Marine Archaeology and Cultural Heritage
Hywind Marine Historic Environment Baseline Technical Report
Statoil ASA

Assignment Number: A100142-S10
Document Number: A-100142-S10-REPT-001

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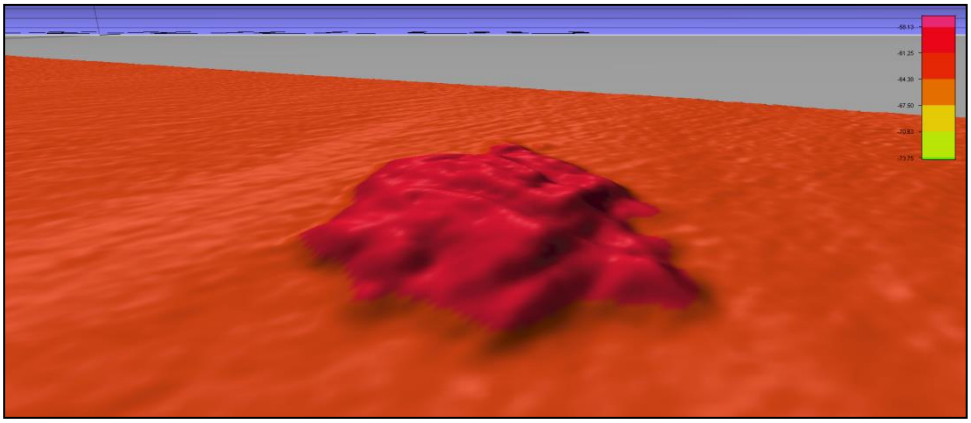
			AT	SF	SF	
A01	02/04/15	Issued for Use	PP ORCA	LF	LF	
R01	17.09.14	Issued for Client Review	ORCA	LF	LF	
Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval

Hywind Scotland Pilot Park Project
Off Peterhead, Aberdeenshire



Marine Historic Environment
Technical Baseline Report

September 2014

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Origination Date:	10th September 2013
Reviser(s):	Liz Foubister, Paul Sharman, Annalisa Christie
Date of last revision:	05/09/2014
Version:	V6
Status:	Final version after client revisions
Circulation:	Paul Sharman, ORCA Marine, paul.sharman@uhi.ac.uk Mark Littlewood, ORCA Marine, mark.littlewood@uhi.ac.uk Annalisa Christie, ORCA Marine, annalisa.christie@uhi.ac.uk Andrea Taylor, Xodus Group Ltd, Andrea.Taylor@xodusgroup.com Liz Foubister, Xodus Group Ltd, Liz.Foubister@xodusgroup.com
Required Action:	Client to read and give feedback or accept
File Name / Location:	X:\MarineArchaeology\ORCA Marine Projects\434_Hywind_Scotland_Export_Cable\Report\Draft Reports\Report Text\Baseline\434_Baseline_Technical_Report_v6.docx
Approval:	

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Executive Summary

ORCA Marine was commissioned by Xodus Group and Hywind (Scotland) Limited (HSL) to assess the potential impacts of the proposed marine wind turbine development of Hywind Scotland Pilot Park, approximately 25km east of Peterhead, Aberdeenshire, near Buchan Deep. This baseline assessment will identify any sites of archaeological or historical significance that might be affected by the proposed development and where / if appropriate make some initial suggestion for managing or mitigating any identified issues and impacts concerning the marine archaeological and heritage resource.

Twenty-one potential shipwreck sites were recorded by the desk-based assessment. Of these, the positions of 12 are tentative, being derived from an unverified location of loss. They have been included in the baseline assessment because although the listed positions in most cases fall outside the export cable corridor and Agreement for Lease Area, the descriptions of their loss indicate they could fall within these areas. Two of the shipwrecks are considered to be of high importance if they are found.

Ten multi-beam echosounder (MBES), twenty-seven side scan sonar (SSS) and two magnetic anomalies were noted during the assessment of the geophysical data collected by the survey company MMT. Of these, one MBES (MBES08), 15 SSS anomalies (SSS01, SSS04 – SSS06, SSS13 – SSS14, SSS17, and SSS20 – SSS27) and one magnetic anomaly (MAG02) were considered to be anthropogenic. Anomaly SSS04 likely represents the remains of the *Muriel,* a steel steamship that sank on 17th September 1918 while carrying a cargo of coal. However, it is situated 500m North (outside) of the export cable route corridor. A further two MBES and seven SSS anomalies were considered to be possibly anthropogenic.

Assessment of the sub-bottom profiler and geotechnical data indicate there is low potential for preservation of submerged palaeoenvironmental remains and there are no submerged landscapes of archaeological interest present in the area. There is low potential for the project to impact on significant unknown, unrecorded vessel remains that may not be visible in geophysical data because of the nature of the seabed within the development area -

bedrock and mobile sediments - which is not conducive to good preservation of submerged cultural heritage.

With the exception of the **high geophysical potential** anomalies SSS06 and MBES08, which are located 9 m South and 85 m North of the inshore section of the proposed export cable route respectively, avoidance of shipwrecks of **high or medium importance** and anomalies of **high or medium geophysical potential** should be entirely possible, since the cable route avoids them by at least 174 m. It is recommended that the wind turbine locations, anchors, moorings and layout of the inter-array cabling avoid the thirteen SSS anomalies and one MBES anomaly considered of **high or medium geophysical potential** within the Proposed Offshore Turbine Deployment Area. However, if for any reason (such as a change in the proposed cable route, necessary layout of turbines), it is not possible to avoid, it is recommended that these wrecks and anomalies be further investigated by diver, drop down camera or remote operated vehicle (ROV), and the data assessed by a marine archaeologist. This work will provide a basis for devising appropriate management and mitigation strategies.

It is recommended that a reporting protocol for accidental discovery of cultural remains be employed. This would mitigate the low possibility that artefacts trapped in sediments or gullies, or the remains of unknown wrecks are disturbed by the construction work.

1.0 Introduction

ORCA Marine was commissioned by Xodus Group Ltd and Hywind (Scotland) Limited (HSL) to assess the potential impacts of a proposed marine wind turbine development (Hywind Scotland Pilot Park Project) approximately 25km east of Peterhead, Aberdeenshire, near Buchan Deep. HSL propose to install five WTG units with a total capacity of up to 30MW within the Proposed Offshore Turbine Deployment Area. These will be attached to the seabed by a three-point mooring spread, and will be connected by inter-array cables. The export cable is planned to come ashore at Peterhead, and will be routed to a switchgear yard and comment to the local distribution network at the Peterhead Grange substation. (Information from Statoil ASA Project Description Document A-100142-S00-TECH-001, 19/03/14.)

This assessment will identify any sites of archaeological or historical importance that might be affected by the proposed development and make some initial suggestion for managing any identified issues and impacts concerning the marine archaeological and heritage resource. This will be used to inform an Environmental Impact Assessment and a chapter in the Environmental Statement. This report incorporates a Desk Based Assessment (DBA) of the possible submerged cultural heritage within the Proposed Offshore Turbine Deployment Area and export cable route corridor prepared by Scientific Underwater Logistics and Diving (SULA Diving) on behalf of ORCA Marine. SULA Diving were also commissioned to assist in the evaluation of the remote sensing survey data (multi-beam echo sounder (MBES), side scan sonar (SSS), Magnetometer and sub-bottom Profiler (SBP)) obtained by survey company MMT on behalf of HSL (*Marine Survey Report: Hywind Offshore Windfarm*; Statoil Doc. No. ST13828-Hywind OW).

The marine historic environment encompasses not only shipwrecks, but also other evidence of human exploitation of maritime resources, such as shipyards, piers, fish traps, anchor sites and submerged landscapes where human beings and early hominids previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish on the coast which is now submerged (*Marine (Scotland) Act* 2010, section 73,

paragraph 5).

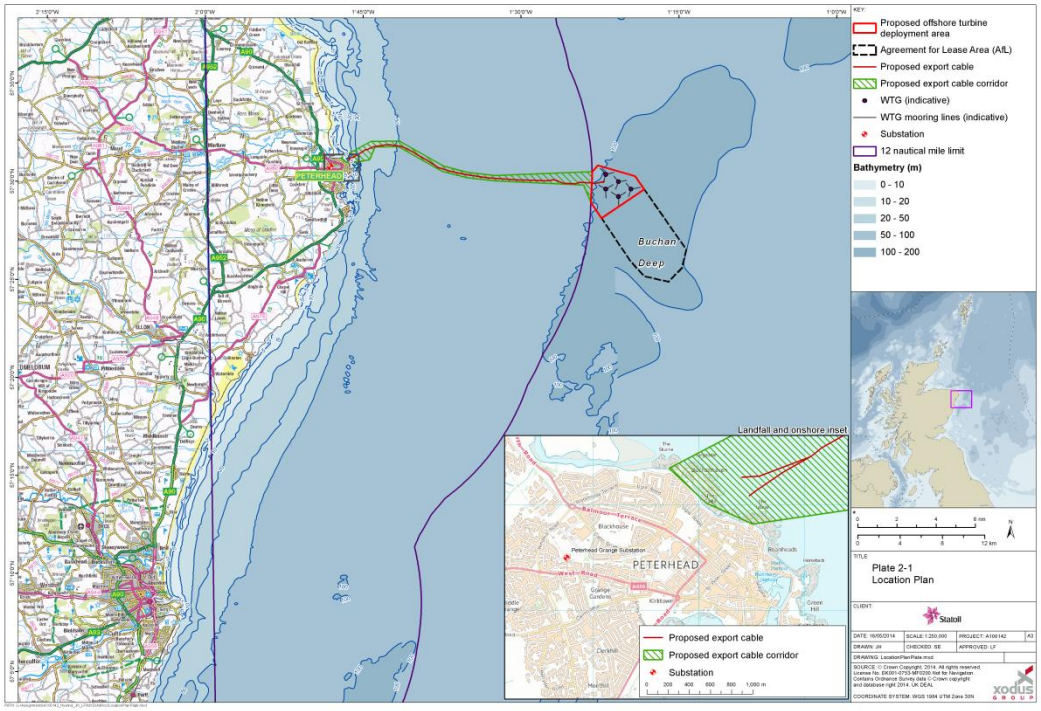
This report includes:

- A review of existing data sources to identify known sites in the area, and the potential for unidentified marine cultural heritage sites and areas;
- A review of the cultural heritage sites identified during the marine geophysics assessment;
- A preliminary indication of possible issues or sensitivities and suggestions for possible further pre-planning assessment work or management strategies; and
- A summary of the results of the DBA and marine geophysics and geotechnical data assessments, in Appendices 2 to 7.

2.0 Aims and Objectives of the Assessment

The baseline assessment report will be used to identify any potential marine historic environment issues or constraints; to evaluate site options and cable route options and to comment upon the sensitivity of the proposed development areas in order to inform the Environmental Impact Assessment (EIA) of the proposal, resulting in an Environmental Statement (ES) chapter. The report will also help inform the decision-making process for the design layout, potential routes and locations of the proposed development prior to the EIA. The DBA covers the Proposed Offshore Turbine Deployment Area and the export cable route corridor, while the geophysical data assessment covers the export cable route corridor and Agreement for Lease Area (AfL) as indicated in **Plate 2-1**.

Plate 2-1 Location of Hywind Scotland Pilot Park Project



The assessment aims to:

- Review existing databases on the marine historic environment in the area, including cultural heritage sites and landscapes, relative sea-level change, submerged cultural remains, wrecks and subsea features; to identify known sites in the area and the potential for unidentified sites and landscapes;
- Analyse the marine geophysical survey data acquired by MMT on behalf of HSL, assessing its quality and identifying any evidence of marine cultural material or subsea remains;
- Review available data in respect of seabed and sub-seabed deposits likely to be of palaeoenvironmental and archaeological interest;
- Identify any deposits of palaeoenvironmental potential within the top two metres of seabed sediments (Holocene deposits) along the export cable route corridor and within the Proposed Offshore Turbine Deployment Area;
- Categorise sites in terms of importance (or sensitivity) and local, regional, national or international relative importance;

- Identify any known or likely sensitive sites or areas and the potential for unknown remains in the development area; and
- Recommend any further work and make initial suggestions for any further assessment, mitigation or management strategies, identifying any potential issues, sensitivities or constraints.

3.0 Assessment Methodology

3.1 Desk-based Assessment

The DBA was conducted to identify possible submerged cultural heritage within the Proposed Offshore Turbine Deployment Area and the export cable route corridor. It was completed in accordance with the Institute for Archaeologists (IfA) *Standard and Guidance for historic environment desk-based assessment* (revised November 2012) and reviewed key data sources of known submerged sites within the orange and green shaded areas detailed in **Plate 2-1.** Any items identified outside, but close to these areas are also detailed this report. This is because the listed positions of many of these sites are unverified. Although the listed positions may be located outside the export cable route corridor and Proposed Offshore Turbine Deployment Area, descriptions of their circumstance of loss indicate they could be located within the Deployment Area and thus be impacted.

The principal reference sources examined for this assessment were:

- The National Monuments Record of Scotland, using the Canmore database website;
- The online Sites and Monuments Record held by Aberdeenshire Council (https://www.aberdeenshire.gov.uk/smrpub/default.aspx);
- Statutory lists, registers and designated areas, including List of Scheduled Ancient Monuments, Designated Wrecks and Historic Marine Protected Areas;
- UK Hydrographic Office (UKHO) wreck register and relevant nautical charts;
- Heath / Ferguson private wreck database, which contains material not published by Ferguson (see Ferguson 1991) and has been added to by Heath and Ferguson as new discoveries of wreck sites have been made;

- Larn, R & Larn, B 1998 *The Ship Wreck Index of Great Britain & Ireland* Vol.4 Scotland (SIBI);
- Whittaker IG 1998 *Off Scotland: a comprehensive record of maritime and aviation losses in Scottish waters*, Edinburgh.

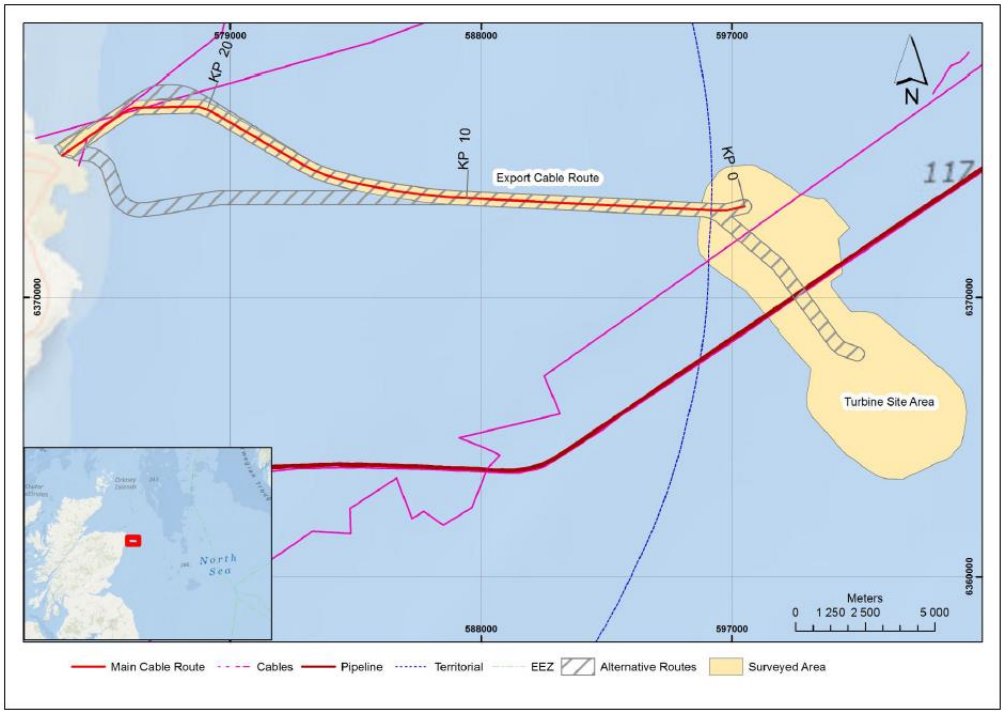
Other readily available archaeological and historical reports, databases and publications were consulted for information about the study area and, where used, are cited in the report.

3.2 Sub-sea survey methods

The methods, resolution limitations and results of the subsea survey by MMT were presented in a report that accompanied the data files for review, received from Xodus Group Ltd (Marine Survey Report: Hywind Offshore Windfarm; Statoil Doc. No. ST13828-Hywind OW). A method summary is provided below.

MMT were contracted by HSL to undertake a geophysical and benthic survey for the Deployment Area and export cable route corridor (**Plate 3-1**).

Plate 3-1 Overview of Hywind Offshore Windfarm survey area (Marine Survey Report: ST13828-Hywind OW



The objective of the surveys was to provide geophysical data to determine geological conditions and hazards affecting the planning, design and installation of the Hywind Scotland Pilot Park and export cable route corridor. Surveys lines along the export cable route corridor were spaced 50m apart with perpendicular cross lines every second kilometre. Line spacing was reduced to 30m in the landfall area of export cable route corridor. The survey toward landfall reached a water depth of 1m LAT. Surveys lines within the AfL were also spaced 50m apart though perpendicular cross lines were reduced to 100m line spacing.

The offshore operations for this project were performed from the survey vessel MV *Franklin* from the 28th of July to 1st of August 2013. The shallow water geophysical survey was undertaken by the MV *Franklin* from 19th of August to the 27th of August 2013. The MV *Franklin* was fitted with a Kongsberg EM710 multi-beam echosounder (MBES), a towed Edgetech 4200 (300/600 kHz) side-scan sonar (SSS), a towed Chirp sub-bottom profiler (SBP) Edgetech 512i, a GeoSparker 200 SBP and a Geometrics G-882 magnetometer. The MV *Ping* was fitted with a Kongsberg EM3002D MBES a towed Edgetech 4200 (300/600 kHz) SSS, a towed Chirp Edgetech DW 106 1 SBP and a Geometrics G-882 magnetometer. All survey data was undertaken in WGS 1984 UTM Zone 30N coordinate system.

3.2.1 Geographic Information Systems (GIS) data

An ArcGIS *.mxd project was created. All MMT survey data supplied in ArcGIS geodatabase *.gdb file format were added to the ArcGIS *.mxd project. This included survey track lines and anomalies recorded by MMT from the marine geophysics, in line and point format. Shapefiles (*.shp) for each marine geophysics method were created with pro-forma attribute fields. All data was inspected systematically by an experienced marine archaeologist. Individual shapefiles were created for each type of anomaly observed in each of the geophysical survey datasets (MBES, SSS, SBP, Magnetometer) in the ArcGIS *.mxd project.

3.2.2 Multi-beam echosounder

MBES data was supplied by MMT as post processed XYZ data in *.txt file format which gives coordinate and depth information. Digital Terrain Models

(DTM) in *.sd file format were created by gridding the XYZ data within Fledermaus.

GIS shapefile data was imported into Fledermaus 7.2.2e and were overlaid onto the DTM with appropriate attribute labels displayed. This included the MMT survey data and anomalies recorded by ORCA Marine from the SSS and magnetometer data. To enable comparison of supplied bathymetric data alongside all of the GIS data, a GeoTIFF of each individual Fledermaus *.sd DTM was exported at as high a resolution as possible. This was then imported into ArcGIS.

3.2.3 Side scan sonar

MMT supplied SSS data as individual geo-referenced images. The geo-referenced mosaics could be viewed in ArcGIS 10. Locations of all contacts were verified against the MBES data, which was also imported into ArcMap as geotiffs and placed as a background to the side-scan sonar images.

3.2.4 Sub-bottom profiling

The SBP data was provided as image files. The SBP survey tracks were supplied by MMT in the ArcGIS geodatabase and this enabled the start and end points of the SBP survey tracks to be ascertained.

3.2.5 Magnetometer

The magnetometer data was supplied in *.txt data format by MMT for each survey line, which gave location and magnetic strength information. These files were catenated into larger files, which were then edited into XYZ fields for gridding as *.SD lines within Fledermaus 7.2.2e following the method detailed for MBES above. This enabled multiple lines to be viewed alongside each other quickly, each line was analysed for spikes and anomalies and these were cross checked against MBES and SSS datasets within the ArcGIS *.mxd project for confirmation and interpretation of anomalies. MMT survey data and anomalies recorded by ORCA Marine from the SSS and magnetometer data were also imported into Fledermaus 7.2.2e for viewing alongside the *.SD files of the magnetometer data and enable easier cross-comparison of datasets.

3.2.6 Geotechnical Assessment

The offshore geotechnical data investigation programme was completed in the period 27th March to the 5th April 2014.

