic - WGS84 Irish Transverse Mercator
Survey Location:	Rosslare Europort Co. Wexford, IRELAND
Survey method:	Boomer
Survey Date:	21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
17/06/2024	0	Draft	MTAL

Contractor:

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Client:

CAUSEWAY GEOTECH

Iarnród Éireann Irish Rail

GDG

Project: Rosslare Europort Offshore Wind Hub

Drawing Title: Rosslare Europort - Boomer Paleo Channels Isopach chart - May 2024

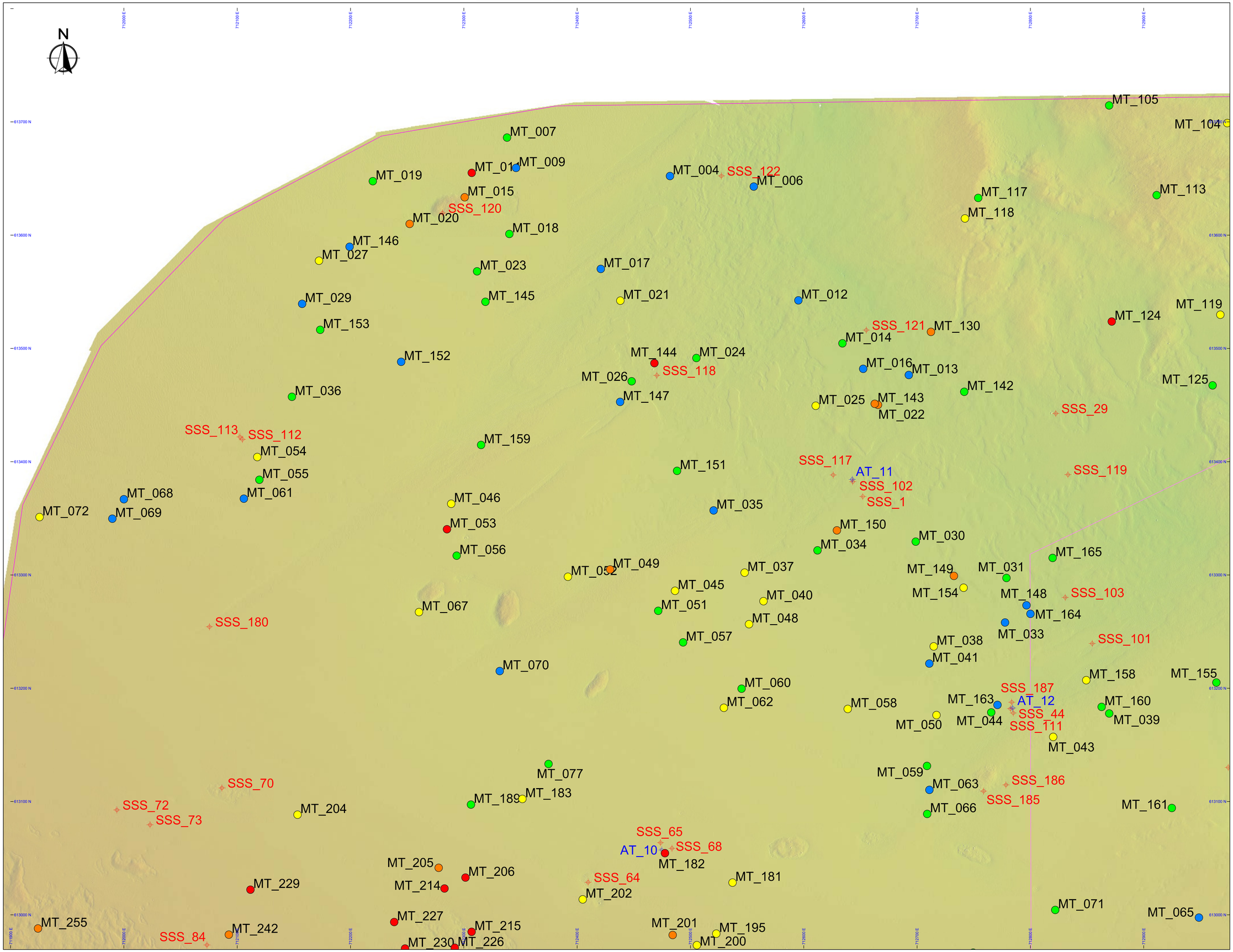
Drawing Status: Draft **Rev:** 0

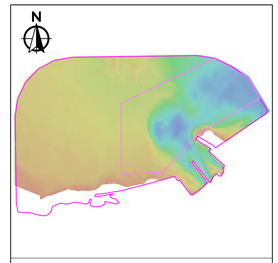
Paper size and scale: 1:2000 @ A1

