Morecambe Offshore Windfarm: Generation Assets

Environmental Statement

Volume 5

Appendix 7.1 Offshore Geophysical Survey

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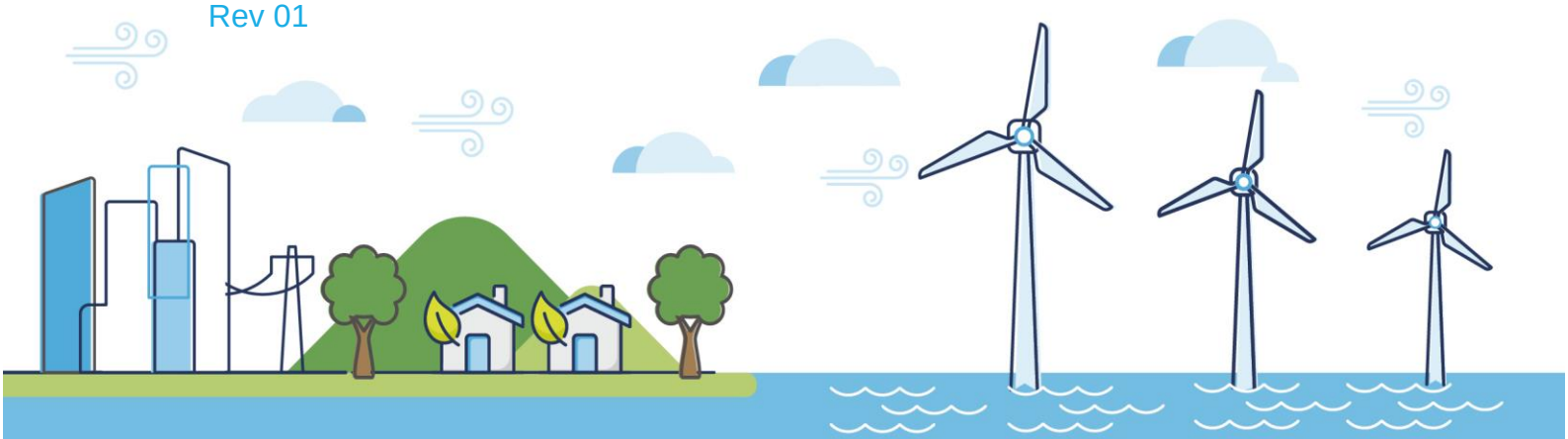
Rev 01



MORECAMBE

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SURVEY REPORT

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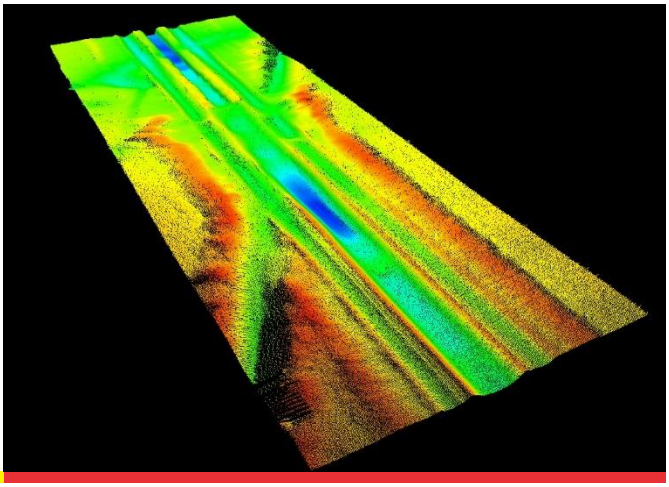

OFFSHORE WIND LTD

MORECAMBE OFFSHORE WINDFARM

OFFSHORE GEOPHYSICAL SURVEY

IRISH SEA
OCTOBER - DECEMBER 2021

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MMT

REVISION HISTORY

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DOCUMENT CONTROL

RESPONSIBILITY	POSITION	NAME
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Approval	Project Manager	Karin Gunnesson

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ABBREVIATIONS AND DEFINITIONS

BGS	British Geological Survey
DPR	Daily Progress Report
DTM	Digital Terrain Model
GIS	Geographic Information System
HSE	Health Safety Environment
HMS	Her / His Majesty's Ship
IHO	International Hydrographic Organisation
ISO	International Organization for Standardization
LAT	Lowest Astronomical Tide
LGM	Last Glacial Maximum
MBES	Multibeam Echo Sounder
M/V	Motor Vessel
QC	Quality Control
PPS	Pulse Per Second
SBP	Sub-bottom Profiler
SSS	Side Scan Sonar
UK	United Kingdom
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VORF	Vertical Offshore Reference Frame
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator
OWL	Offshore Wind Ltd

EXECUTIVE SUMMARY

MMT conducted an offshore geophysical survey for Offshore Wind Ltd as part of a Phase I study for a proposed offshore wind farm. The survey area is located South-West of Morecambe Bay approximately 30 km West of Blackpool. The survey was conducted using the M/V Franklin during October to December 2021 with a geophysical spread that included a multibeam echo sounder, a side scan sonar, an Innomar sub-bottom profiler, a Sparker, and a transverse gradiometer (TVG). The survey area encompassed approx. 126 square km, with approx. 1700 lines km of geophysical survey. The weather during the survey was marginal sea states with periods of standby due to unfavourable survey conditions.

The aim of the geophysical survey was to provide a broad understanding of the geophysical conditions and shallow sub-seabed geology, obtain accurate bathymetry and locate all obstructions which may affect installation of turbines.

The basis for the shallow geology interpretation, included what is widely known about the survey area - that it is underlain by Quaternary sediments, in places at least 43 m thick, that overlie Triassic Bedrock (mudstones and halite). The bedrock lies within 10m below the seabed in only small areas in the southeaster part of the survey area and the centre. The Quaternary sediments indicate a history of glacial influence that resulted in a complex geometry between sediment filled glacial channels, subglacial and glaciomarine depositional units, and sediment filled tunnel valleys incising the bedrock surface.

The seabed sediments across the area are interpreted to be clayey SAND to SAND to gravelly SAND. The seabed sediments are interpreted to be a lag deposit, which is left behind as currents winnow and remove finer sediments and also mobile surficial sands.

Minimum seabed depth observed in the survey area was 18 m and the maximum depth observed was 40 m. Maximum seabed gradients observed were 4°, located primarily on the flanks of mobile sediment bedforms such as megaripples which are observed throughout the area and sand waves in south-west corner. The orientation of the sediment features is coincident with the E-W currents.

79 SSS contacts and 276 magnetometer anomalies were detected during survey. The majority of SSS contacts were identified as boulders and debris, while most magnetometer anomalies were associated with known cables/pipelines and other subsea structures.

Geologic hazards identified from this survey include possibly mobile sediment bedforms that may indicate strong bottom currents, zones of glaciotectonism and paleochannels within Quaternary sediments and incised valleys in the Triassic Bedrock. The deformed sediment units are defined as hazards primarily due to their effects on the material properties (for example shear strength) of the subsurface units. Paleochannels in the glacial units, and sediment-filled tunnel valleys in the underlying bedrock, present a similar hazard with possible lateral and vertical variations in geotechnical properties. Unit four – Till sub cropping in small areas in the southeaster part of the survey area and the centre, has been flagged as geologic hazards due to the potential difficulties to plan drilling and foundations.

1 | INTRODUCTION

1.1 | PROJECT INFORMATION AND SURVEY AREA

Morecambe is a 480MW offshore wind farm owned by Offshore Wind Ltd (OWL), a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy plc. It was awarded as part of the offshore Wind Leasing Round 4 run by The Crown Estate in early 2021. The boundary of the site is shown in Figure 1 and the survey area is located South-West of Morecambe Bay approximately 30 km West of Blackpool. In support of the development of the project, OWL is planning to perform the Phase-1 Geophysical Ground Investigation of the wind farm site, to which this Scope of Work applies

The offshore survey vessel M/V Franklin conducted all aspects of the offshore geophysical survey work. The survey was performed using hull-mounted multibeam echo sounder (MBES) in conjunction with a combined dual-frequency side scan sonar (SSS) installed on a MacArtney Focus-2 ROTV, a TVG with two Geometrics G-882 magnetometers “piggy-backed” behind the ROTV, a medium parametric Innomar sub-bottom profiler (SBP) and a GeoSpark 200 Sparker-type SBP for enhanced penetration in sediments with coarse material.

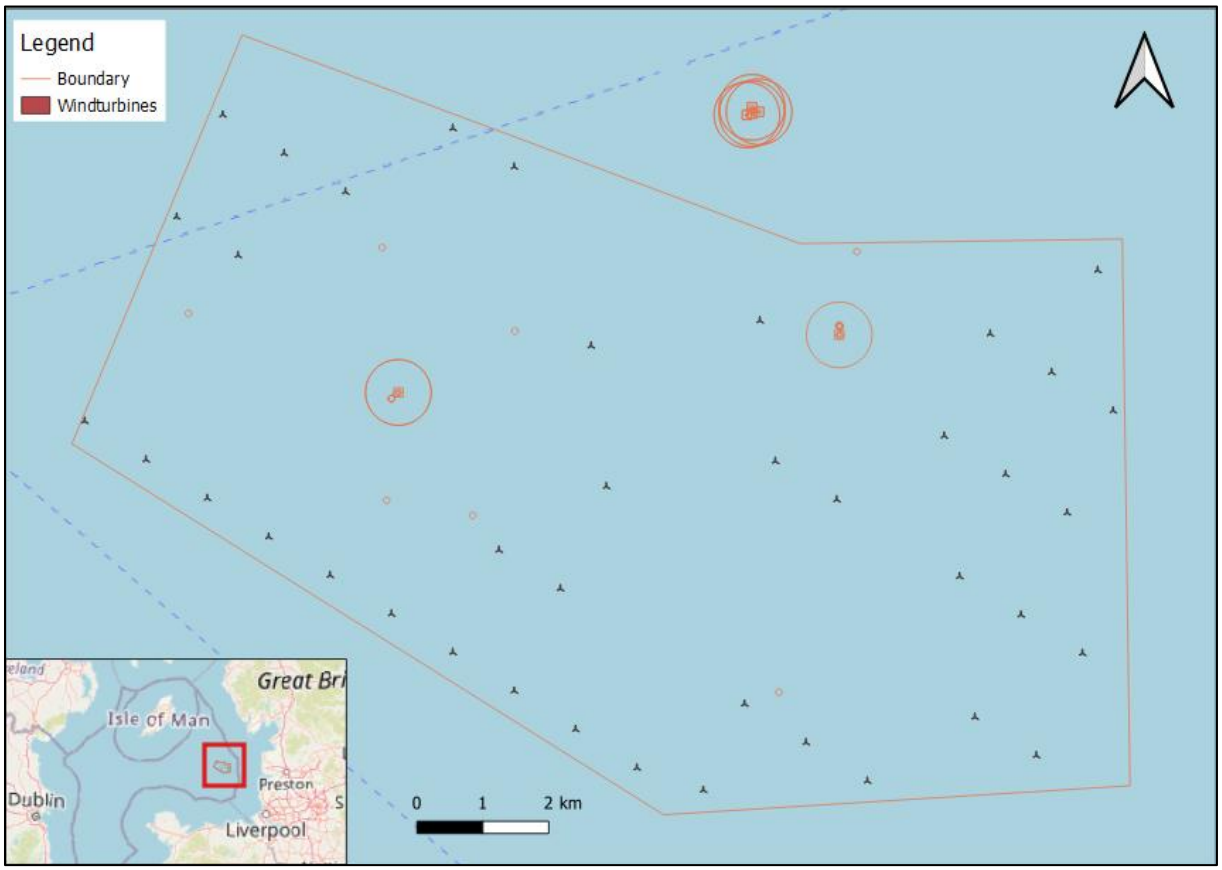


Figure 1 Overview of survey area.

Table 1 Project details.

CLIENT:	Offshore Wind Ltd (OWL)
PROJECT:	Morecambe Offshore Windfarm
MMT PROJECT NUMBER:	103910
SURVEY TYPE:	Geophysical Survey
PURPOSE:	To supplement existing data, obtain accurate bathymetry, locate subsea obstruction and other seabed factors that could affect the wind turbines installation and related assets.
AREA:	Irish Sea
SURVEY PERIOD:	October – November 2021
SURVEY VESSEL:	M/V Franklin
MMT PROJECT MANAGER:	Karin Gunnesson
CLIENT PROJECT MANAGER:	Amy Parry

1.2| SCOPE OF WORK

The survey Scope of Work was divided into two Work Elements to clearly identify work to be completed for the project. The definition of each Work Element is included in Table 2.

Table 2 Definition of work Element for this SoW

Work Element	Purpose	Requirement and Deliverable Summary
1	**Offshore Hydrographic and Geophysical Survey** Surveys within the limits of the survey area described in Figure 3-1. Blanket SSS coverage. SBP on all SSS lines. QC crosslines at max 5km interval and at the area definition boundary Blanket MBES coverage.	• Vessel positioning and operation • Bathymetry and seabed DTM (MBES) • MBES backscatter / pseudo SSS (MBES) • Side Scan Sonar (SSS) • Sub-bottom profiling (SBP) • Gradiometer (TVG) • Additional survey work as requested

The general objectives of the offshore area survey were to:

- Supplement existing survey data from various sources to provide a broad understanding of the geophysical conditions within the survey area.
- Obtain accurate bathymetry, locate all obstructions, and identify other seabed factors which may affect the installation of the wind turbines, subsea cables, and any other associated equipment.
- Establish digital terrain models with specified resolution for basic and detailed engineering purposes.
- Establish vertical route profiles for engineering purposes. Produce a contour plan and map the location of seabed features, particularly any rock outcrops or obstructions.
- Carry out a geophysical survey within the survey area to define the shallow sub-seabed geology across the area and at the foundation locations sufficient for basic foundations design and to aid in the identification of subsea structures.
- Carry out a gradiometer survey to:

- Validate existing and identify any new marine archaeological features.
- Positively locate all existing pipelines and cables, both operational and redundant, within the survey area.
- Acquire relevant survey data to support any necessary engineering associated with cable crossings if necessary.
- Survey and quantify all wrecks identified within the survey area.

1.3| PURPOSE OF DOCUMENT

This report presents the results from the geophysical survey of the Morecambe Offshore Windfarm Project.

The report summarises the conditions within the survey area with regards to; bathymetry, surficial geology and seabed features as well as subsurface geology. Detected contacts and anomalies i.e., boulders, wrecks, debris and magnetic anomalies detected during the survey are presented. Available background data was incorporated into the interpretation model provided in this report. Geologic hazards have been identified and considered.

1.4| REPORT STRUCTURE

REPORT

The results from the geophysical survey are presented in this text report, GIS deliverables and in accompanied charts. Appended to the report are the following:

- Appendix A| Charts
- Appendix B| Contact list
- Appendix C| Anomaly list

CHARTS

The MMT charts illustrate and describe the results from the survey. Chart types included with the report are Overview chart, Magnetic Gradient Charts and Alignment Charts along selected profiles. A list of all produced charts is presented in Appendix A|.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

Survey data is provided within a Seabed Survey Data Model (SSDM) format GIS Geodatabases (GDB) which accompanies this report.

GIS products provided alongside this report are summarised within Table 3.

Table 3 Associated GIS deliverables.

Item	Comments	Format
GIS Database	GIS database including geophysical products in SSDM format.	*.gbd

1.5| REFERENCE DOCUMENTS

The documents used as references to this Interpretative Report are presented in Table 4.

Table 4 Reference documents.

Ref.	Document number	Title	Author
1.	103910-LTD-MMT-HSE-PRO-HAZOP	Hazard and Operability Study Incl. Operational Procedures	MMT
2.	103910-LTD -MMT-HSE-PRO-HSEPLAN	HSE Plan –Northern Franklin	MMT
3.	103910-LTD -MMT-HSE-PRO-ENFNFRANK	Emergency Notification Flowchart – Northern Franklin	MMT
4.	103910-LTD -MMT-QAC-PRO-CADGIS	CAD and GIS Specification	MMT
5.	103910-LTD -MMT-MAC-PRO-NFRANKLIN	Mobilisation and Calibration Procedures – Northern Franklin	MMT
6.	103910-LTD -MMT-MAC-REP-NFRANKLIN	Mobilisation and Calibration Report – Northern Franklin	MMT
7.	103910-LTD -MMT-SCH-PRO-SCHEDULE	Time Schedule	MMT
8.	103910-LTD -MMT-SUR-REP-FIELDREP	Field Report	MMT
9.	103910-LTD -MMT-SUR-REP-SURVEYRE	Survey Report (previous survey in the area)	MMT
10.	103910-LTD -MMT-SUR-REP-OPERATRE	Operation Report	MMT
11.	807469-01-SR-SOW-0001 Rev 1	Scope of Work	Client
12.	807469-01-SR-SOW-002 Rev.1 Addendum_signed	Addendum to Scope of Work	Client
13.	807469-01-SR-SPE-0001 Rev 1	Technical Specification	Client

2| SURVEY PARAMETERS

2.1| GEODETIC DATUM AND GRID COORDINATE SYSTEM

The geodetic datum used for SSS, SBP, TVG, and raw MBES during acquisition and processing are presented in Table 5 and Table 6, respectively.

Table 5 Geodetic parameters used during acquisition.

Horizontal datum: WGS 84	
Datum	World Geodetic System 1984 (6326)
Ellipsoid	World Geodetic System 1984 (7030)
Prime Meridian	Greenwich (8901)
Semi-major axis	6 378 137.000 m
Semi-minor axis	6 356 752.3142 m
Inverse Flattening (1/f)	298.257223563
Unit	International metre

Table 6 Geodetic parameters used during processing.

Horizontal datum: WGS 84	
Datum	World Geodetic System 1984 (6326)
Ellipsoid	World Geodetic System 1984 (7030)
Prime Meridian	Greenwich (8901)
Semi-major axis	6 378 137.000 m
Semi-minor axis	6 356 752.3142 m
Inverse Flattening (1/f)	298.257223563
Unit	International metre

The projections parameters are presented in Table 7.

Table 7 Projection parameters used during processing.

projection parameters	
Projection	UTM
Zone	30 N
Central Meridian	03° 00’ 00’’ W
Latitude origin	0
False Northing	0 m
False Easting	500 000 m
Central Scale Factor	0.9996
Units	metres

2.2| VERTICAL REFERENCE PARAMETERS

The vertical reference parameters used for processing and reporting are presented in Table 8.

Table 8 Vertical reference parameters.

Vertical Reference Parameters	
Vertical reference	LAT
Height model	VORF

2.3| TIME DATUM

Coordinated universal time (UTC) was used on all survey systems on board the vessel. The synchronisation of the vessel's onboard system was governed by the pulse per second (PPS) issued by the primary positioning system. All displays, overlays and logbooks were annotated in UTC. The Daily Progress Report (DPR) refers to UTC.

3| PROCESSED DATA QUALITY

3.1| BATHYMETRY DATA

The objective of the MBES processing workflow is to create a digital terrain model (DTM) that provides an as true as possible representation of the seafloor with the highest possible detail. The bathymetric data processing is made with the following main objectives:

- Provide an accurate depth to seabed for foundation design purposes.
- Provide an accurate surface from which all sub-bottom interpretation is referenced.
- Identify sediment features that may impact site design and/or layout.
- Identify potential UXO in combination with SSS and magnetometer data.

Survey design lines were planned to provide sufficient overlap and data density. Overlap was continuously monitored in real time data displays during acquisition. The lead hydrographer and an onboard processor routinely reviewed the overlap in CARIS by assessing high resolution surfaces and line spacing, which allowed for an ongoing fill plan to be maintained and incorporated into the survey operational plans as needed.

Post-processing and inspection of position, attitude, and navigation data as well as vessel and sensor alignment were performed using the Applanix software, POSPac Mobile Mapping Solutions (MMS), version 8.4. This post-processing workflow was utilized for all data.

Backscatter intensity information was collected in all bathymetry records and processed in QPS Fledermaus Geocoder Toolbox (FMGT), a software designed to better visualize and analyse backscatter data from multibeam sonars. During acquisition, data was processed in FMGT regularly and backscatter were reviewed for any offsets, blunders, and general agreement. Sonar settings were seldom altered, adjusting only the beam angles to mitigate noise and sound velocity artifacts in the outer beams. FMGT utilizes Geocoder, a software tool that implements geometric corrections of backscatter intensities from the sonar and corrects for variable acquisition gains, power levels, pulse widths, ensonification areas, and incidence angles to provide high-resolution and accurate georeferenced images of seafloor morphology and physical properties.

3.2| SIDE SCAN SONAR DATA

SSS data quality was marginally affected by thermocline layers in the north-east of the site but was overall, generally good and in most cases, a full range of 100 m was achieved for both high and low frequencies.

Offshore currents occasionally affected the SSS ROTV motion, resulting in motion artefacts visible in the SSS imagery. Some data smoothing was applied to tow fish heading in order to reduce these artefacts. Minimal data correction to the SSS positioning was required as the navigation quality was generally very good. Using the data acquired, boulders (>0.5m) and other seabed contacts (>1.0m) were able to be identified.

3.3| SUB-BOTTOM PROFILER DATA – INNOMAR

The Innomar penetration varied greatly across the site from 4m to 23m below seabed, this variation was correlated to the thickening of an upper mud facies which did not attenuate the signal as much as areas which had thick sand facies overlain with thin mud facies. There is some MBES and/or Sparker interference as well as weather noise, but these were removed or attenuated by processing, however the quality was good in general and fit for purpose.

3.4| SUB-BOTTOM PROFILER DATA – SPARKER

The Sparker data was of high quality, high resolution (up to 0.3 m vertical resolution in the upper section) data were acquired to at least 50 m below seabed. Often signal penetration was deeper than 50 m below seabed, but the primary signal is difficult to resolve in data returning from below the seabed multiple. In areas where megaripples and sand waves were present on the seabed, the signal is affected and the data below is reduced in quality due to signal interaction with the seabed geometry, however it is fit for purpose.

3.5| TVG DATA

TVG data was generally of high quality with occasional noise present in some files due to bad weather conditions or electrical interference. The total field magnetic data were sampled at 10Hz. Magnetic background noise levels generally did not exceed 2 nT and remained within specifications.

A 5 nT peak-to-peak threshold criteria was used for anomaly picking, with most anomalies being related to linear features associated with cables/pipelines in the area.

3.6| DATASETS CORRELATION

In general, de correlation between the different datasets was good, where surficial features can be seeing between the different datasets in most of the cases. A clear example of this is:

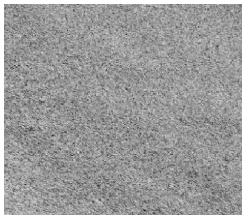
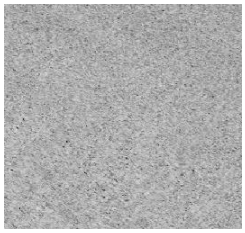
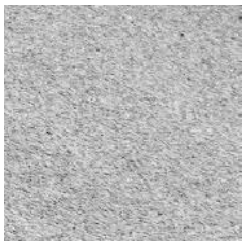
- Perfect correlation between SSS and MBES in terms of Megaripples.
- Perfect correlation between SSS and MBES in the identification of Calder to Rivers Onshore Terminal cable, in those areas where the cable has been visible in both systems.
- Good correlation between SBP, SSS and MBES where Sand Waves are present.
- Good correlation in the SBP dataset between Mainlines and Crosslines.

4| SEABED CLASSIFICATION AND STRATIGRAPHY

4.1| SEABED CLASSIFICATION BASED ON SSS REFLECTIVTY

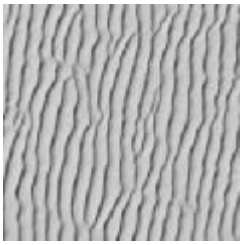
The ID column in Table 9 defines the colour in the charts for the specific sediment type. All particle sizes refer to the soil classification in ISO 14688-1.

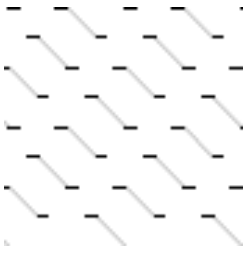
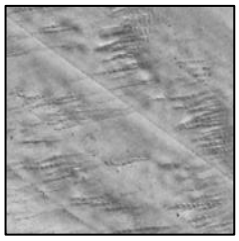
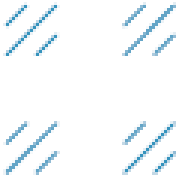
Table 9 Sediment classification.

ID	SSS IMAGE	ACOUSTIC DESCRIPTION	LITHOLOGICAL INTERPRETATION
		High acoustic reflectivity. Grainy texture to coarse texture.	**Gravelly SAND** May contain minor fractions of lithic or shell, silt or clay.
		Medium to low acoustic reflectivity. Slightly grainy texture.	**SAND** May contain minor fractions of lithic or shell, silt or clay.
		Low acoustic reflectivity. Minor grainy texture.	**Clayey SAND** May contain minor fractions of lithic or shell, silt.

The ID column in Table 10 defines the pattern in the charts for the specific feature type.

Table 10 Seabed features classification.

ID	SSS IMAGE	SEABED FEATURE	CRITERIA
		Mega Ripples	Wavelength 0.5 - 25 m

ID	SSS IMAGE	SEABED FEATURE	CRITERIA
		Sand Waves	Wavelength >25 m
		Current lineation	Horizontal bedforms in a WSW-ENE direction
		Trawl Marks	Individual trawl marks

4.2| CLASSIFICATION OF CONTACTS AND ANOMALIES

The SSS contacts greater than 0.5 m in any axis were selected.

During seabed interpretation, boulder occurrence at surface has been grouped based on the frequency and content of boulder following these criteria:

- Occasional 10-20 boulders/50x50 m. Boulders are >0.5 m
- Numerous >20 boulders/50x50 m. Boulders are >0.5m
- No single boulders will be selected within boulder fields

Note: No boulder fields were detected within the survey area.

Magnetic anomalies are classified according to the following criteria:

- Dipole, monopole or complex shape
- Single anomaly or anomalies creating a linear trend
- 10 nT (peak to peak) Anomaly threshold

4.3| SUBSURFACE GEOLOGY CLASSIFICATION

The classifications of the subsurface geology are described according to their seismic facies, stratigraphic boundaries and internal reflector terminations. Interpreted units, their main properties and lithostratigraphic correspondence are presented in (Table 11).

Interpreted seismic units were correlated with established lithostratigraphic formations as per the published literature and BGS.

Table 11 Summary of the seismic units.

STRATIGRAPHY			ACOUSTIC FACIES AND INTERNAL CONFIGURATION	LOWER BOUNDING SURFACE		EXPECTED COMPOSITION
PERIOD	FORMATION	MEMBER		MORPHOLOGY	NATURE	
Quaternary	Surface sands formation	Surface sands	Transparent	Generally smooth	Conformable	Sands, silts
	Western Irish Sea Formation A	Mud facies	Parallel well bedded, displaying onlap	Generally smooth	Conformable	Silts with sands
		Prograding facies	Clinoforms and chaotic	Irregular and occasionally channelled	Erosive	Sands
	Western Irish Sea Formation B	Mud facies	Parallel well bedded	Undulating	Conformable	Silts with sands
	Cardigan Bay Formation	Till	Chaotic	Undulating	Erosive	Diamict
Triassic		Bedrock	Steeply dipping reflectors and chaotic	N/A	N/A	Mudstone and Halite

5| RESULTS

5.1| BATHYMETRY

The area ranges in depth between 18 m – 40 m and is characterised by current driven morphology which dominates the seabed. Large bands of sediment can be seen streaming behind Calder and DP3 platforms and are orientated predominantly in an E - W direction. (Figure 2).

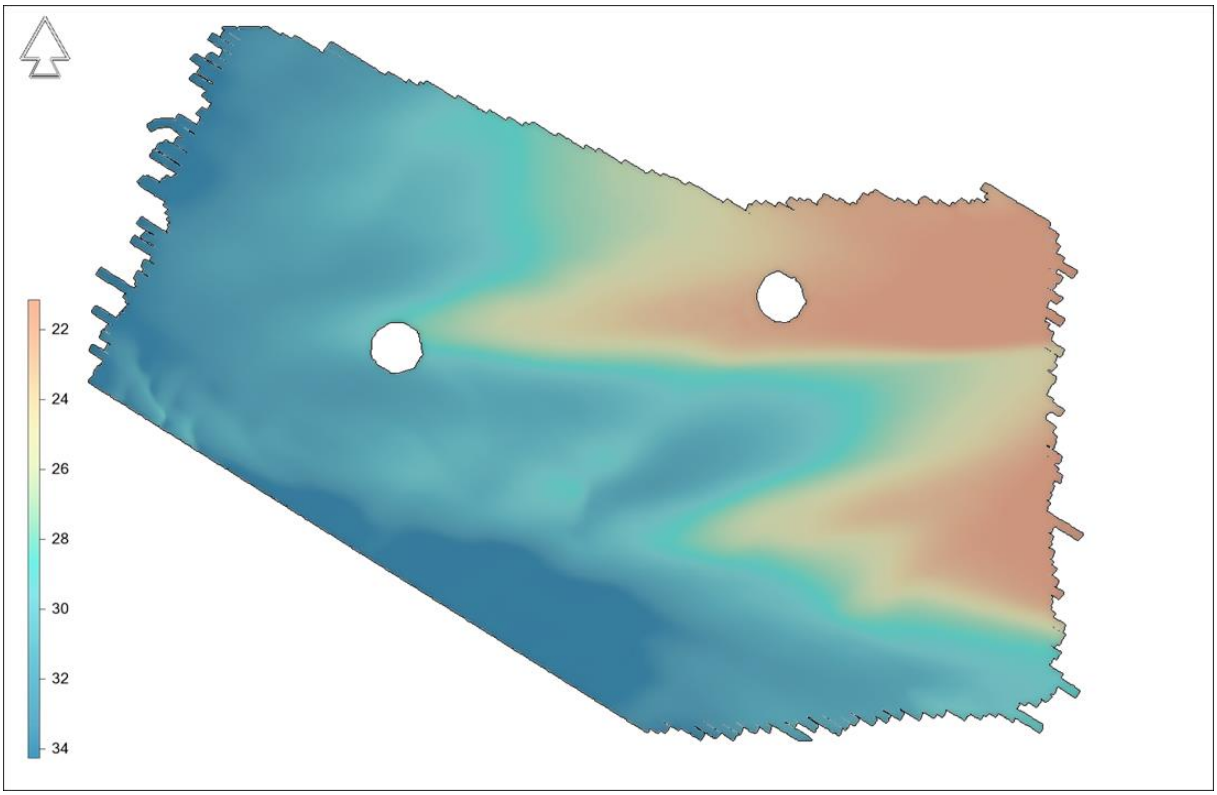


Figure 2 Site Overview.

Megaripples features measuring approximately 0.5 m in height run in a more N-S direction as show in Figure 3 below where a cross section has been taken (between points A and B) in a more dynamic area of seabed.

Slope analysis across the site shows that gradients are low and can be classified as very gentle or gentle and are generally associated with the sediment features as can be seen in Figure 4.

SEABED GRADIENT CLASSIFICATION

The seabed gradient is classified according to Table 12.

Table 12 Seabed gradient classification.

CLASSIFICATION	GRADIENT
Very Gentle	<1°
Gentle	1° - 4.9 °
Moderate	5° - 9.9°
Steep	10° - 14.9°
Very Steep	>15°

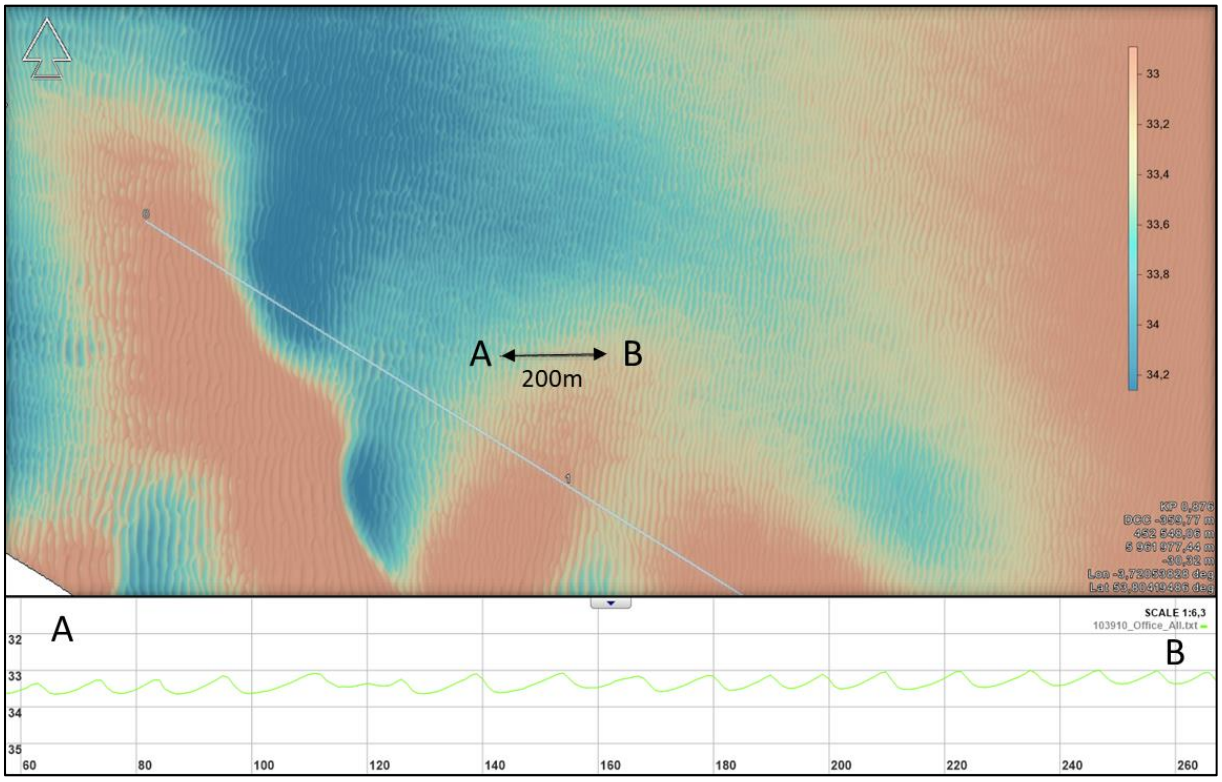


Figure 3 Cross profile showing sediment features near runline OWF_690.

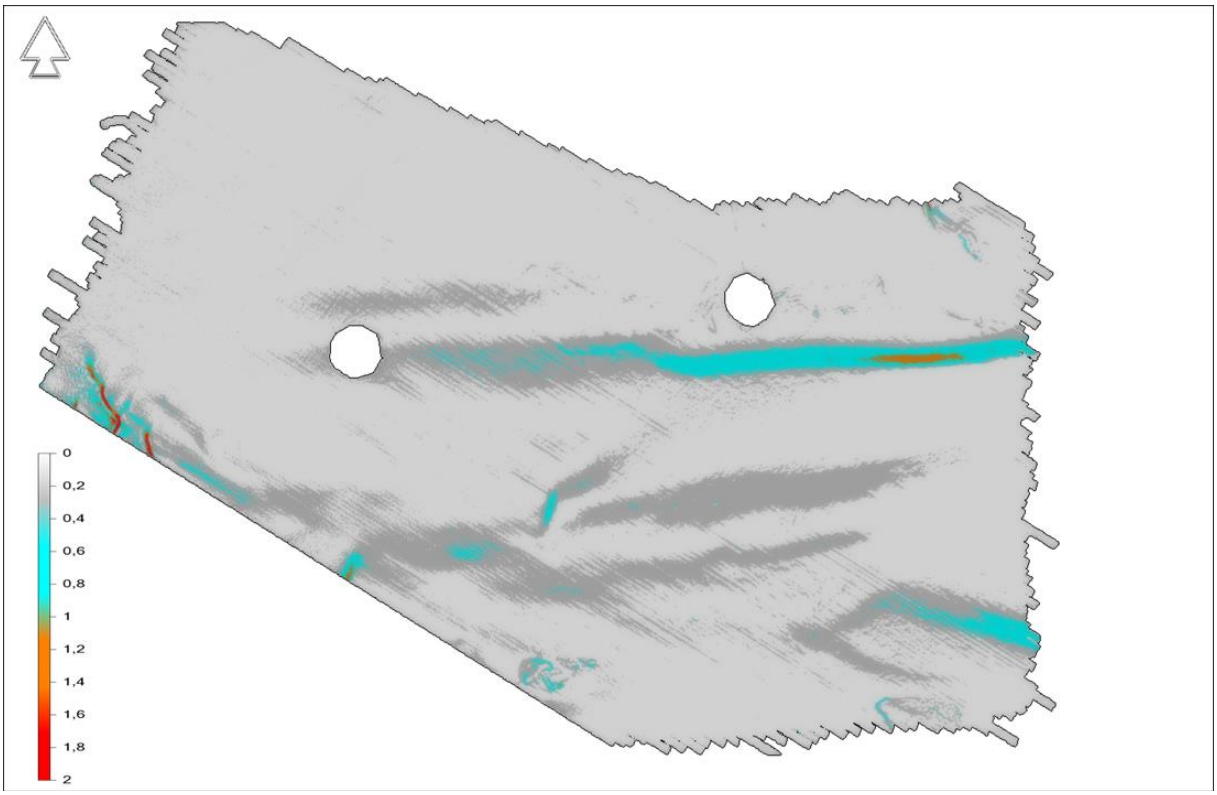


Figure 4 Slope analysis across the survey area.

5.1.1| BACKSCATTER

The backscatter data was used to generate 1 m seabed imagery and a mosaic created across the survey area to provide a comprehensive representation of the characteristics of the seafloor based on differing acoustic properties (Figure 5).

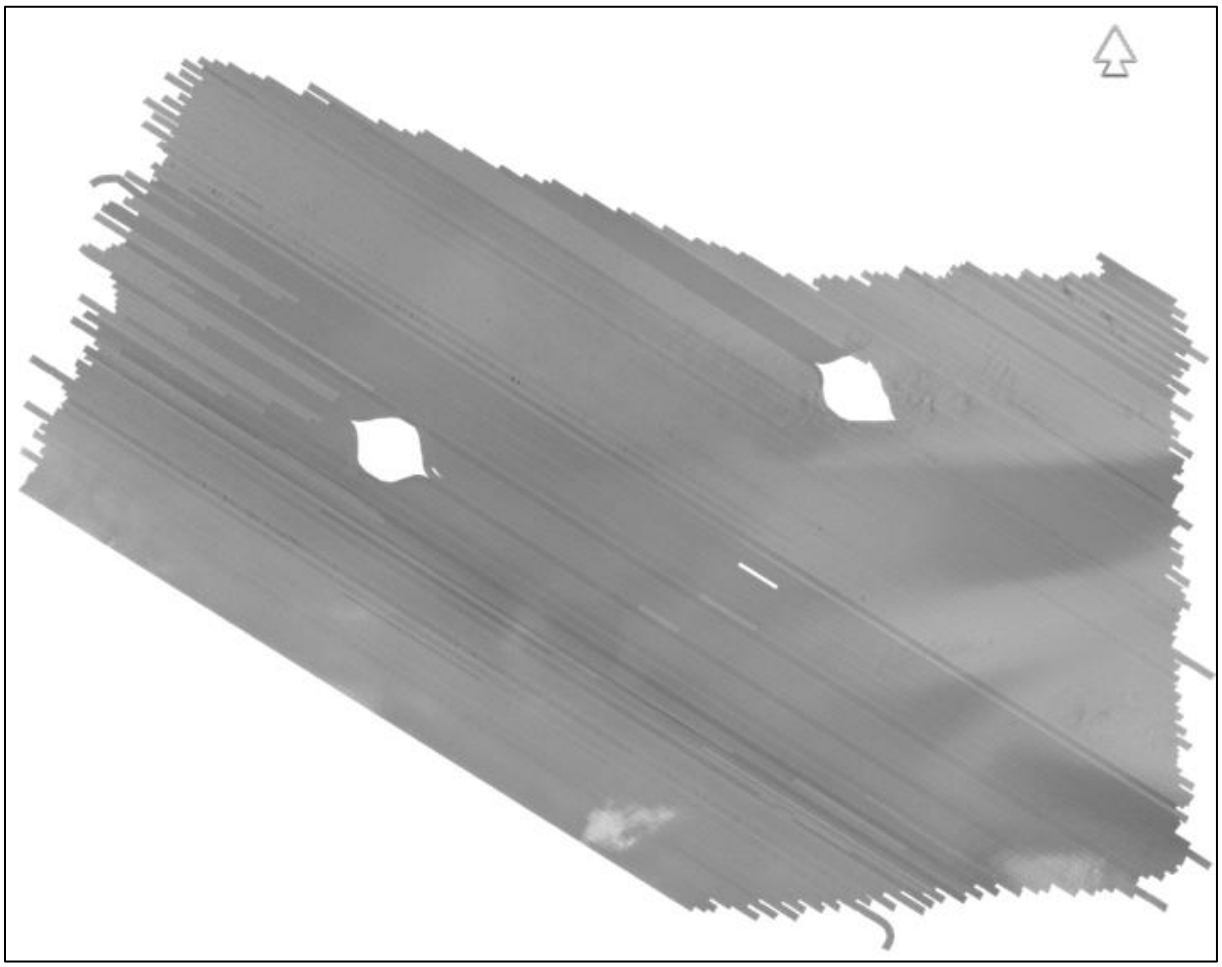


Figure 5 Overview of the Backscatter Mosaic.

5.2| SURFICIAL GEOLOGY AND SEABED FEATURES

5.2.1| SURFICIAL SEDIMENTS

The surficial geology was interpreted from the SSS imagery based on the relative SSS reflectivity, where lighter reflectivity was interpreted as relatively finer grained sediments and darker reflectivity was interpreted as relatively coarser grained sediments. Other influences on SSS reflectivity that were considered included local seabed gradients.

The sediments presented in Figure 6 and Figure 11, were classified as gravelly SAND, SAND and clayey SAND. The area is dominated by SAND and clayey SAND with large extensions of megaripples and trawl marks as main seabed features. Occasional current lineation patches are common in the eastern area. An isolated sand wave area is also present on the south-west corner

The seabed sample soil classifications are based on ISO 14688-1 and ISO 14688-2 (Table 9). Larger areas classified as a major sediment type may have local variations in minor constituent content.

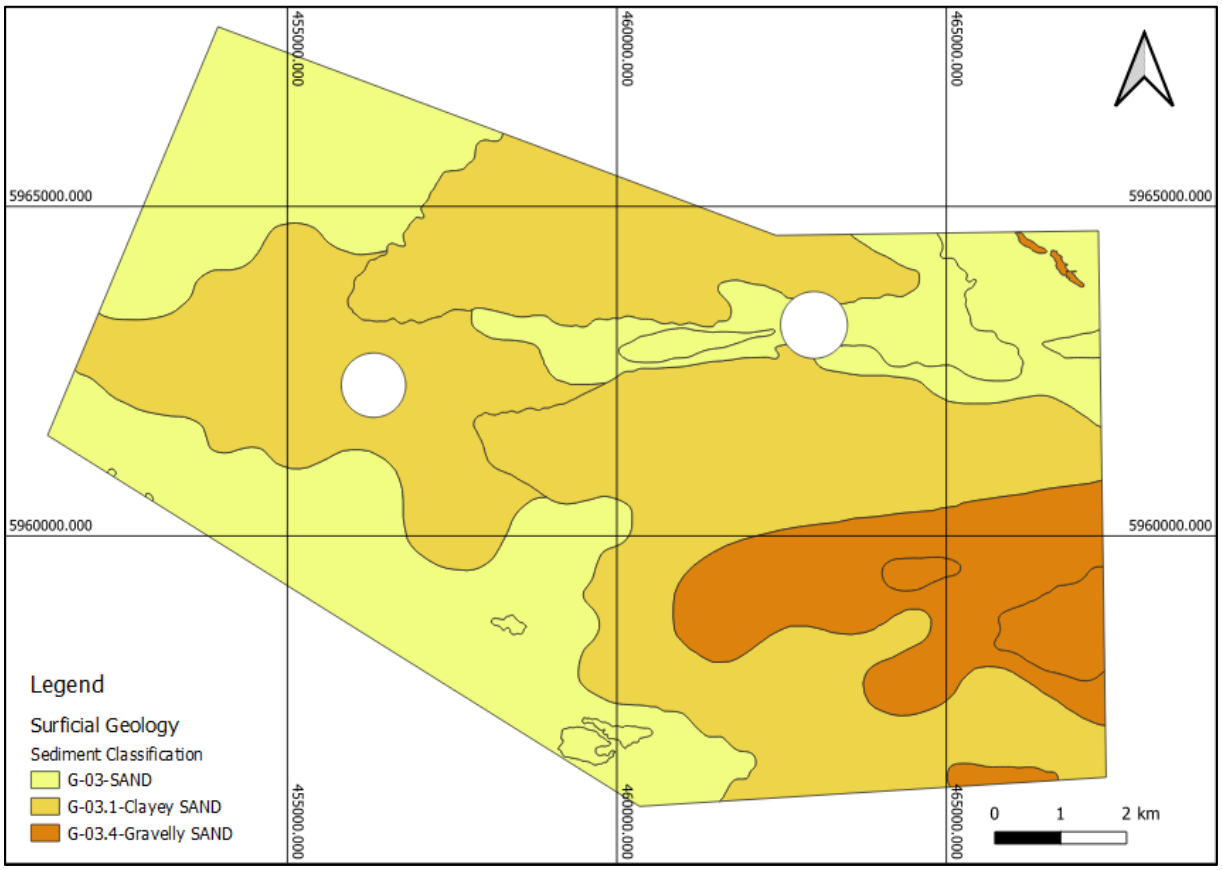


Figure 6 Interpreted seabed sediment types – Colour coded.

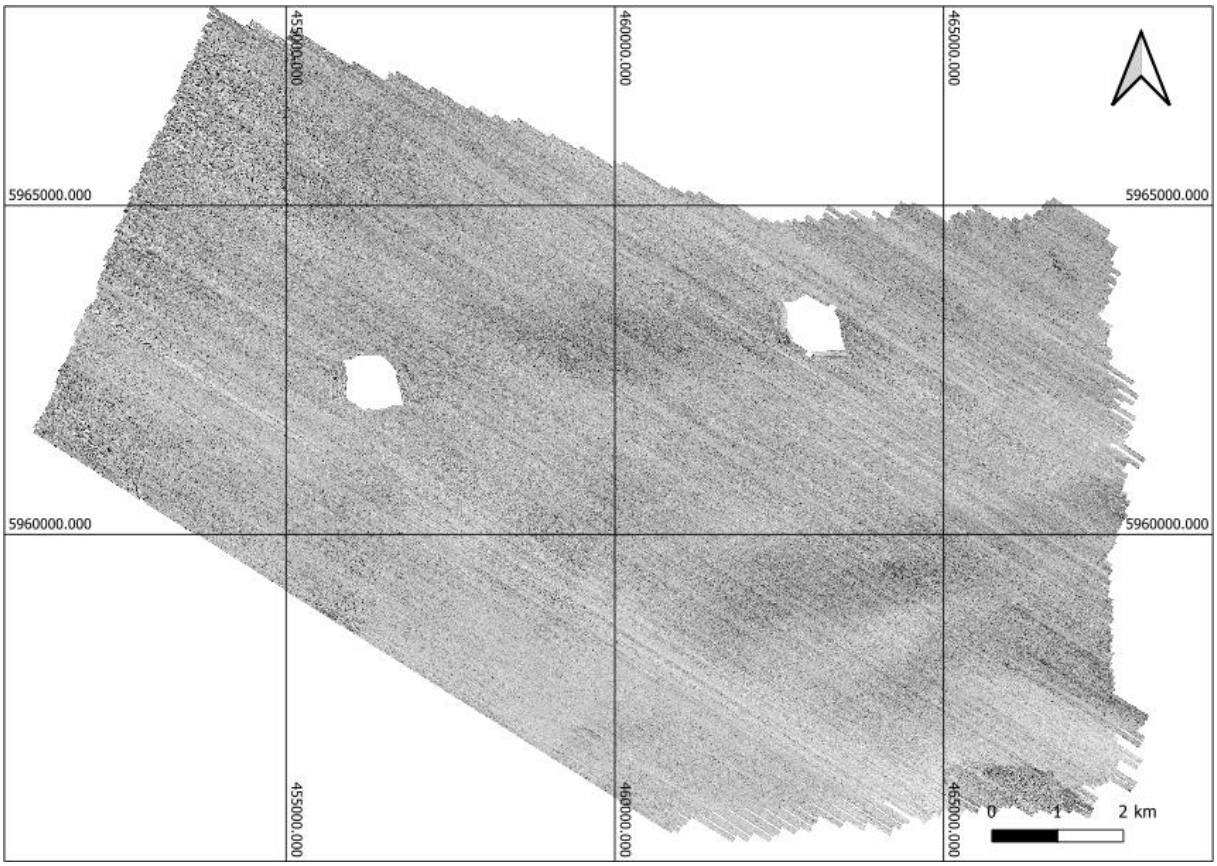


Figure 7 Interpreted seabed sediment types – SSS Raster.

All of the depositional units mapped at the seabed have similar lithology of predominately SAND with laterally variable minor fractions of lithic or shell gravel, clay or silt.

5.2.2| BEDFORMS

Mobile sediment features as megaripples are observed throughout almost the entire survey area and an isolated sand wave zone located at the south-west corner. The mobile sediment bedforms were mapped from a combination of SSS and MBES data (Figure 8) but are often best viewed in the MBES data. It should be noted that the largest bedform feature (Table 10) present in an area is used to classify the zone, smaller bedforms may be present in the same location.

The occurrence of megaripples is predominantly visible at the western part of the survey area (Figure 9). Where megaripples occur in fields, they have wave crests orientated N-S, indicating a bidirectional bottom current orientation of E-W and W-E.

The sand wave occurrence is visible in the south-west corner of the survey area with a crest orientated N-S indicating a strong bottom current orientated W-E (Figure 10).

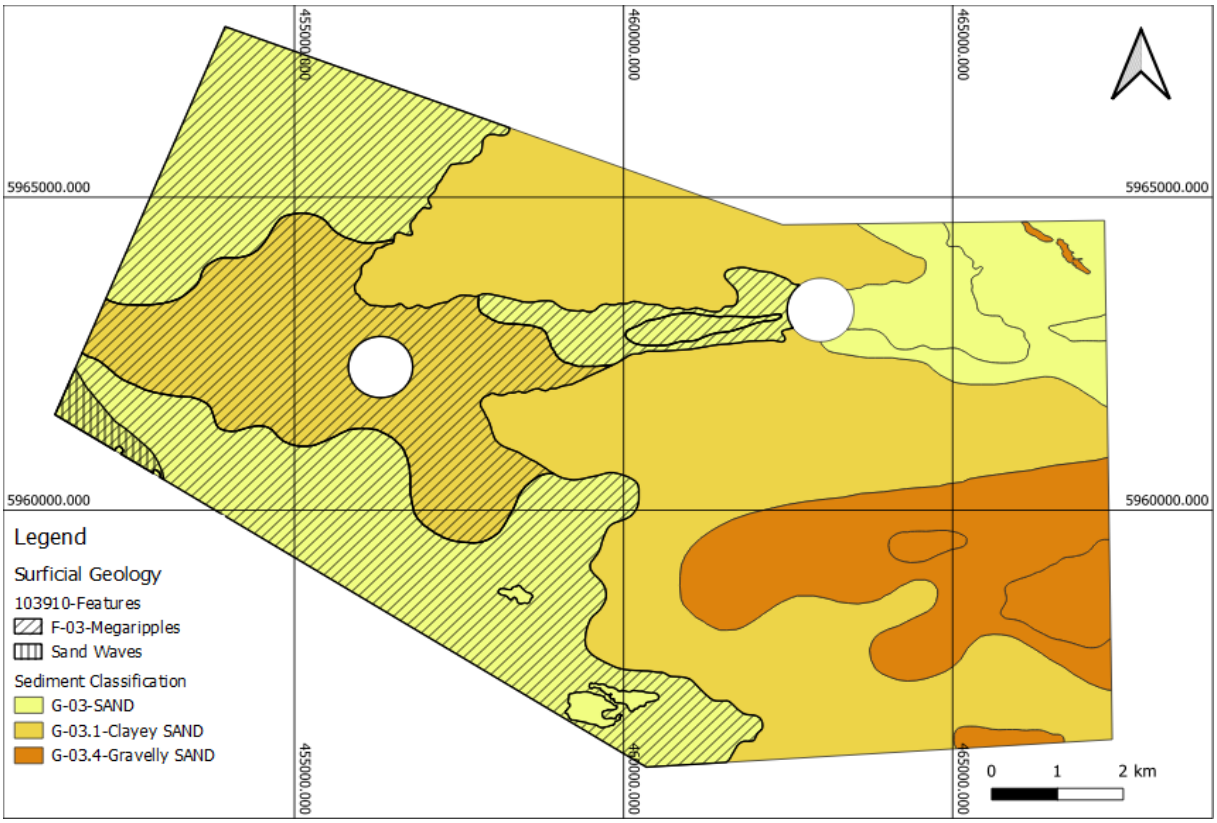


Figure 8 Overview bedforms in the survey area.

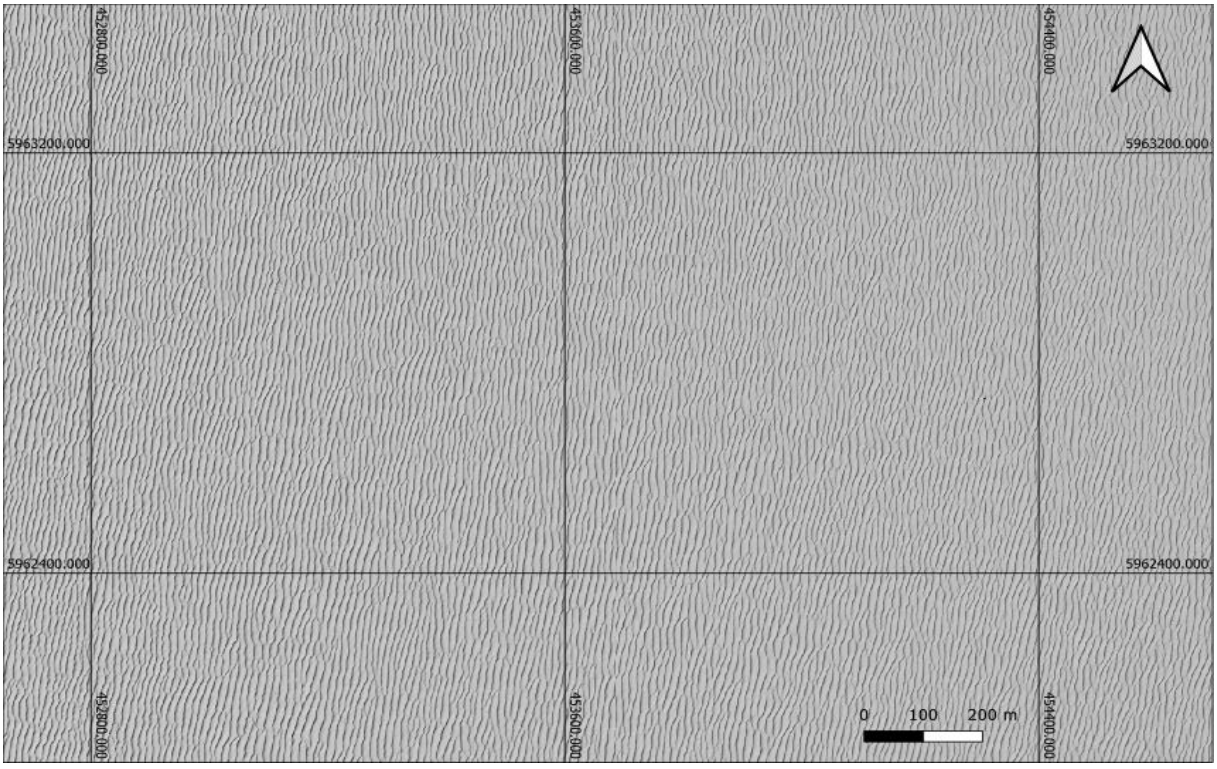


Figure 9 Megaripples sample observed in the survey (MBES dataset).

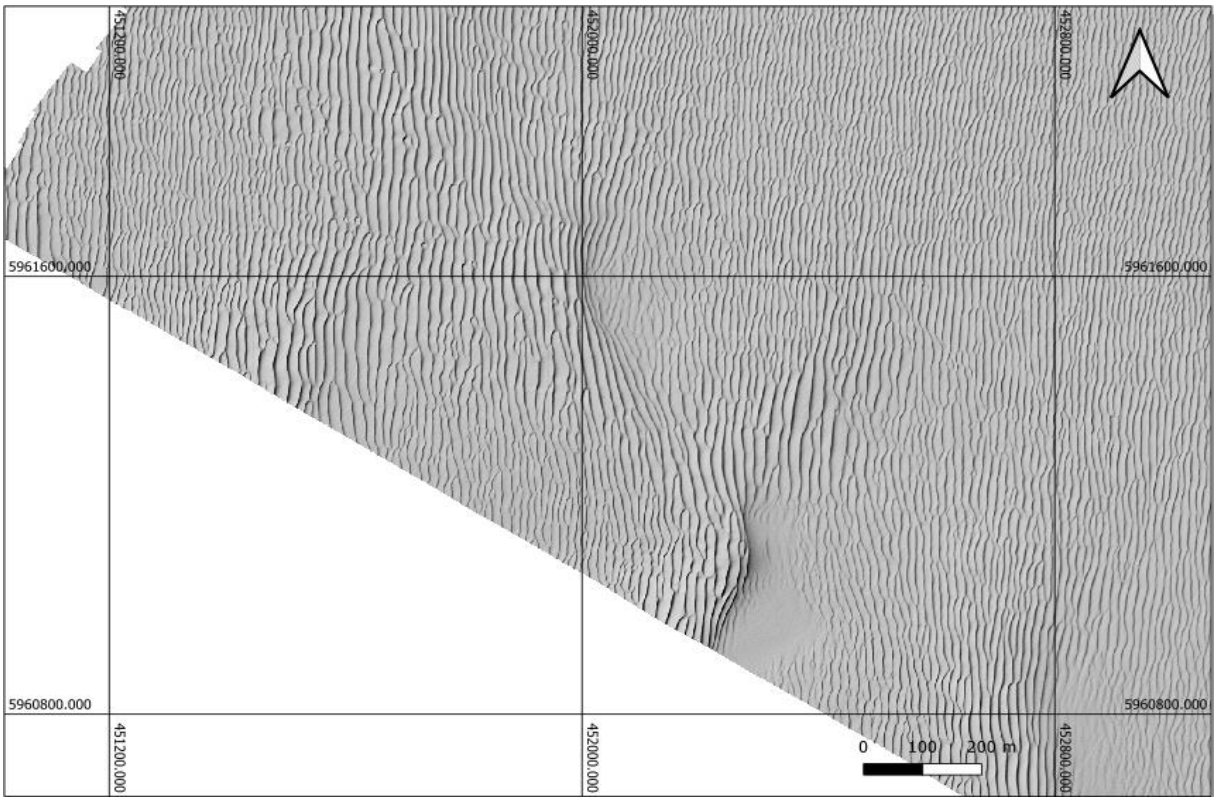


Figure 10 Sand Waves sample observed in the survey (MBES dataset).

Other observed features are current lineation (Figure 11). The current lineation become more common and pronounced in the eastern half of the survey area (NNE-ENE). Overall, the orientation of bedforms across the area is N-S, indicating bidirectional bottom current directions of E-W and W-E.

Figure 11 Current lineation sample observed in the survey area on (SSS dataset).

5.2.3| BOULDERS

Using SSS datasets, a small number of individual and isolated boulders were interpreted throughout the survey area (Figure 12). There are no trends within the boulder distribution across the site, but a slightly larger presence of targets can be found in the eastern parts of the survey area. No boulders fields were identified.

Based on the targets interpreted, the average boulder size is 1.1 m^3 and the maximum boulder size found was 16.6 m^3 (S_FR_B1_0059).

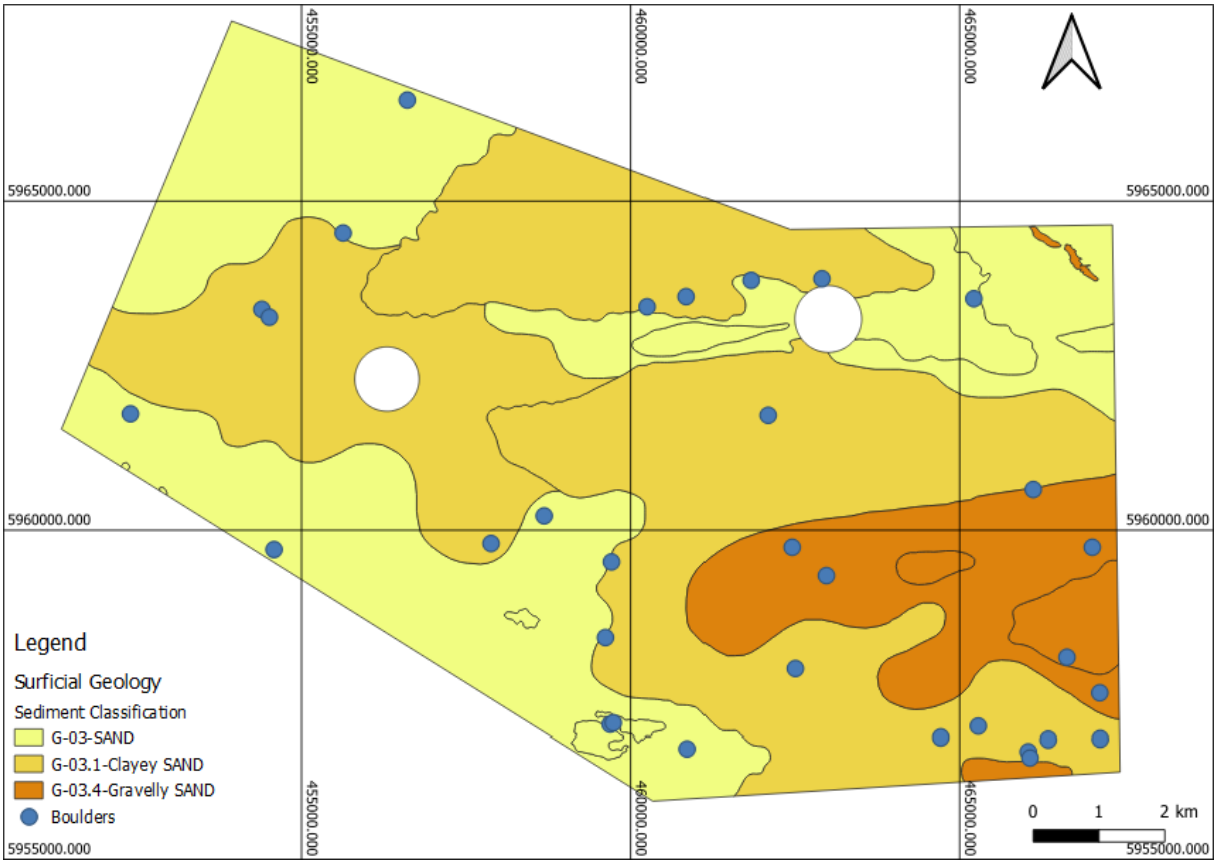


Figure 12 Distribution of individual boulders along the survey area.

5.2.4| TRAWL MARKS

Trawl marks are observed as linear and curvilinear seabed features, often as two parallel scars, throughout the survey area (Figure 13 and Figure 14). Trawl marks are evidence of historical bottom fishing activity. There is wide variety of orientations, and no consistent pattern of trawling locations have been observed. Trawl marks are mainly observed in the clayey SAND sediment type, where trawl mark areas have been identified, but also in the areas classified as SAND and gravelly SAND there is evidence of trawling activities.