Results from a total of 23 Cone Penetration Tests (CPT) and 11 borehole (BH) logs have been assessed from the soil investigation survey of the export cable route corridor and Proposed Offshore Turbine Deployment Area. The CPT tests were carried out on board the *Toisa Voyager* vessel to reach a target depth of approximately 20-25 m below sea floor, while BH tests were carried out aboard the MV *Bucentaur* vessel to depths of up to 20.3-21.3m below sea floor. These records are provided in **Appendix 2**. The logs of the CPT and BH samples were assessed in order to gauge whether the deposits contained any sediments of palaeoenvironmental potential; in particular peats or sediments with high organic contents such as organic silts. The information for the CPT and BH sample logs has all been supplied by GEO, the company contracted by the client to complete a geotechnical assessment of cores taken in the export cable route corridor and Proposed Offshore Turbine Deployment Area.

3.3 Assessment of importance

The importance attributed to each area, site or feature identified is determined following the criteria outlined in **Table 3-1**, which incorporate general guidelines used by statutory authorities and agencies such as the Scottish Government and Historic Scotland, outlined in *Scottish Historic Environment Policy* (SHEP) 2011, Planning Advice Note (PAN 2/2011) *Planning and Archaeology*, the *Marine (Scotland) Act* 2010, English Heritage *Designation Selection Guide: Ships and Boats, Prehistory to Present* (2012) and Wessex Archaeology's three-part *Assessing Boats and Ships 1860-1950* (2011). It should be noted that a site that has not been statutorily designated can still be of high importance. Features for which further information is unavailable are recorded as of uncertain importance. The weight given to historic environment considerations will depend on a number of factors (PAN 2/2011 paragraph 6) including:

- The relative rarity of the feature concerned;
- The completeness of the feature / whether it is a particularly good

example of its type;

- The historical or cultural associations of the feature;
- The value given to the feature by the local community;
- The potential value of the feature as an in situ educational or research resource;
- The potential value of retaining the feature for tourism or place-making.

Table 3-1 Definitions of importance of archaeological and historical sites

Level of importance (sensitivity)	Criteria
Very High	Archaeological and historical sites or areas, submerged prehistoric landscapes and deposits, wrecks, or cargos of international importance, such as World Heritage Sites, and may also include some Designated Wrecks or Historic Marine Protected Areas that are not only of national but of international importance. Shipwrecks dating to the prehistoric, Norse and medieval periods are rare and therefore of very high importance. This may also include vessels and aircraft lost in international conflicts, which may have involved large losses in life. Cargos with very high intrinsic, contextual or associative characteristics.
High	Archaeological and historical site or areas, wrecks and cargos of national importance, Designated Wrecks and Historic MPAs. Vessels and aircraft lost in conflict, which may have involved loss of life. Up to 1913 the shipping industry was a major element in Britain's world influence and wrecks up to this period may (though not necessarily) be of high importance if involved in national and international trade; wrecks and cargos with high intrinsic, contextual or associative characteristics (e.g. rarity, evidence of technological change).
Medium	Archaeological and historical sites or areas, wrecks and cargos of regional importance. This would involve shipwrecks, anchorages and fishing areas prior to 1913 involved in regional industry and trade; wrecks and cargos with moderate intrinsic, contextual or associative characteristics.
Low	Locally important sites or areas, wrecks and cargos. Shipwrecks dating from after 1913 relating to fishing, ferrying or local coastwise trade. Wrecks and cargos with low intrinsic, contextual or associative characteristics.
Negligible	Features that have been recorded but assessed as of no archaeological or historical interest, such as recent wrecks, or have been so damaged they no longer have any historic merit.
Uncertain	Features that cannot be identified without detailed work, but potentially of some interest. Also, for example, if the date of construction and rarity of a vessel is not known, but potentially of some interest. Find spots, which may represent an isolated find, or could represent the location of a hitherto unknown site. Unidentified geophysical anomalies are also of uncertain importance and have been assessed further in Table 3-2.

Most of the anomalies recorded in the analysis of the geophysical datasets could not be assigned a level of importance based on the criteria outlined in **Table 3-1** as very little is known about them. The **potential** for these anomalies to be anthropogenic is therefore outlined in **Table 3-2.** Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies – an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Table 3-2 Definitions of level of potential of geophysical anomalies

Level of geophysical potential	Description
Low	Anomaly is likely to be a natural formation such as a sand dune or bedrock formation. It could also be a processing error of the geophysical data.
Medium	Anomaly lies in an area of intensive human activity such as near ports or areas of peat and other features relating to submerged landscapes. It would also be considered for an anomaly that is possibly anthropogenic but has no definite identification.
High	Anomaly looks anthropogenic; or there is identifiable cultural material; or it is in the area of a known archaeological site, or another anomaly identified to be high potential.

3.4 Study limitations

As requested by the client, the DBA was restricted to the export cable route corridor and Proposed Offshore Turbine Deployment Area. The geophysical data assessment included the export cable route corridor and AfL. Assessment of the rest of the AfL southeast of the Proposed Offshore Turbine Deployment Area did not take any extra time. However, it should be noted that the area covered by the AfL outwith the Proposed Deployment Area is no longer part of the project and will not be included in the EIA and ES.

The sources reviewed for this report were extensive but not exhaustive and there remains the possibility that there may be sites or features of archaeological or historical significance that have not been recorded in this report.

RCHAMS, the Royal Commission for Ancient and Historical Monuments for Scotland, runs the Maritime Project of the National Monuments Record of Scotland (NMRS), which seeks to document maritime sites, defined as ships, boats and crashed aircraft, but not built structures or prehistoric sites (unpublished paper issued by MP of NMRS, 2002). The information in the archive record is largely drawn from Whittaker (1998) and Larn and Larn (1998). These books contain some inaccuracies in the locations of wreck sites, which have been duplicated into the NMRS. If any of these are relevant to report, they are noted and are corrected as far as possible.

There are four wrecks listed in the reference source that have been categorised as Position Approximate (PA), which means that their location, or if they survive at all is not known. The charted position of these sites is based on fishermen's reports and records of vessel loss. This means that some wrecks can have more than one UKHO record – the record associated with the PA charted location and the record associated with the actual remains of the wreck. These are discussed in Section 4.1

The northern alternative route at landfall was not surveyed by MMT. The resolution limitations of the subsea survey data provided by MMT in relation to their applicability for identifying marine historic environment feature are summarised below: :

- Although the general quality of the MBES data was suitable for detecting anomalies, with little banding, rippling or other survey artefacts caused by swell and tidal effects, the resolution of the MBES data is, on its own, not suitable to provide a positive identification of a feature – i.e. confirming that an anomaly is a shipwreck;
- The resolution of the geo-referenced SSS mosaics viewed in ArcGIS 10 was not always sufficient for providing a positive identification of a marine cultural feature;
- While the majority of the survey track images were of sufficient quality to identify features, fifteen of the longer tracks became pixelated when zoomed in. These survey tracks were not considered of high enough resolution to identify potential cultural features. These tracks are summarised in **Appendix 1**;

- Although many areas within the magnetometer survey data are noisy with magnetic responses, anomalies can still be detected, often correlating with features identified by MMT as either boulders or pipelines.

Stills taken during the biodiversity surveys were supplied by the client. However, only two locations correlated with those of anomalies identified during the geophysical data assessment.

Despite the above limitations to the study, the DBA sources and geophysical data analysed were sufficient to be able to provide an adequate baseline assessment on which to base a robust EIA and ES.

4.0 DBA and Geophysical Assessment Results

The locations of all sites and anomalies identified by the DBA and the geophysical data assessment are shown in **Figure 1**. These are discussed below.

4.1 Shipwrecks

UKHO report eight wrecks in the study area, four of which are listed as Position Approximate (PA), meaning that the vessels are known to have sunk in the approximate area, but their exact location of loss is not known. Occasionally these can be based on fishermen's reports of indeterminate debris on the seabed. A further 12 sites are listed on the Canmore database, while wrecksite.eu lists an additional wreck not noted by either UKHO or Canmore, giving 21 potential shipwreck sites in total, summarised in **Appendix 3** and shown in **Figure 2.** The positions of several of the wrecks, particularly those without an associated UKHO reference are noted on Canmore as "essentially tentative, being derived from the unverified location of loss that is cited by Whittaker". They have been included in the DBA because although the listed positions in most cases fall outside the export cable corridor and Proposed Offshore Turbine Deployment Area, the descriptions included within details of their circumstance of loss indicate they could fall within these two areas. These are indicated on **Figure 2** as UV (unverified).

Of the 21 wrecks identified, two were considered of **high importance** if present:

- The SS *Eganæs* (Canmore 208065/101866) was a Norwegian Steamship which sank in March 1917. Though of standard construction and only carrying a cargo of herring, five of the crew died when the vessel was sunk by a U Boat "10 miles East of Peterhead". The position shown for the wreck in **Appendix 3 and Figure 2** as being 1.5 km north of the offshore section of the proposed export cable route is taken from wrecksite.eu, however other recognised sources (UKHO and Canmore) both state the position as unknown.
- Lost in May 1917, the fishing vessel FV *Bel Lily* (UKHO2283; Canmore 101842) was sunk by a mine 1.5 – 2 miles North East of Peterhead with a loss of all crew. Although the coordinates assigned to this wreck by the UKHO place the remains 2.3 km to the North of the inshore section of the proposed export cable route, when the wreck in that position was first dived in 1999 the divers found no conclusive proof of the vessel's identity. Canmore record these remains as 'Bel Lily (Possibly)'.

Two wrecks are considered of **medium importance** if the remains are well preserved as they could provide insight into fishing, ferrying and other coastwise trade:

- The *Alaska* (Canmore 207706), a lugger lost in January 1896, situated 1 km South of the inshore section of the proposed export cable route; and
- The *Sylvanus,* a Schooner lost in December 1859, situated 407 m North of the offshore section of the proposed export cable route.

Although predating 1913, the remains of the following vessels are considered of **low importance** as reports indicate very little remains intact:

- *Resolute* (Canmore 275991) lost in December 1860. Parts of both vessels (including the name board of the R*esolute*) washed ashore in the area of search; and
- *Sweet Home* (Canmore 253853), a lugger lost in July 1884, is

situated 621m South of the inshore section of the proposed export cable route.

The following vessels are considered as **low importance** as they were all lost after 1913. Their listed cargos are only considered to be of local importance, and there are good historical records for their various methods of construction:

- *Trieste* (Canmore 208211) (280 m North of inshore export cable route);
- *Cransdale* (Canmore 208260) (3.6 km North of the inshore section of the proposed export cable route);
- *Bonny Lass* (Canmore 207426) (635m South of the inshore section of the proposed export cable route);
- *Skomer* (Canmore 207408) (2.9 km North of the offshore section of the proposed export cable route);
- *Mudlark* (Canmore 208507);
- *Lizzie M Duncan* (Canmore 292192) (1 km Northeast of the export cable route within the Proposed Offshore Turbine Deployment Area); and
- *SS Mimoas* (407 m North of the offshore section of the proposed export cable route).

A further two wrecks are considered of **negligible importance** as they are both modern vessels considered to be of no historical interest:

- *Stella Marie* (UKHO 2377 (PA, dead) /2392, Canmore 291537/ 321979):and
- *Calvados* (UKHO 2414, Canmore 292193).

Four wrecks were considered of **uncertain importance**:

- In April 1945, 17th Escort Group reported a contact which was subsequently listed as Wreck PA on the chart in 1958. The UKHO record indicates that subsequent MBES surveys conducted by Gardline in June 2009 (Gardline Hydro HI 1155) recorded a large wreck and as such the record for the reported contact was updated to 2281 (UKHO Hydrographic Report for wreck 2281). With the

exception of its dimensions, the identity of the wreck recorded by the Gardline surveys remains unknown, thus this report considers it to be of uncertain importance.

- UKHO record 2271 (Canmore 101739) is listed as 'Wreck PA'. Now considered as a 'dead' record by UKHO. Whittaker thought this record could represent the remains of the *Mudlark*, a dredger which foundered in February 1918 seven miles East of Peterhead.
- UKHO record 2278 (Canmore 101740) is also listed as 'Wreck PA'. Created because there is the 'fisherman's fastener' – an object in the area that causes snags in their gear – noted at this position, the record is now considered 'dead' by UKHO. Whittaker considered these represented the remains of an iron steam trawler the *Skomer* which sank in May 1911 seven miles East Northeast of Buchaness.
- UKHO record 2280, a non-sub contact (NSC) located by a Rear Admiral of the Home Fleet anti-submarine patrol in May 1940.

The records for 2271, 2278, and 2280 were amended to 'dead' by the UKHO, as the reports indicate that the Gardline MBES survey of the area completed in 2010 did not record any remains in the area. These sites are considered of uncertain importance because although the Gardline surveys did not identify any remains at that specific location, the wreckage may still be in the vicinity, and the survey may not have been of sufficient resolution to recognise the remains. Additionally, any remains that are found have yet to be conclusively identified.

As a maritime nation with a reliance on marine based trade and exchange, there have been countless shipwrecks around UK waters from all periods – many of which remain unreported. Founded in the late 17th century, Peterhead has played a key role in maritime shipping and trade – a key stop off point and trading post en-route to Iceland, and countries bordering the North Sea.

As such, there is the moderate probability for unknown, unrecorded vessels to have sunk in the project area. Remains of such vessels and their associated artefacts may not be visible in geophysical data – constructed from materials that do not provide strong geophysical or magnetic returns or buried beneath the surface of the seabed. However, the likelihood for

encountering such remains is reduced by the nature of the seabed within the development area. The seabed comprises bedrock patches and mobile sediments, which are not conducive to good preservation of submerged cultural heritage, though some cultural materials may survive trapped in gullies. Thus there is considered to be **low potential** for the project to impact on unknown significant remains.

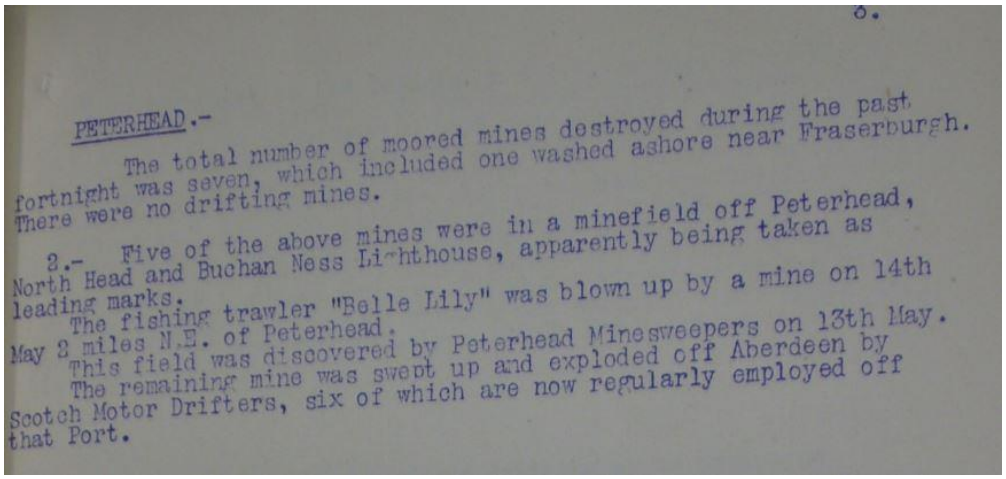
4.2 Unexploded ordnance

During both World Wars small trawlers were converted to minesweepers. These vessels would sweep for mines around the Scotland to keep seaways clear. When swept, the mine would float to the surface where it would be shot at with either a rifle or the deck gun. The marksman would target the Hertz horn to detonate the mine. If the mine failed to detonate he would fire at the mine to damage the mine casing. This would cause the air-filled compartment to flood and the mine to sink, still live, to the seabed.

Drifting mines (those that broke free from their moorings in bad weather) were also often found around the Peterhead area. Although they were installed with a safety feature to disable the mine in the event that it broke free of its mooring by causing it to become inert, these seldom worked and many of the drifting mines were live. Several mines from the nearby Whitten Head minefield either drifted ashore or were dealt with in the same way as a swept mine being either sunk or blown up.

The bi-monthly minesweeping reports note very little activity off Peterhead during 1916; however by 1917 the U Boats were becoming more active off Scotland's NE coast. Most of the mine fields appear to have been laid off Aberdeen, the Firth of Forth or the Moray Firth. There is no record of a minefield within the area of the export cable route corridor or Proposed Offshore Turbine Deployment Area, with the possible exception of the mine that sank the FV *Bel Lily* **(Plate 4-1)**.

Plate 4-1 Extract from ADM 116-1515 bi-monthly minesweeping report May 1917



6.

PETERHEAD.-

The total number of moored mines destroyed during the past fortnight was seven, which included one washed ashore near Fraserburgh. There were no drifting mines.

2.- Five of the above mines were in a minefield off Peterhead, North Head and Buchan Ness Lighthouse, apparently being taken as leading marks.

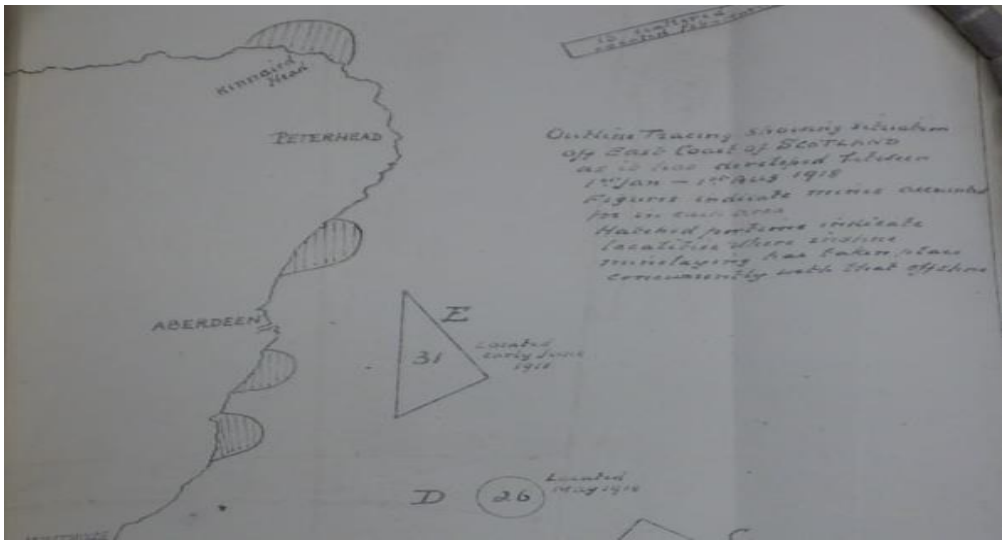
The fishing trawler "Belle Lily" was blown up by a mine on 14th May 2 miles N.E. of Peterhead.

This field was discovered by Peterhead Minesweepers on 13th May.

The remaining mine was swept up and exploded off Aberdeen by Scotch Motor Drifters, six of which are now regularly employed off that Port.

Despite this, several floating mines, both German and British, are reported to have been sunk by the minesweeping patrols off Peterhead without detonating, and it is possible that some of these might have sunk in the study area **(Plate 4-2)**.

Plate 4-2 Extract from ADM 116-1515 bi-monthly mine sweeping reports August 1918 showing areas U Boats with lay mines and the numbers of mines swept



4.3 Aviation losses

No aircraft are known to have crashed along the export cable route corridor or in the Proposed Offshore Turbine Deployment Area.

4.4 Multi-beam echosounder anomalies

The MBES data shows the survey area to be predominantly mega ripples and sand waves with rocky outcrops along the export cable route corridor. The nearshore area of the export cable route corridor comprises an extensive area of bedrock. The seabed topography is well-defined and matches with the data collected from the SSS surveys.

Ten MBES anomalies were identified in the survey area, the distribution of which is shown in **Figure 3**. One (MBES08) was considered of **high geophysical potential**, two are considered of **medium geophysical potential** (MBES06 – MBES07) and seven are considered of **low geophysical potential** (MBES01 – MBES05, MBES09 – MBES10). MBES01, MBES 05 – MBES07 and MBES10 were also identified as anomalies in the SSS survey data (SSS08, SSS07, SSS10, SSS03 and SSS01 respectively) (**Section 4.5**); while MBES08 was also identified by MMT as a high geophysical potential magnetometer contact (MMT OBS_number_M-1090).

All anomalies are low circular or ovular mounds between 0.3m – 2.2m high. With one exception (MBES07) these mounds are all less than 10m long or wide. Images, measurements and descriptions of each anomaly are provided in **Appendix 4.**

4.5 Side scan sonar anomalies

In total there are 27 SSS anomalies in the survey area. Images, measurements and descriptions of these anomalies are provided in **Appendix 5.** The distribution of these anomalies is shown in **Figure 4**. Fifteen of these are considered to be of **high geophysical potential** (SSS01, SSS04 – SSS06, SSS13 – SSS14, SSS17, and SSS20 – SSS27).

