Morven North Offshore Wind Array Project

Environmental Impact Assessment Report

Volume 3, Annex 14.1: Marine Archaeology Shared Technical Report

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1 Introduction

1.1 Document Overview

1.1.1.1 The Morven North Offshore Wind Array Project (hereafter "Morven North") and the Morven South Offshore Wind Array Project (hereafter "Morven South") are both located within the Morven Option Lease Agreement Site (hereafter "Morven Site") in Scottish offshore waters (Figure 1.1). Morven North is located approximately 61.2km from the Aberdeenshire coast (at its closest point) and Morven South is located approximately 86.1km from the Aberdeenshire coast (at its closest point). Each project will comprise wind turbines, Offshore Substation Platforms (OSPs), associated foundations, inter-array and interconnector cables and cable protection. Consent for the offshore export cables of Morven North and Morven South will be consented separately.

1.1.1.2 As shown in Figure 1.1, Morven North is situated northwest of Morven South. The external boundaries of the projects correspond with the boundaries of the Morven Site

1.1.1.3 This Morven North and Morven South Marine Archaeology Shared Technical Report (hereafter referred to as the "Marine Archaeology Shared Technical Report") presents the marine archaeology baseline information and a review of site specific data for both Morven North and Morven South.

1.1.1.4 Consent for Morven North and Morven South will be sought separately, aided by the development of a separate Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for each project. However, the survey campaign and/or desk-based studies that will support the impact assessments for Morven North and Morven South are based on the Morven Site, which accommodates both Morven North and Morven South. Given the comparability and consistency of information collected to inform the assessments for both projects, the baseline characterisation of Marine Archaeology for both Morven North and Morven South is reported in the present Marine Archaeology Shared Technical Report

1.1.1.5 The information from this Marine Archaeology Shared Technical Report provides the technical baseline to inform the assessment of the likely significant effects of Morven North and Morven South on Marine Archaeology. This report accompanies the EIA and/or HRA provided in Volume 2, Chapter 14: Marine Archaeology of the respective EIA Reports and/or HRA for Morven North or Morven South to support the respective consent applications.

1.1.1.6 The aim of this Marine Archaeology Shared Technical Report is to:

- Summarise the potential for submerged prehistoric archaeology to be encountered within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area (hereafter "Morven North and Morven South" Marine Archaeology Study Areas) (Figure 3.1);
- Identify known maritime and aviation sites within the Morven North and South Marine Archaeology Study Areas from available desktop data sources;
- Based on the maritime history of the wider region, assess the potential for the existence of unknown sites and materials within the limits of the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area;
- Present site specific geophysical data from surveys across the Morven North Boundary and the Morven South Boundary (within which Morven North and Morven South will be located), identify anomalies of archaeological interest and characterise these anomalies integrating the results of the site specific data, with the findings of the desk-based work described above;
- Review available site specific geophysical data for deposits of archaeological and palaeoenvironmental interest and integrate the results with the findings of the desktop review.

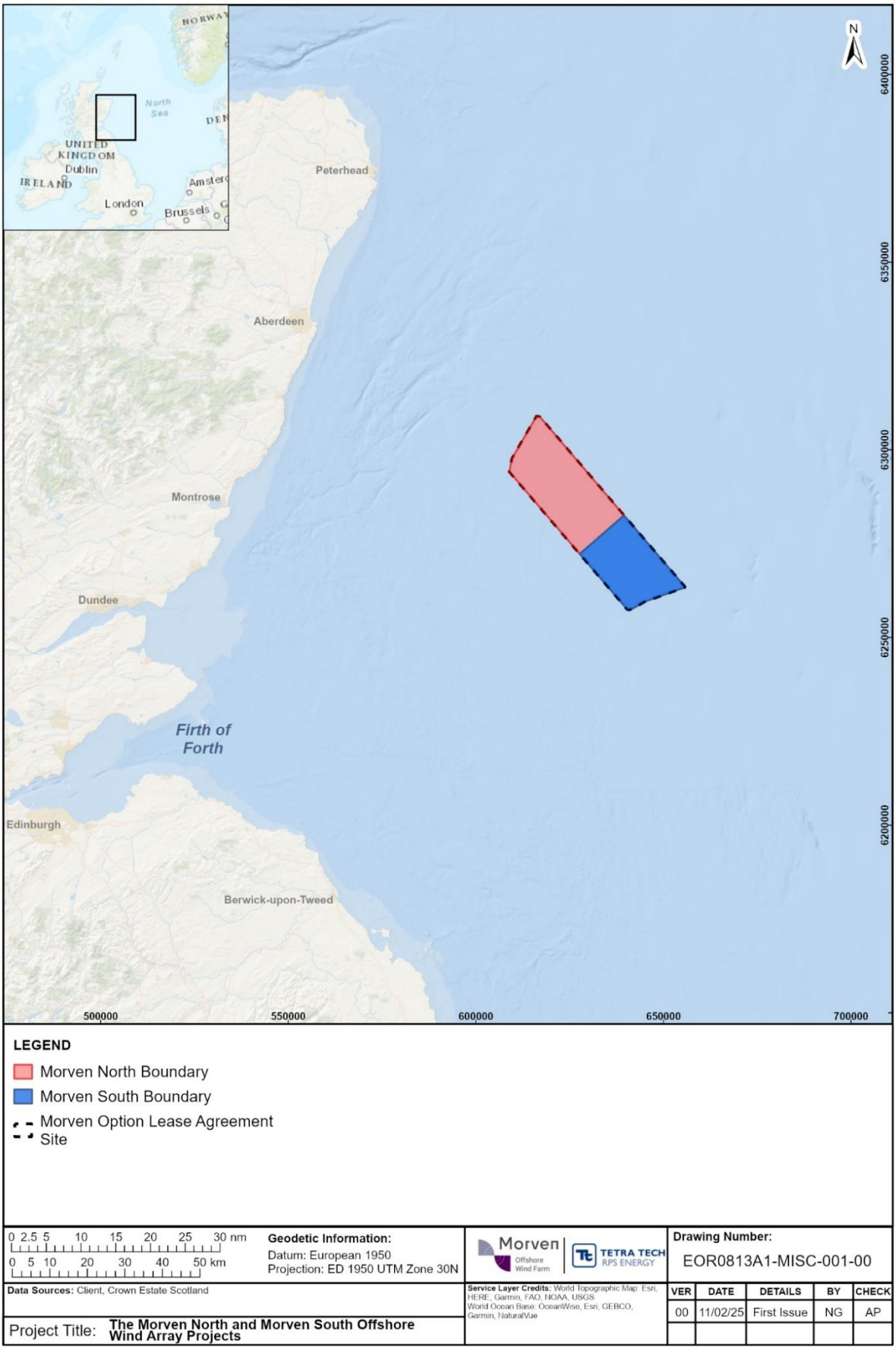

Figure 1.1: The boundaries of the Morven North and the Morven South within the Morven Option Lease Agreement Site

2 Legislation, Policy and Guidance

2.1 Overview

2.1.1.1 This section sets out the legislation, policy, guidance and any development plans relevant to Marine Archaeology in the context of offshore renewable energy development. Legislation, policy and guidance as specific to Marine Archaeology is set out here to provide an appropriate context for the baseline assessment. Further legislation, policy and guidance relating to Marine Archaeology in EIA is detailed within Volume 2, Chapter 2: Policy and Legislation.

2.1.1.2 With regard to marine licensing, Scottish Territorial Waters (STW) is classed as the area of sea within the limits 12 nautical miles (nm) of the territorial coastline. Scottish offshore waters are non-statutory and includes any area of sea beyond 12nm that is within the Exclusive Economic Zone (EEZ) and the United Kingdom (UK) sector of the continental shelf (up to 200nm).

2.1.1.3 Beyond the UK's territorial waters archaeology is generally subject to international legislation and policy, with two exceptions:

- the Merchant Shipping Act 1995;
- the Protection of Military Remains Act 1986.

2.1.1.4 International policy and legislation to which Marine Archaeology is subject includes the United Nations Convention on the Law of the Sea 1982 (United Nations, 1982), the European Convention on the Protection of the Archaeological Heritage (Revised) (the Valletta Convention) (Council of Europe, 1992) and the United Nations Educational, Scientific and Cultural Organisation's (UNESCO) Convention on the Protection of Underwater Cultural Heritage 2001 (UNESCO, 2001).

2.2 Legislation

2.2.1 Protection of Wrecks Act 1973

2.2.1.1 Section 2 of the Protection of Wrecks Act 1973 (UK Government, 1973) provides guidance on the protection for wrecks that are designed as dangerous due to their contents and is administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (RoW).

2.2.2 Ancient Monuments and Archaeological Areas Act 1979 (As Amended)

2.2.2.1 This primarily land-based Act may also be used to provide protection for underwater sites within the UK's territorial waters. Scheduled Monuments and Areas of Archaeological Importance (AAIs) or their equivalent are afforded statutory protection by the Secretary of State, and consent is required for any major works. The Act is administered in Scotland by Historic Environment Scotland (HES), on behalf of Scottish Ministers.

2.2.3 Protection of Military Remains Act 1986

2.2.3.1 The Protection of Military Remains Act 1986 (UK Government, 1986) makes it an offence to interfere with the wreckage of any crashed, sunken or stranded military aircraft or designated vessel, without a licence.

2.2.3.2 All crashed military aircraft receive automatic protection under this Act. Maritime vessels lost during military service are not automatically protected, although the Ministry of Defence has powers to protect any vessel that was in military service when lost. There are two levels of protection offered by this Act:

- Designation as a Protected Place: Protected Places include the remains of any aircraft which crashed while in military service or any vessel designated (by name, not location) which sank or stranded in military service after 04 August 1914. Although crashed military aircraft receive

automatic status as a Protected Place, vessels need to be specifically designated by name. The location of the vessel does not need to be known for it to be designated as a Protected Place.

- Designation as a Controlled Site: Controlled Sites are specifically designated areas which encompass the remains of military aircraft, or a vessel sunk or stranded in military service within the last 200 years. Diving operations for excavation or salvage are effectively prohibited on these sites without a specific licence granted by the Secretary of State in accordance with the provisions of the Act. Official guidance states that for preliminary explorations "there would be no objection to preliminary explorations around the wreck for identification purposes, providing it was not tampered with or disturbed in any way" (Ministry of Defence, 2018).

2.2.4 Merchant Shipping Act 1995

2.2.4.1 The Merchant Shipping Act details the procedures for determining the ownership of maritime finds that turn out to be 'wreck' in the offshore, onshore, or the intertidal zone of UK territorial waters. 'Wreck' includes all craft, parts of these, their cargo or equipment. Section 236 of the Merchant Shipping Act 1995 (UK Government, 1995) stipulates that all wreck within the UK's territorial waters (up to 12nm) and any wreck landed in the UK from outside the UK's territorial waters must be declared to the RoW who acts on behalf of the MCA in administering this section of the Act. If any maritime finds are brought onshore, the RoW must be notified, and the finds must be kept until the RoW determines ownership or requests that they be given to the RoW. This Act is administered by the MCA.

2.2.5 Marine (Scotland) Act 2010

2.2.5.1 The marine historic assets of national importance within STW are protected primarily by the Marine (Scotland) Act 2010 (UK Government, 2010). Part 5, Section 73 of this Act states that an area may be designated as an Historic Marine Protected Area (MPA) if Scottish Ministers consider it desirable to preserve a marine historic asset which is located in the area.

2.2.5.2 A marine historic asset is defined as:

- a vessel, vehicle or aircraft (or part of);
- the remains of a vessel, vehicle or aircraft (or part of);
- an object contained in or formerly contained in a vessel, vehicle or aircraft, a building or other structure (or part of);
- a cave or excavation;
- a deposit or artefact or any other thing which evidences previous human activity.

2.2.5.3 The purpose of Historic MPAs is to preserve by law, marine historic assets of national importance. Permission under the Town and Country (Scotland) Planning Act 1997 or a marine licence under the Marine and Coastal Access Act 2009 (in waters 12nm to 200nm), or under the Marine (Scotland) Act 2010 (from Mean High Water Springs (MHWS) to 12nm) may be required to carry out work inside an Historic MPA.

2.2.5.4 Clear preservation objectives are provided for each Historic MPA and their boundaries are identified as an exclusion zone to activities that could lead to disturbance of the marine historic asset.

2.2.5.5 In Scotland, the Marine (Scotland) Act 2010 has replaced Section 1 of the Protection of Wrecks Act 1973.

2.3 Policy

2.3.1 Marine Policy Statement 2011

2.3.1.1 The UK Marine Policy Statement (MPS) sets out high level marine objectives for ensuring that marine resources are used in a sustainable way (UK Government, 2011).

2.3.1.2 Section 2.6.6 of the MPS relates to the historic environment in marine planning and advises that heritage assets should be conserved through marine planning in a manner appropriate and proportionate to their significance. It advises that when considering the significance of a heritage asset and its setting, the marine plan authority should take into account the particular nature of the interest in the assets and the value they hold for this and future generations.

2.3.1.3 Designated heritage assets in coastal/intertidal zones and territorial/offshore waters may include Scheduled Monuments, Protected Wreck Sites and sites designated under the Protection of Military Remains Act 1986. Non-designated heritage assets of equivalent status should be considered under the same policy principles as designated heritage assets.

2.3.1.4 Where the loss of the whole or material part of a heritage asset's significance is justified, suitable mitigation measures should be put in place. Mitigation requirements should be based on advice from relevant regulators and advisers.

2.3.2 Scotland's Marine Plan 2015

2.3.2.1 The Scottish National Marine Plan (NMP) was published in 2015 and reviewed in 2018 and 2021 and sets out high level objectives for managing offshore development and advice for the preparation of future Regional Marine Plans (RMPs). The NMP is currently under a multi-year review and will undergo a consultation process before being updated in line with stakeholder recommendations (Scottish Government, 2022), consultation is likely in 2025 and should draft versions of the marine plan be available prior to Application any additional archaeological requirements will be adhered to and relevant reporting updated.

2.3.2.2 General Policy 6 within the Scottish NMP relates to the historic environment and states that "Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance" (Scottish Government, 2015a).

2.3.2.3 General Policy 6 identifies that designated heritage assets should be protected in situ within an appropriate setting, and that substantial loss or harm to designated assets should be exceptional and should only be permitted "if this is necessary to deliver social, economic or environmental benefits that outweigh the harm or loss" (Scottish Government, 2015b).

2.3.2.4 General Policy 6 also outlines that proposals for development that may "affect the historic environment should provide information on the significance of known heritage assets and the potential for new discoveries to arise. They should demonstrate how any adverse impacts will be avoided, or if not possible, minimised and mitigated. Where it is not possible to minimise or mitigate impacts, the benefits of proceeding with the proposal should be clearly set out" (Scottish Government, 2015a).

2.3.2.5 The Scottish NMP also states that "where the case for substantial change to heritage asset is accepted, marine decision-making authorities should require applicants to undertake suitable mitigating actions to record and advance understanding of the significance of the heritage asset before it is lost, in a manner proportionate to that significance" (Scottish Government, 2015a).

2.3.3 Scottish Regional Marine Plan

2.3.3.1 The Scottish Marine Regions Order 2015 (Scottish Government, 2015b) established statutory Scottish Marine Regions (SMRs) up to the 12nm limit. Assessment areas which consolidate the existing statutory SMRs with non-statutory Offshore Marine Regions (OMRs) which extend seaward from 12nm to the continental shelf limits adjacent to Scotland. Morven North and Morven South lie within the Long Forties OMR as defined by this framework. In turn, the Long Forties OMR straddles the Forth and Tay and the Northeast SMRs. While there are no specific constraints within the Long Forties OMR, a subsequent offshore export cable corridor would be subject to specific policies regarding the management of any SMR.

2.4 Guidance

2.4.1.1 There are a number of guidance documents that are relevant to Marine Archaeology in the context of offshore renewable development which have been considered in the production of this Marine Archaeology Shared Technical Report. These include:

- UK:
  - Code of Practice for Seabed Development (The Joint Nautical Archaeology Policy Committee, 2006);
  - Historic Environment Guidance for the Offshore Renewable Energy Sector (Wessex Archaeology, 2007);
  - Conservation Principles Policies and Guidance for the Sustainable Management of the Historic Environment (English Heritage, 2008);
  - Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011);
  - Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate, 2014);
  - Code of Conduct (Chartered Institute for Archaeologists, 2014a);
  - Standard and Guidance for Historic Environment Desk-Based Assessment (Chartered Institute for Archaeologists, 2014b);
  - Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects (The Crown Estate, 2021).
- Scotland:
  - Making the Most of Scotland's Seas (Scottish Government, 2010);
  - Designation Policy and Selection Guidance (Historic Environment Scotland, 2019).

3 Methodology

3.1.1 The Study Area

3.1.1.1 The Morven North and South Marine Archaeology Study Areas are defined as the Morven North and Morven South Boundaries with additional 2km buffers. The Morven North Marine Archaeology Study Area overlaps the Morven South Boundary, and the Morven South Marine Archaeology Study Area overlaps the Morven North Boundary, this is shown in Figure 3.1. The Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area were used as the search area for obtaining records from relevant archive databases. This wider Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area allow for a greater understanding of the wider archaeological baseline environment with the dual purpose of enabling recognition of any archaeological trends in the region and allowing any identified archaeological sites to be represented in a broader archaeological context.