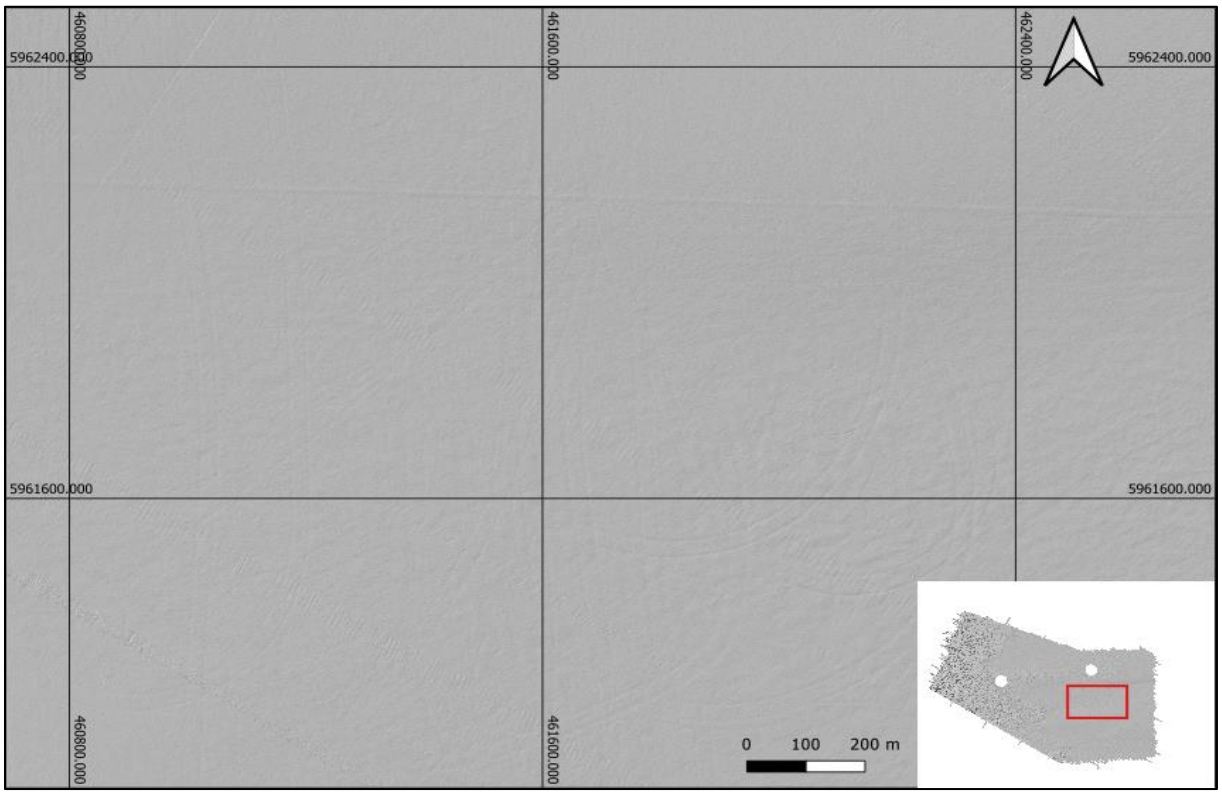


Figure 13 Trawl mark areas observed in the area.

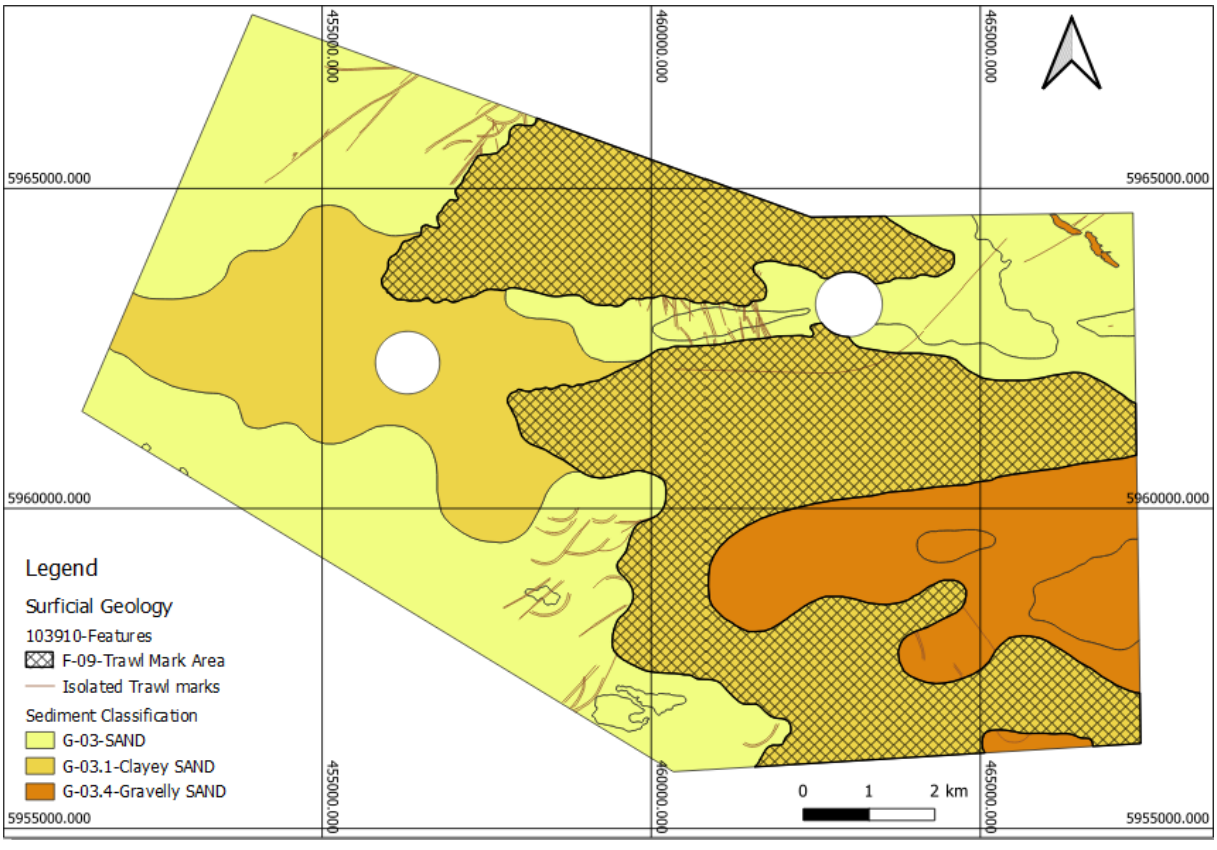


Figure 14 General distribution of trawl marks.

5.3| SHALLOW GEOLOGY

The Innomar data were reviewed and compared to the Sparker data, specifically for shallow geological information that could be seen in the Innomar data but not in Sparker dataset. Good vertical and horizontal correlation of reflectors between the Sparker data and the Innomar data were observed. The base of Unit1 was clearly interpreted on the Sparker data, but on the Innomar the boundary to the underlying sediment was not clear and the interpretation may not have been consistent across lines, for this reason all interpretation was performed on the Sparker data.

5.4| SEISMOSTRATIGRAPIC INTERPRETATION

5.4.1| REGIONAL STRATIGRAPHIC SETTING

The survey area is located in the eastern Irish sea (eastern platform), approximately 30km West of Blackpool. The Irish Sea separates Ireland and Great Britain with a maximum water depth of 175m however on the eastern platform, it is generally less than 50m deep.

The main phase of rifting, which created the basin, occurred during the Middle-Late Jurassic with a NE-SW orientation. During the Cretaceous – Ealy Tertiary the basin was subject to NW-SE compression resulting in arching along the basin centre. This compression event broadly coincided with a regional uplift of the area (Maingarm et al., 1999).

The eastern platform has a highly variable depth of sediment above the bedrock from greater than 50m BSB (below seabed), in some areas the bedrock outcropping at seabed (BGS, Liverpool Bay Seabed sediments and Quaternary geology, 1984).

The deposition and post depositional modifications of these Quaternary units are intimately linked with ice sheet retreat and advance. These Quaternary sediments and the underlying Triassic Bedrock are the units investigated in this survey report.

The British Isles have been repeatedly glaciated to various extents in the Quaternary (Graham et al., 2011) (Figure 15). In some locations, onshore and offshore, evidence for several glacial-interglacial cycles is preserved in the geologic record. However, oftentimes deposits predating the most recent glaciation, the Weichselian/Devensian, are absent (Gordon and Sutherland, 2012). The fact that northern Europe has been glaciated numerous times is not contentious, although the timing and extent of the ice sheet coverage is the subject of debate.

The most relevant glacial period to the interpretation reported on here is the Weichselian/Devensian. The melting of the Weichselian/Devensian ice sheet following the last glacial maximum was nonlinear; the general trend of retreat was interrupted by repeated advancements of the ice margin (Graham et al., 2011).

The Quaternary units within the survey area are expected to comprise Cardigan Bay Formation Till member, Western Irish Sea Formation A and/or B and surface sands Figure 16. Mapping of the individual unconsolidated Quaternary units was well delineated across the survey area. All four units display specific seismic character with a clear basal surface associated with it.

The Western Irish Sea Formation (WIS-A) contains Mud facies, Prograde facies and Chaotic facies (Jackson. D. 1995), while WIS-B contains an Upper Tabular Stratified member with the same three facies as WIS-A (Mellet 2015). Within this report upper units have been reported on as Unit one to Unit five.

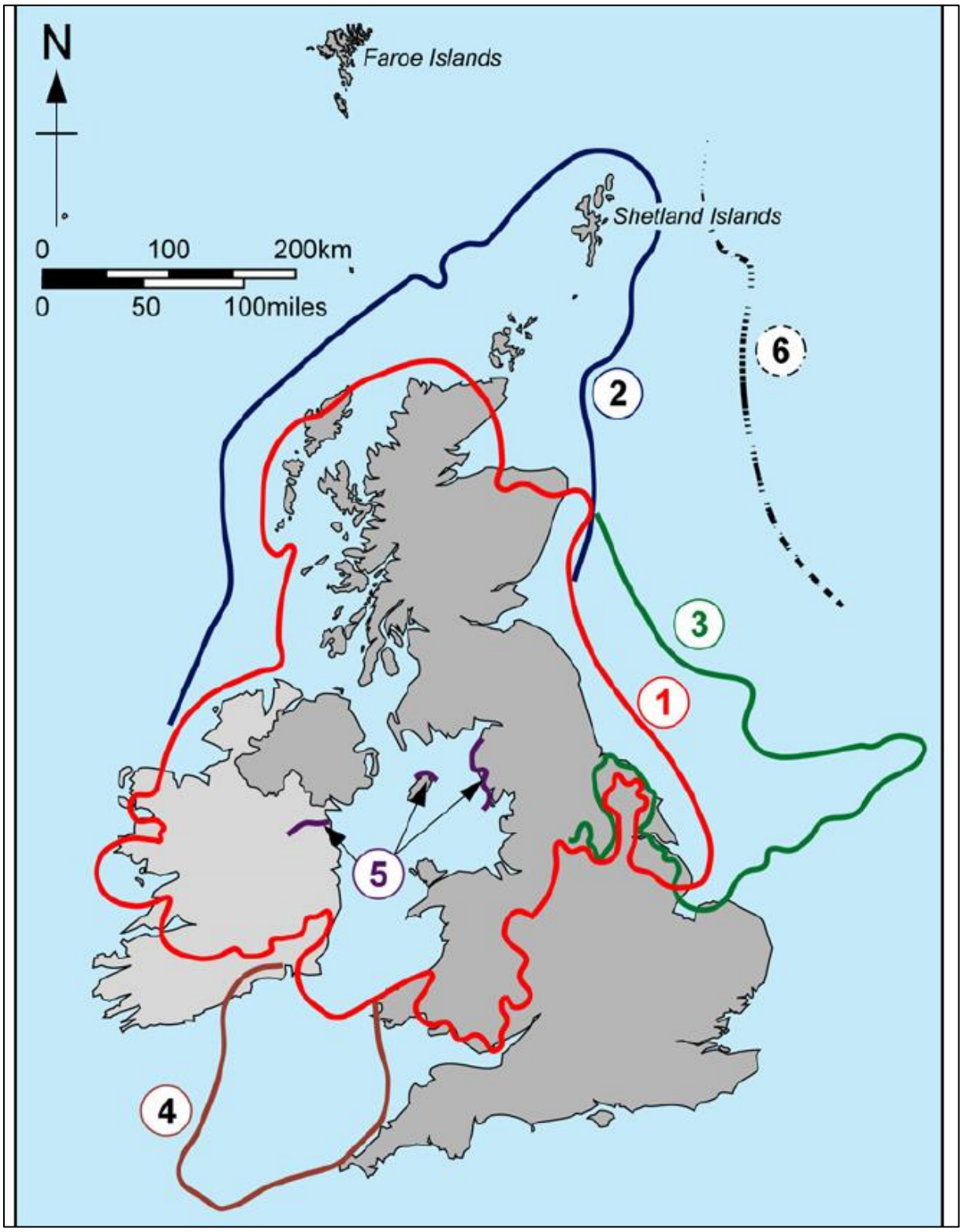


Figure 15 Map depicting estimated position of the ice margin at LGM.
From Boulton and Hagdorn, (2006) according to: 1- Bowen et al., 2002; 2- Hall, 1997; 3- Balson and Jeffrey, 1991; 4- Scourse and Furze, 2001; 5- Ireland – Synge, 1977; Isle of Man- Dackombe and Thomas, 1991; Cumbria- Huddart, 1991; 6- Hall, 1997 in Boulton and Hagdorn, (2006).

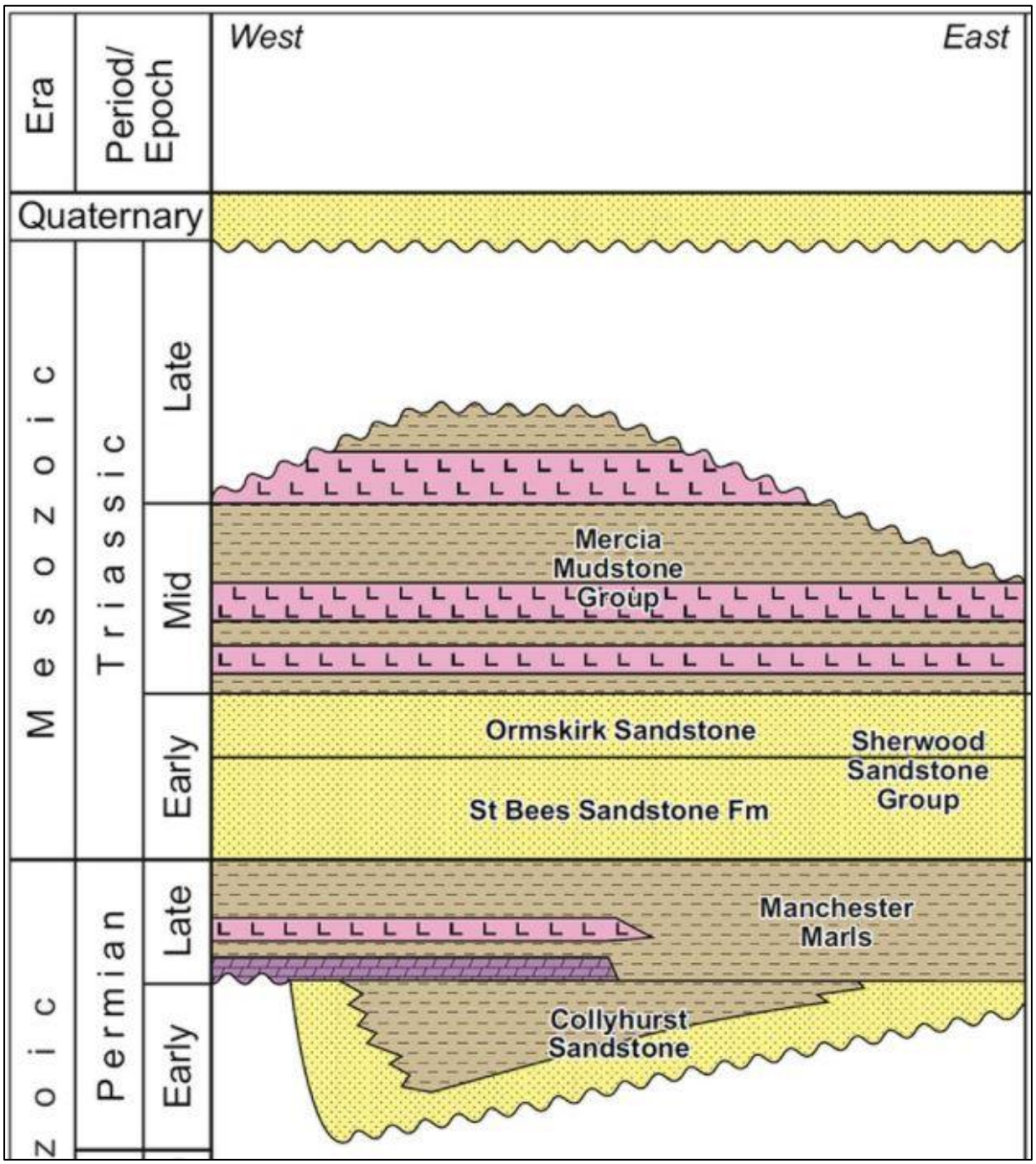


Figure 16 Regional geological framework and seismostratigraphy (Bunce. J. 2018).

The youngest deposits present in the area (i.e., Quaternary sediments in Fig 16) represents sedimentary processes occurring during the Holocene. This is interpreted as a thin veneer on top of older sediments becoming thicker in localized sectors of the area. Below this upper surface sand is another marine environment deposit (interpreted as Unit 1). This unit is underlain by Unit two or Unit three when Unit two is not present, which represent varying depositional environments.

Accurate delineation of the top of bedrock was generally achieved across the site. However, in some areas were not able to be picked due to the presence of the seabed multiple effecting data.

5.4.2| SUBSURFACE GEOLOGY - GEOMODEL

A series of four reflectors form the basis of the seismic interpretation addressed in this report. The seismic horizons were selected based on their geological significance and spatial continuity. The seismic units are described according to their seismic character and stratigraphic boundaries.

Five stratigraphic seismic units were derived from the digitised horizons with the inclusion of the base Seismic Unit (bedrock). The top of the Base Seismic Unit is delineated by the deepest horizon interpreted and extends to the end of the seismic record.

Geologic ages of the mapped units are interpreted to range from Triassic to recent sediments (Holocene). Interpreted seismic units were correlated with established lithostratigraphic formations as per the published literature and BGS.

An assumed acoustic velocity for the sediments within the site of 1600 m/s has been used for all units to the top of bedrock, which is acceptable for the interpreted geology present.

An interpreted seismic section with the project-wide labelling scheme is displayed in Figure 17. The same naming convention will be used for all seismic examples in this report. All seismic profiles presented in this report are in the time domain, numbers on the vertical axis refer to two-way-travel time (seconds). The colour bar for the seismic display is the same for all profiles (Landmark in Kingdom Suite). The colours on the basemaps refer to the depth of the relevant horizon. The colour bar for basemaps are 3D effects in Kingdom Suite, warm colours refer to shallow depths, cold colours refer to greater depths.

Table 13 Subsurface Geology - Units/Horizons.

Unit	Base	Interpreted Sediment
1	H17	Marine silty SAND
2	H40	SAND
3	H45	Silty SAND
4	H50	TILL
5	NA	Triassic Bedrock comprised of mudstone and halite

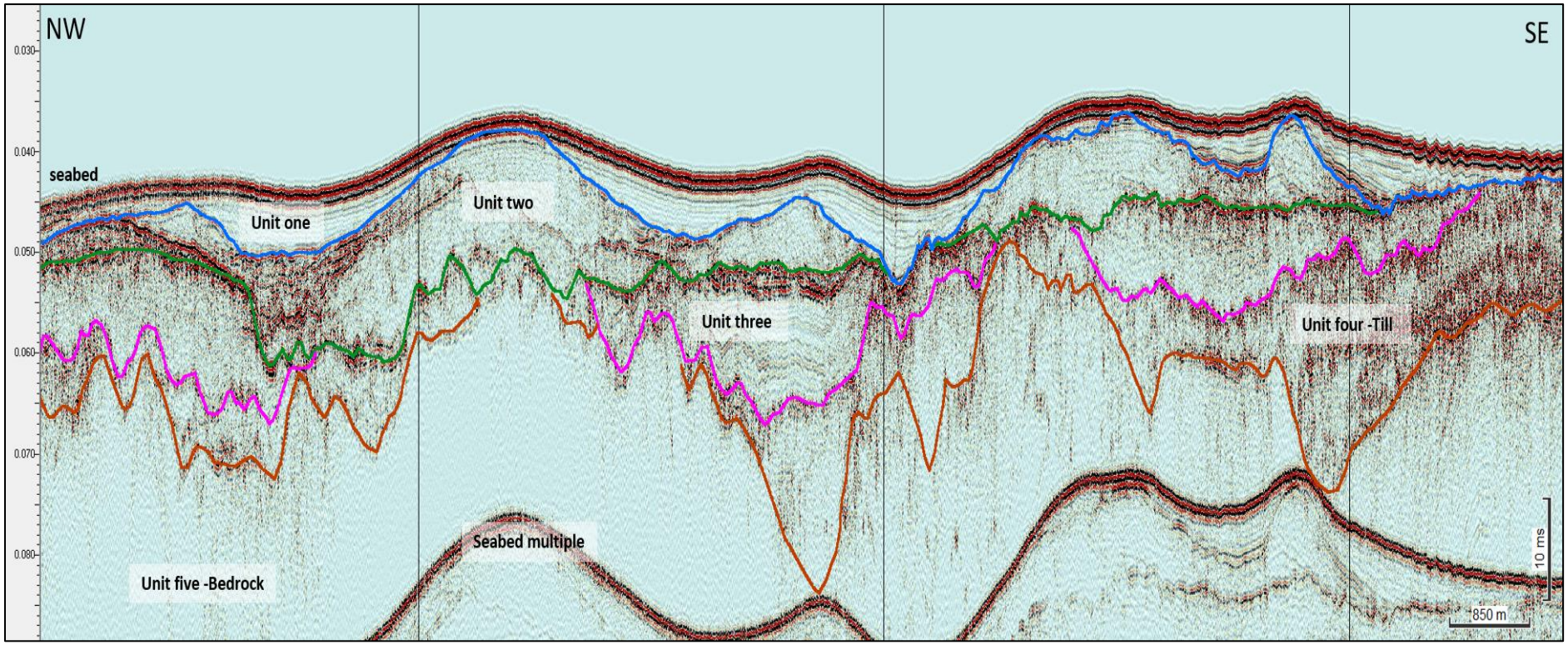


Figure 17 Seismic profile Line 4225 (individual files merged) with geological interpretation, labelling and colour scheme.

5.4.3| UNIT ONE

A continuous layer of “recent” sediments was interpreted across the site. This is interpreted to consist of marine silty sands. At the top of this unit, directly below seabed, is a veneer of unconsolidated and mobile sands, indicated by ripples and bedforms being present at seabed. This sand veneer is generally 1 m in thickness but up to 6 m thickness below sand waves found in the south-west of the site (Figure 19).

The base of Unit one (represented with H17 horizon) is found to be sub cropping (less than 1m) extending to a maximum of 10 m below the seabed (Figure 18).

The seismic character of this unit is typically represented by acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy, compared to that of more chaotic character below (Figure 20). The upper mobile surface sand is only imaged when sand waves are present and displays a transparent seismic character (Figure 20).

This unit is interpreted to be a mud facies of the Western Irish Sea Formation A with a veneer of surficial sands. This unit is deposited after the Holocene transgression, which occurred after the Devensian ice age, in a marine environment.

Subaqueous bedforms are observed in the seismic data profiles (Figure 19) which gives a sense of their possible vertical scale. The timing and degree to which these features may be mobile cannot be determined from the seismic data alone.

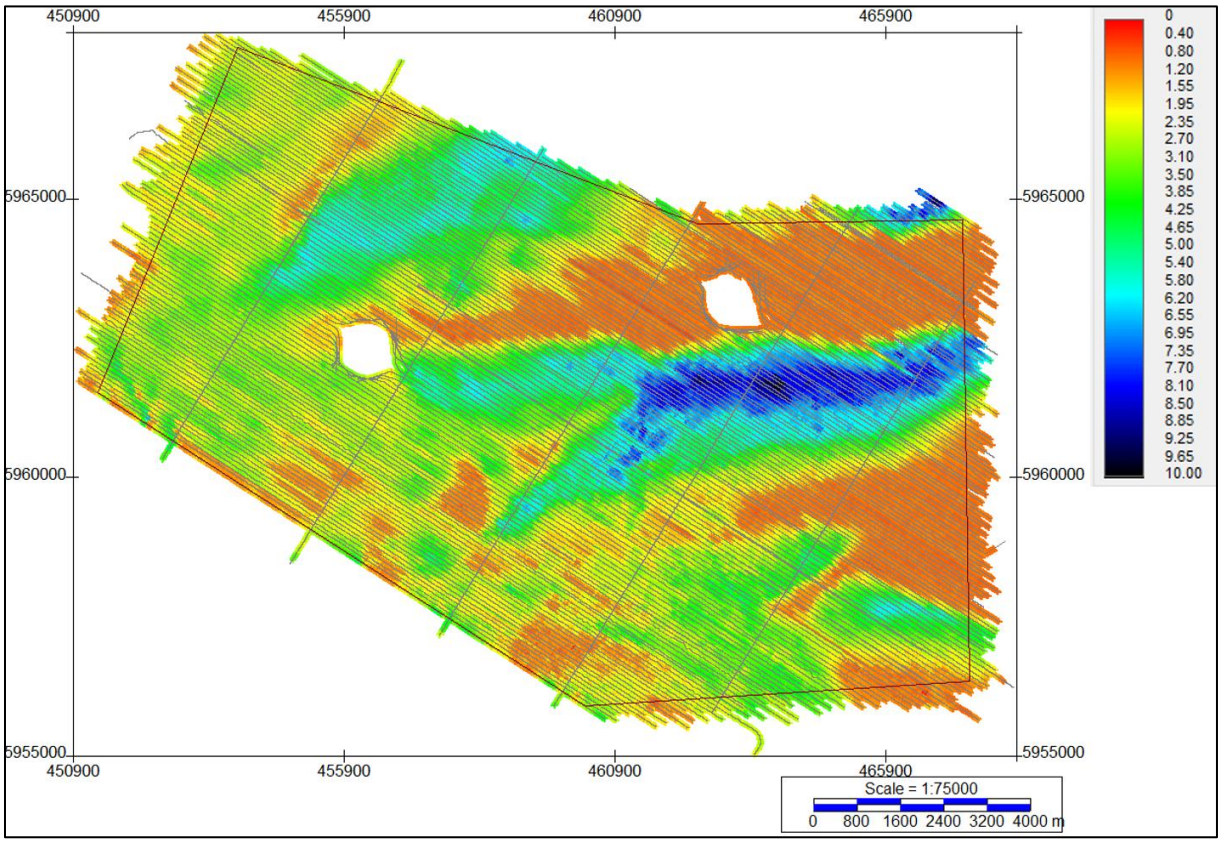


Figure 18 Depth below seabed to the base of the mud facies (Unit one).

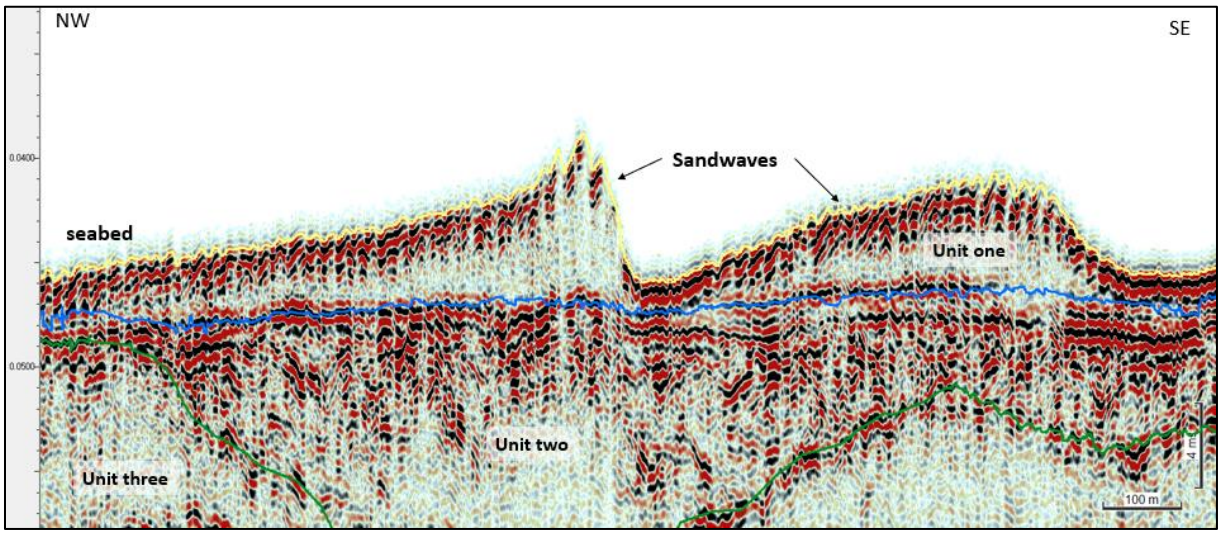


Figure 19 Unit one makes the base of subaqueous bedforms (Line 75.103). Horizons: Yellow is Seabed, Blue is H17, Green is H40.

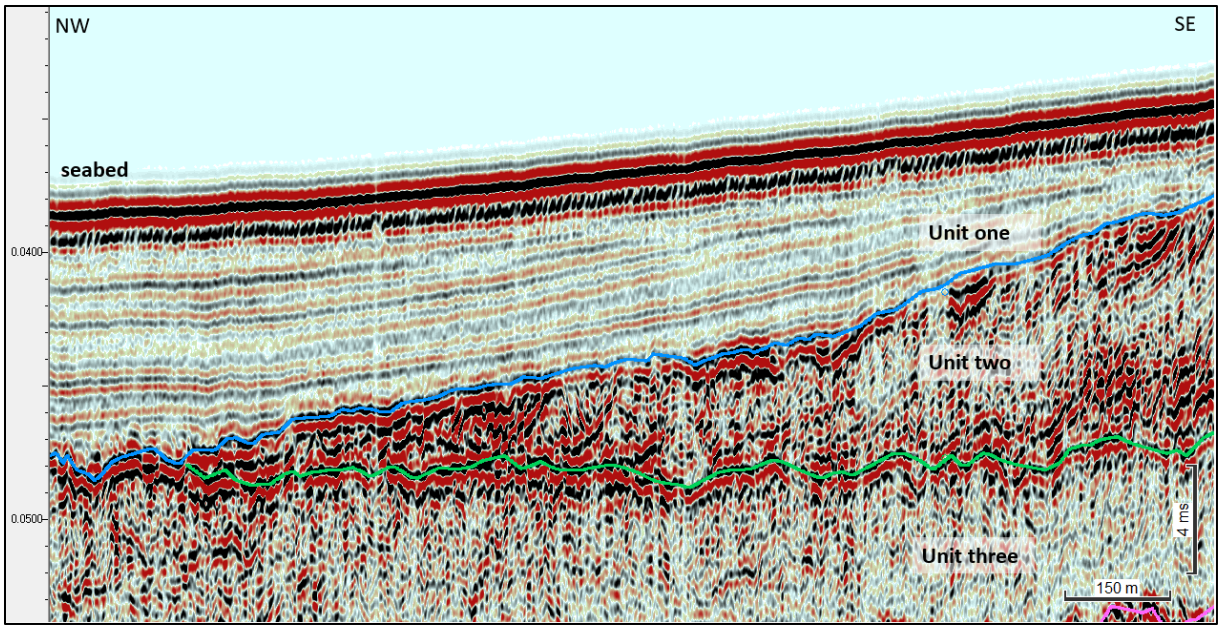


Figure 20 Unit one with typical well bedded character displaying onlap and low seismic amplitude (Line 7050.21). Horizons: Blue is H17, Green is H40.

5.4.4| UNIT TWO

Below the most recent marine deposit across the site is interpreted to be a unit consisting of higher sand content, however there are some areas where this unit is not present. The higher proportion of sand is expected due to the difference in penetration within Innomar data when crossing from a thick recent deposit to a thin recent deposit and thicker Unit two and the lack of finer bedding.

The base of Unit two (represented with H40 horizon) is found between 1m and 23 m below the seabed (Figure 21).

This unit displays variable seismic character, in some areas it displays prograding clinoforms (Figure 22) and possibly offlap, and a chaotic seismic character in other areas. The variability of seismic

character may in be part due to the direction of acquisition imaging the subsurface. This unit is interpreted to be a prograded facies of the Western Irish Sea Formation A. The prograding facies are interpreted as representing a prodeltaic and glaciomarine setting, marking transition from ice-proximal to fully marine with the onset of the Holocene transgression (Jackson et al. 1995).

However, this organised stratigraphy is observed to be deformed by glaciotectonism. Internal deformation is variable and ranges from mild contortion of internal bedding to full destruction of the original depositional architecture (Figure 23).

This unit displays a continuous high amplitude basal reflector (Figure 24). When this unit is not present this high amplitude base is the base of the mud facies unit which overlies this unit. The basal geometry is generally flat in the central and eastern areas of the site, however in the west, channels are interpreted.

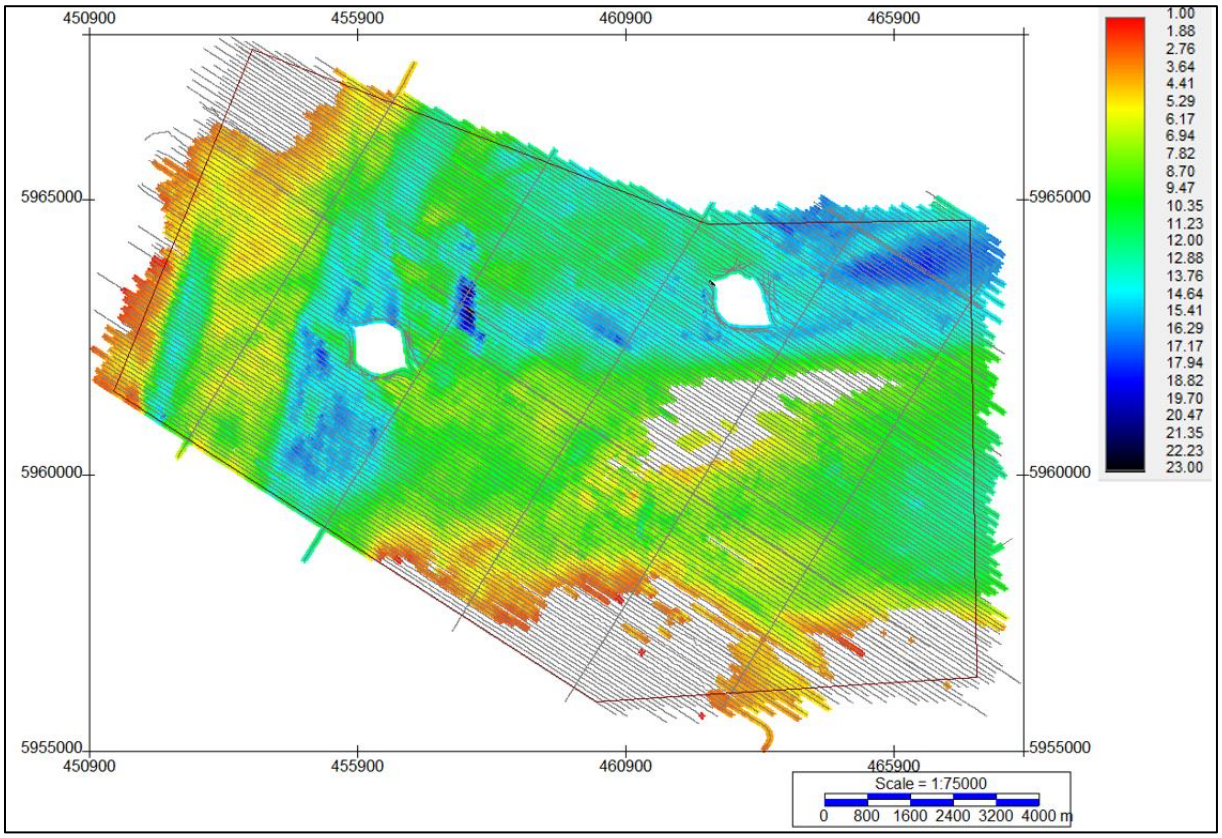


Figure 21 Depth below seabed to the base of prograding facies (Unit two).

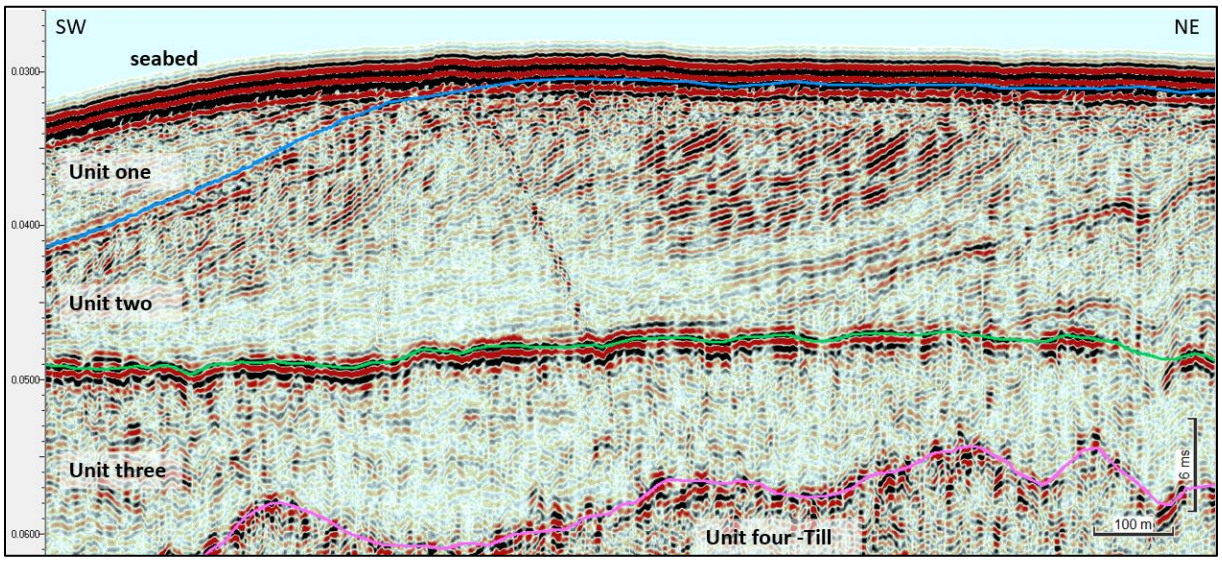


Figure 22 Clinoform sequence, found at the north-east of the survey area within Unit two (Line X 12500). Horizons: Blue is H17, Green is H40, Pink is H45.

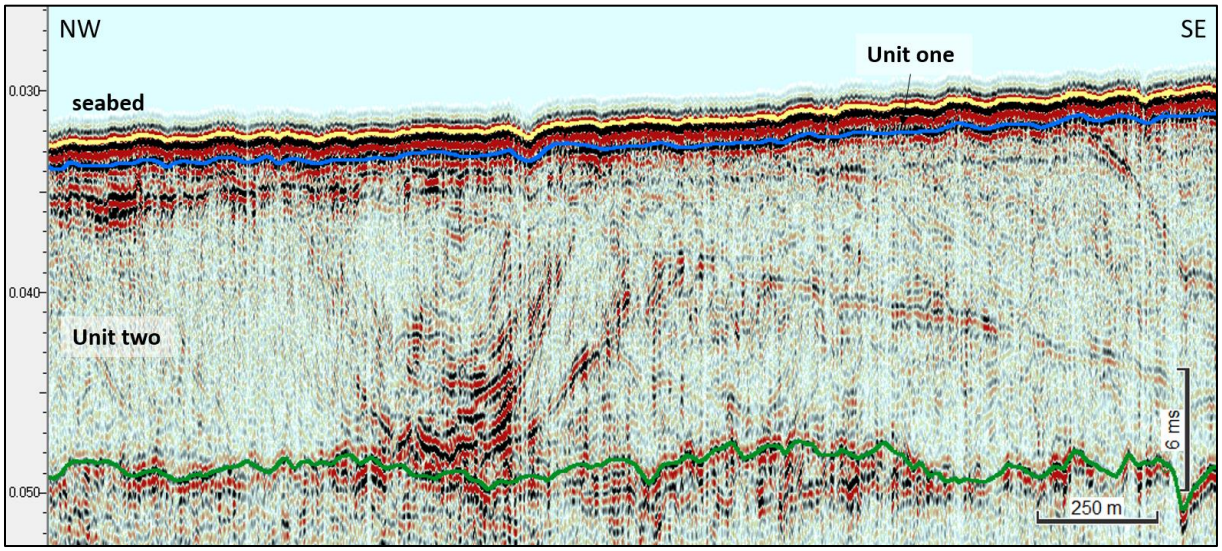


Figure 23 Deformed stratigraphy of Unit two by glaciotectonism (Line 8700.027). Horizons: Yellow is Seabed, Blue is H17, Green is H40.

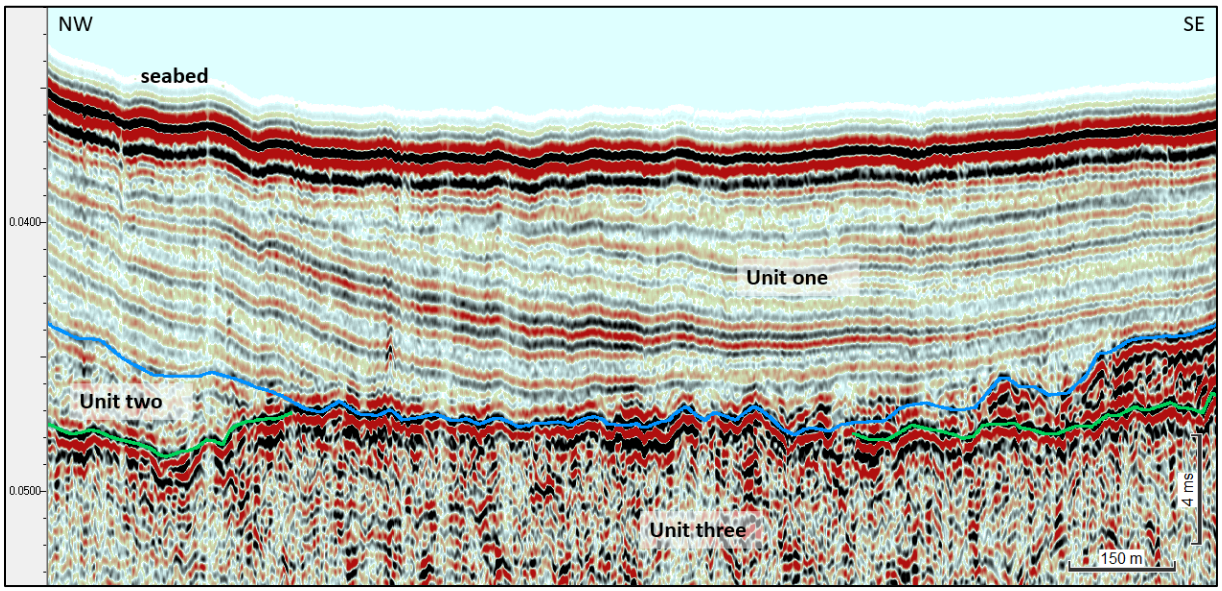


Figure 24 Basal reflector of Unit two and Unit one (Line 7275.26). Horizons: Blue is H17, Green is H40.

5.4.5| UNIT THREE

Unit three is overlain by Unit two, or Unit one when two is absent. This unit is interpreted to comprise of silty sand. This unit is present across the majority of the site, with an area within the central site where it has been interpreted to be absent, along with other small areas across the site. This unit overlies till, when that unit is present, but also directly overlies the basement rock in some areas of the site.

There are NNW-SSE trending “channels” present in the west of the site, the undulating nature of the base of this unit could be due to the underlying tills top geometry being affected by icebergs grounding.

The base of unit three (represented with H45 horizon) is found between 1 m and 29 m below the seabed (Figure 25). In the central North of the site, this unit is the thickest and deepest.

The well bedded seismic character exhibited is conformable to its basal geometry (Figure 26). Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. The seismic character of this unit is relatively consistent, and the pick was unambiguous with the base being clear and continuous.

This unit is interpreted to be a mud facies of the Upper Tabular stratified member of the Western Irish Sea Formation B and as such this Unit three is interpreted to be of a similar lithology to that of Unit one. However, it could be a mud facies of the Western Irish Sea Formation A; which has been observed at different depths in seismic sections; from available literature (Jackson et al. 1995). Both interpretations have the same lithology, but of differing ages.

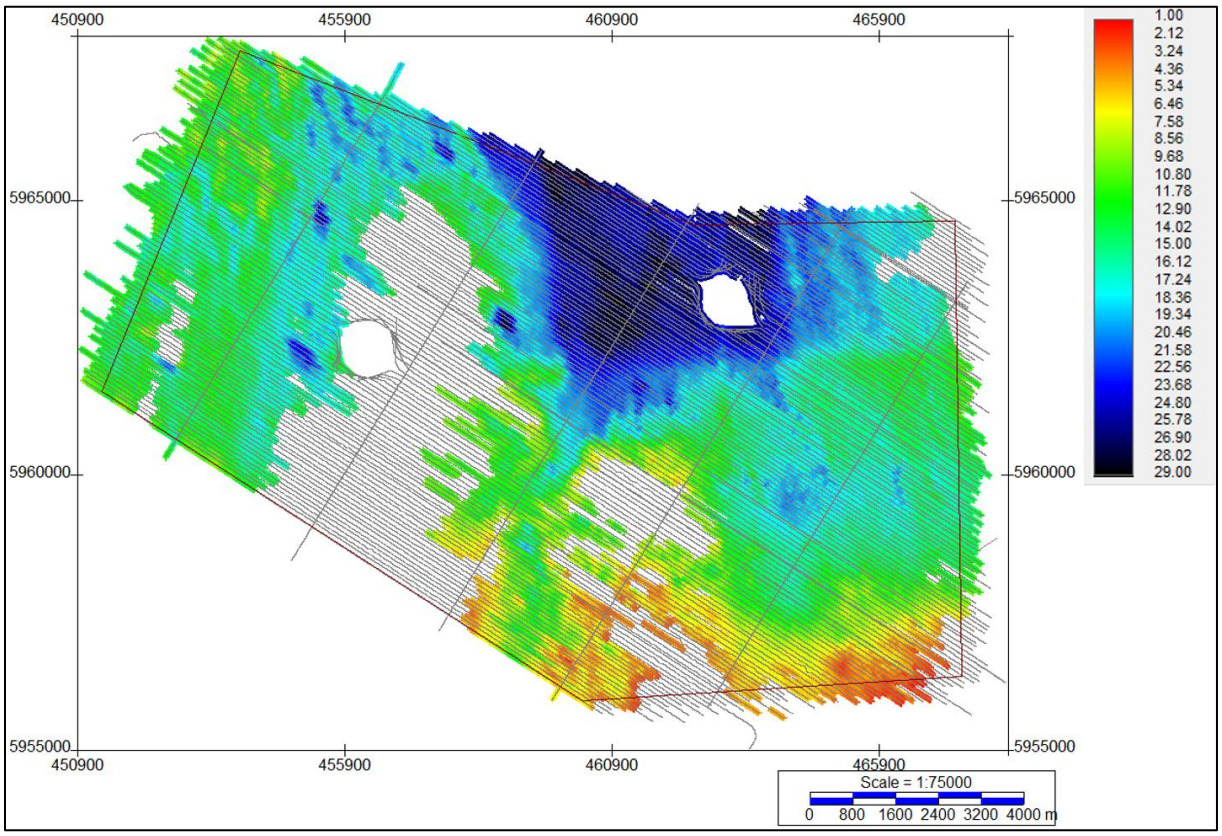


Figure 25 Depth below seabed to the base of the mud facies (Unit three).

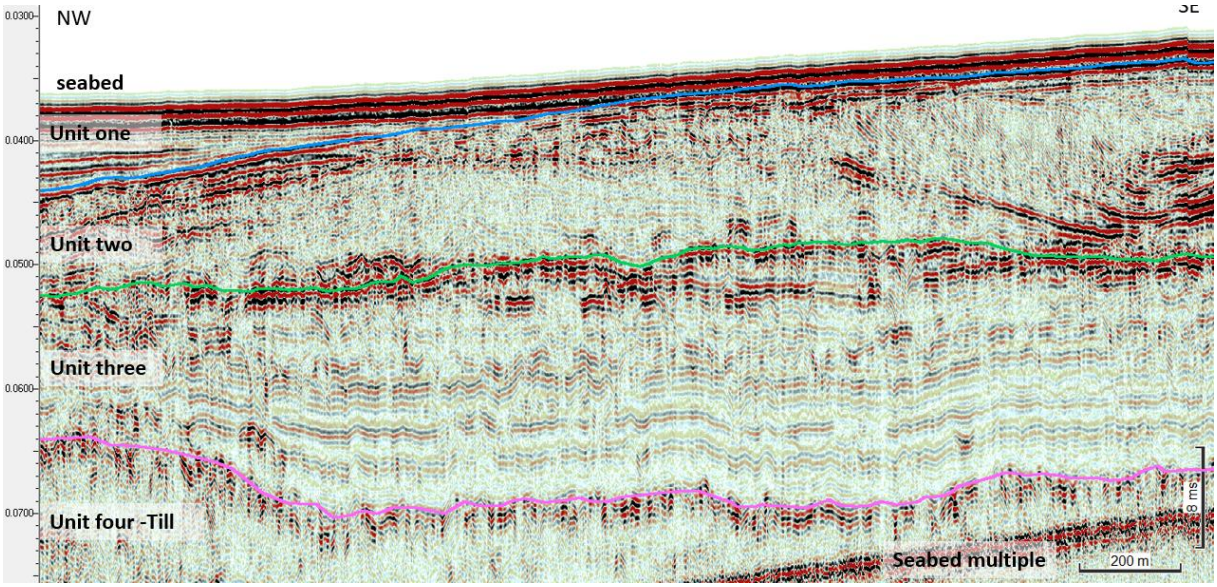


Figure 26 Well layered seismic character of Unit three (Line 6825.032). Horizons: Blue is H17, Green is H40, Pink is H45.

5.4.6| UNIT FOUR - TILL

This unit has been interpreted below Unit three, Unit two or Unit one, when three or two are absent. It is a seismically chaotic unit which is discontinuous across the site and of varying thickness. This unit is interpreted to comprise of TILL. This unit was deposited in relation to the Devensian ice age which effected the Irish sea. This unit is expected to comprise of stiff or hard clay with clasts of sand (Coughlan. 2019) and diamict.

The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. The base of this unit (represented with H50 horizon) is the top of bedrock, generally seen by an angular unconformity.

The TILL unit occurs across nearly the entire site. The base of the TILL member is found between 3 m and 43 m below the seabed (Figure 27). A limitation of acquisition is that in some areas, specifically central north of the site, the base of this unit could not be picked due to the presence of the seabed multiple effecting the data. It is complicated to predict the behaviour of the surface represented by the base of Unit four (H50) in the areas limited by a multiple, but since the Unit three deepest recorded depth is precisely in the central north part of the area, it could be expected that the deepest location of Unit four is also in this area, with depths that could even exceed the reported 43 m.

This unit is interpreted to be a TILL member of the Cardigan Bay Formation. The internal seismic character of the TILL unit is complex (

Figure 28), with often chaotic character, higher amplitude and discontinuous reflectors being observed.

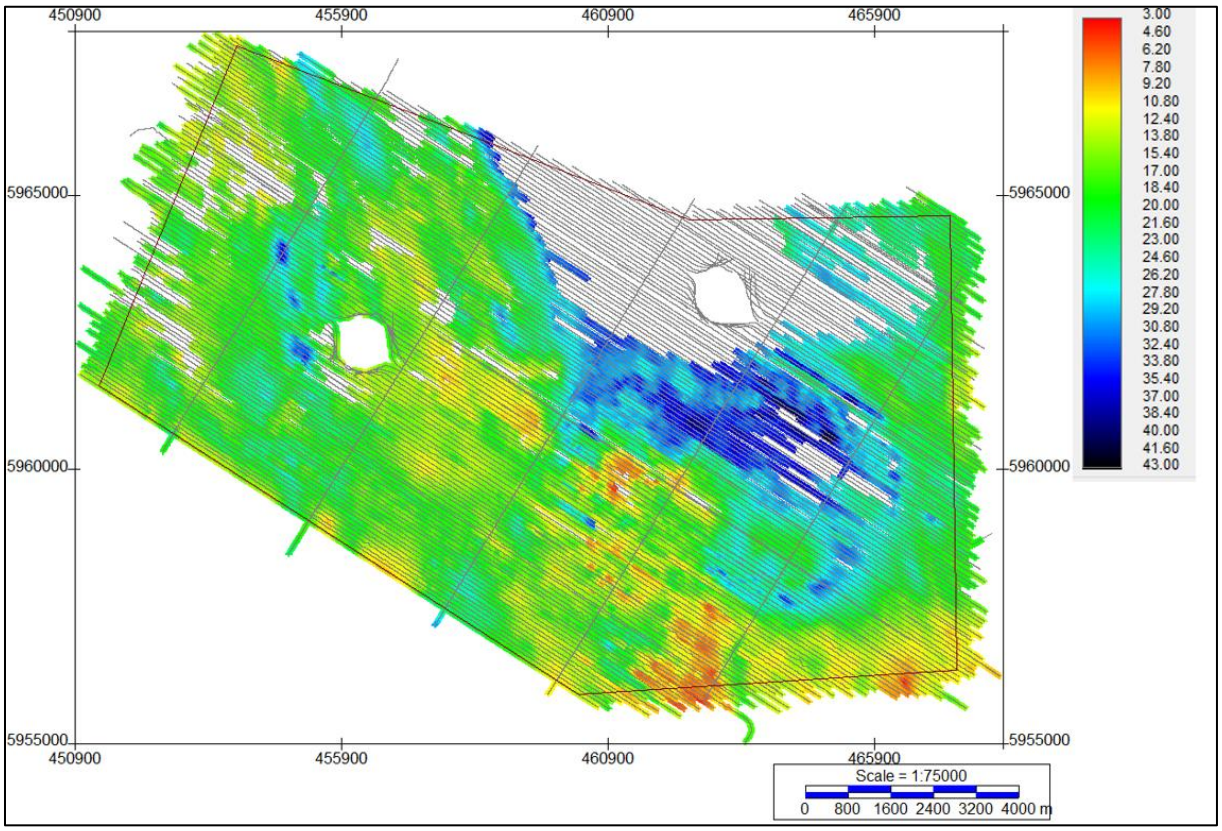


Figure 27 Depth below seabed to the base of the Till (Unit four).

Unit four is sub cropping in isolated areas, specially at the south-east corner, with its closest point to the seabed at approximate 3.5 m BSB (461957.7 E 5956230.4 N) with top defined by H17 (base of Unit one) and slightly by H40 (base of Unit two) and in centre of the area, with the closest point to seabed at approximate 4.5 m BSB (460998.0 E 5959686.2 N) with top defined by H40 (base of Unit two). Figure 29 to Figure 31 present an overview of Unit four from three lines in the south-east corner of the area.

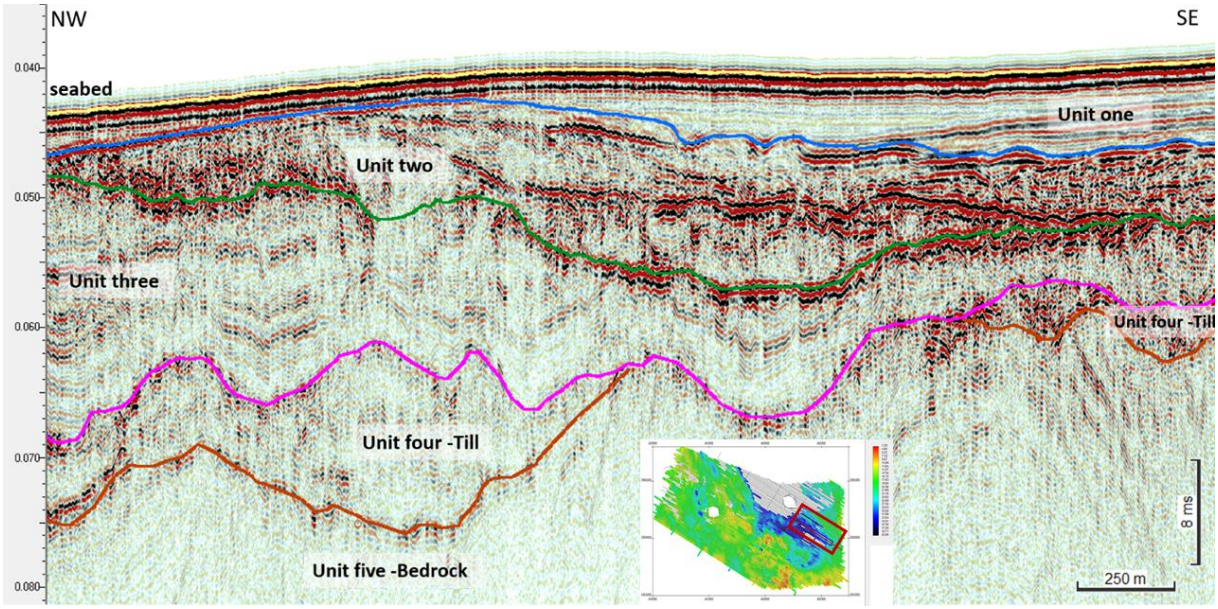


Figure 28 Chaotic acoustic stratigraphy of the Till unit (Line 6525.017). Horizons: Blue is H17, Green is H40, Pink is H45, Brown is H50.

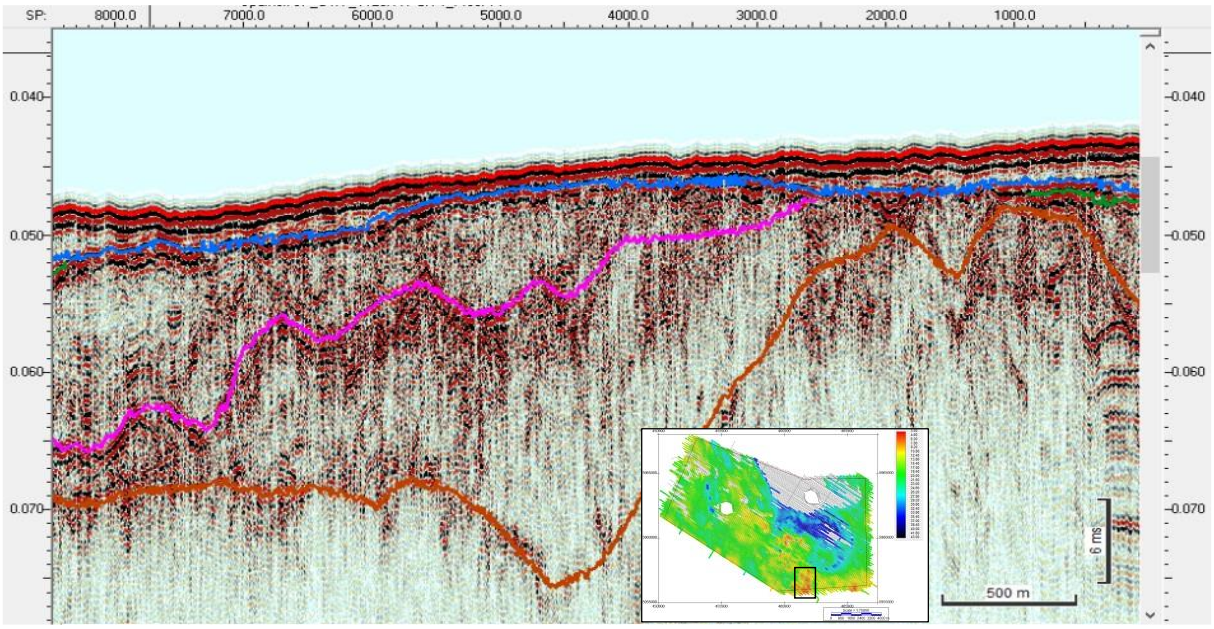


Figure 29 Unit four sub cropping in south-east corner (Line 1125.117). Horizons: Blue is H17, Green is H40, Pink is H45, Brown is H50.

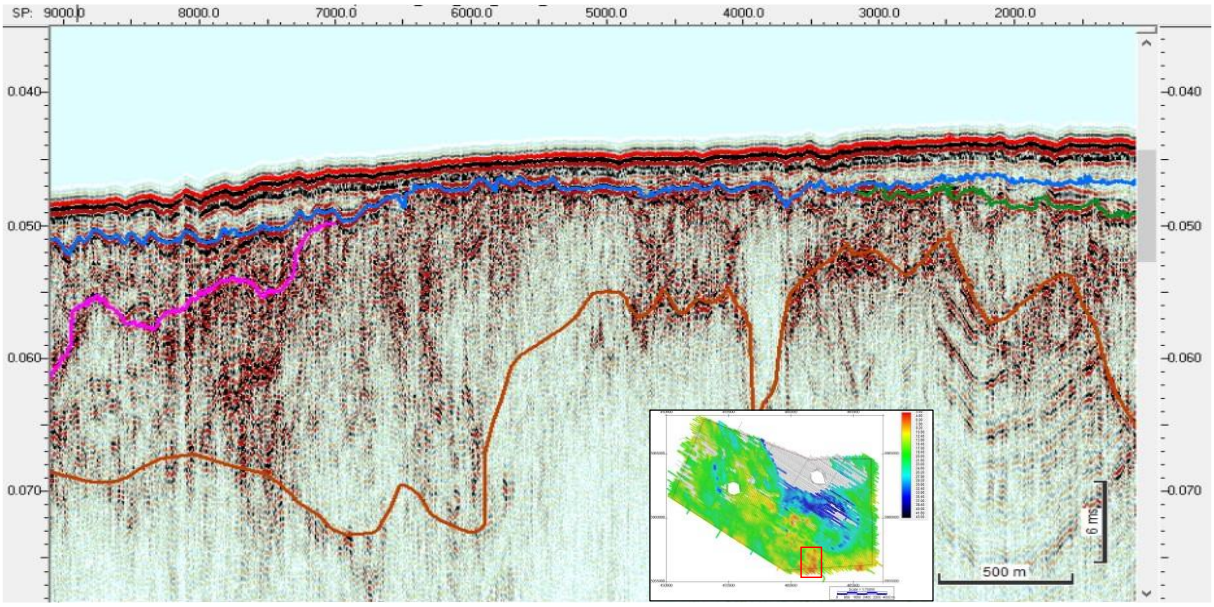


Figure 30 Unit four sub cropping in south-east corner (Line 1275_b). Horizons: Blue is H17, Green is H40, Pink is H45, Brown is H50.

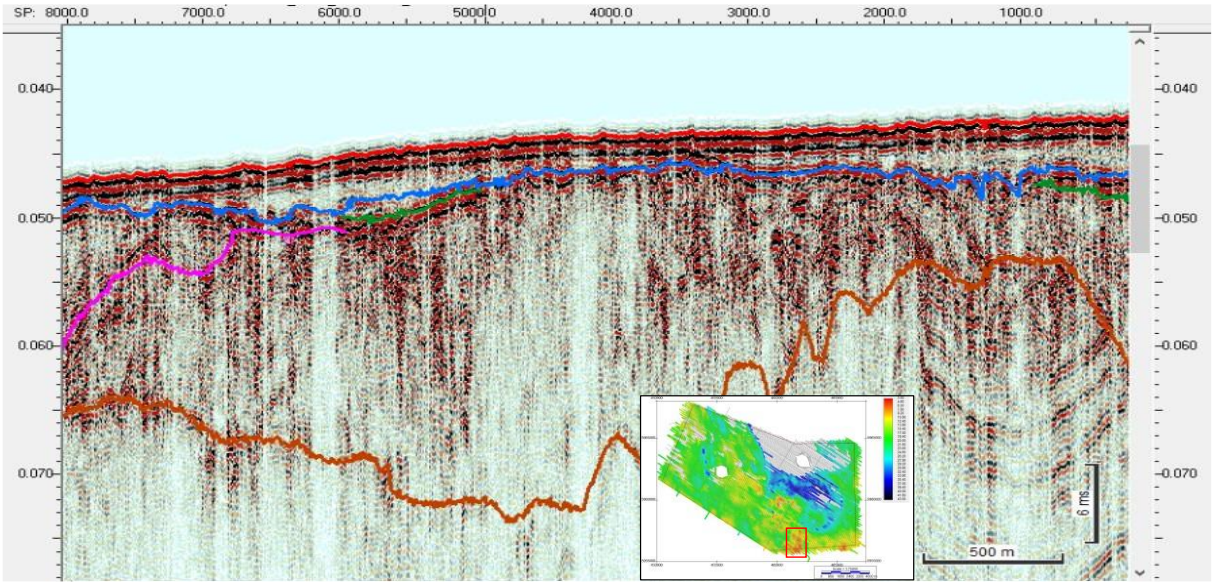


Figure 31 Unit four sub cropping in south-east corner (Line 1475). Horizons: Blue is H17, Green is H40, Pink is H45, Brown is H50.