SSS01 was considered of high geophysical potential due to its close proximity to the reported PA position for the *Cransdale*.

SSS04 is situated just north of the export cable route corridor and correlates to the position of a known wreck that of the *Muriel,* a steel steamship that sank on 17th September 1918 while carrying a cargo of coal. Reports

indicate the vessel was torpedoed. This wreck was not noted in the DBA as its position is not publicly available – the record has been classified as "restricted commercial" on the Seazone Hydrospatial Wreck data provided by the client.

Although nine of these anomalies (SSS05, SSS13 – SSS14 and SSS20 – SSS25) are definitely anthropogenic, they likely represent sections of cable, chain or rope that have been discarded and left on the seabed.

The remaining four high geophysical potential anomalies are areas of scattered indeterminate debris - two of these (SSS006 and SSS017) are within the export cable route corridor while the remaining two (SSS26 and SSS27) are within the Proposed Offshore Turbine Deployment Area.

A further seven anomalies were considered to be of **medium geophysical potential** (SSS07 – SSS12 and SSS16) were small (<10m) contacts with very strong return. It is possible that these are anthropogenic features, but they have no definite identification.

Five anomalies were considered to be of **low geophysical potential** (SSS02, SSS03, SSS15, SSS18 and SSS19). Although SSS03 is close to the position listed for the wreck of the *Skomer* (PA), the contact gave no magnetic return from the magnetometer surveys and is therefore considered to be a large isolated outcrop of bedrock, an interpretation supported by assessment of photographs taken during the biodiversity surveys (462-stat_FR_BIO_DDV_S08). SSS02 was identified as coils of rope on the seabed by assessment of photographs taken during the same surveys (462-stat_FR_BIO_DDV_S06).

4.6 Magnetic anomalies

All of the magnetic anomalies identified by MMT are considered of **low importance**. MMT recorded 1145 magnetic anomalies, over 50% of which were listed as "unknown anomaly". Assessment of the spatial distribution of these unknown anomalies does not reveal any patterns that are likely to document the presence of a wreck site or sites. With the exception of MMT magnetometer anomaly observation number M-1090 (which is in the same location as MBES08) none of these unknown anomalies correlate to

features identified during our assessment of either the MBES or SSS data. MMT identified the remaining anomalies as boulders, known cables or bedrock.

In addition to the MMT anomalies, our assessment of the data highlighted two further anomalies. Images and descriptions of these are presented in **Appendix 6**, and distribution of the features can be seen in **Figure 5**. Neither of these contacts corresponds to either the MBES or SSS anomalies. MAG01 is considered of **high geophysical potential** as it was identified close to the location of the wreck the *Annemieke* (noted on the Seazone Hydrospatial Wreck data provided by the client). MAG02 is considered of **low geophysical potential** as there was no corresponding negative response and there are no anomalies from other datasets (SSS and MBES) located in the vicinity.

4.7 Potential for submerged landscapes and cultural remains

Hominids and humans have occupied the UK continental shelf (UKCS) at various times for more than 700,000 years, but finds showing this are incredibly rare. Although in general terms, the potential for submerged prehistoric archaeology and landscapes across wide areas of the UKCS is high (Wessex Archaeology 2009, 9), the potential for site preservation in areas of the shelf deeper than 80m is low (Flemming 2003: 16).

The Hywind Pilot Park Project is situated within the Department for Trade and Industry's (now Department of Energy and Climate Change) Strategic Environmental Assessment (SEA) Area 5 for offshore oil and gas.

Flemming (2004: 24) notes "no submarine prehistoric artefacts have been found in SEA5". This is attributed to the area's "complexity of…late Pleistocene history, and the spatial variability" (Flemming 2004: 21). The sand waves and mega ripples which make up the surficial deposits across most of the export cable route corridor and the AfL indicate that "waves and currents combined are moving modern sediments rapidly on the seabed" (Flemming 2004: 18). In these areas the potential for preservation of submerged prehistoric artefacts and palaeo-landscapes is low.

The nearshore section of the export cable route corridor "consists of an

extensive area with Bedrock" (Statoil Doc. No. ST13828-Hywind OW 2014: 22), so there is only a low possibility that cultural material may survive embedded in sediment deposits that have accumulated in any gullies, where they are protected from disturbance.

4.7.1 Sub-bottom profiler data assessment

MMT recorded five units of the shallow geology within the SBP survey tracks, summarised in their report (Statoil Doc No. ST13828-Hywind OW, 2014: 21, 26-27, 35).

No evidence of submerged cultural-historical material or palaeo-landscape features were recorded on analysis of the available processed sub-bottom images, other than sections of a surface pipe or cable observed on several of the tracks.

4.7.2 Offshore geotechnical data assessment

The offshore geotechnical data comes from two main sources: cone penetration tests and borehole sampling. See **Appendix 7** for the full report. The dominant sediments through which the borehole and cone penetration test results were taken are gravelly sands and silty, sandy clays and are likely to represent deposits of Holocene and Pleistocene age (Sutherland, 1984; GEO, 2014).

Cone penetration test (CPT) results

A total of twenty-three CPTs were executed at twenty-three locations across the offshore area of the export cable route corridor (11) and Proposed Offshore Turbine Deployment Area (12). The maximum penetration depth reached during the survey was 6.00m (ST14460-CPT-10) within the area of the export cable and 25.00m (ST14460-CPT-151) in the Proposed Offshore Turbine Deployment Area (see **Appendix 2**). The common composition of sediments across both areas were relatively shallow gravelly sands with a thickness of between 0.3m (ST14460-CPT-08) to 2.4m (ST14460-CPT-21) underlain by sandy, silty clays. The base of the clay deposits was not reached and therefore are likely to extend below the maximum depth of 25.0m. No organic remains or sediments (e.g. wood, peat, organic silts)

were recorded in any of the CPT logs.

Borehole (BH) results

A total of eleven BH samples were taken from eleven locations along the export cable route corridor (7) and within the Proposed Offshore Turbine Deployment Area (4). The maximum depth reached by BH sampling during the survey was 10.00m (ST14457-BH03) within the area of the cable route and 22.20m (ST14451-BH142+142A) within the Proposed Offshore Turbine Deployment Area (see **Appendix 2**). Similar to the CPT results, the BH sampling showed a sedimentary sequence of silty, gravelly sand, often with shell fragments present in the upper part of the sequence, with thicknesses of between 0.10m (ST14457-BH11+11A) and 2.10m (ST14457-BH09) within both the export cable route corridor and Proposed Offshore Turbine Deployment Area. Clay deposits were recorded underlying the sand deposits as in the CPT results. The base of the clay deposits was not reached and thus it is likely that they extend below the maximum depth reached of 22.20m. In one location (ST14457-BH15) a layer of gravels, 0.10m thick was recorded overlying the sand deposits. No organic remains or sediments were recorded in any of the BH logs.

The results of the BH and CPT records from across the cable route show a depositional sequence spanning depths of approximately 0.40 (ST14460-CPT-19) to 25.00m (ST14460-CPT-151). The sequences within both records were seen to comprise principally of minerogenic deposits. The sequences encountered within the records appear to confirm that the cable route extends into a sequence of shallow Holocene deposits of silty fine to medium sands, underlain by Witch Ground Formation sandy to sandy, gravelly clays. In the Proposed Offshore Turbine Deployment Area, similar sequences were encountered with Forth Formation deposits recording overlying Witch Ground Formation deposits, and in some locations underlying Wee Bankie Formation deposits of hard sandy, gravelly clays were reached.

The sedimentary sequences recorded from both of the different sampling methods used are of low palaeoenvironmental potential. The dominance of sands within the Holocene deposits in the development area means that conditions for the preservation of microfossils such as pollen and

macrofossils such as seeds and fruits are not present and thus limit the amount of palaeoenvironmental information available within the area. There is some potential for the presence of micro-fauna such as ostracods to be present within the sands and clays, while shell fragments were also observed in the majority of the CPT and BH samples. Such fossil marine fauna can provide palaeoclimate data (e.g. temperature) from glacial and interglacial events.

5.0 Preliminary Recommendations

5.1 Potential mitigation strategies

Ideally, it is best to manage the presence of cultural heritage sites by locating construction footprints and routeing cables and other infrastructure to avoid them. However, where this is not possible, various strategies can be put in place. In general terms, the summarised management and mitigation measures suggested below will result in the avoidance, reduction, remedying or offsetting of any impacts on cultural heritage by a development project, singly or in combination, as appropriate. It is likely that most of these would not be required for the Hywind Scotland Pilot Park Project. Specific recommendations will be made in the EIA and subsequent ES chapter.

Strategy 1: Avoidance. This strategy would be recommended either if it is easy to avoid the site, with no or little impact on the works, or if the site is of major importance. An alternative mitigation strategy will be suggested where possible if avoidance is not feasible within the proposed development scheme.

Strategy 2: Geophysical or other targeted remote survey. In the event of the discovery of significant archaeology, targeted high resolution remote survey, including use of a remote operated vehicle (ROV), may be recommended in order to identify or record sites and their contexts. The results of these surveys may lead to the implementation of further mitigation strategies.

Strategy 3: Sampling. Vibrocore, grab samples or auger samples may be required if subsurface palaeo-landscapes are to be damaged or destroyed. Provision should be made for their analysis.

Strategy 4: Detailed structure or wreck survey and salvage.

Plans/elevations at a scale of 1:10-1:200 will be made of maritime structures (e.g. piers, fish traps) with a full photographic record prior to destruction. Wrecks should be recorded in an appropriate manner by specialists in marine archaeology. Attempts will be made to retrieve and conserve representative examples of the fabric. In addition, Strategies 5, 6 and/or 7 and 8 may be implemented.

Strategy 5: Intrusive archaeological assessment. This response will be recommended for all sites and shore wrecks with significant or unknown archaeological potential prior to any intrusive works. An intrusive assessment would groundtruth geophysical survey results and assess the nature, extent and preservation of archaeological remains. The findings of the intrusive assessment may require the upgrading of fieldwork to Strategy 8.

Strategy 6: Watching brief. This response will be recommended for all sites and shore wrecks with high archaeological potential and where there will be intrusive works. A watching brief may be conducted while ground-breaking construction works are happening if there is a potential for but no conclusive proof of archaeological remains. The works will allow opportunity for salvage excavation. The findings of the watching brief may require the upgrading of fieldwork to Strategy 8.

Strategy 7: Full archaeological excavation. This level of mitigation may be deemed necessary as a result of evidence gathered by other levels and should be conducted by specialists in marine archaeology. Provision should be made for the examination and possible conservation of any artefacts recovered. Specialist samples will be taken from key deposits and fabric. Plans/elevations should be made at scale 1:10 and/or 1:20 with a full photographic record. Provision should be made for post-excavation work bringing the results together in a report of publication standard in accordance with Historic Scotland and other professional guidelines.

Strategy 8: Further documentary research and archiving. This response includes further detailed examination of unusual archival sources that would not routinely be consulted. It also allows for copying of documents considered relevant, which then may be archived with relevant bodies such as the Royal Commission for Ancient and Historical Monuments of Scotland

(RCHAMS), the local SMR, the NMRS, the Receiver of Wreck, UKHO, MCA and MEDIN, as appropriate.

Strategy 9: Reporting protocols. A reporting protocol for the accidental discovery of cultural remains should be instated in line with The Crown Estate (2014) *Protocol for Archaeological Discoveries: Offshore Renewables Projects,* prepared by Wessex Archaeology Ltd for The Crown Estate http://www.wessexarch.co.uk/projects/marine/tcerenewables.

Strategy 10: Other recommendations. These could include recommendations for tidal current surveys, detailed sampling turbine positioning, procedures concerning anchoring, seabed disturbance and so on. The particular type of suggested strategy will be detailed where the recommendation is made.

5.2 Export cable route

There are **no shipwrecks of high or medium importance** known within the cable corridor and, with two exceptions (SSS06, and MBES08), avoidance of anomalies of **high or medium geophysical potential** (named below) should be entirely possible.

Three SSS anomalies (SSS01, SSS05 and SSS06) **(Figure 6)** and two MBES anomalies (MBES07 and MBES08) **(Figure 3)** considered of **high or medium geophysical potential** were recorded within the export cable route corridor.

SSS06 and MBES08 are both situated in close proximity to the proposed export cable route corridor – 9 m South and 85 m North of the inshore section of the proposed export cable route respectively. It is recommended that both these anomalies be further investigated by diver, drop down camera or ROV, and the data be assessed by a marine archaeologist to attempt a positive identification. MBES08 is included in these recommendations as it is situated in an area where other pipelines/cables bisect the proposed export cable route, and there is likely to be greater impact on the seabed in these areas, due to the use of more extensive rock armour than elsewhere along the route.

It should be noted that although the cable route misses the remaining high or medium geophysical potential anomalies that have been identified by at least 174 m, if the route changes and it is not possible to avoid them, we recommend that these anomalies be further investigated by diver, drop down camera or ROV, and the data be assessed by a marine archaeologist so they can be positively identified. This work will provide a basis for devising appropriate management and mitigation strategies.

No recommendations are made for the four anomalies and two wreck sites of **low geophysical potential or low importance**.

As noted in Section 4.7, there is **low potential** for submerged landscapes, palaeoenvironmental evidence and prehistoric cultural remains in the export cable route corridor, although there is a **low possibility** that cultural material may be present in the gullies and sediments around the bedrock outcrops that are visible in the nearshore section.

We recommend that a reporting protocol for accidental discovery of cultural remains be employed – as per *Strategy 9* (Section 5.1). This would mitigate the low possibility that artefacts trapped in sediments or gullies, or the remains of unknown wrecks are disturbed by the construction work.

5.3 Proposed Offshore Turbine Deployment Area

There are **no shipwrecks of high or medium importance** known within the Proposed Offshore Turbine Deployment Area.

Thirteen SSS anomalies (SSS09, SSS10, SSS12 – SSS14, SSS17, SSS20, SSS22 – SSS25, and SSS27) **(Figure 7)** and one MBES anomaly (MBES08) **(Figure 3)** considered of **high or medium geophysical potential** were recorded within the Proposed Offshore Turbine Deployment Area.

If it is not possible to avoid them when positioning the turbine anchors or laying the inter-array cables, we recommend that these anomalies be further investigated by diver, drop down camera ROV, and the data be assessed by a marine archaeologist so that, if possible, they can be positively identified. This work will provide a basis for devising appropriate management and

mitigation strategies.

No recommendations are made for the two anomalies of **low geophysical potential**, or the one shipwreck site of **low importance** with an approximate position that falls within this area (*Lizzie Duncan*).

As noted in Section 4.7, the sand waves and mega ripples which make up the surficial deposits across most of the Proposed Offshore Turbine Deployment Area are indicative of mobile sediments that reduce the potential for preservation of submerged cultural material and palaeo-landscapes as these are likely to "destroy and scatter a submerged site" (Flemming 2004: 18).

Despite the **low potential** for survival of remains in this area, we recommend that a reporting protocol for accidental discovery of cultural remains be employed – as per *Strategy 9* (Section 5.1).

5.4 AfL Area

It is not known if there is desk-based evidence for the presence of shipwrecks or other remains in the AfL outwith the Proposed Offshore Turbine Deployment Area, since no DBA was conducted for this area (at the time of commencement of the marine archaeology technical report, this area of the AfL was no longer part of the proposed project).

Five SSS anomalies (SSS07, SSS08, SSS11, SSS16 and SSS26) **(Figure 8)** and one magnetic anomaly (MAG01) **(Figure 5)** considered of **high or medium geophysical potential** were recorded outside of the Proposed Offshore Turbine Deployment Area, but within the AfL area.

If the proposed turbine locations were to shift into the AfL beyond the Proposed Offshore Turbine Deployment Area, we recommend that a DBA is conducted for the area. If it was not possible to avoid the anomalies, we recommend that they are investigated by diver, drop down camera or ROV, and the data be assessed by a marine archaeologist so they can be positively identified. This work will provide a basis for devising appropriate management and mitigation strategies.

No recommendations are made for the six anomalies of **low geophysical**

potential.

As noted in Section 4.7, the sand waves and mega ripples which make up the surficial deposits across most of the Proposed Offshore Turbine Deployment Area are indicative of mobile sediments that reduce the potential for preservation of submerged cultural material and palaeo-landscapes as these are likely to "destroy and scatter a submerged site" (Flemming 2004: 18). The conditions are likely to be similar in the AfL.

Should works occur in the AfL, we would recommend that a reporting protocol for accidental discovery of cultural remains be employed – as per *Strategy 9* (Section 5.1).

5.5 Outside of the study area

The sites and anomalies noted below lie outside the export cable route corridor and Proposed Offshore Turbine Deployment Area and therefore should not be impacted.

One SSS anomaly, confirmed as a shipwreck (SSS04) was noted approximately half a kilometre North of the boundary of the export cable route corridor **(Figure 6)**. A further fifteen potential shipwreck sites, identified as part of the DBA, have positions close to but outside the export cable route corridor and Proposed Offshore Turbine Deployment Area. Four of these have confirmed coordinates (the *Bel Lily,* sonar contact, non-sub contact*;* Wreck PA: UKHO 2271*)*, the rest are unverified positions based on locations of loss cited in Whittaker (1998) (**Figure 2)**. Six of the shipwrecks are considered of low importance.

Should the export cable route corridor or Proposed Offshore Turbine Deployment Area be moved, then mitigation strategies to deal with potential impacts on these sites and anomalies will need to be identified and implemented.

6.0 Summary

Twenty-one potential wreck sites were identified during the DBA and another through the assessment of the SSS data (SSS04, the *Muriel*). The positions

of twelve wrecks are tentative, derived from the unverified location of loss indicated in Whittaker (1998). Thus although several of these sites are depicted as outside the export cable route corridor and the Proposed Offshore Turbine Deployment Area, there is the potential that some remains could be within the study area.

Three of the potential shipwreck sites are considered of **high importance** – the SS *Eganaes, Bel Lily*and the *Muriel* were all sunk during World War 1. Although the *Bel Lily* has a confirmed position to the north of the export cable route corridor, divers visiting the remains at this site found no conclusive proof of the vessel's identity. The *Muriel* is situated half a kilometer to the North of the export cable route corridor and the location of the *Eganaes* is uncertain.

Two of the sites – the *Alaska* and the *Sylvanus* - would be considered of **medium importance** if they are well preserved as they could provide insight into fishing, ferrying and other coastwise trade. Canmore lists their unverified locations as being 1 km South and 407 m North of the proposed export cable route respectively based on descriptions of vessel loss recorded in Whittaker (1998), but their confirmed positions are unknown,.

Four sites are considered of **uncertain importance**, because the identity of the wrecks is unknown and the sites are listed as PA. Thus, wreckage may be in the vicinity. Nine sites noted in the DBA were considered of **low importance**, because reports indicate very little remains intact, or because we have good historical records for the construction of the vessels and they were not carrying cargo of any importance. A further two wrecks are considered of **negligible importance** as they are both modern vessels considered to be of no historical interest.

There is the moderate probability for unknown, unrecorded vessels to have sunk in the project area that may not be visible in geophysical data – constructed from materials that do not provide strong geophysical or magnetic returns or buried beneath the surface of the seabed. However, the likelihood for encountering such remains is reduced by the nature of the seabed within the development area - bedrock and mobile sediments - which is not conducive to good preservation of submerged cultural heritage. Thus there is considered to be **low potential** for the project to impact on

unknown significant remains.

Ten MBES, 27 SSS and two magnetic anomalies were noted during the assessment of the geophysical data. Of these, one MBES (MBES08), 15 SSS anomalies (SSS01, SSS04 – SSS06, SSS13 – SSS14, SSS17, and SSS20 – SSS27) and one magnetic anomaly (MAG01) were considered to be anthropogenic (**high geophysical potential**). A further two MBES and seven SSS anomalies were considered to be possibly anthropogenic (**medium geophysical potential**). The remaining seven anomalies were considered to be of **low geophysical potential**. All anomalies identified by MMT in their assessment of the magnetometer data are considered to be of **low importance**.

The Hywind Scotland Pilot Park Project is located in an area considered to have low potential for the preservation of submerged cultural landscapes or materials. The MBES and SSS data show the area to be predominantly mega ripples and sand waves with rocky outcrops along the export cable route corridor, the nearshore area of the export cable route corridor comprising an extensive area of bedrock. The surficial deposits across the study area (excepting the areas of bedrock) tend to indicate highly mobile modern sediments, not conducive to the preservation of cultural remains and submerged landscapes. No palaeo-landscape features were observed in the assessment of the SBP survey tracks. Assessment of the geotechnical data indicate there is **low potential** for preservation of submerged palaeoenvironmental remains and no submerged landscapes of archaeological interest were identified.