Job Number: 2405_CG_RG_01 **Date:** 17/06/2024

Drawn By: MTAL **Checked By:** BSMI

Rosslare Europort Offshore Wind Hub - Geophysic targets chart 01





Key plan:

Legend:

- MT — Magnetometer anomalies colored by amplitude
- SSS — Sidescan-sonar contact
- AT — Multibeam sonar targets
- Boomer survey boundary
- Geophysic survey boundary
- Coastline

0 14.9 59.7 119.4 m

General Notes:

Unit:	Metre
Datum:	LAT
Projection:	Geographic - WGS84 ITM
Survey Location:	Rosslare Europort, Co. Wexford IRELAND
Survey method:	Multibeam echosounder Sidescan-sonar Marine magnetometer Sub-Bottom profiler Boomer
Survey Date:	26th, 27th, 29th October 2023 & 07th November 2023 20th and 21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
20/06/2024	0	Draft	ALQ

Client: CAUSEWAY GEOTECH

Contractor:

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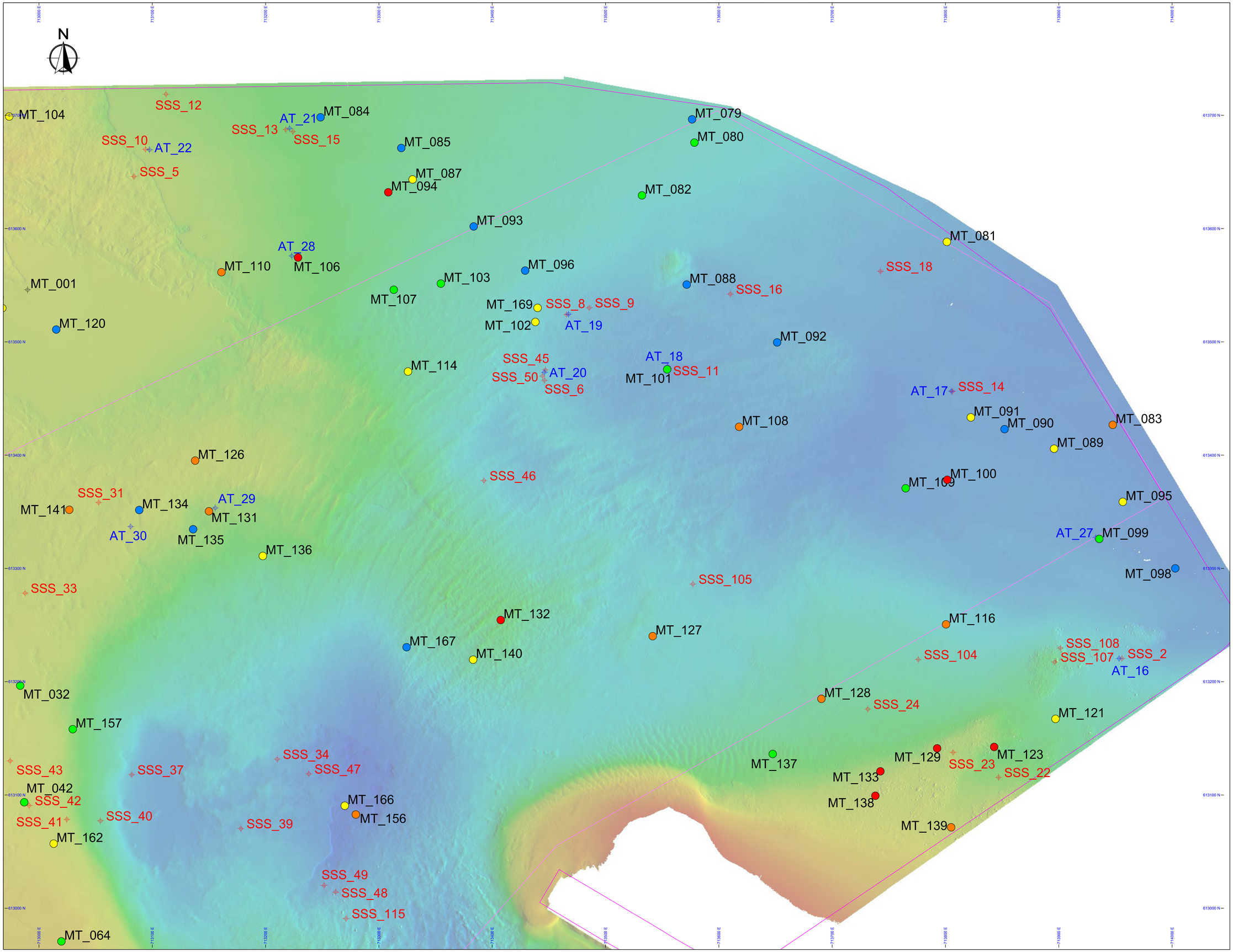
Client:	Causeway Geotech
Project:	Rosslare Europort Offshore Wind Hub Geophysical Survey
Drawing Title:	Rosslare Europort Offshore Wind Hub - Geophysic targets chart
Drawing Status:	Draft
Rev:	0
Paper size and scale:	1:1500 @ A1
Job Number:	2311_CG_RG_01
Date:	21/06/2024
Drawn By:	ALQ
Checked By:	MTAL