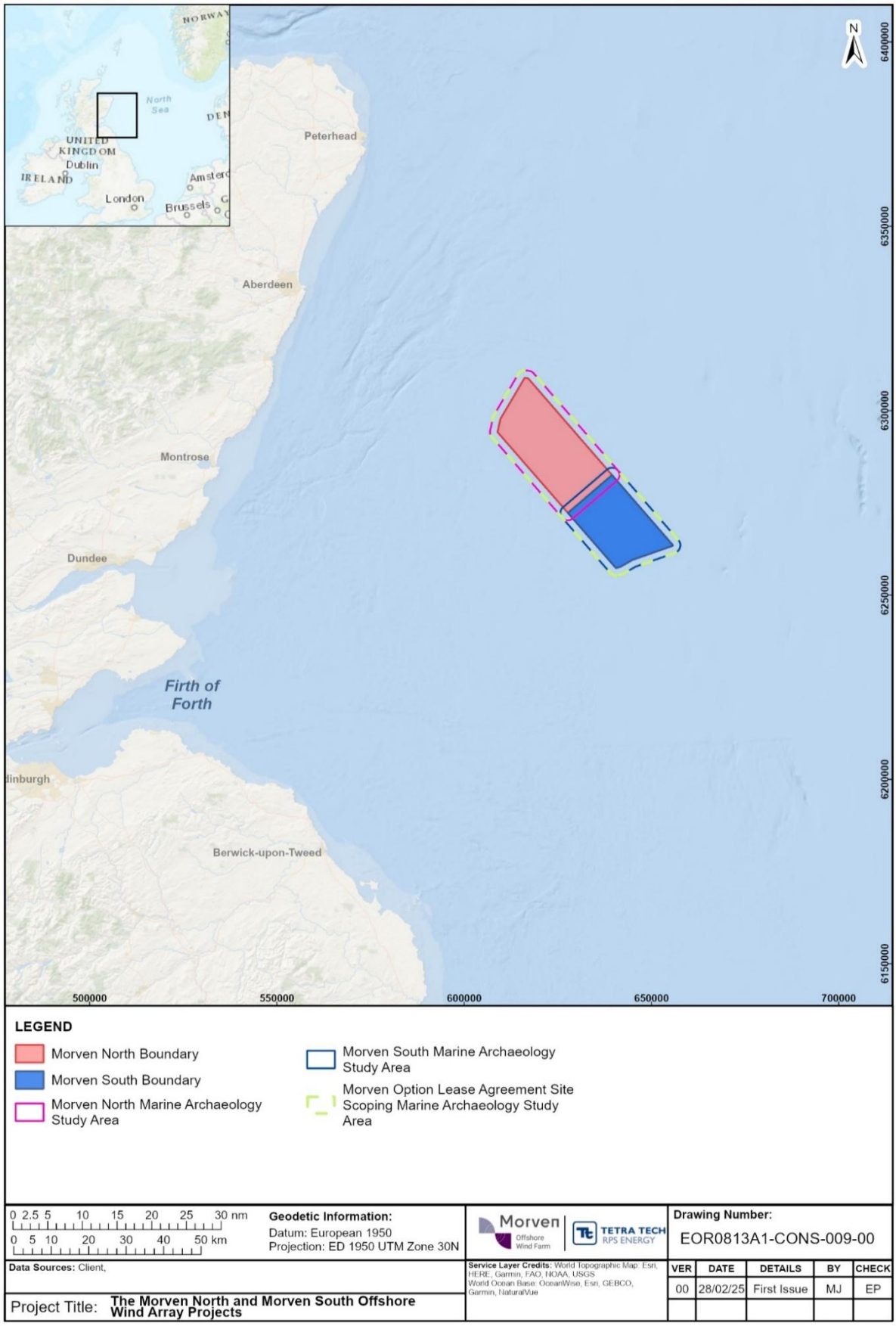

Figure 3.1: Morven North Boundary, Morven South Boundary and the Morven North and South Marine Archaeology Study Areas

3.2 Desktop Study

3.2.1.1 Marine Archaeology within this Marine Archaeology Shared Technical Report is considered within the following categories:

- Submerged prehistoric archaeology: this includes palaeochannels and other inundated terrestrial landforms that may preserve sequences of sediment of palaeoenvironmental interest, Palaeolithic and Mesolithic sites and artefacts;
- Maritime Archaeology: relates generally to craft or vessels and any associated structures or cargo;
- Aviation archaeology: this comprises all military and civilian aircraft crash sites and related wreckage.

3.2.2 Data Sources

3.2.2.1 Several sources were consulted to inform the desktop study of the Marine Archaeology Shared Technical Report. These are provided in Table 3.1. Additional sources consulted include historic Ordnance Survey maps and Admiralty Charts.

Table 3.1: Summary of key desktop data sources

Title	Source	Year	Author
United Kingdom Hydrographic Office (UKHO) Wreck and Obstructions Data	UKHO	2023	UKHO
National Record of the Historic Environment (NRHE) records (Canmore) including shipping and aviation wrecks, protected wrecks and Historic MPAs	HES	2023	HES
Protected Wrecks Map	Marine Scotland	2023	Marine Scotland
GeoIndex (Offshore)	British Geological Survey (BGS)	2023	BGS
Submerged Landscapes Data	European Marine Observation and Data Network (EMODnet) Geology	2022	BGS

3.2.3 Data Structure

3.2.3.1 The above sources were compiled into gazetteers (see Appendix A) to compose a marine archaeological baseline for the purposes of this Marine Archaeology Shared Technical Report.

3.2.3.2 The historic environment records (HERs) have been classified between records where material is known to be on the seabed and 'recorded losses.' Recorded losses are events of vessels that are known to have been lost in the area but do not have accurately located remains associated with them.

3.2.3.3 Where multiple entries across the datasets occur that relate to the same archaeological receptor, the coordinates form the UKHO dataset have been used, as they are most frequently updated with the latest survey positions.

4 Site Specific Surveys

4.1 Overview

4.1.1.1 Site specific geophysical surveys were carried out by Gardline between 11 April 2022 and 14 August 2022. The survey resulted in the mobilisation of a Multibeam Echo Sounder (MBES), a Sidescan Sonar (SSS), a transverse gradiometer (TVG) magnetometer, a parametric Sub-bottom Profiler (SBP) and 2-Dimensional Ultra High Resolution Seismic (2D UHRS).

4.1.1.2 Survey operations were undertaken within a pre-defined boundary of approximately 858km2. The pre-defined boundary overlaps the Morven North Boundary and Morven South Boundary but is smaller than the Morven North and South Marine Archaeology Study Areas (Figure 3.1). Therefore, the site specific survey area and data extents are hereafter referred to as the 'Morven North and Morven South Marine Archaeology survey area' when discussing the interpretations drawn from those data.

4.1.1.3 Geotechnical site investigations (shallow seafloor cone penetration tests) were conducted in 2022 by Fugro Marine Limited, followed by 23 deep boreholes from 13 locations within the Morven North Boundary and Morven South Boundary. Borehole logs were provided to MSDS Marine and COARS for a Stage 1 assessment of the sedimentary sequences (MSDS Marine, 2024). Geoarchaeological recording (Stage 2 assessment) was then undertaken on samples of five of the boreholes (MSDS Marine, 2025).

Figure 4.1: Morven North and Morven South Marine Archaeology survey areas.

4.1.2 Technical Specifications

4.1.2.1 All geophysical data was collected to a specification that fulfils the requirements of Section 3 of Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects (The Crown Estate, 2021).

4.1.2.2 The data were collected to a specification appropriate to achieve the following interpretation requirements:

- SSS: ensonification of anomalies > 0.5m;
- MBES: ensonification of anomalies > 2.0m;
- magnetometer (TVG): 5nT threshold for anomaly picking;
- SBP: penetration of up to 10m was achieved;
- 2D UHRS: penetration of > 80m was achieved.

4.1.3 Data Quality and Limitations

4.1.3.1 The data collected across the extents of the Morven North and Morven South Marine Archaeology survey areas are of good quality overall, and in the case of MBES provided 100% coverage. SBP data were collected to a pre-determined line plan, largely providing suitable coverage and penetration for the interpretation of the palaeoenvironment (Figure 4.1). The magnetometer data were collected to a pre-determined line plan suitable for the identification of ferrous material with a peak-to-peak amplitude of 5nT, with the minimum detection size increasing with distance from the track lines.

4.1.4 Processing

4.1.4.1 The archaeological assessment of data was undertaken by a qualified and experienced maritime archaeologist at MSDS Marine with a background in geophysical and hydrographic data acquisition, processing and interpretation.

4.1.4.2 MSDS Marine were provided with the survey deliverables by TTRPS, including both raw and processed data, alongside interpretations and operations reports. The primary deliverables are shown in Table 4.1. The assessment considers the full extents of the survey data, which was collected within the Morven North and Morven South Marine Archaeology survey area. The assessment of UKHO and NRHE data was undertaken within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

Table 4.1: Data deliverables to MSDS Marine

Sensor	Data type	Format
Sidescan Sonar (SSS)	Raw lines (Low Frequency (LF) and High Frequency (HF))	.xtf
	Processed lines (HF)	.xtf
	Mosaic (LF) 4.0ppm	.tif
	Contacts	.shp and .csv
UHRS and SBP (both)	Raw lines	.sgy
	Processed lines	.sgy
	Isopach	.shp
	Horizons	.tif
Magnetometer (TVG)	Raw lines	.csv
	Contacts	.csv

Sensor	Data type	Format
Multibeam bathymetry	Raw lines	.xyz
	Grids (at 1.0m)	.xyz
	Mosaic (at 1.0m)	.tiff
Geographical Information System (GIS)	Geodatabase	.gdb
Reports	Interpretation report	.pdf
	Operations report	.pdf

4.1.4.3 The data were analysed in conjunction with the desktop datasets listed in Table 3.1 to determine any potentially significant archaeological material that may be present within the Marine Archaeology Study Area. The criteria for the assessment of archaeological potential is presented in Table 4.2.

Table 4.2: Criteria for the assessment of archaeological potential

Potential	Criteria
Low	An anomaly potentially of anthropogenic origin but that is unlikely to be of archaeological significance. Examples may include discarded modern debris such as rope, cable, chain, or fishing gear; small, isolated anomalies with no wider context; or small boulder-like features with associated magnetometer readings.
Medium	An anomaly believed to be of anthropogenic origin but that would require further investigation to establish its archaeological significance. Examples may include larger unidentifiable debris or clusters of debris, unidentifiable structures, or significant magnetic anomalies.
High	An anomaly almost certainly of anthropogenic origin and with a high potential of being of archaeological significance - high potential anomalies tend to be the remains of wrecks, the suspected remains of wrecks, or known structures of archaeological significance.

4.2 Combined Assessment

4.2.1.1 Following the assessment of all datasets, the results were imported into ESRI ArcGIS Pro 3.1.1, a GIS software package, and reviewed alongside each other, along with Geotiffs of the SSS, MBES and Magnetometer data. The concurrent review allows the amalgamation of duplicate anomalies, the assessment of the wider context, and an understanding of the extents of a feature that may be partially buried or span across two or more lines of data.

4.2.1.2 Data from the UKHO, including the positions of wrecks and obstructions, and the relevant Canmore records, as well as all other relevant data such as third-party assets (see Section 4) were assessed to ensure that any additional information is drawn upon, but also that anomalies are not unnecessarily identified as having archaeological potential when the origination can be identified. The resultant remaining anomalies assessed as having archaeological potential were compiled into a gazetteer and a shapefile.

4.2.1.3 The interpretation of geophysical and hydrographic data is, by its very nature, subjective. However, with experience and by analysing the form, size and characteristics of an anomaly, a reasonable degree of certainty as to the origin of an anomaly can be achieved.

4.2.1.4 Measurements can be taken in most data processing software, and while largely accurate, discrepancies can be noted due to a number of factors. Where there is uncertainty as to the potential of an anomaly, or its origin, a precautionary approach is always taken to ensure the most appropriate mitigation for the historic environment.

4.2.1.5 It should be noted that there may be instances where an anomaly may exist on the seabed but not be visible in the geophysical data. This may be due to being covered by sediment or being obscured from the line of sight of the sonar. The use of both SSS and MBES data mitigates this by visualising anomalies from multiples angles, including from above. Anomalies were named following the standard MSDS Marine convention, [PROJECTYEAR_ID], e.g., MOV23_XXX.

5 Submerged Prehistoric Archaeology

5.1 Overview

5.1.1.1 The geological processes which form a sequence of seabed deposits provide baseline information to inform an understanding of the Marine Archaeology Study Area's submerged prehistoric archaeological potential. This section therefore describes the seabed geological sequence and seabed topography within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, as a foundation for the sections which follow. It has been informed by a characterisation of the results from the site specific geophysical surveys, as described in Section 4 above, and by relevant documentary sources.

5.1.1.2 The data available for the submerged prehistoric assessment includes:

- Site specific 2D UHRS data and SBP data;
- Interpretation reports, including:
  - Technical File Note: Preliminary Ground Model. Morven Windfarm Development Central North Sea (Hough, 2023);
  - Geotechnical investigations, including boreholes and vibrocores, and seismic surveys undertaken by the BGS (Gatliff *et al.*, 1994).
- Research papers and publications including:
  - United Kingdom offshore regional report: the geology of the central North Sea (Gatliff *et al.*, 1994);
  - Marr Bank Sheet 56° N - 02° W Quaternary Geology (British Geological Survey, 2020).

5.2 Pre-Quaternary Bedrock

5.2.1.1 The bedrock within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area is varied. In the western parts of the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, and a small pocket within the centre of the site, siliciclastic and argillaceous rock of the Early Cretaceous Cromer Knoll Group is present, while in the centre, and east, chalks of the Late Cretaceous period are present.

5.3 Quaternary Sequence

5.3.1.1 Seismic data from the Morven North and South Marine Archaeology Study Areas demonstrates that Quaternary units overlay the bedrock, including both Pleistocene and Holocene deposits (MSDS Marine, 2023). The average thickness of deposits within the Morven North and South Marine Archaeology Study Areas is between 30m and 50m in thickness. However, assessment of seismic data has indicated channel systems extending to depths of at least 130m in thickness in some places, indicating localised areas where the Quaternary sequence exceeds that mapped by the BGS.

5.3.1.2 Quaternary stages, their ages, climatic regime and associated Marine Isotopic Stage (MIS) is given in Table 5.1. The upper units of the Quaternary sequence are mapped using SBP and UHRS data, while mapping of the lower units is not yet complete. The Quaternary sediment deposit sequence within the Morven North and South Marine Archaeology Study Areas is given in Table 5.2. The Quaternary stages and their associations with archaeological periods is given in Table 5.1. It should be noted that the information presented in Table 5.2 is based on geological models and analysis of the SBP data. Preliminary concordance of borehole lithology, by depth, to Quaternary Formations is presented in Table 5.2.

Table 5.1: Quaternary chronology (based on Historic England (No date); dates from Lisiecki and Raymo (2005))

Stage		Age		Climate	MIS	Archaeological Associations
		Start	End			
Holocene		11,700	Present	Interglacial	1	Mesolithic, Neolithic, Bronze Age, Iron Age, Roman, Medieval, and Modern periods. The Holocene is the current time period within the larger geological time scale known as the Quaternary Period.
Devensian	Loch Lomond	12,900	11,700	Stadial	2	Coincides with the late Upper Palaeolithic and the early Mesolithic.
	Windermere	14,700	12,900	Interstadial		
	Dimlington	29,000	14,700	Stadial		Arrival in the UK of late Middle Palaeolithic Neanderthals, who were followed approximately 31,000 BP by early Upper Palaeolithic, anatomically modern humans (Homo sapiens).
	Upton Warren	57,000	29,000	Interstadial	3	
		71,000	57,000	Stadial	4	
	Brimpton	82,000	71,000	Interstadial	5a	
		87,000	82,000	Stadial	5b	
	Chelford	96,000	87,000	Interstadial	5c	
		109,000	96,000	Stadial	5d	
Ipswichian		123,000	109,000	Interglacial	5e	Last interglacial in the UK. Overlaps with the late Middle Palaeolithic.
Wolstonian	Late	191,000	123,000	Stadial	6	Variable Pleistocene deposition. Incorporates the Lower and Middle Palaeolithic.
	Aveley	243,000	191,000	Interglacial	7	
	Early	300,000	243,000	(?)Stadial	8	
	Purfleet	337,000	300,000	Interglacial	9	
	Unnamed	374,000	337,000	(?)Stadial	10	
Hoxnian		424,000	374,000	Interglacial	11	
Anglian		478,000	424,000	Stadial	12	
Hoxnian		424,000	374,000	Interglacial	11	
Anglian		478,000	424,000	Stadial	12	
Cromerian complex		866,000	478,000	The sequence is poorly understood but evidence for a series of small expansions of the British Ice Sheet marking at least four interstadials and five warm episodes	13-21	

Table 5.2: Quaternary sequence of the Morven North and South Marine Archaeology Study Areas