5.4.7| UNIT FIVE - BEDROCK

The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group. The base of this unit (Triassic Bedrock) was not mapped as it extends beyond the end of the seismic record and thus its total thickness is unknown. The top of the bedrock, comprised by the base of Unit Four (represented by H50) in conjunction with the base of Unit Three (represented by H45) when H50 is absent, varies from 3 m to 43 m below the seabed (Figure 32). However, the depth of the top of this unit is not known for the entire site due to the seabed multiples strongly effecting some areas making the pick uncertain. The bedrock surface is clearly erosional and is represented by an angular unconformity across much of the site (Figure 33). The geometry of the top

of Triassic bedrock is variable across the site with one area it being considerably deeper below seabed than surrounding areas.

Quaternary sediments rest unconformably on the Triassic Bedrock making this surface the base of Quaternary deposition.

The seismic character of the Triassic Bedrock generally displays steeply dipping reflectors and also chaotic character, this changes across the site and is not proposed to be of any specific internal geological change of the unit.

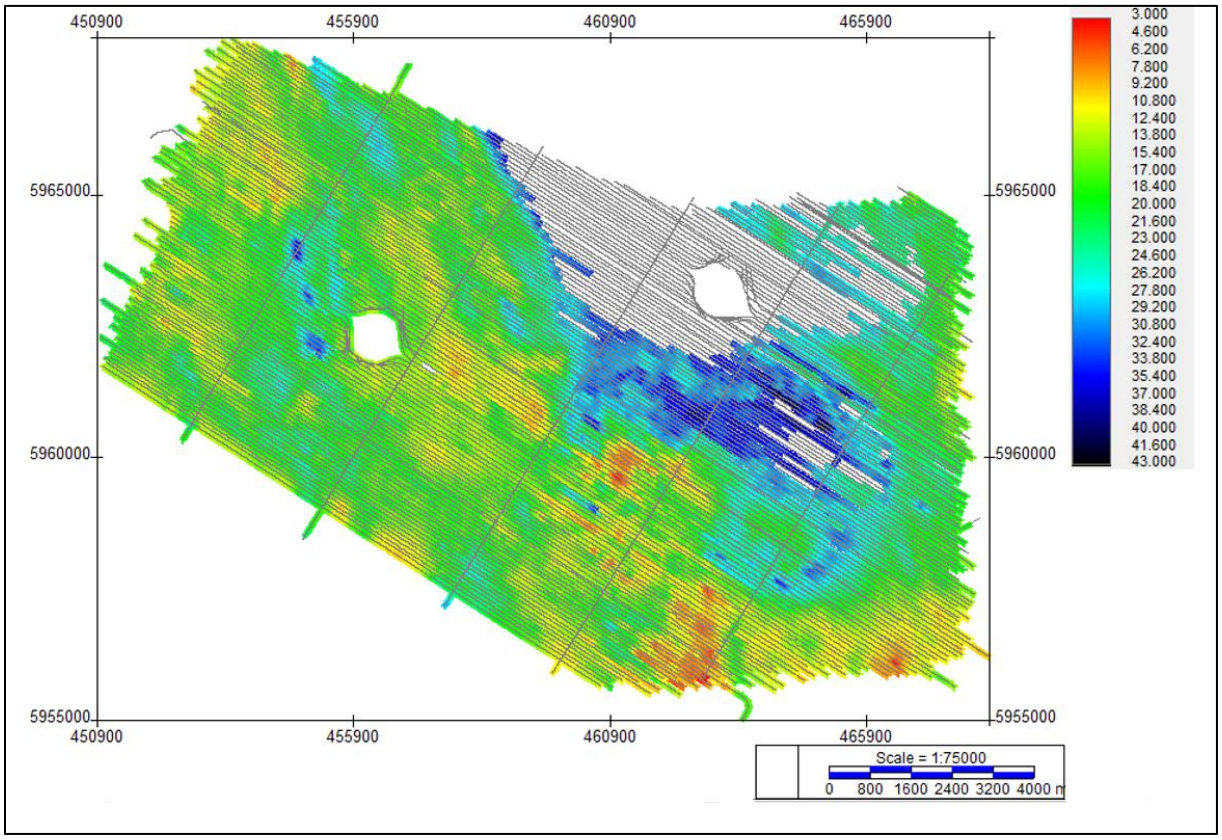


Figure 32 Depth below seabed of the top of the Triassic Bedrock.

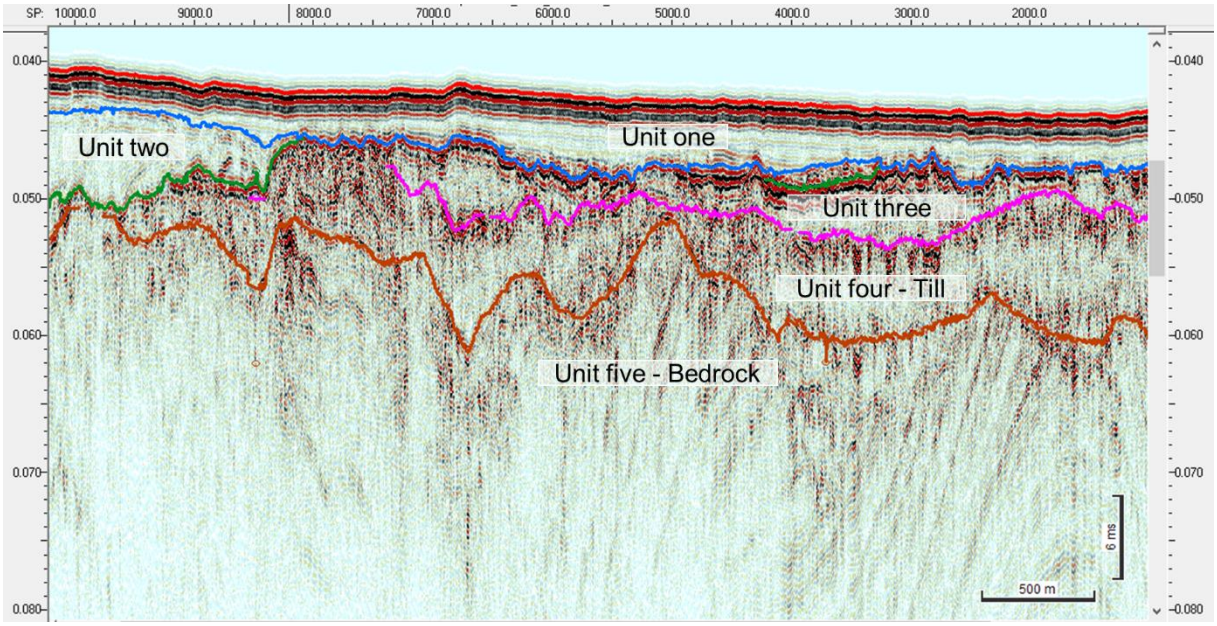


Figure 33 Bedrock surface is represented by an (angular) unconformity across much of the survey area (Line 2525). Horizons: Blue is H17, Green is H40, Pink is H45, Brown is H50.

5.4.8| SUMMARY AND DISCUSSION

The site is located in a complex geologic setting. The Irish Sea experienced many periods of glaciation during the Pleistocene. The Quaternary sediments are the product of glacial and post glacial depositional processes, and some units are glaciotectonised. The geological framework which is set out in this report aims to map the important units.

Along some portions of the shelf, only the deposits related to the last glaciation are preserved. Previous deposits, early to middle Pleistocene, have been removed or reworked into recent glacial formations. The net effect of glacial cycles, glaciotectonics and the limited accommodation space afforded by the continental shelf has resulted in a fragmented, laterally discontinuous sediment record.

A maximum effort was made to delineate the boundaries which displayed clear changes in seismic character and thus expected lithological change. Mapping of the underlying Triassic Bedrock was straightforward as it represented a major seismic character change with the overlying Quaternary units.

All horizons had clear surfaces to digitize, with top and base being unambiguous reflectors and/or changes in seismic character. The base of till was sometimes not picked due to the presence of the seabed multiple which affected the data below.

The entire site is underlain by a thick succession of Triassic rock, the base which is deeper than the data's extent, comprising mudstones and halite. This unit comprises the bedrock in the survey area. The bedrock surface is undulating likely caused by glacial processes creating erosive channels.

The till unit is comprised of stiff or hard clay with clasts of sand and diamict. The till unit overlies the Triassic Bedrock. This unit is not present completely across the survey area and varies greatly in thickness. The seismic character being chaotic is in agreement with its glacial depositional origin and unsorted constituents.

Unit three comprises of silty sand being from glaciomarine to marine depositional setting. The seismic character displays well bedded and medium amplitude reflectors which agree with the interpretation of its lithology and depositional environment. Across the site the seismic character does change to a more chaotic appearance but is expected to be the same facies. This unit is not present completely across

the survey area and varies greatly in thickness. There is an area in the central north of the site where this unit exhibits greater thickness than the rest of the site.

Unit two comprises of sand being from a deltaic to glaciomarine depositional setting. The seismic character displays prograding clinoforms and also some glaciotectonic deformation, is observed within these sequences. Across the site the seismic character does change to a more chaotic appearance but is expected to be the same facies. This unit is not present completely across the survey area and varies greatly in thickness. In the East its base is generally horizontal, however in the West it is expressed as channels.

Unit one comprises of silty sand from glaciomarine to marine depositional setting, this being the most recent sedimentary deposit. The seismic character displays well bedded, parallel and medium amplitude reflectors which exhibit onlap to the underlying unit. Directly below the seabed there is expected to be a thin veneer of surface sand across the site, however where sand waves, in the south-west, are present the thickness increases.

5.5| SUMMARY CONTACTS AND ANOMALIES

A total of 79 SSS contacts were identified on the survey data. The SSS contacts are summarised in Table 14.

A total of 276 magnetic anomalies were detected in the survey data. Most of the anomalies are associated with subsea structures (Cable/Pipeline, wellheads, etc). No MAG anomaly correlates with an observed SSS targets. The magnetic anomalies are summarised in Table 15.

Full details of all contacts and anomalies are presented in Appendix B| and Appendix C|. An overview distribution of the SSS contacts and MAG anomalies is presented in Figure 34.

Table 14 Summary of SSS contacts.

CLASSIFICATION	NUMBER
Boulder	32
Debris	47
Wrecks	0
Total	**79**

Table 15 Summary of MAG anomalies.

CLASSIFICATION	NUMBER
Cable / Pipeline	211
Wellhead	10
Other unknown	55
Total	**276**

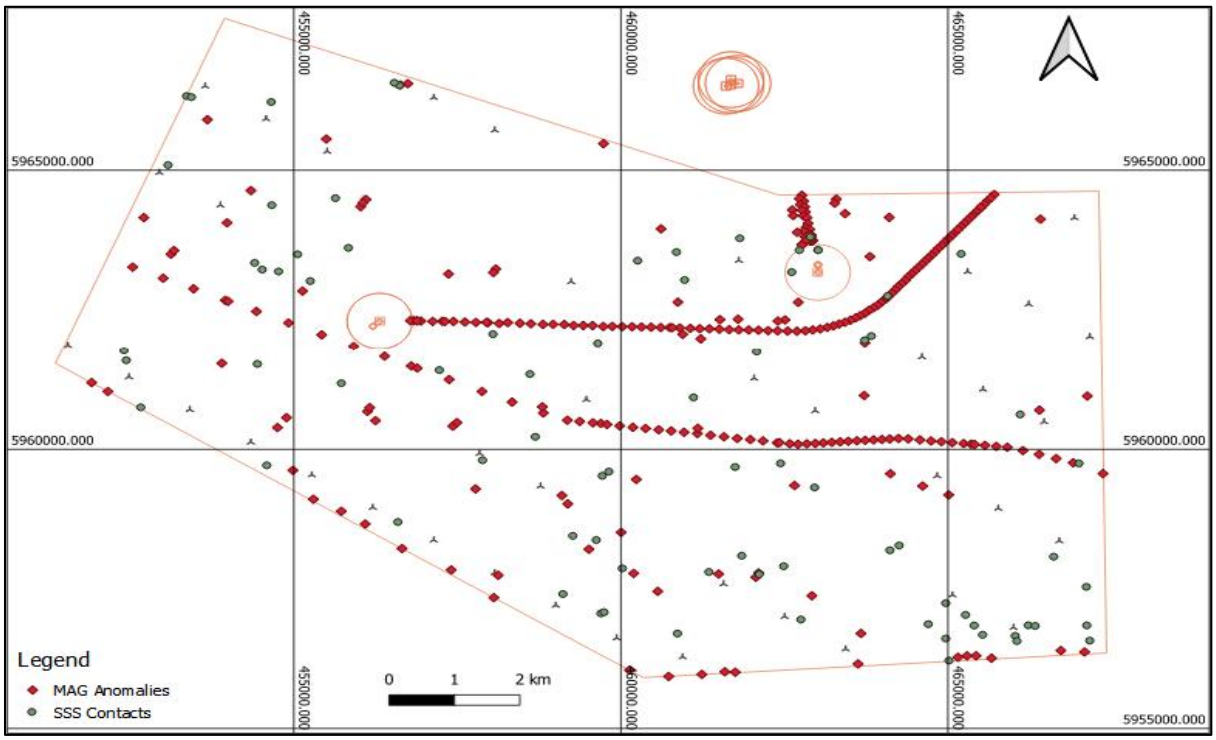


Figure 34 Distribution of SSS Contacts and MAG anomalies across the survey area.

5.5.1| WRECKS

Although background data suggested the presence of two wrecks within the survey area (Figure 35 to Figure 39), there is no evidence of these wrecks. No other wrecks or wreck like-shape feature were found during the survey.

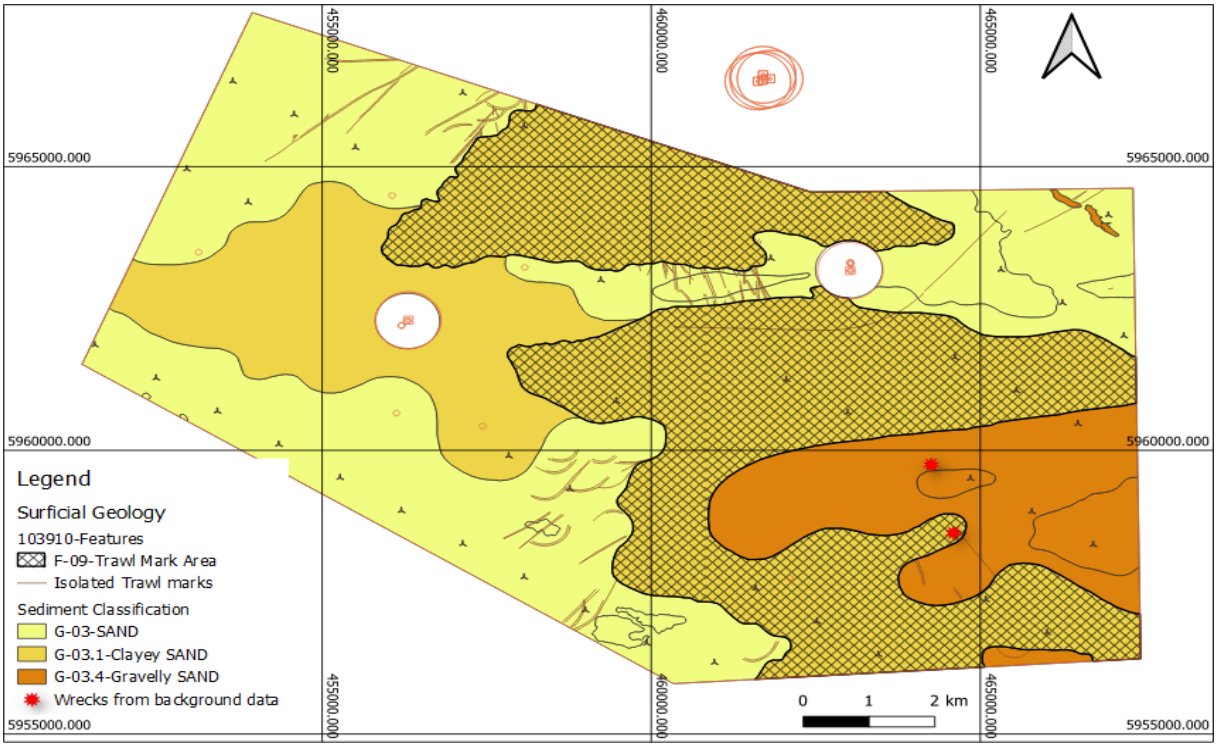


Figure 35 Wreck from background data - overview.

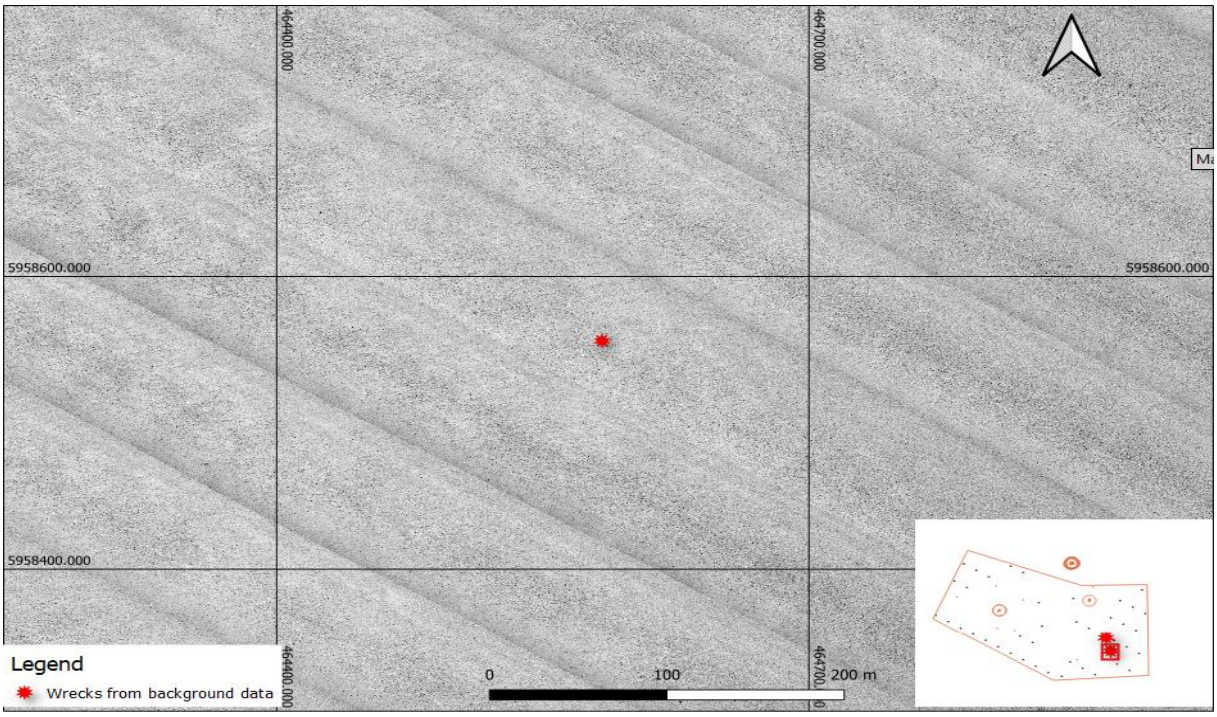


Figure 36 Most southern wreck from background data - SSS dataset - overview.

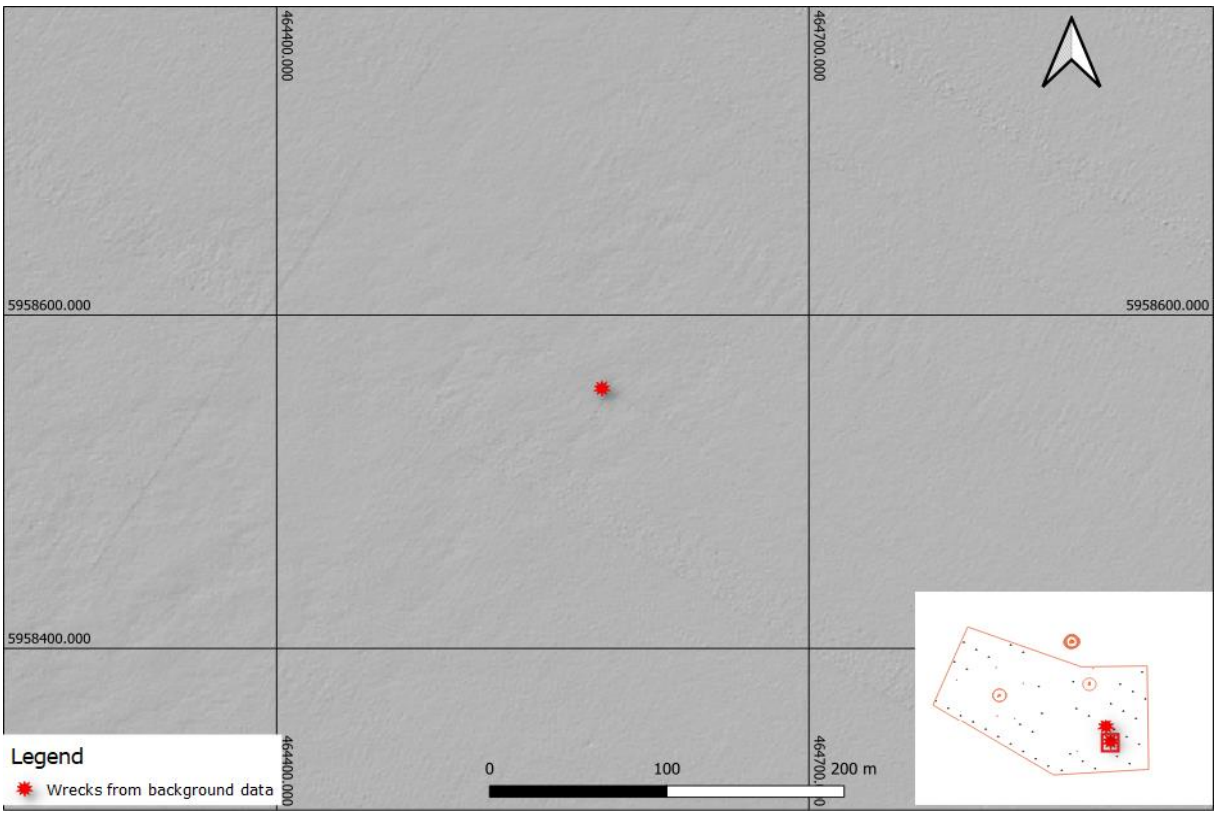


Figure 37 Most southern wreck from background data - MBES dataset - overview.

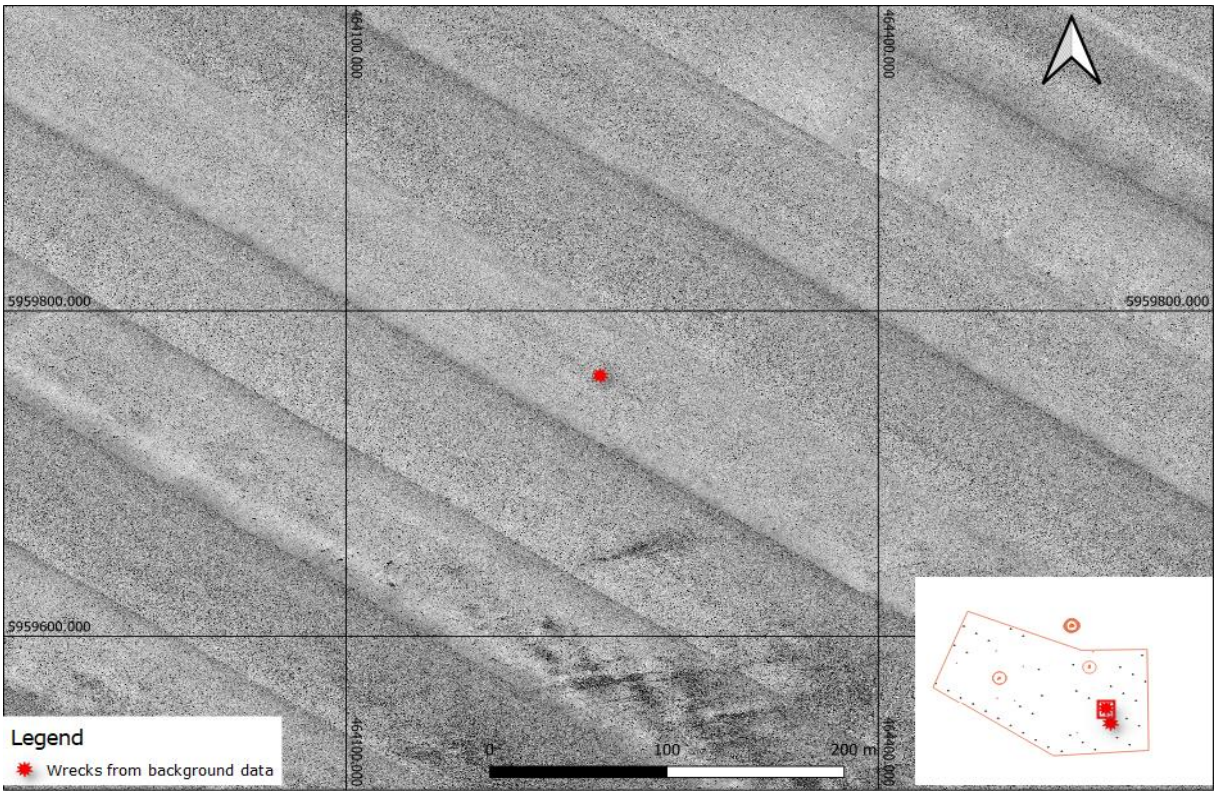


Figure 38 Most northern wreck from background data - SSS dataset - overview.

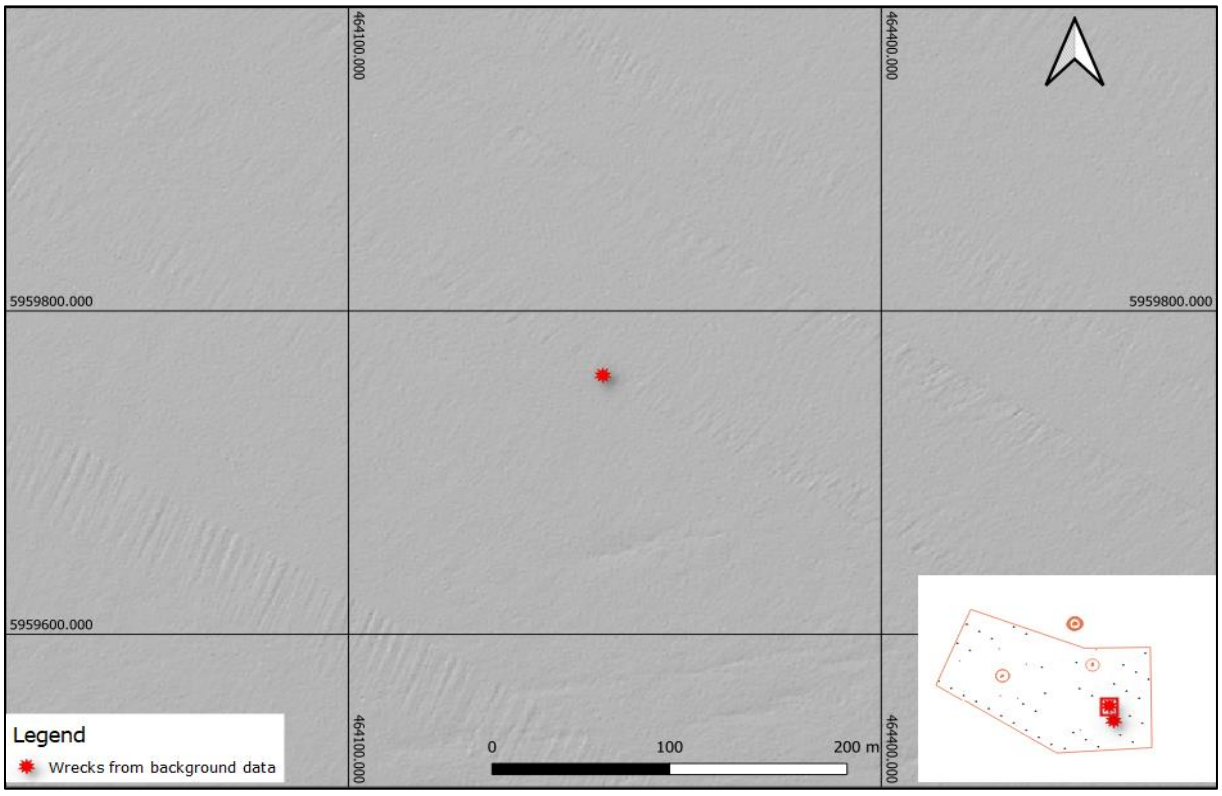


Figure 39 Most northern wreck from background data - MBES dataset - overview.

5.6| SUMMARY CABLES AND PIPELINES

According to available background data, there are nine known subsea structures (cables / pipelines) in the area. All assets but Calder to CPP1 were identified in the MAG dataset, while Calder to Rivers Onshore Terminal was partially visible in both SSS and MBES datasets (Structure exposed) and Lanis 1 was partially visible in the SSS dataset suggesting the structure is exposed at 542666.2 E 5960740.4 N.

The correlation between the As-Given and the As-Found cable/pipeline positions is in general good, with offsets within approximately 20 m from the As-Given positions.

Table 16 show the subsea structure detection status on each system.

Table 16 Cable and pipelines status on each system.

Subsea Asset	MBES	SSS	SBP	TVG
Morecambe DP3 to CPP1 (5 structures)	Not Visible	Not Visible	Not Visible	Yes (Partially)
Calder to Rivers Onshore Terminal	Yes (Partially)	Yes (Partially)	Not Visible	Yes
Calder to CPP1	Not Visible	Not Visible	Not Visible	Not Visible
Hibernia Atlantic	Not Visible	Not Visible	Not Visible	Yes
Lanis 1	Not Visible	Yes (Partially)	Not Visible	Yes (Partially)

5.7| GEOLOGICAL HAZARDS

5.7.1| MOBILE SEDIMENTS AND BEDFORMS

Where burial of installations (for example cables) has been used as mitigation against other hazards (for example, anchoring or bottom fishing) then migrating bedforms may cause the buried installations to be exposed to those hazards. Migrating bedforms may also result in cable or pipeline spans. Additionally, mobile sediment features may indicate strong bottom currents and the potential for scour around fixed seabed installations.

Mobile sediment features such as megaripples are observed throughout a large extension of the survey area, while sand waves have been identified on the south-west corner to a less extent.

5.7.2| BOULDERS

Boulders represent a hazard to drilling and burial operations. In areas of particularly strong currents, boulders may also move along the seabed. Surface boulders are observed throughout the survey area (5.2.3| Boulders), predominately as isolated and individual boulders. No boulder fields were identified within the area.

Based on the targets interpreted, the average boulder size is 1.1 m^3 and the maximum boulder size found was 16.6 m^3 (S_FR_B1_0059).

5.7.3| SUB CROPPING TILL

Unit four, interpreted to be comprised by Till, have been identified sub cropping mainly on the south-east corner of the survey area, with its closest point to the seabed at approximate of 3.5 m (BSB). Special care should be taken in these areas that could potentially present challenges for drilling and foundation calculations (Figure 40 to Figure 42).

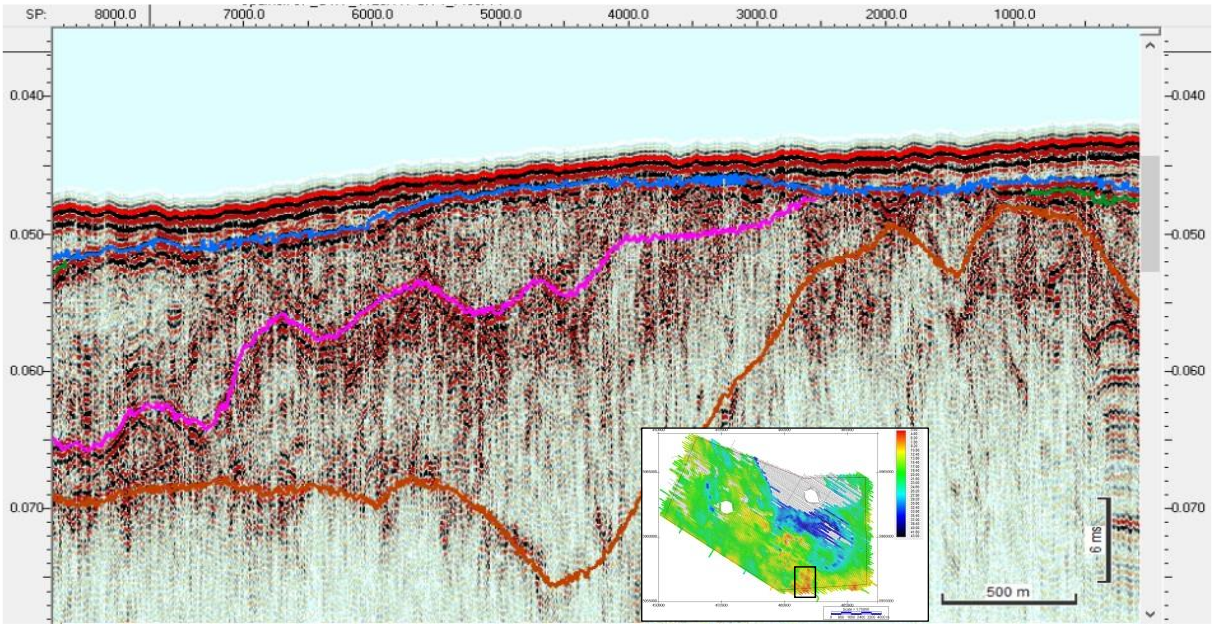


Figure 40 Sub cropping TILL geohazard in south-east corner (Line 1125.117).

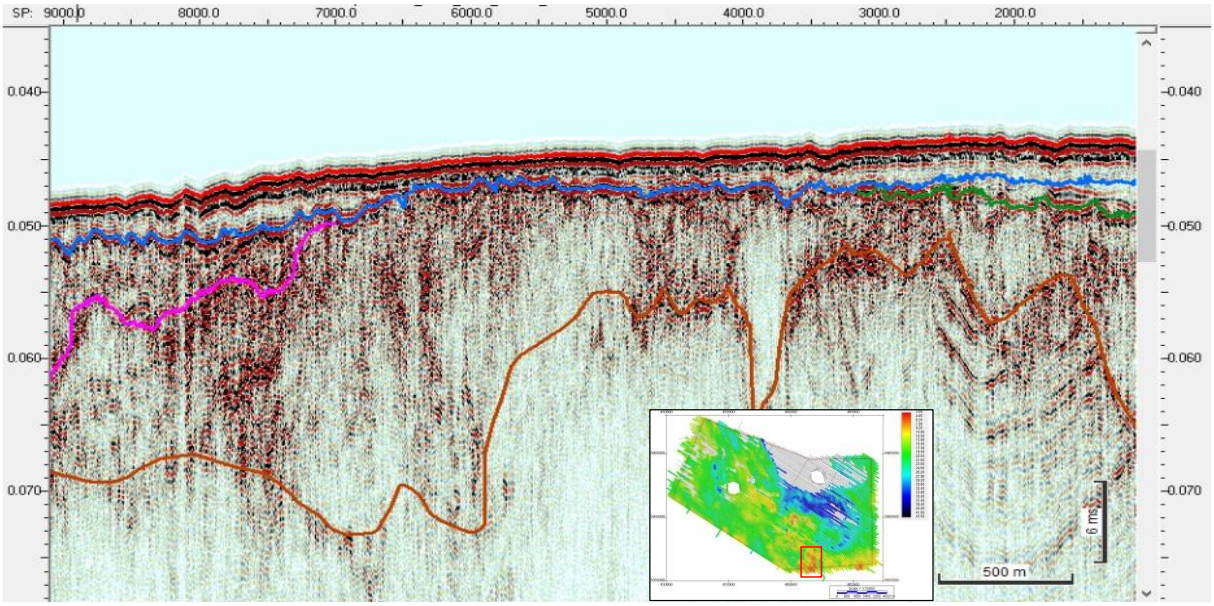


Figure 41 Sub cropping TILL geohazard in south-east corner (Line 1275_b).

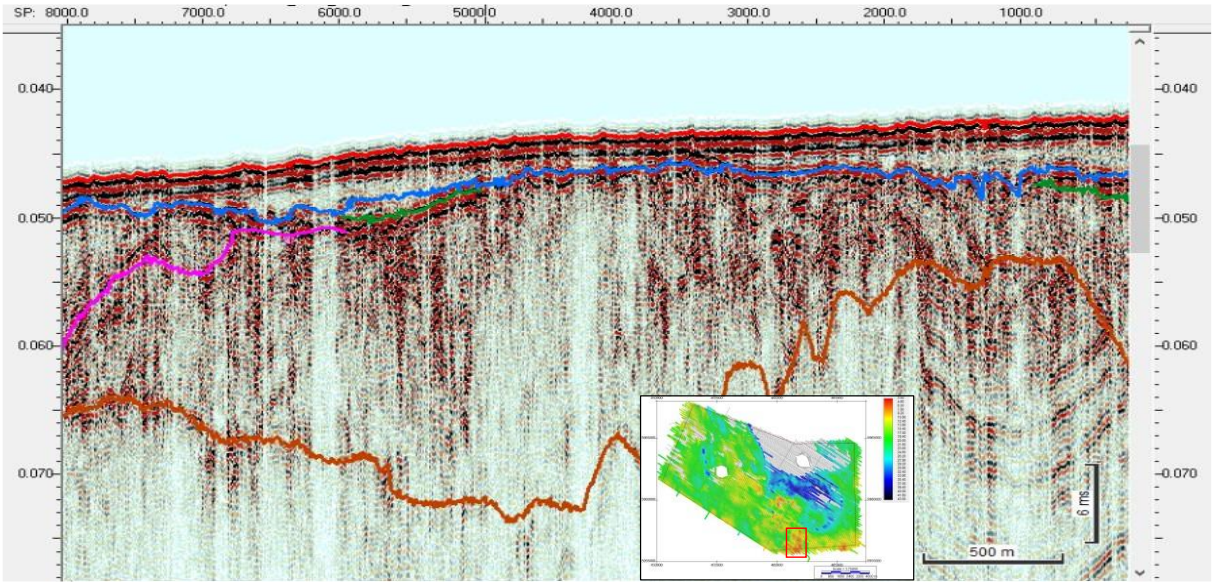


Figure 42 Sub cropping TILL geohazard in south-east corner (Line 1475).

5.7.4| EROSIVE CHANNELS

Due to glacial activity within the survey area, it is possible for a variety of glacial landforms to be present, such as tunnel valleys or incised bedrock channels.

Paleo-channels occur across the site at the top surface of the Triassic Bedrock and in the prograding facies of Western Irish Sea Formation A. The origin of the channels is interpreted to be related to subglacial drainage and glaciofluvial actions. The scale of the channel features is variable ranging from a few metres to several kilometres in width. The largest and deepest channels are incised in the Triassic Bedrock. These channels are interpreted to have formed sub glacially as tunnel valley systems by the advance of the ice sheet in the Irish Sea. The bedrock channels or tunnel valleys are infilled with the till unit or a mud facies when absent.

The prograding facies of Western Irish Sea Formation A was deposited in a deltaic to glaciomarine environment. The west of the survey area displays channels which incise into the underlying sediments, compared to that of a horizontal base in the east. These channels are oriented N-S and could be attributed to tunnel valleys. The more relevant channels form the base of the unit and there are easily depictable (Figure 43 to Figure 45). However, intraformational erosive surfaces occur across the site. Locally, these can define channel-like structures. The sediment which is within these channels displays a more chaotic seismic character compared to the clinoforms or other bedding displayed outside of these channels.

These tunnel valleys can contain sediment composition which is different from that outside of the channel and be of different consolidation not only laterally but vertically within the channel axis.

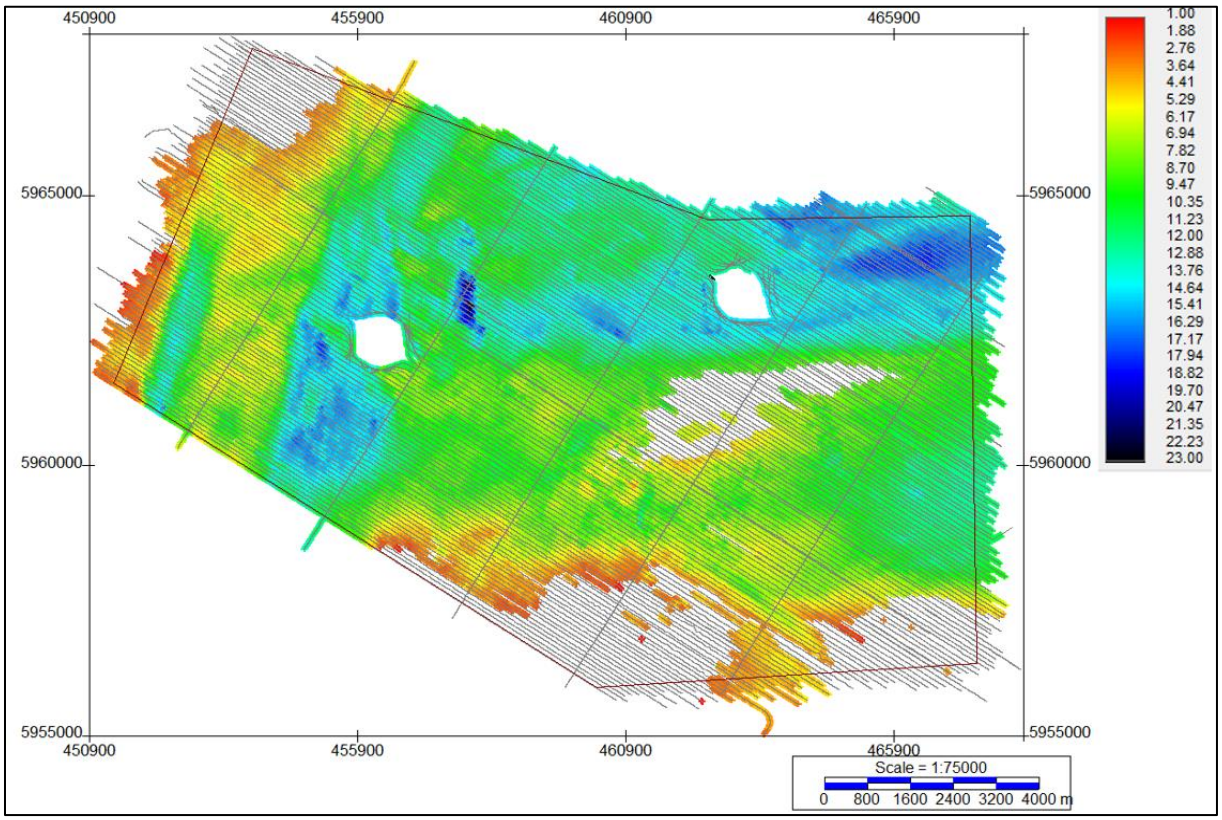


Figure 43 Glacial channels within Unit two. Basemap.

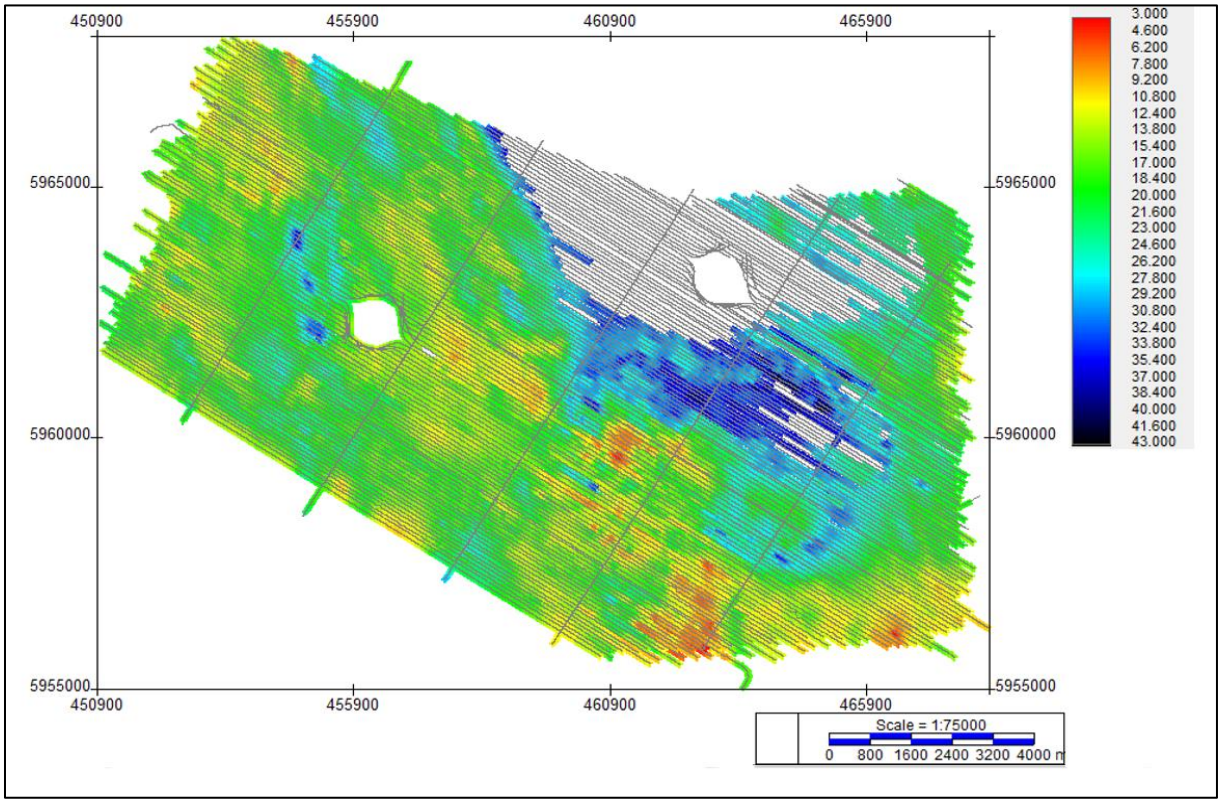


Figure 44 Glacial channels within Unit five. Basemap.

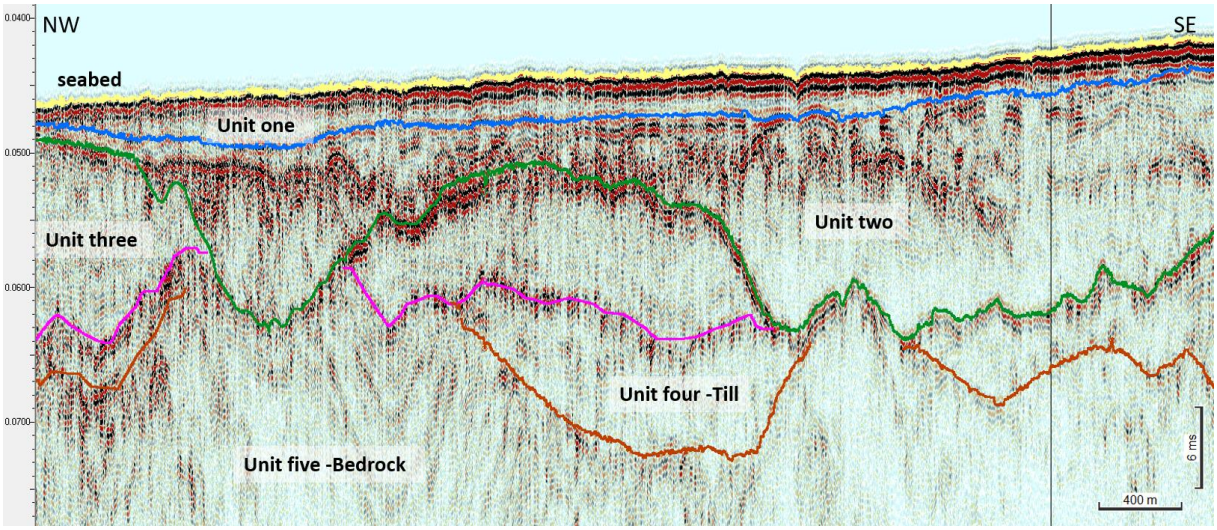


Figure 45 Glacial channels within Unit two and Unit five (Line 1350.118)

6 | RESERVATIONS AND RECOMMENDATIONS

The results in this report, both geological descriptions and sonar contact and magnetometer anomaly selection, are based on interpretations of geophysical data obtained during the survey. It should be taken into account that there is a natural limitation in the accuracy of interpretation.

It is only possible to tell if mobile sediment features such as megaripples and sand waves are presently active with a time series of comparable survey data sets.

A dedicated UXO survey has not been performed, being the survey just focus on the identification of subsea structures such as cables and pipelines.

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8 | APPENDICES

APPENDIX A | CHARTS

MMT_910_FR_CHART_LIST.xlsx

APPENDIX B | CONTACT LIST

MMT_910_FR_SSS_TARGETS_REV04.csv

APPENDIX C | ANOMALY LIST

MMT_910_FR_MAG_TARGETS_REV03.xls›

Chart Name	Chart Type
103910-LTD-MMT-SUR-DWG-AL425001	Alignment
103910-LTD-MMT-SUR-DWG-AL425002	Alignment
103910-LTD-MMT-SUR-DWG-AL425003	Alignment
103910-LTD-MMT-SUR-DWG-AL425004	Alignment
103910-LTD-MMT-SUR-DWG-AL425005	Alignment
103910-LTD-MMT-SUR-DWG-AL425006	Alignment
103910-LTD-MMT-SUR-DWG-AL425007	Alignment
103910-LTD-MMT-SUR-DWG-AL680001	Alignment
103910-LTD-MMT-SUR-DWG-AL2125001	Alignment
103910-LTD-MMT-SUR-DWG-AL2125002	Alignment
103910-LTD-MMT-SUR-DWG-AL2125003	Alignment
103910-LTD-MMT-SUR-DWG-AL2125004	Alignment
103910-LTD-MMT-SUR-DWG-AL2125005	Alignment
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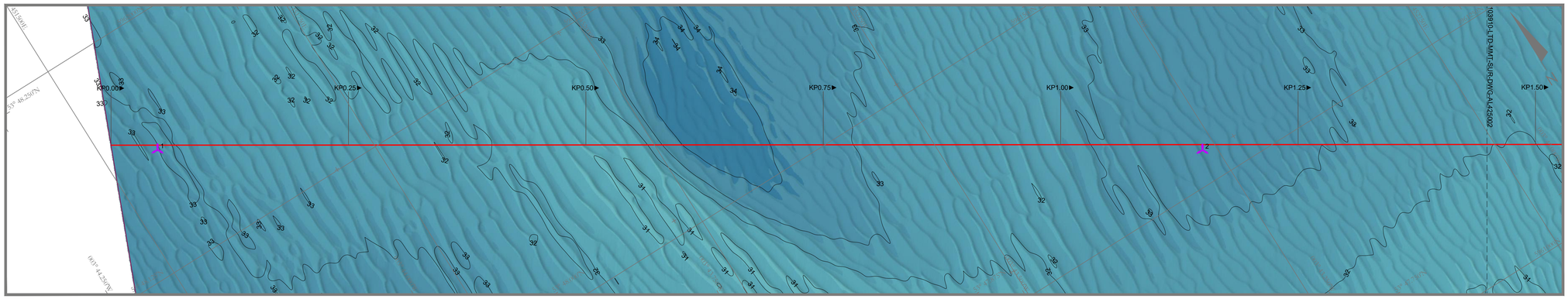
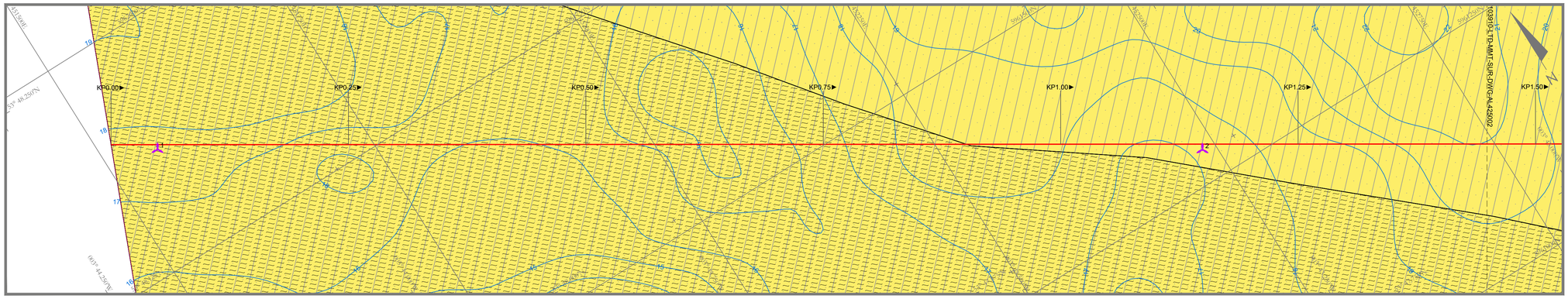
103910-LTD-MMT-SUR-DWG-AL8850002	Alignment
103910-LTD-MMT-SUR-DWG-AL10500001	Alignment
103910-LTD-MMT-SUR-DWG-MAG001	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG002	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG003	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG004	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG005	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG006	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-MAG007	Magnetic Gradient
103910-LTD-MMT-SUR-DWG-OV001	Overview

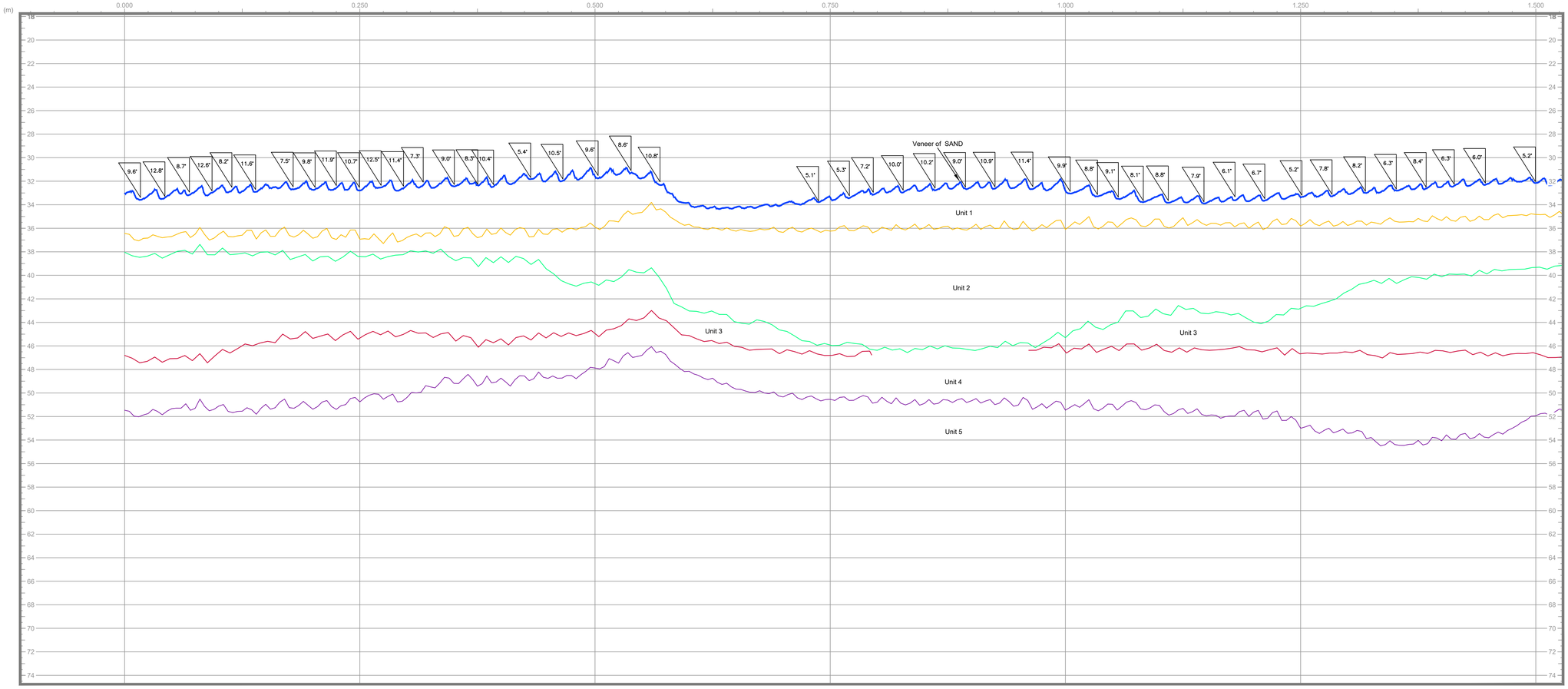
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

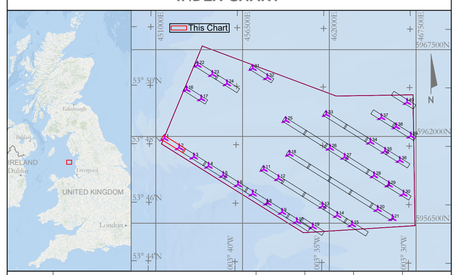
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
		H17	
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.		Unit 2
		H40	
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.		Unit 3
		H45	
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.		Unit 4 - TILL
		H50	
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

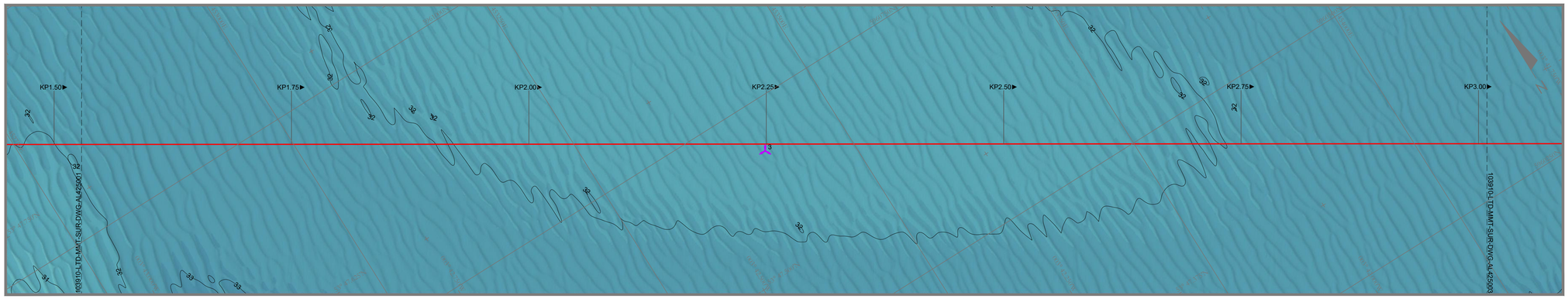
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

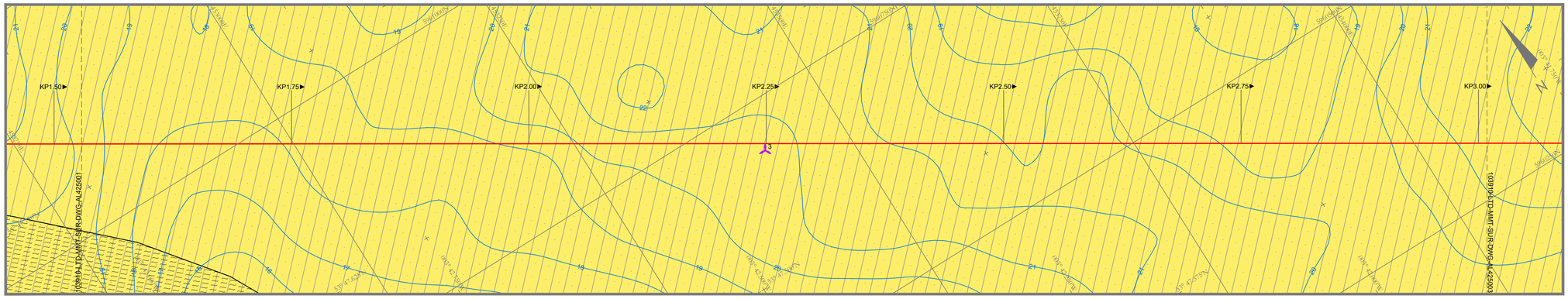
Survey Line: OWF_425 | KP 0.000 - 1.529

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 007

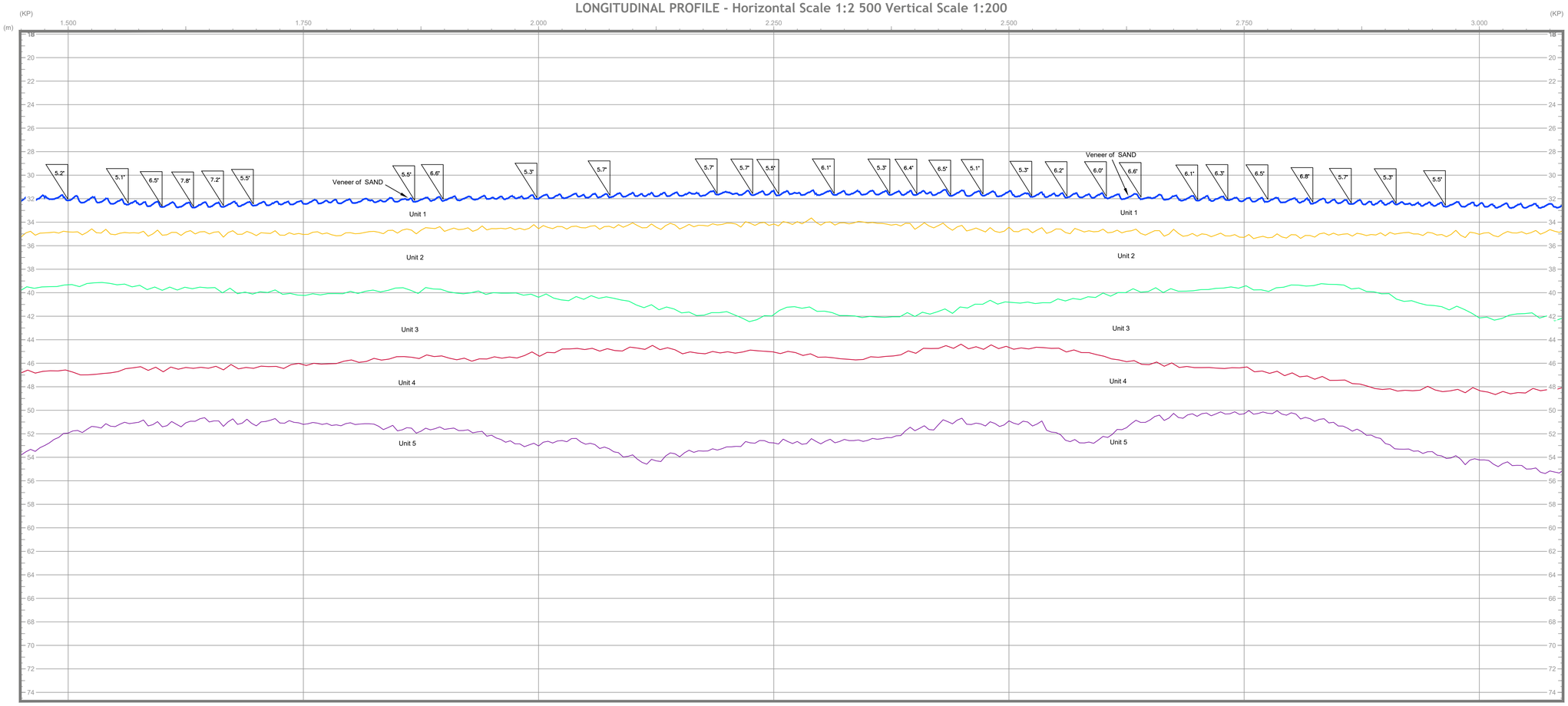
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

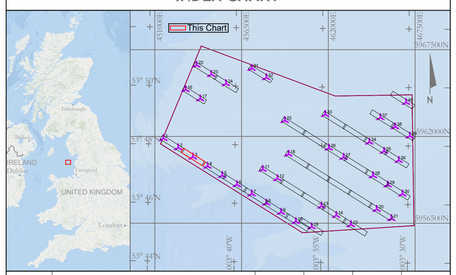
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda,
Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