Rosslare Europort Offshore Wind Hub - Geophysic targets chart



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Survey Date:	26th, 27th, 29th October 2023 & 07th November 2023 20th and 21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
20/06/2024	0	Draft	ALQ

Client:

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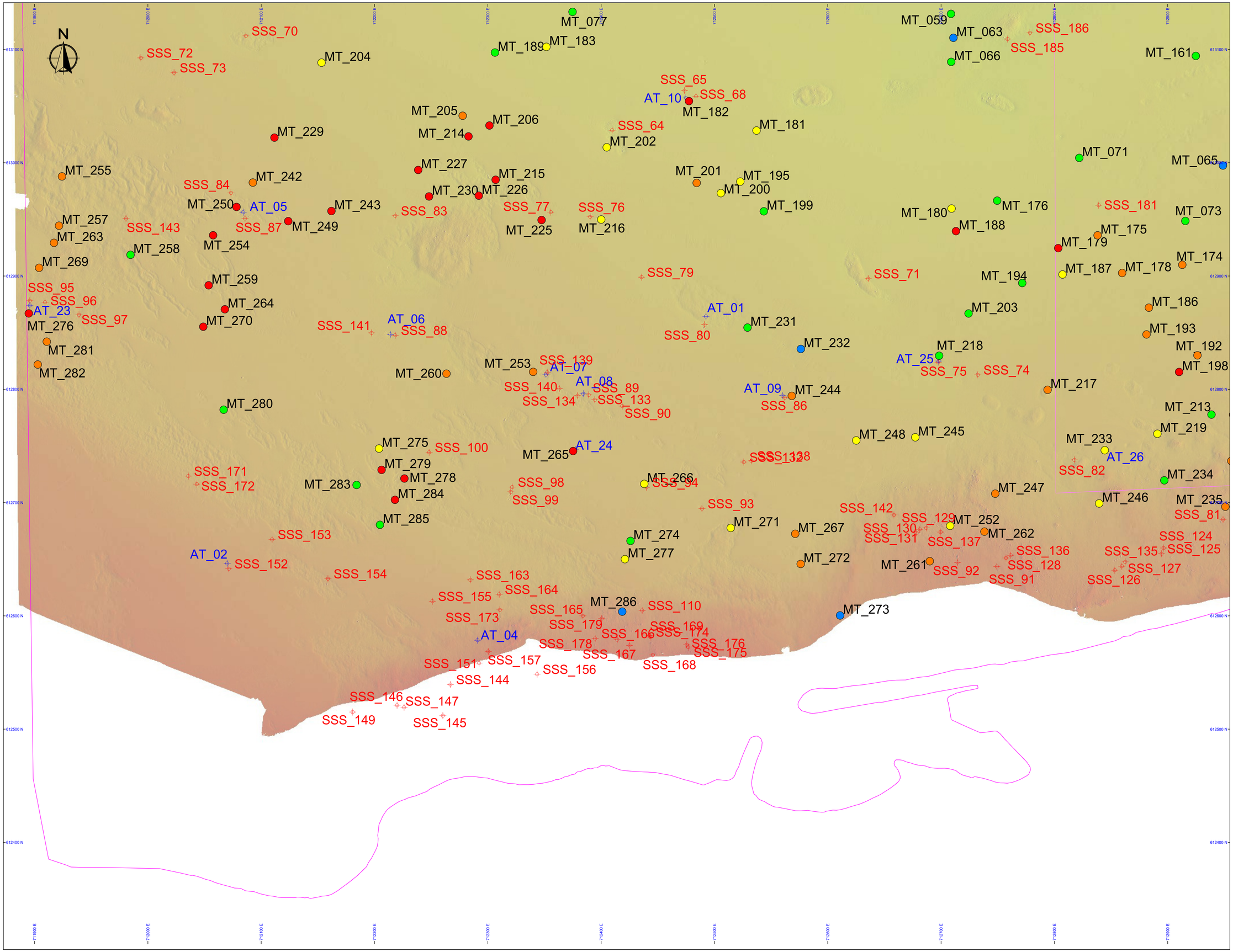
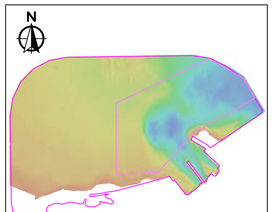
Client: Causeway Geotech	
Project: Rosslare Europort Offshore Wind Hub Geophysical Survey	
Drawing Title: Rosslare Europort Offshore Wind Hub - Geophysic targets chart	
Drawing Status: Draft	**Rev:** 0
Paper size and scale: 1:1500 @ A1	
Job Number: 2311_CG_RG_01	**Date:** 21/06/2024
Drawn By: ALQ	**Checked By:** MTAL

Rosslare Europort Offshore Wind Hub - Geophysic targets chart 03





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Survey Date:	26th, 27th, 29th October 2023 & 07th November 2023 20th and 21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
20/06/2024	0	Draft	ALQ