Correlated formation and member	Description	Age	Depositional environment	Archaeological potential
Surface sediment	Surface sands, with thickness ranging from 0m to 10m (thickest in areas where sandwaves are present).	Holocene	Marine	Low
Forth Formation	Channel fill deposits, between 10m to 60m deep, up to 3km wide. Irregular basal surface with a high amplitude reflector possibly indicating cobble basal lag deposit. CPT investigations refused at this depth also indicating a hard surface. Shallow braided channels are also present with a different seismic character.	Devensian/ Holocene	Glacial to marine	Low
Marr Bank Formation	Sheet-like deposit, between 10m to 30m thick, though maximum of 65m and minimum of 0m. Acoustic character ranges from amorphous to parallel bedded indicating glacial outwash, with likely cross bedding of sand bars. The basal reflector is strong and bright indicating a cobble or boulder rich layer. Basal tills (deposited as an unstratified deposit) are present in some areas.	Devensian	Glacial to proglacial outwash plains	Low
Coal Pit Formation	The formation is present primarily as a channel and infill deposit, up to 130m deep, cutting down to bedrock in places. The channel bases have an irregular erosion surface and a chaotic/structureless fill. High amplitude reflectors in the base may represent shells or pebbles of the lower coal pit (tested in BGS BH 81/37).	MIS 6-3	Marine to glaciomarine, with potential for intertidal deposits in the Ipswichian	Low
Fisher Formation	Acoustic character of the Fisher Formation typically includes parallel sub-horizontal reflectors with small intraformational channels in seismic sections. It is thought that this unit is present within the Morven North and South Marine Archaeology Study Areas , but not yet fully mapped.	MIS 10-6	Subglacial to glaciomarine	Low
Ling Bank Formation	Acoustic character of the Ling Bank typically appears as a complex, stacked, concave-up, commonly irregular, curved seismic reflectors, with evidence of channels and infills that have an amorphous seismic signature. It is thought that this unit is present within the Morven North and South Marine Archaeology Study Areas , but not yet fully mapped.	MIS 12-10	Arctic glacial to marine interglacial	Low

Correlated formation and member	Description	Age	Depositional environment	Archaeological potential
Aberdeen Ground Formation	Wedge shaped deposit. Upper parts of the formation are present within Morven North and South Marine Archaeology Study Areas (proved at BGS BGH 81/27); however, the unit is not yet fully mapped.	Early to middle Pleistocene (MIS 100-MIS 13)	Varied (often glacial) but predating the earliest evidence of human activity in Scotland	Low
Correlated formation and member	Description	Age	Depositional environment	Archaeological potential
Surface sediment	Surface sands, with thickness ranging from 0m to 10m (thickest in areas where sandwaves are present).	Holocene	Marine	Low

5.3.1.3 As can be seen in Table 5.2, the Aberdeen Ground Formation appears to represent the earliest Quaternary deposit within Morven North and South Marine Archaeology Study Areas , The Aberdeen Ground Formation was laid down between 2.52 million to 500,000 years BP (British Geological Society, 2020). The Aberdeen Ground Formation is an Early to Middle Pleistocene unit with a varied depositional environment. The date range of the formation suggests some contemporaneity with some of the earliest hominid activity in the UK such as Happsiburgh (800,000 BP) (Historic England, 2023, Westaway, 2011) and Boxgrove (circa 500,000 BP) (Pope *et al.*, 2020) but it predates the earliest evidence of human activity in Scotland (circa 13,000 BP), so the archaeological potential of this unit is therefore low.

5.3.1.4 The Ling Bank formation is thought to be present in the Morven North and South Marine Archaeology Study Areas as interpreted from the UHRS data, although the extent of the deposit within the Array is not yet determined. Palaeoenvironmental assessments of known deposits, such as from BGS borehole 81/34, demonstrated that the formation was largely laid down under arctic glacial to marine conditions with the upper parts of the unit deposited during an interglacial phase (Gatliff *et al.*, 1994). The arctic conditions and marine and glacial origin of aspects of the formation indicate its limited archaeological potential, as does the formation predating the earliest evidence of hominin activity in Scotland. Therefore, the archaeological potential of this unit is low.

5.3.1.5 The Fisher Formation is thought to be present in the Morven North and South Marine Archaeology Study Areas as interpreted from the UHRS data, although the extent of the deposit within the Morven North and South Marine Archaeology Study Areas are not yet determined. The formation has been noted in boreholes 90km and 135km (BGS borehole 81/29 and 81/34 respectively) to the southeast of the Morven North and South Marine Archaeology Study Areas (MSDS Marine, 2023). The formation has been interpreted as a deposit laid down in a transitional glaciomarine environment during the Wolstonian stage, which included a series of glaciations and associated sea level change. Two boreholes, one 150km to the northeast and one in the outer Moray Firth indicate subglacial and glaciomarine depositional environments, respectively. In addition to the deposit predating the earliest hominin activity in Scotland, such environments are not conducive to human activity, so the archaeological potential of this unit is therefore low.

5.3.1.6 The Coal Pit Formation fills erosive features thought to be associated with a Wolstonian glaciation (Merritt *et al.*, 2007). The deposit is represented by channels, up to 130m in depth, which cross-cut Morven North and South Marine Archaeology Study Areas and incise the lower Quaternary units, to the bedrock in places. The deposition of the Coal Pit Formation was long-lived, potentially spanning vastly different environmental conditions during the late Wolstonian, Ipswichian interglacial, and early to mid-Devensian glacial phases (MIS 6-3; 191,000 to 29,000 years BP). The deposit has been

interpreted as representing an intertidal to shallow inner shelf environment in its upper parts, and glaciomarine environment in its lower parts. In addition to the deposit predating the earliest hominin activity in Scotland, such environments are not conducive to human activity. Although intertidal areas may have been exploited by human communities in the past, marine shelf environments of the lower deposits would have been uninhabitable. Therefore, the archaeological potential of this unit is therefore low.

5.3.1.7 The Marr Bank Formation was formed during the Devensian Glaciation (122,000 to 10,000 BP). A BGS core (BGS BH74/07) taken 5km to the north of the Morven North Boundary gave a date of 17,734 +/- 480 BP (minimum age) for the deposit. During this period, the ice edge extended from the coast of Scotland out into the North Sea; while the full extent of the Scottish Ice Sheet (SIS) is a subject of debate, current thought is that the SIS extended to an interface point with Scandinavian ice sheets. It overlays the Coal Pit Formation and earlier Quaternary deposits and covers the entire area within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. It is a sheet-like deposit, between 10m and 30m thick in most places. The Marr Bank Formation is generally interpreted by the BGS as a glaciomarine deposit laid down in a shallow water, high boreal to arctic environment. However, the seismic character indicates that the formation within the Morven North and South Marine Archaeology Study Areas is characterised by outwash plains, with a basal till in some areas. Sea levels were lower during the Devensian including during the Dimlington Stadial (29,000 to 14,700 BP) when they were up to 120m lower than the Present Day (Smith *et al.*, 2017). Sea Level however rose rapidly following deglaciation and, in Scotland, were higher than the Present Day (by 15,000 to 13,500 BP). Lower parts of the deposit may represent a till, deposited during a period of ice advance or oscillation. Glacial outwash and till deposits are inhospitable. Furthermore, the UK more broadly is thought to have been uninhabited during the Dimlington Stadial (ca 22,000 to 13,000 BP). The archaeological potential for this unit is therefore low.

5.3.1.8 The Forth Formation overlies the Marr Bank Formation. The deposit is characterised by multi-phased channel infill sediments which extend across the Morven North and South Marine Archaeology Study Areas . The channels are generally up to 10m in depth, though occasionally up to 60m deep, and up to 3km wide. In the Morven North Boundary there are also braided channel systems evident within this deposit. The formation originated in the late glacial and Holocene periods and has characteristics of marine, glaciomarine, fluviomarine and estuarine sediments. It is possible that the channels may have been formed in an outwash plain setting as has been discussed for the Marr Bank Formation, later filled by sediments of the Forth Formation (MSDS Marine, 2023). It is inferred from the current seismic data that the Forth Formation channels were formed by glacial meltwater and the archaeological potential of this unit is therefore low.

5.4 Sea Level Data

5.4.1.1 Having considered the Quaternary depositional sequence from within the Morven North and South Marine Archaeology Study Areas in Section 5.3, sea levels are demonstrably relevant to understanding the potential depositional environments, particularly for the Marr Bank and Forth Formations.

5.4.1.2 The Forth Formation is separated into four members, two of which are likely to be those deposits present within the Morven North and South Marine Archaeology Study Areas . The Forth Formation is thought to have been deposited during the Lateglacial Interstadial, a relatively warm period that occurred towards the end of the last glaciation in Britain (13,000 to 11,000 BP). Although sea levels were likely regressing on the east coast during this period, deposits within the inner estuaries in eastern Scotland provide evidence of raised marine deposits during this period (Holloway *et al.*, 2002; Peacock, 1999; Stoker *et al.*, 2008). This demonstrates the likelihood that the Morven North and South Marine Archaeology Study Areas experienced marine to glaciomarine conditions and was therefore uninhabitable during this period.

5.4.1.3 Colder conditions were re-established during the Loch Lomond Stadial (ca. 11,000 to10,000 BP), creating a now-submerged shoreline, termed the Main Lateglacial Shoreline (Stoker *et al.*, 2008). Deposition of the St Andrews Bay Member of the Forth Formation is thought to have begun during

this period and continued throughout the Holocene (Stoker *et al.*, 2008). The deposit represents shallow marine or estuarine environments; the estuarine elements indicate broad archaeological and palaeoenvironmental potential associated with the Forth Formation that spans the late Upper Palaeolithic and Mesolithic.

5.4.1.4 To the southeast of North Berwick (approximately 124km to the south of the Morven South Boundary), the Main Lateglacial Shoreline was encountered at a depth of between -27m and -18m Ordnance Datum (OD). The Morven North and South Marine Archaeology Study Areas lie at depths greater than 62.08m Lowest Astronomical Tide (LAT) and so are likely to have been submerged during the St Andrews Bay depositional period and therefore suggests very limited potential for archaeological remains. Additionally, the glacial conditions of the region during this period would have been unfavourable for human habitation.

5.4.1.5 The Morven North and South Marine Archaeology Study Areas fluctuated between glacial and marine conditions during the Devensian and Holocene periods. While the area may have seen periods of sub-aerial exposure (e.g. during active phases as a glacial outwash plain), such environments are not associated with human activity; conversely, any archaeological material may have been at least reworked, if not obliterated during periods of ice sheet expansion. Therefore, there is very low potential for submerged prehistoric archaeology to be encountered in the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

5.5 Stage 1 Geoarchaeological Investigation

5.5.1.1 In 2023, Fugro Marine Limited were commissioned to undertake geotechnical site investigations within the Morven Site Archaeology Study Area, consisting of 23 deep boreholes collected from 13 locations within both the Morven North Boundary and the Morven South Boundary (MSDS, 2024).

5.5.1.2 A complete marine geoarchaeological investigation should consist of four stages, following the guidance provided by Gribble and Leather (2011). Stage 1 evaluation was completed in 2023 by Coastal and Offshore Research Services (COARS) on behalf of MSDS Marine (2024). Stage 1 evaluation consists of a geoarchaeological review of core logs comprising a desk-based assessment of geotechnical core logs and photographs.

5.5.1.3 The core descriptions, available photographs and the evolving ground model interpretation were assessed in relation to their geoarchaeological potential. Some material may have been suitable for scientific dating of several Pleistocene Formations (some of which are currently very poorly dated) and some material may have been suitable for other geoarchaeological and palaeoenvironmental assessment.

5.5.1.4 Following the results of the stage one geoarchaeological assessment five boreholes were recommended for Stage 2. These would aid in providing further insight into the Pleistocene glaciation and marine transgression within this area of the North Sea. The recommended boreholes were:

- MRV-BH23-76A: 18.15m to 18.80m (BASE OF MARR BANK FORMATION);
- MRV-BH23-Q-6: 23.00m to 23.95m (Unit LB-2 of LING BANK FORMATION);
- MRV-BH23-63alt: 28.90m to 30.40m (Unit LB-2 of LING BANK FORMATION);
- MRV-BH23-6A: 43.00m to 44.50m (Unit ABG-2 of ABERDEEN GROUND FORMATION);
- MRV-BH23-194A: 43.25m to 45.65m (Possibly Unit ABG-undiff of ABERDEEN GROUND FORMATION).

5.6 Stage 2 Geoarchaeological Investigation

5.6.1.1 Stage 2 of a geoarchaeological investigation comprises geoarchaeological recording of the cores identified in Stage 1 in order to fully assess their archaeological potential (Gribble and Leather, 2011). This was undertaken on the five recommended boreholes (Section 5.5) (MSDS Marine, 2025).

5.6.1.2 The Stage 2 geoarchaeological recording revealed a series of shallow marine and marine deposits likely associated with arctic / glacial conditions. The recorded deposits showed good correlations with the seismostratigraphy developed for the ground model and correlation with existent studies and the Pleistocene stratigraphy of this area of the central North Sea (Gatliff *et al.,* 1994). For MRV-BH23-194a, the recorded sediments inferred the presence of a basal unit of the upper Aberdeen Formation that may be present beneath the Ling Bank Formation and above the Smith Bank Formation that currently is not recorded at this location within the Stage 2 ground model.

5.6.1.3 Shell preservation was poor in all samples assessed, with no material that might be suitable for Amino Acid Racemisation dating. Where laminated silts and fine sands were present, these were associated with older deposits from the Aberdeen Ground or Ling Bank Formation, implying a probable late Early to early Middle Pleistocene age. Such deposits are likely to be at the limit of Luminescence dating using Optically Stimulated Luminescence and post-infrared infrared stimulated luminescence, with the depositional environment (shallow marine to marine) meaning that bleaching of quartz or feldspars may only have been partial, resulting in incomplete zeroing and therefore inaccurate dating.

5.6.1.4 The likely inability to assign exact ages to these deposits using scientific dating techniques (Grant and Marshall 2025) means that the geoarchaeological potential of these deposits is diminished. The assessed deposits are also unlikely to make any contributions to improve our understanding of glacial dynamics during the Middle Pleistocene, though the presence of a mixed lithology gravel in both MRV-BH23-76a (lower Marr Bank Formation) and MRV-BH23-194a (upper Aberdeen Ground Formation) may infer the presence of drop stones and a proglacial environment.

5.6.1.5 Any palaeoenvironmental assessment of these deposits would likely yield evidence for arctic marine conditions, with no evidence for terrestrial or semi-terrestrial submerged palaeol and surfaces.

5.6.1.6 The samples from the 2023 boreholes subject to geoarchaeological recording were shown to be unsuitable for scientific dating that may help to secure the chronology of these Pleistocene Formations. The depositional environment implied by each of these samples is likely to be shallow marine to marine, with some associated with a proglacial environment. These samples were therefore deemed to have low geoarchaeological potential. No recommendations were made for further investigation (Stage 3 geoarchaeological assessment) of the 2023 borehole samples.

5.7 Submerged Prehistoric Archaeology Potential

5.7.1.1 This section characterises the potential for submerged prehistoric archaeology to be present within the Morven North and South Marine Archaeology Study Areas such as chance finds, deposits containing archaeological material (e.g. flint tools), or submerged landscapes. This section is informed by the site specific geophysical and geotechnical data and desk-based review.

5.7.1.2 The prehistoric period of the UK covers from the earliest hominin occupation (potentially as early as circa 970,000 BP) to the end of the Iron Age and the Roman invasion of Britain in Anno Domini (AD) 43. The coastline of the UK underwent dramatic changes during this time, and areas of the seabed that are now fully submerged would have been exposed allowing the opportunity for hominins to exploit and inhabit the landscape. Glacial events including the Anglian (480,000 to 430,000 BP), the Wolstonian (350,000 to 132,000 BP) and the Devensian (122,000 to 10,000 BP) (see Table 5.1) and intervening periods of marine transgression have affected the coastline of the UK and therefore the archaeological potential of these areas.

5.7.1.3 Submerged prehistoric archaeological potential is determined with reference to evidence for human activity in the UK during each period, and the contemporary environment within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. Depositional environment and post-depositional factors are also key to understanding potential, and as such geological deposits present within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area form an important consideration in understanding

archaeological, palaeoenvironmental and palaeol and scape potential. Geological periods referred to in this section are defined by the date ranges presented in Table 5.2.

5.7.2 Lower Palaeolithic to Late Upper Palaeolithic (circa 950,000 to 18,000 BP)

5.7.2.1 Deposits representing varied depositional environments in the Early to Middle Pleistocene are present within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, indicating that the area may have had landscapes inhabitable by humans.

5.7.2.2 The very earliest hominin occupations of Britain are represented by the sites of Happisburgh 3 (949,000 to 935,000 BP or 866,000 to 815,000 BP) and Pakefield (790,000 to 761,000 BP) on the coast of East Anglia (Historic England, 2023). Both sites are represented by small numbers of lithic technology artefacts. Hominins appear to have been absent from Britain in the subsequent Anglian Glacial stage (478,000 to 423,000 BP). This and subsequent glaciation in the Wolstonian (380,000 to 130,000 BP) and Devensian (110,000 to 12,000 BP) glaciation likely obliterated these landscapes and destroyed or reworked any archaeological material that may have been left. Stage 1 geoarchaeological assessment indicated the possibility of terrestrial deposition within the Fisher and Ling Bank Formations within one core, based on the common presence of pollen and absence of marine microfossils. Later deposits at the base of the Marr Bank Formation from another core may signal a terrestrial proglacial environment, with sediments possibly deposited in a braided/anastomosing riverbed or glacial outwash plain. Deposits above these in the Forth and Marr Bank Formations are associated with marine or glaciomarine depositional environments indicating final submergence at this time and are therefore unlikely to relate to any submerged palaeolandscapes features. Additionally, there is evidence of raised marine deposits within the inner estuaries in eastern Scotland. These deposits indicate that these areas were submerged by the Windermere Interstadial (circa 15,000 to 13,000 BP) (Peacock, 1999; Holloway *et al.,* 2002; Stoker *et al.,* 2008;). The Morven North and South Marine Archaeology Study Areas are characterised by glacial deposits and ice sheet deformation during the Devensian, and therefore was inhospitable for humans, meaning that there is little to no potential for the survival of Lower to Late Upper Palaeolithic material.