7.0 Conclusions

With the exception of the **high geophysical potential** anomalies SSS06 and MBES08, which are located 9 m South and 85 m North of the inshore section of the proposed export cable route respectively, avoidance of shipwrecks of **high or medium importance** and anomalies of **high or medium geophysical potential** should be entirely possible since the cable route avoids them by at least 174 m. However, if for any reason there is a change in the proposed cable route, it is recommended that these wrecks and anomalies be further investigated by diver, drop down camera or ROV,

and the data assessed by a marine archaeologist. This work will provide a basis for devising appropriate management and mitigation strategies.

It is recommended that the wind turbine locations, anchors, moorings and layout of the inter-array cabling avoid the thirteen SSS anomalies and one MBES anomaly considered of **high or medium geophysical potential** within the Proposed Offshore Turbine Deployment Area. If it is not possible to avoid them, it is recommended that these wrecks and anomalies be further investigated by diver, drop down camera or ROV, and the data assessed by a marine archaeologist so that, if possible, they can be positively identified. This work will provide a basis for devising appropriate management and mitigation strategies.

We recommend that a reporting protocol for accidental discovery of cultural remains be employed. This would mitigate the low possibility that artefacts trapped in sediments or gullies, or the remains of unknown wrecks are disturbed by the construction work.

8.0 References

8.1 Legislation and Policy Documents

The *Marine (Scotland) Act* 2010 and the *Marine and Coastal Access Act* 2009

Historic Scotland (2011). *Scottish Historic Environment Policy* (SHEP 2011)

Historic Scotland (2012). *Marine Protected Areas in the Seas around Scotland: Guidelines on the selection, designation and management of Historic Marine Protected Areas*, (2012)

Planning Advice Note (PAN 2/2011): *Planning and Archaeology*

Scottish Planning Policy (SPP) February 2014

8.2 Professional and Industry Standards and Best Practice

The Crown Estate (2014) *Protocol for Archaeological Discoveries: Offshore Renewables Projects*, Wessex Archaeology Ltd for The Crown Estate

English Heritage (2012). *Ships and Boats: Prehistory to Present. Designation Selection Guide.*

Institute for Archaeologists (IfA) *Standard and Guidance for historic environment desk-based assessment* (revised November 2012)

Marine Environmental Data Information Network (MEDIN) Data standards and guidelines http://www.oceannet.org/marine_data_standards/

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Wessex Archaeology (2011a). *Assessing Boats and Ships 1860-1913 Archaeological Desk-Based Assessment*. February 2011. Ref: 70861.01.

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8.3 Hywind Scotland Pilot Park Project Reports

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Appendix 1: Summary of low resolution SBP tracks

SBP Survey Track Image Number	Description of Resolution
ST13828_TRCch_Hywind_M_C_20130918_350	Very pixilated image
ST13828_TRCch_Hywind_M_P50_20130919_413	Very pixilated image
ST13828_TRCch_Hywind_M_P50_INFILL_20130927_421	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_P50_INFILL_20130927_426	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_P50_INFILL_20130927_429	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_P100_20130919_405	Very pixilated image
ST13828_TRCch_Hywind_M_P250_20130919_408	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_S50_20130919_414	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_S50_INFILL_20130927_425	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_S100_20130919_411	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_S200_20130919_409	Fairly pixilated, poor image
ST13828_TRCch_Hywind_M_S250_20130919_406	Very pixilated image
ST13828_TRCch_Hywind_M_S250_20130919_407	Fairly pixilated, poor image
ST13828_TRCch_Hywind_TC_TC3850_20130919_053	Fairly pixilated, poor image

Appendix 2: Cone PenetrationTesting and Borehole data

CPT Data: Summary of sediment depths					
Unit key:	1	GRAVEL			
	2	SAND			
	3	CLAY			
Borehole	**Depth (m)**	**Sediment**	**Unit**	**Easting**	**Northing**
Export cable route corridor					
ST14460-CPT-05	0.0-0.8	Gravelly, silty SAND	2	593,108.70	6,373,269.30
	0.8-3.0	Stiff silty, sandy CLAY	3		
ST14460-CPT-06	0.0-1.0	Gravelly, silty SAND	2	592,288.10	6,373,312.90
	1.0-3.0	Firm to stiff, sandy CLAY	3		
ST14460-CPT-08	0.0-0.3	Gravelly, silty SAND	2	589,497.10	6,373,388.80
	0.3-3.0	Firm to stiff silty, sandy, gravelly, CLAY	3		
ST14460-CPT-10	0.0-0.6	Silty, gravelly SAND	2	582,804.70	6,374,258.80
	0.6-1.4	Sandy, silty CLAY	3		
	1.4-6.0	Stiff to very stiff silty, sandy CLAY	3		
ST14460-CPT-12	0.0-1.7	Gravelly SAND	2	579,887.20	6,375,700.40
	1.7-3.0	Stiff to very stiff, sandy, silty CLAY	3		
ST14460-CPT-14	0.0-1.4	Gravelly silty SAND	2	578,212.30	6,376,567.30
	1.4-3.0	Sandy CLAY	3		
ST14460-CPT-16	0.0-0.5	Gravelly, silty SAND	2	576,096.50	6,376,600.20
	0.5-1.0	Sandy CLAY	3		
ST14460-CPT-17	0.0-0.4	Clayey, silty, gravelly SAND	2	575,101.20	6,376,289.00
	0.4-2.0	Silty, sandy, gravelly CLAY	3		
ST14460-CPT-19	0.0-0.4	Silty SAND	2	573,734.60	6,375,559.50
ST14460-CPT-20	0.0-1.9	Gravelly to silty SAND	2	573,563.80	6,375,499.60
ST14460-CPT-21	0.0-2.4	Silty, gravelly, SAND	2	573,435.70	6,375,447.80
Proposed Offshore Turbine Deployment Area					
ST14460-CPT-02	0.0-0.7	Gravelly SAND to silty SAND	2	595,903.40	6,373,125.30
	0.7-3.0	Very soft to soft silty CLAY	3		
ST14460-CPT-111	0.0-0.9	Gravelly, siilty SAND	2	599,505.90	6,375,447.00
	0.9-7.5	Very soft to firm silty CLAY	3		
	7.5-19.6	Firm to stiff CLAY	3		
	19.6-22.2	Stiff to very stiff, silty sandy CLAY	3		
ST14460-CPT-112b	0.0-0.6	Silty, gravelly SAND	2	599,733.00	6,371,830.10
	0.6-9.2	Very soft to firm silty CLAY	3		
	9.2-15.6	Firm to stiff silty CLAY	3		

	15.6-21.4	Stiff to very stiff CLAY	3		
ST14460-CPT-121	0.0-0.7	Silty, gravelly SAND	2	598,345.30	6,373,747.80
	0.7-8.4	Very soft to stiff silty CLAY	3		
	8.4-22.0	Firm to stiff silty CLAY	3		
	22.0-22.8	Stiff to very stiff silty CLAY	3		
ST14460-CPT-122	0.0-10.9	Very soft to firm silty CLAY with gravelly, silty sand in the top 1m.	3	598,525.80	6,372,519.30
	10.9-20.5	Firm to stiff silty CLAY	3		
	20.5-22.6	Very stiff sandy, silty CLAY	3		
ST14460-CPT-123	0.0-1.0	Gravelly, silty SAND	2	599,548.50	6,373,343.30
	1.0-19.4	Very soft to stiff silty CLAY	3		
	19.4-21.0	Stiff to very stiff silty CLAY	3		
ST14460-CPT-131	0.0-10.5	Very firm sandy, silty CLAY	3	597,047.00	6,374,478.20
	10.5-20.0	Firm to stiff CLAY	3		
ST14460-CPT-132	0.0-9.2	Very soft to firm sandy, silty CLAY	3	597,347.00	6,373,118.20
	9.2-21.5	Firm to stiff silty CLAY	3		
	21.5-23.5	Stiff to very stiff sandy, silty CLAY	3		
ST14460-CPT-133	0.0-0.4	Silty gravelly SAND	2	598,349.70	6,347,087.60
	0.4-10.0	Very soft to firm, sandy, silty CLAY	3		
	10.0-20.0	Firm to stiff, silty CLAY	3		
	20.0-23.3	Very stiff, sandy, silty CLAY	3		
ST14460-CPT-141	0.0-8.2	Very soft to soft, sandy, silty CLAY	3	598,112.30	6,372,212.90
	8.2-21.0	Firm to stiff, silty CLAY	3		
	21.0-23.0	Very stiff silty CLAY	3		
ST14460-CPT-151	0.0-15.5	Soft to stiff, sandy, silty CLAY with gravelly sand on the top 10-20cm.	3	596,901.00	6,372,897.10
	15.5-23.5	Stiff silty CLAY	3		
	23.5-25.0	Very stiff sandy, silty CLAY	3		
ST14460-CPT-153	0.0-0.5	Gravelly, silty SAND	2	598,290.30	6,372,946.00
	0.5-10.0	Soft to firm sandy, silty CLAY	3		
	10.0-19.6	Firm to stiff, silty CLAY	3		
	19.6-22.4	Very stiff sandy, silty CLAY	3		

Borehole data: Summary of sediment depths					
Unit key:	1	GRAVEL			
	2	SAND			
	3	CLAY			
Borehole	**Depth (m)**	**Sediment**	**Unit**	**Easting**	**Northing**
Export cable route corridor					
ST14451-BH03	0.0-2.0	Light olive brown slightly gravelly silty calacareous silica fine to medium SAND with many fine to medium gravel-sized shell fragments. Gravel is fine subangular to subrounded of mixed lithologies	2	595,216.50	6,373,168.70
	2.0-2.5	Very soft to firm very dark slightly silty, slightly sandy CLAY	3		
	2.5-10.0	Firm silty CLAY	3		
ST14451-BH07	0.0-2.5	Firm to stiff very dark grey slightly sandy, slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of mixed lithologies	3	591,03.8	6,373,374.40
	2.5-3.0	Firm to stiff, sandy CLAY	3		
ST14457-BH09	0.0-2.1	Very dark grey, slightly silty, very gravelly, fine to coarse SAND with many fine to coarse gravel-sized shell fragments. Gravel is fine to coarse subangular to subrounded of mixed lithologies	2	585.521.9	6,373,723.40
	2.1-2.5	Firm very dark grey slightly sandy, slightly gravelly CLAY. Gravel is fine subrounded of mixed lithologies	3		
	2.5-3.0	Firm silty CLAY	3		
ST14451-BH11+11A	0.0-0.1	Olive brown slightly silty very gravelly medium to coarse SAND with fine to medium gravel-sized shell fragments. Gravel is fine to medium subangular to subrounded of mixed lithologies.	2	580,219.20	6,375,548.70
	0.1-2.7	Stiff to hard very dark grey, slightly sandy gravelly CLAY. Gravel is fine to coarse, subangular to subrounded of mixed lithologies.	3		
	2.7-3.0	Stiff CLAY	3		

ST14451-BH13	0.0-0.2	Light olive brown slightly silty gravelly fine to medium SAND with many fine to medium gravel-sized shell fragments. Gravel is fine to coarse subangular to subrounded of mixed lithologies.	2	579,410.30	6,375,944.10
	0.2-2.7	Soft to firm, very dark grey, slightly sandy, slightly gravelly CLAY with few fine to medium gravel-sized shell fragments. Gravel is subangular to subrounded of mixed lithologies.	3		
	2.7-7.0	Very stiff sandy, silty CLAY	3		
ST14451-BH15	0.0-0.1	Very sandy multicoloured fine to coarse subangular to rounded GRAVEL of mixed lithologies. Sand is light yellowish brown, fine to medium.	1	576,337.40	6,376,623.50
	0.1-2.0	Very dark greyish brown, silty to very silty, fine to medium SAND with traces of fine gravel-sized shell fragments.	2		
	2.0-2.5	Stiff very dark greyish brown, slightly gravelly, sandy CLAY. Gravel is fine to medium subangular to rounded of mixed lithologies.	3		
	2.5-3.0	Sandy, silty CLAY	3		
ST14451-BH18	0.0-1.5	Light olive brown, slightly silty, fine to medium SAND with few fine gravel-sized shell fragments.	2	573,986.30	6,375,719.40
	1.5-1.7	Gravelly SAND	2		
Proposed Offshore Turbine Deployment Area					
ST14451-BH113	0.0-0.5	Olive grey slightly clayey, silty, fine to medium SAND, with many fine to coarse gravel-sized shell fragments.	2	600,847.10	6,372,681.40
	0.5-9.0	Very soft to firm dark grey slightly sandy CLAY	3		
	9.0-16.0	Soft to firm very dark greyish brown slightly sandy, slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mixed lithologies.	3		
	16.0-20.5	Firm to stiff very dark greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is fine to medium subangular to rounded of mixed lithologies.	3		
	20.5-21.2	Sandy, silty CLAY	3		

ST14451-BH142+142A	0.0-0.4	Olive grey silty fine to medium SAND with many fine to medium gravel-sized shell fragments	2	598,784.10	6,371,022.70
	0.4-3.6	Very soft dark grey to dark greyish brown, slightly sandy to sandy CLAY	3		
	3.6-18.1	Soft to firm very dark greyish brown, slightly gravelly, slightly sandy to sandy CLAY. Gravel is fine to coarse subangular to subrounded of mixed lithologies.	3		
	18.1-21.3	Very stiff to hard dark brown, slightly gravelly sandy CLAY. Gravel is fie to coarse subangular to subrounded of mixed lithologies (with a possible cobble at 18.08m).	3		
	21.3-22.2	Sandy, silty CLAY	3		
ST14451-BH143	0.0-0.5	Dark olive brown fine to medium SAND with shell fragments	2	599,470.40	6,372,221.00
	0.5-5.0	Very soft to dark soft grey slightly sandy CLAY	3		
	5.0-19.0	Soft to firm dark grey, slightly sandy, slightly gravelly CLAY with traces of fine gravel-sized shell fragments. Gravel is fine to coarse subangular to subrounded of mixed lithologies.	3		
	19.0-20.3	Stiff dark brown, slightly sandy gravelly CLAY wioth traces of shell fragments. Gravel is fine to coarse, subangular to subrounded of mixed lithologies.	3		
	20.3-21.6	Silty CLAY	3		
ST14451-BH152	0.0-0.8	Dark olive grey silty fine to medium SAND with fine to medium gravel-sized shell fragments.	2	597,600.40	6,371,686.60
	0.8-20.3	Very soft to firm, very dark grey slightly sandy, slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mixed lithologies.	3		

Appendix 3: Potential shipwrecks identified by DBA

Name	UKHO reference	Canmore reference	Description	Circumstance of loss	Date Lost	Date Reported	Lat (WGS84)	Long (WGS84)	Proximity to development	Source (Note 1)	Importance	Reason
SS *Egenæs*		208065 (101866)	Norwegian Steamship; 399 tons; Carrying a cargo of herring.	Sunk by U Boat 10 miles east of Peterhead.	22/03/1917	N/A	57 30.317N (wrecksite)	001 27.650W	Unknown	1,2,13	High	Loss of life; wartime remains
Bel Lily	2283	101842	Steam Trawler	Sunk by mine 1.5 to 2 miles NE of Peterhead crew of 10 all lost.	14/05/1917	N/A	57 32.838 N	001 43.187 W	Unknown	1,2,3,7, 13	High	Loss of life; wartime remains.
Alaska		207076	Lugger	Lost 1.25 ENE of Peterhead (1)	08/01/1896	N/A	57 31 00N	001 44.000W	Unknown	1,2,5	Medium	If preserved, remains could provide insight into fishing, ferrying or coastwise trade.
Sylvanus		292191	Schooner.	Sank 8 miles off Peterhead	04/12/1859	N/A	57 30.000N	001 30.000W	Unknown	1	Medium	If preserved, remains could provide insight into fishing, ferrying or coastwise trade.
Resolute		275991	Ship	Part of hull and name board washed ashore at Buchanhaven. Circumstances of loss unknown.	22/12/1860	N/A	57 30.9N	001 47.1 W	Unknown	5	Low	Little of the vessel remains intact
Sweet Home		253853	Lugger	In Canmore only. Wreckage found on Roanheads, reported as 'Body ashore'. Circumstances of loss unknown.	15/07/1884	N/A	57 30.6N	001 46.3W	Unknown	5	Low	Little of the vessel remains intact
Bonny Lass *(Bonnie Lass)*		207426	Schooner; 87 tons, Carrying a cargo of coal.	Vessel in collision then foundered 4.5 miles off Peterhead.	15/02/1906	N/A	57 30N	001 38W	Unknown	1,2	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
Skomer		207488	Iron Steam Trawler A194	Vessel was in collision. Reports indicate it sank 7 miles ENE of Buchanness.	15/05/1911	N/A	57 31.45N	001 34.3W	Unknown	1,2,3, 13	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
Mudlark		208507	Dredger; 109 ton. steel hopper barge, in ballast.	Vessel foundered 7 miles East of Peterhead.	16/02/1918	N/A	57 31N	001 33W	Unknown	1,2	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
Trieste		208211	Iron Steamship carrying a cargo of coal.	Vessel stranded on Girdle Shoal, 0.75 mile N of Peterhead.	16/07/1918	N/A	57 31 .071N (Wrecksite)	001 46.717W	Unknown	1,2,3, 13	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
SS Mimoas			Swedish Steamship	Sunk after a collision ''Off Aberdeen''	04/11/1918	N/A	57 30N (wrecksite)	001 30W	Unknown	13	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
Lizzie M Duncan		292192	Aux Lugger	Foundered 13 miles off Peterhead	30/08/1927	N/A	57 30N	001 22W	Unknown	1	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods

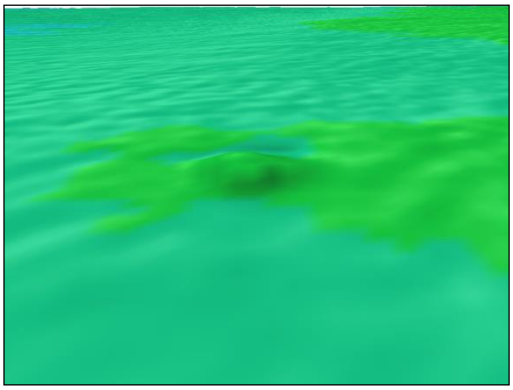
Cransdale		208260	Steam Trawler.	Vessel foundered under tow after being ashore near St Fergus: in 17 fathoms.	21/01/1931	N/A	57 33.0 N	001 46.0W	Unknown	1.2.3.5	Low	Ship and cargo of local importance; post-date 1913; good historical records of construction methods
Name	**UKHO**	**Canmore**	**Description**	**Circumstance of loss**	**Date Lost**	**Date Reported**	**Lat (WGS84)**	**Long (WGS84)**	**Proximity to development**	**Source**	**Importance**	**Reason**
Stella Marie (PA) (now dead)	(2377 Dead)	291537 (dead Hydro)	Remains not located by Gardline. UKHO record amended to 'Dead'.	Unknown.	11/03/1987	N/A			Unknown		Negligible	Modern fishing vessel. No historical interest
Stella Marie (Possibly)	2392	321979	Motor Fishing Vessel. Located 1997, examined by ROV found vessel upright, intact etc. Name not visible, approx. 5m proud of seabed 20m long. Gardline surveys provide additional dimensions suggest 30m by 8m wide, but not further details. Listed as Stella Marie (possibly) although the dimensions are inconsistent. New record as 2377 amended to 'Dead'.	Foundered.	11/03/1987	1997/ 2009	57 31.481N	001 22.522W	Unknown	7,13	Negligible	Modern fishing vessel. No historical interest
Calvados	2414	292193	Motor Fishing Vessel	Foundered 15 miles east of Peterhead. UKHO has this vessel 45 miles from Peterhead	26/05/1993		57 30 N (Canmore) 57 22.294N (UKHO)	001 18W (Canmore) 000 24.100W (UKHO)	Unknown	1,5, 7,13	Negligible	Modern fishing vessel. No historical interest
PA on Chart		101840 (Cransdale Possibly)	Contact reported by 17th Escort Group. Wreck PA amended to dead in 2009, replaced by UKHO record 2281 (below)	Nature and identity of wreckage unknown.	Unknown	01/04/1945	57 31 48N	001 43 00W	Unknown	1,12	Uncertain	Record has been updated to 2281
Sonar Contact	2281		Sonar contact. Large wreck found by Gardline (2009) 41m long 5.5m high	Identify of vessel unknown.	Unknown	01/04/1945 21/06/2009	57 31.581 N	001 40.859 W	Unknown	7,13	Uncertain	Wreckage needs to be identified.
Wreck PA (Dead)	2271	101739 (Mudlark)	Wreck PA. Remains not located by Gardline surveys 2009. Record amended to 'Dead'. Whittaker thought this could be the remains of the Mudlark	Unknown	Unknown		57 29.500N	001 32.500W	Unknown	1,7,12,13	Uncertain	Not located by Gardline survey
Wreck PA (Dead)	2278	101740 (Skomer, possibly)	Wreck PA. Approximate position reported in 1956 as a Fisherman's fastener. Remains were not observed by Gardline surveys in 2009. Record amended to Dead. Whittaker thought this could be the remains of the Skomer.	Unknown.	Unknown	1956	57 30 833N	001 38.333W	Unknown	1,7,12, 13	Uncertain	Not located by Gardline survey
Non Sub Contact (NSC)	2280		NSC reported by a Rear Admiral of the Home Fleet Anti-Submarine Patrol. Contact not located by Gardline. Record amended to 'Dead'.	Unknown	Unknown	07/05/1940	57 31.30N	001 33.00W	Unknown		Uncertain	Not located by Gardline survey