Client: CAUSEWAY GEOTECH

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Client: Causeway Geotech

Project: Rosslare Europort Offshore Wind Hub Geophysical Survey

Drawing Title: Rosslare Europort Offshore Wind Hub - Geophysic targets chart

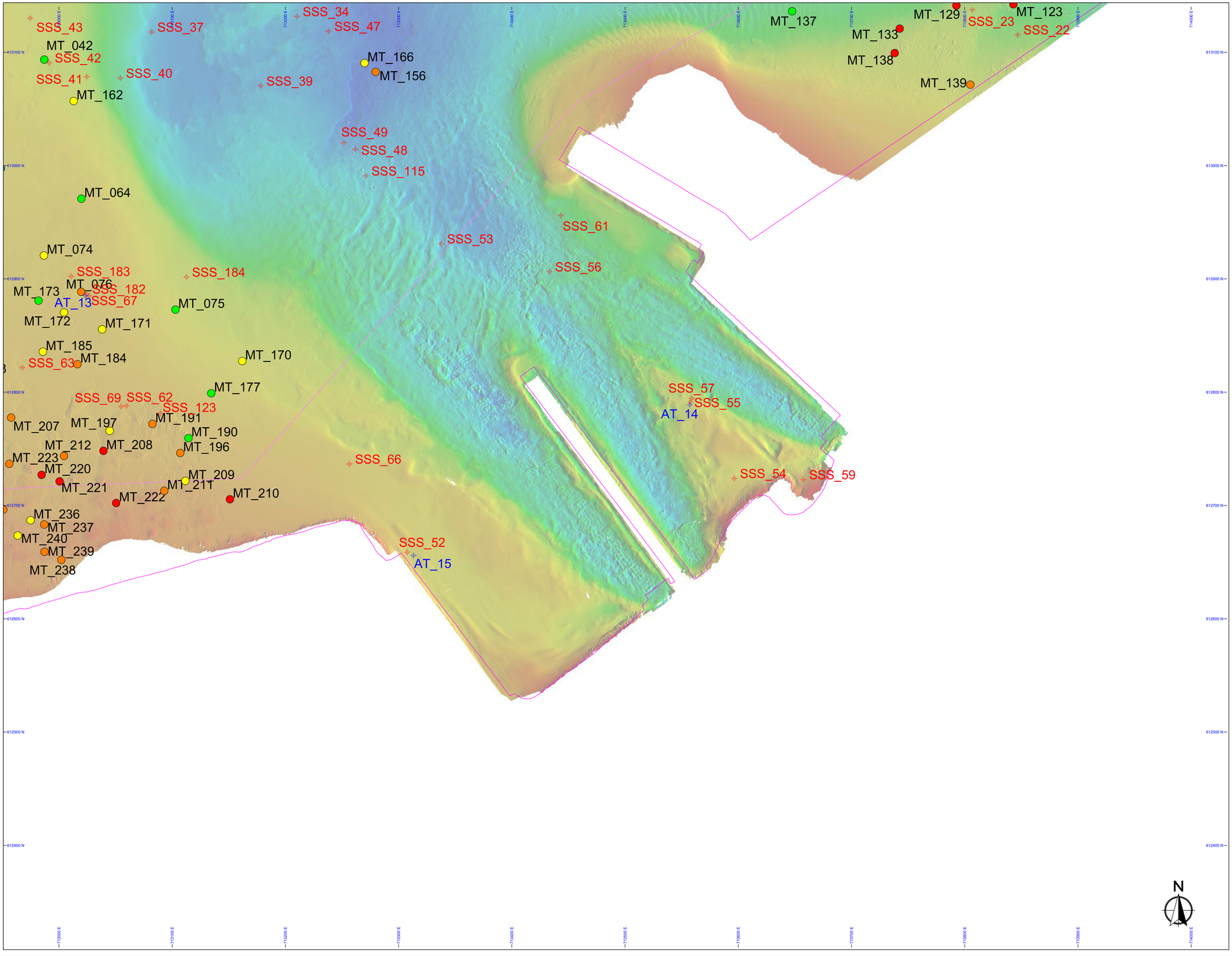
Drawing Status: Draft **Rev:** 0

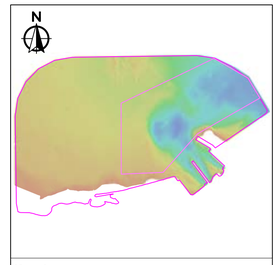
Paper size and scale: 1:1500 @ A1

Job Number: 2311_CG_RG_01 **Date:** 21/06/2024

Drawn By: ALQ **Checked By:** MTAL

Rosslare Europort Offshore Wind Hub - Geophysic targets chart 04





Key plan:

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Survey Location:	Rosslare Europort, Co. Wexford IRELAND
Survey method:	Multibeam echosounder Sidescan-sonar Marine magnetometer Sub-Bottom profiler Boomer
Survey Date:	26th, 27th, 29th October 2023 & 07th November 2023 20th and 21st May 2024

Revisions:

Date:	Rev:	Description:	Drawn By:
20/06/2024	0	Draft	ALQ

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Client: Causeway Geotech

Project: Rosslare Europort Offshore Wind Hub Geophysical Survey

Drawing Title: Rosslare Europort Offshore Wind Hub - Geophysic targets chart

Drawing Status: Draft **Rev:** 0

Paper size and scale: 1:1500 @ A1

Job Number: 2311_CG_RG_01 **Date:** 21/06/2024

Drawn By: ALQ **Checked By:** MTAL