5.7.3 Last Glacial Maximum (LGM) to Mesolithic (circa 18,000 to 10,000 BP)

5.7.3.1 The Morven North and South Marine Archaeology Study Areas may have quickly been submerged following the LGM. Deposits within the inner estuaries in eastern Scotland provide evidence of raised marine deposits and were thus submerged by the Windermere Interstadial (circa 15,000 to 13,000 BP) (Holloway *et al.*, 2002, Peacock, 1999, Stoker *et al.*, 2008). The discovery of a single flint scraper in a borehole core off Viking Bank (150km northeast of Lerwick, Shetland) is unique not just for its depth, but also for its distance from the shore. The flint could be as old as 11,000 BP (Long *et al.*, 1986). If not secondarily derived, the find suggests human occupation of the Scottish shelf in pre-Holocene times, or a stone tool lost during a fishing expedition (Finlayson and Edwards, 2003, Flemming, 2003).

5.7.3.2 The North Berwick Lateglacial shoreline was established by colder conditions during the Loch Lomond Stadial (circa 13,000 to 12,000 BP) and the marine transgression in this part of the northwest North Sea would have been complete by circa 8,000 BP, or perhaps even earlier (Sturt *et al.*, 2013, UK Government, 2022). The seabed within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, however, is 60m deeper than the location of the Lateglacial palaeoshoreline. The relative positions of the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area and the palaeoshoreline, and the stages of marine transgression indicate that the Morven North and South Marine Archaeology Study Areas have remained submerged from shortly after the LGM to the Present Day. Due to the relatively rapid submergence after the LGM, there is very low potential for evidence of human occupation or activity.

6 Maritime and Aviation Archaeology

6.1 Maritime Archaeology Potential

6.1.1 Introduction

6.1.1.1 The maritime archaeology of the UK is a product of a complex interplay of constantly evolving coastal and marine activities, sea use, and international links from the late Upper Palaeolithic to the Present Day. This section reviews the potential presence of maritime and aviation archaeology (including military remains) within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.1.2 Prior to the advent of the Lloyds of London list of shipping casualties in 1751, there was no official record of ship losses (Wessex Archaeology, 2007). Presently, the UKHO maintains a register of wreck locations; the Wrecks Database contains ca. 70,000 records, of which approximately 20,000 are named vessels (UK Government, 2022). The number of known sites for Scottish waters stands at over 20,000 (Wessex Archaeology, 2007). Although shipwrecks are a standalone category of site, they should be seen as integral parts of the wider periods and historical processes with which they were associated. Records of known wreck sites and losses in UK waters are biased towards the Modern Period, as a function of increased traffic and increased reporting due to the introduction of marine insurance, as well as a higher proportion of metal components in ships that allow for greater survival and detection (Burton *et al.*, 2007). Therefore, the precise locations of most wrecks which pre-date the Modern Period are not known. Work has been done to try to correct these biases through the collation of information relating to trade routes and patterns of shipping that focus on the Medieval period (Auer, 2004).

6.1.1.3 The maritime archaeological record for the Morven North and South Marine Archaeology Study Areas has been considered chronologically for the following broad temporal phases as described in Table 6.1. However, due to the rare survival of maritime archaeological evidence during the Palaeolithic and Mesolithic, these periods have been considered under the umbrella term 'Early Prehistoric.'

Table 6.1: Archaeological periods and associated date ranges (ScARF 2012)

Period	Date range
Palaeolithic	c. 700,000 to 12000 BC
Mesolithic	12000 to 4100 BC
Neolithic	4100 to 2500 BC
Chalcolithic and Bronze Age	2500 to 800 BC
Iron Age	800 BC to AD 400
Roman presence	AD 77 to 211
Medieval	AD 400 to 1500
Modern	AD 1500 to Present Day

6.1.2 Early Prehistory (Palaeolithic and Mesolithic)

6.1.2.1 There is no evidence of maritime archaeological remains in the UK that pre-date the start of the Holocene. However, global examples suggest that watercraft were in use by the Middle Palaeolithic

period, such as the suggestion that the colonisation of Australia by approximately 40,000 BC involved island hopping (Lourandos, 1997).

6.1.2.2 During the late Upper Palaeolithic (40,000 to approximately 12,000 BC), it is possible that simple watercraft such as logboats or rafts were used for coastal journeys and fishing around Britain (Wessex Archaeology, 2007). A late Upper Palaeolithic blade (ca. 12,000 BC) is known from the floodplain at Ravenscraig, Inverugie and is recorded within the Canmore dataset but, as an isolated find, it is unclear to what extent communities were accessing riverine and marine resources in this part of Scotland at this time.

6.1.2.3 The existence of watercraft during the Mesolithic is inferred by the presence of Mesolithic archaeological material on insular land masses such as Ireland, for example. Towards the end of the Mesolithic, at about 5,000 BC the land bridge between the UK and Europe was severed for the last time (Wessex Archaeology, 2007). Contact across the new seas intensified the need for some form of vessel; multiple hide boats or basket-boats are thought to have been capable of sea voyages at this time (McGrail, 1987; Parry and McGrail, 1991; Dunkley, 2016). Simple watercraft such as logboats and multiple hide boats are cross-period and examples have been recorded from the Bronze Age to the Medieval, thus scientific dating is necessary to determine age rather than typological categorisation (ScARF, 2012f).

6.1.2.4 The first archaeological evidence for the use of watercraft in the UK is represented by the fragments of a wooden oar, dated to the Mesolithic, found at Star Carr, in Yorkshire (England) (Van de Noort, 2011, Wessex Archaeology, 2007). A late Mesolithic or early Neolithic burial in a partially burnt dugout canoe was found in St Albans, Hertfordshire in 1988 (Dunkley, 2016). Middens on Oronsay illustrate a seasonal but sustained reliance on limpet Patella vulgata and saithe Pollachius virens from the foreshore. Archaeological experimentation in western Scotland have demonstrated that marine fish could be hooked and trapped from the coast rather than harvested by boat (Groom *et al.*, 2019).

6.1.2.5 Section 5.7 illustrated the palaeolandscape potential for the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. It is possible that the glacial and periglacial nature of the region meant that human occupation of this part of Scotland was rare, infrequent, or relatively late. The submergence of the Morven North and South Marine Archaeology Study Areas and insular nature of Early Prehistoric archaeology suggests that the potential is very low.

6.1.3 Neolithic, Chalcolithic, and Bronze Age

6.1.3.1 No evidence of Neolithic, Chalcolithic or Bronze Age maritime activity has been recorded within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.3.2 Direct archaeological evidence for the exploitation of the marine environment and maritime activity in the Neolithic period is rare and limited to logboat finds outside of Scotland (Bradley *et al.*, 1997; Johnstone, 1980; Wilkinson and Murphy, 1995). Shell middens in the UK containing the faunal remains of deep-sea fish are also known from this period, suggesting marine exploitation of those resources (Ellmers, 1996).

6.1.3.3 The Bronze Age was a period of technological innovation and of expansion of trade and exchange networks. The discovery of porcellanite stone axes from Ireland on the Western Isles of Scotland and the UK mainland implies transport of these objects by sea (Breen and Forsythe, 2004; McGrail, 1978). This was facilitated by the introduction of new forms of boats for both marine and coastal/riverine transport. The evidence for Bronze Age settlement, funerary and agricultural activity throughout the vast majority of mainland Scotland as well as on the islands implies that widespread movement of people had to have been occurring (ScARF, 2012).

6.1.3.4 Evidence for Bronze Age maritime activity has been recorded throughout the UK in the discovery of several inland watercraft and sea-faring vessels. The Carpow logboat from the Tay Estuary is an

inshore example of a common, cross-period vessel type (Strachan, 2010). An earlier oak log boat fragment from Scotland survives from Catherinefield, Dumfries and Galloway, which dates to circa 2,000 BC (Mowat, 1996). In addition to boat fragments there are also several known examples of potentially prehistoric paddles and oars, although none of the Scottish examples appear to have been directly dated (Strachan, 2010).

6.1.3.5 Examples of Bronze Age sea-faring craft such as five sewn-plank boats discovered at Ferriby in North Yorkshire (Chapman and Chapman, 2005, Van de Noort, 2011), the Brigg 'raft', also on the Humber (Yorkshire) (McGrail, 1994), Caldicot Castle Lake, Gwent (Wales) (Parry and McGrail, 1991) and the remains of a boat at Dover, Kent (England) (Clark, 2004) have been discovered elsewhere in the UK. This suggests that boats of this time were being utilised in UK waters and the lack of evidence in Scotland may be down to a lack of archaeological investigation in Scottish waters.

6.1.3.6 However, due to the organic construction materials that would have been used for these craft, the potential for the survival of Bronze Age archaeological material within the Morven North and South Marine Archaeology Study Areas is very low.

6.1.4 Iron Age and the Roman Presence in Scotland

6.1.4.1 No evidence of Iron Age or Roman maritime activity has been recorded in the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.4.2 Broad geographical and chronological narratives have emphasised the importance of the Atlantic Ocean as a routeway and for communication in the pre-Roman Iron Age (Cunliffe, 2001). Remains certainly from Iron Age vessels are yet known from Scotland, but crannogs dwellings constructed upon artificial islands are associated with small watercraft. In 1981, for example, a 1.35m oak paddle was excavated at Oakbank Crannog on Loch Tay (Dixon, 1981). Though crannogs and the earlier vessel examples are from inland lacustrine sites, interaction with the sea can be inferred from other types of archaeological evidence from the Northern Isles of Orkney and Shetland.

6.1.4.3 A number of whale bone artefacts have been recovered from Iron Age sites in Scotland (such as Foshigarry, North Uist (Finlay, 1991)), Orkney (Nicholson and Davies, 2007) and Shetland (Cussans and Bond, 2010). It is, however, unclear whether these were derived from primary whale hunting from ocean-faring vessels, shore drives, or opportunistic recovery from beached animals (Baldwin, 2008; MacGregor, 1974). Exploitation of other marine resources interpreted from fishbones deposited within middens indicate a concentration of inshore or coastal fishing. This changes towards the end of the Iron Age and turn of the Medieval, where excavated fish bones indicate an increase in offshore fishing practices (Cerón-Carrasco, 1995; Cerón-Carrasco, 1998a; Cerón-Carrasco, 1998b; Cerón-Carrasco, 2005; Colley, 1983; Finlay, 1996; Seller, 1989; Sharples, 2005).

6.1.4.4 The Roman period in Scotland is limited in both duration and extent when compared to the rest of the UK. Though Roman remains are known from beyond the Antonine Wall, these are temporary and the level of interaction by sea between the established frontier and the maritime areas of northeast Scotland are not well understood.

6.1.4.5 While the Roman presence in Scotland was short lived and patchy, the Roman invasion force of AD 43 was necessarily brought to Britain by ship, and the maintenance of the province of Britannia within the empire through the extraction of agricultural surplus, mineral wealth, and the creation of diplomatic ties was in large part a maritime endeavour.

6.1.4.6 In the north of Scotland, the Pictish period straddles the traditional periodic divide of Iron Age and Early Medieval periods elsewhere in the UK. Pictish culture is heavily demonstrated in the archaeological record of northern and eastern northern Scotland between the late third and early ninth centuries AD (Mann, 1974; Hunter, 2007).

6.1.4.7 Documentary sources attest that there may have been a maritime element to Pictish society. The annals of Tigernach recorded that in AD 729, 150 Pictish ships were wrecked upon 'Ros-Cuissine', possibly Troup Head, Aberdeenshire (Anderson, 1922; Cessford, 2004). Examples of sea-faring is

present in Pictish Art, surviving on carved stones. The most well-known depiction of a boat is on a stone found at Cossans, Angus. Close to the base on the rear is a double-ended, mastless, plank-built vessel with a high prow and stern, a rudder, and possibly oars (Ritchie, 1989; Laing and Laing, 1993; Foster, 1996; Carver, 1999).

6.1.4.8 Maritime technology from this period includes a substantial, sea-going vessel (known as the 'Romano-Celtic' type) which was developed in northwest Europe during the later Iron Age (Marsden, 1994). Examples include the Blackfriars Boat, from London (Marsden, 1994; Dunkley, 2016) and the Barlands Farm boat, from the Severn Estuary in southeast Wales (Lawer and Nayling, 1993; Nayling and McGrail, 2004). The 'County Hall' ship is a particular example of a boat constructed using typically Mediterranean techniques, but dendrochronological evidence demonstrated that it was constructed in Britain during the Roman period (Marsden, 1994). Roman period wrecks from Scotland are, however, as yet unknown.

6.1.4.9 Together with the evidence for substantial military movement, diplomatic engagements, and commercial trade this suggests that Iron Age and Roman maritime traffic may have passed through the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. It is also likely that many more vessels of this period were lost than the available archaeological evidence suggests. The use of organic construction materials, however, means that the potential for the survival of maritime archaeology material from this period is low.

6.1.5 Medieval

6.1.5.1 No evidence of early Medieval or Medieval maritime activity has been recorded within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, but regional evidence suggests a lively period of engagement with the sea.

6.1.5.2 Maritime activity in the North Sea and in the vicinity increased during the early Medieval period. This was due in part, to Viking raiding, the intensification of regional trade and migration, and the growth of several ports on the east coast of the UK (Kelly, 1992; Hutchinson, 1997; Friel, 2003; Middleton, 2005).

6.1.5.3 Archaeological evidence for vessels from this period is rare. A small number of early Medieval boats are known from the inland waterways of Perth and Kinross, such as the Errol 2 logboat, one of two surviving examples from a concentration recorded from the Tay Estuary (Mowat, 1996; Strachan, 2010). The boat has yielded radiocarbon dates of AD 548 and AD 599 (Strachan, 2010). As discussed for the previous archaeological periods, logboats and skin-and-hide vessels were well suited to rivers and estuaries and the evolution of plank-built, sail carrying ships over the early Medieval period enabled increased seaborne travel (Crumlin-Pedersen, 2010).

6.1.5.4 The Viking presence and influence along the east coast of Scotland would have demanded the control of rivers and estuaries which secured access to trade routes and passage across the North Sea. Evidence of Viking influence in Scotland is reflected in place names and also the location of Viking hoards along the Forth and Tay estuaries (Owen, 1999). The range of geographical contact and the richness of procurable objects is demonstrated by the Galloway Hoard, from southwest Scotland. The hoard included objects reflecting cultural affinities as far afield as Central Asia, implying long-distance maritime communication networks (Goldberg, 2023).

6.1.5.5 The sea was not only a present feature of the Norse community's lived experience, but maritime identity is also reflected in the mortuary Archaeology of Scotland, attested by 'boat graves' from pagan Norse cemeteries such as the Scar boat burial (Owen and Dalland, 1999) and two boat graves from Westness (Kaland, 1993; Sellevold, 1999).

6.1.5.6 The level of shipping passing through the Morven North and South Marine Archaeology Study Areas during the earlier Medieval period is high enough to suggest that there is a moderate to good potential for archaeological remains to exist within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.5.7 The developing trading networks across Europe achieved a degree of formalisation in the latter centuries of the Medieval period. Lübeck, modern Germany, became the capital of the Hanseatic League, a confederation of port cities ultimately encompassing nearly 200 settlements across seven modern day countries across the Baltic and North Seas, from Sweden and Russia in the north and east, to the Netherlands in the southwest. The Hanseatic League and others like it greatly contributed to the maritime transportation of goods across the North Sea (Hutchinson, 1997; Woodman, 1997).

6.1.5.8 Maritime technology advanced rapidly during this period to accommodate larger cargoes. Relatively few physical remains have been found from Medieval shipping anywhere in Scotland, but boat fragments from a probably substantial sea-faring ship were produced from excavations in Perth, including frames, lengths of clinker planking, an oarport cover and tholes (pins on which oars pivot while rowing) (Martin and Bogdan, 2012; ScARF, 2012c).

6.1.5.9 Due to the inferred increase in shipping during this period and the potentially increased visibility of possible wrecks, there is moderate to good potential for archaeological remains to exist within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.6 Modern

6.1.6.1 The growth of commercial maritime trade that began during the later Medieval period continued and expanded in the Modern Period. Alongside overseas ventures which were expanding rapidly, inland and local coasting trade continued to be important in the region. During this period, the number of vessels crossing the North Sea increased significantly, particularly during the Medieval period and the merger of the Royal Scots Navy with the Kingdom of England's Royal Navy after the Acts of Union in 1707 (Murdoch, 2010). The Morven North and South Marine Archaeology Study Areas were therefore an area of concentrated commercial and military maritime activity.

6.1.6.2 From the 18th century onwards, records were kept of ship losses, with records becoming more detailed from the 19th century. Rapid industrialisation in the 18th and 19th centuries revolutionised shipbuilding, introducing technological innovation that precipitated fundamental changes in maritime technology. By the end of the 19th century with the advent of the steam engine, the introduction of iron hulls and the development of the screw propeller had wrought major transformations on ships and shipping (Lambert, 2001). Although steam and steel came to dominate shipping during the 19th century, there remained a strong local core of maritime activity around much of the coast of the UK which retained the more traditional, often wooden vessel types. For example, at the turn of the 20th century, much of the fishing in the North Sea was still conducted by fleets of sailing smacks and there was a rise in fishing settlements along the east coast during the 18th and 19th centuries.