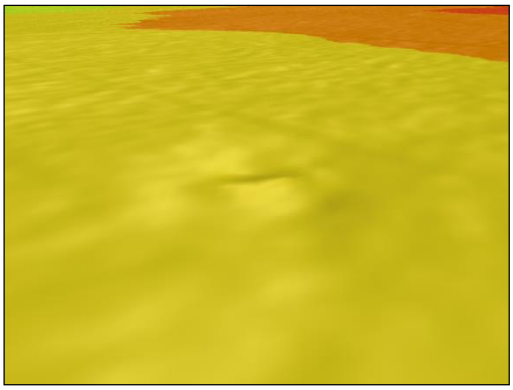
Note 1 – Source of shipwreck information

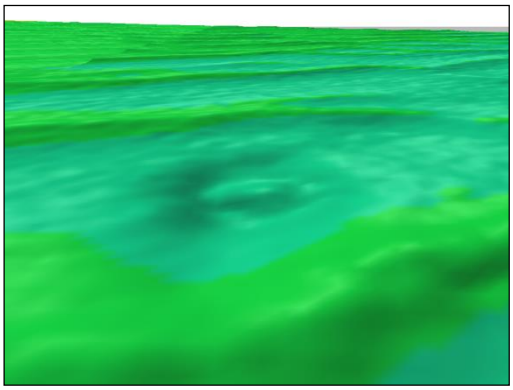
1 = Whittaker (1998); 2 = Larn & Larn (1998); 3 = Baird (2003); 4 = Ferguson (1991); 5 = Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS); 6 = Lloyds List; 7 = UKHO 8= Hepper (2006) 9= Lloyds War Losses WW1; 10= Lloyds War Losses WW2 11= Rohwer (1998) 12= Ridley, Dive Scotland Vol 3 (1992) 13 = Wrecksite.eu

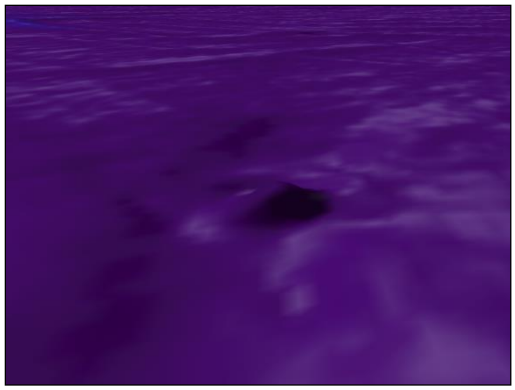
Appendix 4: MBES anomalies

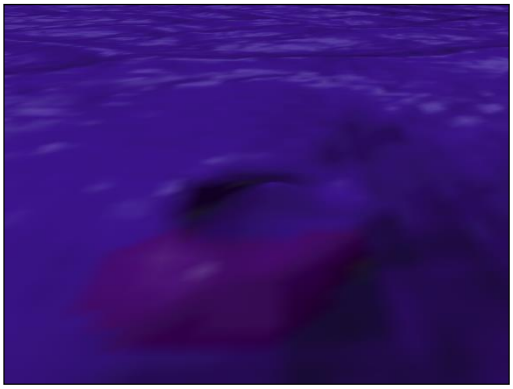
Where the distance of an anomaly from the cable is given, this is from the position of the cable as depicted in Figures 1 to 8, based on the client's shapefile RENEWABLES_EXPORT_CABLE_ROUTE_REV2_STATOIL_140227, received from Andrea Taylor, Xodus Group Ltd, 2014-05-24.

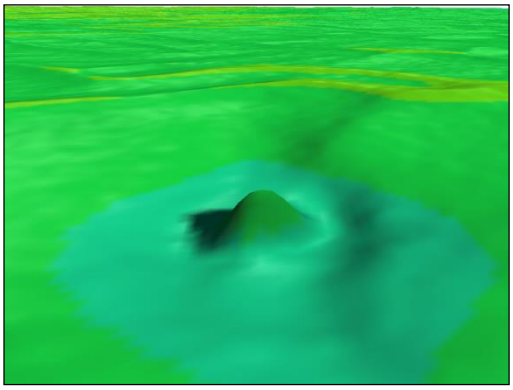
Anomaly	MBES01	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_002	
WGS UTM Zone 30N	602794 E	6364012 N
Dimensions	4.6 m	
Description	Low mound 0.3 m in height 4.6 m in diameter, in 107 m of water depth on a slight ripply seabed. SSS08 also marks this anomaly	
Level of geophysical potential	Low	
Proximity to Development	In southern AfL (outwith proposed offshore turbine deployment area)	

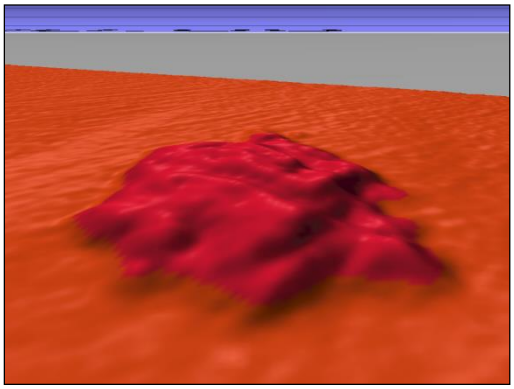
Anomaly	MBES02	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_002	
WGS UTM Zone 30N	604319 E	6365228 N
Dimensions	4.7 m	
Description	Low linear mound aligned Southwest-Northeast with very slight scour surrounding it. Mound is 4.7 m long and 0.06 m high. Seabed is generally flat with water depth of 102 m	
Level of geophysical potential	Low	
Proximity to Development	In southern AfL (outwith proposed offshore turbine deployment area)	

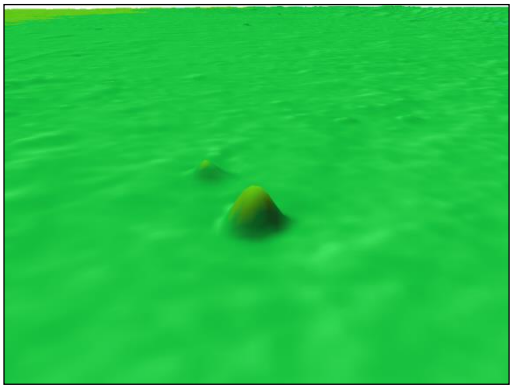
Anomaly	MBES03	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_003	
WGS UTM Zone 30N	598828 E	6373913 N
Dimensions	5.2 m	
Description	Low mound with very slight scour surrounding it. Mound is 5.2 m in diameter 0.8 m high. Scour is aligned North-South given an overall feature length of 10.5 m. Feature lies within Southwest-Northeast sand waves in 107 m of water.	
Level of geophysical potential	Low	
Proximity to Development	In Proposed Offshore Turbine Deployment Area	

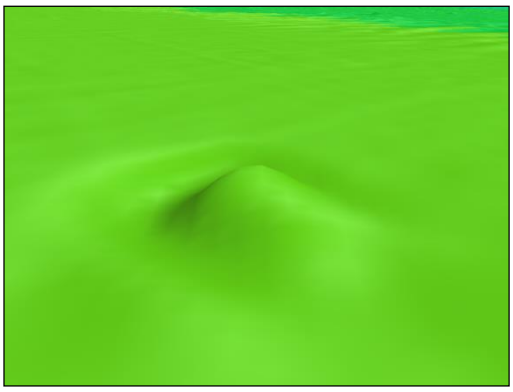
Anomaly	MBES04	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_004	
WGS UTM Zone 30N	599825 E	6369732 N
Dimensions	5.7 m x 3.6 m	
Description	Low mound 0.9 m in height 5.7 m Northwest-Southeast by 3.6 m Northwest-Southeast. There is possible slight scouring to the Northwest 0.1 m deep. Feature is in 118 m of water depth on rippled seabed.	
Level of geophysical potential	Low	
Proximity to Development	In southern AfL (outwith proposed offshore turbine deployment area)	

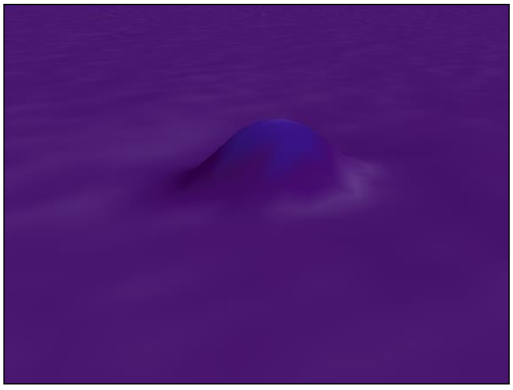
Anomaly	MBES05	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_005	
WGS UTM Zone 30N	599075 E	6368501 N
Dimensions	4.6 m	
Description	Low mound 0.6 m in height, 4.6 m in diameter. There are slight scouring depressions to the North and South, 8 m on a North-South alignment. Feature is in 117 m of water depth surrounded by slight sand waves. SSS07 also marks this anomaly.	
Level of geophysical potential	Low	
Proximity to Development	In southern AfL (outwith proposed offshore turbine deployment area)	

Anomaly	MBES06	
		
Source	ST12828_DTMpre_Hywind_2013001_TurbineArea_008	
WGS UTM Zone 30N	599075 E	6368501 N
Dimensions	5.3 m x 3.5 m	
Description	Mound 2 m in height, aligned Southwest-Northwest. 5.3 m length, 3.5 m Northwest-Southwest. 40.6 m to the Southwest of M-163 Mag contact (Cable or wire). Feature is 108 m of water depth surrounded by slight sand ripples. SSS10 also marks this anomaly	
Level of geophysical potential	Medium	
Proximity to Development	In Proposed Offshore Turbine Deployment Area	

Anomaly	MBES07	
		
Source	ST12828_DTMpre_Hywind_2013004_MainRoute_003	
WGS UTM Zone 30N	580873 E	6375403 N
Dimensions	52.63 m x 26.2 m	
Description	Probably bedrock outcrop 2 m high aligned North-South, 52.63 m x 26.20 m. Feature sits on flat seabed in 61 m of water. Feature is 666 m to West of PA for wreck of Skomer. SSS03 also marks this anomaly	
Level of geophysical potential	Medium	
Proximity to Development	240 m Northeast of the cable	

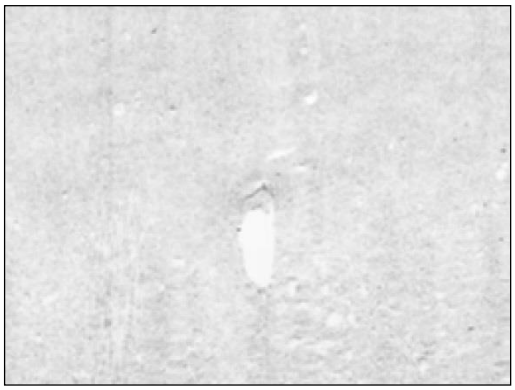
Anomaly	MBES08	
		
Source	ST12828_DTMpre_Hywind_2013004_MainRoute_004	
WGS UTM Zone 30N	573698 E	6375637 N
Dimensions	5.25 m x 3.50 m	
Description	Mound 2.2 m in height, aligned North-South, 5.25 m x 3.50 m on a flat seabed at a depth of 24.7 m. There are slightly smaller mounds immediately to the North that may be associated with this contact. MMT survey have marked this as a high anomaly MAG contact (MMT Observation Number M-1090)	
Level of geophysical potential	High	
Proximity to Development	85 m North of cable	

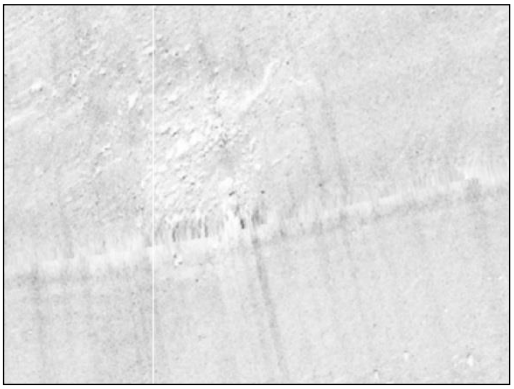
Anomaly	MBES09	
		
Source	ST12828_DTMpre_Hywind_2013004_MainRoute_004	
WGS UTM Zone 30N	573679 E	6375331 N
Dimensions	8.38 m x 6.15 m	
Description	Mound 1.2m in height with surrounding scour on flat, possibly sandy seabed in 22.3m of water. Mound is aligned North-South, 8.38 m x 6.15 m.	
Level of geophysical potential	Low	
Proximity to Development	177 m South of cable	

Anomaly	MBES10	
		
Source	ST12828_DTMpre_Hywind_2013004_MainRoute_004	
WGS UTM Zone 30N	576694 E	6376512 N
Dimensions	6.02 m x 3.46 m	
Description	Mound 1.2 m in height on flat seabed in 51.06 m water depth. Feature is aligned Northeast-Southeast, 6.02 m x 3.46 m. SSS01 also marks this anomaly	
Level of geophysical potential	Low	
Proximity to Development	174 m South of cable	

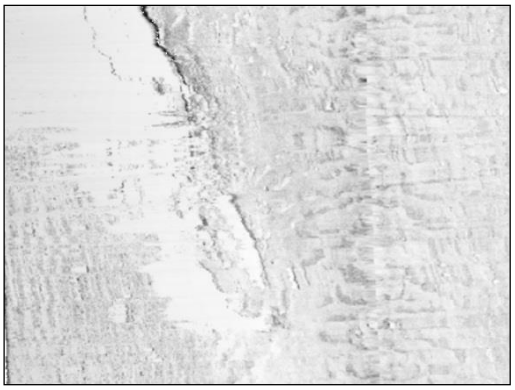
Appendix 5: SSS anomalies

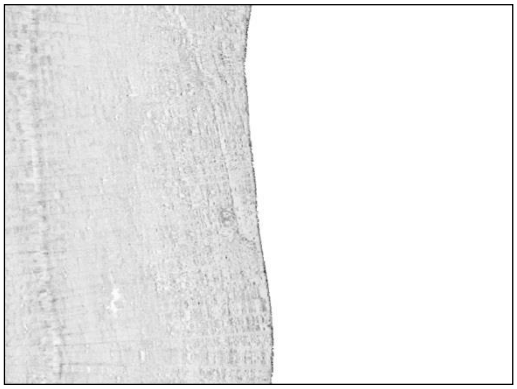
Where the distance of an anomaly from the cable is given, this is from the position of the cable as depicted in Figures 1 to 8, based on the client's shapefile RENEWABLES_EXPORT_CABLE_ROUTE_REV2_STATOIL_140227, received from Andrea Taylor, Xodus Group Ltd, 2014-05-24.

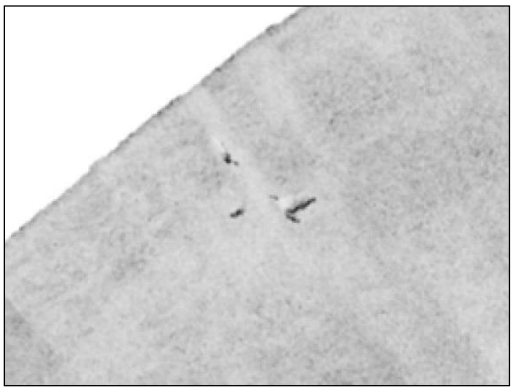
Anomaly	SSS01	
		
Source	ST13828_SSS_Hywind_M_P250_20130925_480	
WGS UTM Zone 30N	576693 E	6376514 N
Dimensions	6.1 m x 4.7 m	
Description	Unknown circular contact, slight scour. 160 m West of PA contact for wreck, possibly Cransdale. MBES01 also marks this anomaly.	
Level of geophysical potential	High	
Proximity to development	176 m South of cable	

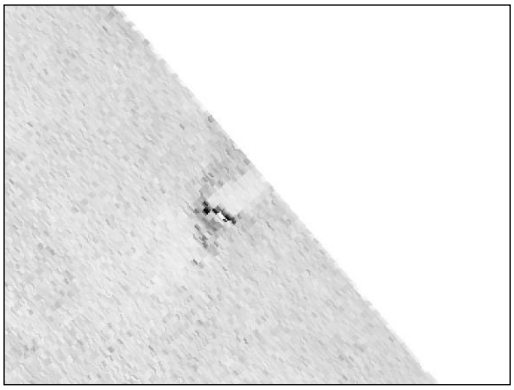
Anomaly	SSS02	
		
Source	ST13828_SSS_Hywind_M_S100_20130926_487	
WGS UTM Zone 30N	577214 E	6376912 N
Dimensions	29 m x 29m	
Description	Large isolated contact, slight scour, possibly natural	
Level of geophysical potential	Low	
Proximity to development	194 m North of cable	

Anomaly	SSS03	
		
Source	ST13828_SSS_Hywind_M_S200_20130926_484	
WGS UTM Zone 30N	580869 E	6375408 N
Dimensions	54 m x 26 m	
Description	Large contact, 665 m West of wreck (PA) possibly *Skomer*; No return from Magnetometer data, indicates probable rock outcrop despite proximity to wreck PA. MBES07 also marks this anomaly.	
Level of geophysical potential	Low	
Proximity to development	211 m North-east of cable	

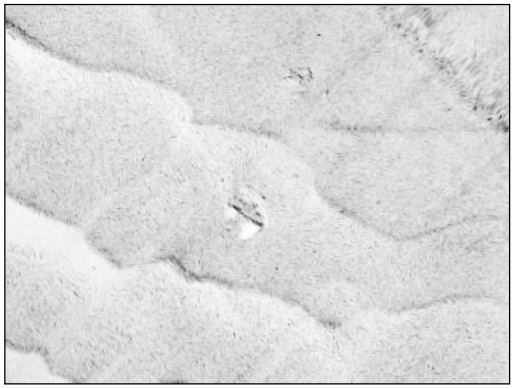
Anomaly	SSS04	
		
Source	ST13828_SSS_Hywind_M_XKP22_500_20130925_505	
WGS UTM Zone 30N	575625 E	6377605 N
Dimensions	21.5 m x 5 m	
Description	Large contact, poor sonar data, close to charted position for Muriel (Seazone Hydrospatial Wreck Data).	
Level of geophysical potential	High	
Proximity to development	1080 m North of cable	

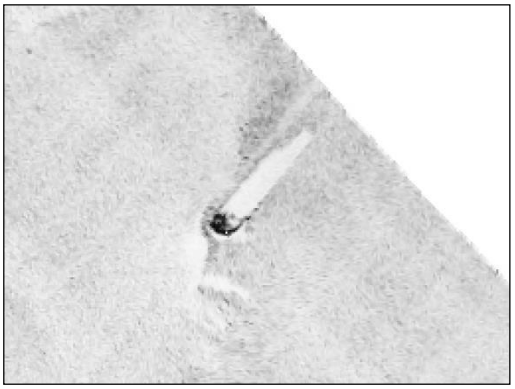
Anomaly	SSS05	
		
Source	ST13828_SSS_Hywind_M_XKP22_250_20130925_503	
WGS UTM Zone 30N	575986 E	6377042 N
Dimensions	400 m x 2 m	
Description	Long cable running North to South.	
Level of geophysical potential	High	
Proximity to development	465 m North of cable	