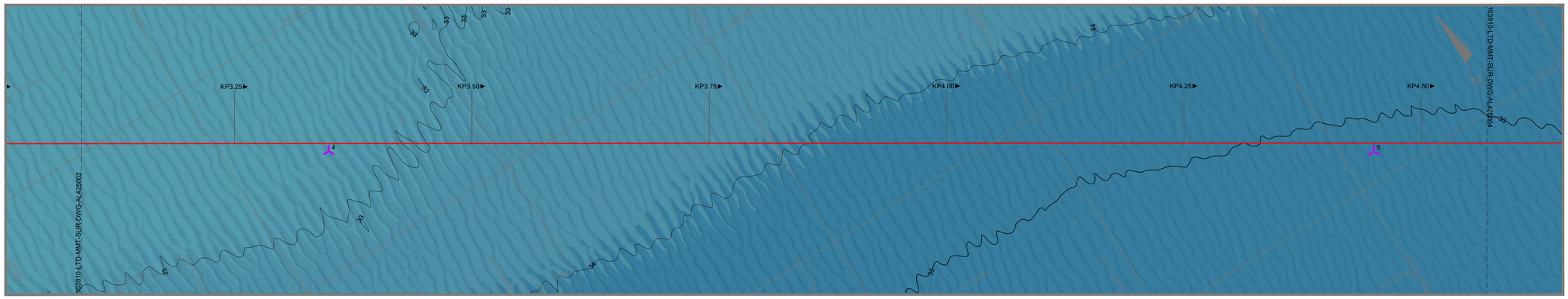
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

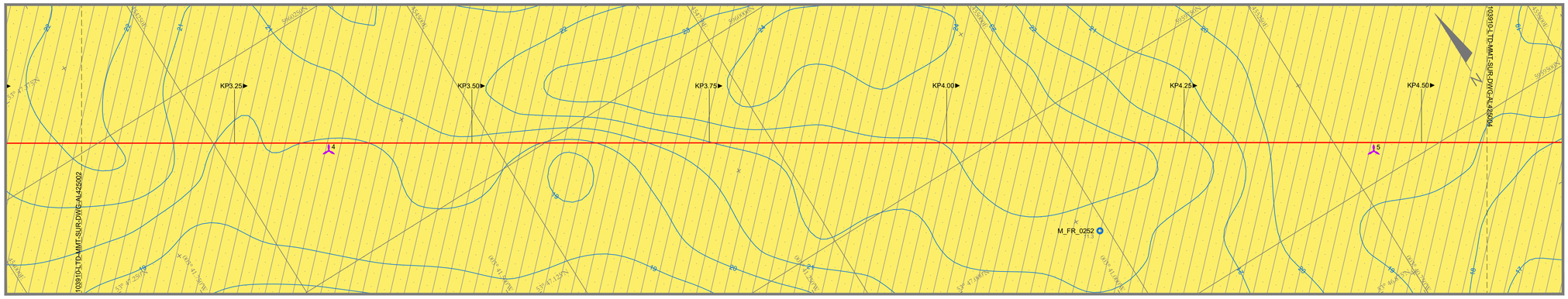
Survey Line: OWF_425 | KP 1.449 - 3.089

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 007

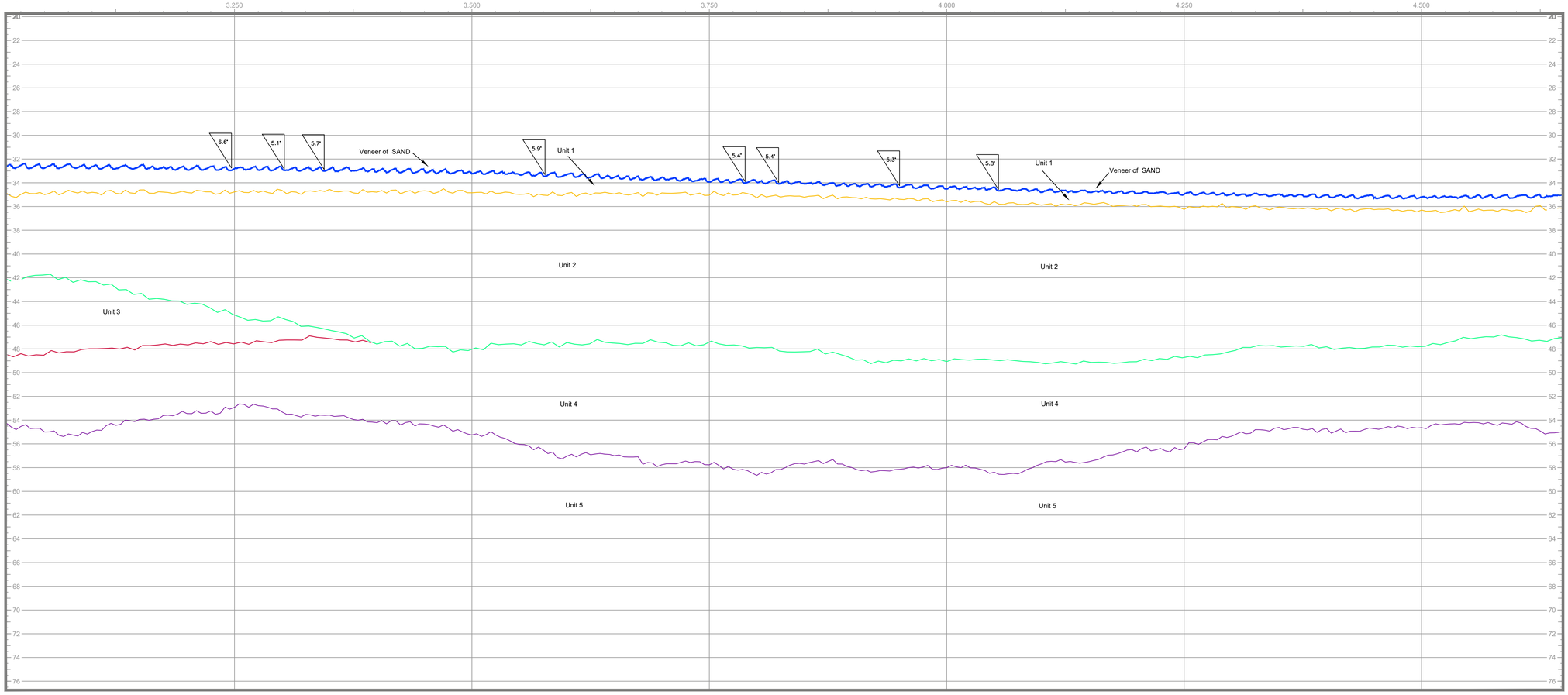
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Matchline to Neighbouring Chart with Chart ID (103910-LTD-MMT...)
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

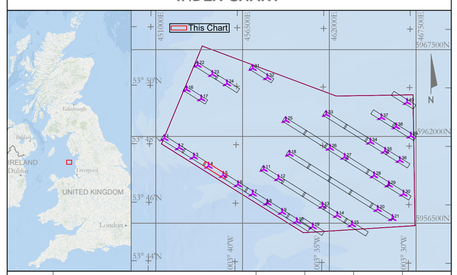
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TYG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

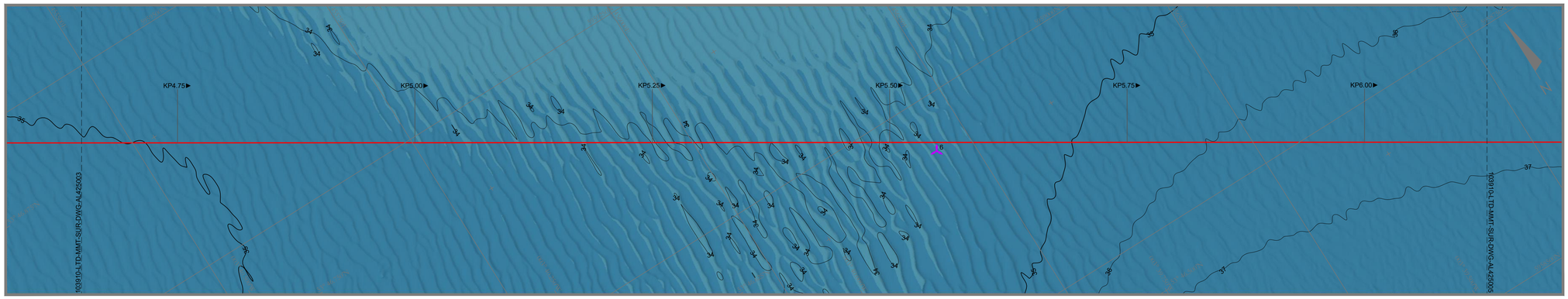
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

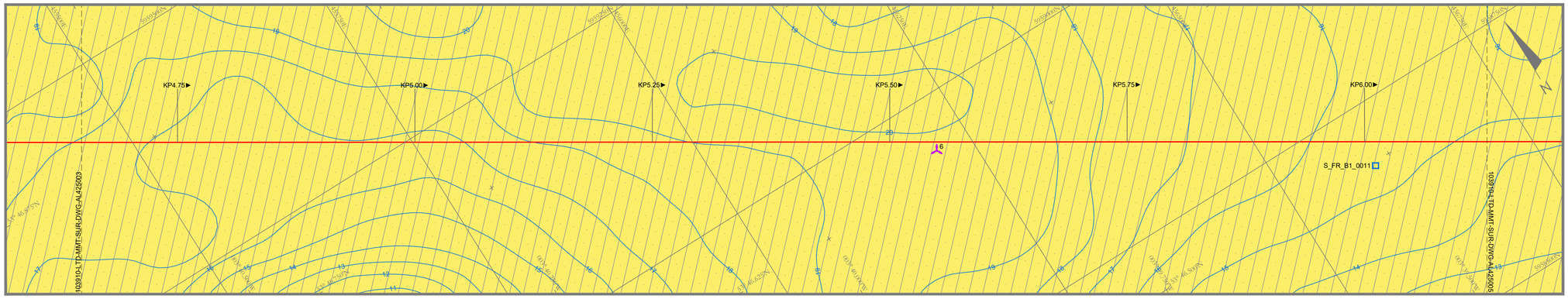
Survey Line: OWF_425 | KP 3.009 - 4.649

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	003 of 007

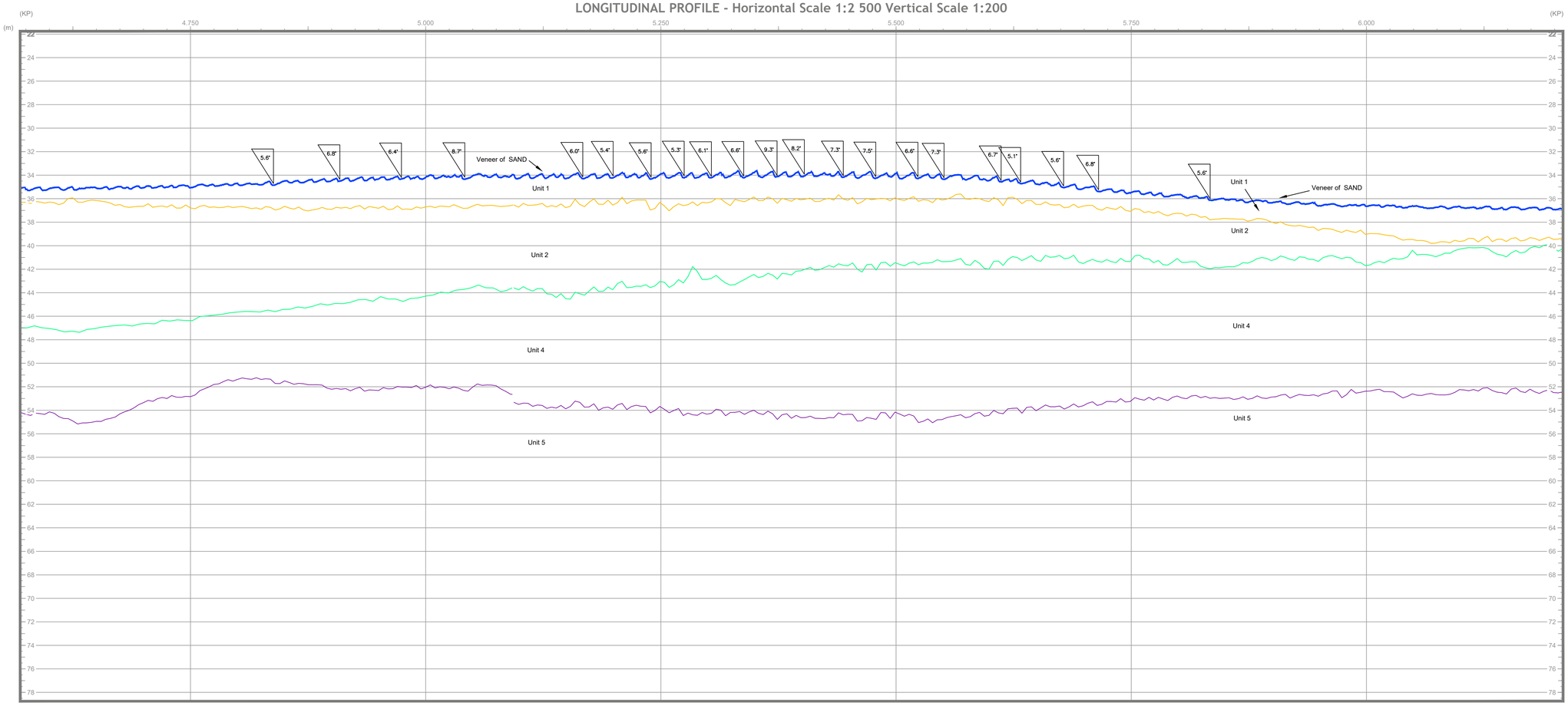
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
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SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
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- Megaripples
- Sand waves
- Trawl Mark Area
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- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

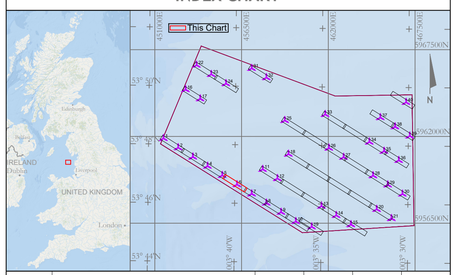
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H45	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Scotland
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Contractor :
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SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

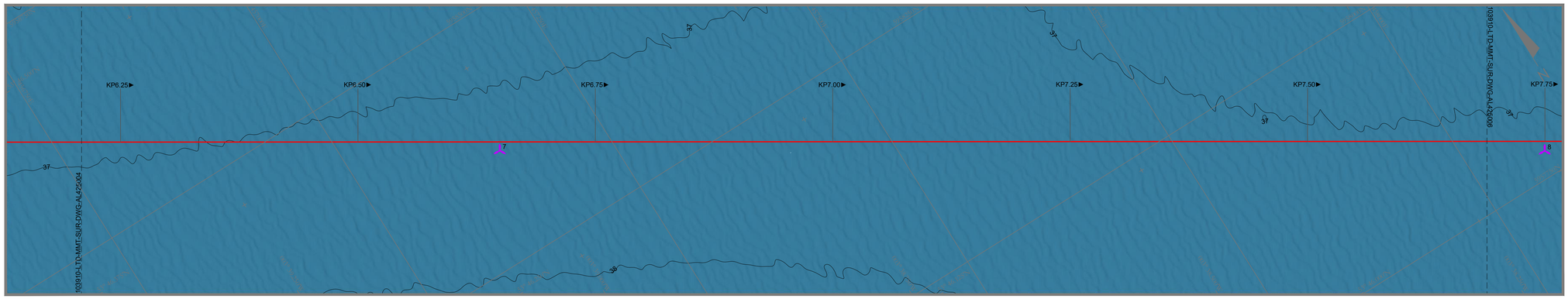
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

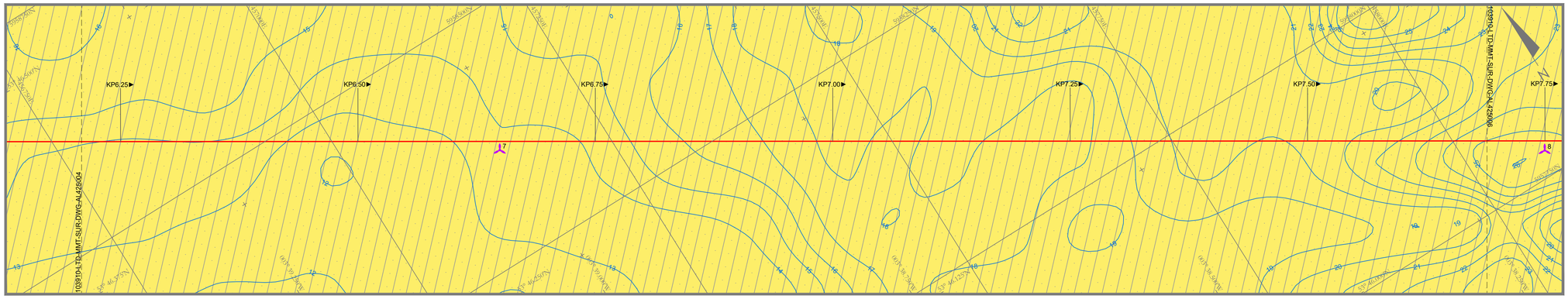
Survey Line: OWF_425 | KP 4.569 - 6.209

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	004 of 007

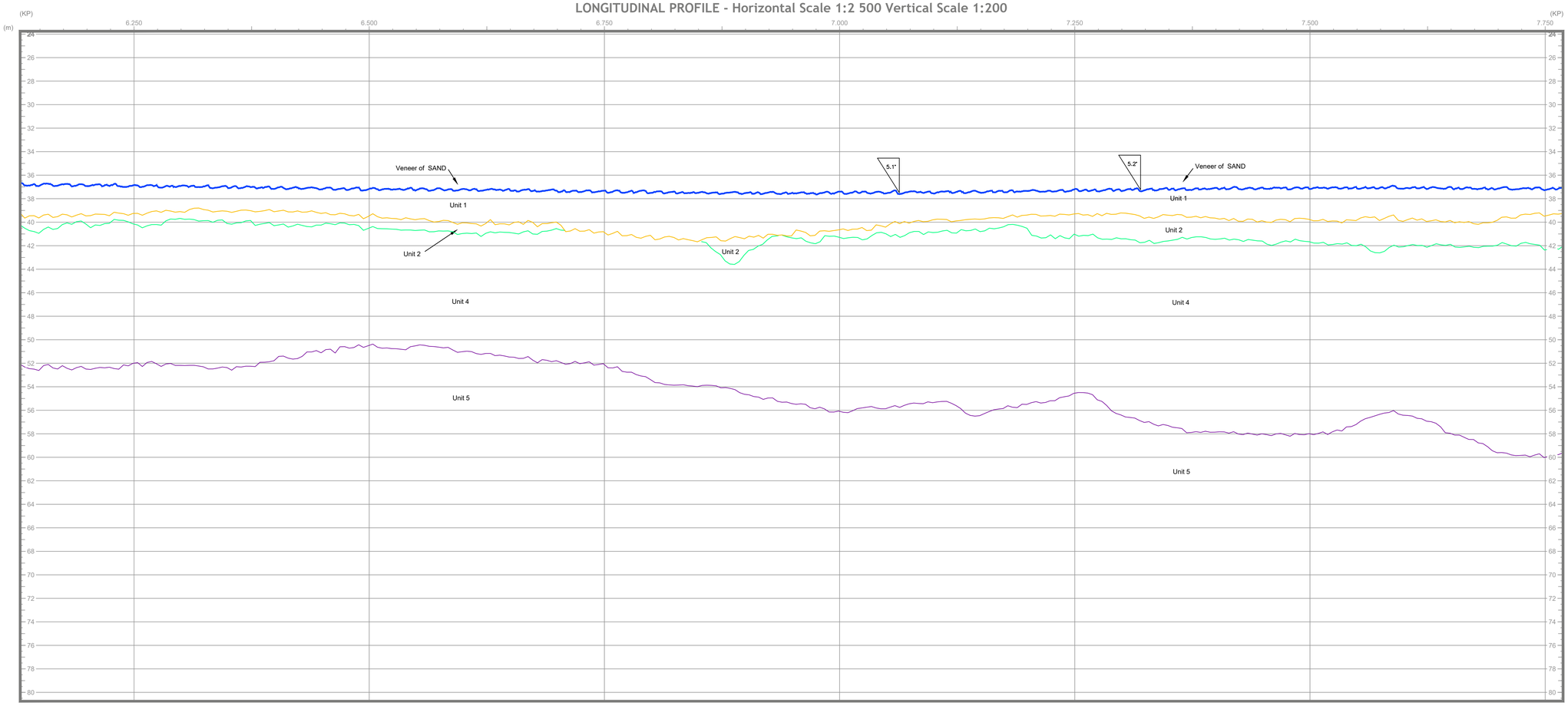
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

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LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
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- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
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SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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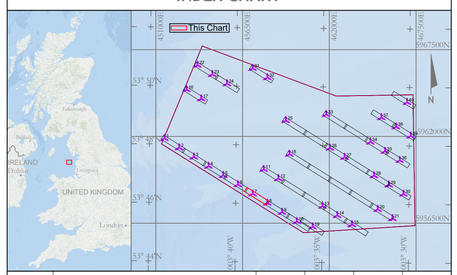
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

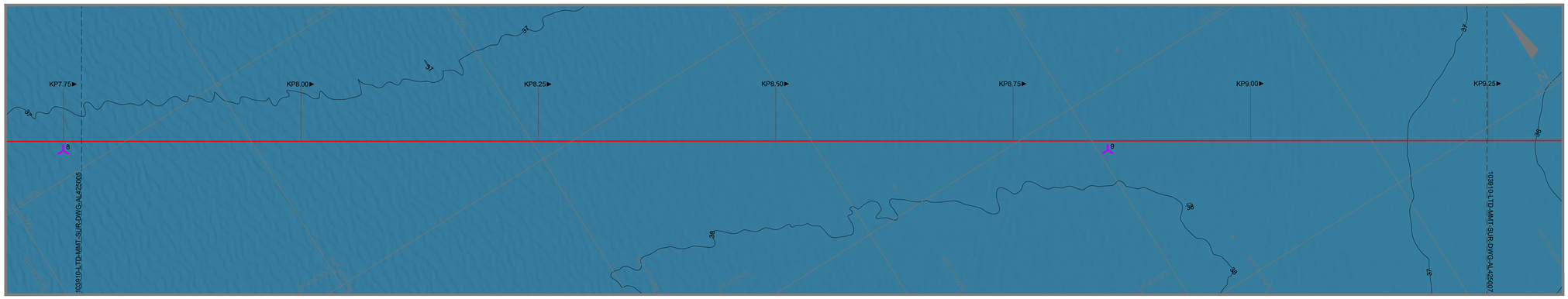
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

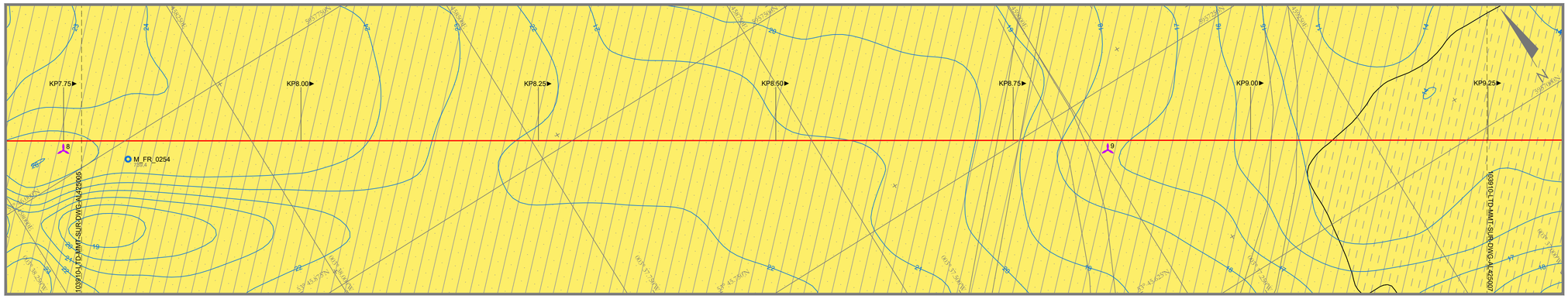
Survey Line: OWF_425 | KP 6.129 - 7.769

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	005 of 007

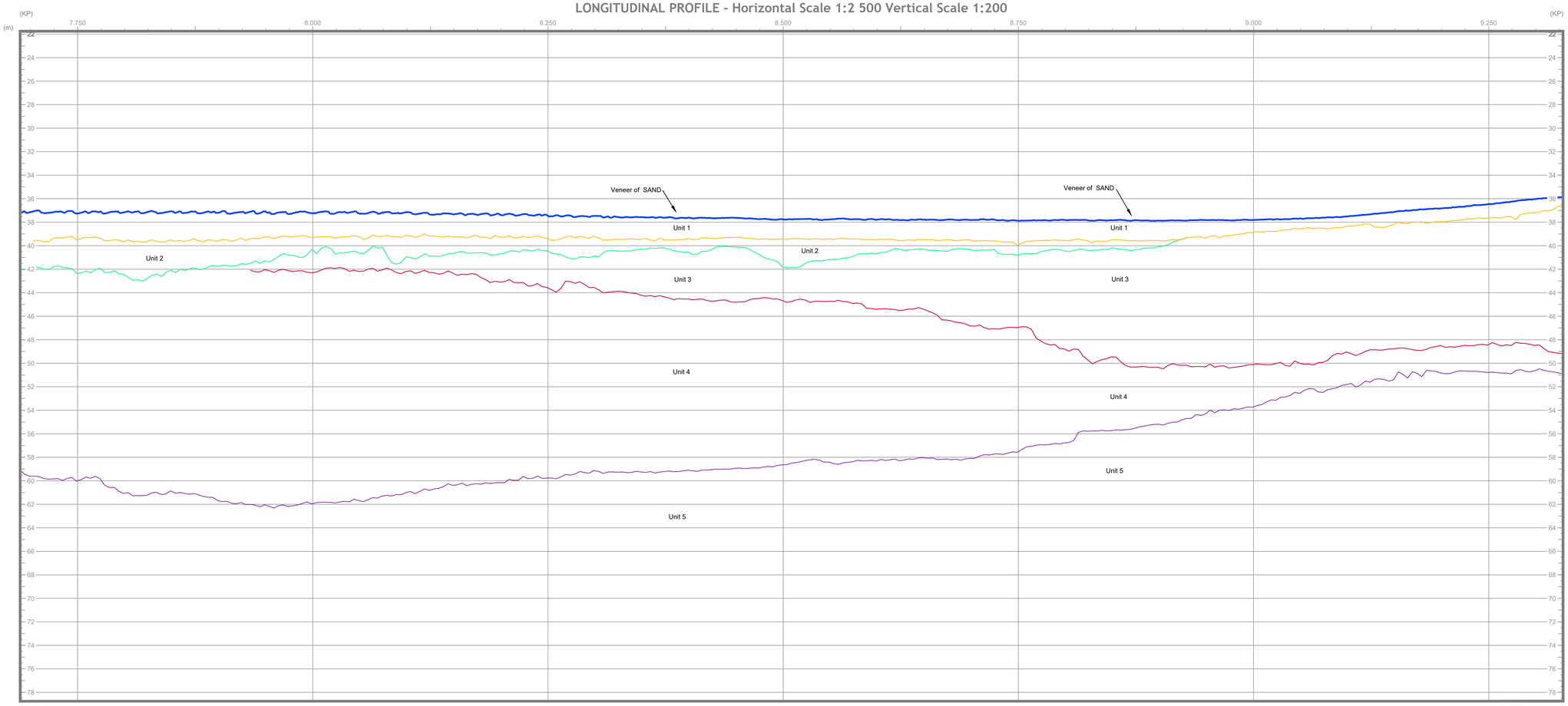
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

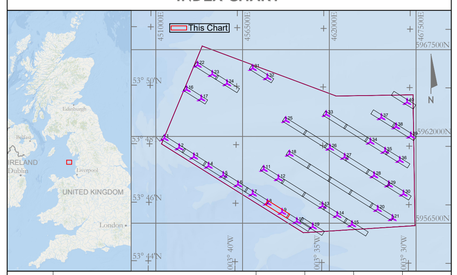
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

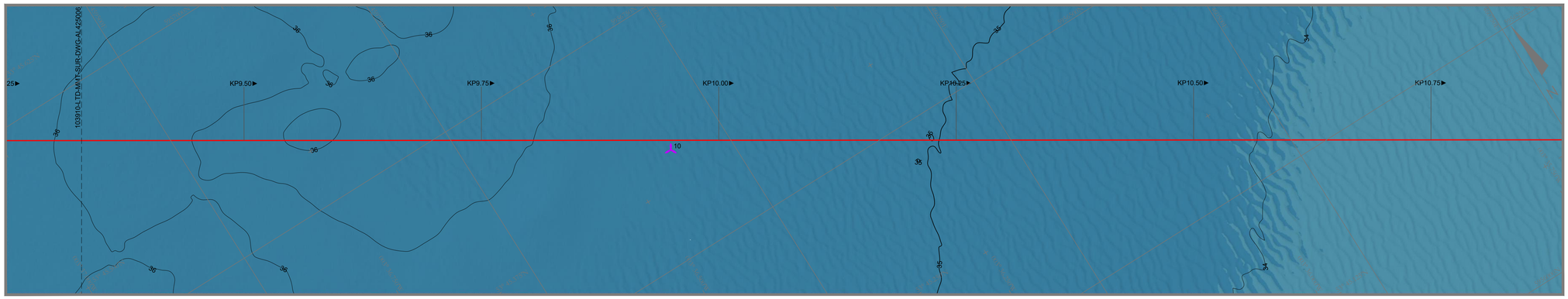
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

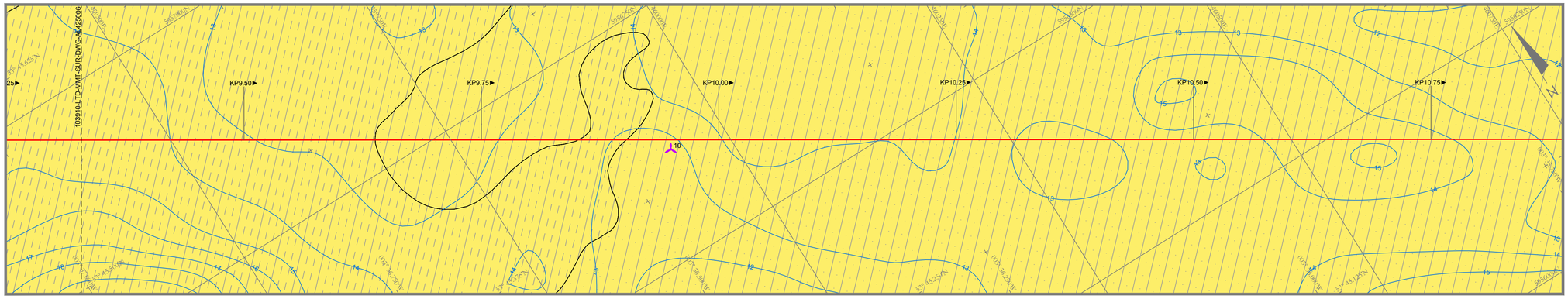
Survey Line: OWF_425 | KP 7.689 - 9.329

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425006
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	006 of 007

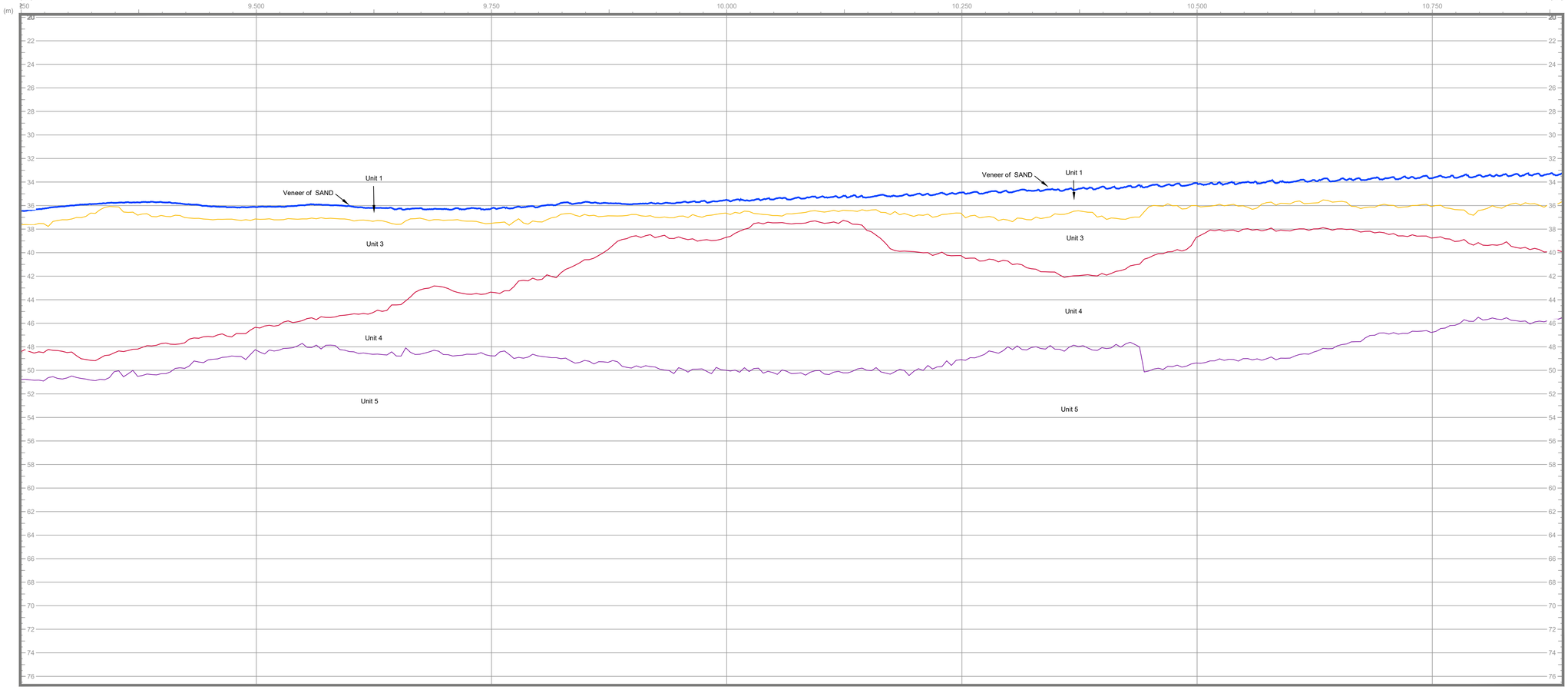
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6 — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

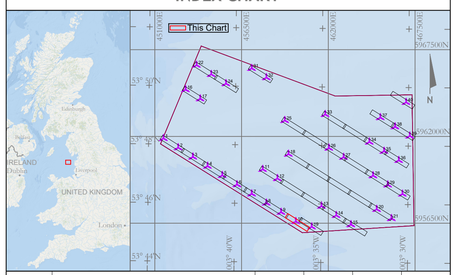
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

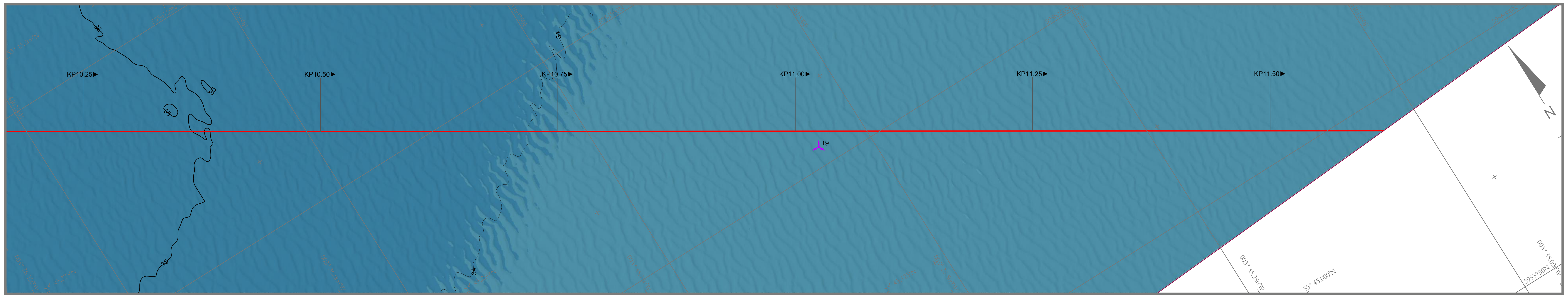
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

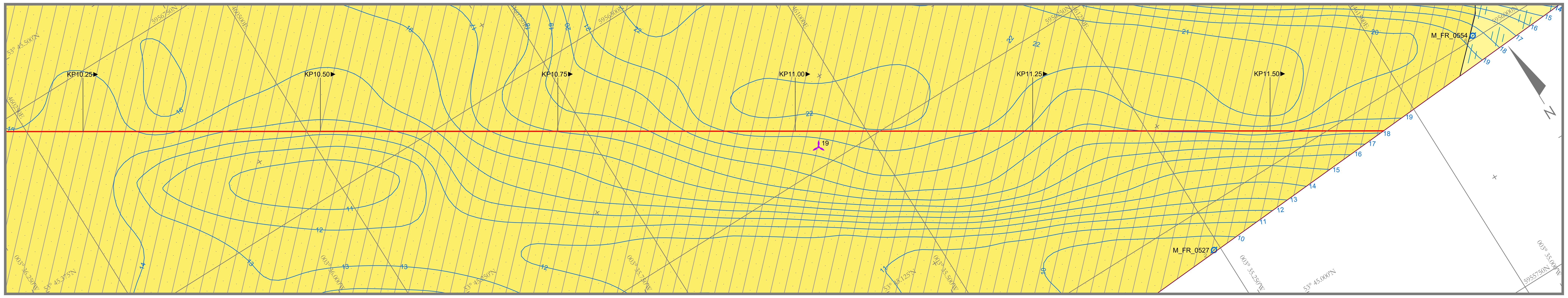
Survey Line: OWF_425 | KP 9.249 - 10.889

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL425007
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	007 of 007

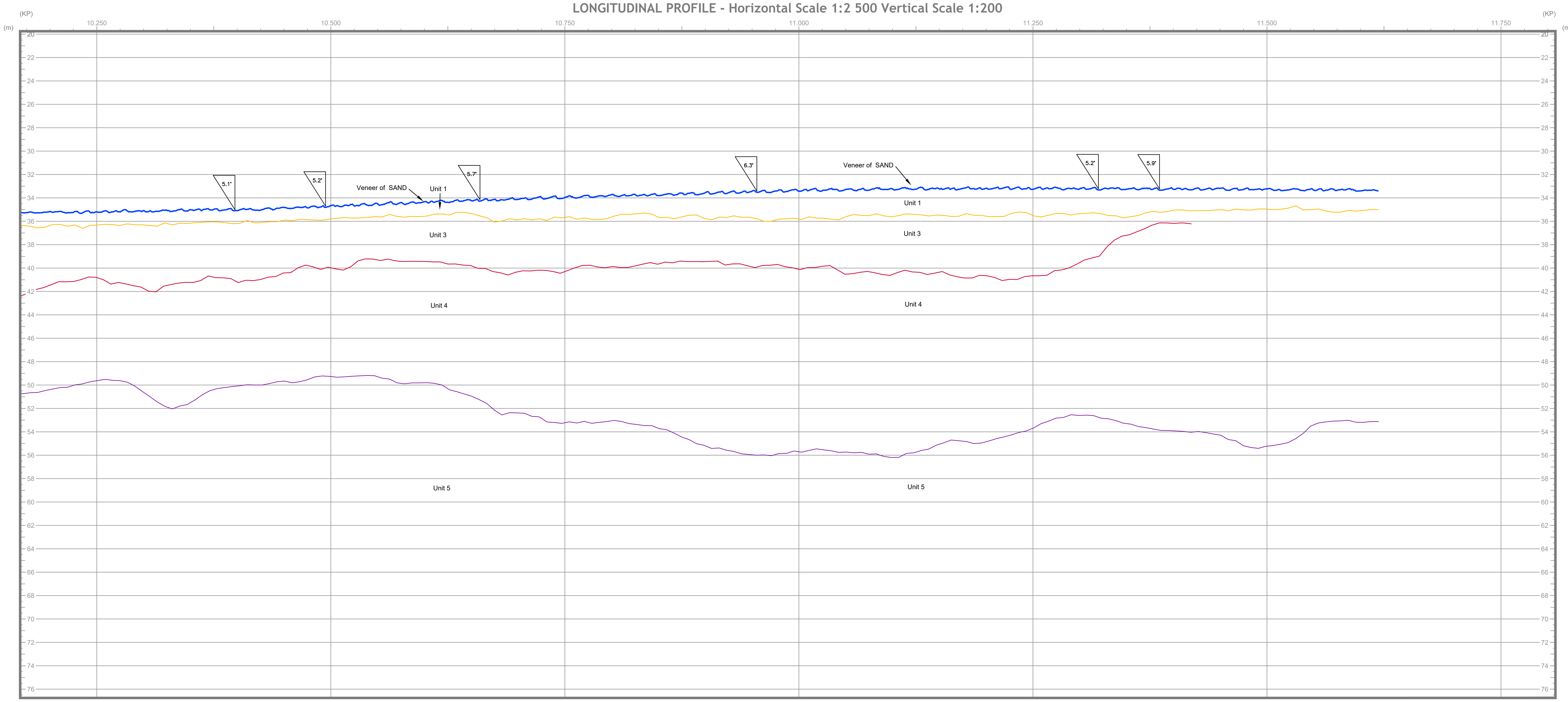
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

KP 1.00 ▶	Survey Line Route Reference with KP	103910-LTD-MMT...	Matchline to Neighbouring Chart with Chart ID
1	Proposed Wind Turbine Location with ID*		Surface Infrastructure 500 m Exclusion Zone*
	R4 OWL Morecambe*	*	Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

24 — Water Depth Contour LAT, 1 m

25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

	SAND	S_FR_B1_0103	SSS Contact with ID
	Clayey SAND	S_FR_B1_0100	SSS Linear Contact with ID
	Gravelly SAND	M_FR_0117 5.2	MAG Contact with ID and nT Value
	Current Lineation	M_FR_0040 3.6	MAG Linear Contact with ID and nT Value
	Megaripples		As Found Cable/Pipeline - MBES
	Sand waves		As Found Cable/Pipeline - SSS
	Trawl Mark Area		Trawl Mark Lines
	Possible Boulder (ID has been omitted for clarity)		Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

	Seabed Profile		Horizon H45
	Horizon H17		Horizon H50
	Horizon H40	6.3°	Slope Gradient (>5°)

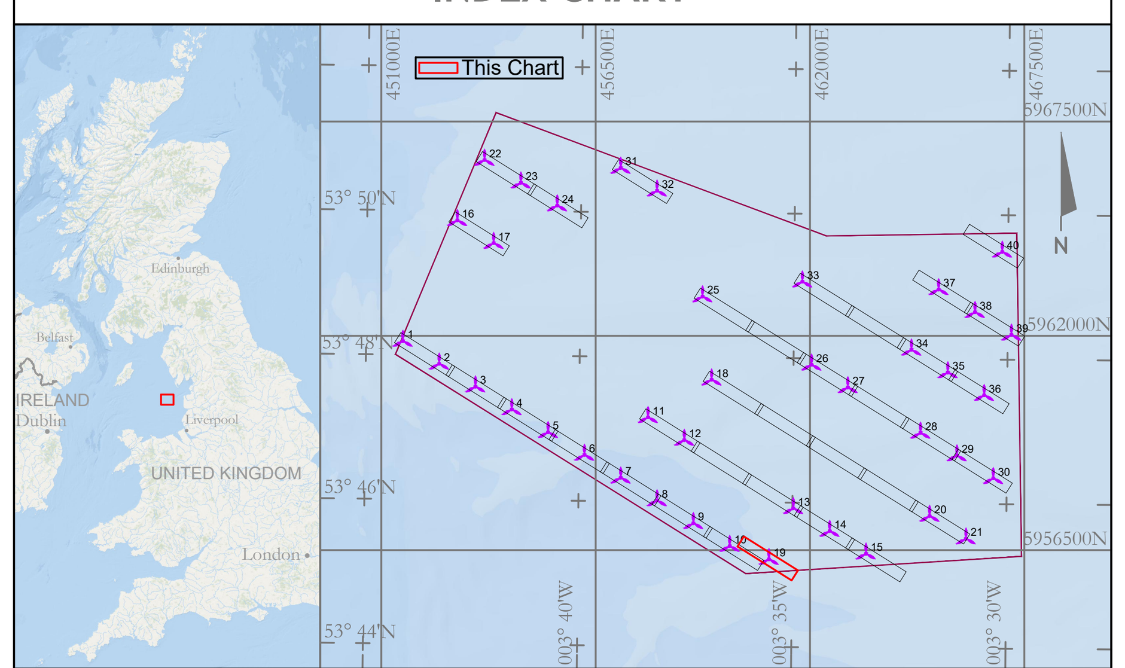
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H45	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.dddddddd
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS MV 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :

FLOTATION ENERGY

Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Contractor :

MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda,
Sweden

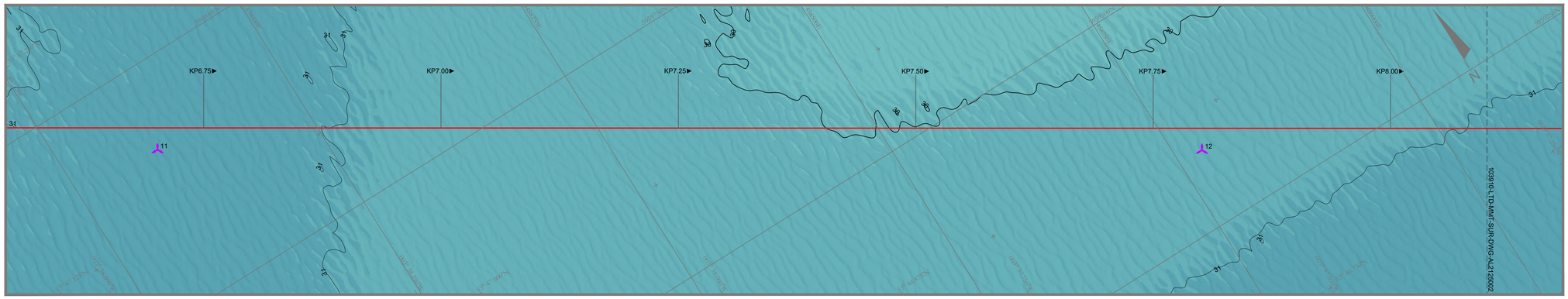
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

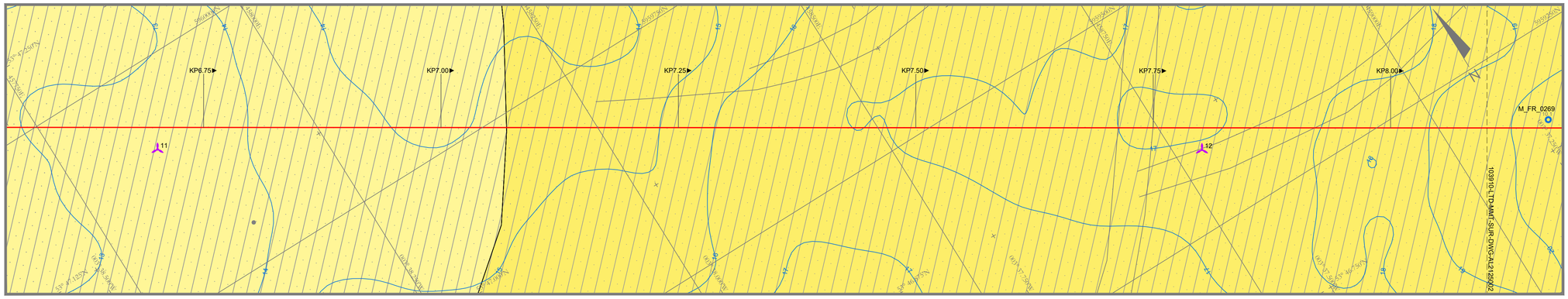
OFFSHORE GEOPHYSICAL SURVEY
MORECAMBE OFFSHORE WINDFARM
ALIGNMENT CHART
Survey Line: OWF_680 | KP 10.168 - 11.619

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL680001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 001

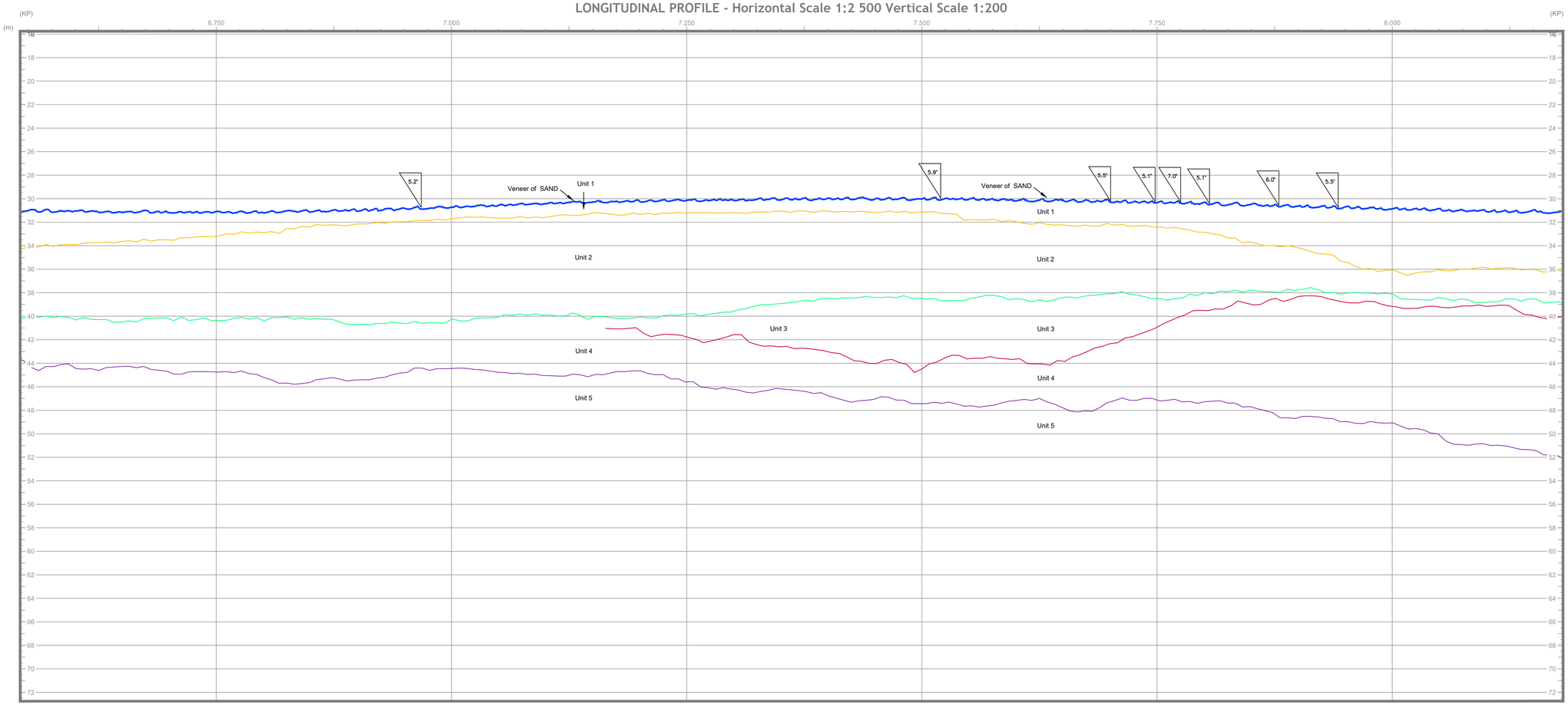
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Offshore Wind Leases
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
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- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
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SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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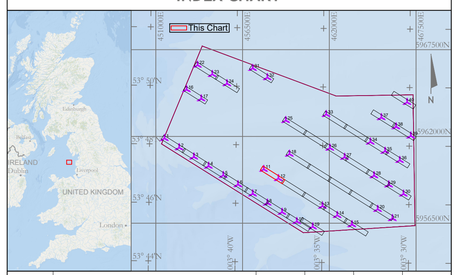
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

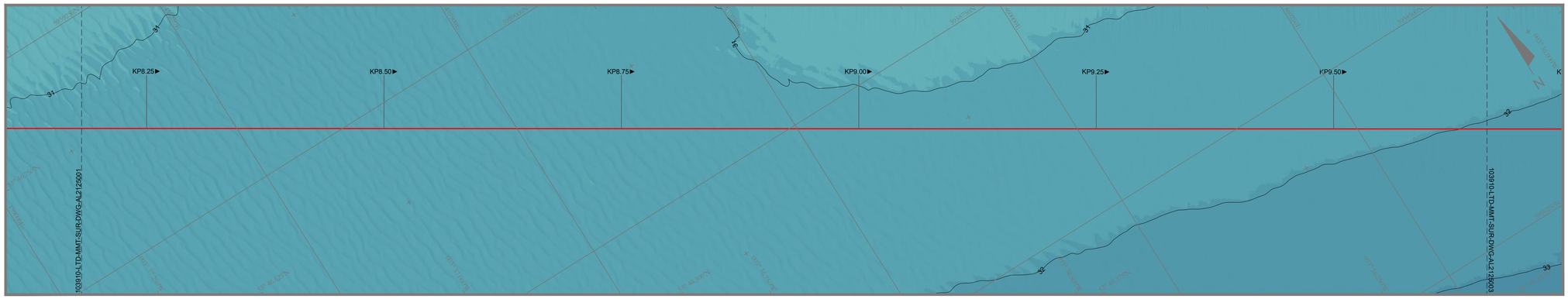
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

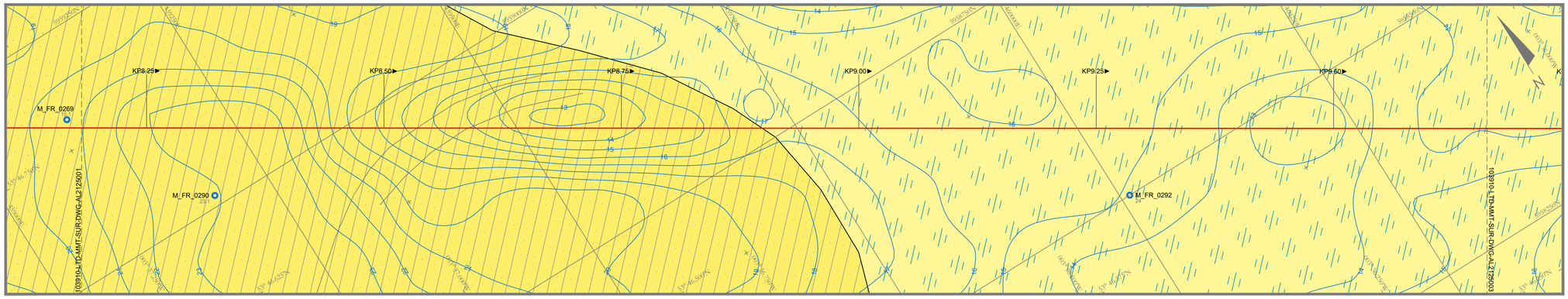
Survey Line: OWF_2125 | KP 6.542 - 8.182

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL2125001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 005

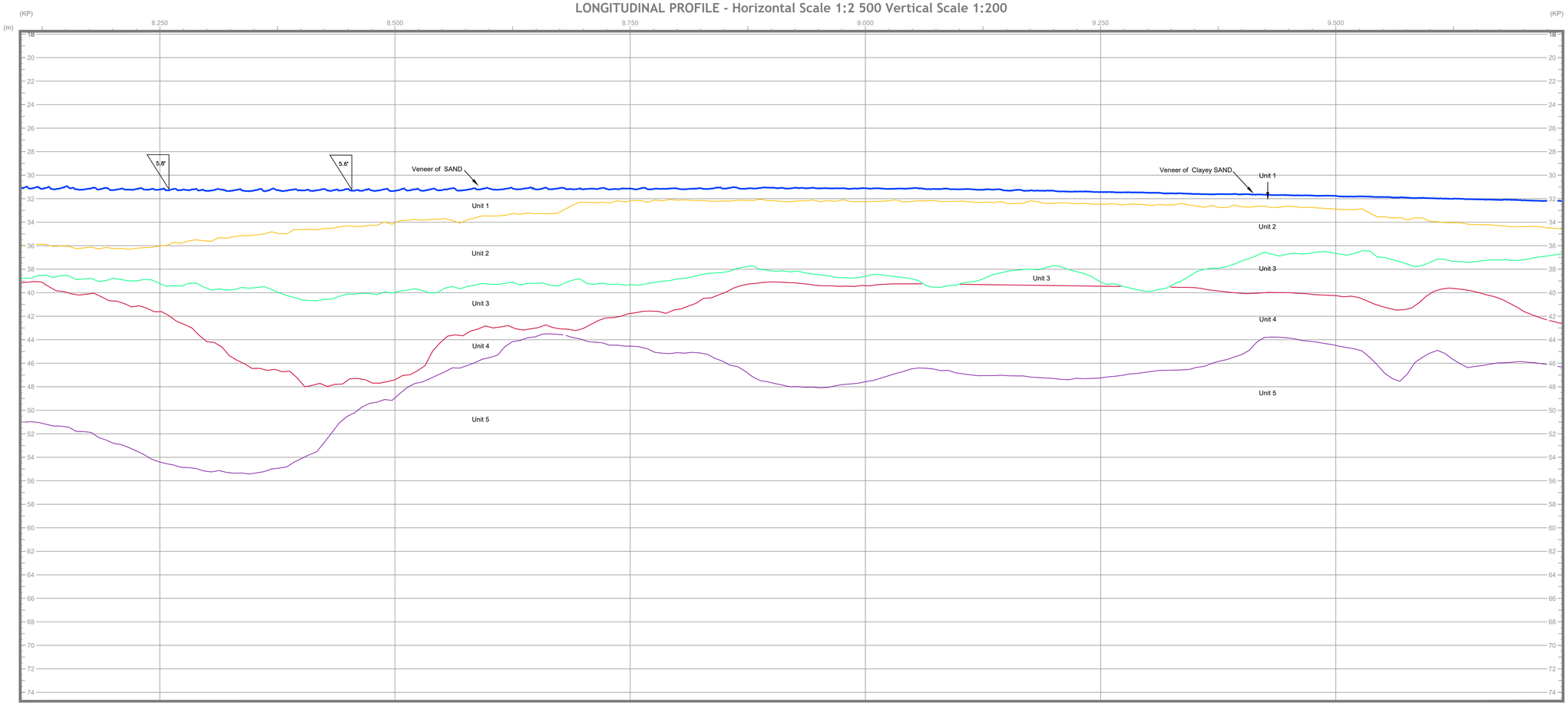
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

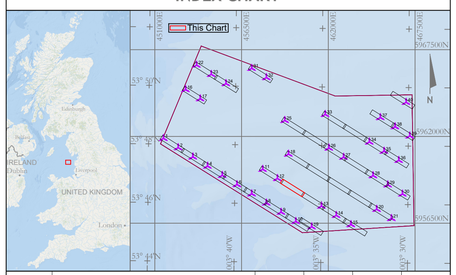
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H45	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda,
Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

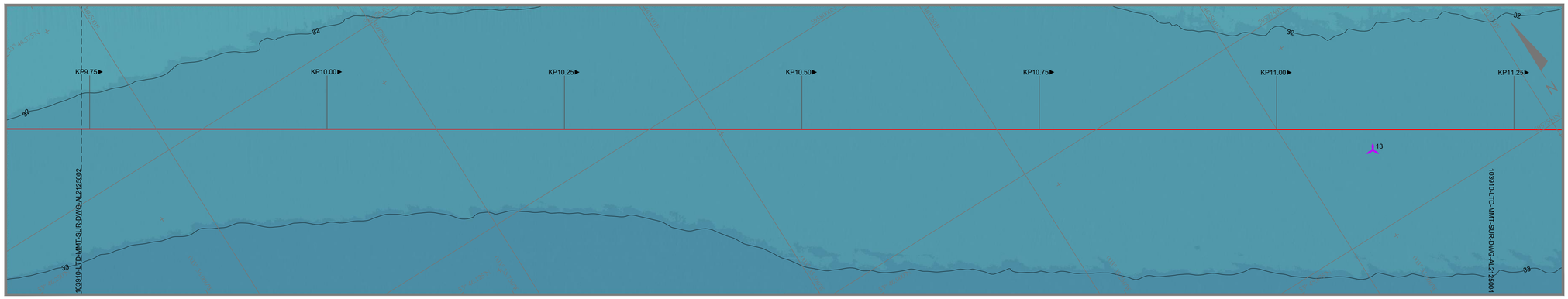
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

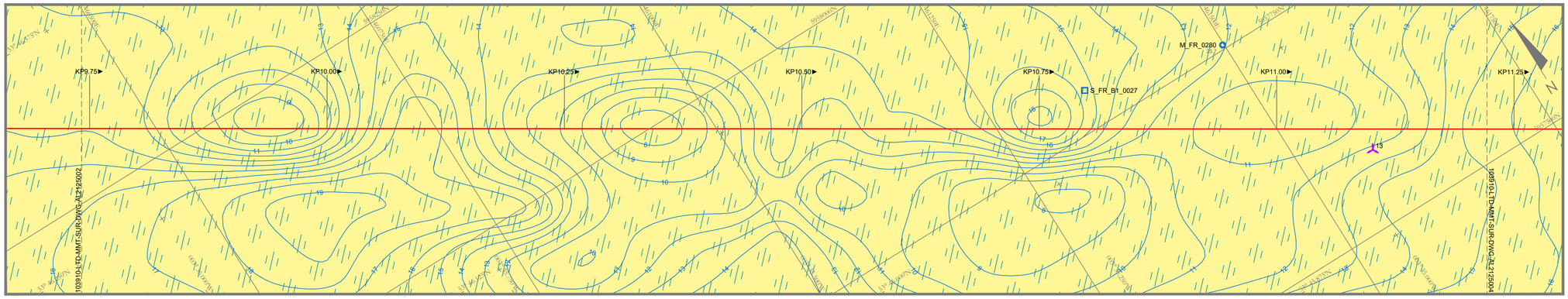
Survey Line: OWF_2125 | KP 8.102 - 9.742

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL2125002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 005

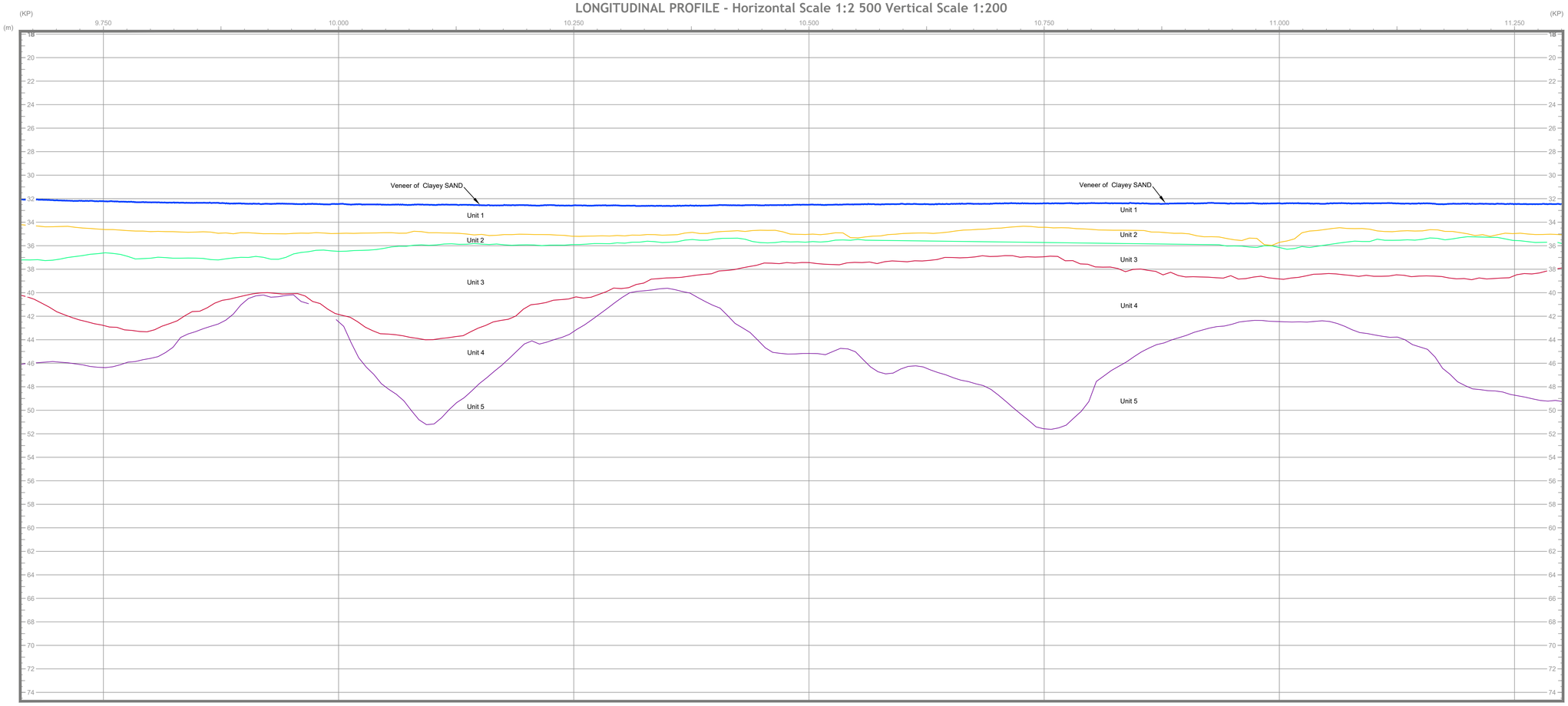
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2
- M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