6.1.6.3 The potential for the discovery of unknown maritime archaeology from the Modern Period within the Morven North and South Marine Archaeology Study Areas is high.

6.1.7 Modern Military Remains

6.1.7.1 The maritime archaeological record of the 20th century until the Present Day is dominated by remains associated with the two World Wars. Warships, submarines and U-boats along with cargo vessels, personnel transport vessels and aircraft, comprise the known vessel losses during this period. The majority of known shipwrecks in the North Sea basin within which the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area are located are the results of military activity. It is thought that initial losses in World War One were due to the blackouts along the coast which led to wrecks along the shoreline and then the subsequent U-boat offensive which sunk a number of Royal Navy submarines (and U-boats) in the Outer Tay and Forth and North Sea basin (Ferguson, 1991). During World War Two, approximately 50 merchant vessels were sunk off the northeast coast, along with military vessels (Headland Archaeology, 2011). The potential for the discovery of unknown maritime archaeology from both World Wars is high.

6.1.8 Recorded Losses

6.1.8.1 Data for recorded shipping losses were obtained as appropriate from the NRHE held by HES (Canmore). The Canmore dataset provides a general picture of maritime casualties in the last 150 to 200 years. However, it is worth noting that there is potential for further shipping losses to have happened within the Morven North and South Marine Archaeology Study Areas in addition to the ones recorded in this dataset.

6.1.8.2 Recorded losses represent maritime and aviation losses that are known to have occurred in the vicinity but to which no specific location can be attributed. Recorded losses are often grouped with reference to a geographic, hydrographic or other point of reference, making the positional data of these records unreliable. However, they do provide information on the historical marine traffic of the general region and therefore the archaeological potential.

6.1.8.3 There are three recorded losses from the UKHO and NRHE databases located within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area; these represent non-wartime shipping casualties from the 19th and 20th centuries. Competitor was a wooden schooner that was abandoned east of Montrose on 28 November 1852 with a cargo of wheat. Bosphorous was an iron paddle steam trawler that foundered southeast of Girdle Ness on 05 May 1904. The third recorded loss is of a derelict that was seen drifting on 19 July 1920 north east of the Firth of Forth. Details of recorded losses are given in Appendix A.

6.1.9 Navigation Hazards

6.1.9.1 The majority of known and recorded wreck sites lie relatively close to the coast. The proximity of many historical sailing routes to the coast and the natural hazards of northeast Scotland can be expected to have been a determining factor in many maritime casualties in the past (Wessex Archaeology, 2008). Information regarding the whereabouts of wrecks may also be influenced by selective reporting, where knowledge of their whereabouts is advantageous to seafarers, such as around sandbanks and shipping channels (Burton *et al.*, 2007). It may be that there are many undiscovered wreck sites in areas which do not meet these criteria.

6.1.10 Aviation Archaeology Potential

6.1.10.1 Thousands of military and civilian aircraft casualties have occurred in UK waters since the advent of powered flight in the early 20th century. The bulk of these are casualties of World War Two and most are concentrated off the south and southeast coasts of England. However, there is clear potential for aircraft casualties the northern North Sea (Wessex Archaeology, 2008).

6.1.10.2 While the aviation archaeology record is potentially very large, the ephemeral nature of aircraft wrecks ensures that many sites remain unknown and unrecorded. In addition, despite the potential extensive losses at sea, records are seldom tied to an accurate position. These difficulties complicate any assessment of the likely presence of aircraft wreckage on any particular area of seabed.

6.1.10.3 Since World War Two, despite the volume of both military and civilian air traffic, there have been few aviation losses off the east coast of Scotland and none in the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.1.10.4 The full potential for post-war aircraft remains to be discovered within the Morven North and Morven South Marine Archaeology Study Areas, however it is considered to be low. Aircraft lost while on military service are automatically protected under the Protection of Military Remains Act 1986. Civilian aircraft wrecks are not subject to protection under the terms of the Protection of Military Remains Act 1986.

6.1.11 Overview of Marine Archaeology Potential

6.1.11.1 An overview of the marine archaeological potential within the Morven North and South Marine Archaeology Study Areas is presented in Table 6.2.

Table 6.2: Summary of archaeological potential by receptor type and time period

Receptor	Potential	Value
Submerged prehistoric archaeology	Low	Local/Regional/National
Paleoenvironmental evidence	Low	National
Early prehistoric maritime evidence	Low	National
Bronze Age maritime evidence	Low	National
Iron Age and Roman maritime evidence	Low to Moderate	National
Medieval maritime evidence	Moderate	Regional/National
Modern maritime evidence	High	Local/Regional/National
Modern military remains	High	Local/Regional/National

6.2 Designated and Known Wrecks

6.2.1.1 No designated sites have been identified within the datasets for the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.2.2 Desktop Data

6.2.2.1 The wrecks and obstructions dataset held by the UKHO and Canmore held by HES were consulted for relevant marine archaeology records. Within the UKHO data there are eight entries that relate to wreck sites within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. Of these, six are considered 'live' by the UKHO. A live UKHO record is one where material has been positively identified on the seabed at some time for example though geophysical survey data or diver reports and is therefore considered to exist at this location.

6.2.2.2 Of the six live entries, four have been located by the site specific geophysical survey and are discussed fully in Section 6.3.2. Of these six records, five are located in the Morven North Marine Archaeology Study Area and one in the Morven South Marine Archaeology Study Area.

Morven North Desktop Data

6.2.2.3 Four unknown wrecks within the UKHO data have been located by the geophysical data assessment. The details of these anomalies are considered in full in Section 6.3 below, with the locations shown in Figure 6.1.

6.2.2.4 Unknown wreck UKHO 3170 is further than 100m outside of the Morven North Boundary which is out of the range of the geophysical survey data. While it is possible that those wrecks occur at those positions, there is no pathway for direct impact. No further information on the unknown wreck (UKHO 3170) can be obtained from the datasets.

6.2.2.5 The remaining two UKHO records - Anton (UKHO ID 3169, sunk 1917) and an unknown vessel (UKHO 3163) - are listed as 'dead', indicating that no remains of these wrecks are currently visible on the seabed. The geophysical survey data has not established any material at these locations although there remains the possibility that these sites have become buried or dispersed over time and that archaeological material may be present on the seabed. Full details of these sites are presented in Appendix A and the recorded locations are shown in Figure 6.1.

Morven South Desktop Data

6.2.2.6 Only one of the six recorded sites is located in the Morven South Marine Archaeology Study Area; The Ailsa was a steamship previously named Twilight was captured by a German submarine in 1915 and scuttled. The actual location of the scuttling of Ailsa is uncertain, but there is a high potential for wreck remains or debris in the vicinity. The record for Ailsa is more than 100m outside the Morven South Boundary and therefore not within the Marine Archaeology survey area.

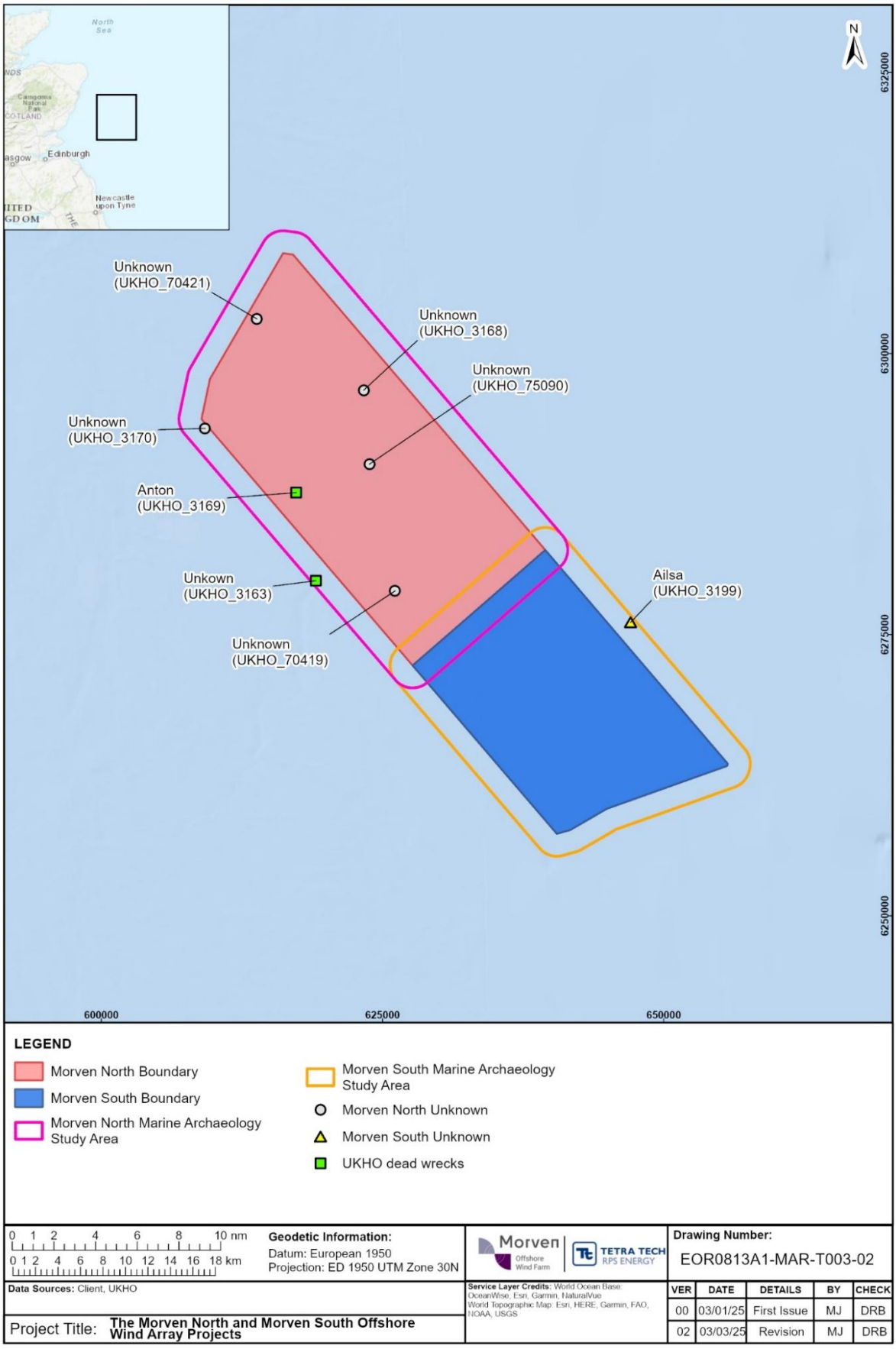

Figure 6.1: Desktop data identified within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

6.3 Geophysical Seabed Features Assessment

6.3.1.1 A total of 154 anomalies of potential archaeological interest were identified within the Marine Archaeology survey area during the archaeological assessment of the geophysical data. Of these, 149 are within the Morven North Boundary and Morven South Boundary and the remaining five anomalies lie outside of the Morven North Boundary and Morven South Boundary but within the extents of the geophysical survey area. Of the 154 anomalies, five have been classified as high potential anomalies (Section 6.3.2), 12 as medium potential (Section 6.3.3), and 137 as low potential anomalies (Section 6.3.4). The distribution of these can be seen in Figure 6.2. Full details of the anomalies of archaeological interest identified during the geophysical survey are presented in Appendix A.

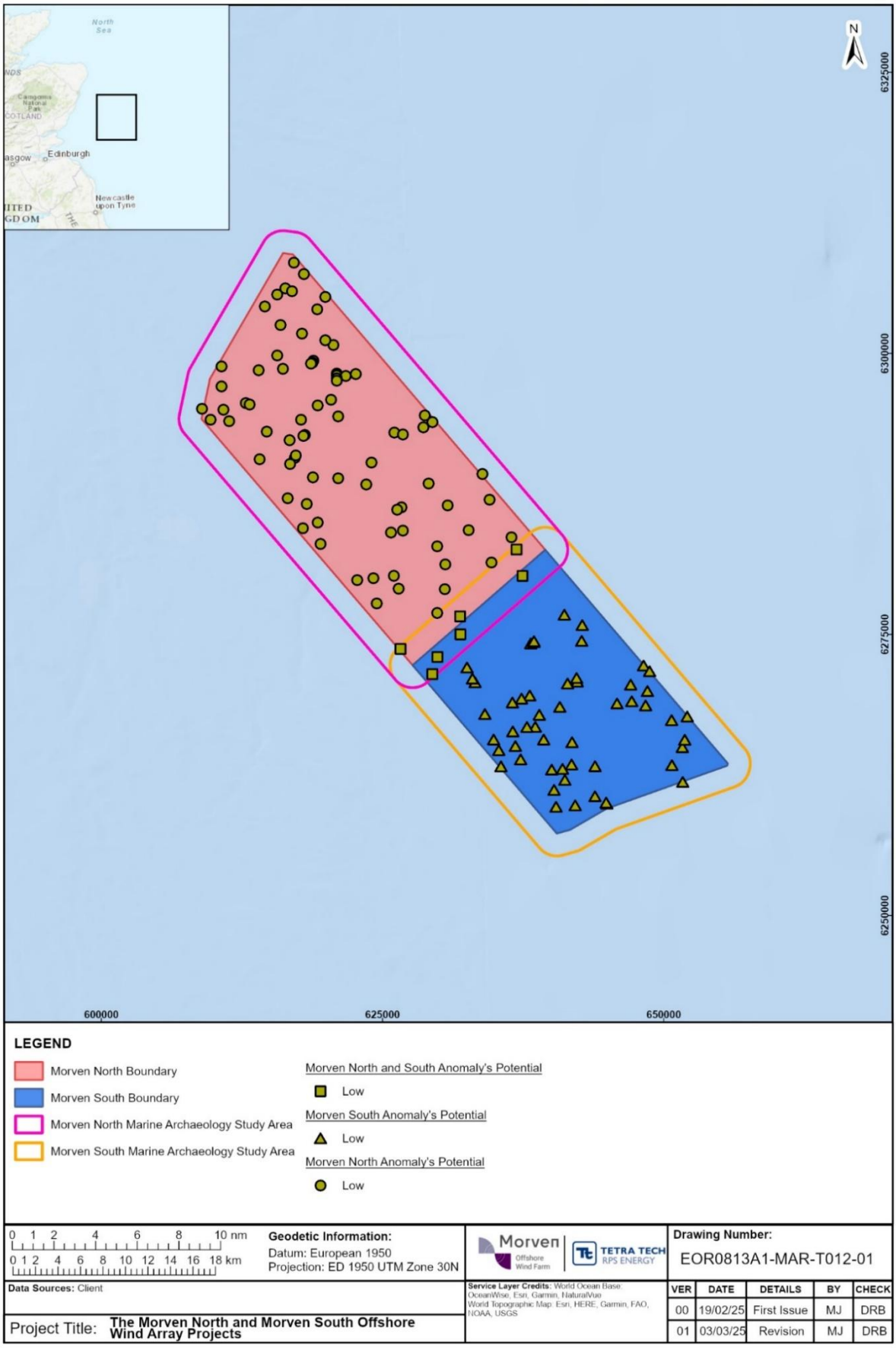

Figure 6.2: Low potential Geophysical anomalies within the Marine Archaeology survey areas.