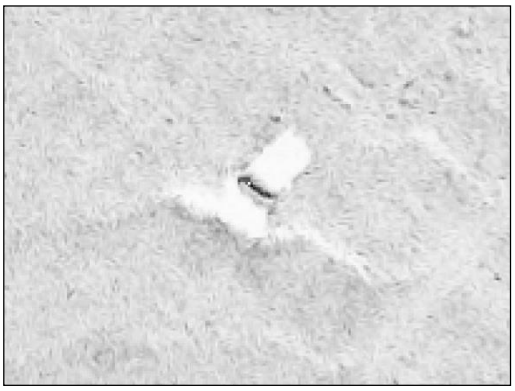
Anomaly	SSS06	
		
Source	ST13828_SSS_Hywind_PI_SSS_20130925_027	
WGS UTM Zone 30N	573377 E	6375410 N
Dimensions	12 m x 9 m	
Description	An area of indeterminate debris, possibly anthropogenic.	
Level of geophysical potential	High	
Proximity to development	9 m South of cable	

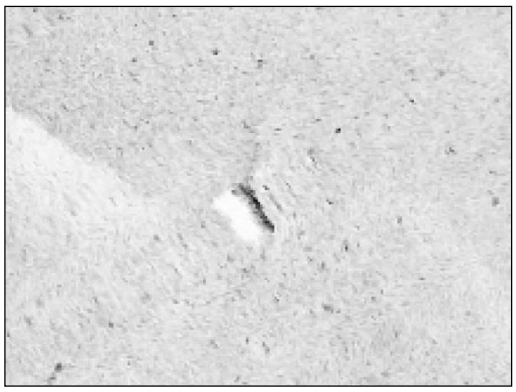
Anomaly	SSS07	
		
Source	ST13828_SSS_Hywind_TA1100_20130808_017	
WGS UTM Zone 30N	599080 E	6368500 N
Dimensions	8 m x 7.6 m	
Description	Contact with hard return; possibly anthropogenic MBES07 also marks this anomaly.	
Level of geophysical potential	Medium	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

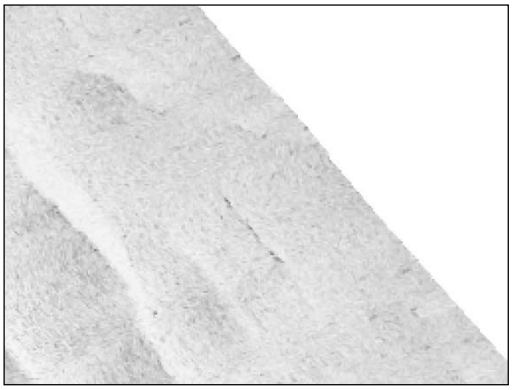
Anomaly	SSS08	
		
Source	ST13828_SSS_Hywind_TA_TA1050_20130808_016	
WGS UTM Zone 30N	602793 E	6364019 N
Dimensions	3 m x 1 m	
Description	Contact with hard return, possibly anthropogenic. MBES01 also marks this anomaly.	
Level of geophysical potential	Medium	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

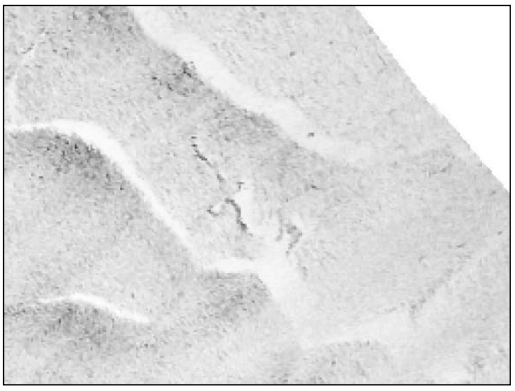
Anomaly	SSS09	
		
Source	ST13828_SSS_Hywind_TB_TB1150_20130814_195	
WGS UTM Zone 30N	596481 E	6371408 N
Dimensions	6.2 m x 3 m; 3 m x 2 m	
Description	An area of indeterminate debris. Additional debris 19m North-northeast of point.	
Level of geophysical potential	Medium	
Proximity to development	In Proposed Offshore Turbine Deployment Area (1.5 km South of cable)	

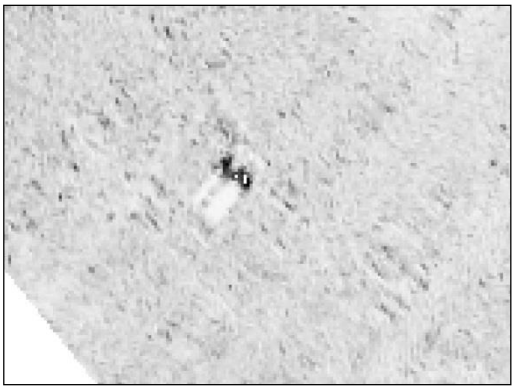
Anomaly	SSS10	
		
Source	ST13828_SSS_Hywind_TB_TB2100_20130818_142	
WGS UTM Zone 30N	597977 E	6371265 N
Dimensions	6 m x 3 m	
Description	Strong contact, large shadow. Possible anthropogenic. MBES06 also marks this anomaly.	
Level of geophysical potential	Medium	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

Anomaly	SSS11	
		
Source	ST13828_SSS_Hywind_TB_TB2100_20130818_145	
WGS UTM Zone 30N	603151 E	6365333 N
Dimensions	3.7 m	
Description	Hard contact with good return and large shadow; possibly anthropogenic.	
Level of geophysical potential	Medium	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

Anomaly	SSS12	
		
Source	ST13828_SSS_Hywind_TB_TB2200_20130818_140	
WGS UTM Zone 30N	597650 E	6371662 N
Dimensions	5.5 m	
Description	Hard contact, good shadow; possibly anthropogenic.	
Level of geophysical potential	Medium	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

Anomaly	SSS13	
		
Source	ST13828_SSS_Hywind_TB_TB2200_20130818_140	
WGS UTM Zone 30N	597233 E	6372278 N
Dimensions	290 m	
Description	Partly buried cable running Northwest to Southeast	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area (885 m South of cable)	

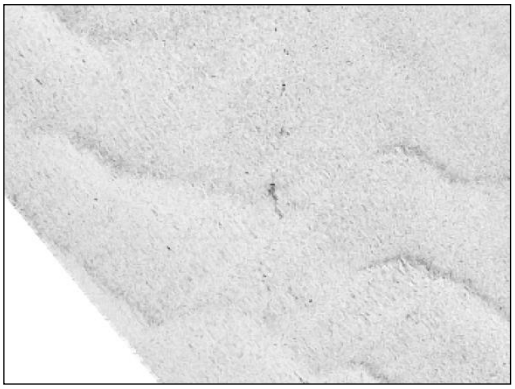
Anomaly	SSS14	
		
Source	ST13828_SSS_Hywind_TB_TB2250_20130815_246	
WGS UTM Zone 30N	597023 E	6372572 N
Dimensions		
Description	Possible end to partly buried cable SSS13.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area (550 m South of cable)	

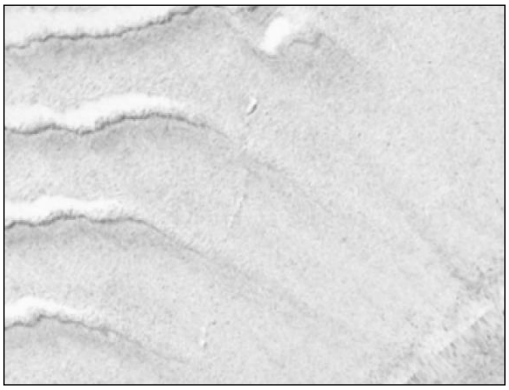
Anomaly	SSS15	
		
Source	ST13828_SSS_Hywind_TB_TB2350_20130815_251	
WGS UTM Zone 30N	603733 E	6364902 N
Dimensions		
Description	Strong return and good shadow, possibly natural	
Level of geophysical potential	Low	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

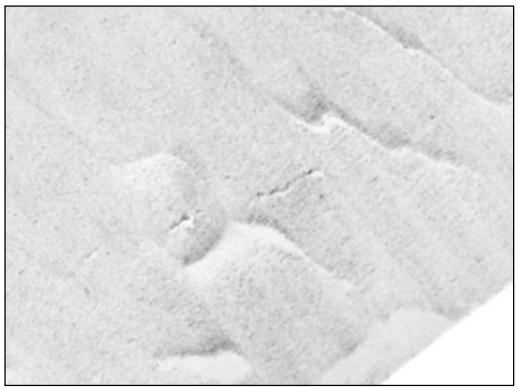
Anomaly	SSS16	
		
Source	ST13828_SSS_Hywind_TB_TB2450_20130815_255	
WGS UTM Zone 30N	599508 E	6369923 N
Dimensions	3.5 m	
Description	Small contact, possible pipe.	
Level of geophysical potential	Medium	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

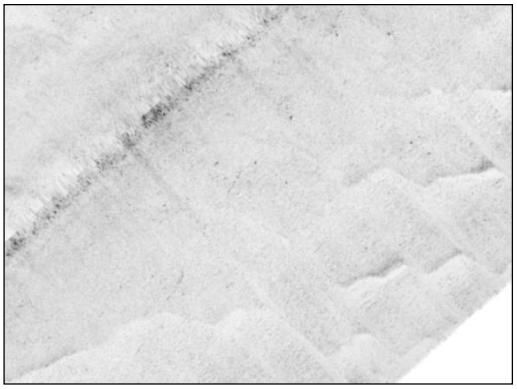
Anomaly	SSS17	
		
Source	ST13828_SSS_Hywind_TB_TB2500_20130818_124	
WGS UTM Zone 30N	596388 E	6373569 N
Dimensions	34 m x 13 m	
Description	Area of anthropogenic debris; several dispersed contact.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area (470 m North of cable)	

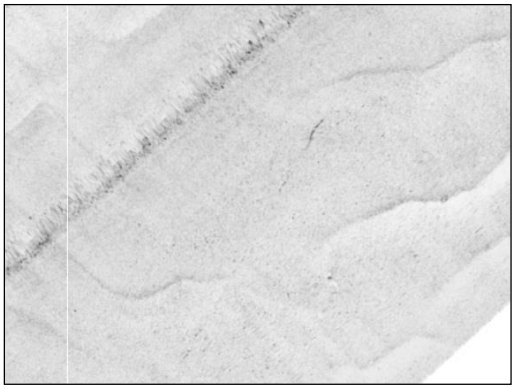
Anomaly	SSS18	
		
Source	ST13828_SSS_Hywind_TC_TC3700_20130811_079	
WGS UTM Zone 30N	604746 E	6365927 N
Dimensions	41 m	
Description	Length of possible cable or wire running North-northeast to South-southwest	
Level of geophysical potential	Low	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

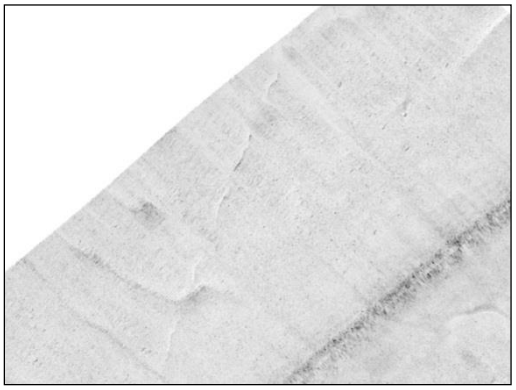
Anomaly	SSS19	
		
Source	ST13828_SSS_Hywind_TD_TD3650_20130817_317	
WGS UTM Zone 30N	599662 E	6371539 N
Dimensions		
Description	Possible chain or cable.	
Level of geophysical potential	Low	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

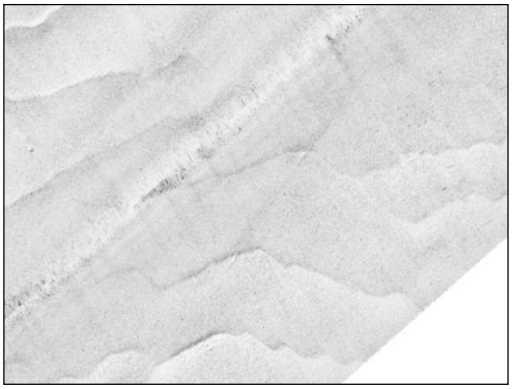
Anomaly	SSS20	
		
Source	ST13828_SSS_Hywind_TD_TX12700_20130927_399	
WGS UTM Zone 30N	595773 E	6373549 N
Dimensions	37 m	
Description	Possible chain or cable.	
Level of geophysical potential	High	
Proximity to development	424m North of cable	

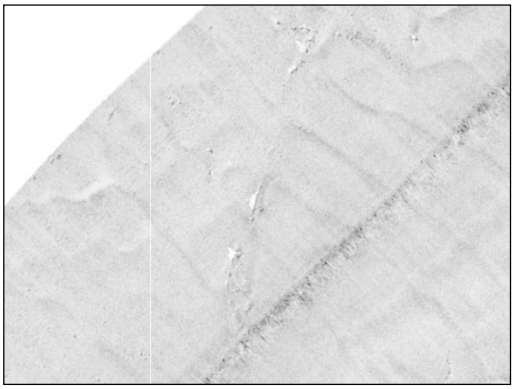
Anomaly	SSS21	
		
Source	ST13828_SSS_Hywind_TX_TX10400_20130927_566	
WGS UTM Zone 30N	596766 E	6371256 N
Dimensions	37 m	
Description	Possible chain or cable.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

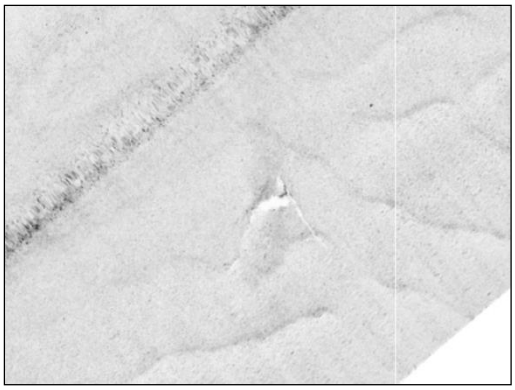
Anomaly	SSS22	
		
Source	ST13828_SSS_Hywind_TX_TX10800_20130927_557	
WGS UTM Zone 30N	596991 E	6372022 N
Dimensions	+150 m	
Description	Possible cable or chain, part buried.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

Anomaly	SSS23	
		
Source	ST13828_SSS_Hywind_TX_TX11000_20130927_552	
WGS UTM Zone 30N	597292 E	6372532 N
Dimensions	56 m	
Description	Possible chain or cable.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area (660 m South of cable)	

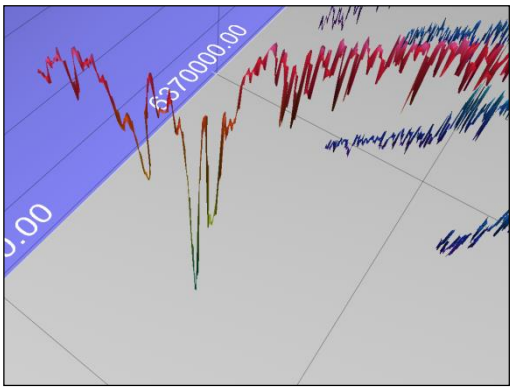
Anomaly	SSS24	
		
Source	ST13828_SSS_Hywind_TX_TX11100_20130927_440	
WGS UTM Zone 30N	597207 E	6372691 N
Dimensions	91 m	
Description	Possible chain or cable, part buried.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area (487 m South of cable)	

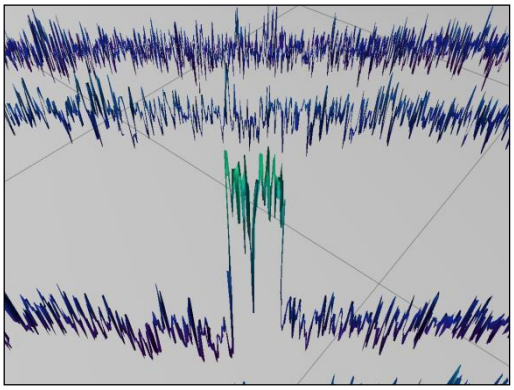
Anomaly	SSS25	
		
Source	ST13828_SSS_Hywind_TX_TX11200_20130927_438	
WGS UTM Zone 30N	598464 E	6373821 N
Dimensions	+ 400 m	
Description	Possible cable, part buried.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

Anomaly	SSS26	
		
Source	ST13828_SSS_Hywind_TX_TX7500_20130927_622	
WGS UTM Zone 30N	599083 E	6369523 N
Dimensions	84 m	
Description	Possible part buried wreck, cable or lost trawl.	
Level of geophysical potential	High	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

Anomaly	SSS27	
		
Source	ST13828_SSS_Hywind_TX_TX8900_20130927_596	
WGS UTM Zone 30N	599921 E	6372031 N
Dimensions	84 m	
Description	Indeterminate contact with wire or cable off to the Southeast, possibly anthropogenic.	
Level of geophysical potential	High	
Proximity to development	In Proposed Offshore Turbine Deployment Area	

Appendix 6: Magnetometer anomalies

Anomaly	MAG01	
		
Source	ST13828_MAG_Hywind_TX_TX8000_20130827_0001_0359	
WGS UTM Zone 30N	597866 E	6369064 N
Field strength	416.51	
Description	Mag contact 208 m to SE of *Annemieke* contact (SZFEATCODE: 15901: WRECKS_For_Internal_Use_Only)	
Level of geophysical potential	High	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

Anomaly	MAG02	
		
Source	ST13828_MAG_Hywind_TX_TX1300_20130816_0001_0155	
WGS UTM Zone 30N	605064 E	6366482 N
Field strength	786.47	
Description	On Line ST13828_MAG_Hywind_TX_TX1300_20130816_0001_0155. Possible bad data, no negative response and no noted features (MBES, SSS, MMT) nearby.	
Level of geophysical potential	Low	
Proximity to development	In southern AfL (outwith proposed offshore turbine deployment area)	

Appendix 7: Geotechnical report

Palaeoenvironmental and Archaeological Assessment of Marine Geotechnical Data for the proposed Hywind Offshore Wind Farm and Export Cable, Peterhead

Dr Scott Timpany, ORCA Marine

INTRODUCTION

This report is prepared for Xodus Group and Hywind (Scotland) Limited (HSL) and presents the results of an archaeological and palaeoenvironmental assessment of marine and onshore geotechnical survey data in connection with the Hywind Scotland Pilot Park Project, a proposed marine wind turbine development and export cable off Peterhead. This assessment covers the export cable route corridor and the Proposed Offshore Turbine Deployment Area, located 25km east of Peterhead, in the British North Sea.

Aims and Objectives

The aim of this report is to provide an archaeological assessment of the palaeoenvironmental potential of sediments affected by the proposed route of the cable and within the Proposed Offshore Turbine Deployment Area area. This will be undertaken through the examination of the geotechnical data; namely cone penetration testing (CPT) and borehole (BH) results that have been taken across the export cable route corridor and the Proposed Offshore Turbine Deployment Area. This assessment will provide specific site data that will aid in identifying potential impacts of the scheme on any sediment of palaeoenvironmental and archaeological interest.

The specific objectives of the assessment are to:

- Review available data in respect of seabed and sub-seabed deposits likely to be of palaeoenvironmental and archaeological interest;
- Identify any deposits of palaeoenvironmental potential within the top two metres of sea-bed sediments (Holocene deposits) along the export cable route corridor and within the Proposed Offshore Turbine

Deployment Area; and

- Present mitigation measures where appropriate to the findings of the assessment.

Overview of the Area

In order to place the results of the geo-technical report into the wider context of the palaeoenvironment of the area of the export cable route corridor and the Proposed Offshore Turbine Deployment Area, it is important to consider the previous work done in these areas. A brief overview of such work is given below.

Sedimentology

A thick sequence of Quaternary sediments of up to 1,000m has been deposited in the North Sea Basin, which contain evidence of at least five major glacial episodes over a period of two millennia (Sutherland, 1984). The proposed export cable route corridor and the Proposed Offshore Turbine Deployment Area, lie within the central area of the North Sea in an area that sea-level and palaeogeographic models have shown to have been submerged throughout the Holocene (e.g. Sturt *et al*, 2013). Prior to this it was covered by an ice sheet during the Devensian, the Last Glacial period, from around 125,000 BP (Sutherland, 1984). The land is still undergoing isostatic uplift as a result of the weight of this former ice sheet and Smith *et al* (2000, 2006) have recorded that this area has undergone between 0.0-1.0m of uplift since approximately 6,850 BP. Recent studies have shown that the area is still rising (readjusting) at a rate of between 0.65mm (Brookes *et al*, 2011) and 1mm (Woodworth *et al*, 2009) per year.