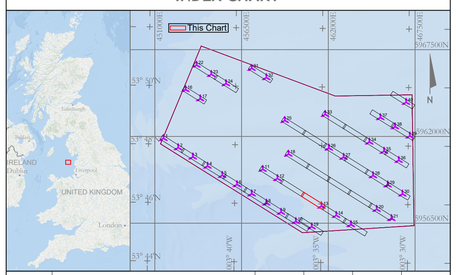
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

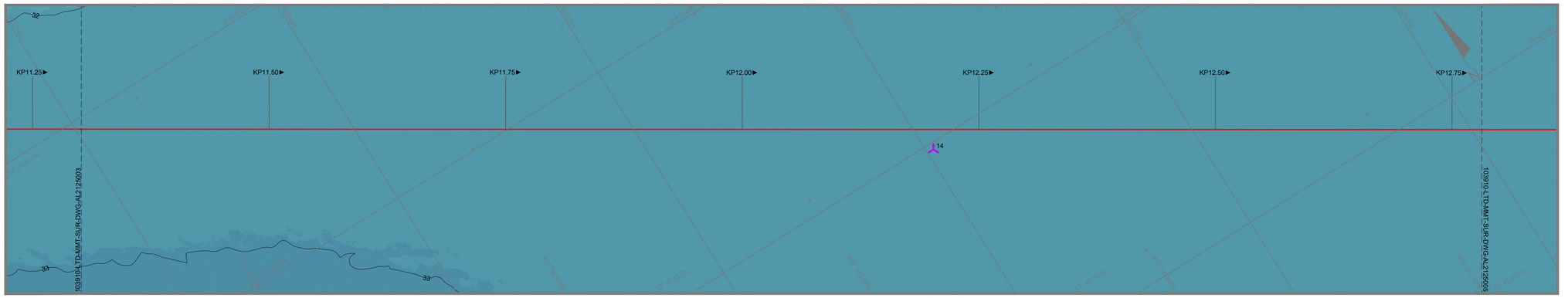
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

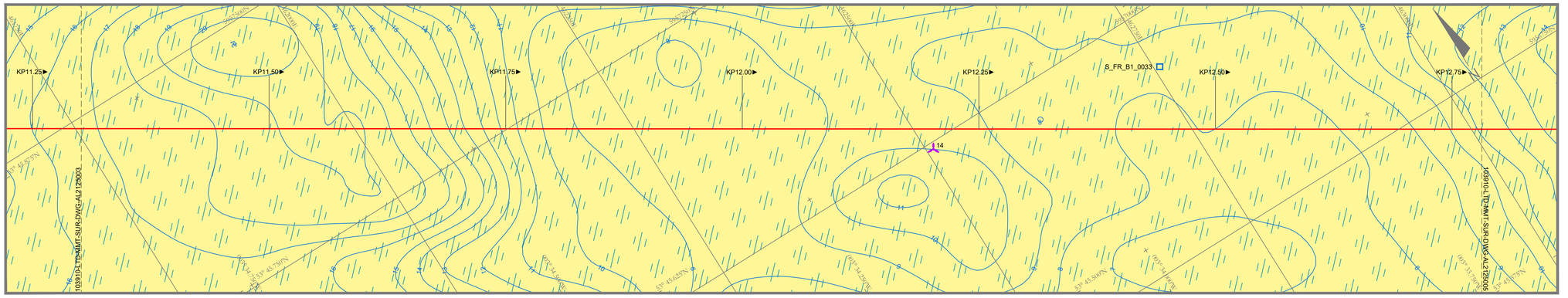
Survey Line: OWF_2125 | KP 9.662 - 11.302

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL2125003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	003 of 005

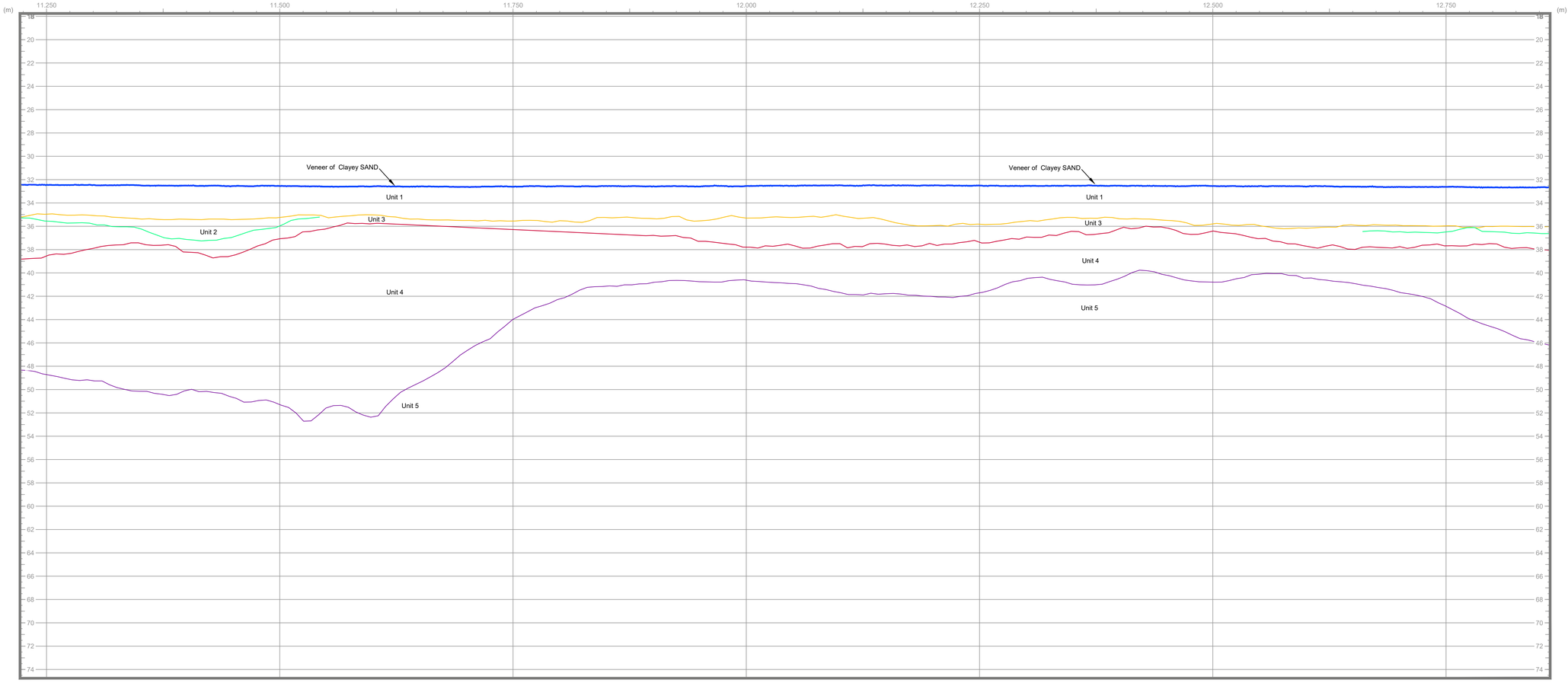
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Matchline to Neighbouring Chart with Chart ID
- 103910-LTD-MMT... — Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
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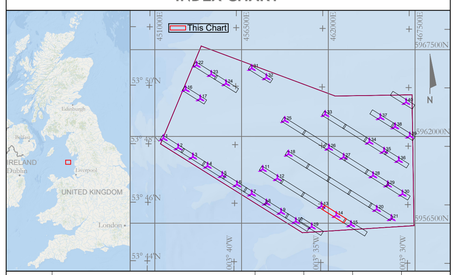
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
FLOTATION ENERGY
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

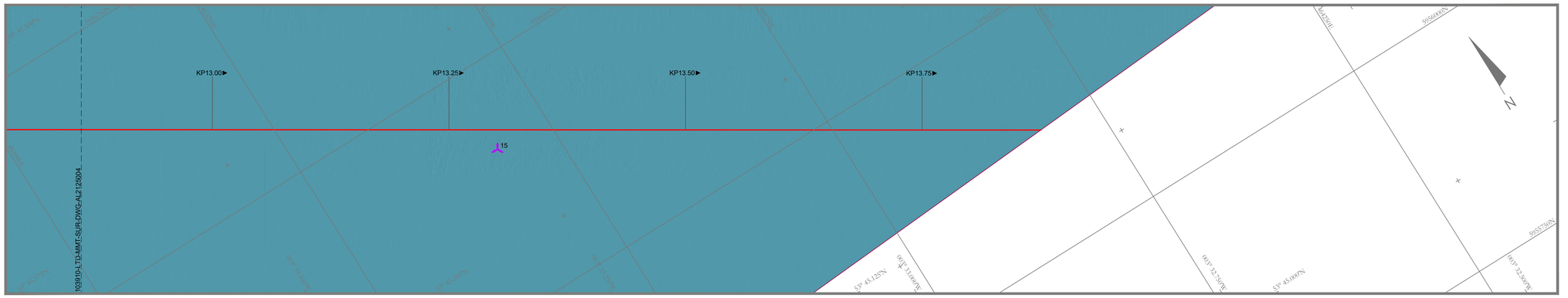
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

Survey Line: OWF_2125 | KP 11.222 - 12.862

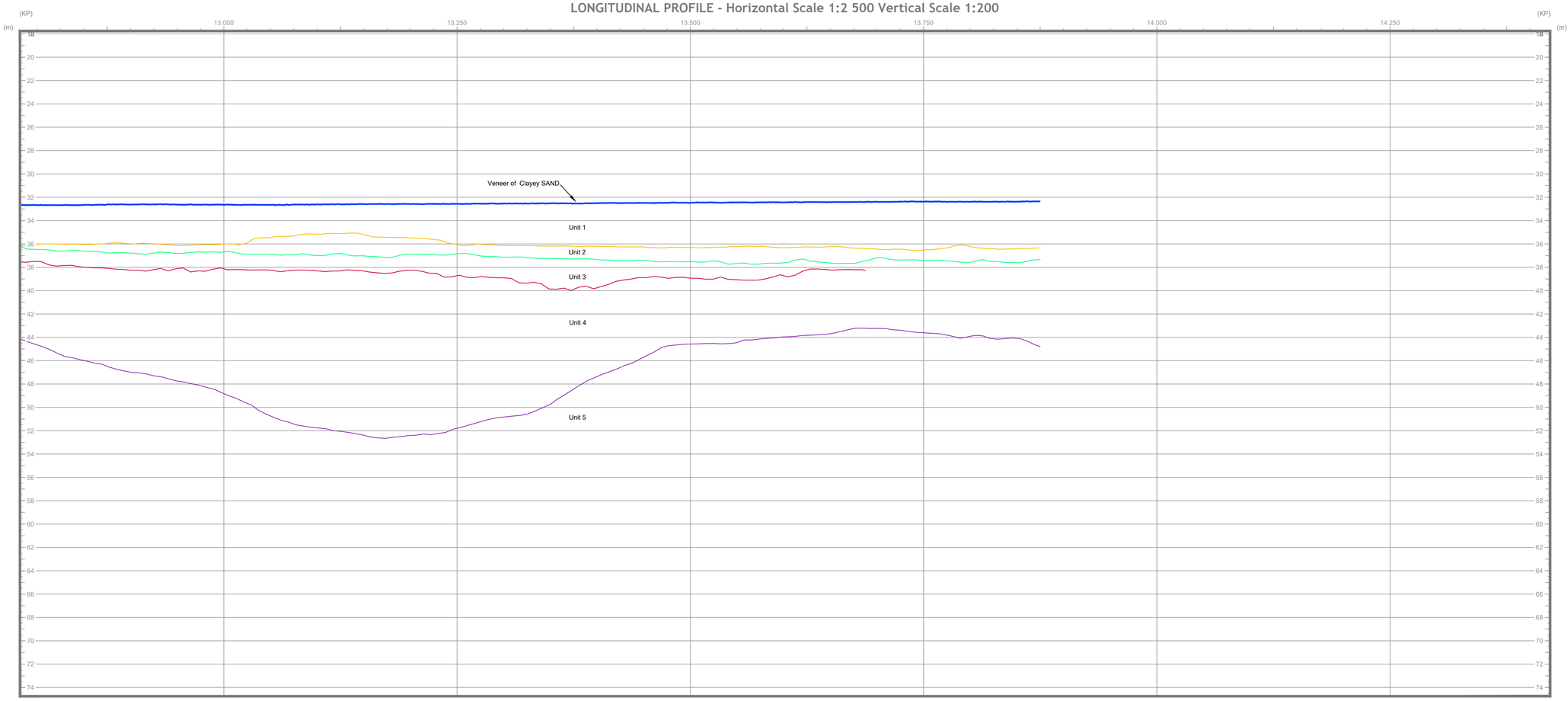
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL2125004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	004 of 005

BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500

LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

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- SAND
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- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117, 5.2 — MAG Contact with ID and nT Value
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- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
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- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
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- 6.3' — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
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		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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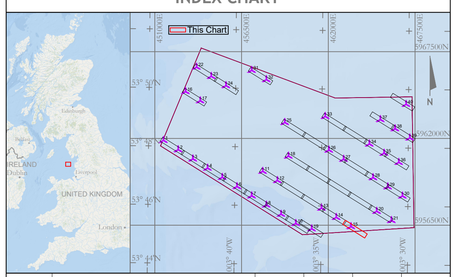
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

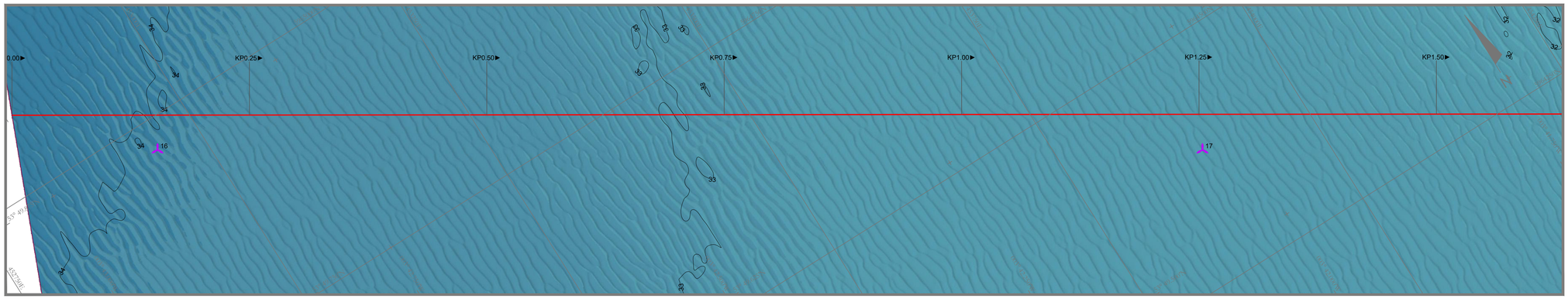
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

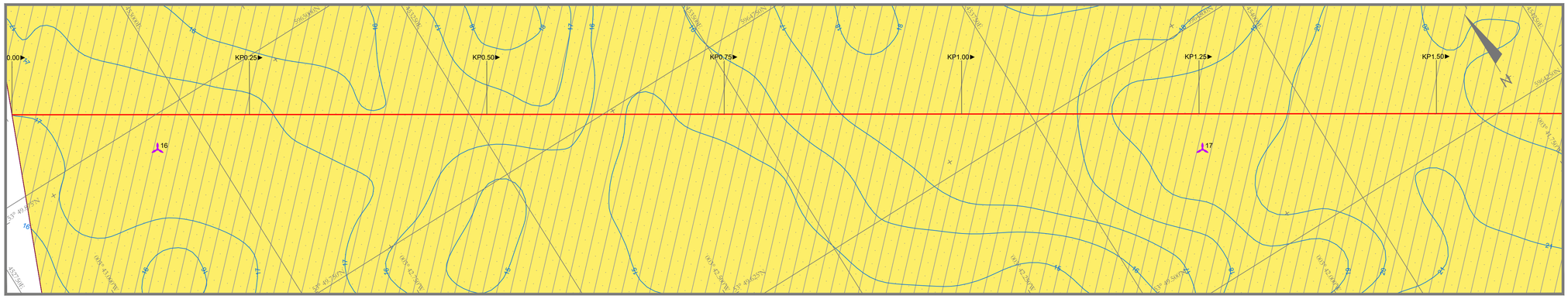
Survey Line: OWF_2125 | KP 12.782 - 13.875

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL2125005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	005 of 005

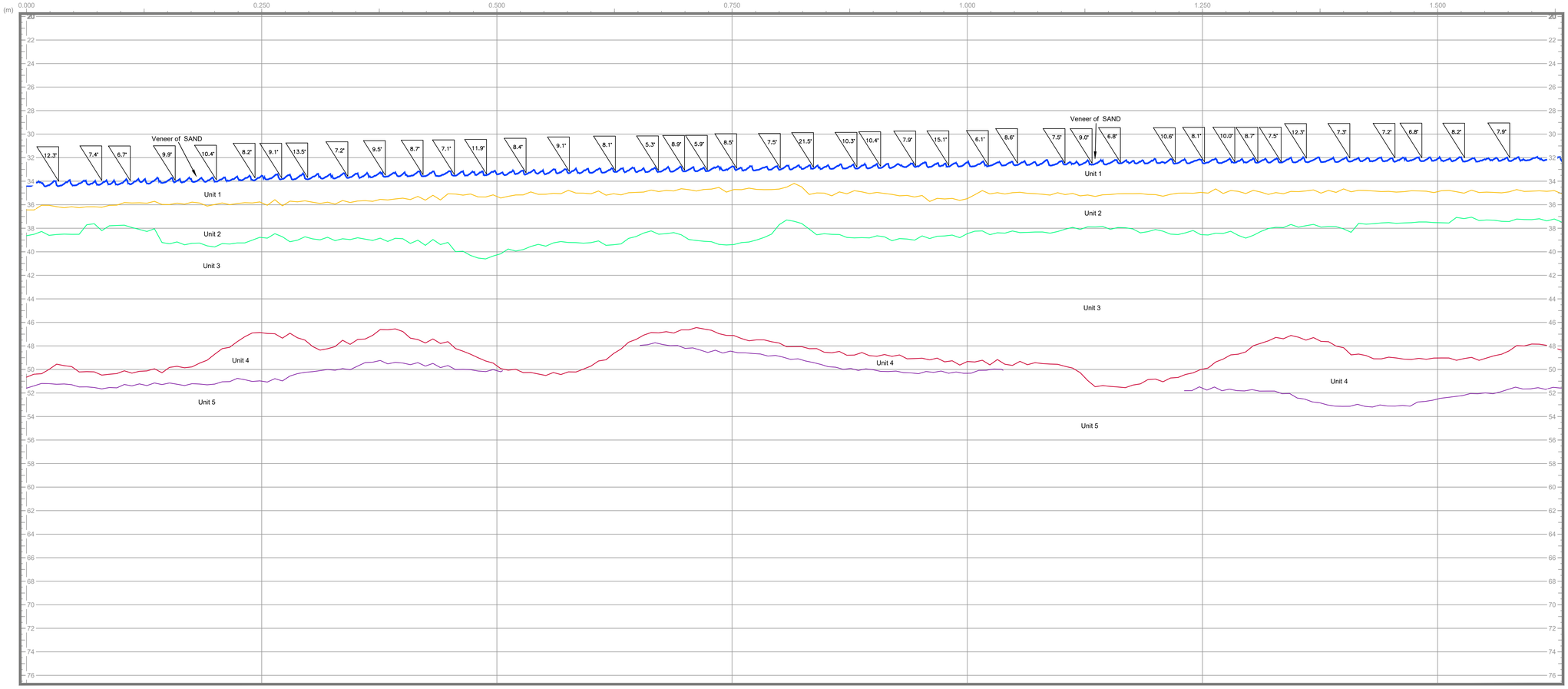
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- M_FR_0040 5.2 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

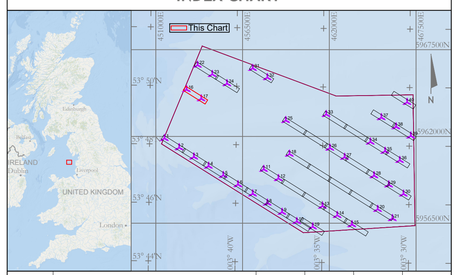
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H45	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
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Contractor :
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SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

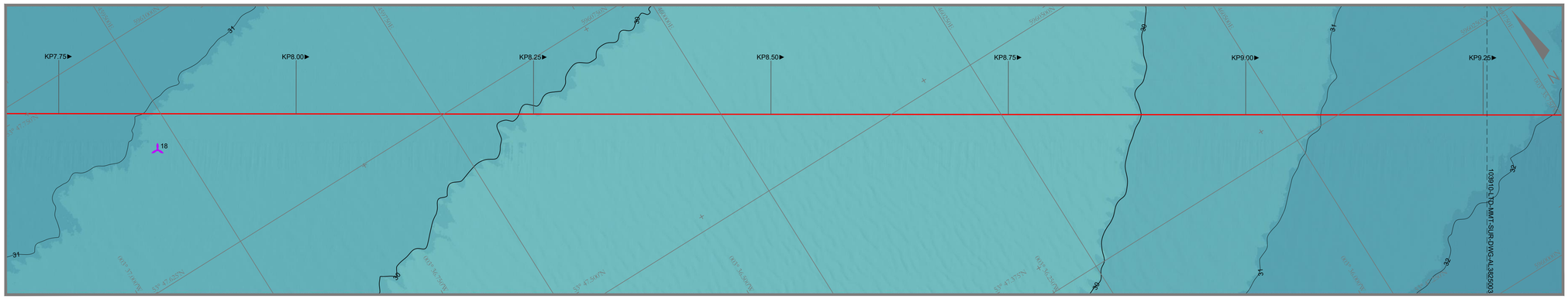
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

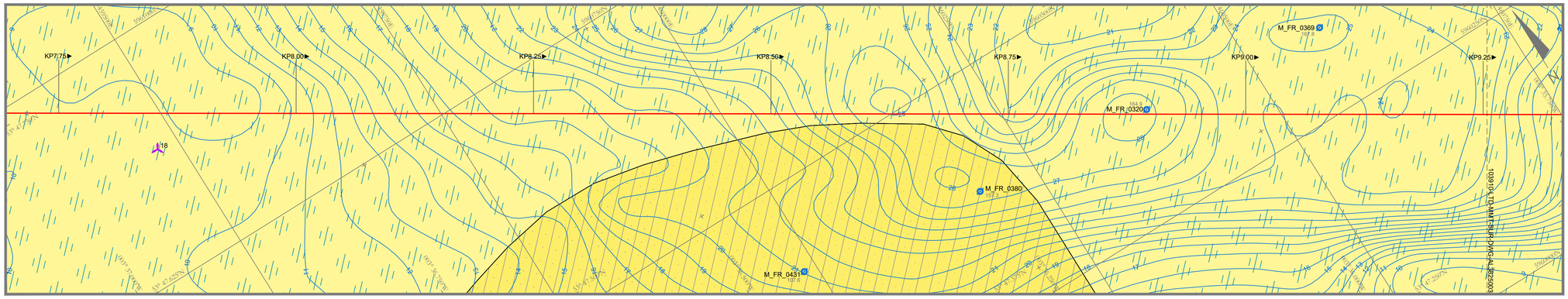
Survey Line: OWF_3825 | KP 0.000 - 1.633

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 006

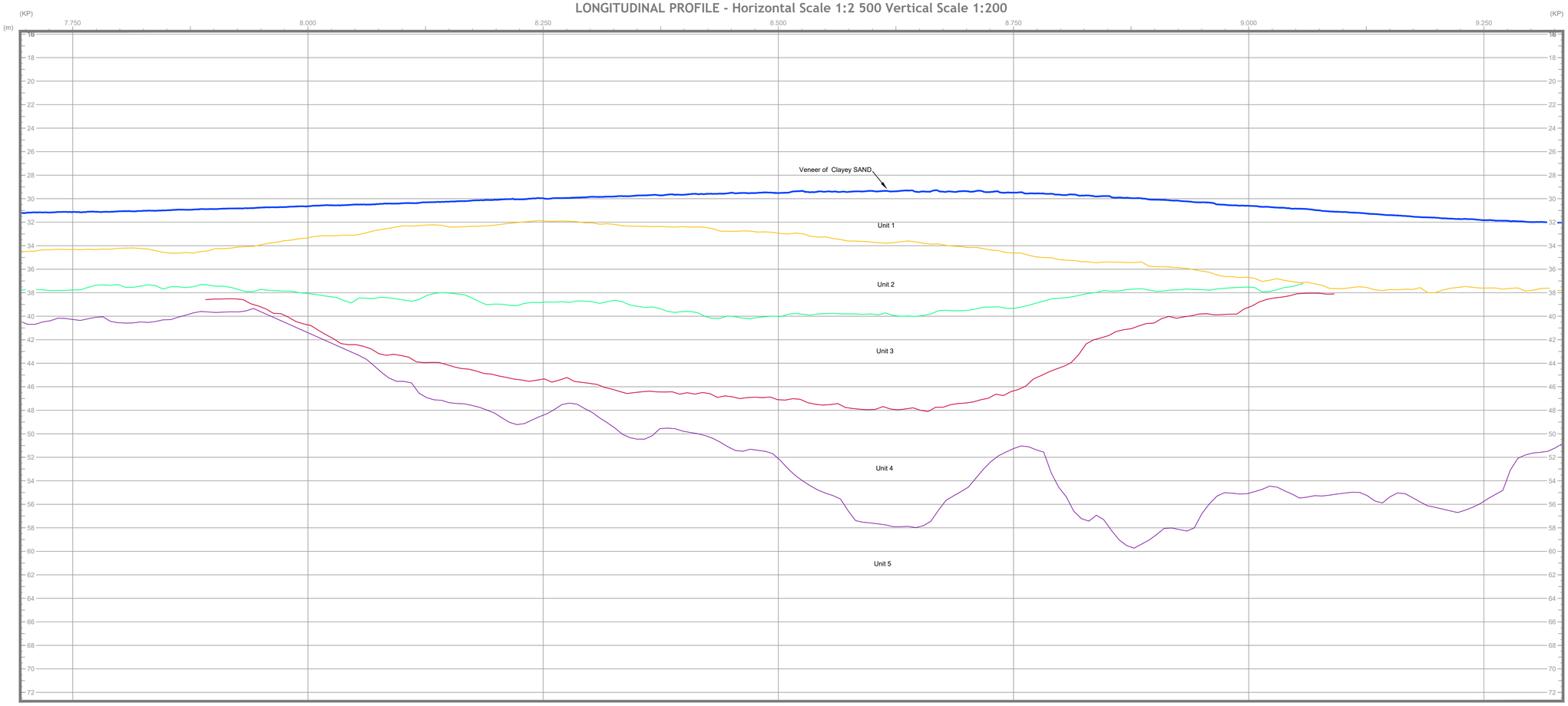
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- M_FR_0040 5.2 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

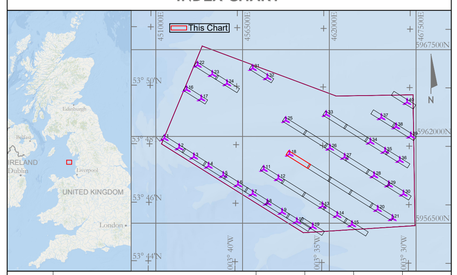
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
		H17	
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.		Unit 2
		H40	
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.		Unit 3
		H45	
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.		Unit 4 - TILL
		H50	
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
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FLOTATION ENERGY
Tel: +44 (0) 7712 864013
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

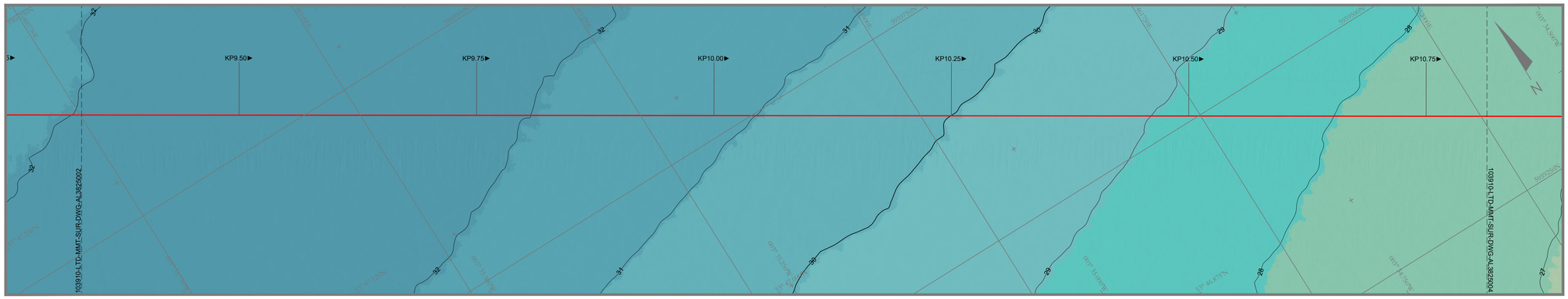
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

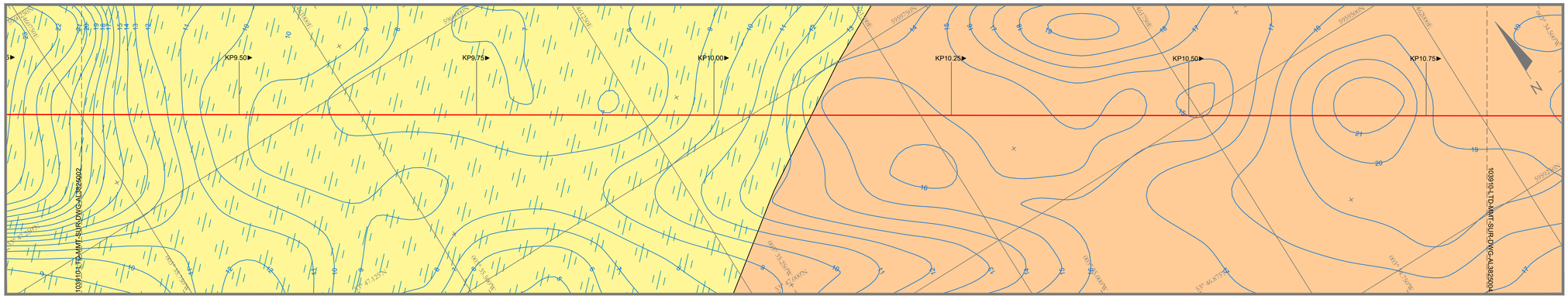
Survey Line: OWF_3825 | KP 7.694 - 9.334

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 006

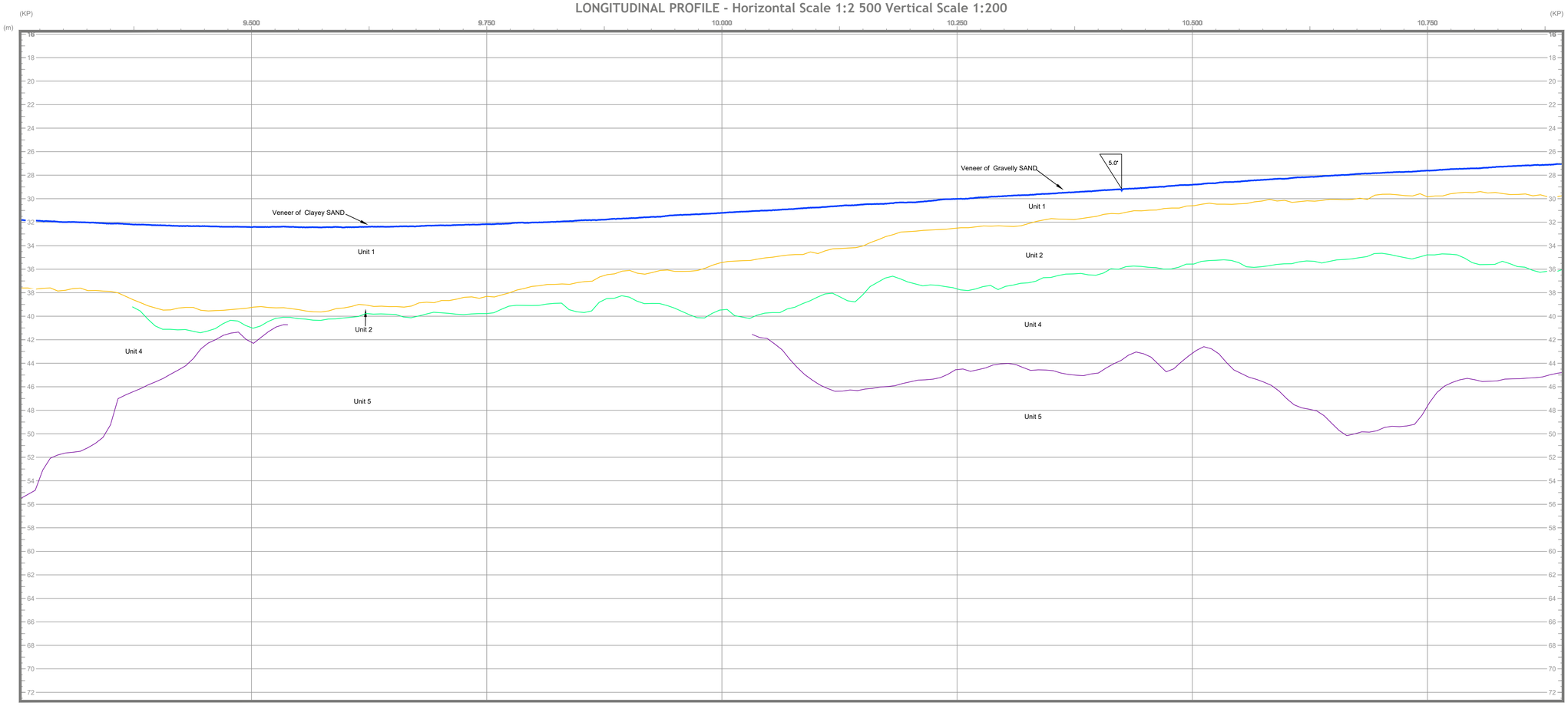
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
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SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
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- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
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- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	H17	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H40	Unit 2
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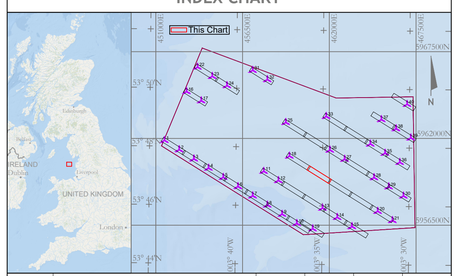
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H50	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
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Contractor :
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Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

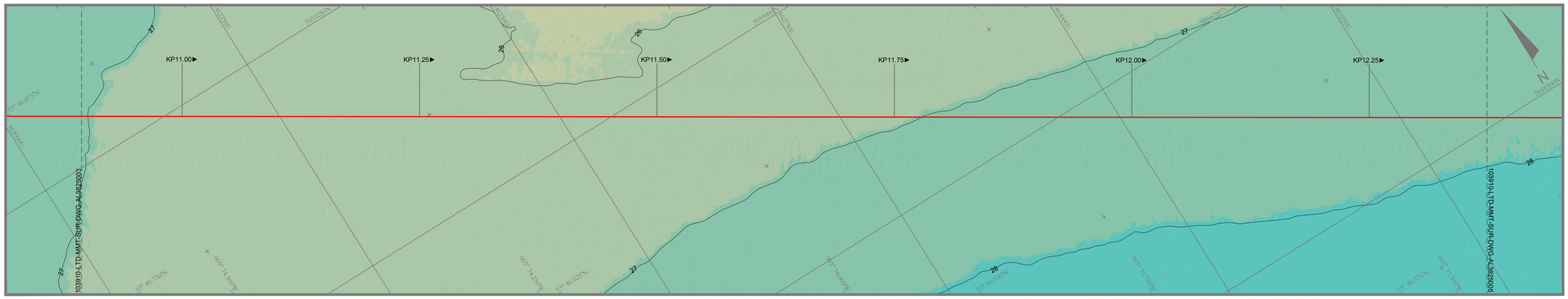
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

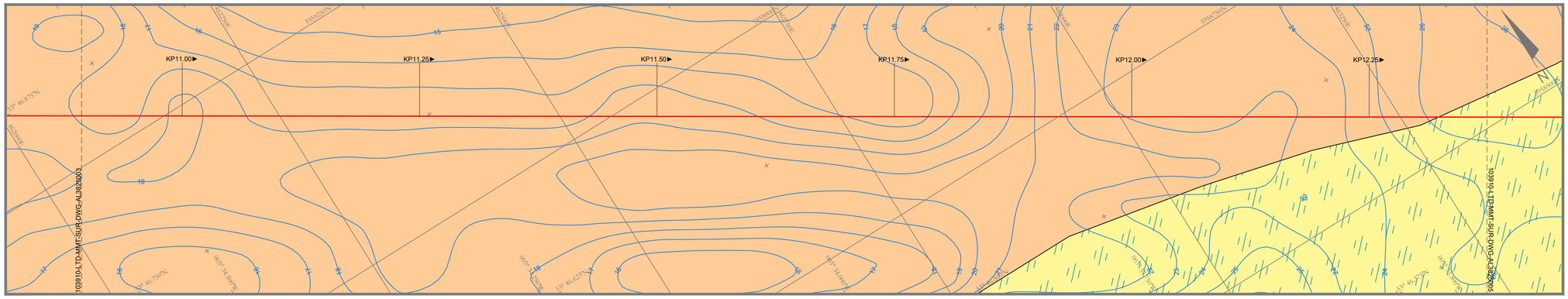
Survey Line: OWF_3825 | KP 9.254 - 10.894

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	003 of 006

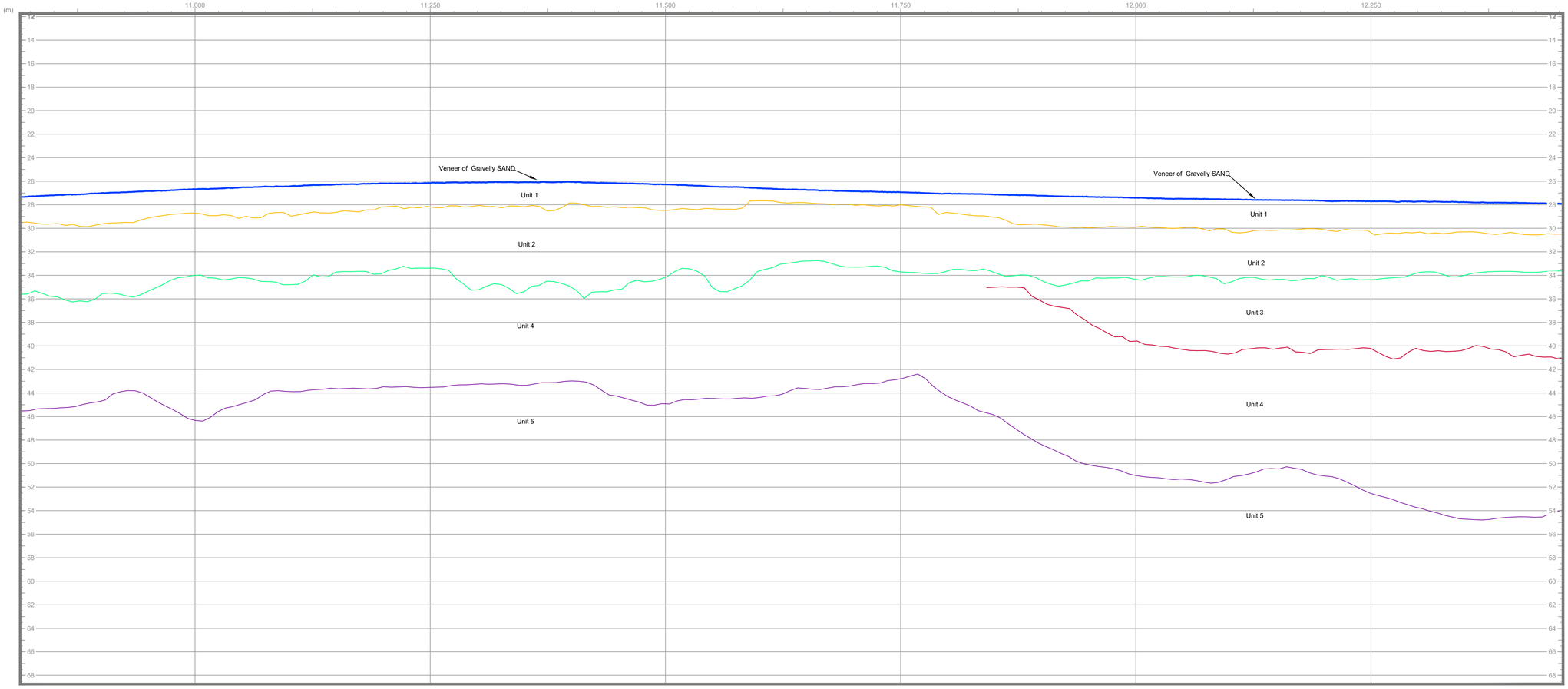
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
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- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

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SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
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- Current Lineation
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- Sand waves
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LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
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- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
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		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
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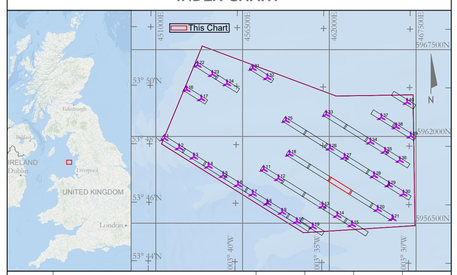
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

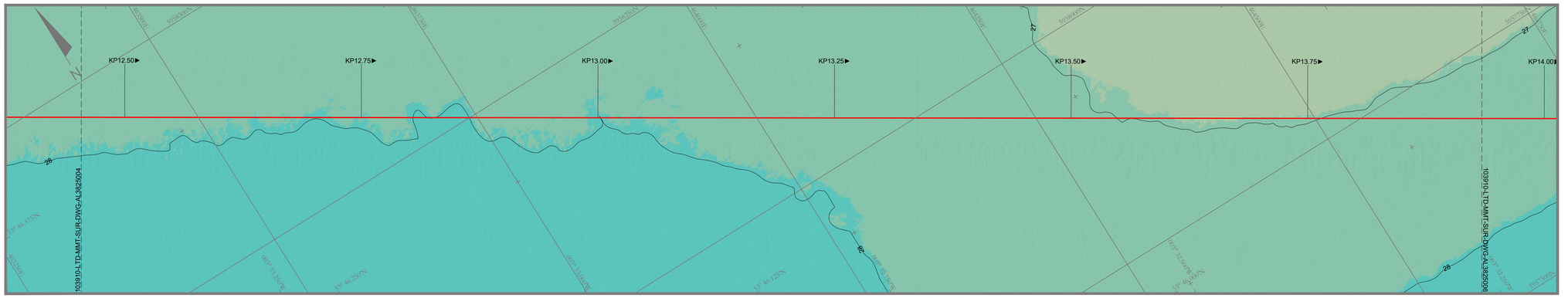
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

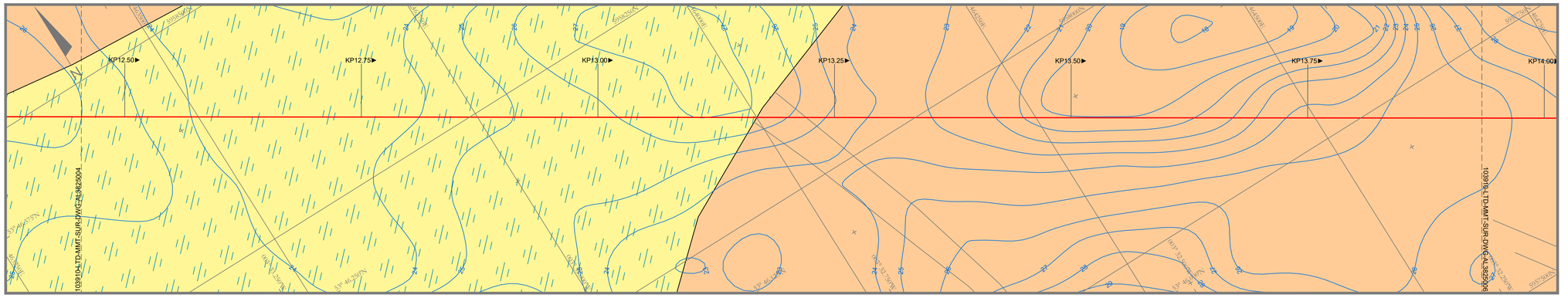
Survey Line: OWF_3825 | KP 10.814 - 12.454

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	004 of 006

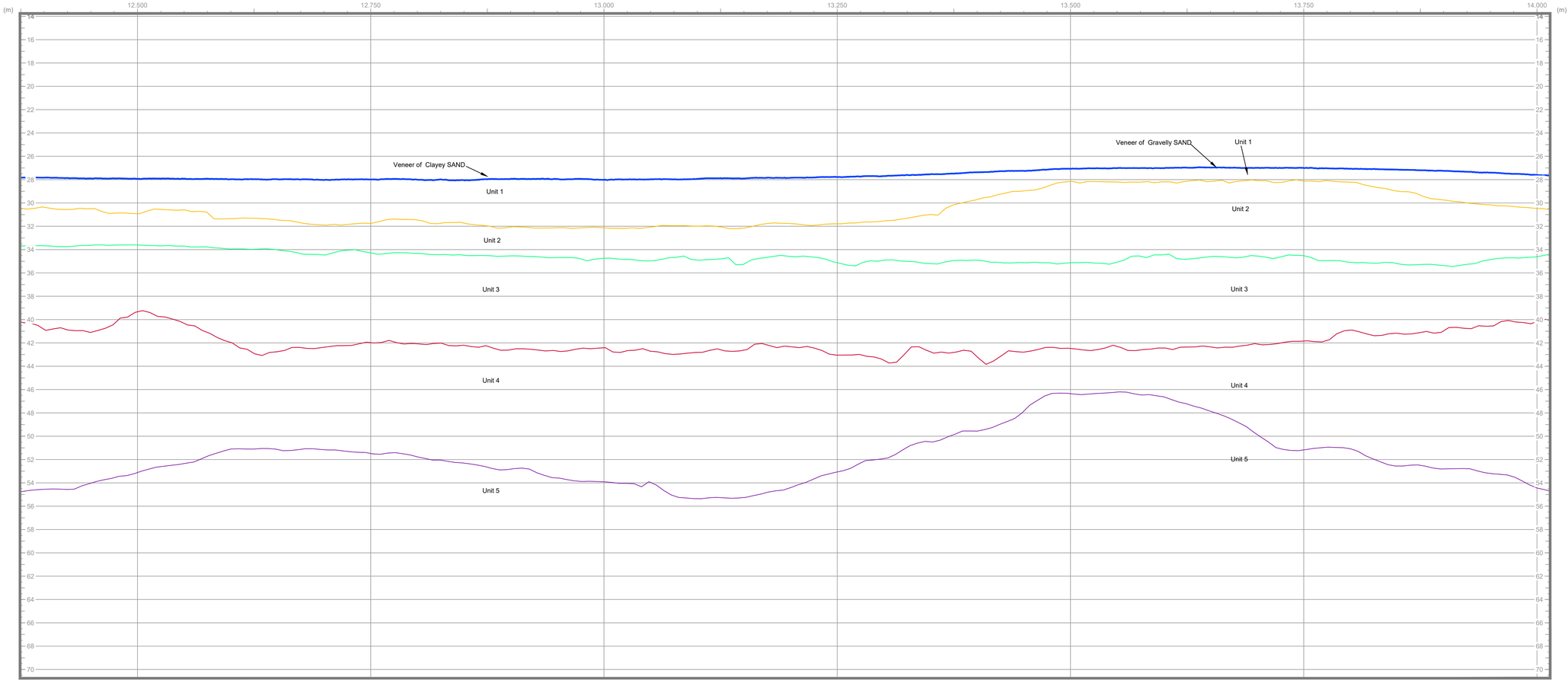
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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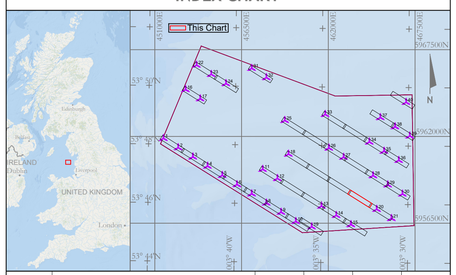
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
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Contractor :
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Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

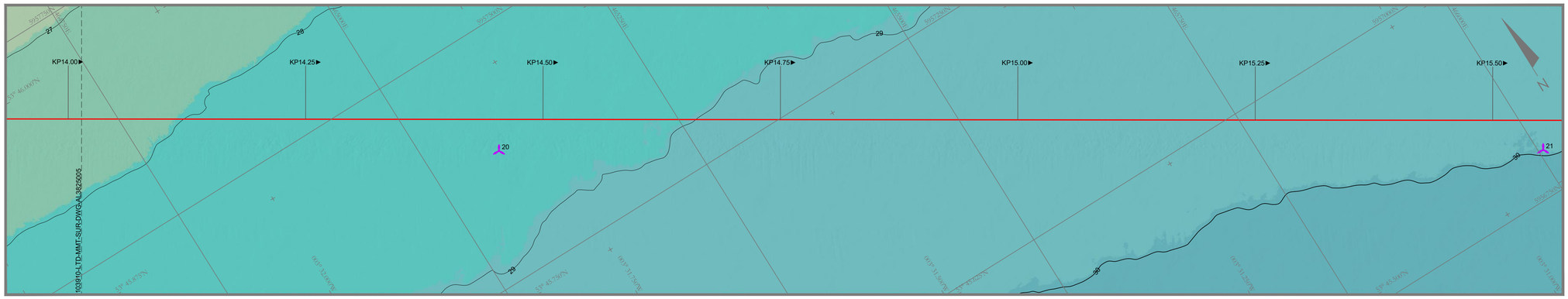
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

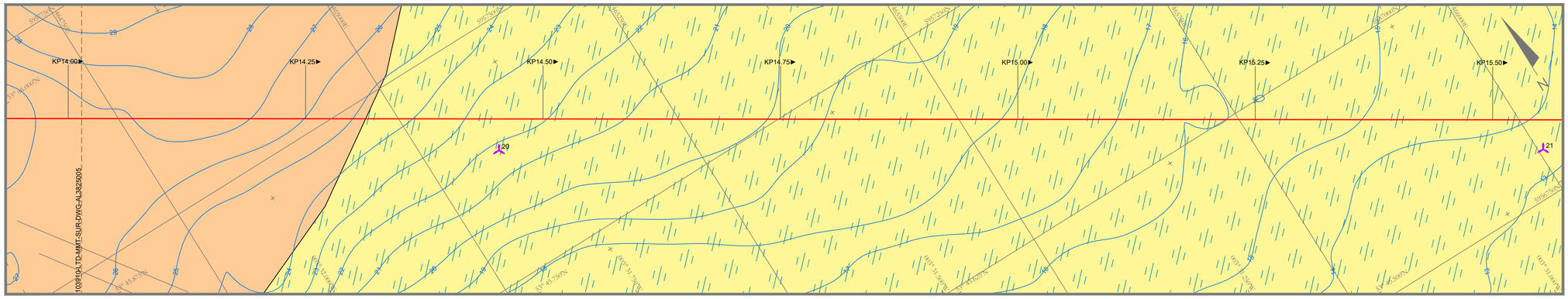
Survey Line: OWF_3825 | KP 12.374 - 14.014

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	005 of 006

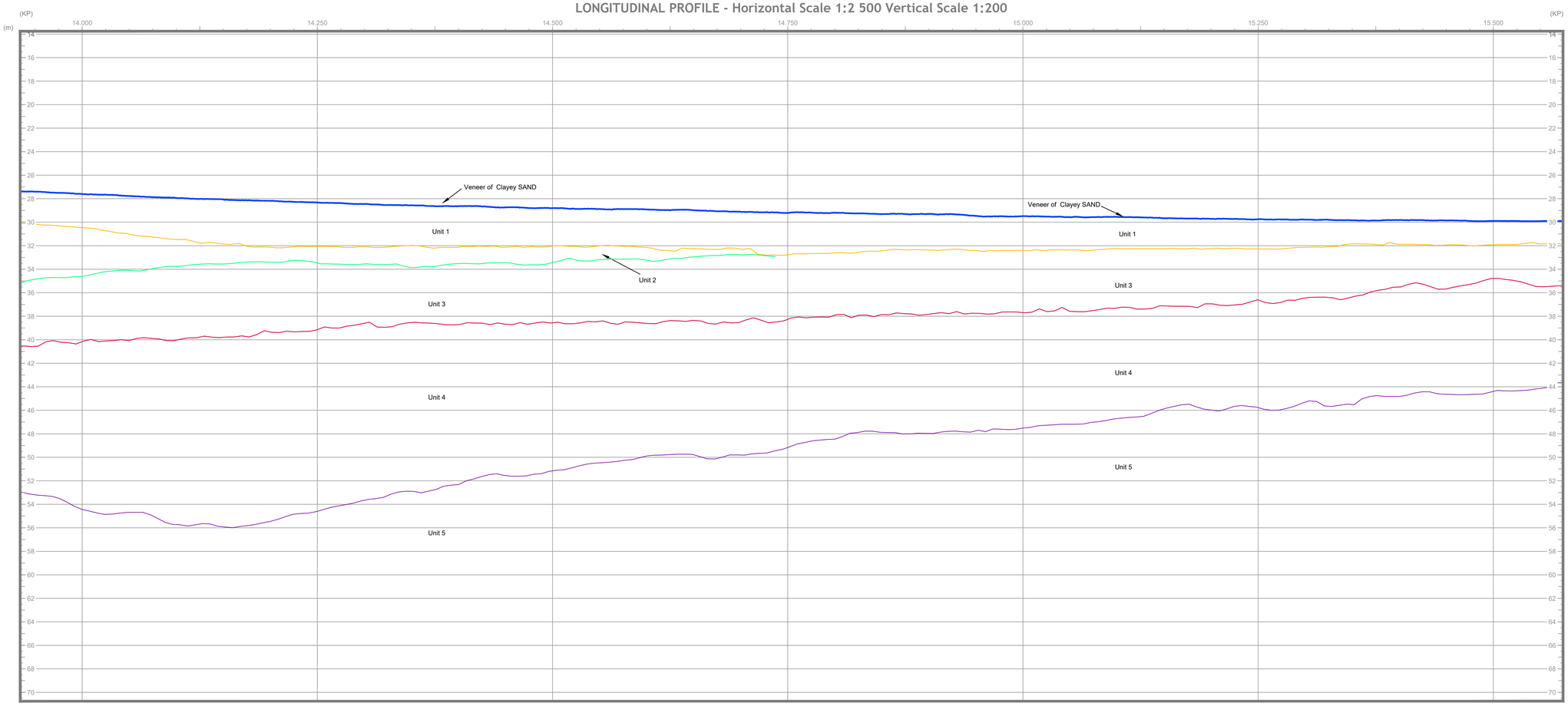
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6" — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
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Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
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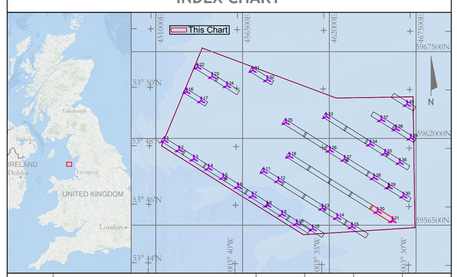
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

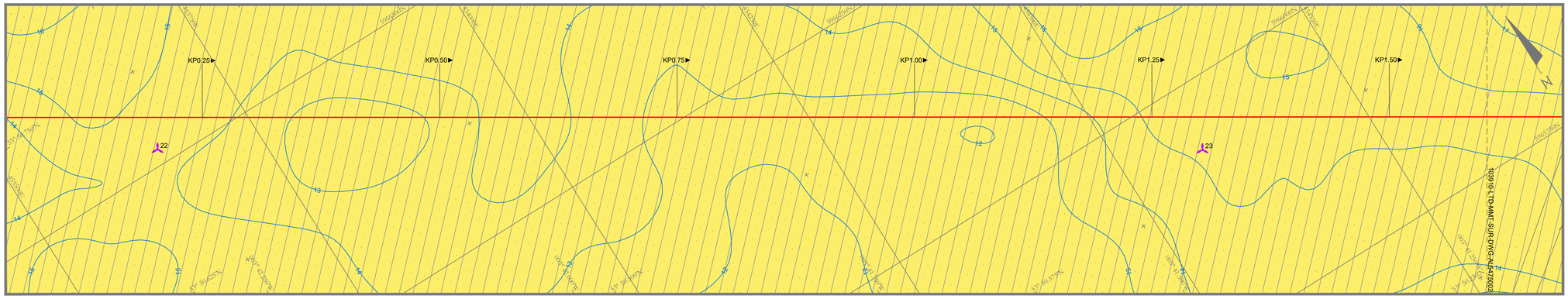
ALIGNMENT CHART

Survey Line: OWF_3825 | KP 13.934 - 15.574

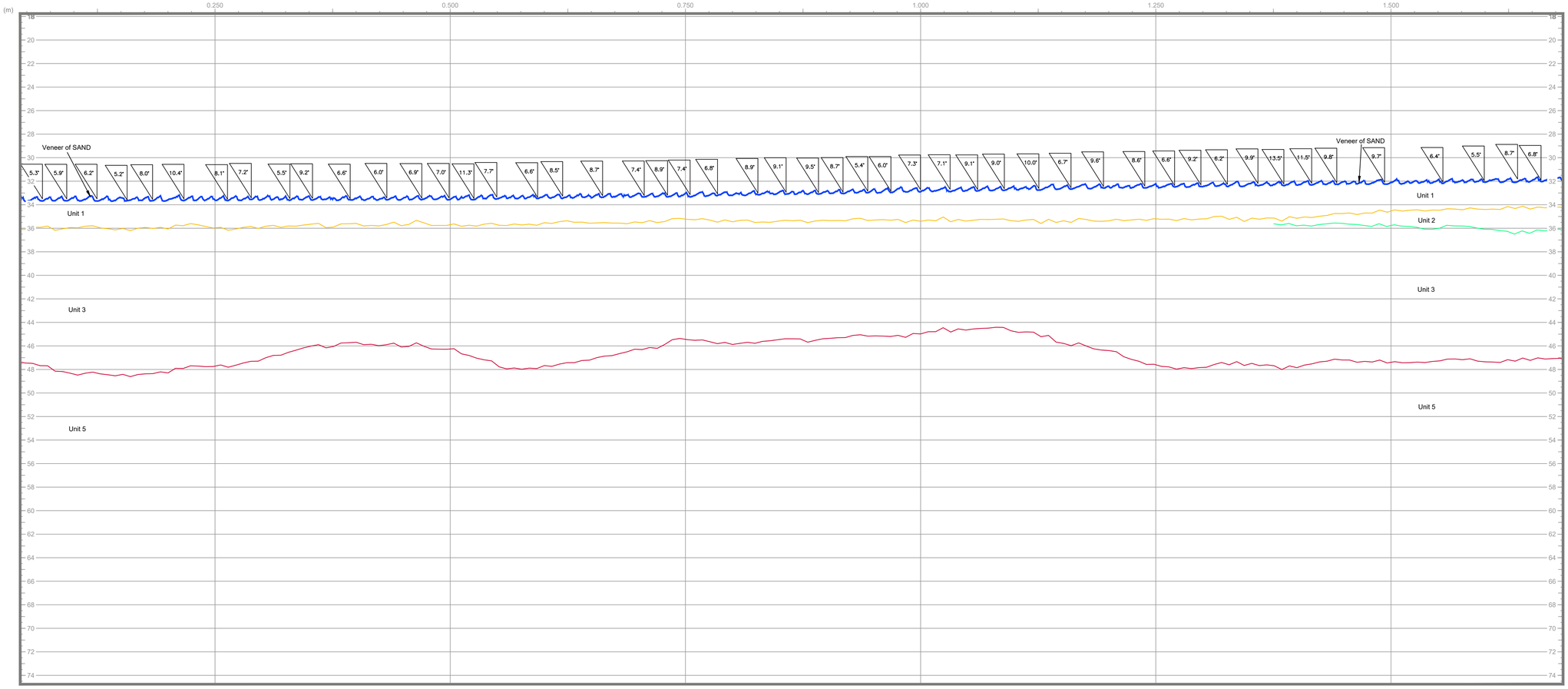
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL3825006
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	006 of 006

BATHYMETRY - Horizontal Scale 1:2 500

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
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- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
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- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
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Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/V 320
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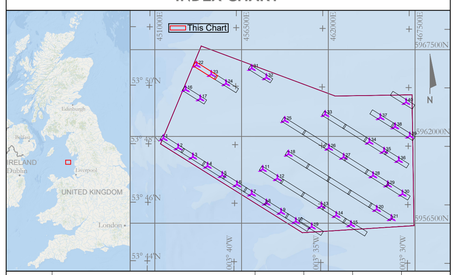
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
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Contractor :
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Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

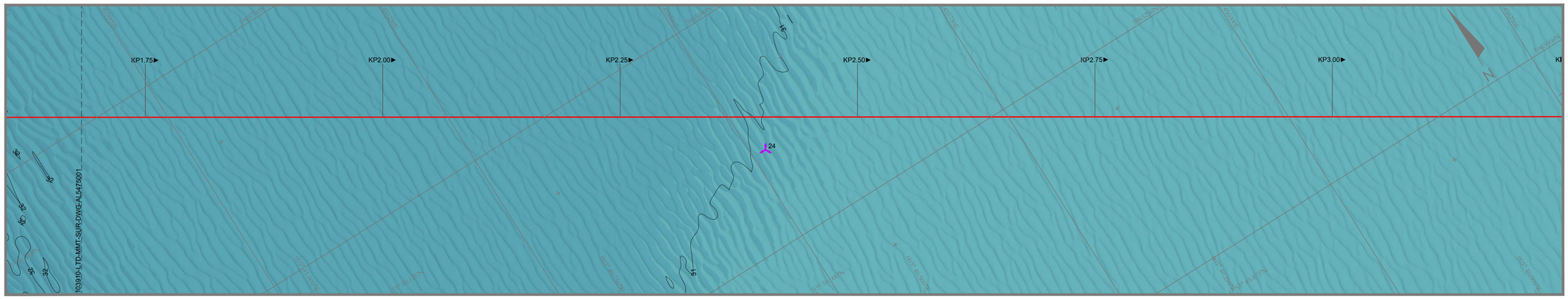
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