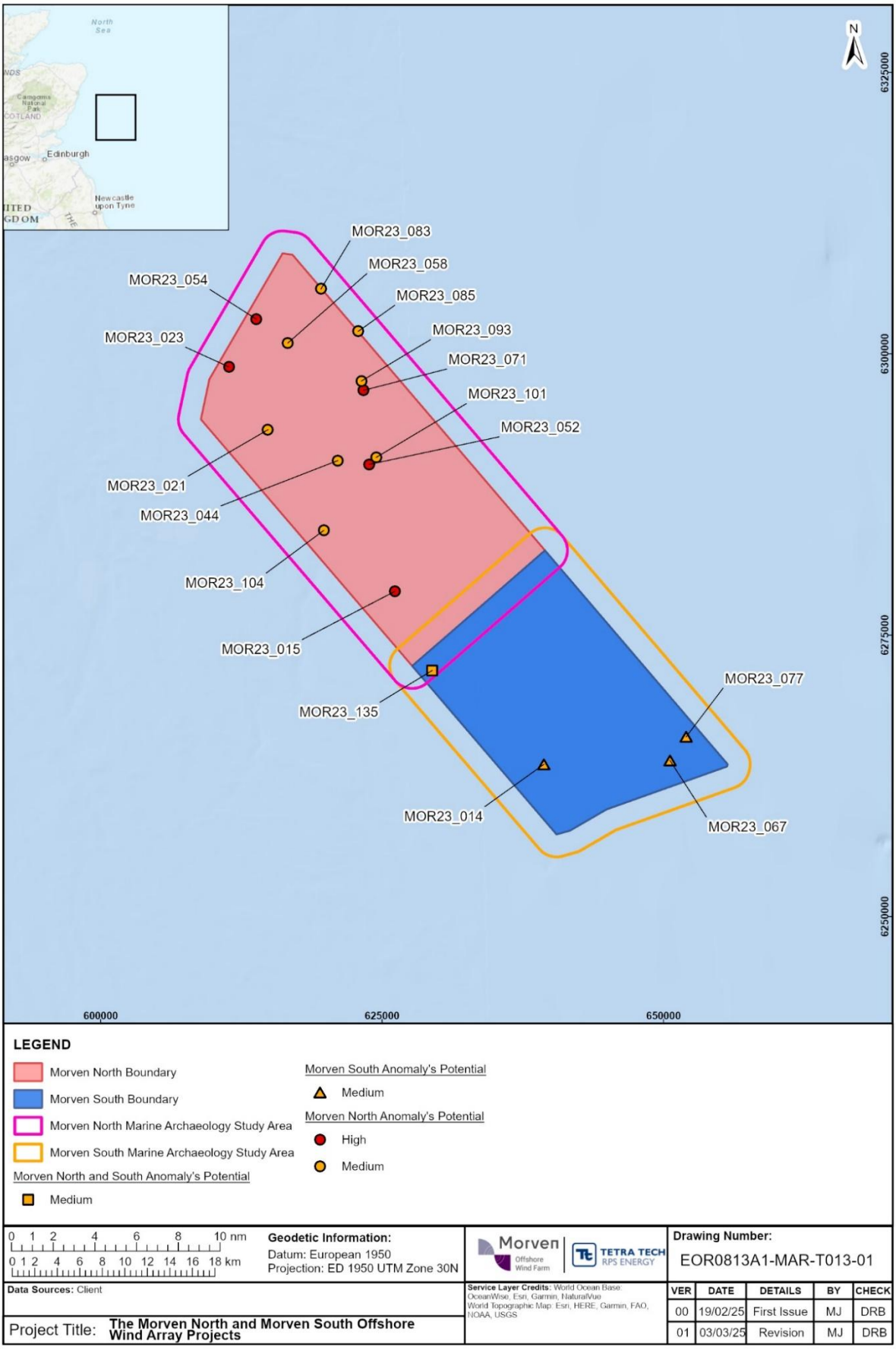

Figure 6.3: High and Medium potential Geophysical anomalies within the Marine Archaeology survey areas

6.3.2 High Potential Anomalies

6.3.2.1 Anomalies that are likely to represent archaeological features have been classed as high potential anomalies. The high potential anomalies include four wrecks and one potential wreck.

6.3.2.2 The five high potential anomalies are described below and the distribution of these is shown in Figure 6.3. All five high potential anomalies are located in the Morven North Marine Archaeology Study Area. There are no high potential anomalies located within the Morven South Marine Archaeology Study Area.

Morven North

6.3.2.3 MOR23_15 is visible in the MBES data but is outside the extents of the SSS data and has no associated magnetic anomaly. The location correlates with UKHO record 74019 and Canmore record 324310. The anomaly is the coherent remains of a wrecked vessel oriented approximately northwest to southeast with the bow apparently to the southeast. The anomaly measures 35.8m x 10.1m, with a measurable height of 3.5m. The wreck appears largely intact with likely superstructure visible. Although recorded in both the UKHO and Canmore datasets, neither provide any details regarding construction, date of sinking, or identity of the vessel.

6.3.2.4 MOR23_023 is visible in the SSS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly has been classified as high potential as the apparent potential remains of a wrecked vessel. In the SSS data the anomaly appears as a prominent concentration of debris measuring 23.3m x 11.9m, but the dimensions are truncated due to the data extent not covering the entire anomaly. Three further features, possibly representing debris, are visible approximately 19.0m to the south and to the east. Within the MBES data the anomaly is predominantly characterised by a kidney-shaped mound measuring 10.7m x 4.7m, with a measurable height of 0.6m. A further smaller mound measuring 4.1m x 3.0m lies to the north, with potential evidence of partially buried material to the west. The form of the anomaly and distribution of apparently associated features in its vicinity strongly indicate the remains of a wrecked vessel.

6.3.2.5 MOR23_052 is visible in the SSS and MBES data and has an associated magnetic anomaly of 557nT. The location correlates with UKHO record 3168 and Canmore record 322378 (Canmore, 2012). The anomaly represents the coherent remains of a wrecked vessel measuring 33.7m x 7.6m, with a measurable height of 2.4m. The wreck is oriented north by northeast to south by southwest with what appears to be the bow to the south. The wreck appears intact and upright. Evidence of collapse is visible towards the bow and there appears to be deck beams in the SSS data. The form of the visible structure and the associated magnetic anomaly suggest steel construction. Although this wreck is recorded in both the UKHO and Canmore datasets, other than the year of identification given as 1919, neither provide any details regarding construction, date of sinking, or identity.

6.3.2.6 MOR23_054 is visible in the MBES data and has no associated magnetic anomaly. The location correlates with UKHO record 75090 and Canmore record 324516 (Canmore, 2012). The anomaly is the coherent remains of a wrecked vessel measuring 27.9m x 9.1m, with a measurable height of 2.4m. The wreck is oriented approximately northeast to southwest with what appears to be the bow possibly to the northeast. Within the SSS data the outline of the wreck appears largely intact with some potential superstructure visible. Extending to the south is a linear feature with a larger feature at its terminus, potentially indicating the ship's anchor, or the snagged remains of another vessel's anchor. The MBES show much greater evidence of collapse with north and south sections of the wreck not readily visible, though there appears to be a concentration of material towards the centre. Although this wreck is recorded in both the UKHO and Canmore datasets, neither provide any details regarding construction, date of sinking, or identity of the vessel.

6.3.2.7 MORE23_071 is partially visible in the SSS due to the data extent and fully visible within the MBES dataset. There is an associated magnetic anomaly of 36,854nT. The location correlates with UKHO record 70421 and Canmore record 324312 (Canmore, 2012). The anomaly is the coherent remains of a wrecked vessel measuring 66.4m x 14.8m, with a measurable height of 7.5m. The wreck is

oriented northeast to southwest with what appears to be the bow to the northeast. The wreck appears to be upright and, although showing signs of potential collapse, the outline remains largely coherent and with significant height relative to the seabed. A large area of debris, measuring 24.8m x 14.7m extends southwest from the wreck. A linear feature ca. 28m long extends from approximately amidships to the northwest.

Morven South

6.3.2.8 There are no high potential anomalies located within the Morven South Marine Archaeology Study Area.

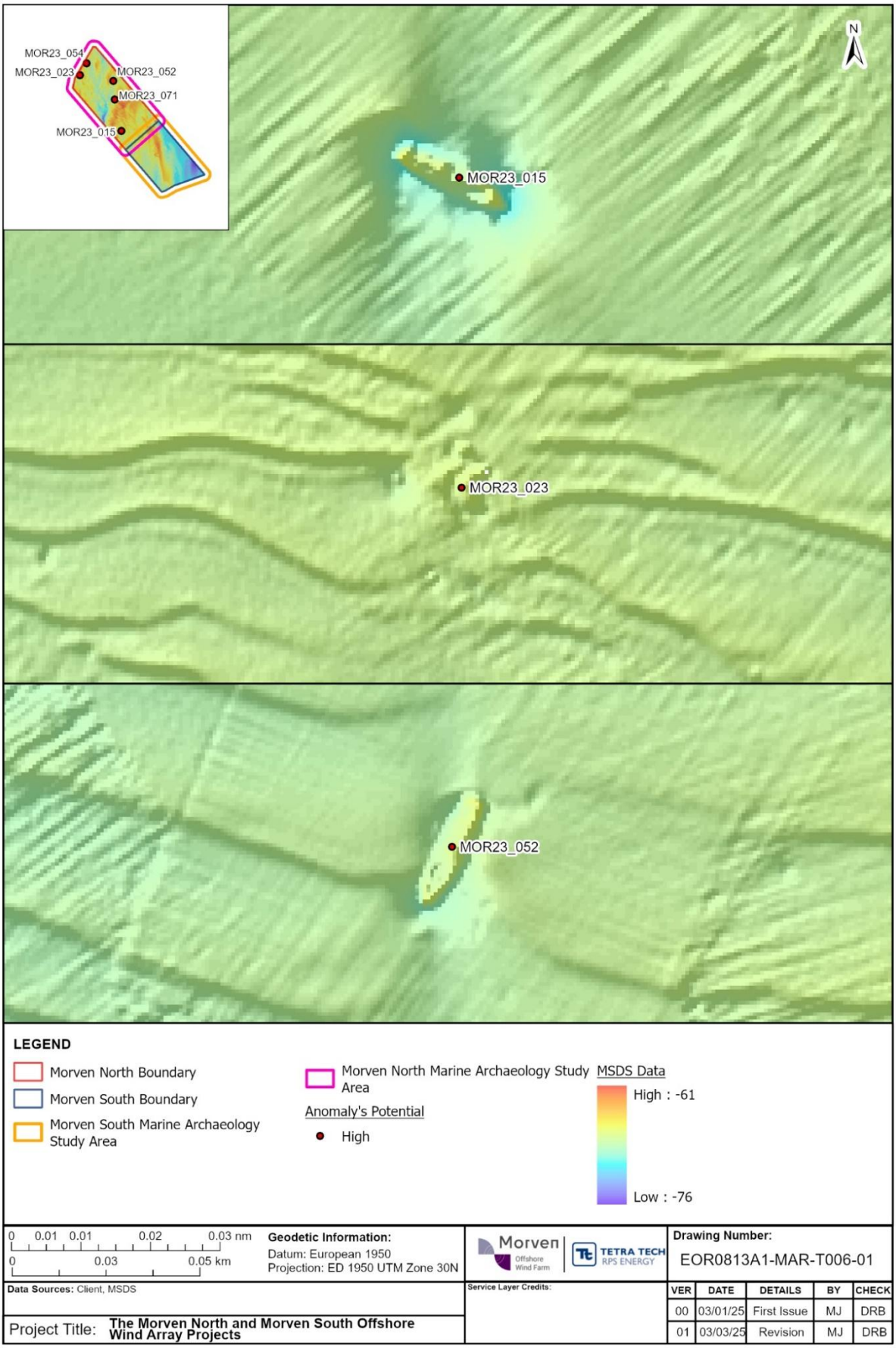

Figure 6.4: High potential anomalies MOR23_015, MOR23_023, and MOR23_052

Figure 6.5: High potential anomalies MOR23_054 and MOR23_071

6.3.3 Medium Potential Anomalies

6.3.3.1 Medium potential anomalies are those that have characteristics that indicate a likelihood of representing anthropogenic material such as debris or potential debris.

6.3.3.2 The 12 medium potential anomalies are presented in Table 6.3 and the distribution of these is shown in Figure 6.3. Eleven of the anomalies are present within the Morven North Boundary and Morven South Boundary while one (MOR23_085) lies 32m outside the Morven North Boundary but within the extents of geophysical data.

6.3.3.3 Further assessment of the medium potential anomalies, possibly by Remotely Operated Vehicle (ROV) would be required to better understand the origin and character, and therefore the archaeological significance, of all medium potential anomalies.

Morven North

6.3.3.4 Of the 12 total medium potential anomalies, nine are present in the Morven North Marine Archaeology Study Area (Table 6.3). While MOR23_135 is within the Morven North Marine Archaeology Study Area, it is also within the Morven South Boundary.

Morven South

6.3.3.5 Of the 12 total medium potential anomalies, four are present in the Morven South Marine Archaeology Study Area (Table 6.3).