Recent BH and CPT results (see below) have shown sediments offshore of Peterhead consist predominantly of sands and clays extending to depths in excess of 25.00m (GEO, 2014). The sediments relating to the Holocene deposits are thought to make up the upper 2-3m of the lithostratigraphy; however, problems still remain with the paucity of dates available for these sequences (Sutherland, 1984). These sediments have been identified from the current study as mainly sands, gravelly sands, gravels and clays. These uppermost sequences, dating to the Holocene within the area, have been coined the Forth Beds, consisting of the Upper, Middle and Lower Forth

Beds (Thomson, 1978). No organic sediments of Holocene age have been recorded in the offshore area around Peterhead, with the accumulation of peat deposits appearing to be restricted to inland estuarine areas (e.g. Smith *et al*, 1999).

Underlying the Forth Beds are Quaternary, predominantly clay, deposits of Devensian Age, which include the Witch Ground Formation, the Wee Bankie Beds and the Marr Bank Beds, which are of Late Devensian Age (Thomson, 1978; Sutherland, 1984). These formations are known to occur off the east coast of Scotland, with Sutherland (1984) mapping them as occurring across the present Hywind Scotland Pilot Park area. The Witch Ground Formation comprises glaciomarine, sandy, pebbly muds of approximately 10m thickness, which often denote filled in channels cutting into the underlying sediments (Wee Bankie Beds), which formed in a shallow arctic sea and are middle to late Devensian in age (Holmes, 1977; Sutherland, 1984). The Wee Bankie Beds have been described as irregularly distributed till-like sediments consisting of lenses of sands and gravels, together with fossiliferous clays (Gregory *et al*, 1978), which reach thicknesses of up to 40.00m in a belt of moraine-like ridges (the Wee Bankie Moraine). The Wee Bankie Beds are seen to define the terminus of the western end of the Marr Bank Beds, described as a series of compacted sands and silts with intermittent layers of gravel (Holmes, 1977). The two formations are believed to be contemporaneous with the Marr Bank Beds having been radiocarbon dated to the Late Devensian period, c. 21,000 to 17,000 BP (Sutherland, 1984).

Relative sea level change

Holocene relative sea-level change has been investigated across numerous sites along the eastern coastline of Scotland and show a broad trend of falling sea-level from the Late Glacial Maximum of c. 15,000 BP to around 10,000 BP to levels below that of present day sea-level; the early-Holocene minimum (Shennan *et al*, 2000; Shennan and Horton, 2002; Smith *et al*, 1999, 2010, 2012). This is followed by a period of sea-level rise, which had culminated between 7000-5000BP across the east coast of Scotland, when sea-level began to fall (e.g. Smith *et al*, 2010, 2012), with this trend continuing in the area to the present (Shennan and Horton, 2002). It is

thought that the driving cause for sea-level fall within this area is glacio-isostatic uplift (Smith *et al,* 2006, 2012).

Relative sea-level change (RSL) studies for this part of the east coast of Scotland, near to Peterhead, have taken place in the lower Yithan Valley, to the south and inland of the export cable corridor route by Smith *et al* (1999). The study from this area is useful in providing regional information on RSL change more specific to the area of Peterhead. A series of sea-level index points were obtained from radiocarbon dated buried peats in order to construct a RSL curve for this area. The curve generally fits with the broader trend of RSL change recorded for eastern Scotland, with a period of rapid RSL increase from -9.0m OD to +3.5m OD from the period 8000 BP to 5000 BP. Following this rise there is a probable stepped overall fall in RSL to +2.0m OD to 1000 BP, this is followed by a small rise in RSL to approximately +2.1m OD to the present (Smith *et al*, 1999). However, due to the inland location of this study there will be variation of RSL change of this area and the offshore location of the export cable route corridor and the Proposed Offshore Turbine Deployment Area due to different levels of isostatic uplift within these two areas.

Palaeoenvironmental work and potential

Previous studies across the development area, both offshore and onshore, have identified those sediments present consisting mainly of sands, silts, clays and muds. The CPT and BH results presented here (see below) reaffirm the presence of these sediments types and the low potential of the offshore proposed development area for palaeoenvironmental study. The potential reworking of sediments in the offshore area also reduces the potential of the sediments to offer accurate information (e.g. Flemming 2004).

There are no direct palaeoenvironmental studies from within the Hywind Scotland Pilot Park area, with the nearest study again from the inland area of the Yithan Valley, which focused on Holocene changes in RSL and vegetation (Smith *et al*, 1983, 1999). Buried peats and estuarine clays were used to provide palaeoenvironmental information from pollen and diatom studies, with radiocarbon dates from the peats also providing RSL index points (see above). The earliest peats were found to date to soon after the

end of the last glacial period with peat formation beginning at 10,190±60 BP (SRR-4707) and continued to form until 8290±45 BP (SRR-4706). Following this period of stable peat accretion the stratigraphy shows a sequence of intercalated peats and estuarine clays accumulating between 8140±45 BP (SRR-4710) and 5390±45 BP (SRR-4719), indicating a period of oscillating RSL. The sequence is overlain by a peat to silty peat, which is dated to between 4000±80 BP (SRR-1769) and 3816±55 BP (SRR-1192) (Smith *et al*, 1983, 1999). Pollen information from the sedimentary sequences reveals a changing landscape of initial open heath and grassland following the end of the glacial period to the recolonization of trees and eventual forming of deciduous woodland before replacement by alder carr and eventual open vegetation with birch-pine woodland. The diatom evidence also reveals a changing landscape from initial freshwater, shallow pools to fully estuarine, brackish water. Also of note is evidence for the Storegga Slide tsunami from a sand layer dated to c.7400-7100 BP in the sequence (Smith *et al*, 1983, 1999). The above studies indicate there may be some potential for the presence of buried peats and palaeoenvironmental data in the onland part of the cable route, should it be placed in previously undisturbed sediments.

METHODOLOGY

The following outlines the methodology used for the assessment of the geotechnical data. The offshore investigation programme being completed in the period 27th March to the 5th April 2014.

Assessment of the Offshore Geotechnical Data

Results from a total of 23 CPT tests and 11 BH logs have been assessed from the soil investigation survey of the export cable route corridor and the Proposed Offshore Turbine Deployment Area. The CPT tests were carried out on board the *Toisa Voyager* vessel to reach a target depth of approximately 20-25 m below sea floor, while BH tests were carried out aboard the MV *Bucentaur* to depths of up to 20.3-21.3m below sea floor. These records are provided in Appendix 2. The logs of the CPT and BH samples were assessed in order to gauge whether the deposits contained any sediments of palaeoenvironmental potential; in particular peats or sediments with high organic contents such as organic silts. The information for the CPT and BH sample logs has all been supplied by GEO.

RESULTS

Offshore Geotechnical Data Assessment

The offshore geotechnical data comes from two main sources: cone penetration tests and borehole sampling. The dominant sediments through which the borehole and cone penetration test results were taken are gravelly sands and silty, sandy clays and are likely to represent deposits of Holocene and Pleistocene age (Sutherland, 1984; GEO, 2014).

Cone penetration test (CPT) results

A total of twenty-three CPTs were executed at twenty-three locations across the offshore area of the proposed export cable route corridor (11) and Proposed Offshore Turbine Deployment Area (12). The maximum penetration depth reached during the survey is 6.00m (ST14460-CPT-10) within the area of the export cable route corridor and 25.00m (ST14460-CPT-151) in the Proposed Offshore Turbine Deployment Area (see Appendix 2). The common composition of sediments across both areas were relatively shallow gravelly sands with a thickness of between 0.3m (ST14460-CPT-08) to 2.4m (ST14460-CPT-21) underlain by sandy, silty clays. The base of the clay deposits were not reached and therefore are likely to extend below the maximum depth of 25.0m. No organic remains or sediments (e.g. wood, peat, organic silts) were recorded in any of the CPT logs.

Borehole (BH) results

A total of eleven BH samples were taken from eleven locations along the proposed export cable route corridor (7) and within the Proposed Offshore Turbine Deployment Area (4). The maximum depth reached by BH sampling during the survey is 10.00m (ST14457-BH03) within the export cable route corridor and 22.20m (ST14451-BH142+142A) within the Proposed Offshore Turbine Deployment Area (see Appendix 2). Similar to the CPT results the BH sampling showed a sedimentary sequence of silty, gravelly sand, often with shell fragments present in the upper part of the sequence, with thicknesses of between 0.10m (ST14457-BH11+11A) and 2.10m (ST14457-BH09) within both areas. Clay deposits were recorded underlying the sand

deposits as in the CPT results. The base of the clay deposits was not reached and thus it is likely that they extend below the maximum depth reached of 22.20m. In one location (ST14457-BH15) a layer of gravels, 0.10m thick was recorded overlying the sand deposits. No organic remains or sediments were recorded in any of the BH logs.

DISCUSSION

The results of the BH and CPT records from across the cable route show a depositional sequence spanning depths of approximately 0.40 (ST14460-CPT-19) to 25.00m (ST14460-CPT-151). The sequences within both records were seen to comprise principally of minerogenic deposits. The sequences encountered within the records appear to confirm the location of the cable route extends into a sequence of shallow Holocene deposits of silty fine to medium sands, underlain by Witch Ground Formation sandy to sandy, gravelly clays. In the Proposed Offshore Turbine Deployment Area similar sequences were encountered with Forth Formation deposits recording overlying Witch Ground Formation deposits and in some locations underlying Wee Bankie Formation deposits of hard sandy, gravelly clays were reached.

The sedimentary sequences recorded from both of the different sampling methods used are of low palaeoenvironmental potential. The dominance of sands within the Holocene deposits in the development area means that conditions for the preservation of microfossils such as pollen and macrofossils such as seeds and fruits are not present and thus limit the amount of palaeoenvironmental information available within the area. There is some potential for the presence of micro-fauna such as ostracods to be present within the sands and clays, while shell fragments were also observed in the majority of the CPT and BH samples. Such fossil marine fauna can provide palaeoclimate data (e.g. temperature) from glacial and interglacial events.

CONCLUSIONS

- The VC and BH records from the route of the export cable route corridor and Proposed Offshore Turbine Deployment Area show a sedimentary sequence dominated by minerogenic sediments of

sands and clays.

- The nature of the Holocene sediments being Sands and Clays indicates there is low potential for palaeoenvironmental study.
- RSL and palaeogeographic information for this area indicate that it has remained marine throughout the Holocene; therefore no submerged landscapes of Holocene age and archaeological interest are present in the area.

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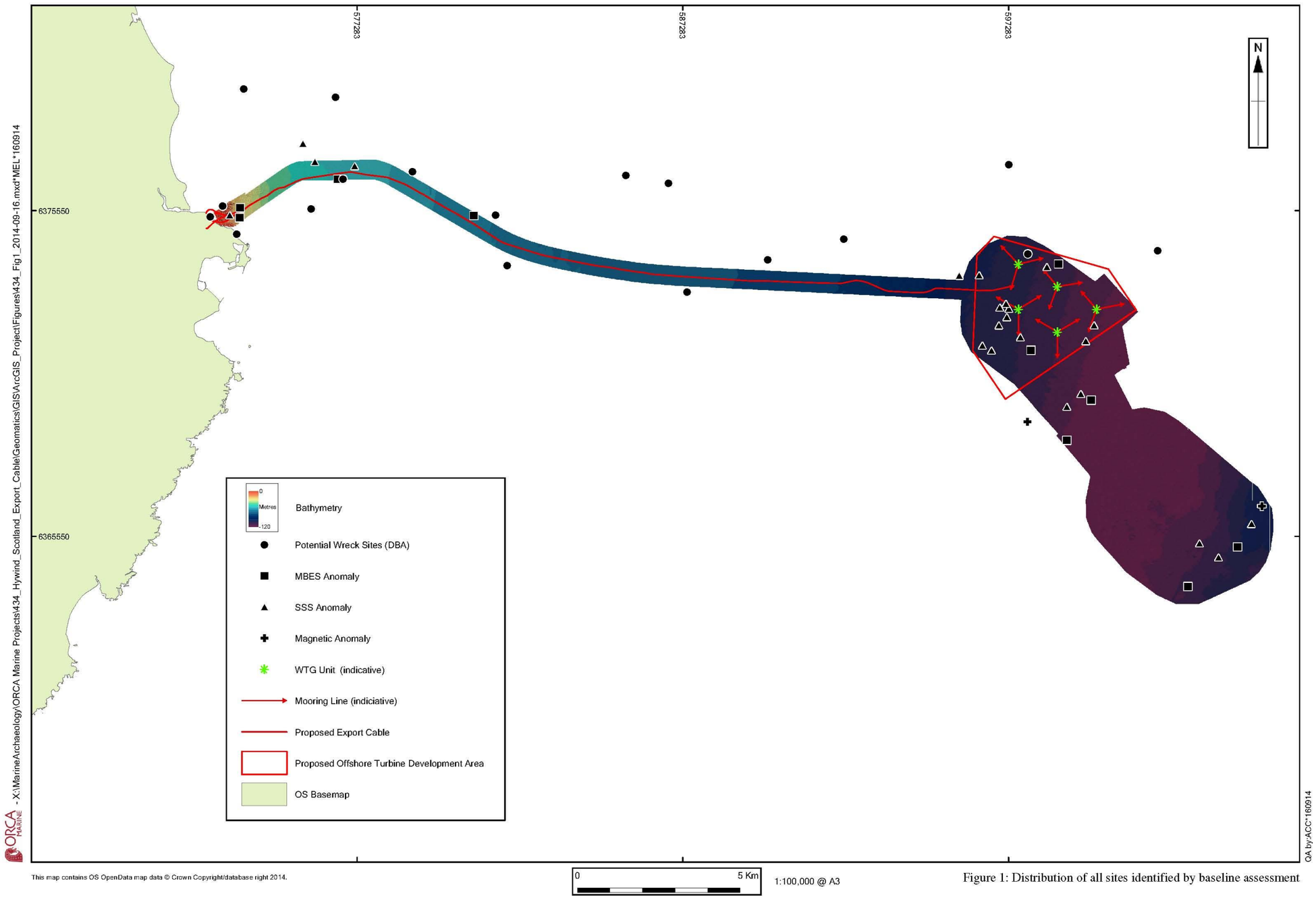


Figure 1: Distribution of all sites identified by baseline assessment

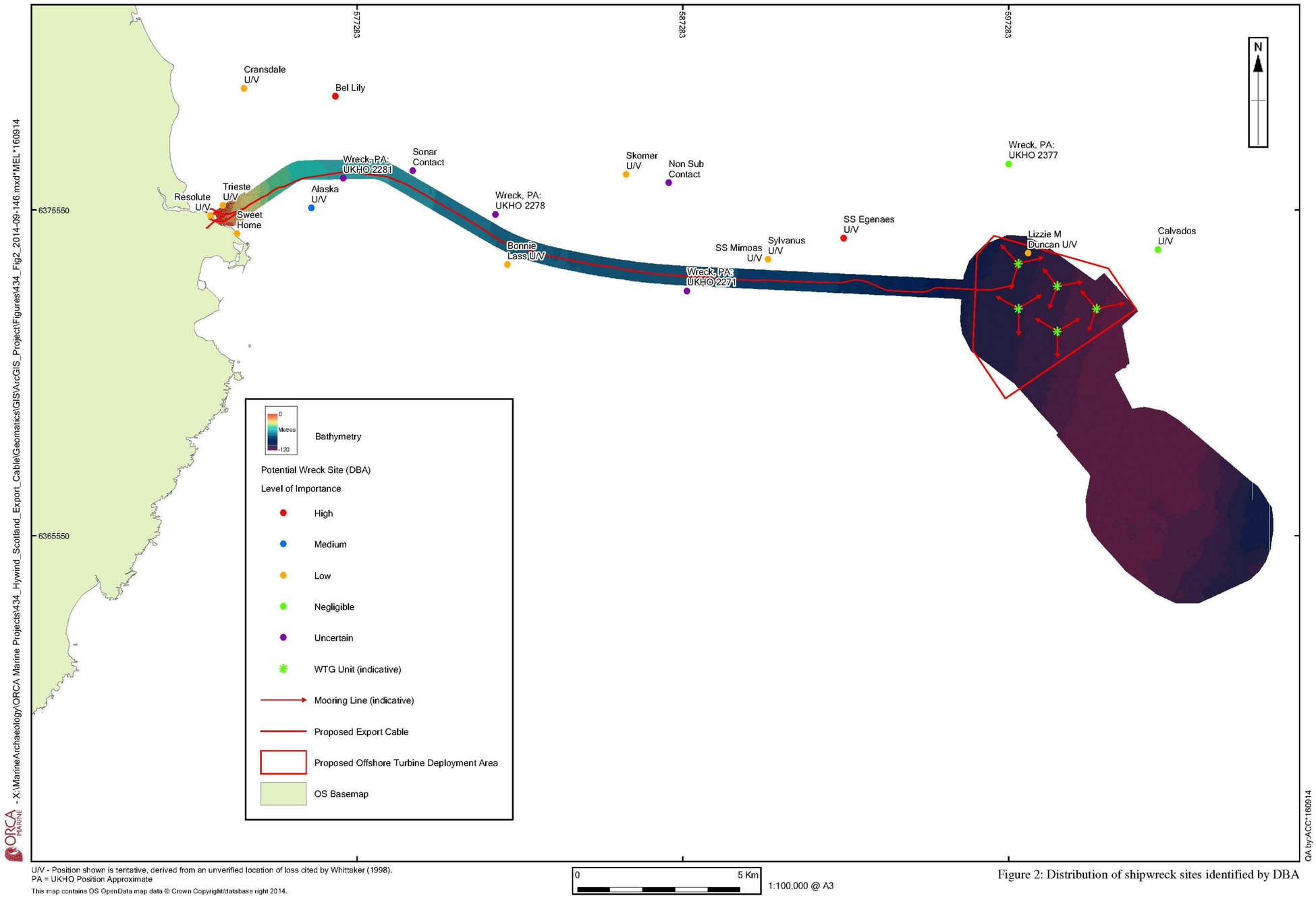
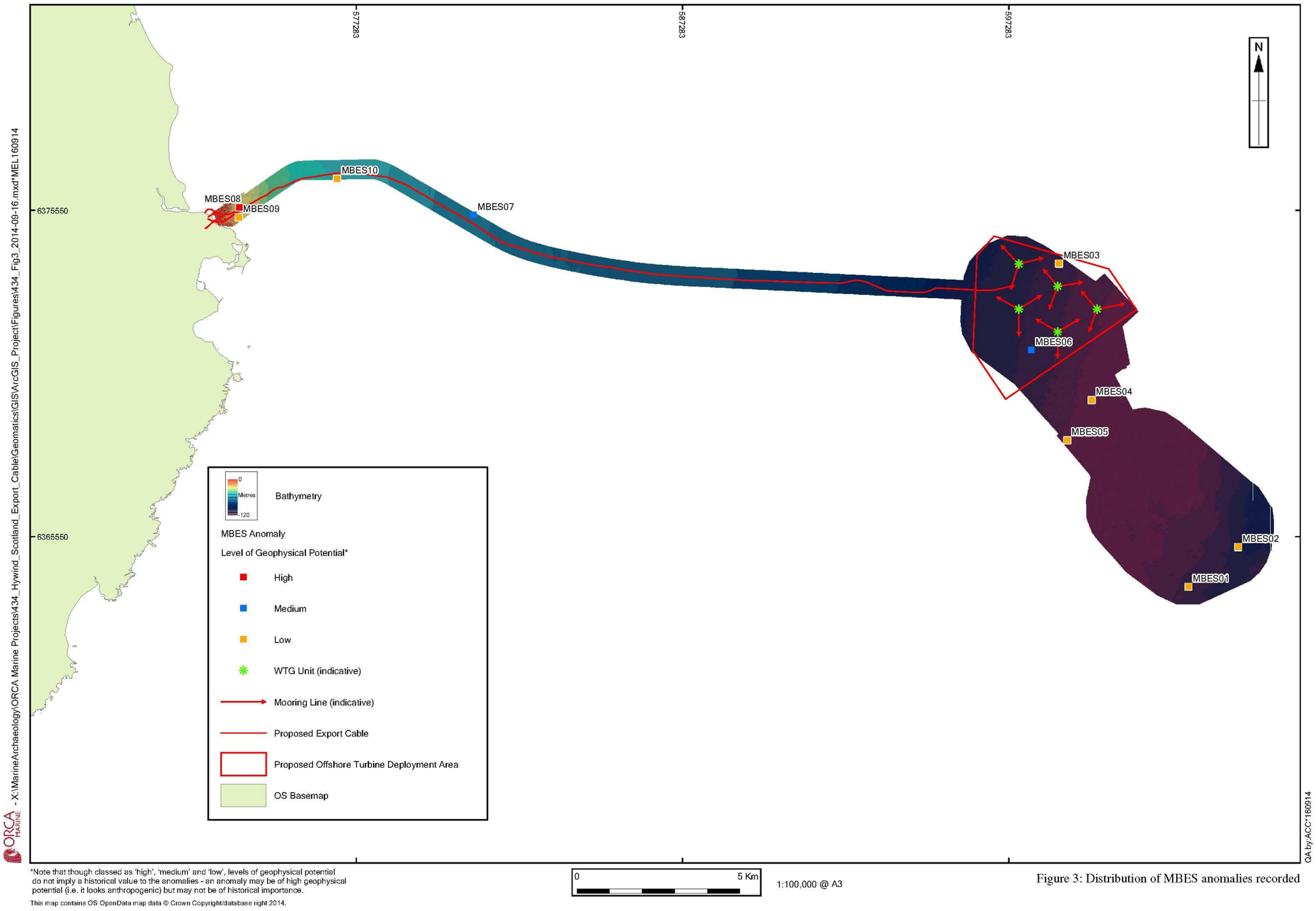
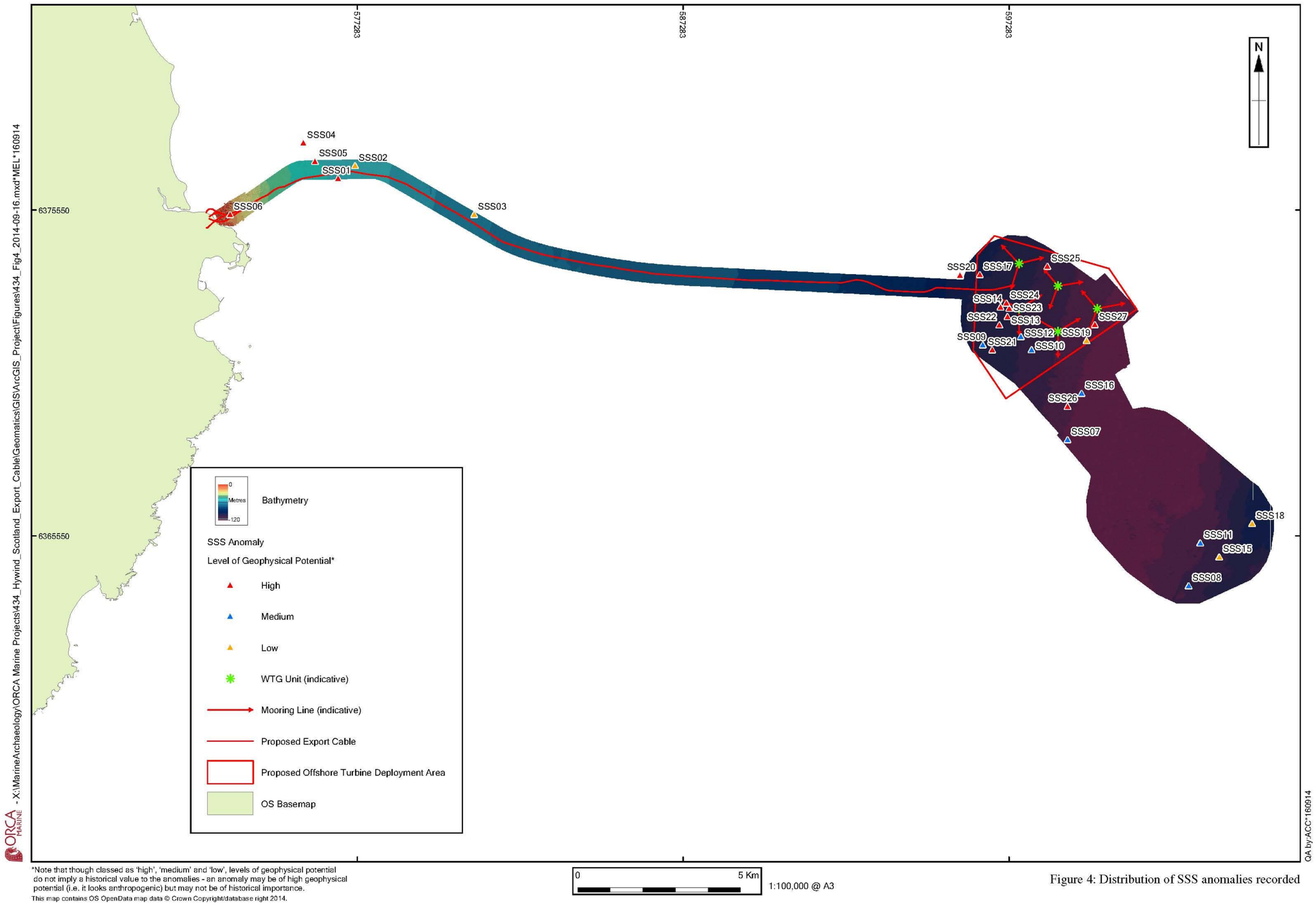