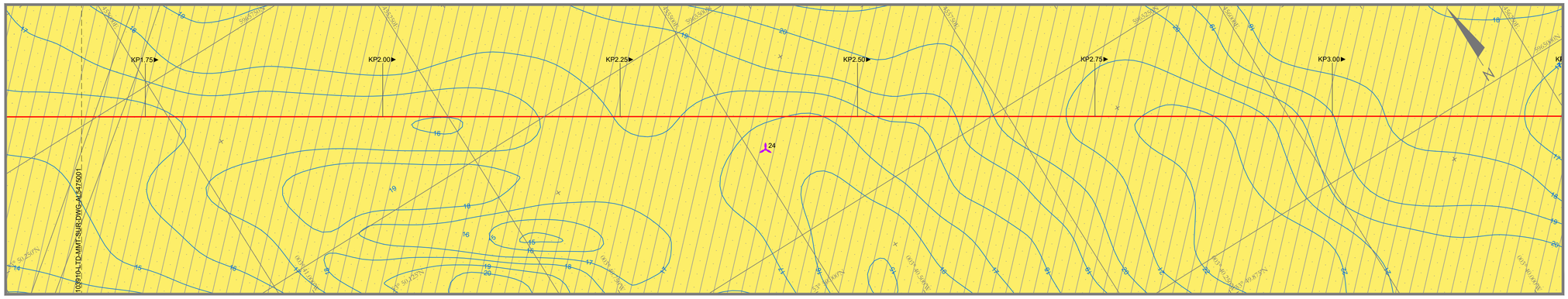
Survey Line: OWF_5475 | KP 0.043 - 1.683

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 008

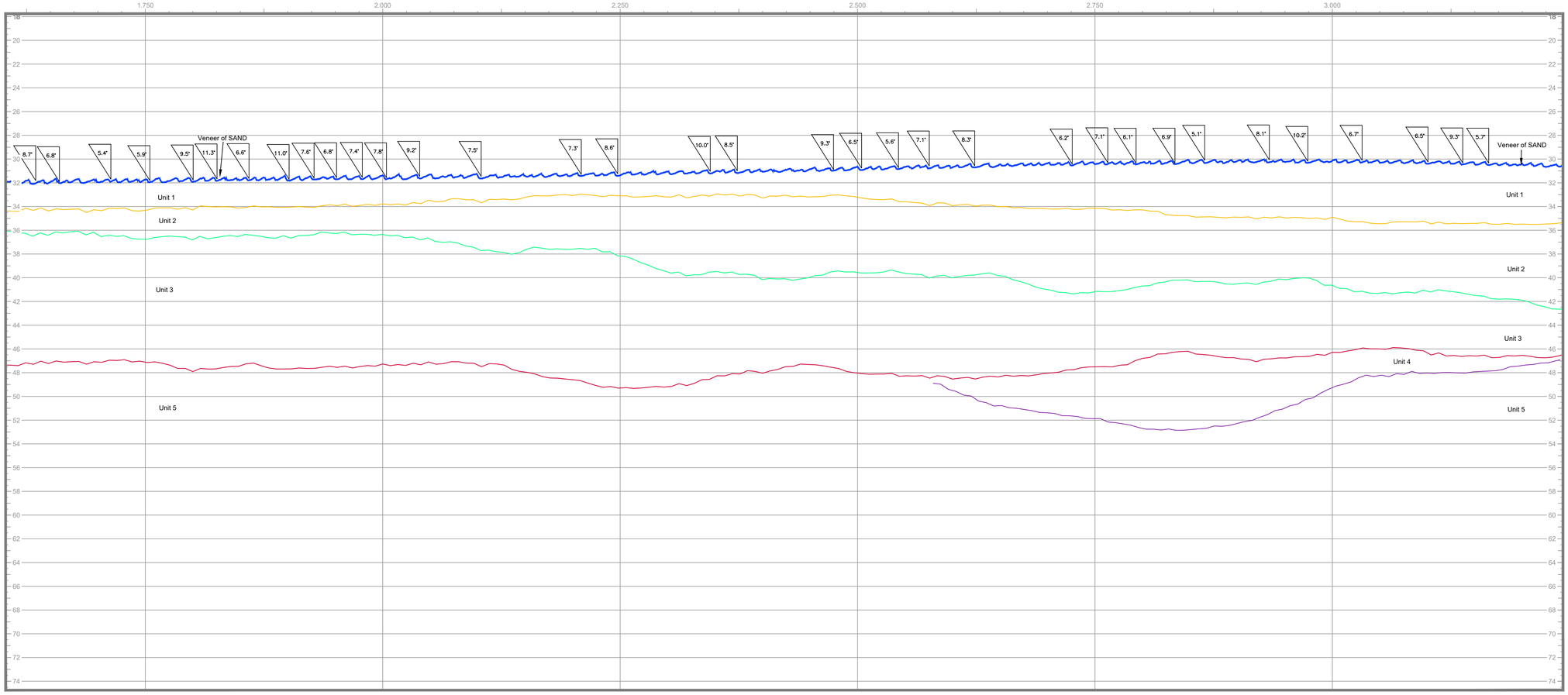
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

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LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
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SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
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Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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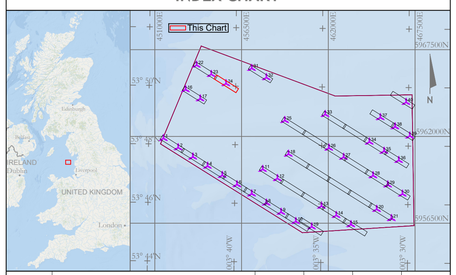
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

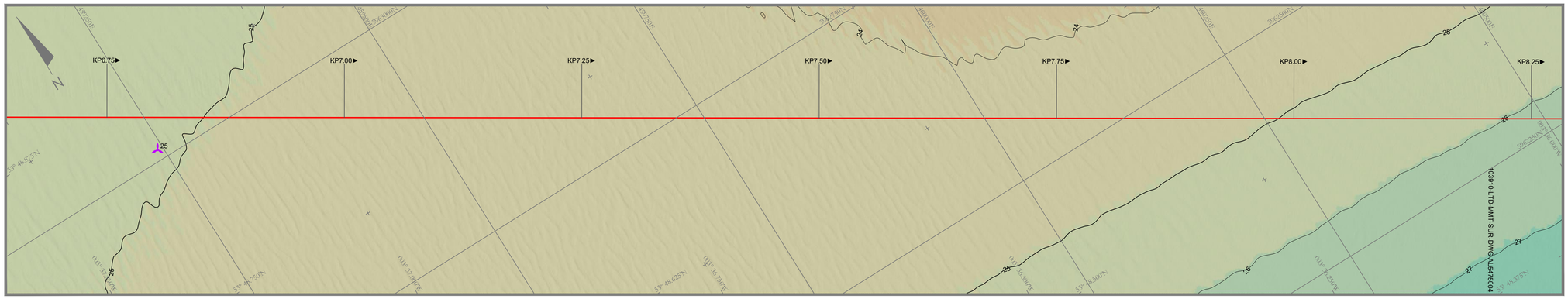
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

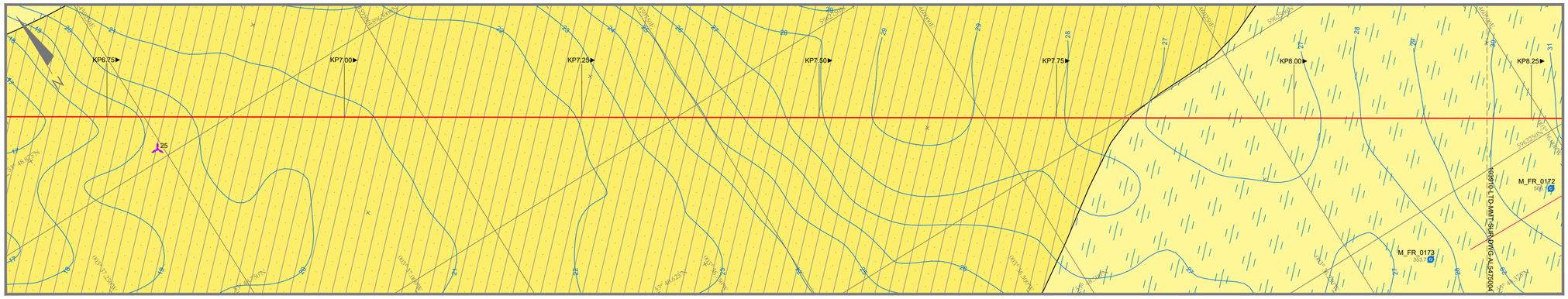
Survey Line: OWF_5475 | KP 1.603 - 3.243

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 008

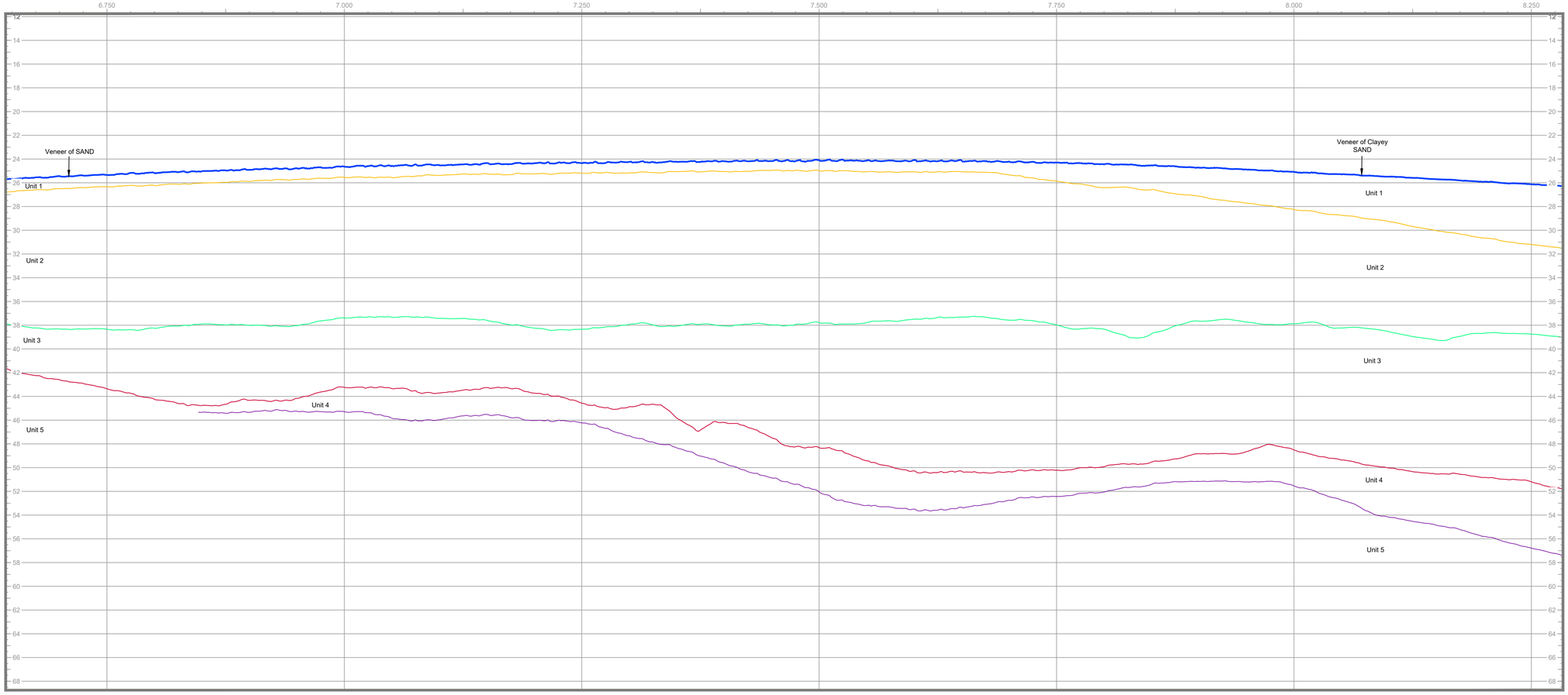
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Matchline to Neighbouring Chart with Chart ID (103910-LTD-MMT...)
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

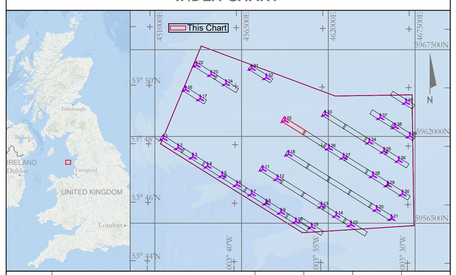
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TYG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Scotland
FLOTATION ENERGY
Tel: +44 (0) 7712 864013
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

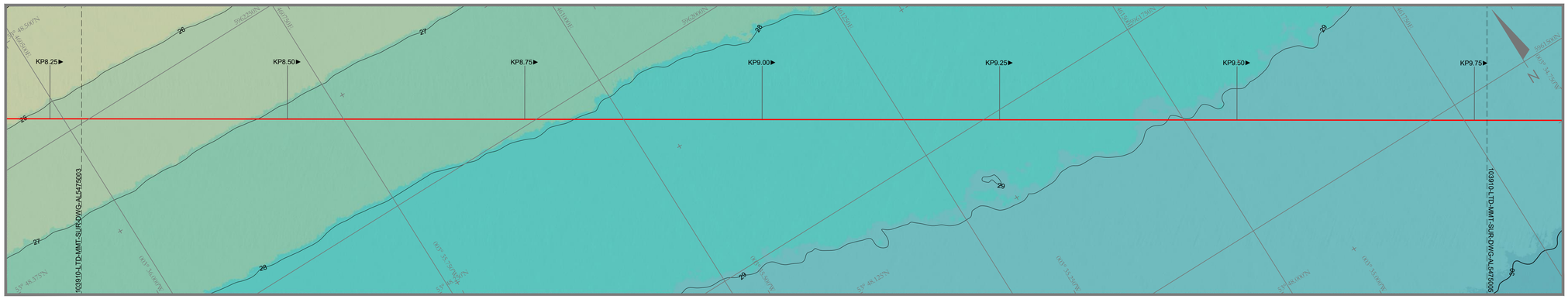
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

Survey Line: OWF_5475 | KP 6.643 - 8.283

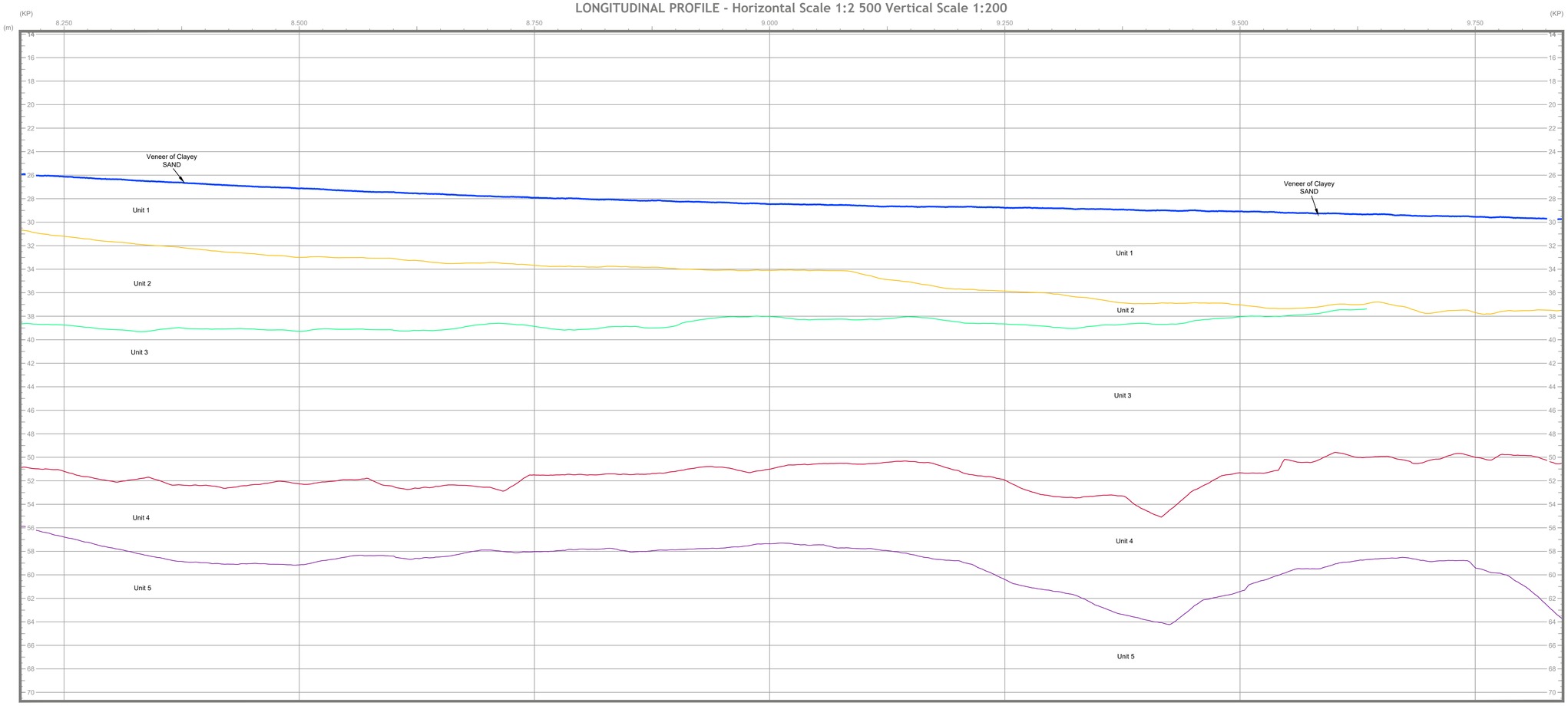
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	003 of 008

BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500

LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

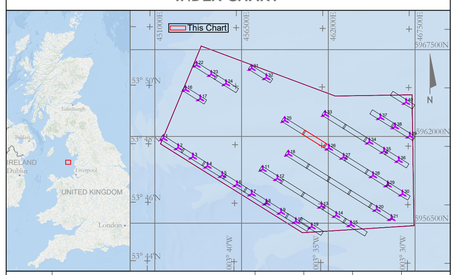
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
		H17	
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.		Unit 2
		H40	
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.		Unit 3
		H45	
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.		Unit 4 - TILL
		H50	
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

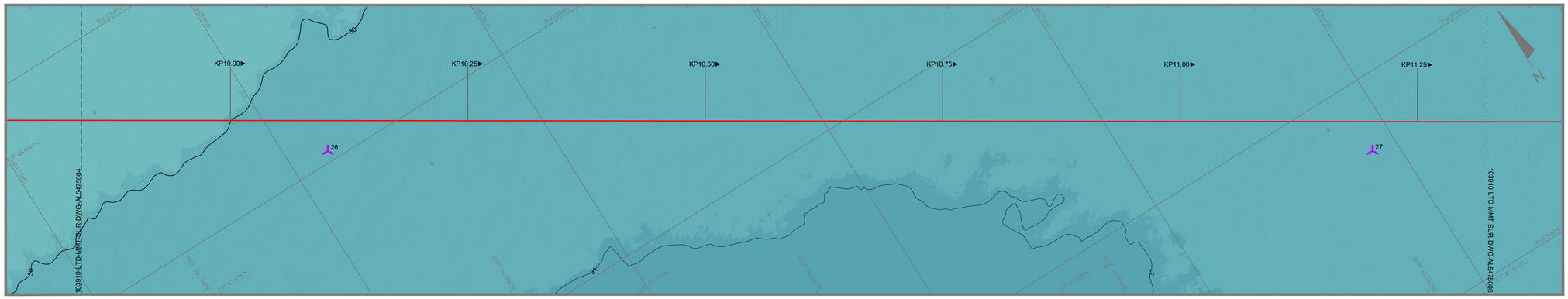
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

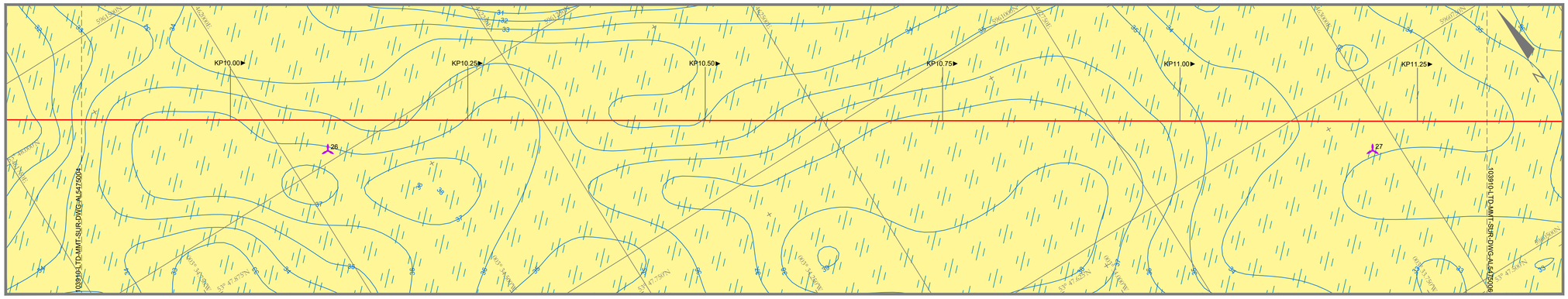
Survey Line: OWF_5475 | KP 8.203 - 9.843

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	004 of 008

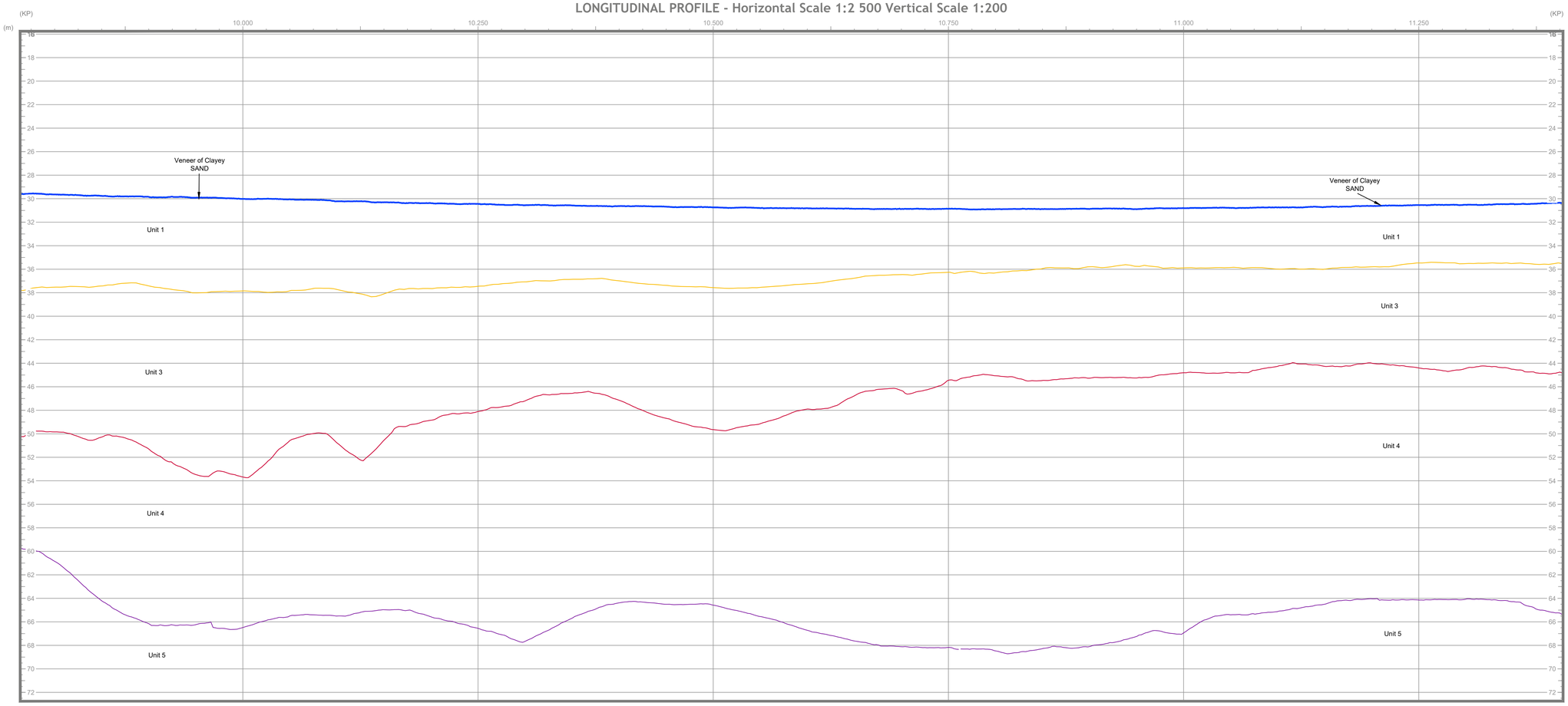
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2
- M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
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Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
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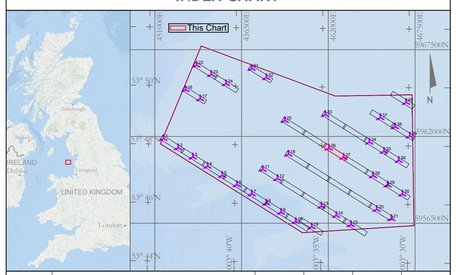
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

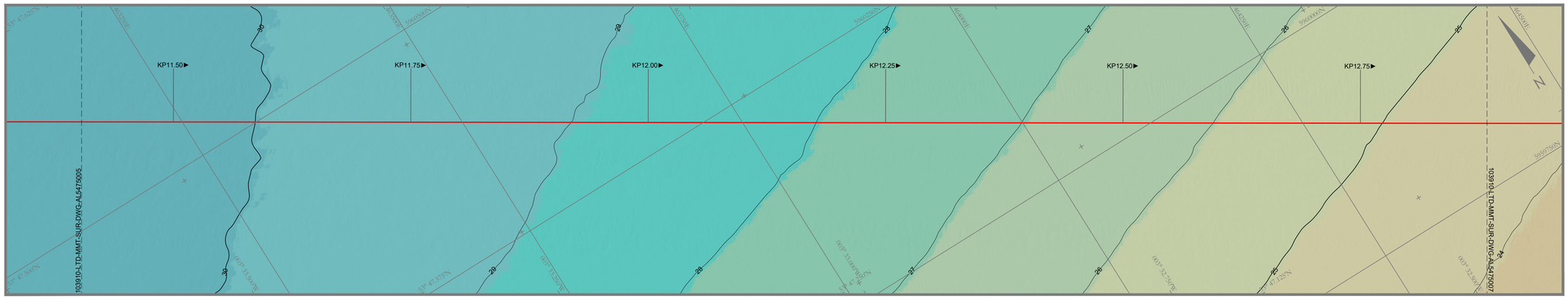
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

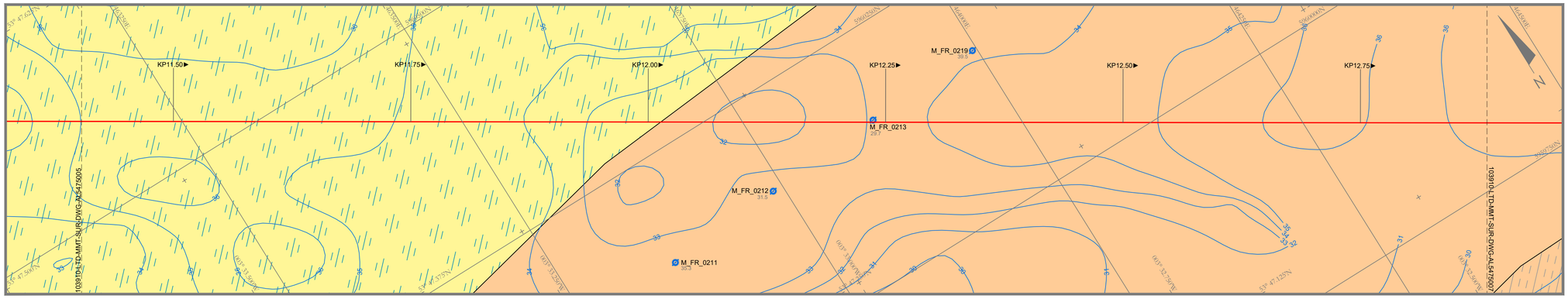
Survey Line: OWF_5475 | KP 9.763 - 11.403

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	005 of 008

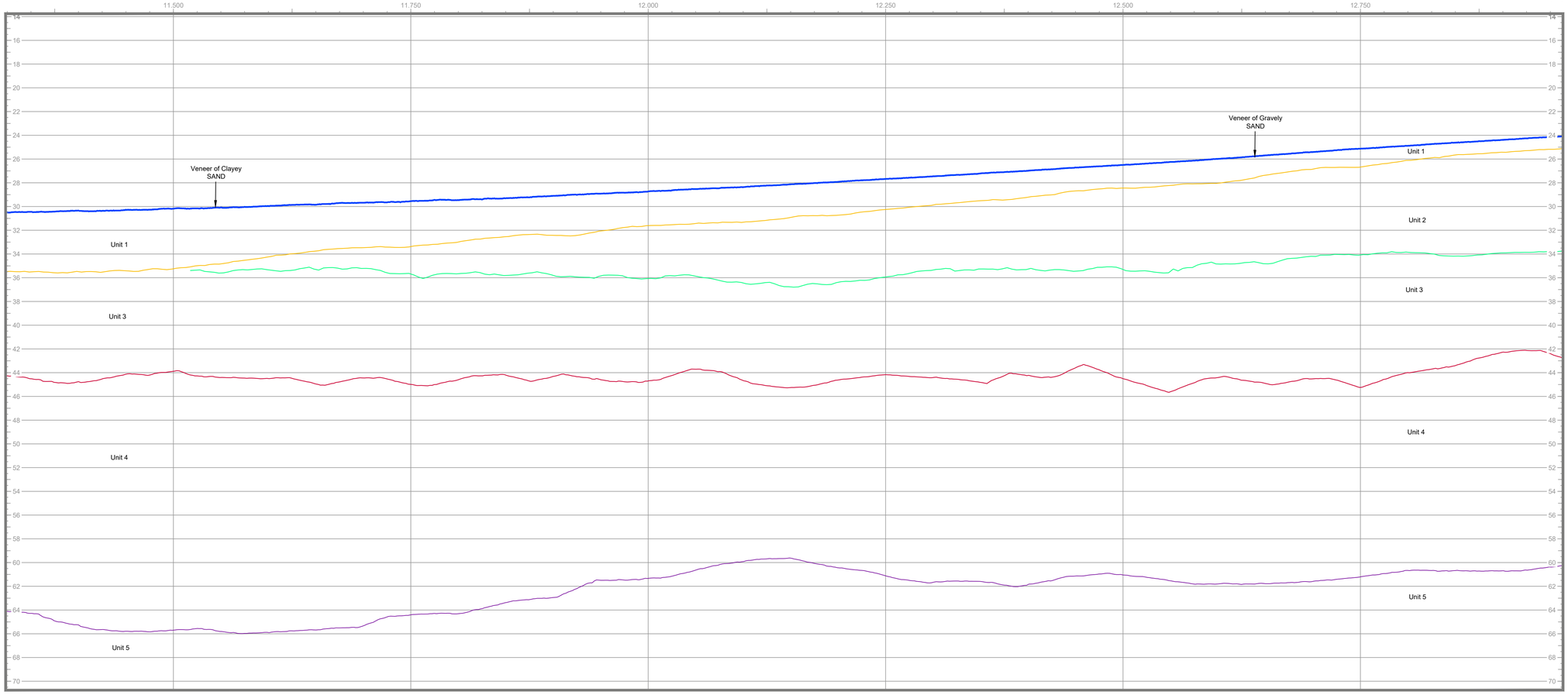
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Matchline to Neighbouring Chart with Chart ID (103910-LTD-MMT...)
- Proposed Wind Turbine Location with ID*
- Surface Infrastructure 500 m Exclusion Zone*
- R4 OWL Morecambe*
- * Client Provided

BATHYMETRY

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LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
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SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
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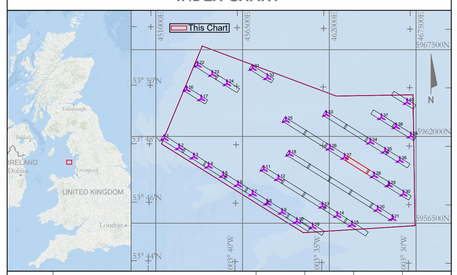
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

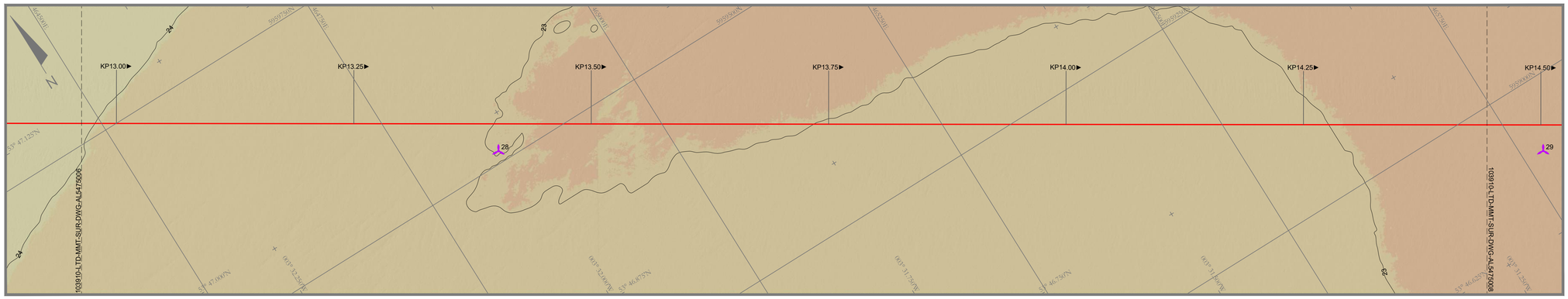
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

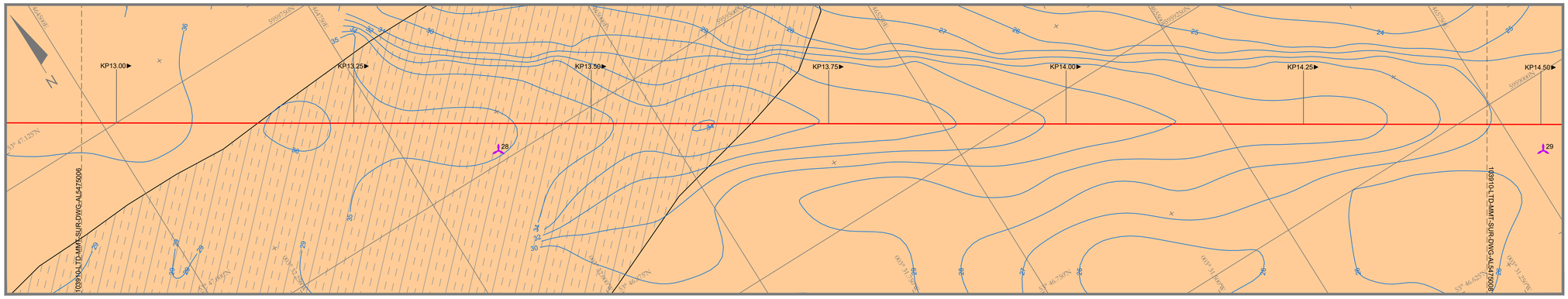
Survey Line: OWF_5475 | KP 11.323 - 12.963

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475006
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	006 of 008

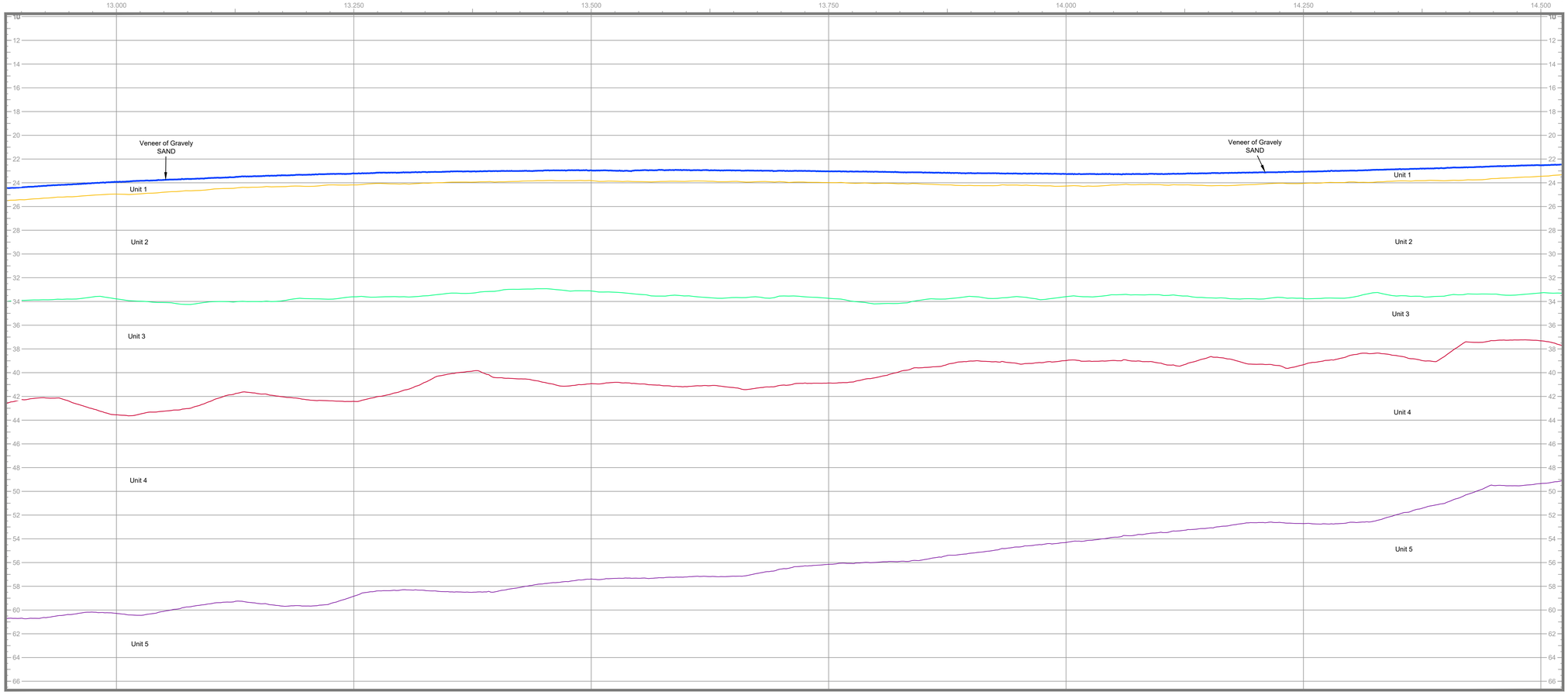
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

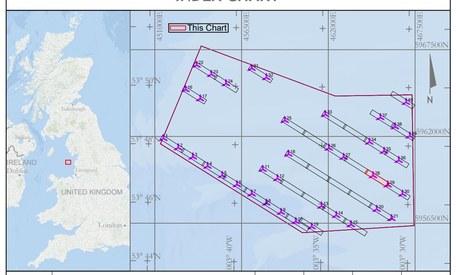
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

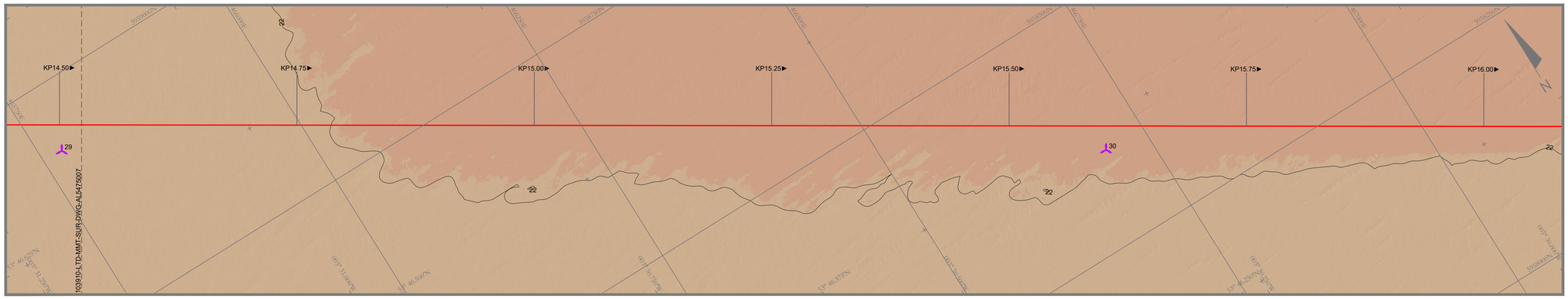
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

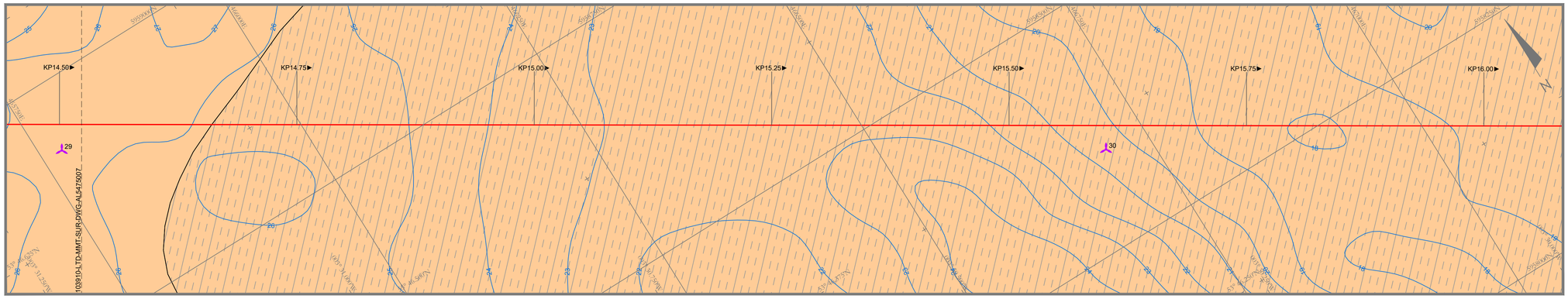
Survey Line: OWF_5475 | KP 12.883 - 14.523

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475007
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	007 of 008

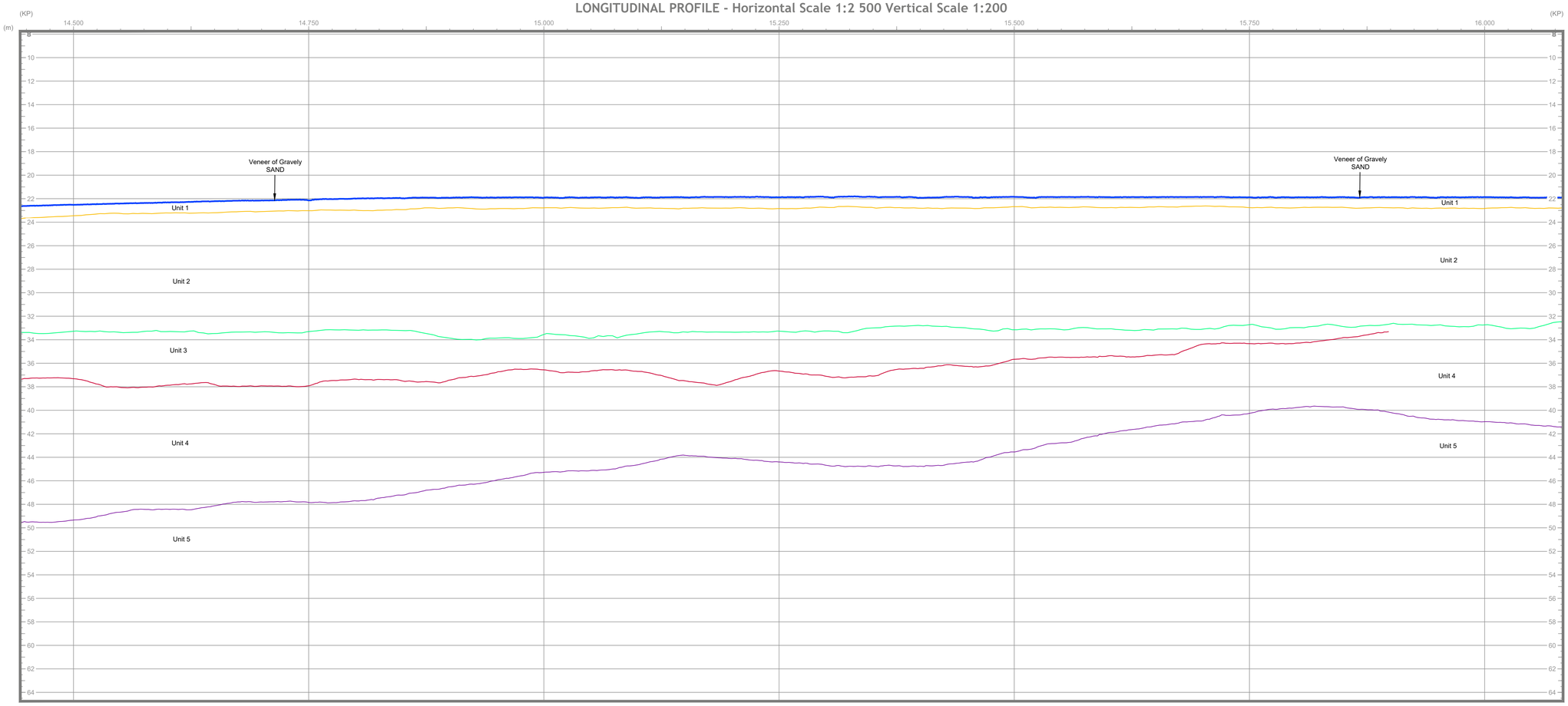
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3' — Slope Gradient (>5°)

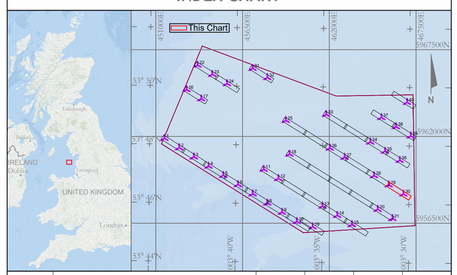
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.	SB	Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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FLOTATION ENERGY
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

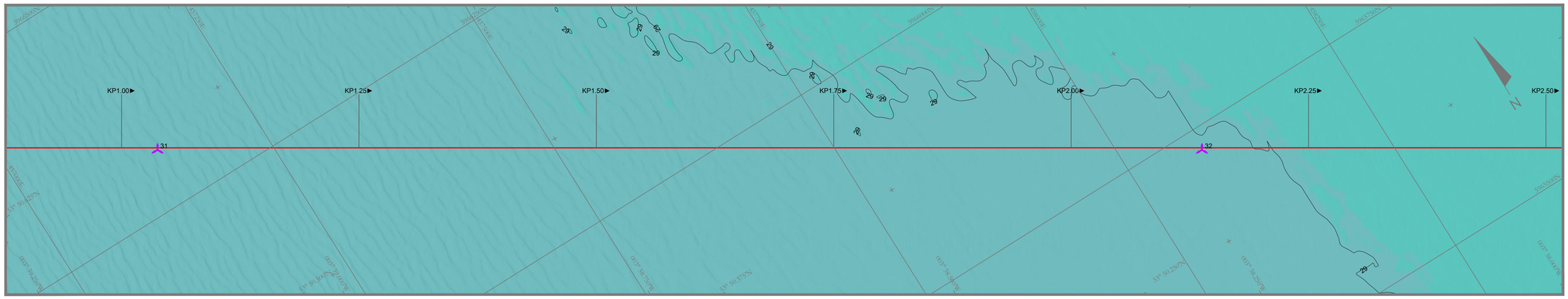
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

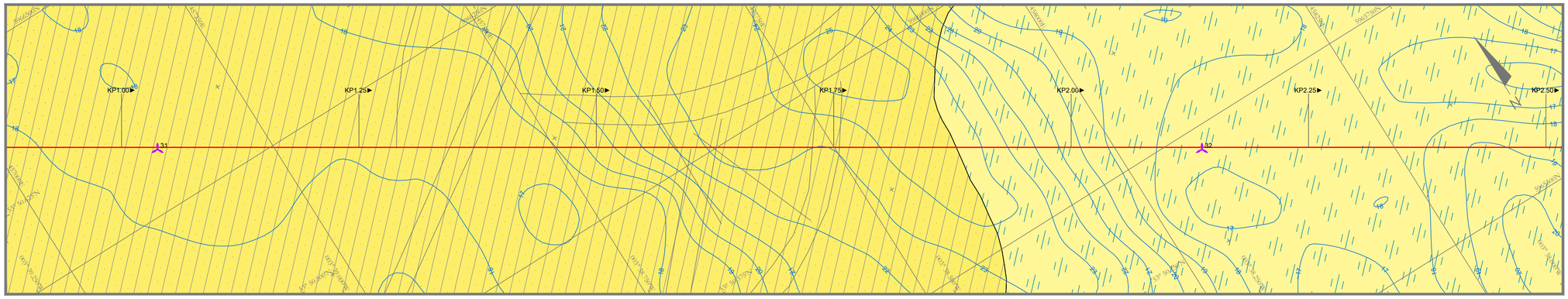
Survey Line: OWF_5475 | KP 14.443 - 16.083

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL5475008
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	008 of 008

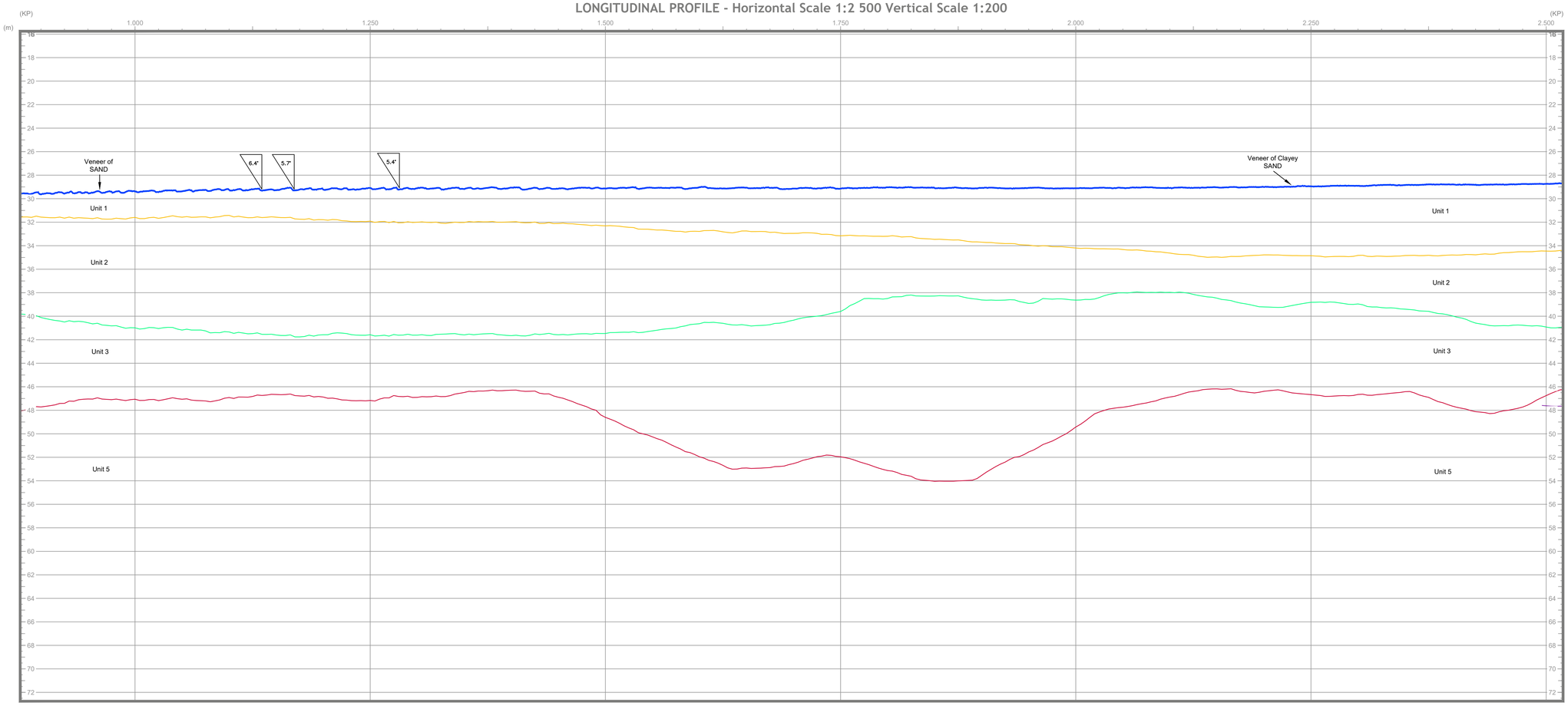
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
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- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

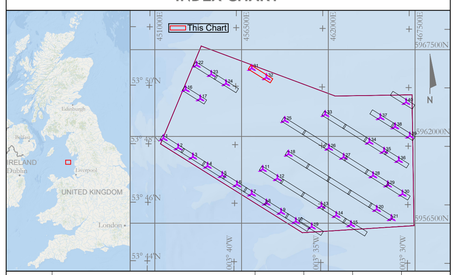
Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
		H17	
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.		Unit 2
		H40	
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.		Unit 3
		H45	
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.		Unit 4 - TILL
		H50	
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TYG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
Scotland
FLOTATION ENERGY
Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda,
Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

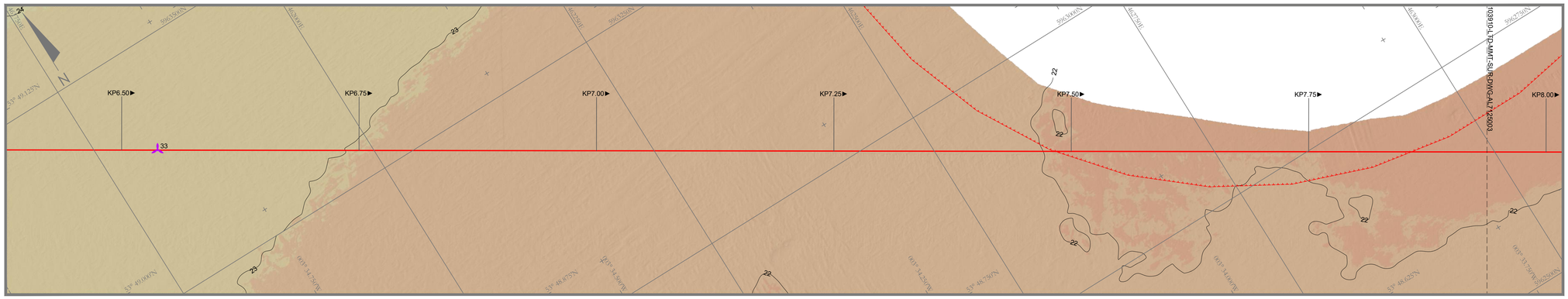
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

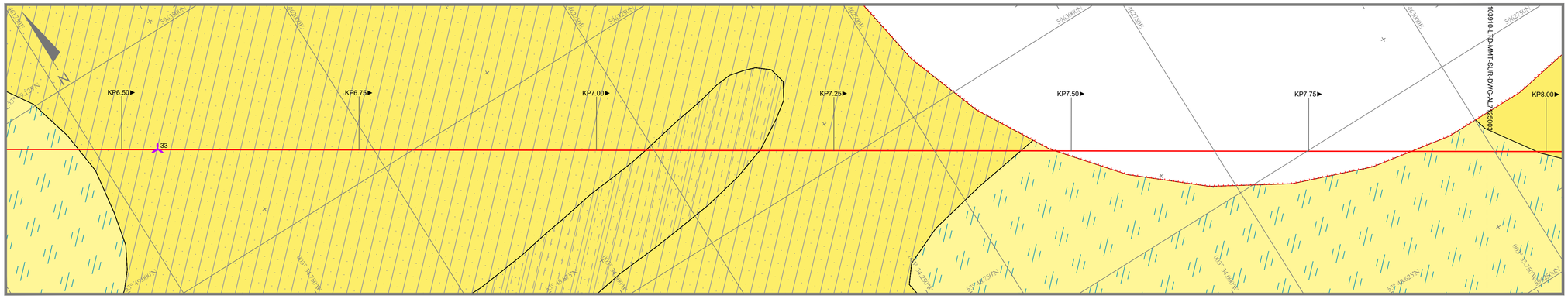
Survey Line: OWF_7125 | KP 0.878 - 2.518

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL7125001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 005

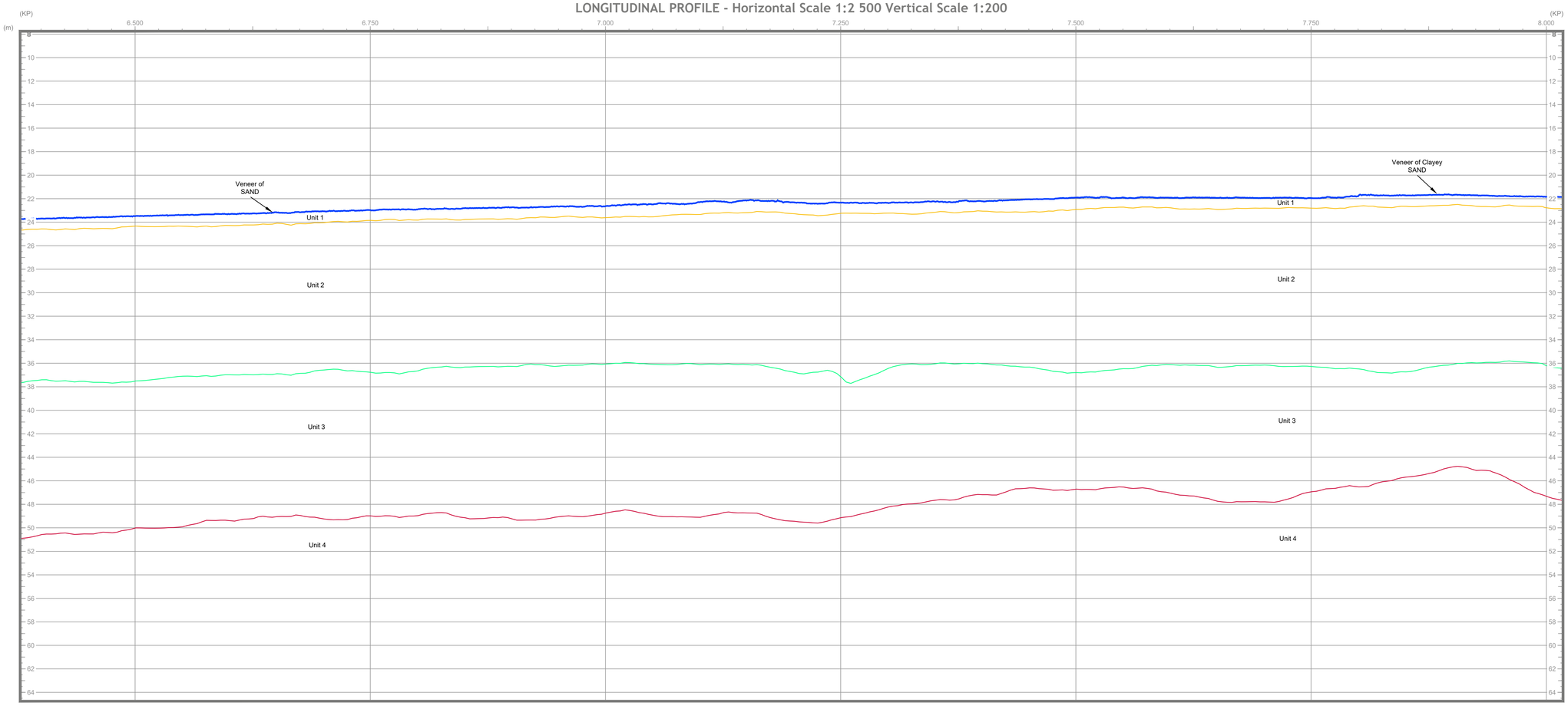
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
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- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2
- M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6' — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
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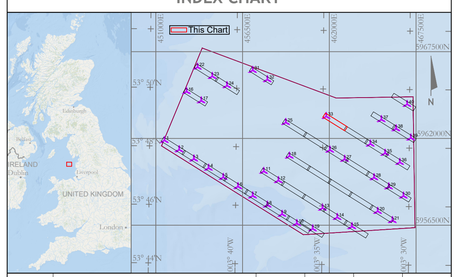
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
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12 Alva Street
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

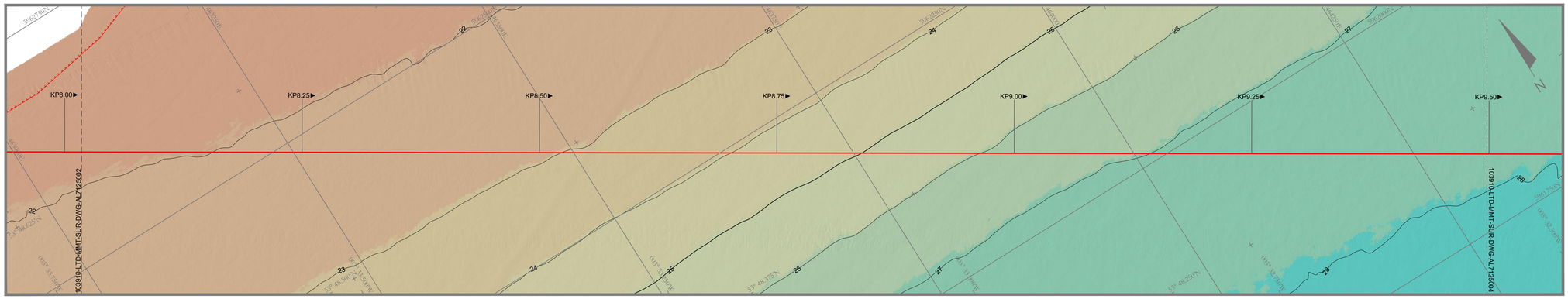
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

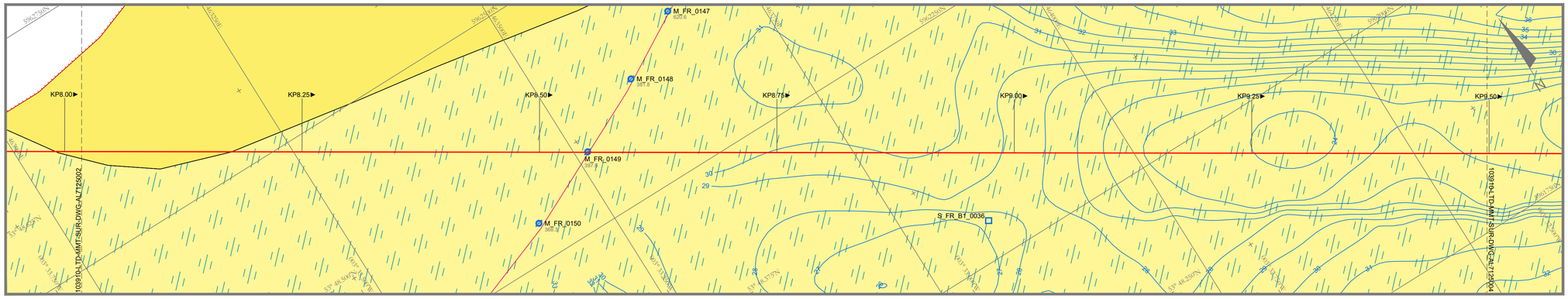
Survey Line: OWF_7125 | KP 6.378 - 8.018

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL7125002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 005