Figure 6.6: Medium potential anomalies MOR23_014, MOR23_021, and MOR23_044

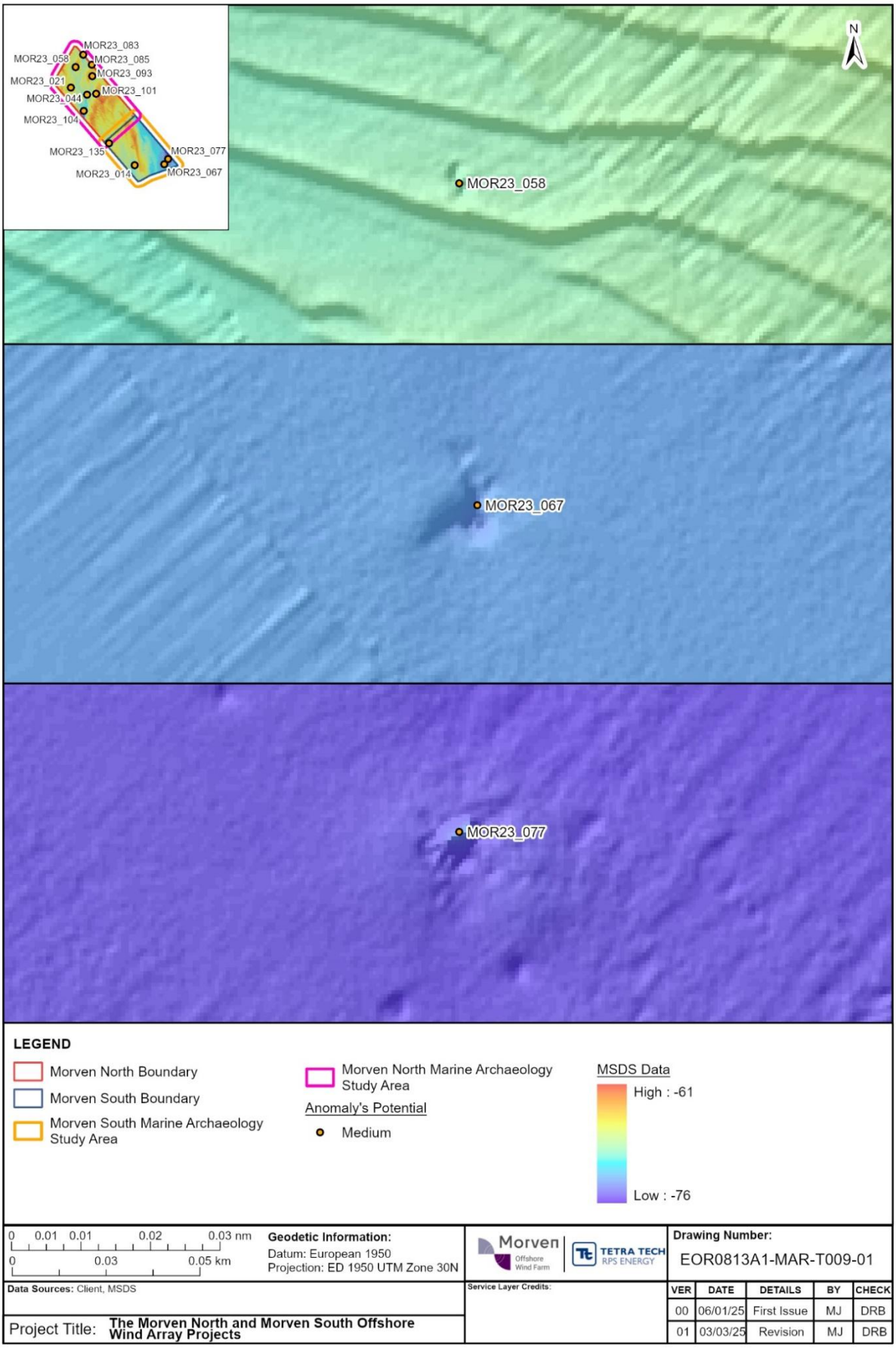

Figure 6.7: Medium potential anomalies MOR23_058, MOR23_067, and MOR23_077

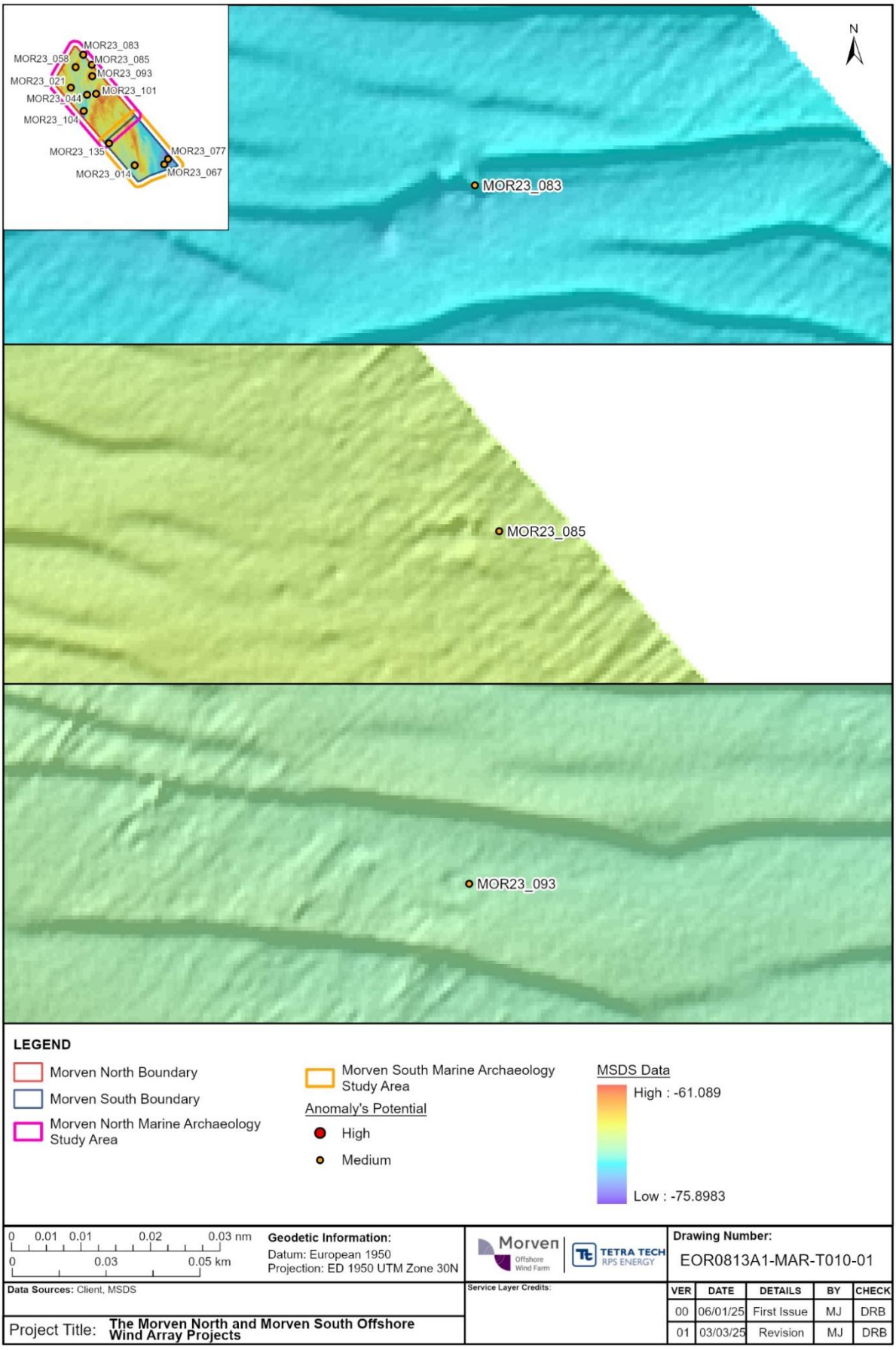

Figure 6.8: Medium potential anomalies MOR23_083, MOR23_085, and MOR23_093

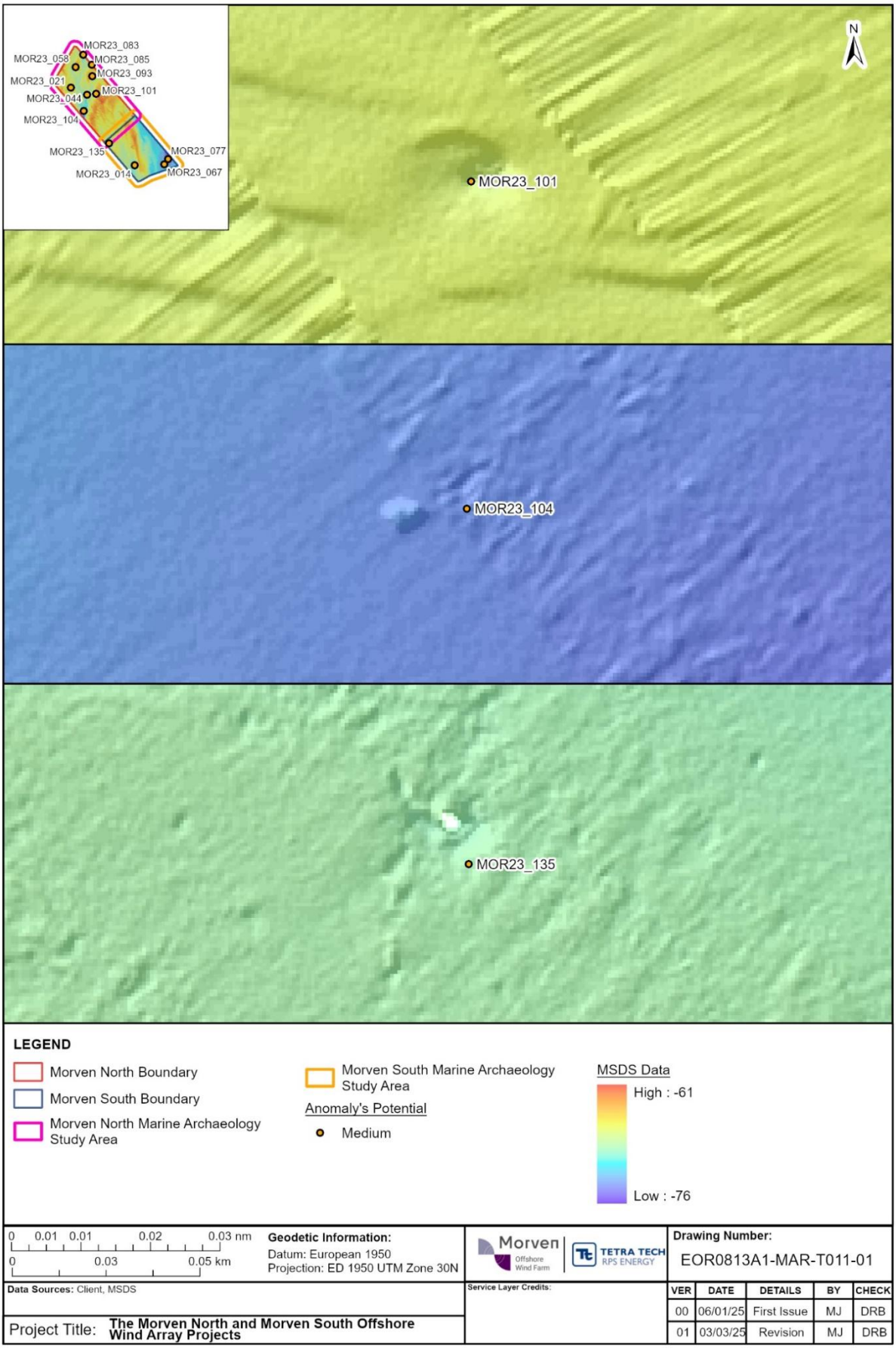

Figure 6.9: Medium potential anomalies MOR23_101, MOR23_104, and MOR23_135

Table 6.3: Medium potential anomalies

ID	Category	Description	Marine Archaeology Study Area
MOR23_014	Likely geological	MOR23_014 is visible in the SSS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. If not geological, the form of the mound and the association with potentially anthropogenic material (represented by an irregular spread of features to the northwest of the mound) suggest the possible presence of partially buried material of archaeological interest.	Morven South
MOR23_021	Potential debris	MOR23_021 is visible in the SSS as two prominent clusters of potential debris. The location does not correlate with any UKHO or NRHE records. The clusters are not visible in the MBES dataset, but associated scour can be seen bisecting the edge of the sand wave.	Morven North
MOR23_044	Mound	MOR23_044 is visible in the SSS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. In the SSS dataset the feature appears as a prominent 'L'-shaped feature. The feature in the MBES dataset appears as an isolated and prominent mound.	Morven North
MOR23_058	Potential debris	MOR23_058 is visible in the SSS and MBES dataset but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly is visible in the SSS dataset as a cluster of smaller features, potentially anthropogenic debris; in the MBES the anomaly is visible as two ovular depressions surrounded by a slight ridge.	Morven North
MOR23_067	Potential debris	MOR23_067 is visible in the SSS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly appears in the SSS dataset as an area of associated small features which, individually, be interpreted as boulders but is uncharacteristic for the area of seabed. Within the MBES the anomaly is visible as a series of depressions, or scour pits, likely caused by the features. It is possible that the feature at this location is geological in origin, but a cautionary medium potential rating has been assigned.	Morven South
MOR23_077	Potential debris	MOR23_077 is visible in the SSS and MBES data and has an associated magnetic anomaly of 19nT. The location does not correlate with any UKHO or NRHE records. The anomaly appears in the SSS dataset as an irregular 3.6m x 3.1m feature surrounded by a large spread of potentially associated smaller features. The anomaly appears in the MBES dataset as a prominent mound with visible but incoherent features in its immediate vicinity.	Morven South
MOR23_083	Potential debris	MOR23_083 is visible in the SSS and MBES dataset but does not have an associated	Morven North

ID	Category	Description	Marine Archaeology Study Area
		magnetic anomaly. The location does not correlate with any UKHO or NRHE dataset. The anomaly is visible in the SSS data as a substantial, prominent, irregular feature. The feature appears similar in the MBES data and bisects a sand wave. The origin of the anomaly is unclear, but the form and irregularity may indicate an anthropogenic source.	
MOR23_085	Potential debris	MOR23_085 lies outside of the Morven North Boundary but within the extents of the geophysical data. It is visible in the SS and MBES data but has no associate magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly is visible in the SSS dataset as three objects or three clusters of objects. Though the anomaly is visible in the MBES dataset it is not dissimilar to other seabed features within the area. It is possible the feature is of geological origin, but an anthropogenic source cannot be ruled out.	Morven North
MOR23_093	Debris	MOR23_093 is visible in the SSS data as two prominent linear features but is not confidently observable in the MBES data and has no associated magnetic anomaly. The form of the features suggests an anthropogenic source for the anomaly.	Morven North
MOR23_101	Debris	MOR23_101 is visible in the SSS and MBES data but has no associate magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly is visible in the SSS data as two prominent linear features in association with smaller features within the immediate vicinity. The MBES data shows the anomaly lying within a large scour pit. While the origin of the anomaly is not entirely clear, it is highly likely to be from an anthropogenic source.	Morven North
MOR23_104	Likely geological	MOR23_104 is visible in the SSS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly is visible in the SSS data as two prominent and irregular features, appearing unusual within the wider area of seabed. Only the northwestern of the two features is visible in the MBES dataset, appearing as a prominent mound with an irregular surface which, if not geological, may suggest an object that is at least partially buried.	Morven North
MOR23_135	Potential debris	MOR23_135 is visible in the SS and MBES data but has no associated magnetic anomaly. The location does not correlate with any UKHO or NRHE records. The anomaly lies at the edge of the SSS survey line so thus is only partially ensonified. The feature is visible in the SSS data as an incoherent cluster of primarily linear features. The anomaly appears in the MBES dataset as an area of disturbed seabed with small mounds and areas of scour. While the	Located within both the North and South study areas but located within Morven South Boundary

ID	Category	Description	Marine Archaeology Study Area
		origin of the anomaly is not clear, it likely has an anthropogenic source but may be modern debris such as fishing gear.	

6.3.4 Low Potential Anomalies

6.3.4.1 The 137 low potential anomalies predominantly represent likely geological features, modern debris such as infrastructure, chain, cable or rope, or small items of debris with no distinguishing features indicating archaeological potential and are therefore not considered further within this report. The positional data of the low potential anomalies is presented in Appendix A and are further considered in the Outline WSI and PAD (which is provided as an accompanying document to this Marine Archaeology Shared Technical Report and the Morven North Offshore Wind Array Project and Morven South Offshore Wind Array Project EIA)

Morven North

6.3.4.2 Of the 137 total low potential anomalies, 86 are present in the Morven North Marine Archaeology Study Area. While four are within the Morven North Marine Archaeology Study Area, they are also within the Morven South Boundary (Appendix A).

Morven South

6.3.4.3 Of the 137 low potential anomalies, 59 are present in the Morven South Marine Archaeology Study Area. While three are within the Morven South Marine Archaeology Study Area, they are also within the Morven North Boundary (Appendix A).

7 Summary

7.1 Submerged Prehistoric Archaeology

7.1.1.1 Site specific geophysical and geotechnical survey data has identified deposits which are predominantly either glacial or marine, indicating that the environment was either inhospitable for humans or submerged relatively shortly after the end of the LGM. The Stage 1 geoarchaeological assessment concluded that there was no potential for the survival of prehistoric archaeological material within the 23 boreholes assessed, and the Stage 2 assessment showed the depositional environment implied by each of the samples was likely to be shallow marine to marine, with some associated with a proglacial environment. The samples, and therefore the wider area, were therefore deemed to have low geoarchaeological potential. Development and adherence to a WSI and PAD will ensure mitigated impacts to any as yet unidentified archaeological receptors within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

Morven North

7.1.1.2 The potential for the survival of submerged prehistoric archaeology within the Morven North Marine Archaeology Study Area is very low.

Morven South

7.1.1.3 The potential for the survival of submerged prehistoric archaeology within the Morven South Marine Archaeology Study Area is very low.

7.2 Maritime and Aviation Archaeology

7.2.1.1 Geophysical survey has identified five high potential anomalies, 12 medium potential anomalies, and 137 low potential anomalies within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area. The high potential anomalies comprise four wrecks and one potential wreck. The 12 medium potential anomalies comprise anomalies interpreted as representing debris or potential debris, as well as an anomalous mound and two likely geological features.

7.2.1.2 These represent a broad range of potential archaeological material to be present within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area, from established wreck sites to possible archaeological debris. Archaeological material from the Modern Period, including modern military remains or vessels and cargo relating to fishing, transport or trade, is considered most likely to be encountered in the study area. Development and adherence to a WSI and PAD will ensure mitigated impacts to any as yet unidentified archaeological receptors within the Morven North Marine Archaeology Study Area and the Morven South Marine Archaeology Study Area.

Morven North

7.2.1.3 All five high potential anomalies are located within the Morven North Marine Archaeology Study Area. Of the 12 total medium potential anomalies, nine are present in the Morven North Marine Archaeology Study Area, with one of these also situated within the Morven South Boundary.

Morven South

7.2.1.4 Of the five high potential anomalies identified by the geophysical survey, none are located within the Morven South Marine Archaeology Study Area. Of the 12 total medium potential anomalies, four are present in the Morven South Marine Archaeology Study Area.

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Appendix A

A. 1: Gazetteer of Marine Archaeology Identified Within the Desktop Data

Name	UKHO ID	NRHE ID	Longitude	Latitude	Description	Marine Archaeology Study Area
Ailsa	3199	322394	0° 36.359' W	56° 36.244' N	Captured by a German submarine and then scuttled 30 miles (mi) east by northeast from Bell Rock. The actual location of the wreck is uncertain but possibly in the vicinity.	Morven South
Unknown	3170	322380	1° 12.882' W	56° 46.151' N	The collapsed but upright remains of a wreck, bow to the north.	Morven North
Unknown (MOR23_015)	70419	324310	0° 56.738' W	56° 38.111' N	The remains of a wreck.	Morven North
Unknown (MOR23_052)	3168	322378	0° 58.633' W	56° 44.219' N	The remains of a wreck.	Morven North
Unknown (MOR23_054)	75090	324516	1° 8.105' W	56° 51.332' N	The remains of a wreck.	Morven North
Unknown (MOR23_071)	70421	324312	0° 58.942' W	56° 47.771' N	The remains of a wreck.	Morven North
Anton	3169		1° 5.09' W	56° 42.96' N	The remains of a wreck sunk in 1917, now listed as a 'dead' wreck.	Morven North

Name	UKHO ID	NRHE ID	Longitude	Latitude	Description	Marine Archaeology Study Area
Unknown	3163		1° 3.59' W	56° 38.71' N	The remains of a wreck, now listed as a 'dead' wreck.	Morven North

A. 2: Gazetteer of Recorded Losses

NRHE ID	Name	Description
200463	*Bosphorous*	Classified as iron paddle steam trawler: date of loss cited as). Bosphorus foundered approximately 37 miles southeast of Girdle Ness on 05 May 1904.
248583	*Competitor*	Classified as wooden schooner with cargo of wheat. Competitor was abandoned 70 miles east of Montrose on 28 November 1852.
942558	Unknown 1920	Derelict seen 19 July 1920 north east of the Firth of Forth.