Figure 2: Distribution of shipwreck sites identified by DBA



*Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies - an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Figure 3: Distribution of MBES anomalies recorded



*Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies - an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Figure 4: Distribution of SSS anomalies recorded

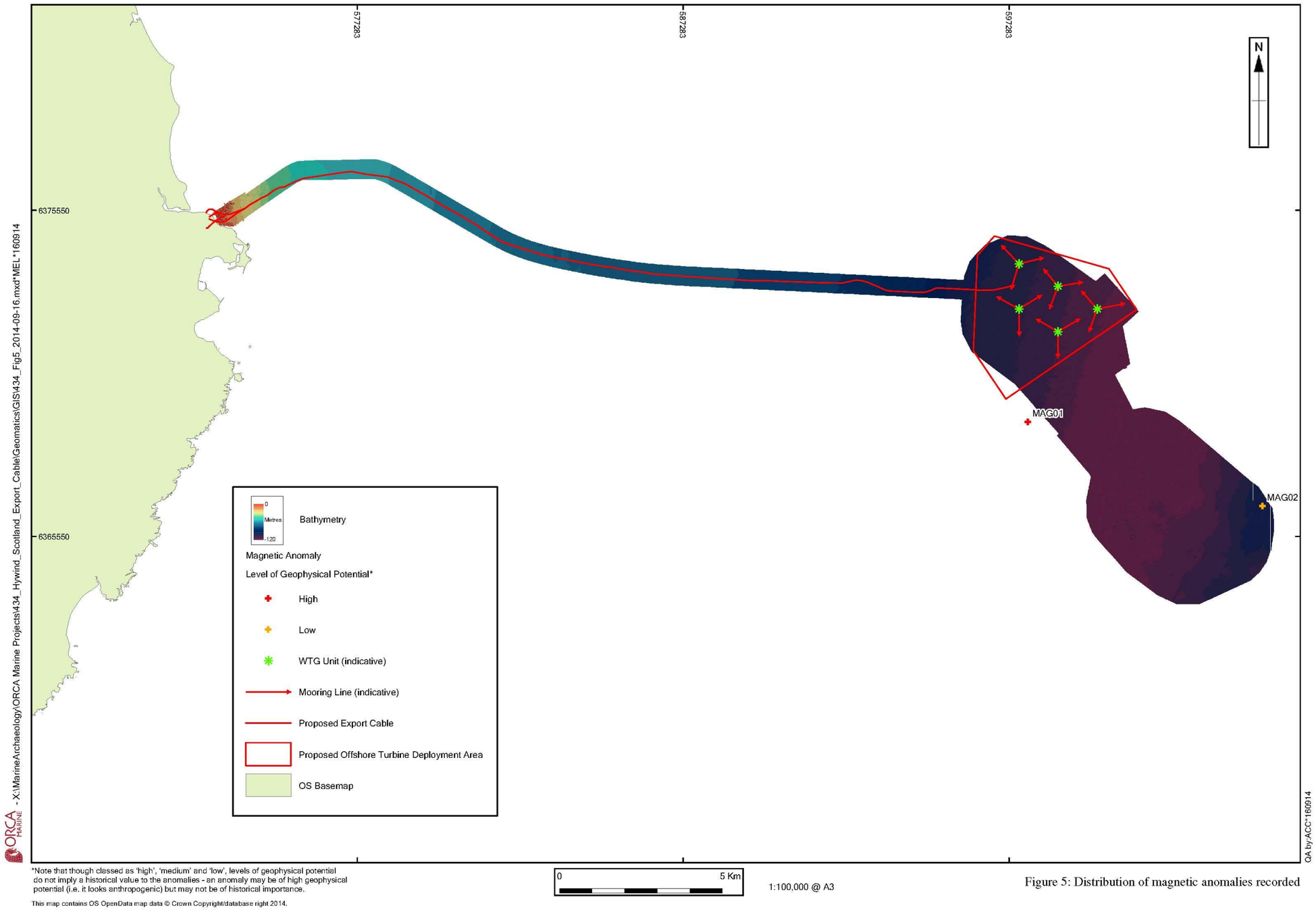
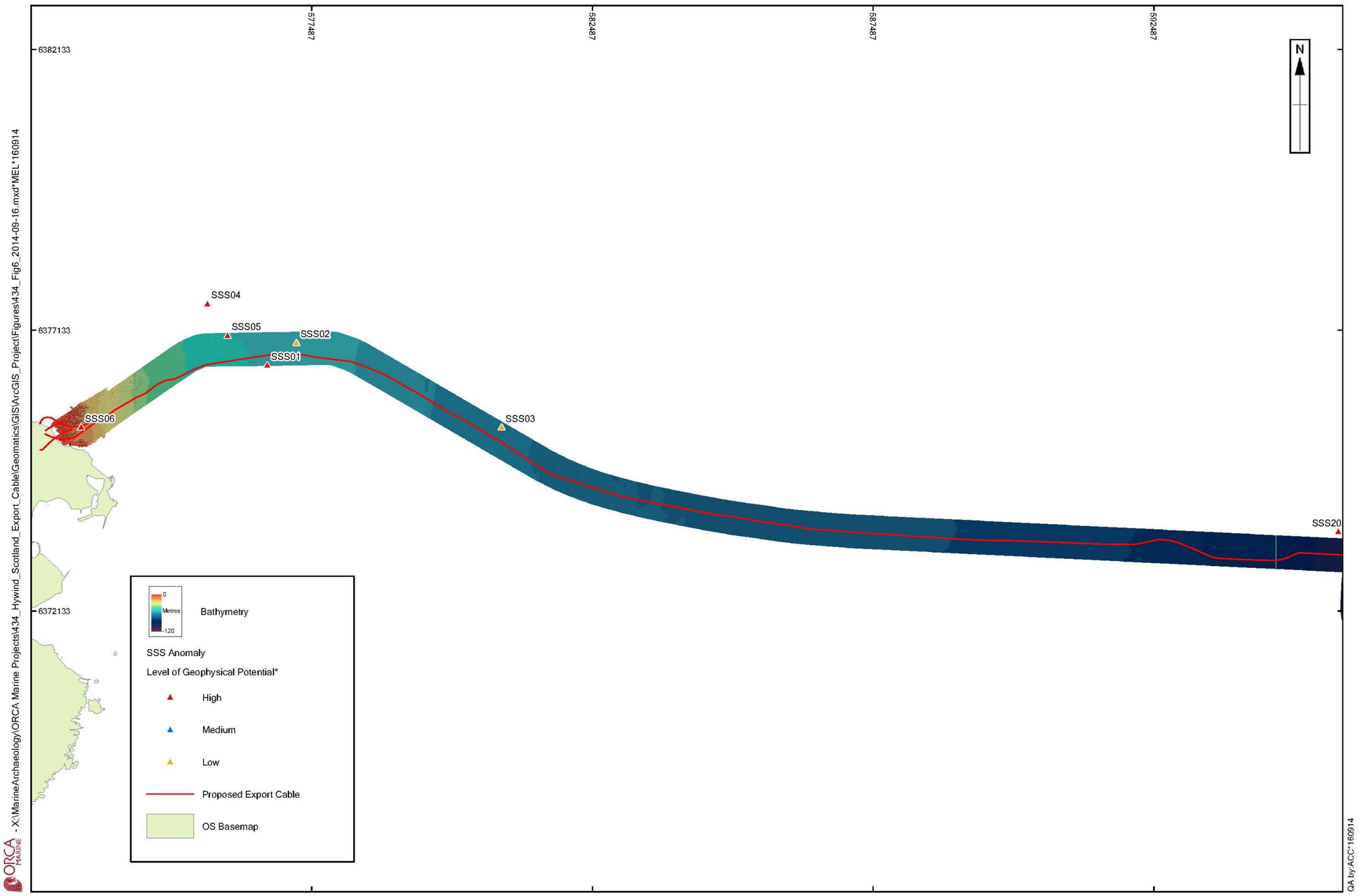
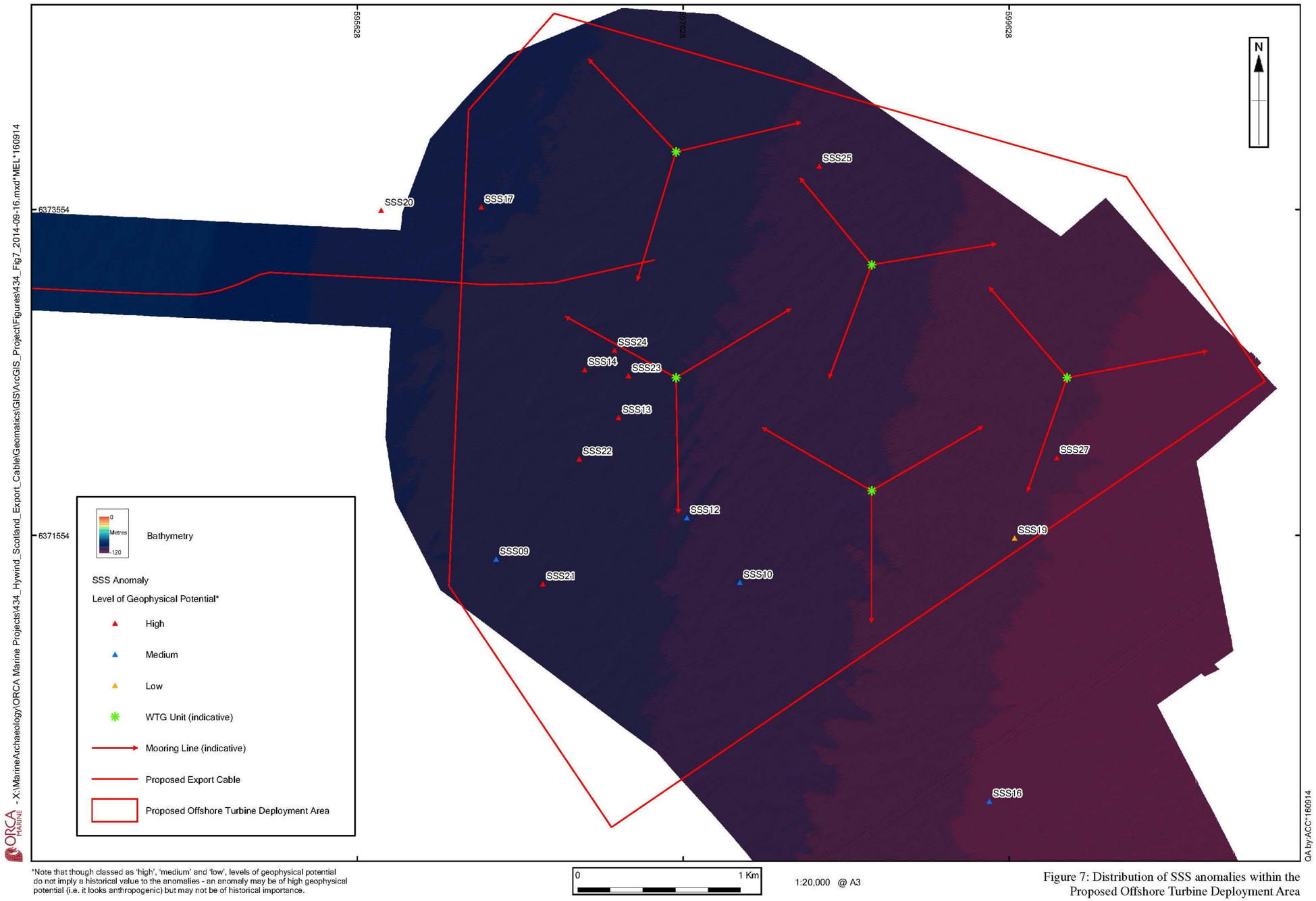


Figure 5: Distribution of magnetic anomalies recorded



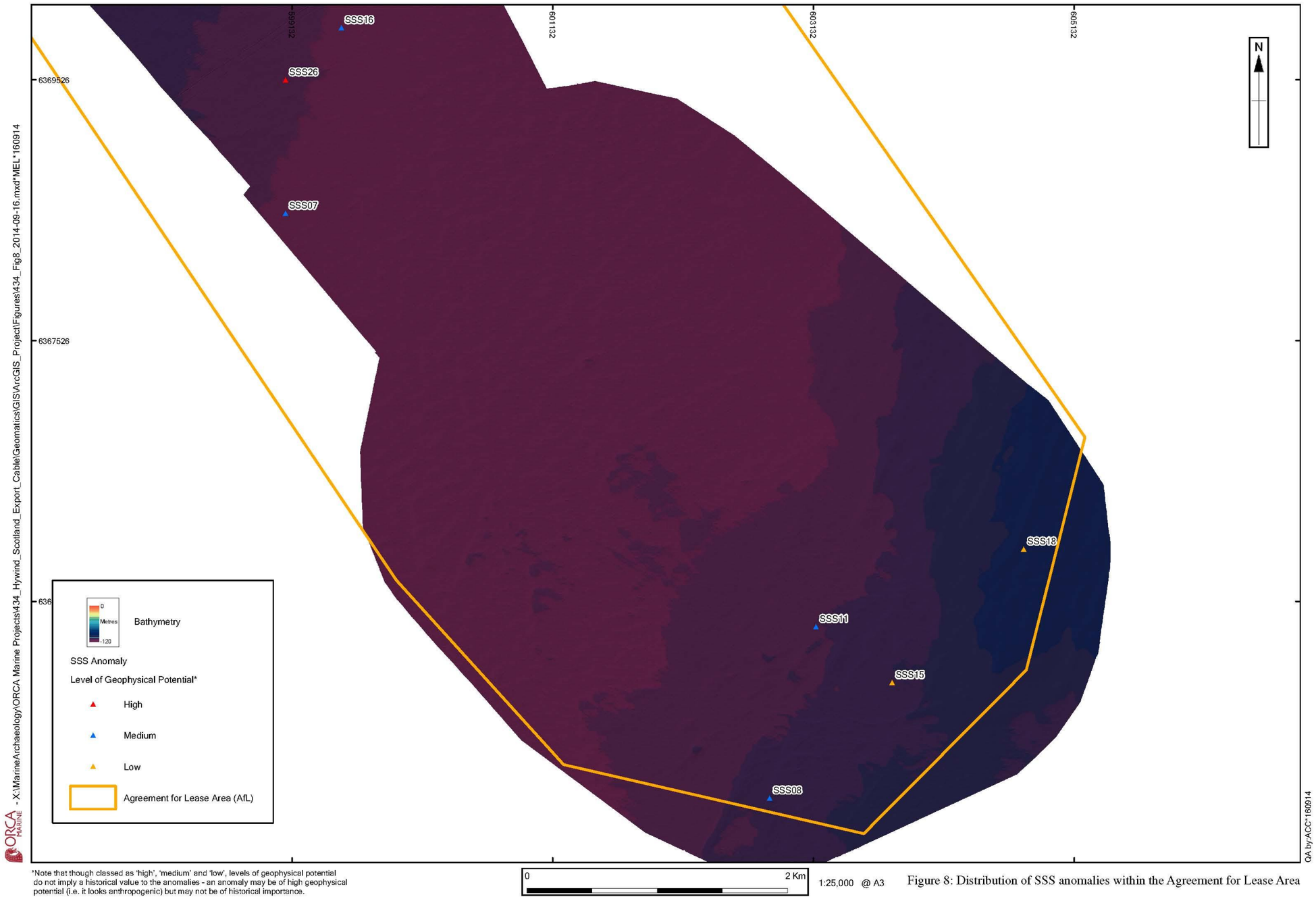
*Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies - an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Figure 6: Distribution of SSS anomalies within the export cable route corridor



*Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies - an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Figure 7: Distribution of SSS anomalies within the Proposed Offshore Turbine Deployment Area



*Note that though classed as 'high', 'medium' and 'low', levels of geophysical potential do not imply a historical value to the anomalies - an anomaly may be of high geophysical potential (i.e. it looks anthropogenic) but may not be of historical importance.

Figure 8: Distribution of SSS anomalies within the Agreement for Lease Area