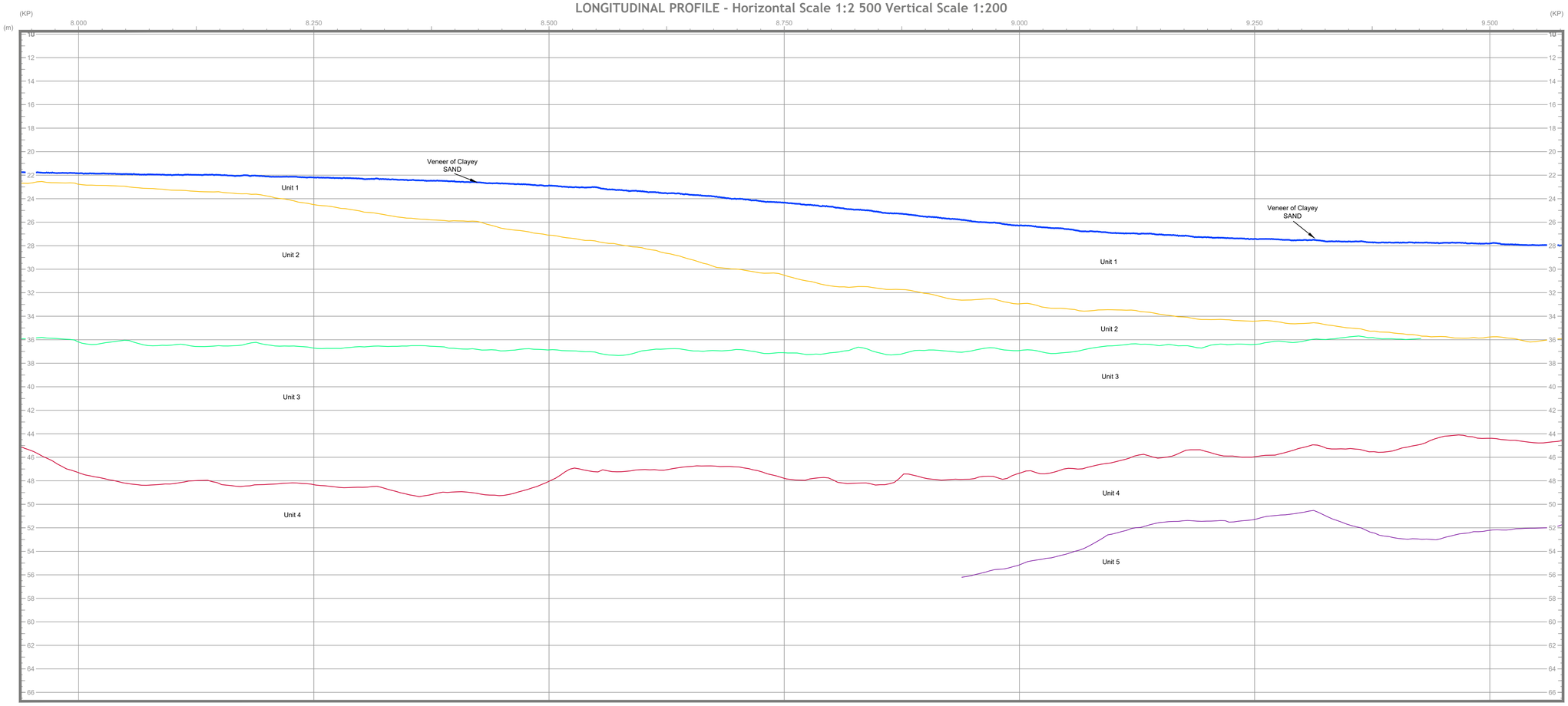
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
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- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value
- As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
		H17	
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.		Unit 2
		H40	
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.		Unit 3
		H45	
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.		Unit 4 - TILL
		H50	
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	Top - Bedrock	Unit 5 - Bedrock

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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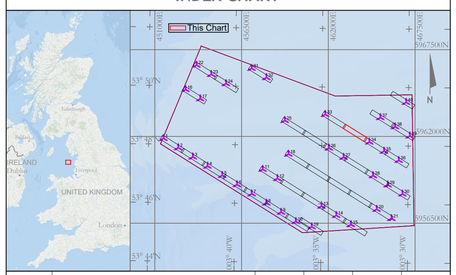
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Scotland
FLOTATION ENERGY
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

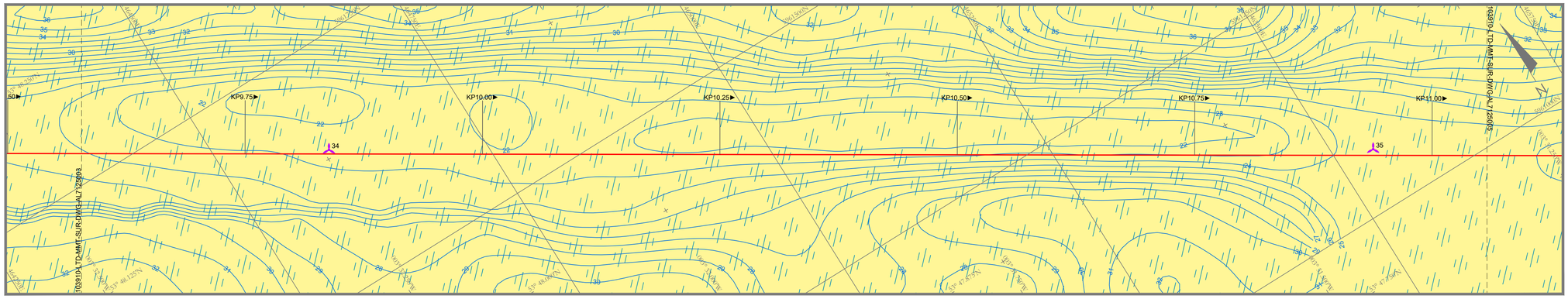
ALIGNMENT CHART

Survey Line: OWF_7125 | KP 7.938 - 9.578

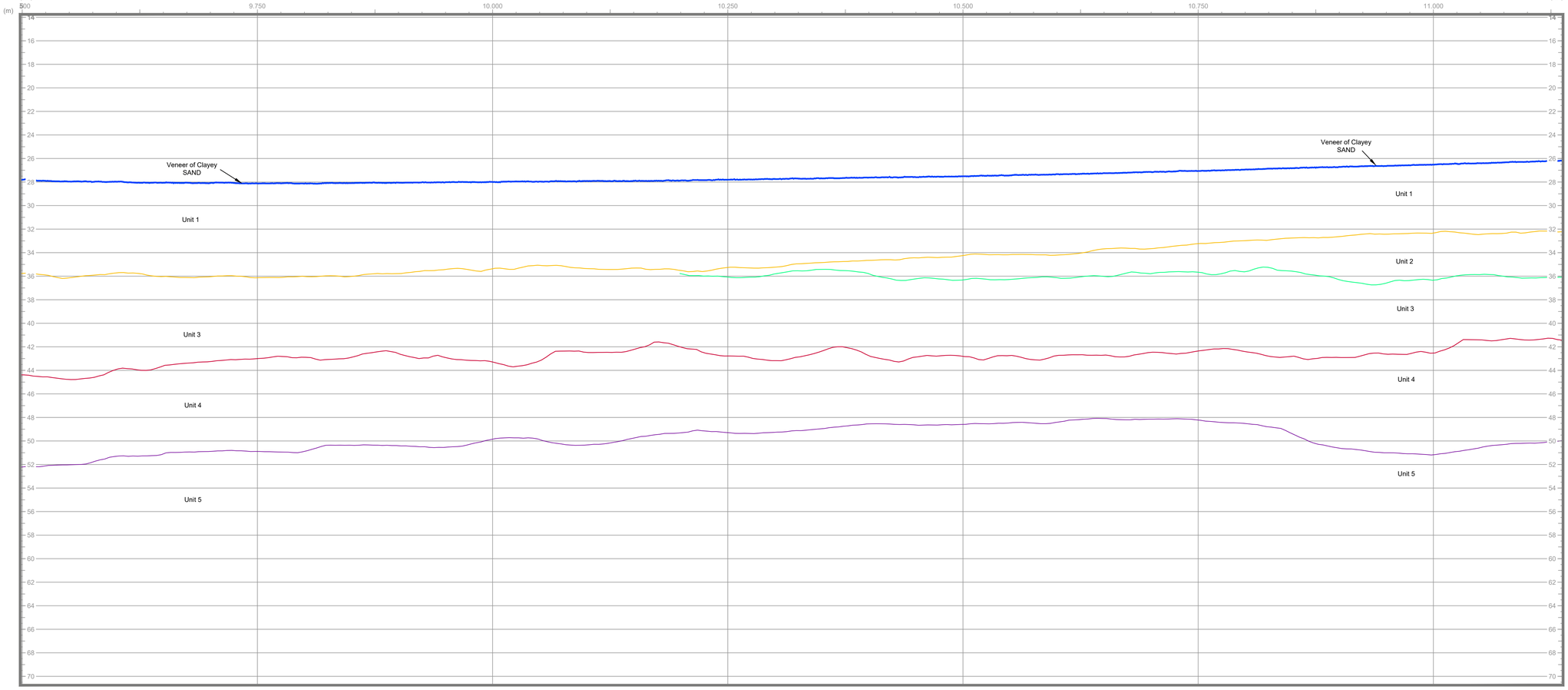
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL7125003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	003 of 005

BATHYMETRY - Horizontal Scale 1:2 500

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

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SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
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- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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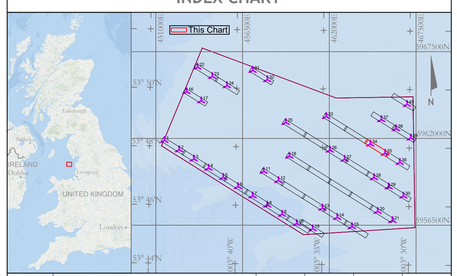
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
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12 Alva Street
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

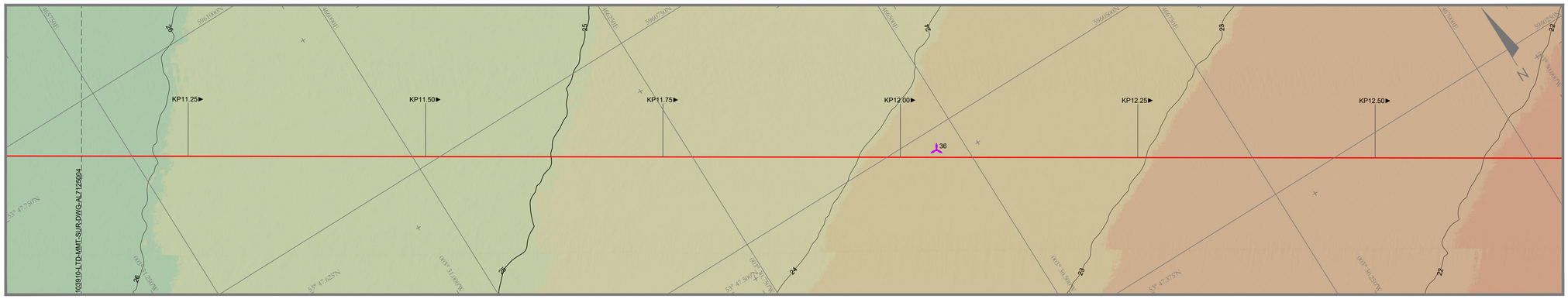
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

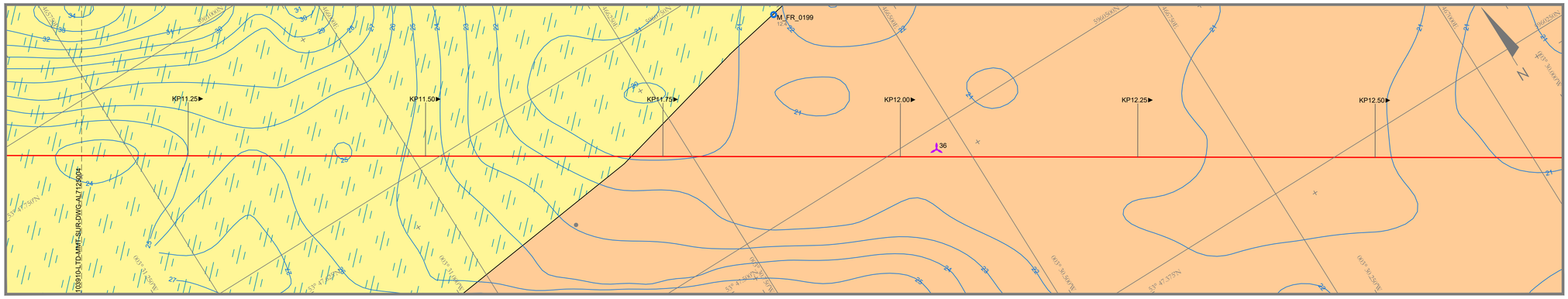
Survey Line: OWF_7125 | KP 9.498 - 11.138

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL7125004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	004 of 005

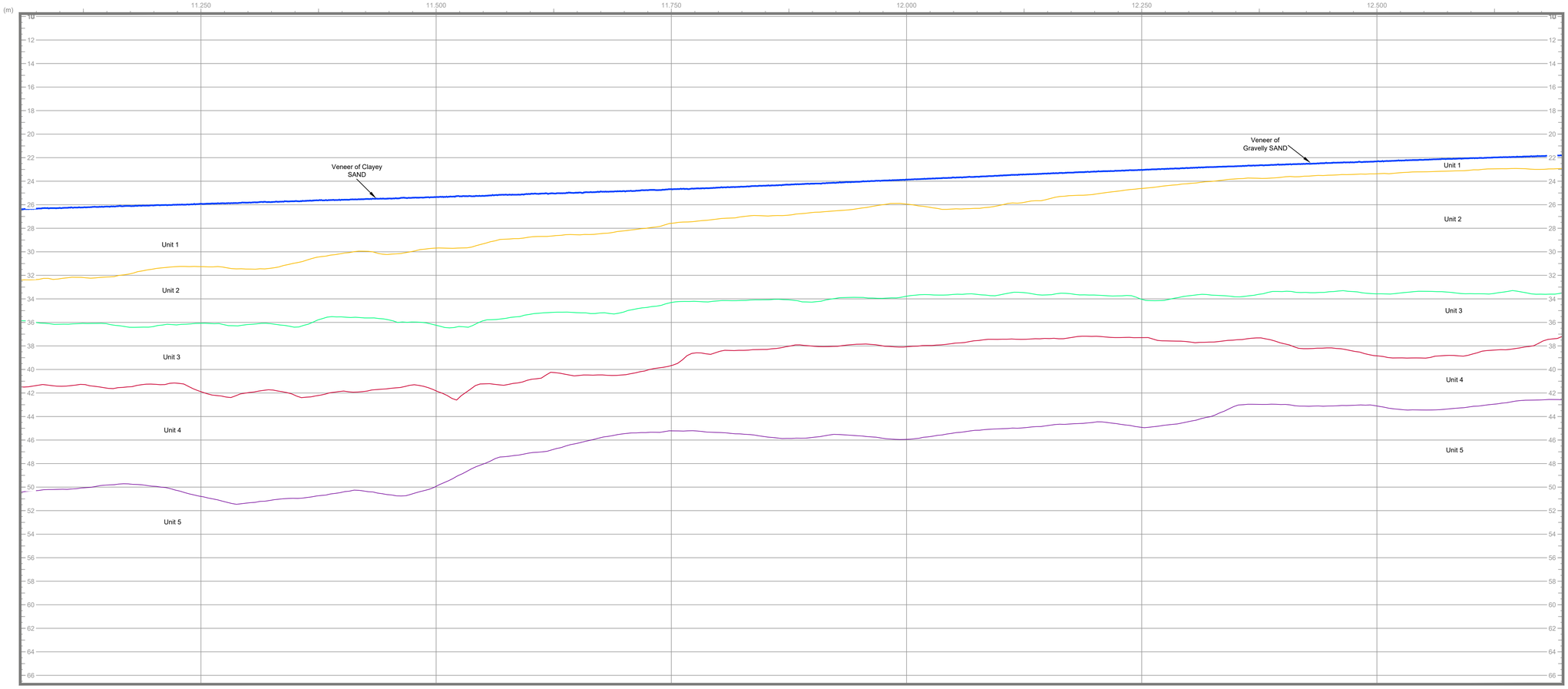
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

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SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
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- Sand waves
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LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
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- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
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Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
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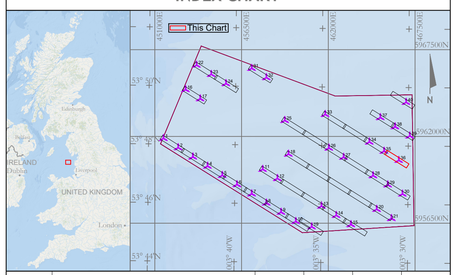
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
Edinburgh EH2 4QG
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Tel: +44 (0) 7712 864013
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

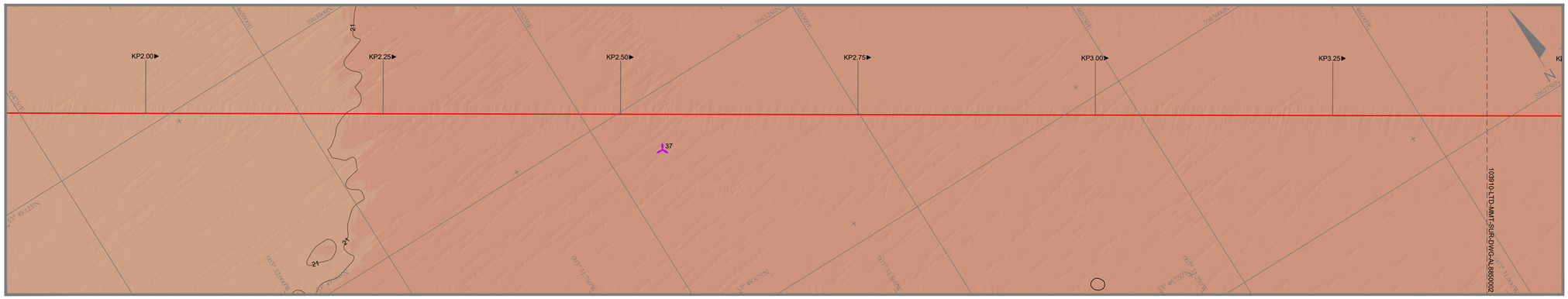
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

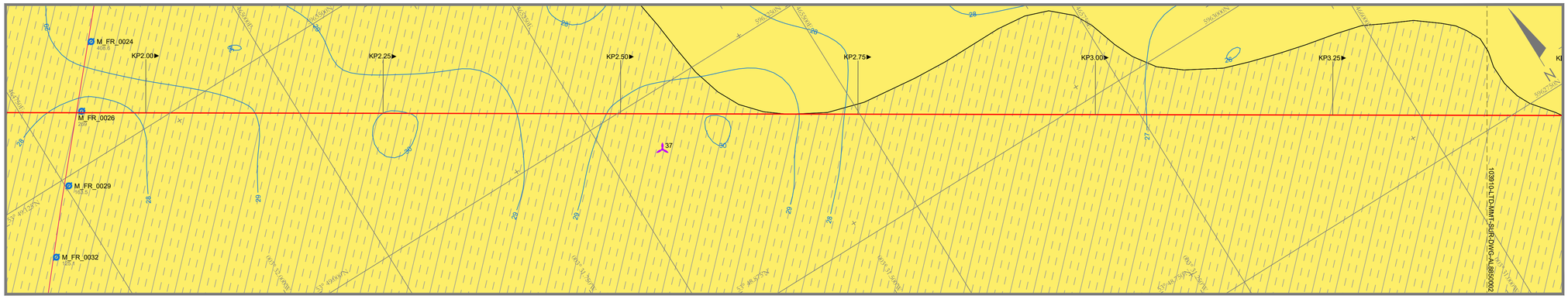
Survey Line: OWF_7125 | KP 11.058 - 12.698

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL7125005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	005 of 005

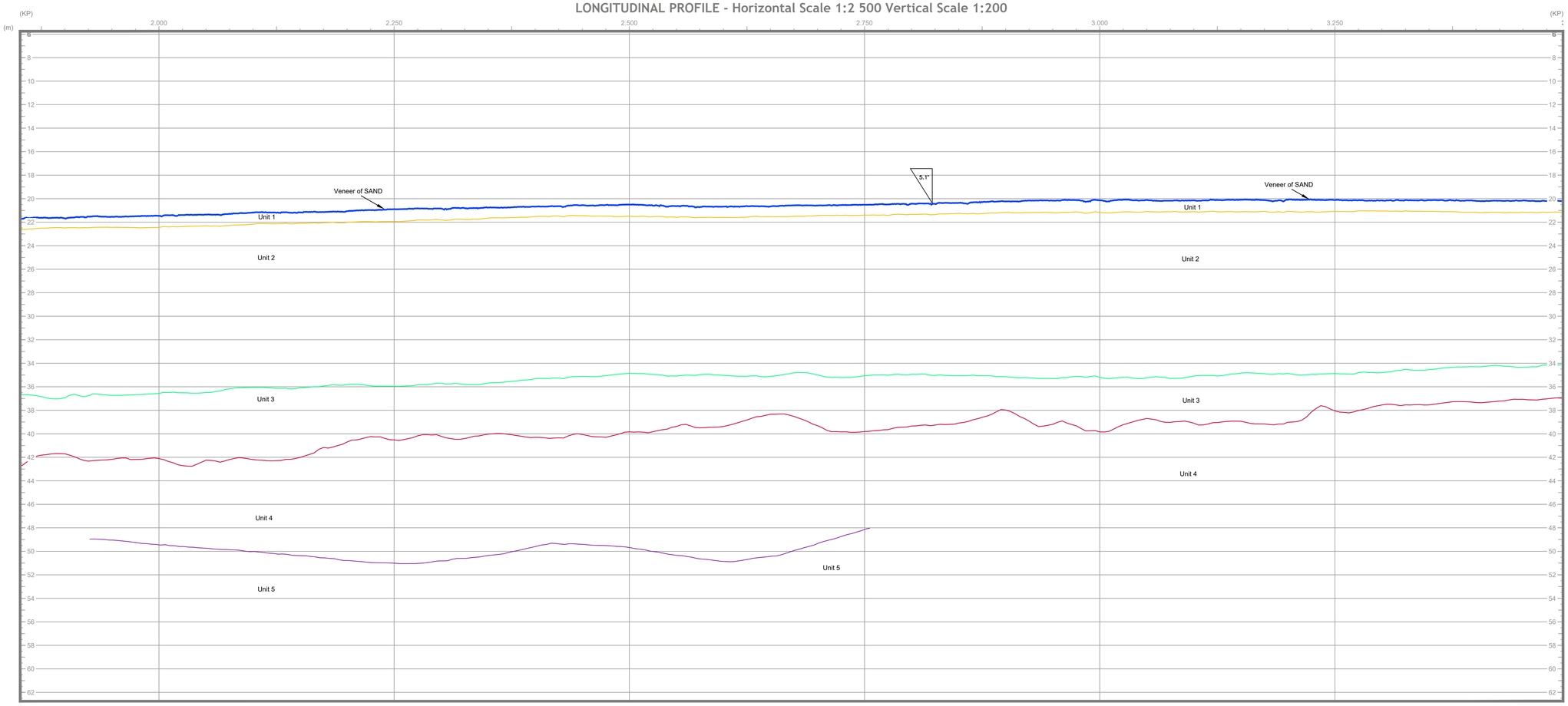
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
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BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

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- 25 — Water Depth Contour LAT, 5 m

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- SAND
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LONGITUDINAL PROFILE

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SURVEY NOTES

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Central Scale Factor	: 0.9996
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Coastline	: From background database (for guidance only)
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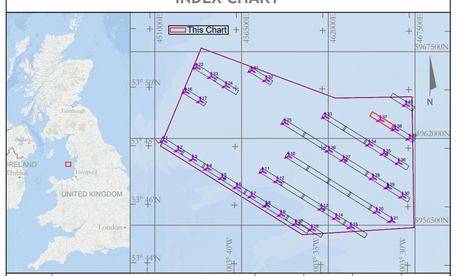
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS M/ 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

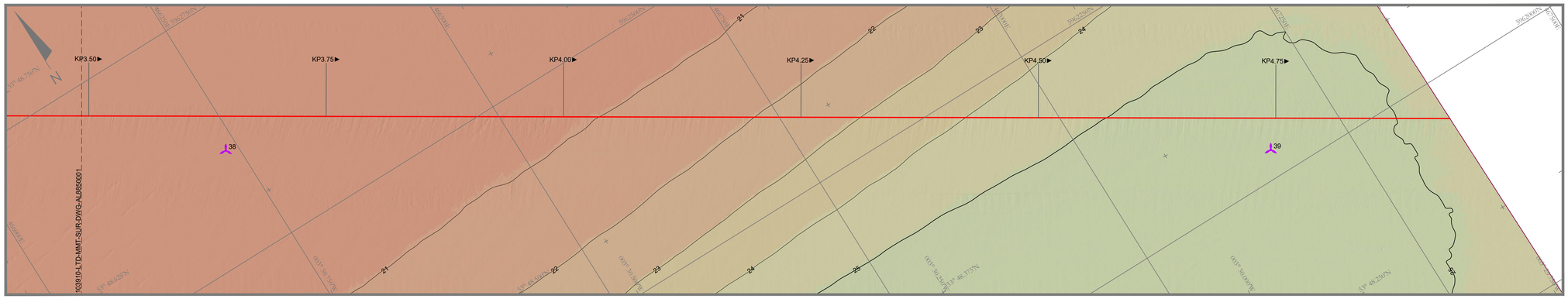
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

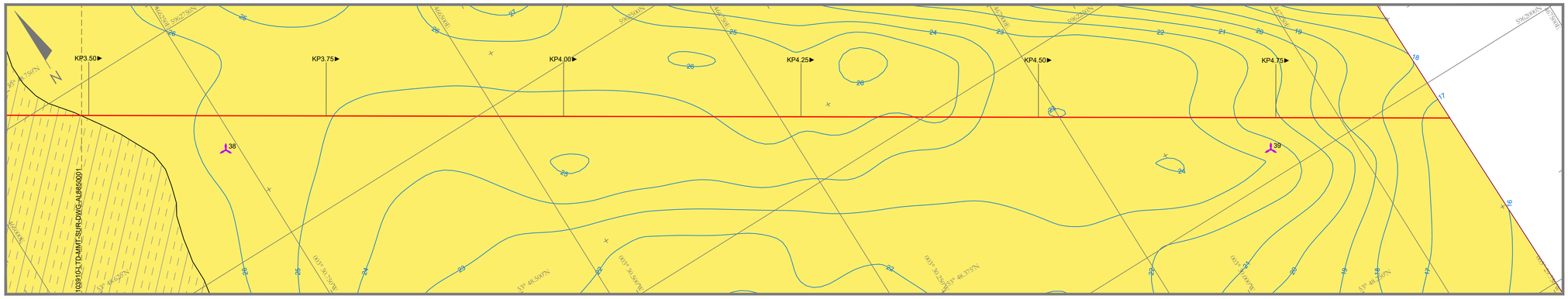
Survey Line: OWF_8850 | KP 1.852 - 3.492

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL8850001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 002

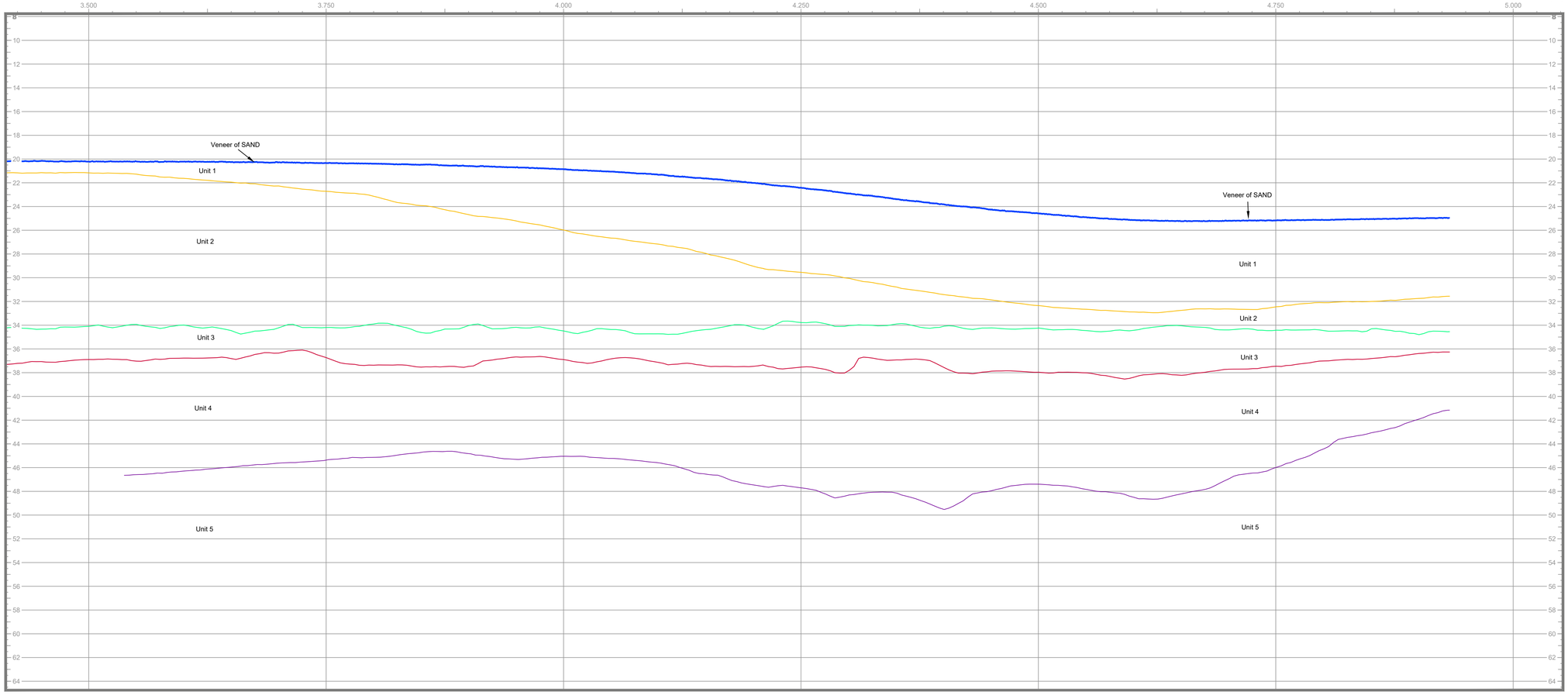
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ► — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — Exclusion Zone*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

- 24 — Water Depth Contour LAT, 1 m
- 25 — Water Depth Contour LAT, 5 m

SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH

- SAND
- Clayey SAND
- Gravelly SAND
- Current Lineation
- Megaripples
- Sand waves
- Trawl Mark Area
- Possible Boulder (ID has been omitted for clarity)
- S_FR_B1_0103 — SSS Contact with ID
- S_FR_B1_0100 — SSS Linear Contact with ID
- M_FR_0117 — MAG Contact with ID and nT Value
- 5.2
- M_FR_0040 — MAG Linear Contact with ID and nT Value
- 3.6 — As Found Cable/Pipeline - MBES
- As Found Cable/Pipeline - SSS
- Trawl Mark Lines
- Isopach contour at 1 m interval - Top of Bedrock

LONGITUDINAL PROFILE

- Seabed Profile
- Horizon H17
- Horizon H40
- Horizon H45
- Horizon H50
- 6.3° — Slope Gradient (>5°)

Ortho Stratigraphy	Geologic Setting	Horizon	Unit
		SB	
Quaternary	Acoustically well bedded parallel and laterally continuous reflections which show onlapping sequence stratigraphy. Interpreted to be a mud facies with a veneer of surface of sands.		Unit 1
Quaternary	Variable seismic character, ranging from prograding clinoforms, and possibly offlap, to a chaotic seismic character. The unit consists of higher sand content.	H17	Unit 2
Quaternary	Well bedded seismic character exhibited is conformable to its basal geometry. Laterally the seismic character changes to a more chaotic character but is expected to be the same lithology. This unit is interpreted to comprise of silty sand.	H40	Unit 3
Quaternary	The unit is absent in some areas where it is interpreted that the Unit three (mud facies) overlays the bedrock directly. This unit is expected to comprise of stiff or hard clay with clasts of sand and diamict.	H45	Unit 4 - TILL
Triassic	The entirety of the survey area is underlain by Triassic Bedrock comprised of mudstone and halite belonging to the Mercia Mudstone Group.	H50	Unit 5 - Bedrock
		Top - Bedrock	

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
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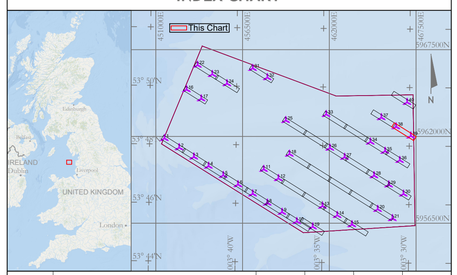
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TYG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

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Project:

OFFSHORE GEOPHYSICAL SURVEY

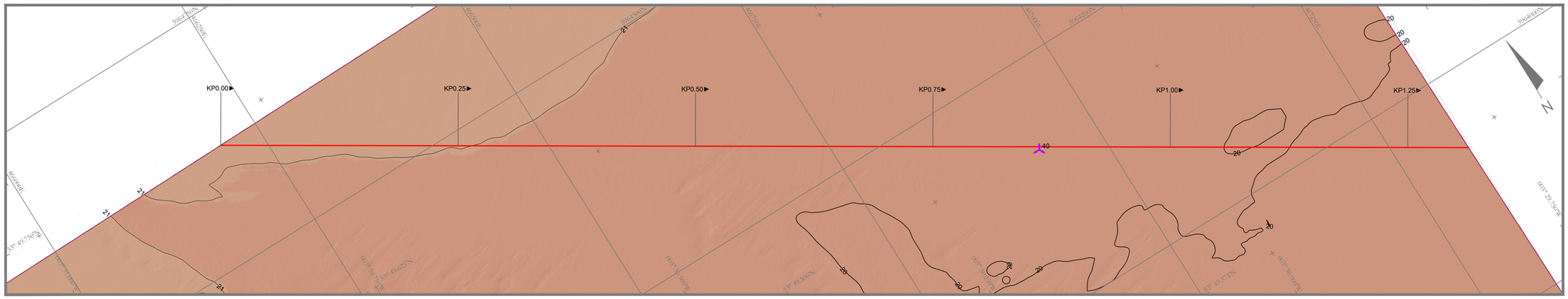
MORECAMBE OFFSHORE WINDFARM

ALIGNMENT CHART

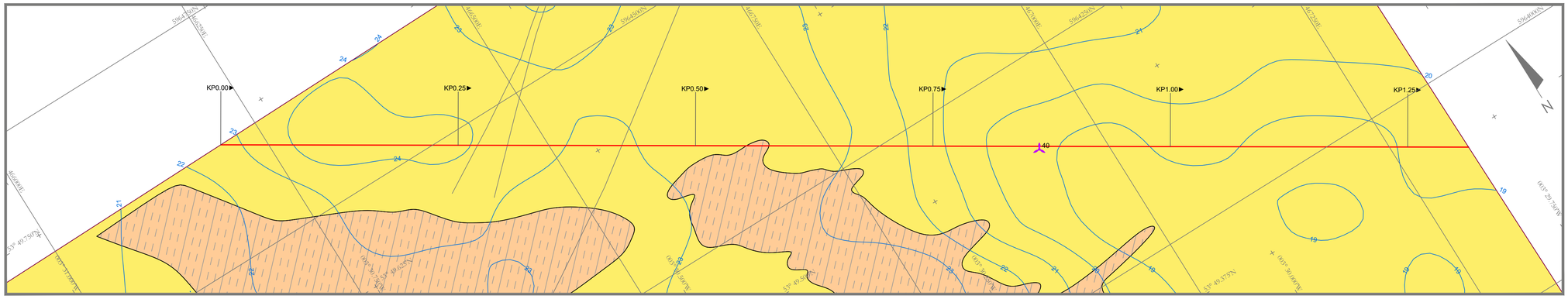
Survey Line: OWF_8850 | KP 3.412 - 4.933

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL8850002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	002 of 002

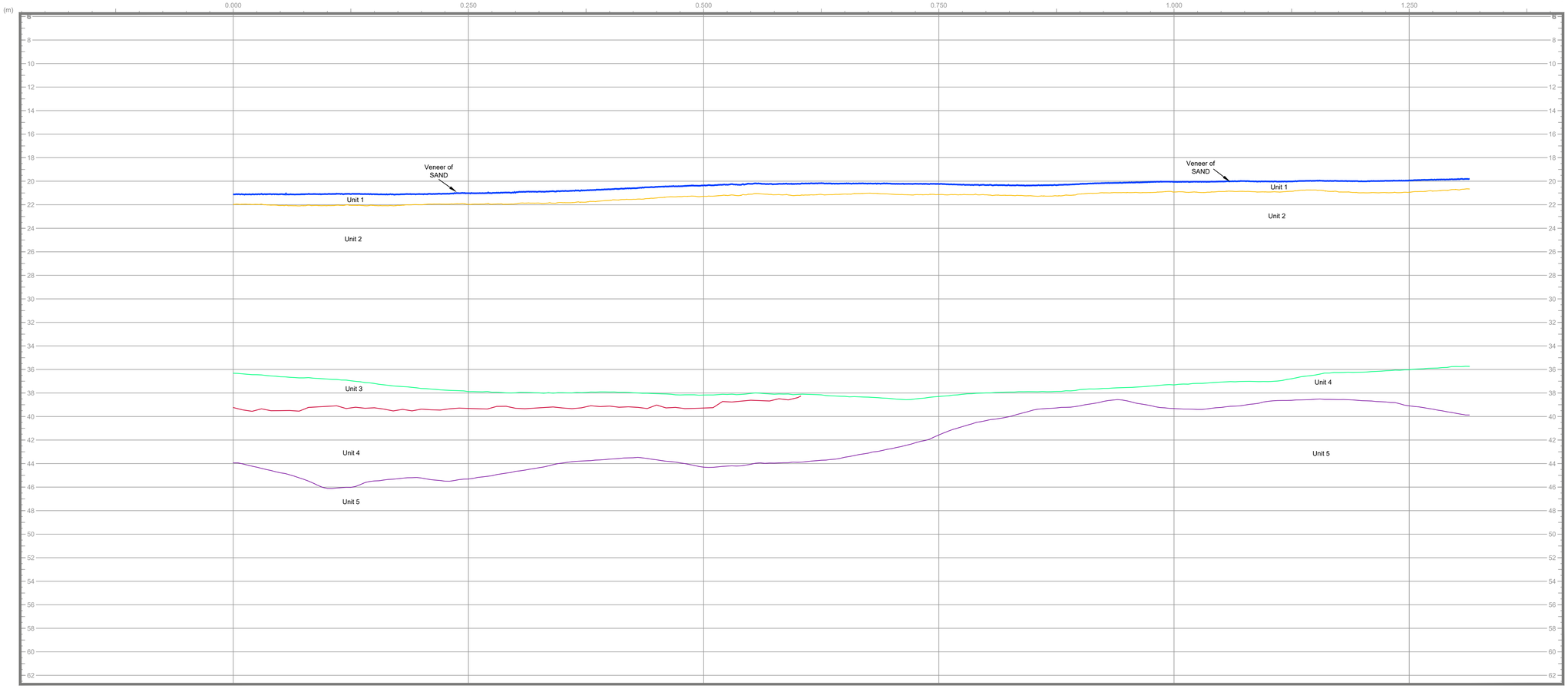
BATHYMETRY - Horizontal Scale 1:2 500



SURFICIAL GEOLOGY, SEABED FEATURES & ISOPACH - Horizontal Scale 1:2 500



LONGITUDINAL PROFILE - Horizontal Scale 1:2 500 Vertical Scale 1:200



LEGEND

- KP 1.00 ▶ — Survey Line Route Reference with KP
- 1 — Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe* — R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

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- 5.2 M_FR_0040 — MAG Linear Contact with ID and nT Value
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- As Found Cable/Pipeline - SSS
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LONGITUDINAL PROFILE

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- Horizon H17
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SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DD.ddddddddd
Central Scale Factor	: 0.9996
False Easting	: 500,000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS M/V 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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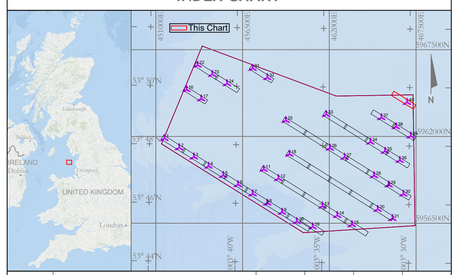
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 — 50 — 100 — 150 — 200 — 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
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Contractor :
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Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

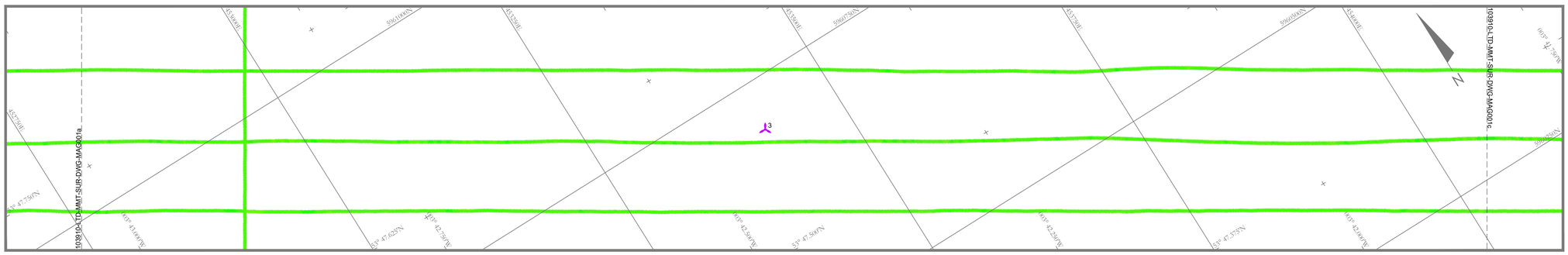
ALIGNMENT CHART

Survey Line: OWF_10500 | KP 0.000 - 1.314

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-AL10500001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	1:200	Route Revision :	N/A
Chart Type :	Alignment Chart	Segment Chart No. :	001 of 001

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

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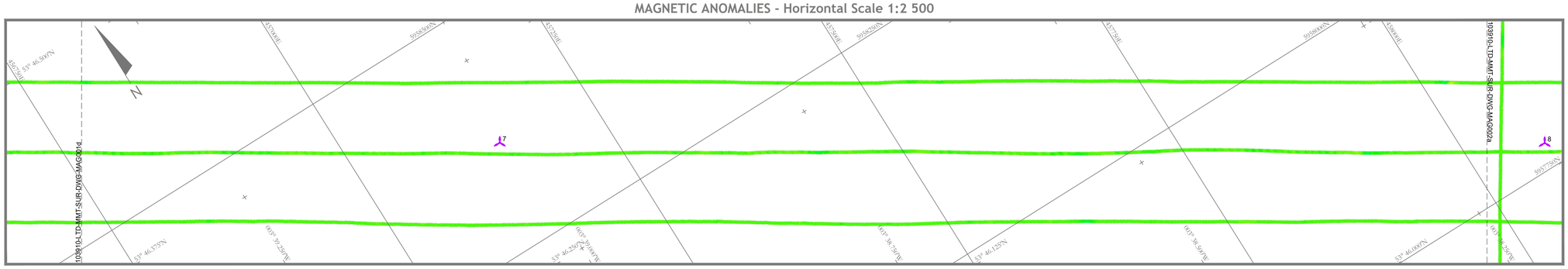
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

M_FR_0117 9.2 — MAG Contact with ID and nT Value

M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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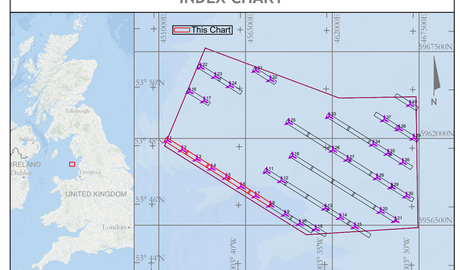
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
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Contractor :
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Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

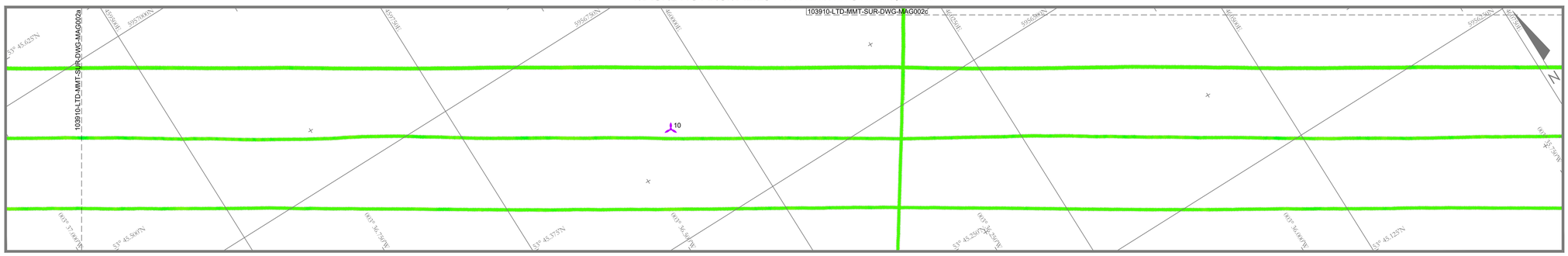
MORECAMBE OFFSHORE WINDFARM

MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

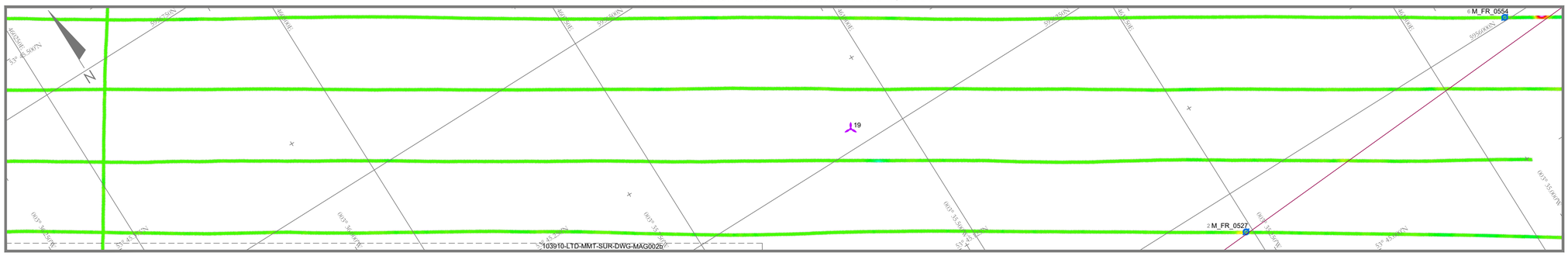
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG001
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	001 of 007

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

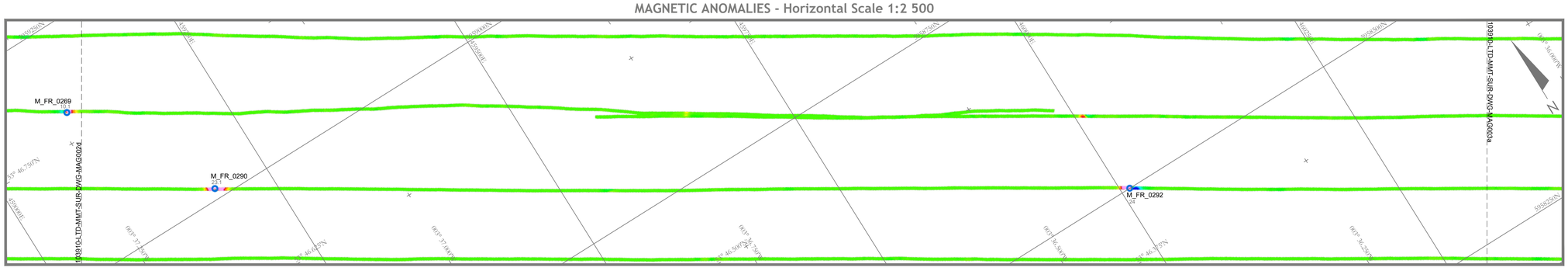


MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

- M_FR_0117 9.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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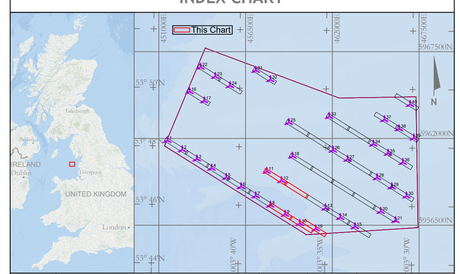
Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

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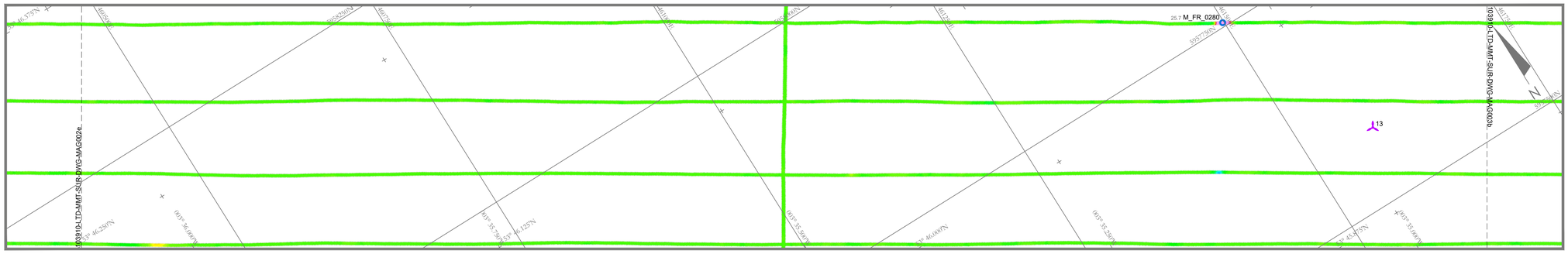
Project:

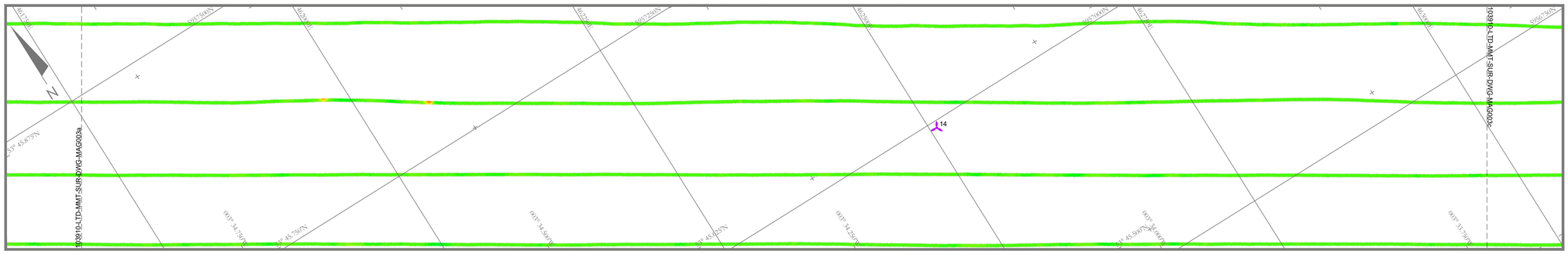
OFFSHORE GEOPHYSICAL SURVEY
MORECAMBE OFFSHORE WINDFARM
MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG002
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	002 of 007

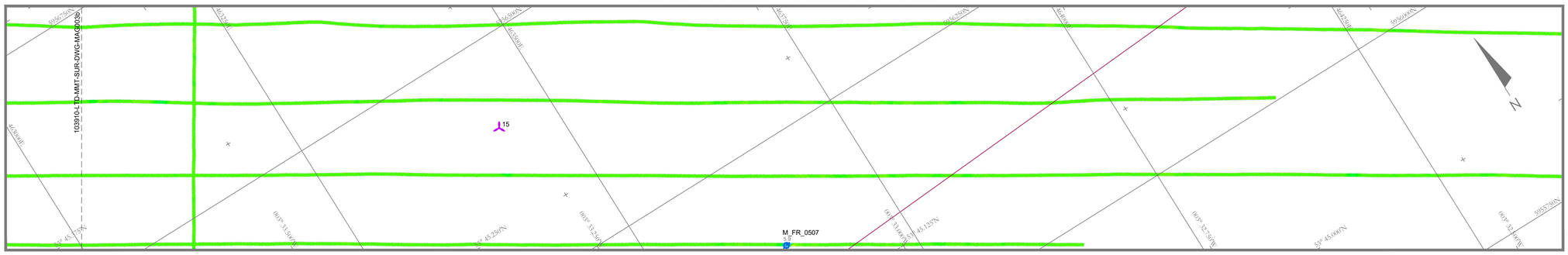
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



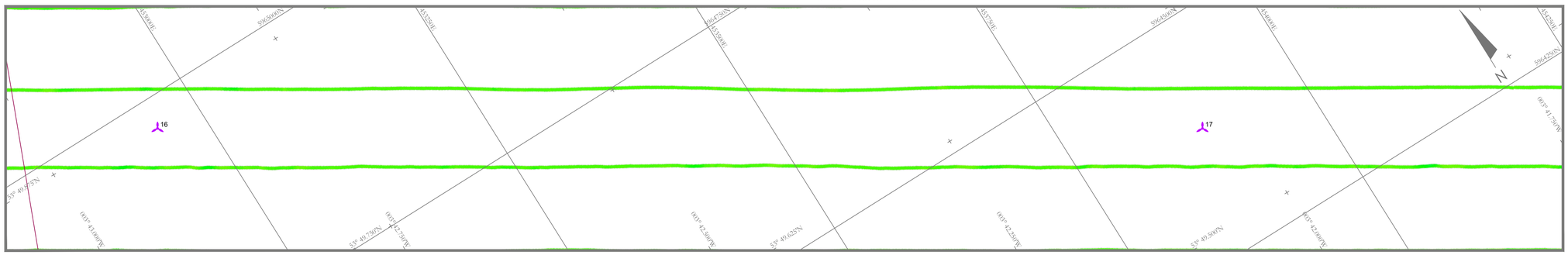
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



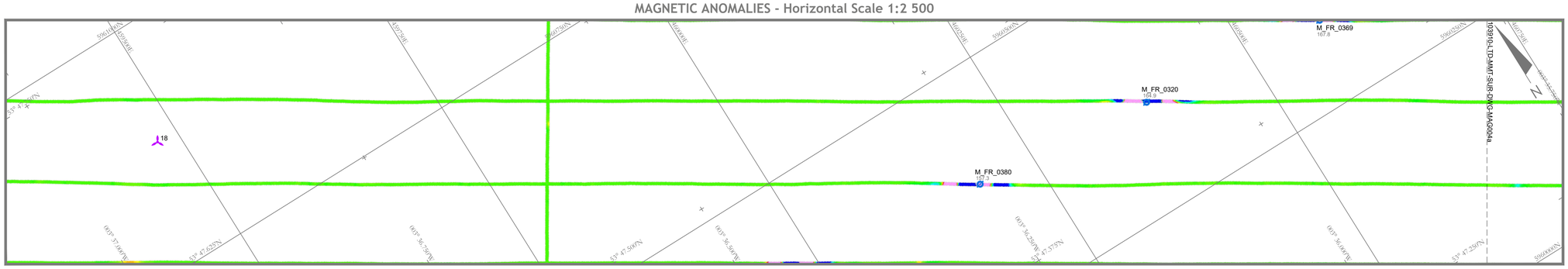
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

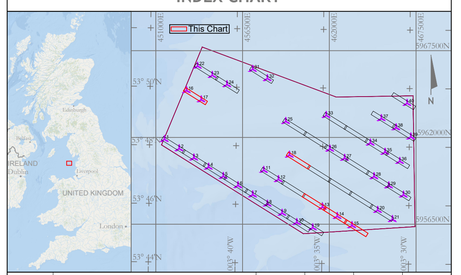
- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS MV 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
Flotation Energy plc
12 Alva Street
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Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda,
Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

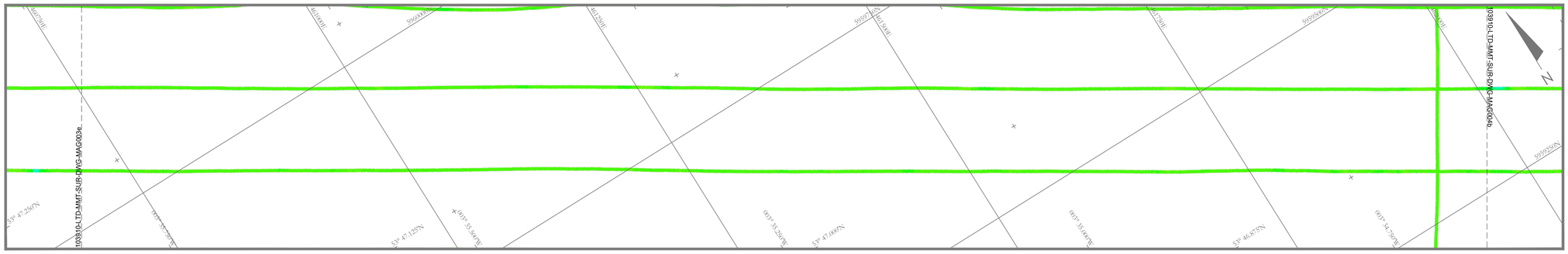
OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

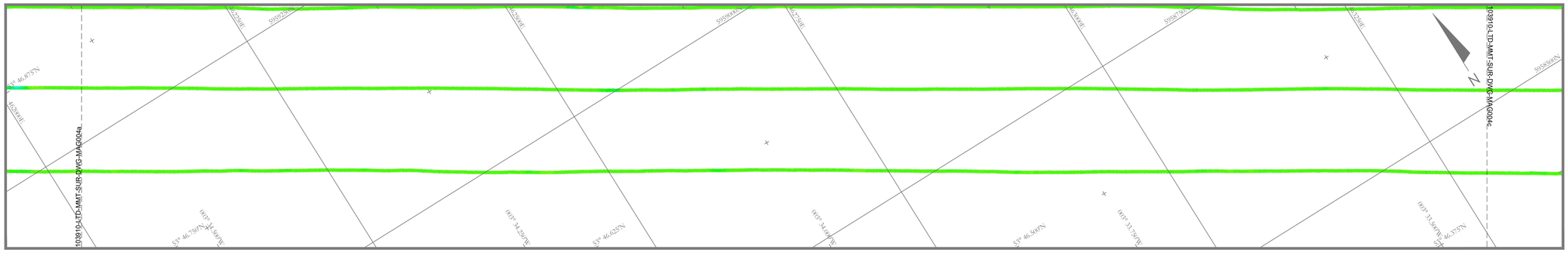
MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG003
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	003 of 007

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

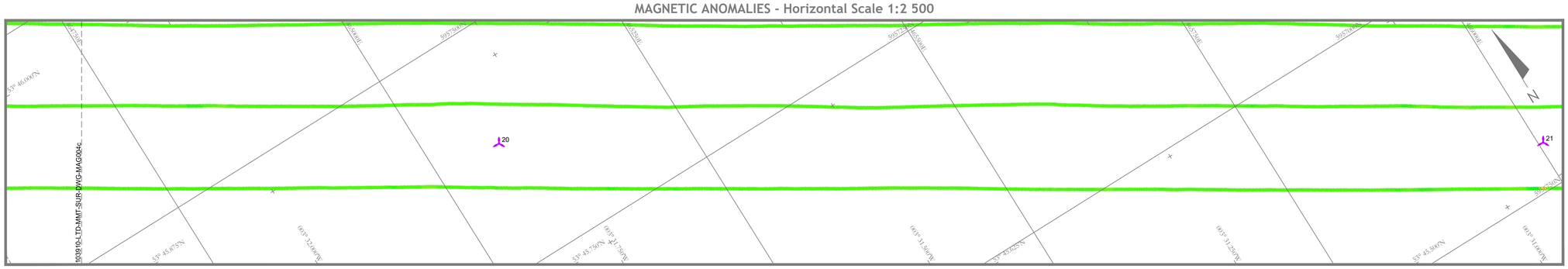


MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

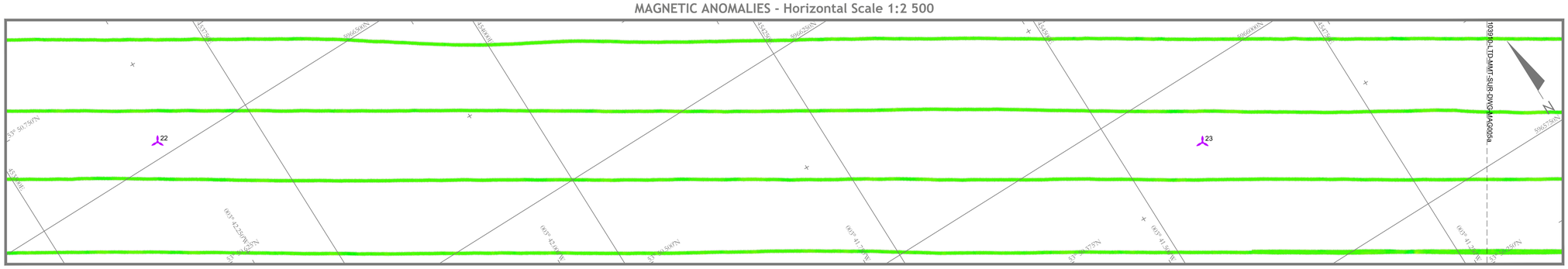


MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

M_FR_0117 9.2 — MAG Contact with ID and nT Value

M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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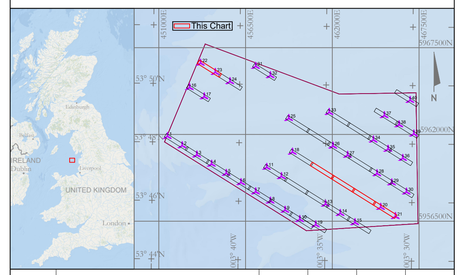
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
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12 Alva Street
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
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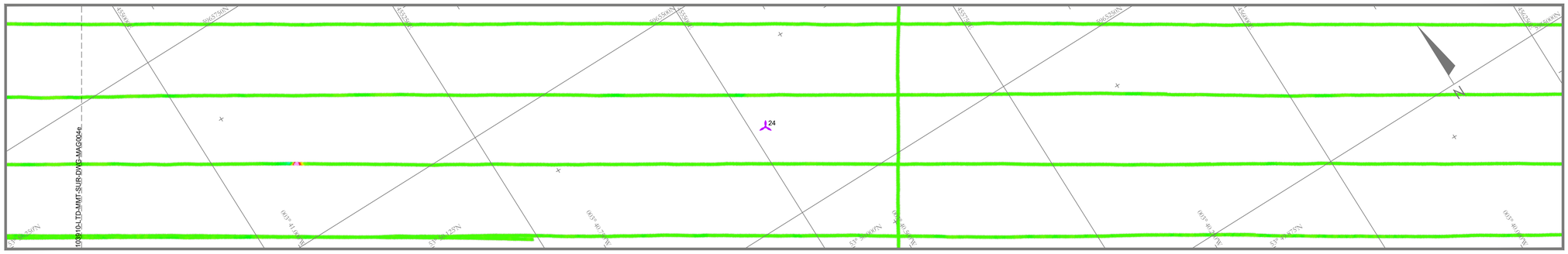
Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

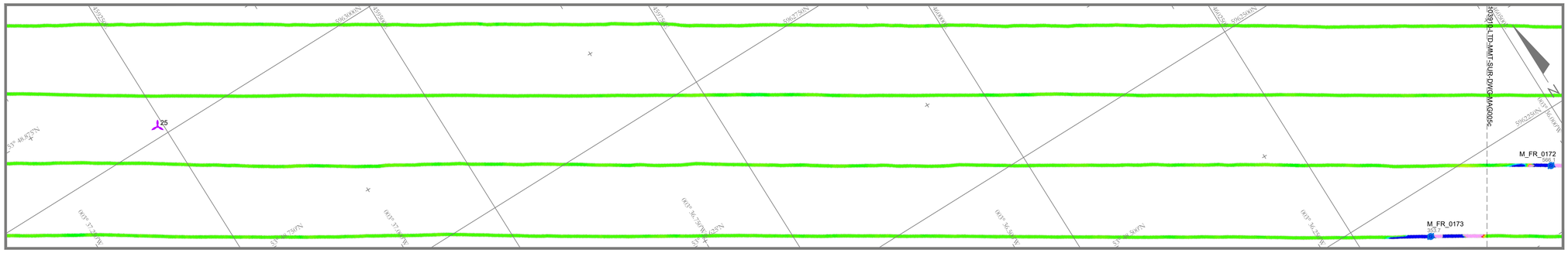
OFFSHORE GEOPHYSICAL SURVEY
MORECAMBE OFFSHORE WINDFARM
MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG004
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	004 of 007

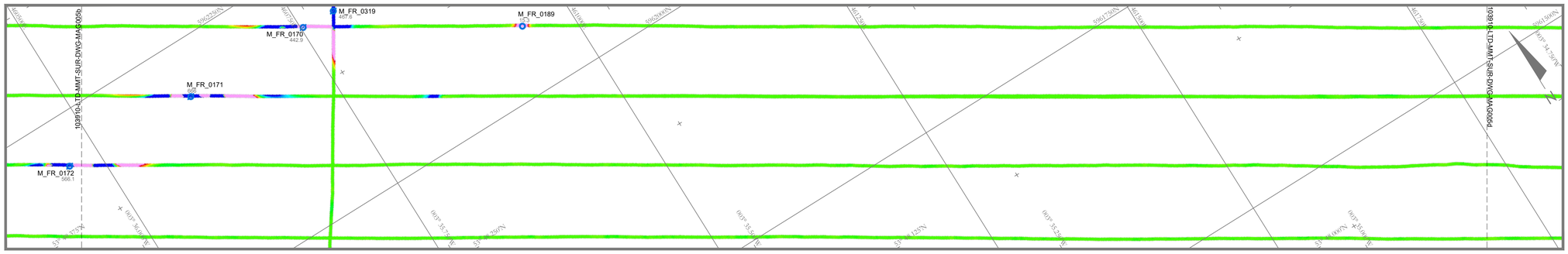
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



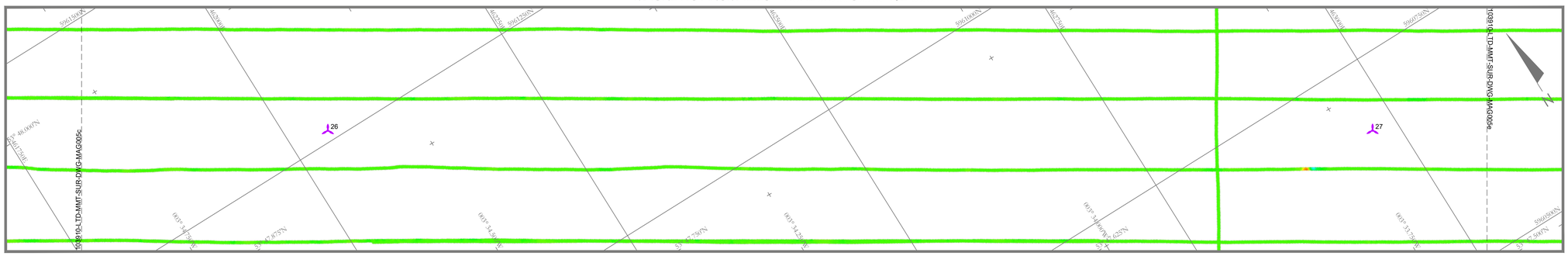
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



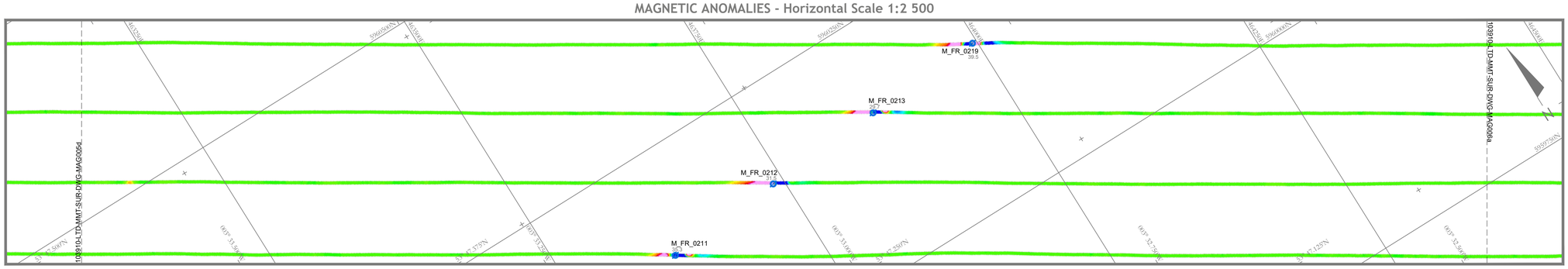
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

- M_FR_0117 9.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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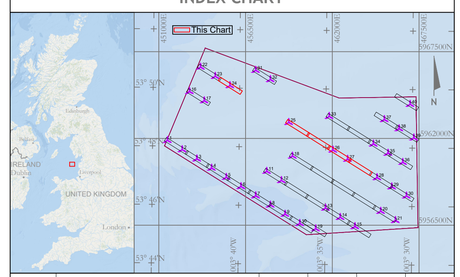
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
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Contractor :
MMT
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

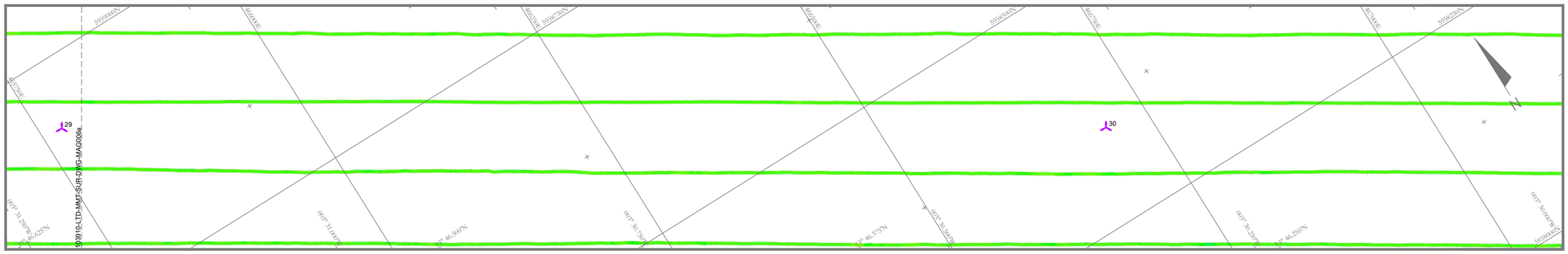
MORECAMBE OFFSHORE WINDFARM

MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG005
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	005 of 007

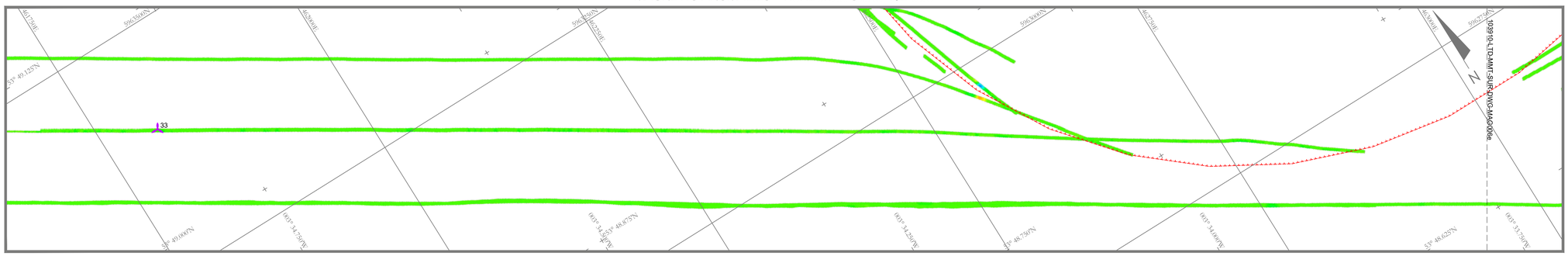
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

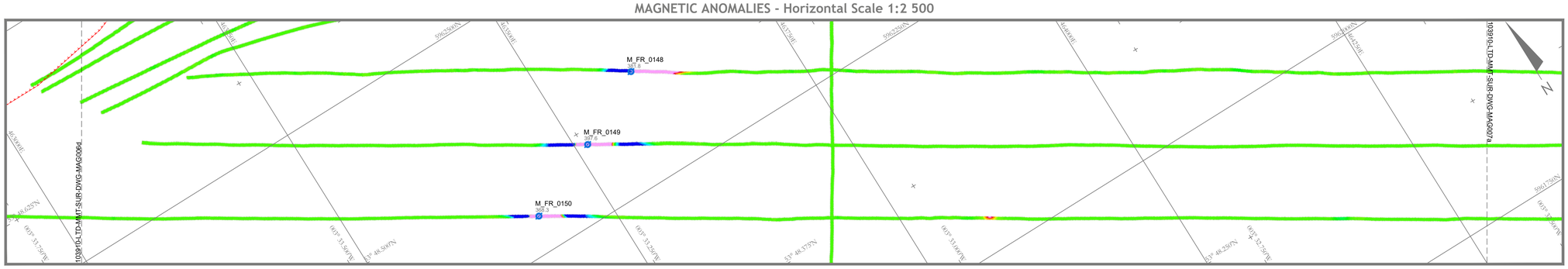


MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

- M_FR_0117 5.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
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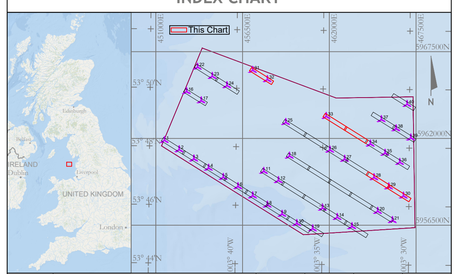
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
Flotation Energy plc
12 Alva Street
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Tel: +44 (0) 7712 864013
E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
Sven Källfelts Gata 11
SE-426 71 Västra Frölunda, Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

OFFSHORE GEOPHYSICAL SURVEY

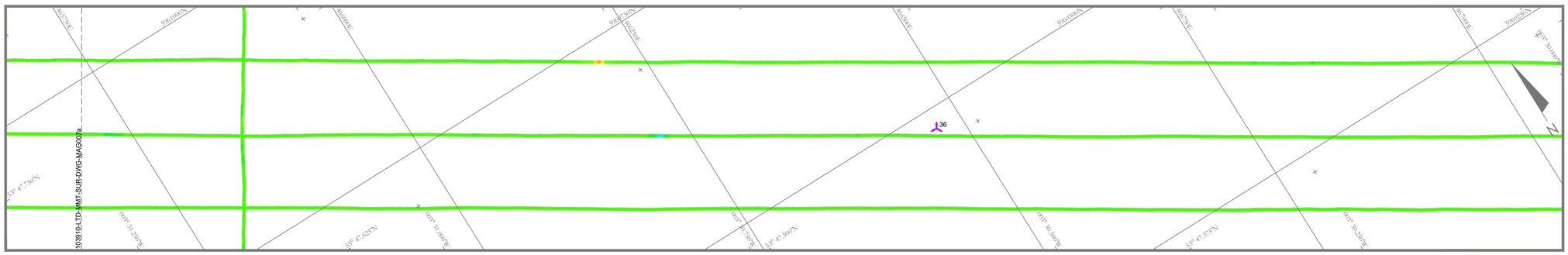
MORECAMBE OFFSHORE WINDFARM

MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

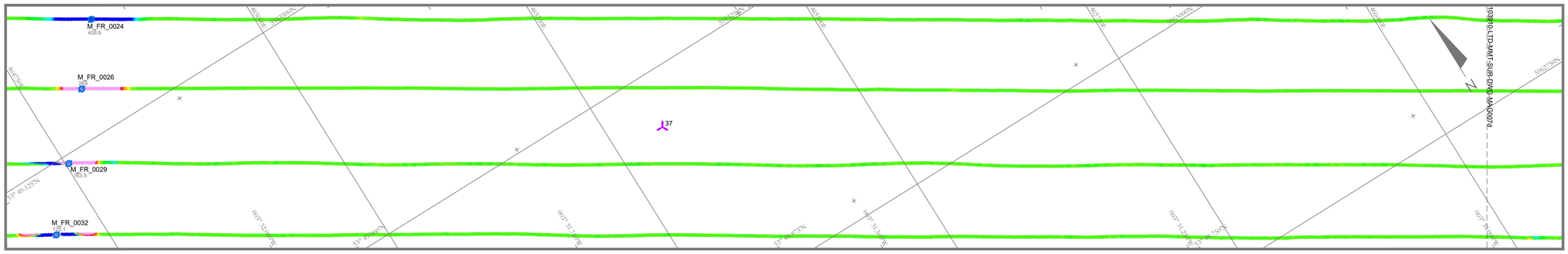
Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG006
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	006 of 007

MAGNETIC ANOMALIES - Horizontal Scale 1:2 500

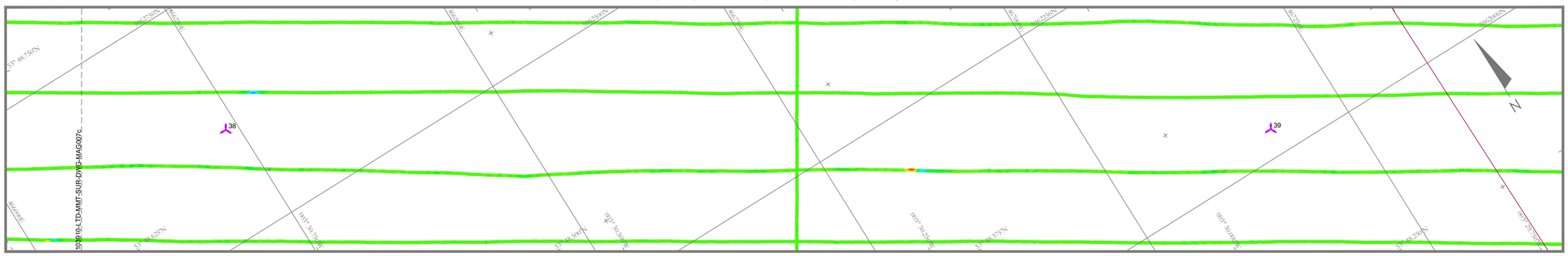
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



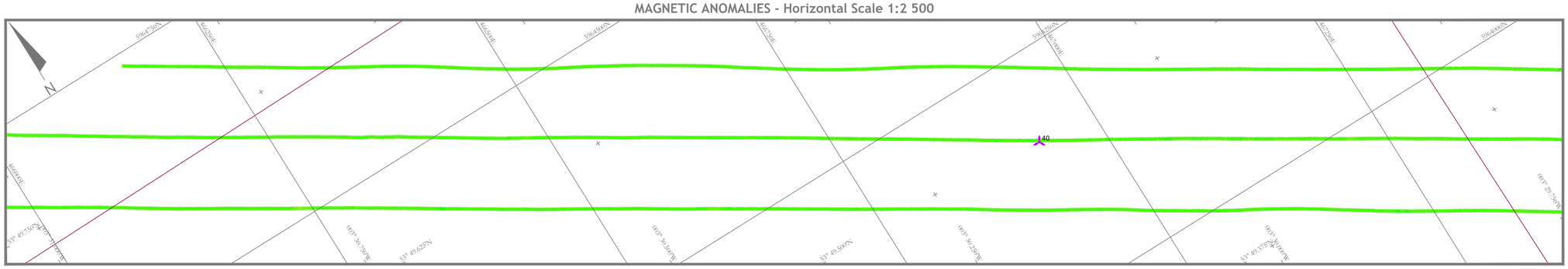
MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



MAGNETIC ANOMALIES - Horizontal Scale 1:2 500



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- 103910-LTD-MMT... — Matchline to Neighbouring Chart with Chart ID
- Surface Infrastructure 500 m Exclusion Zone*
- * Client Provided

MAGNETIC ANOMALIES

-10 -4 -3 -2 -1 0 1 2 3 4 10

Total field Residual. Values in nT.

- M_FR_0117 9.2 — MAG Contact with ID and nT Value
- M_FR_0040 3.6 — MAG Linear Contact with ID and nT Value

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
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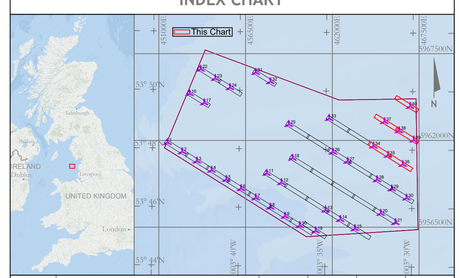
Scale bar : 0 50 100 150 200 250 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

Client :
FLOTATION ENERGY
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E-Mail: enquiries@flotationenergy.com

Contractor :
MMT
MMT
Sven Källfelts Gata 11
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Sweden
Tel: +46 (0)31 762 03 00
E-mail: info@mmt.se

Project:

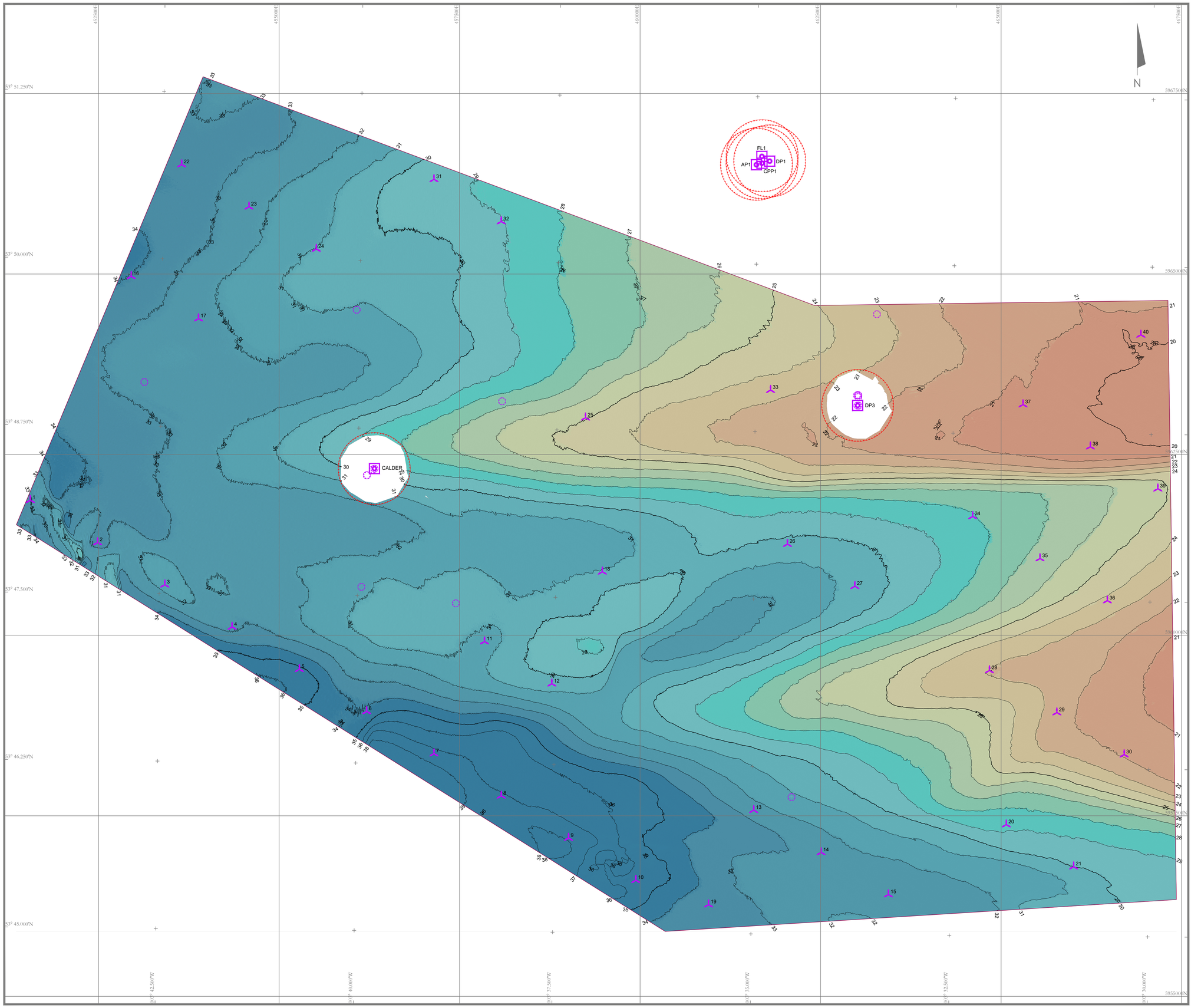
OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

MAGNETIC GRADIENT CHART
MAGNETIC IMAGE WITH MAGNETIC CONTACTS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-MAG007
Horizontal Scale:	1:2 500	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	Magnetic Gradient Chart	Segment Chart No. :	007 of 007

BATHYMETRY - Horizontal Scale 1:25 000



LEGEND

- Proposed Wind Turbine Location with ID*
- R4 OWL Morecambe*
- Platform*
- Surface Infrastructure 500 m Exclusion Zone*
- Wells 50 m Buffer*

* Client Provided

BATHYMETRY

21 22 23 24 25 26 27 28 29 30 31 32 33 34 (m)

Depths are given in metres and refer to LAT

24 Water Depth Contour LAT, 1 m

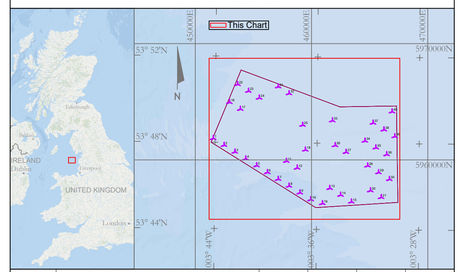
25 Water Depth Contour LAT, 5 m

SURVEY NOTES

Horizontal Datum	: WGS84, Grid north displayed in charts
Projection	: UTM Zone 30 N, Chart Latitude and Longitude are given in format DDMM.mmm
Central Scale Factor	: 0.9996
False Easting	: 500.000 m
False Northing	: 0 m
Latitude Origin	: 0°
Central Meridian	: 3° 00' 00" W
Dimensions	: In metres unless otherwise stated
Water Depths	: Data is given in metres and refers to LAT
Reference Document	: MMT project No. 103910
Coastline	: From background database (for guidance only)
Survey Date	: October - December 2021
Offshore vessel	: M/V Northern Franklin
Positioning	: Applanix POS MV 320 with C-Nav 3050 with C-NavC2 corrections on the SF2 service
Secondary Positioning	: C-Nav 3050 using C-NavC2 corrections on the SF1 service
Primary Gyro and INS System	: Applanix POS MV 320
Underwater Positioning System	: iXblue GAPS
Multibeam Echo Sounder	: Kongsberg EM2040D (200-400 kHz)
Parametric Sub-Bottom Profiler	: Hullmounted Innomar Medium 100
Side Scan Sonar	: EdgeTech 2200 (300/600 kHz) - ROTV mounted
Magnetometer TVG	: 2 x Geometrics G882
Sub-bottom Profiler	: GeoSpark 200TIP
Sound Velocity Sensor	: Valeport SVX2, deployed over the side Real-time SVS Valeport miniSVS, hull-mounted at the MBES transducers

Scale bar : 0 500 1 000 1 500 2 000 2 500 m

INDEX CHART



Revision	Revision Description	Drawn	Checked	Approved	Date
A	Issue for Use	ZHL	TE	KG	2022-03-24
02	For Client Review	ZHL	TE	KG	2022-02-01

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Project:

OFFSHORE GEOPHYSICAL SURVEY

MORECAMBE OFFSHORE WINDFARM

OVERVIEW CHART
BATHYMETRY IMAGE WITH BATHYMETRY CONTOURS

Chart size:	ISO A1 - 841 x 594 mm	Client Doc. No. :	103910-LTD-MMT-SUR-DWG-OV001
Horizontal Scale:	1:25 000	MMT Doc. No. :	103010
Vertical Scale:	N/A	Route Revision :	N/A
Chart Type :	North Up Chart	Segment Chart No. :	001 of 001

Official_ID	X	Y	Anomaly_T	Min	Max	PtoP	Wavelengt	Comment
M_FR_0003	466418.37	5964133.8	Dipole	-4.4	10.6	15	23.7	
M_FR_0004	465709.51	5964574.7	Positive Mc	0	1083	1083	52	Cable / Pipeline
M_FR_0005	465607.63	5964461.7	Dipole	-129.6	10	139.6	75.2	Cable / Pipel
M_FR_0006	465512.4	5964350.8	Dipole	-11.4	276.4	287.8	66.4	Cable / Pipel
M_FR_0007	465409.43	5964233.8	Negative M	-637.1	0	637.1	65.7	Cable / Pipel
M_FR_0008	465357.05	5964175	Negative M	-396.9	0	396.9	109.7	Cable / Pipel
M_FR_0010	465307.03	5964120.1	Dipole	-63.6	18.2	81.8	102.9	Cable / Pipel
M_FR_0011	465259.45	5964062.8	Positive Mc	0	621.4	621.4	133.7	Cable / Pipel
M_FR_0012	465205.67	5964002.4	Positive Mc	0	554.2	554.2	66.4	Cable / Pipel
M_FR_0014	465112.1	5963897.8	Dipole	-15.1	54.9	70	49.3	Cable / Pipel
M_FR_0016	465057.36	5963834	Positive Mc	0	478	478	78.6	Cable / Pipel
M_FR_0018	465005.26	5963779.6	Dipole	-62.7	19.6	82.3	63.6	Cable / Pipel
M_FR_0019	464954.58	5963720.8	Negative M	-72.5	0	72.5	101.3	Cable / Pipel
M_FR_0021	464908.36	5963664.8	Negative M	-180	0	180	142.4	Cable / Pipel
M_FR_0023	464105.52	5964165.4	Dipole	-10	1.9	11.9	65.9	
M_FR_0024	464853.67	5963607.8	Negative M	-408.6	0	408.6	132.8	Cable / Pipel
M_FR_0026	464806.4	5963550.8	Positive Mc	0	269	269	95.5	Cable / Pipel
M_FR_0027	463297.82	5964493.8	Negative M	-53.5	0	53.5	214.4	
M_FR_0028	463272.89	5964420.1	Positive Mc	0	68.3	68.3	151.6	Wellhead
M_FR_0029	464753.26	5963491.4	Dipole	-7.4	156.1	163.5	105.4	Cable / Pipel
M_FR_0032	464702.39	5963434.5	Dipole	-43.8	81.3	125.1	87.2	Cable / Pipel
M_FR_0033	463430.87	5964233	Positive Mc	0	25.4	25.4	23.2	
M_FR_0034	462771.23	5964560.6	Dipole	-63.7	155.4	219.1	70.8	Cable / Pipel
M_FR_0035	464653.49	5963380.4	Negative M	-294	0	294	71.5	Cable / Pipel
M_FR_0036	464603.36	5963323.2	Negative M	-669.6	0	669.6	118.1	Cable / Pipel
M_FR_0037	462797.84	5964456.4	Positive Mc	0	613.1	613.1	56.8	Cable / Pipel
M_FR_0038	462732.11	5964499.8	Dipole	-77.6	8.9	86.5	25.1	Cable / Pipel
M_FR_0042	462748.39	5964395.2	Positive Mc	-0.1	28	28.1	29.4	Cable / Pipel
M_FR_0043	462813.13	5964353.3	Positive Mc	0.1	264.4	264.5	78.4	Cable / Pipel
M_FR_0045	464549.43	5963266.3	Dipole	-95.5	11.2	106.7	75	Cable / Pipel
M_FR_0047	464499.24	5963211.1	Negative M	-153	0	153	49.2	Cable / Pipel
M_FR_0049	462623.11	5964298.9	Dipole	-6.4	4.5	10.9	50.8	Cable / Pipel
M_FR_0050	462826.79	5964260.1	Dipole	-245.2	8.8	254	60	Cable / Pipel
M_FR_0051	462772.72	5964293.6	Dipole	-53.4	24.6	78	21.9	Cable / Pipel
M_FR_0055	462792.45	5964193.6	Negative M	-43.8	0	43.8	18.4	Cable / Pipel
M_FR_0056	462849.29	5964159.2	Positive Mc	0	295.4	295.4	31.2	Cable / Pipel
M_FR_0058	464448	5963153.8	Negative M	-470	0	470	121.2	Cable / Pipel
M_FR_0060	464394.9	5963097.3	Negative M	-211.7	0	211.7	145.5	Cable / Pipel
M_FR_0061	463810.83	5963463.3	Dipole	-12.1	13.9	26	42.9	
M_FR_0062	462864.81	5964058.7	Complex	-21.7	114.5	136.2	79.5	Cable / Pipel
M_FR_0065	462638.87	5964198.4	Positive Mc	0	10.2	10.2	44.8	Cable / Pipel
M_FR_0068	462833.93	5963986.6	Positive Mc	0	47.3	47.3	24.3	Cable / Pipel
M_FR_0069	462891.58	5963950.2	Positive Mc	0	178.8	178.8	54.6	Cable / Pipel
M_FR_0071	464349.61	5963036.8	Dipole	-17.5	323.4	340.9	66.1	Cable / Pipel
M_FR_0072	464298.29	5962982	Dipole	-44.5	206.3	250.8	47.1	Cable / Pipel
M_FR_0073	462910.01	5963852.2	Dipole	-88.2	232.7	320.9	76.4	Cable / Pipel
M_FR_0074	462856.34	5963885.6	Positive Mc	0	33.5	33.5	21.3	Cable / Pipel
M_FR_0075	462801.54	5963920.3	Dipole	-5	6.9	11.9	21.6	Cable / Pipel
M_FR_0077	462699.71	5963896.9	Negative M	-11.3	0	11.3	47.6	Cable / Pipel
M_FR_0078	462819.86	5963819.2	Positive Mc	0	11	11	40.7	Cable / Pipel
M_FR_0079	462873.03	5963781.7	Dipole	-44.5	24.7	69.2	26.7	Cable / Pipel
M_FR_0080	462932.61	5963742.7	Negative M	-248.6	0	248.6	49.9	Cable / Pipel

M_FR_0081	464244.77	5962925.9	Negative M	-236.5	0	236.5	49	Cable / Pipeline
M_FR_0082	465459.55	5964291	Positive Mc	0	1126.5	1126.5	45.4	Cable / Pipel
M_FR_0084	465158.84	5963950.7	Negative M	-196.8	0	196.8	40	Cable / Pipel
M_FR_0098	456748.2	5966560.2	Dipole	-2	9.6	11.6	71.1	
M_FR_0100	456637.69	5966537.6	Dipole	-2.7	8.1	10.8	42.3	
M_FR_0104	462715.54	5962644.5	Dipole	-5.3	5.1	10.4	52.2	
M_FR_0105	460618.33	5963959.8	Dipole	-2.5	64.4	66.9	68.3	
M_FR_0116	462513.96	5962329.2	Dipole	-1.4	10.1	11.5	45	Cable / Pipel
M_FR_0120	455503.66	5965568.6	Positive Mc	0	18.8	18.8	31.6	
M_FR_0122	458093.05	5963240.8	Positive Mc	0.1	1092.4	1092.5	141.3	Wellhead
M_FR_0126	460875.65	5962646.9	Dipole	-230.4	207.3	437.7	51.6	
M_FR_0130	461518.68	5962334	Dipole	-9	7.4	16.4	33.9	
M_FR_0132	461795.16	5962340.4	Dipole	-10.5	9.1	19.6	28.3	
M_FR_0134	459430.2	5962229	Dipole	-62.8	684.1	746.9	121.3	Cable / Pipel
M_FR_0135	459735.19	5962211.6	Dipole	-185.8	74.2	260	40	Cable / Pipel
M_FR_0136	459873.43	5962212.7	Dipole	-57	149.8	206.8	64	Cable / Pipel
M_FR_0137	460024.72	5962208.7	Dipole	-111.8	786	897.8	92.4	Cable / Pipel
M_FR_0138	464199.13	5962868.9	Dipole	-37.7	246.9	284.6	45.9	Cable / Pipel
M_FR_0139	464148.5	5962810.8	Positive Mc	0	238.6	238.6	55.1	Cable / Pipel
M_FR_0140	464095.16	5962754.9	Negative M	-423.7	0	423.7	92	Cable / Pipel
M_FR_0141	464046.11	5962699.9	Positive Mc	0	319.1	319.1	48	Cable / Pipel
M_FR_0142	463985.15	5962643.5	Negative M	-245.7	0	245.7	109.7	Cable / Pipel
M_FR_0143	463929.69	5962593.3	Dipole	-148.7	123.3	272	67.8	Cable / Pipel
M_FR_0144	463866.99	5962546.6	Negative M	-291.4	0	291.4	136.1	Cable / Pipel
M_FR_0145	463798.02	5962501.8	Dipole	-229.2	25.9	255.1	56.9	Cable / Pipel
M_FR_0146	463735.45	5962448.6	Dipole	-111.4	73.6	185	61.7	Cable / Pipel
M_FR_0147	463662.85	5962405.3	Dipole	-569.2	51.4	620.6	61.8	Cable / Pipel
M_FR_0148	463592.21	5962365.3	Dipole	-143.8	238	381.8	85.7	Cable / Pipel
M_FR_0149	463512.87	5962324.4	Positive Mc	0	397.6	397.6	41	Cable / Pipel
M_FR_0150	463429.42	5962287.7	Positive Mc	-0.2	368.1	368.3	34.4	Cable / Pipel
M_FR_0151	463339.01	5962254.6	Negative M	-398.2	0.2	398.4	47	Cable / Pipel
M_FR_0152	463251.91	5962221.6	Negative M	-433.2	0	433.2	43.7	Cable / Pipel
M_FR_0153	463158.47	5962194.2	Dipole	-126.1	401.9	528	43.2	Cable / Pipel
M_FR_0154	463051.14	5962168	Positive Mc	0	1060.6	1060.6	36	Cable / Pipel
M_FR_0155	462937.19	5962149.5	Negative M	-198.7	0	198.7	74.7	Cable / Pipel
M_FR_0156	462824.58	5962134.9	Dipole	-748.7	541.9	1290.6	80.8	Cable / Pipel
M_FR_0157	462695.43	5962126.6	Dipole	-172.2	25.7	197.9	47.2	Cable / Pipel
M_FR_0158	462552.54	5962128.8	Dipole	-99	471.3	570.3	40.4	Cable / Pipel
M_FR_0159	462400.25	5962133.4	Dipole	-131.7	96	227.7	59.3	Cable / Pipel
M_FR_0160	462254.24	5962137	Dipole	-57.2	301.6	358.8	53.6	Cable / Pipel
M_FR_0161	462107	5962145.2	Dipole	-457.5	291.9	749.4	52	Cable / Pipel
M_FR_0162	461959	5962148.4	Complex	-321.7	379.3	701	121.9	Cable / Pipel
M_FR_0163	461807.09	5962150.8	Dipole	-119.6	385.6	505.2	52.1	Cable / Pipel
M_FR_0164	461660.13	5962155.4	Dipole	-413.4	307.8	721.2	58.7	Cable / Pipel
M_FR_0165	461509.11	5962163.2	Dipole	-73	202.2	275.2	108.6	Cable / Pipel
M_FR_0166	461358.27	5962169.9	Complex	-99.7	994.3	1094	122	Cable / Pipel
M_FR_0167	461209.26	5962171.7	Complex	-137.8	105.2	243	45	Cable / Pipel
M_FR_0168	461066.56	5962177.6	Complex	-301.7	50.7	352.4	54.3	Cable / Pipel
M_FR_0169	460905.79	5962185.1	Dipole	-161.4	91.5	252.9	113.2	Cable / Pipel
M_FR_0170	460752.43	5962191.8	Dipole	-67.1	375.8	442.9	48.7	Cable / Pipel
M_FR_0171	460613.54	5962192.8	Complex	-528.4	137.6	666	55.5	Cable / Pipel
M_FR_0172	460466.47	5962198.2	Dipole	-348.8	217.3	566.1	41.9	Cable / Pipel
M_FR_0173	460319.4	5962202	Complex	-225.6	128.1	353.7	76.3	Cable / Pipel

M_FR_0174	460175.54	5962207.6	Complex	-134.3	160	294.3	39.5	Cable / Pipeline
M_FR_0175	456027.78	5964358.4	Positive Mc	0	11.4	11.4	374.2	
M_FR_0176	456108.59	5964485	Positive Mc	0.1	67.2	67.3	91.9	Wellhead
M_FR_0179	462405.18	5962309.1	Dipole	-11.7	5.7	17.4	35.8	Cable / Pipel
M_FR_0182	463734.96	5961917	Positive Mc	0	18	18	25.9	
M_FR_0184	463722.51	5960951.3	Positive Mc	-3.3	21.8	25.1	51.1	
M_FR_0189	460948.99	5962070.6	Positive Mc	0	15.3	15.3	33.3	
M_FR_0190	461226.4	5961988.8	Positive Mc	0	10.5	10.5	16.7	
M_FR_0199	466401.72	5960690.3	Positive Mc	0	12.4	12.4	15.3	
M_FR_0200	467133.32	5960941.9	Positive Mc	0	13.9	13.9	33	
M_FR_0202	465013.99	5959171.5	Positive Mc	0	16	16	45.8	
M_FR_0203	464616.31	5959330.3	Negative M	-19.1	0	19.1	42.3	
M_FR_0204	464123.89	5959550.7	Dipole	-7.1	6.5	13.6	29.2	
M_FR_0206	462846.81	5960087	Dipole	-14.6	57.2	71.8	43.9	Cable / Pipel
M_FR_0207	463099.15	5960103.7	Complex	-13.3	48.2	61.5	46.1	Cable / Pipel
M_FR_0208	463228.67	5960113.6	Dipole	-19.8	46.9	66.7	39.2	Cable / Pipel
M_FR_0209	463356.56	5960121.8	Dipole	-28.2	20.08	48.28	41.5	Cable / Pipel
M_FR_0210	463480.25	5960132.2	Complex	-25.3	15.2	40.5	52.6	Cable / Pipel
M_FR_0211	463611.63	5960140.1	Complex	-28.7	6.6	35.3	44.7	Cable / Pipel
M_FR_0212	463738.84	5960149.2	Dipole	-15.6	15.9	31.5	68.9	Cable / Pipel
M_FR_0213	463867.67	5960157	Complex	-17.7	12	29.7	46.3	Cable / Pipel
M_FR_0219	463995.19	5960163.6	Complex	-16.4	23.1	39.5	76.5	Cable / Pipel
M_FR_0220	464114.15	5960173.7	Dipole	-20.3	14.6	34.9	49.8	Cable / Pipel
M_FR_0221	464248.08	5960182.4	Complex	-20.1	19.6	39.7	84.8	Cable / Pipel
M_FR_0222	464395.61	5960176.2	Complex	-13.6	14.6	28.2	120.2	Cable / Pipel
M_FR_0223	464575.23	5960156.9	Complex	52.5	44.7	97.2	37.6	Cable / Pipel
M_FR_0224	464745.24	5960137.8	Complex	-27.1	28.9	56	36.7	Cable / Pipel
M_FR_0225	464903.16	5960124.4	Positive Mc	0	14.6	14.6	46.2	Cable / Pipel
M_FR_0227	465069	5960108	Complex	-19.1	14.7	33.8	47.4	Cable / Pipel
M_FR_0228	465243.53	5960091.2	Complex	-28.4	39.1	67.5	38.8	Cable / Pipel
M_FR_0229	465356.64	5960081.7	Dipole	-15.8	70.2	86	38.1	Cable / Pipel
M_FR_0231	465409.89	5960074	Complex	-155.2	123.5	278.7	33.9	Cable / Pipel
M_FR_0232	465568.85	5960059.5	Complex	-91.2	60.2	151.4	48.1	Cable / Pipel
M_FR_0233	465742.29	5960040.4	Complex	-56.6	76.2	132.8	40.2	Cable / Pipel
M_FR_0234	465910.87	5960024.2	Complex	-21.4	56.8	78.2	57.5	Cable / Pipel
M_FR_0235	466148.71	5959965.2	Complex	-28.4	55.9	84.3	64.2	Cable / Pipel
M_FR_0236	466397.58	5959897.6	Complex	-54.1	64	118.1	58.8	Cable / Pipel
M_FR_0237	466656.98	5959821.9	Complex	-44.3	48.5	92.8	75.8	Cable / Pipel
M_FR_0238	466917.05	5959748.1	Complex	-99.6	61.5	161.1	874.7	Cable / Pipel
M_FR_0239	467372.83	5959553.3	Complex	-145.3	128.2	273.5	204.2	Cable / Pipel
M_FR_0240	455732.21	5958878.5	Complex	-1	2.2	3.2	112.2	Cable / Pipel
M_FR_0241	457412.05	5957827.9	Negative M	-5.3	0	5.3	19.4	Cable / Pipel
M_FR_0245	453905.48	5961530.6	Dipole	-5.2	5.3	10.5	69.6	
M_FR_0247	454756.09	5960377.8	Dipole	-13.5	26.5	40	64.4	
M_FR_0249	454894.43	5960555.7	Dipole	-1.4	15.1	16.5	72.3	
M_FR_0252	454992.12	5959611	Complex	-7.8	3.5	11.3	155.1	
M_FR_0254	458129.83	5957731.9	Complex	-627.8	111.6	739.4	708.9	
M_FR_0258	456132.19	5960666.8	Positive Mc	-65.8	1074.2	1140	192.4	Wellhead
M_FR_0261	452544.29	5963274.6	Complex	-28	30	58	205.4	Cable / Pipel
M_FR_0266	456254.4	5960501.8	Negative M	-67.7	2.5	70.2	69.5	
M_FR_0267	457783.06	5959278.5	Dipole	-33.6	6	39.6	57.8	
M_FR_0269	459102.94	5959161.4	Dipole	-3	7.1	10.1	49	
M_FR_0271	459517.12	5958198.1	Dipole	-6.8	5.3	12.1	36.3	

M_FR_0272	460200.59	5957766.6	Dipole	-11	8.8	19.8	57.6	
M_FR_0273	460567.93	5957443.9	Negative M	-11	0	11	38.6	
M_FR_0276	459698.93	5960451.4	Dipole	-27.9	33.4	61.3	61.3	Cable/Pipeline
M_FR_0277	454435.38	5962480.4	Complex	-137.7	141.8	279.5	279.5	Cable/Pipelir
M_FR_0279	463674.32	5956690.3	Positive Mc	-0.9	13.8	14.7	32.5	
M_FR_0280	461498.56	5957754.5	Positive Mc	-0.3	25.4	25.7	18.9	
M_FR_0281	453009.59	5963075.1	Complex	-44.1	48.2	92.3	207.3	Cable / Pipel
M_FR_0285	462068.21	5957697.1	Positive Mc	0	20.6	20.6	232.3	Wellhead
M_FR_0286	457436.12	5960402.4	Positive Mc	0	48.9	48.9	298.2	Wellhead
M_FR_0287	456166.03	5960734	Negative M	-16.5	0	16.5	325.8	Wellhead
M_FR_0290	459192.65	5959011	Positive Mc	-2	21.1	23.1	48.1	
M_FR_0292	460009.41	5958500.1	Dipole	-9.5	14.5	24	57.9	
M_FR_0293	453128.6	5963505.8	Positive Mc	-53.1	1205.4	1258.5	135.9	Wellhead
M_FR_0294	455432.71	5962061	Complex	-130.3	115.3	245.6	285.2	Cable/Pipelir
M_FR_0295	457498.22	5960466.9	Negative M	-34	4.9	38.9	265.7	Cable/Pipelir
M_FR_0296	453958.82	5962680.2	Complex	-137.8	139.5	277.3	235.2	Cable/Pipelir
M_FR_0297	456393.15	5961658.1	Complex	-35.4	35.8	71.2	155	Cable/Pipelir
M_FR_0300	454925.54	5962274.7	Complex	-144.8	115.1	259.9	278	Cable/Pipelir
M_FR_0304	458820.14	5960638.6	Complex	-48.5	39.2	87.7	207.5	Cable/Pipelir
M_FR_0305	466730.05	5956383.9	Dipole	-4	1.4	5.4	70.9	Cable / Pipel
M_FR_0308	457276.75	5962305.5	Complex	-35.1	208	243.1	159.1	Cable/Pipelir
M_FR_0310	462109.11	5957774.8	Dipole	-9.6	112.9	122.5	145.4	Wellhead
M_FR_0315	462923.87	5957365.4	Dipole	-12.5	20.3	32.8	61.4	
M_FR_0319	460788.55	5962189.7	Negative M	-451.7	15.9	467.6	85.7	Cable/Pipelir
M_FR_0320	460382.32	5960361.3	Complex	-93.1	71.8	164.9	137.2	Cable/Pipelir
M_FR_0321	467090.88	5956358.3	Complex	-2.9	3.2	6.1	96.7	Cable / Pipel
M_FR_0322	460773.28	5960317.2	Complex	-30.3	106.4	136.7	195.7	Cable / Pipel
M_FR_0323	457621.16	5962290.6	Complex	-140.5	1194.7	1335.2	187.4	Cable / Pipel
M_FR_0325	455920.34	5961851.9	Complex	-52	64.8	116.8	251.4	Cable / Pipel
M_FR_0328	462976.54	5960093	Dipole	-41.2	41.3	82.5	92.4	Cable / Pipel
M_FR_0329	459572.12	5962227.4	Positive Mc	-87.9	755.8	843.7	125	Cable / Pipel
M_FR_0330	458057.09	5963178.9	Positive Mc	2	41.5	43.5	219.4	
M_FR_0331	456062.05	5964425.8	Positive Mc	-1.1	76.8	77.9	176.2	
M_FR_0332	453685.87	5965915.3	Dipole	-6.6	7	13.6	29.9	
M_FR_0335	456800.87	5961482.1	Positive Mc	-2.6	27.3	29.9	91.2	Cable / Pipel
M_FR_0337	455304.82	5959093.8	Positive Mc	0	2.6	2.6	34.7	Cable / Pipel
M_FR_0338	462659.1	5959338.9	Positive Mc	-4.5	21.7	26.2	25.3	
M_FR_0339	461174.02	5960271.5	Complex	-153.2	41.8	195	160.4	Cable / Pipel
M_FR_0340	457972.95	5962281.8	Complex	-540.4	96.8	637.2	219	Cable / Pipel
M_FR_0342	456892.65	5961443.2	Complex	-22	21.9	43.9	160.9	Cable / Pipel
M_FR_0344	465156.97	5956263.5	Negative M	-4.5	0.1	4.6	37.2	Cable / Pipel
M_FR_0345	457316.09	5962301.2	Negative M	-517	0	517	48.8	Cable/Pipelir
M_FR_0346	453174.64	5963571.7	Negative M	-19.6	2.3	21.9	329	Wellhead
M_FR_0347	461983.42	5960162.2	Complex	-19.9	90.7	110.6	121.6	Cable / Pipel
M_FR_0348	458629.05	5962260.7	Complex	-97.6	219.3	316.9	195.7	Cable / Pipel
M_FR_0349	461782.93	5960183.4	Dipole	-77.7	73.7	151.4	105.5	Cable / Pipel
M_FR_0350	458461.49	5962268.5	Complex	-368.5	103.3	471.8	200.9	Cable / Pipel
M_FR_0352	453985.86	5964068.3	Negative M	-38.2	-0.1	38.1	28.6	
M_FR_0354	454350.2	5964645.9	Negative Di	-18.3	4.7	23	82.3	
M_FR_0357	458144.8	5962266	Positive Mc	-43.2	488.2	531.4	152.1	Cable / Pipel
M_FR_0359	461180.6	5960364.3	Positive Mc	-2.9	31.7	34.6	94.6	
M_FR_0360	461375.64	5960239.8	Complex	-82.6	61.3	143.9	147.4	Cable / Pipel
M_FR_0363	460969.61	5960294.2	Complex	-101.1	35.4	136.5	120.9	Cable / Pipel

M_FR_0365	457789.87	5962284	Positive Mc	-51.2	579.1	630.3	128.8	Cable / Pipeline
M_FR_0366	458342.47	5960834.4	Complex	-52.7	52.8	105.5	113.7	Cable / Pipel
M_FR_0368	465669.07	5956247	Dipole	-2.7	2.6	5.3	78.6	Cable / Pipel
M_FR_0369	460582.55	5960337.9	Complex	-85.7	82.1	167.8	146.4	Cable / Pipel
M_FR_0371	457445.2	5962302.8	Complex	-178.8	177.8	356.6	119.6	Cable / Pipel
M_FR_0373	457380	5961238.9	Complex	-19.5	15.6	35.1	133.8	Cable / Pipel
M_FR_0374	460240.5	5959448.3	Negative M	-13.8	0	13.8	37.6	
M_FR_0377	465294.35	5956289	Negative M	-3	1.2	4.2	45.4	Cable / Pipel
M_FR_0380	460187.98	5960381.2	Complex	-103.9	53.4	157.3	105.2	Cable / Pipel
M_FR_0381	457128.17	5962301.8	Positive Mc	-61	224.2	285.2	189.9	Cable / Pipel
M_FR_0383	457370.88	5963151.7	Dipole	-6.8	5.3	12.1	34.3	
M_FR_0385	458813.39	5962248.1	Positive Mc	-40.5	992.2	1032.7	62.2	Cable / Pipel
M_FR_0386	462176.64	5960139	Dipole	-50.5	52.4	102.9	97.7	Cable / Pipel
M_FR_0388	462394.05	5960104.3	Negative M	-85.1	32.4	117.5	119.2	Cable / Pipel
M_FR_0389	458968.16	5962249.8	Complex	-211.8	311.4	523.2	132.6	Cable / Pipel
M_FR_0390	452714.45	5964160.8	Negative M	-7.1	3.1	10.2	72.3	
M_FR_0391	455139.48	5962845.6	Dipole	-6.3	3.8	10.1	62.6	
M_FR_0392	456840.43	5962314.7	Positive Mc	-32.1	734.7	766.8	79.6	Cable / Pipel
M_FR_0393	458804.94	5960749.1	Dipole	-7.6	9.3	16.9	31.9	
M_FR_0394	459187.07	5960509.1	Positive Mc	-17.1	55.4	72.5	104.5	Cable / Pipel
M_FR_0401	454000.45	5962662.4	Dipole	-2.8	77.9	80.7	99	Cable / Pipel
M_FR_0403	456886.26	5962314.9	Negative M	-171	10.3	181.3	82.5	Cable / Pipel
M_FR_0405	459376.29	5960487	Positive Mc	-14	60	74	53.9	Cable / Pipel
M_FR_0408	465560.02	5964401.9	Negative M	-423.1	7.8	430.9	123.9	Cable / Pipel
M_FR_0409	464070.6	5962728.2	Complex	-636.9	925.1	1562	169.4	Cable / Pipel
M_FR_0411	462427.2	5960109	Dipole	-11.3	45	56.3	104.9	Cable / Pipel
M_FR_0414	465658.87	5964516.2	Positive Mc	-8.8	339.6	348.4	62.8	Cable / Pipel
M_FR_0416	462711.36	5960079.1	Positive Mc	-19.8	58.8	78.6	66.6	Cable / Pipel
M_FR_0417	459282.15	5962229	Complex	-322.6	289.4	612	133.2	Cable / Pipel
M_FR_0418	456787.65	5962315.9	Positive Mc	-52.3	547.7	600	44.2	Cable / Pipel
M_FR_0419	459578.26	5960462.6	Positive Mc	-20.2	57.4	77.6	92.6	Cable / Pipel
M_FR_0421	462586.35	5960088.1	Positive Mc	-28.2	58.7	86.9	80.6	Cable / Pipel
M_FR_0422	459139.32	5962246.5	Complex	-503.6	259.2	762.8	141	Cable / Pipel
M_FR_0424	459792.12	5960432.9	Complex	-55.5	49.8	105.3	74.3	Cable / Pipel
M_FR_0427	456949	5962308.9	Positive Mc	-292.4	949.8	1242.2	66.6	
M_FR_0431	459986.09	5960407.7	Negative M	-79.4	28.2	107.6	76.1	Cable / Pipel
M_FR_0433	462930.44	5963763.1	Positive Mc	-4.7	206.1	210.8	60.8	Cable / Pipel
M_FR_0434	462769.68	5963675.2	Positive Mc	0.4	11.3	11.7	31.2	
M_FR_0436	462917.94	5963819.6	Positive Mc	-14.5	1792	1806.5	65.3	Cable / Pipel
M_FR_0438	465509.53	5964346.4	Dipole	-8.5	201.8	210.3	106.5	Cable / Pipel
M_FR_0439	462902.35	5963740.2	Complex	-208	9.3	217.3	121.1	
M_FR_0442	462901.39	5963741.7	Complex	-238	5.7	243.7	132.3	Cable / Pipel
M_FR_0443	462839.77	5963749.1	Positive Mc	-2.3	17	19.3	33.1	Cable / Pipel
M_FR_0444	462880.87	5963770.1	Complex	-221.8	19	240.8	118.7	Cable / Pipel
M_FR_0445	462836.65	5963758.1	Dipole	-0.7	9.5	10.2	69.4	Cable / Pipel
M_FR_0447	459738.43	5965485.6	Dipole	-0.4	14.1	14.5	8.6	
M_FR_0448	453474.07	5962886	Complex	-97.6	86.6	184.2	317.2	Cable / Pipel
M_FR_0465	465433.44	5956289.7	Dipole	-1.7	1.8	3.5	93.3	Cable / Pipel
M_FR_0481	452164.81	5961024.2	Complex	-0.9	2.3	3.2	108.4	Cable / Pipel
M_FR_0482	451916.45	5961182.8	Complex	-3	6.1	9.1	188.6	Cable / Pipel
M_FR_0493	461752.65	5955996.1	Dipole	-0.5	3	3.5	77.8	Cable / Pipel
M_FR_0507	463629.84	5956144.7	Dipole	-4.3	1.6	5.9	35	Cable / Pipel
M_FR_0513	460136.3	5956032.2	Complex	-1.9	1.6	3.5	208.1	Cable / Pipel

M_FR_0525	456660.13	5958211	Complex	-3.1	2.7	5.8	330.4	Cable / Pipeline
M_FR_0526	460734.88	5955920.9	Dipole	-2.2	1	3.2	46.5	Cable / Pipel
M_FR_0527	461243.09	5955957	Positive Mc	-0.5	1.5	2	72.1	Cable / Pipel
M_FR_0537	456097.79	5958650.2	Complex	-1.2	1.1	2.3	117.2	Cable / Pipel
M_FR_0544	458062.86	5957331.6	Dipole	-1	2.3	3.3	108.3	Cable / Pipel
M_FR_0554	461593.79	5956003.4	Complex	-1.3	4.7	6	206.2	Cable / Pipel
M_FR_0555	458275.06	5962282.1	Complex	-88.8	492.8	581.6	206	Cable / Pipel
M_FR_0556	457951.35	5962286	Complex	-455.2	77.3	532.5	231.7	Cable / Pipel
M_FR_0557	456891.38	5962312.9	Complex	-384.5	21.4	405.9	193.6	Cable / Pipel
M_FR_0564	462770.52	5963672.8	Positive Mc	0.4	10.9	10.6	33.3	Cable / Pipel
M_FR_0565	461580.33	5960212	Complex	-39.1	118.4	157.5	101.5	Cable / Pipel
M_FR_0566	457882.78	5961024.4	Complex	-19.3	25.1	44.4	131.9	Cable / Pipel

ID	EASTING	NORTHING	LATITUDE (I	LONGITUDE	LENGTH (m	WIDTH (m)	HEIGHT (m)	WATER DEF	CLASSIFICA	COMMENT
S_FR_B1_0(	452411.44	5961763.5	53.80226	-3.722579	1.1	0.4	0.1	33.1	Boulder	
S_FR_B1_0(	452445.16	5961584.3	53.800652	-3.72204	0.6	0.5	0	32.9	Debris	
S_FR_B1_0(	452666.65	596074	53.793085	-3.718547	6.6	0.2	0.1	30.9	Debris	
S_FR_B1_0(	454448.75	5961518.2	53.800237	-3.691612	2.2	0.6	0.1	32.5	Debris	
S_FR_B1_0(	454593.27	5959701.1	53.783919	-3.68915	1	0.2	0.1	35.1	Boulder	
S_FR_B1_0(	454660.7	5966232.2	53.842623	-3.689089	0.9	0.2	0.1	32.6	Debris	
S_FR_B1_0(	455641.64	596451	53.827229	-3.673932	1.9	0.9	0	31	Boulder	No measured height
S_FR_B1_0(	455732.23	5961171.6	53.797233	-3.672076	2.3	0.4	0.1	32.3	Debris	
S_FR_B1_0(	456617.71	5966529.9	53.845466	-3.659389	1	0.6	0.1	30.4	Boulder	
S_FR_B1_0(	456596.28	5958686.2	53.774968	-3.658609	1.1	0.4	0.1	36.8	Debris	
S_FR_B1_0(	457890.49	5959792.7	53.785019	-3.639123	0.8	0.9	0.1	31.2	Boulder	
S_FR_B1_0(	459119.46	5957397.1	53.763586	-3.620154	4.9	0.3	0.1	36.9	Debris	Linear debris
S_FR_B1_0(	459269.94	5958439.1	53.772963	-3.618009	1.6	0.2	0.1	33.4	Debris	
S_FR_B1_0(	459627.96	5958364.5	53.77232	-3.612567	1.3	1	0.4	33.1	Boulder	
S_FR_B1_0(	459699.75	5957049.1	53.760504	-3.611306	1.3	0.3	0.2	36.1	Boulder	
S_FR_B1_0(	459746.98	5957070.7	53.760701	-3.610592	1	0.6	0.1	35.9	Boulder	
S_FR_B1_0(	460026.56	5957856.4	53.767785	-3.606454	1.4	0.7	0	35.2	Debris	
S_FR_B1_0(	460260.55	5963389.9	53.817536	-3.603617	1.4	1.2	0.2	24.7	Boulder	
S_FR_B1_0(	460854.27	5963544.1	53.818967	-3.594619	1.1	0.5	0.1	24.6	Boulder	
S_FR_B1_0(	460868.69	5956688.8	53.757354	-3.59353	1.1	0.5	0.1	33.7	Boulder	
S_FR_B1_0(	460979.29	5963043.8	53.81448	-3.592657	5.9	0.4	0.1	23.1	Debris	Linear Debris
S_FR_B1_0(	461349.96	5957791.1	53.767298	-3.586369	0.8	0.8	0	32.3	Debris	
S_FR_B1_0(	461821.93	5963790.7	53.821255	-3.579952	3	0.5	0.2	24.3	Boulder	
S_FR_B1_0(	462080.42	5961741.3	53.802855	-3.575773	1.1	1.2	0.2	28.9	Boulder	
S_FR_B1_0(	462105.65	5957756.4	53.767041	-3.5749	1.7	0.3	0.1	31	Debris	Possible fishi
S_FR_B1_0(	462116.7	5957749.5	53.76698	-3.574732	3.1	2.6	0.7	31.3	Debris	Possible fishi
S_FR_B1_0(	462755.68	595694	53.759751	-3.564941	1	0.4	0	32.3	Debris	
S_FR_B1_0(	463732.2	5961963.9	53.804974	-3.55072	5.3	0.3	0.1	27.5	Debris	Possible cabl
S_FR_B1_0(	463832.55	5962039.2	53.805657	-3.549205	1.9	1.2	0	26.8	Debris	
S_FR_B1_0(	464081.43	5962756	53.812117	-3.54551	2.3	0.4	0	21.1	Debris	Possible cable/wire. No measured height
S_FR_B1_0(	465204.88	5963512	53.818988	-3.528534	1.1	0.2	0.2	20.9	Boulder	
S_FR_B1_0(	466107.85	5960612.6	53.792988	-3.514499	1	0.4	0.1	24.8	Boulder	
S_FR_B1_0(	466619.34	5958065	53.770123	-3.506459	2.3	0.5	0.3	23	Boulder	
S_FR_B1_0(	467005.41	5959735.3	53.785161	-3.50078	2.6	1.1	0.4	21.5	Boulder	
S_FR_B1_0(	463017.33	5963581.3	53.81946	-3.561769	5	1.5	0.4	23	Debris	Possible fishi
S_FR_B1_0(	463018.67	5963578.3	53.819433	-3.561748	4.4	2.5	0	23	Debris	No measurec
S_FR_B1_0(	461851.86	5958082.5	53.769954	-3.578791	1.4	0.4	0	30.9	Debris	Possible scaf
S_FR_B1_0(	458697.42	5960212.7	53.788858	-3.626933	5.2	2.6	0.8	29.9	Boulder	
S_FR_B1_0(	459820.55	5959589.5	53.783345	-3.609804	0.8	0.8	0	31.8	Debris	
S_FR_B1_0(	465019	5956204.2	53.753294	-3.530528	4.3	0.8	0.1	31.8	Debris	
S_FR_B1_0(	467118.92	5957525.2	53.765304	-3.498822	1.1	0.9	0.2	26.5	Boulder	
S_FR_B1_0(	464702.57	5956856.4	53.759135	-3.535401	1.3	0.6	0.1	31.2	Boulder	
S_FR_B1_0(	459719.89	5959513.3	53.782653	-3.611322	1.8	0.7	0.1	31.7	Boulder	
S_FR_B1_0(	461750.48	5959671.2	53.784225	-3.580526	4.2	0.8	0.2	29.6	Debris	
S_FR_B1_0(	464115.96	5958179.8	53.770989	-3.544453	2.8	0.7	0.1	27.4	Debris	Possible fishi
S_FR_B1_0(	466231.29	5956835.6	53.759049	-3.512212	6.3	3.5	0.8	29.7	Debris	Possible fishi
S_FR_B1_0(	454670.23	5964384	53.826013	-3.688671	5.5	4	0.1	31.7	Debris	Possible fishi
S_FR_B1_0(	462445.17	5959735.4	53.784853	-3.569991	7.5	4.1	0.5	27.7	Boulder	
S_FR_B1_0(	462965.17	5959305.3	53.781024	-3.562047	0.9	0.7	0.4	25.4	Boulder	
S_FR_B1_0(	467125.35	5956833.9	53.759091	-3.498651	1.3	1.2	0	29.4	Boulder	
S_FR_B1_0(	457230.62	5961407.6	53.79948	-3.649362	2.4	0.8	0.2	31.7	Debris	
S_FR_B1_0(	453083.55	5965101.6	53.832322	-3.712884	1	0.5	0.2	34.1	Debris	
S_FR_B1_0(	455840.3	5963619.7	53.819244	-3.670786	0.9	0.4	0.1	32.3	Debris	
S_FR_B1_0(	467170.4	5956561.5	53.756646	-3.497939	0.9	0.5	0.2	29.5	Debris	
S_FR_B1_0(	462493.71	5957893.8	53.768304	-3.56903	1.6	0.9	0.1	30.3	Boulder	
S_FR_B1_0(	464969.98	5956599.5	53.756843	-3.531316	1.5	0.5	0	31.7	debris	No measurec
S_FR_B1_0(	464256.91	5958266.2	53.771775	-3.542324	1.2	0.9	0	26.9	Debris	
S_FR_B1_0(	466335.16	5956824.1	53.758952	-3.510635	1.2	0.7	0.1	29.6	Boulder	
S_FR_B1_0(	458050.28	5962074.1	53.805536	-3.637009	1	0.4	0.1	29	Debris	

S_FR_B1_0(	455063.87	5963503.6	53.818135	-3.682563	0.6	0.2	0	32.4	Debris	
S_FR_B1_0(	459651.85	5961908.1	53.804171	-3.612668	2.5	0.6	0	29	Debris	
S_FR_B1_0(	454773.61	5963196.3	53.815348	-3.686926	0.9	0.8	0	32.4	Debris	
S_FR_B1_0(	455257.43	5963025.2	53.813852	-3.679553	1.5	1.1	0.1	31.3	Debris	
S_FR_B1_0(	458615.04	5961335.5	53.798944	-3.628334	2.1	0.7	0	31.5	Debris	No measured height
S_FR_B1_0(	454407.61	5963350.7	53.816704	-3.692507	3.2	1.6	0.2	32.5	Boulder	
S_FR_B1_0(	465404.48	5956832.4	53.758966	-3.524752	2.1	0.6	0.2	30.9	Debris	
S_FR_B1_0(	454522.45	5963231.5	53.815642	-3.690746	1.5	0.6	0	32.7	Boulder	
S_FR_B1_0(	466031.1	5956646.5	53.757337	-3.515228	0.5	0.4	0.1	30.6	Boulder	
S_FR_B1_0(	466057.82	5956554	53.756506	-3.514812	1	0.6	0	30.6	Boulder	
S_FR_B1_0(	461114.08	5960918.3	53.795387	-3.590342	1.2	0.5	0.1	30.5	Debris	
S_FR_B1_0(	465272.38	5957022.7	53.760667	-3.526777	2.1	1.1	0	29.8	Boulder	
S_FR_B1_0(	464969.76	5957233.2	53.762539	-3.531391	1.6	1.5	0.1	29.1	Debris	
S_FR_B1_0(	465533.27	5956666.4	53.757482	-3.52278	1.8	1.3	0	31.3	Debris	
S_FR_B1_0(	456542.98	5966576.5	53.845878	-3.660531	2.1	0.5	0	30.5	Debris	
S_FR_B1_0:	453367.76	5966338.6	53.843465	-3.708754	55.5	0.4	0	33.8	Debris	Possible cabl
S_FR_B1_0:	453440.87	5966319.6	53.843301	-3.70764	28.9	0	0	34	Debris	Possible cable/wire. No measured height
S_FR_B1_0:	462615.96	5963184.7	53.815867	-3.567817	2.2	2.9	0.6	22.3	Debris	Possible fishi
S_FR_B1_0:	462731.58	5963578.5	53.819414	-3.566109	5.6	8	0.2	22.9	Debris	
S_FR_B1_0:	462897.47	5963815.9	53.82156	-3.563618	1.5	0.9	0.1	23.5	Boulder	