A. 3: Gazetteer of anomalies in the Morven North Marine Archaeology Study Area

Name	Potential	Latitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_001	Low	001° 10.6850' W	56° 46.5002' N			Likely geological	4.3	1.8	0.6	
MOR23_003	Low	001° 13.0175' W	56° 47.1283' N			Potential debris	2.3	0.4	0.3	
MOR23_004	Low	001° 12.2801' W	56° 46.6061' N			Chain, cable, or rope	13.2	0.2	nmh	
MOR23_005	Low	001° 04.0838' W	56° 42.4238' N			Potential debris	9.5	1.8	0.7	
MOR23_006	Low	001° 03.1911' W	56° 41.5370' N			Likely geological	3.1	2.4	0.3	
MOR23_007	Low	000° 58.4762' W	56° 38.7752' N			Likely geological	2.9	1.1	0.3	
MOR23_010	Low	001° 08.0791' W	56° 44.6367' N			Potential debris	3.8	0.7	0.3	
MOR23_011	Low	000° 53.2271' W	56° 34.8751' N			Potential debris	8.8	1.1	0.1	

Name	Potential	Latitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_012	Low	001° 07.4002' W	56° 45.9487' N			Seabed disturbance	24.9	6.6	0.2	
MOR23_015	High	000° 56.6256' W	56° 38.1515' N	70419	324310	Wreck	35.8	10.1	2.7	
MOR23_018	Low	000° 56.7202' W	56° 38.8619' N			Potential debris	5.3	0.9	0.1	
MOR23_019	Low	001° 03.4809' W	56° 43.7108' N			Potential debris	7.2	1.5	0.7	
MOR23_020	Low	001° 05.0409' W	56° 44.6631' N			Potential debris	5.5	6.1	0.7	
MOR23_021	Medium	001° 07.2653' W	56° 46.0613' N			Potential debris	10.6	4.4	0.4	
MOR23_022	Low	001° 09.1660' W	56° 47.3515' N			Potential debris	2.7	1.8	1.1	
MOR23_023	High	001° 10.5161' W	56° 49.1227' N			Potential wreck	23.3	11.9	0.6	
MOR23_026	Low	000° 53.0203' W	56° 37.0264' N			Potential debris	2.9	0.7	0.1	
MOR23_027	Low	001° 05.4371' W	56° 45.5231' N			Potential debris	5.9	2.9	0.1	
MOR23_029	Low	000° 51.1655' W	56° 35.9257' N			Potential debris	3.5	1.5	0.4	
MOR23_033	Low	001° 01.3068' W	56° 43.6237' N			Potential debris	1.8	1.4	0.2	
MOR23_035	Low	001° 04.1080' W	56° 45.7340' N			Potential debris	2.9	0.5	0.1	
MOR23_036	Low	001° 04.2145' W	56° 45.6911' N			Potential debris	8.8	0.3	nmh	
MOR23_037	Low	000° 56.8396' W	56° 40.9585' N			Potential debris	3.5	1.6	0.3	
MOR23_040	Low	001° 04.3814' W	56° 46.4770' N			Likely geological	7.2	0.8	0.4	
MOR23_041	Low	000° 52.3015' W	56° 38.1472' N			Likely geological	6.8	0.8	0.3	
MOR23_043	Low	001° 07.9877' W	56° 48.9066' N			Chain, cable, or rope	177.8	0.2	0.1	24.0
MOR23_044	Medium	001° 01.2390' W	56° 44.4948' N			Mound	8.6	2.6	0.6	
MOR23_045	Low	000° 55.7773' W	56° 41.0279' N			Likely geological	4	0.9	0.3	
MOR23_047	Low	000° 52.1995' W	56° 39.3403' N			Likely geological	2.1	2.1	0.4	
MOR23_048	Low	000° 52.8702' W	56° 40.2084' N			Likely geological	11.5	0.6	nmh	
MOR23_049	Low	000° 55.8657' W	56° 42.1364' N			Potential debris	7.4	0.3	0.1	

Name	Potential	Latitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_050	Low	001° 05.8360' W	56° 48.9356' N			Likely geological	15.6	4	0	
MOR23_051	Low	001° 02.9201' W	56° 47.1419' N			Potential debris	4.4	0.2	0	
MOR23_052	High	000° 58.5407' W	56° 44.2635' N	3168	322378	Wreck	33.7	7.6	2.4	557.0
MOR23_053	Low	001° 06.3079' W	56° 49.5885' N			Chain, cable, or rope	70.4	0.3	0	
MOR23_054	High	001° 08.0072' W	56° 51.3762' N	75090	324516	Wreck	27.9	9.1	1.7	
MOR23_056	Low	001° 01.1214' W	56° 46.5903' N			Potential debris	8.2	5.3	0.1	
MOR23_058	Medium	001° 05.3045' W	56° 50.1888' N			Potential debris	16.1	10.9	0.2	
MOR23_061	Low	001° 03.1664' W	56° 49.2795' N			Chain, cable, or rope	78.8	1	0.1	
MOR23_062	Low	001° 03.2627' W	56° 49.2008' N			Potential debris	4.4	3.8	0.1	
MOR23_063	Low	001° 07.2896' W	56° 51.9599' N			Chain, cable, or rope	273.2	0.5	0.1	
MOR23_064	Low	001° 05.9330' W	56° 51.0468' N			Potential debris	4.5	1.1	0.6	
MOR23_065	Low	000° 51.8459' W	56° 42.1569' N			Potential debris	2.8	0.8	0.5	
MOR23_066	Low	000° 48.1614' W	56° 39.3691' N			Potential debris	10.8	0.5	nmh	
MOR23_068	Low	001° 01.1491' W	56° 48.6350' N			Chain, cable, or rope	75.1	0.2	nmh	
MOR23_069	Low	001° 01.1766' W	56° 48.5402' N			Chain, cable, or rope	93.6	0.8	nmh	
MOR23_070	Low	001° 00.3887' W	56° 48.5250' N			Chain, cable, or rope	226.8	0.4	0.1	
MOR23_071	High	000° 58.8359' W	56° 47.8184' N	70421	324312	Wreck	66.4	14.8	7.5	36854.0
MOR23_073	Low	001° 05.4277' W	56° 52.7920' N			Potential debris	2.4	0.9	0.1	
MOR23_074	Low	001° 01.3835' W	56° 50.0210' N			Chain, cable, or rope	86.3	0.9	nmh	
MOR23_075	Low	000° 46.3873' W	56° 40.5441' N			Linear feature	11.5	0.6	0.1	
MOR23_076	Low	001° 02.6881' W	56° 51.7544' N			Fishing gear	276.5	0.5	nmh	
MOR23_078	Low	000° 48.1761' W	56° 42.3820' N			Likely geological	7.3	0.9	0.5	
MOR23_079	Low	001° 04.8773' W	56° 52.6510' N			Chain, cable, or rope	73.9	0.3	0.1	

Name	Potential	Latitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_080	Low	000° 52.9247' W	56° 46.1669' N			Potential debris	3.8	0.6	0.1	
MOR23_081	Low	001° 04.6179' W	56° 54.0198' N			Chain, cable, or rope	40.2	0.4	0.1	
MOR23_082	Low	001° 03.7706' W	56° 53.4437' N			Fishing gear	56.6	2.2	nmh	
MOR23_083	Medium	001° 02.2725' W	56° 52.7365' N			Potential debris	15.4	2.5	0.6	
MOR23_084	Low	001° 06.1794' W	56° 52.5046' N			Potential debris	4.1	3.6	0.6	
MOR23_085	Medium	000° 59.1210' W	56° 50.6537' N			Potential debris	13.8	2.1	1	
MOR23_087	Low	001° 11.2131' W	56° 49.1340' N			Chain, cable, or rope	101.2	0.3	0.1	
MOR23_088	Low	001° 01.9563' W	56° 52.3290' N			Likely geological	3.9	0.9	0.4	
MOR23_089	Low	001° 04.0787' W	56° 50.5924' N			Chain, cable, or rope	6	5.7	0.1	
MOR23_090	Low	001° 08.8599' W	56° 47.2743' N			Chain, cable, or rope	9.1	9.5	0.1	
MOR23_091	Low	001° 02.0768' W	56° 50.2602' N			Chain, cable, or rope	160	0.2	nmh	
MOR23_092	Low	000° 53.7445' W	56° 45.9365' N			Linear feature	10.2	0.1	nmh	
MOR23_093	Medium	000° 58.9913' W	56° 48.2650' N			Debris	14.6	10.1	0.2	
MOR23_095	Low	001° 04.9524' W	56° 44.7660' N			Chain, cable, or rope	39.8	0.2	nmh	
MOR23_096	Low	001° 05.7619' W	56° 42.7263' N			Likely geological	4.1	2.2	0.7	
MOR23_097	Low	000° 56.2824' W	56° 45.7365' N			Chain, cable, or rope	93.6	0.2	nmh	
MOR23_098	Low	000° 59.8917' W	56° 38.7117' N			Likely geological	2.7	4.9	0.8	
MOR23_099	Low	000° 53.5828' W	56° 46.4970' N			Chain, cable, or rope	115.4	0.3	nmh	
MOR23_100	Low	000° 55.5566' W	56° 45.6313' N			Likely geological	8.9	1.4	0	
MOR23_101	Medium	000° 57.8923' W	56° 44.5911' N			Debris	9.1	2.7	0.4	
MOR23_102	Low	000° 58.3588' W	56° 44.3219' N			Chain, cable, or rope	22.4	0.4	0.1	
MOR23_103	Low	001° 04.4818' W	56° 41.2748' N			Chain, cable, or rope	290	0.2	nmh	
MOR23_104	Medium	001° 02.6429' W	56° 41.1684' N			Likely geological	26.2	6.9	0	

Name	Potential	Latitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_105	Low	000° 56.2300' W	56° 42.0394' N			Potential debris	5.6	0.6	0.1	
MOR23_106	Low	000° 53.4497' W	56° 43.2445' N			Potential debris	2.9	4.3	0.7	
MOR23_107	Low	000° 48.7060' W	56° 43.6268' N			Potential debris	7.6	1.1	1.2	
MOR23_108	Low	000° 50.0762' W	56° 40.9402' N			Linear feature	4.6	0.6	0.2	
MOR23_109	Low	000° 56.3365' W	56° 38.2393' N			Potential debris	5.2	2.6	0.1	
MOR23_110	Low	000° 51.1438' W	56° 36.7863' N			Potential debris	2.7	1.5	0.4	
MOR23_133	Low	000° 53.7134' W	56° 34.0613' N			Potential debris	40.6	6	0.3	
MOR23_135	Medium	000° 53.6851' W	56° 34.2693' N			Potential debris	29	12.6	0.4	
MOR23_138	Low	001° 11.2448' W	56° 48.1837' N			Likely geological	8.4	1.3	0.7	
MOR23_139	Low	001° 05.4659' W	56° 44.3799' N			Potential debris	3.4	2.4	0.3	
MOR23_140	Low	001° 01.1683' W	56° 48.4193' N			Chain, cable, or rope	84.7	7	0.1	
MOR23_141	Low	001° 01.1666' W	56° 48.3023' N			Chain, cable, or rope	169.4	6.6	0.1	
MOR23_142	Low	000° 45.6141' W	56° 38.6294' N			Chain, cable, or rope	11.6	6.4	0.1	
MOR23_143	Low	000° 59.5022' W	56° 48.6011' N			Fishing gear	85.4	0.4	0.1	
MOR23_145	Low	000° 46.0561' W	56° 39.9042' N			Likely geological	3.7	2.5	0.7	
MOR23_147	Low	001° 02.9830' W	56° 40.4885' N			Likely geological	1.7	1.8	0.2	
MOR23_149	Low	001° 03.3610' W	56° 49.1458' N			Fishing gear	16.3	1.6	0.1	
MOR23_150	Low	001° 01.7260' W	56° 47.3887' N			Chain, cable, or rope	57.2	0.2	nmh	
MOR23_152	Low	000° 58.2411' W	56° 37.5696' N			Debris	0	0	0	399.0
MOR23_153	Low	001° 11.1228' W	56° 47.0575' N			Debris	0.9	0.4	0.4	105.0
MOR23_156	Low	000° 58.8694' W	56° 43.2817' N			Debris	1.9	0.6	0.2	72.0
MOR23_157	Low	000° 56.4096' W	56° 35.3120' N			Debris	1.7	1.2	0.2	59.0

A. 4: Gazetteer of potential anomalies in Morven South Marine Archaeology Study Area

Name	Potential	Longitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_002	Low	000° 43.2687' W	56° 27.5570' N			Potential debris	2.3	0.9	0.1	
MOR23_008	Low	000° 49.1692' W	56° 32.1098' N			Fishing gear	30.1	15.1	0.4	
MOR23_009	Low	000° 46.1959' W	56° 29.8840' N			Potential debris	3	0.9	0.1	
MOR23_011	Low	000° 53.2271' W	56° 34.8751' N			Potential debris	8.8	1.1	0.1	
MOR23_013	Low	000° 43.3899' W	56° 28.3687' N			Potential debris	2.5	2	0.1	
MOR23_014	Medium	000° 44.1743' W	56° 29.6496' N			Likely geological	28.6	17.5	1.3	50
MOR23_016	Low	000° 50.5935' W	56° 34.3695' N			Potential debris	4.3	0.8	nmh	
MOR23_017	Low	000° 42.4259' W	56° 28.8299' N			Likely geological	2.3	0.6	0	
MOR23_024	Low	000° 46.7529' W	56° 32.6202' N			Potential debris	3.6	1	0.3	
MOR23_025	Low	000° 44.8357' W	56° 31.4173' N			Potential debris	7	0.8	0.2	
MOR23_028	Low	000° 39.8671' W	56° 27.9977' N			Chain, cable, or rope	58.6	1.4	nmh	
MOR23_029	Low	000° 51.1655' W	56° 35.9257' N			Potential debris	3.5	1.5	0.4	
MOR23_030	Low	000° 38.8655' W	56° 27.6222' N			Chain, cable, or rope	33.8	0.3	nmh	
MOR23_031	Low	000° 38.9218' W	56° 27.6773' N			Chain, cable, or rope	14.7	0.3	nmh	
MOR23_032	Low	000° 41.8006' W	56° 29.5593' N			Linear feature	6.3	0.3	0.1	
MOR23_034	Low	000° 44.4569' W	56° 31.9895' N			Potential debris	2	0.6	0.1	
MOR23_038	Low	000° 45.2269' W	56° 32.9318' N			Linear feature	5	0.5	0	
MOR23_039	Low	000° 41.6931' W	56° 30.6241' N			Potential debris	5	0.6	0.2	
MOR23_042	Low	000° 39.7751' W	56° 29.4395' N			Likely geological	7.8	0.7	0.2	
MOR23_046	Low	000° 42.6530' W	56° 32.3376' N			Likely geological	8.7	0.9	0.2	
MOR23_055	Low	000° 44.9908' W	56° 35.4223' N			Seabed disturbance	15	3.9	nmh	
MOR23_059	Low	000° 44.7126' W	56° 35.4836' N			Potential debris	10.3	4.5	0	
MOR23_060	Low	000° 41.0693' W	56° 33.5178' N			Potential debris	7.1	0.5	0.5	

Name	Potential	Longitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_067	Medium	000° 33.2460' W	56° 29.6274' N			Potential debris	25.7	4.1	0.3	
MOR23_072	Low	000° 40.5659' W	56° 35.4641' N			Potential debris	7.4	0.6	0.1	
MOR23_077	Medium	000° 31.7791' W	56° 30.7356' N			Potential debris	28	24.3	1.8	19.0
MOR23_110	Low	000° 51.1438' W	56° 36.7863' N			Potential debris	2.7	1.5	0.4	
MOR23_111	Low	000° 41.9917' W	56° 36.7468' N			Chain, cable, or rope	148.7	0.3	nmh	
MOR23_112	Low	000° 44.7055' W	56° 35.5240' N			Chain, cable, or rope	150.5	0.1	nmh	7.0
MOR23_113	Low	000° 47.9213' W	56° 29.5804' N			Potential debris	7.1	3.1	nmh	
MOR23_114	Low	000° 35.2695' W	56° 34.1835' N			Chain, cable, or rope	13.1	0.2	0.1	
MOR23_115	Low	000° 40.4698' W	56° 36.2212' N			Potential debris	6.3	2.2	0.5	
MOR23_116	Low	000° 48.4797' W	56° 30.8757' N			Chain, cable, or rope	94.4	0.6	0.1	35.0
MOR23_117	Low	000° 46.7988' W	56° 31.2360' N			Potential debris	3.9	0.5	0.1	
MOR23_118	Low	000° 41.1157' W	56° 33.6938' N			Mound	63.9	23.8	0.5	
MOR23_119	Low	000° 41.9128' W	56° 33.4430' N			Chain, cable, or rope	8.1	5.6	nmh	
MOR23_120	Low	000° 45.5584' W	56° 31.4248' N			Potential debris	9	0.4	nmh	
MOR23_121	Low	000° 46.6152' W	56° 30.5288' N			Chain, cable, or rope	67.4	0.4	nmh	
MOR23_122	Low	000° 44.1451' W	56° 30.7983' N			Potential debris	3	0.6	0.1	
MOR23_123	Low	000° 31.6433' W	56° 31.6641' N			Likely geological	8	2	0.3	
MOR23_124	Low	000° 36.4442' W	56° 33.2858' N			Chain, cable, or rope	7.5	4.6	0.2	
MOR23_125	Low	000° 32.2356' W	56° 28.5383' N			Likely geological	6.5	1	0.3	
MOR23_126	Low	000° 37.6843' W	56° 32.4062' N			Chain, cable, or rope	26.9	4.7	0.1	
MOR23_127	Low	000° 36.4034' W	56° 32.4889' N			Potential debris	4.3	0.5	0.3	
MOR23_128	Low	000° 43.5377' W	56° 29.3447' N			Chain, cable, or rope	9.7	2	0.1	
MOR23_129	Low	000° 32.1588' W	56° 30.2046' N			Chain, cable, or rope	32.1	0.3	0.1	

Name	Potential	Longitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_130	Low	000° 33.0042' W	56° 31.5157' N			Potential debris	6.9	0.4	0.1	
MOR23_131	Low	000° 33.1151' W	56° 29.3608' N			Potential debris	8.8	2.7	0.1	
MOR23_132	Low	000° 41.6071' W	56° 27.5942' N			Potential debris	16.8	3.1	0.1	
MOR23_133	Low	000° 53.7134' W	56° 34.0613' N			Potential debris	40.6	6	0.3	
MOR23_134	Low	000° 48.0656' W	56° 30.3580' N			Likely geological	14.6	6.2	0.2	
MOR23_135	Medium	000° 53.6851' W	56° 34.2693' N			Potential debris	29	12.6	0.4	
MOR23_136	Low	000° 49.9339' W	56° 33.6464' N			Chain, cable, or rope	7	6.6	0.1	
MOR23_137	Low	000° 50.1515' W	56° 33.8268' N			Chain, cable, or rope	4.4	1.7	0.1	
MOR23_142	Low	000° 45.6141' W	56° 38.6294' N			Chain, cable, or rope	11.6	6.4	0.1	
MOR23_144	Low	000° 35.2136' W	56° 32.2649' N			Potential debris	9.8	3.9	0.1	
MOR23_145	Low	000° 46.0561' W	56° 39.9042' N			Likely geological	3.7	2.5	0.7	
MOR23_146	Low	000° 34.7668' W	56° 33.8989' N			Chain, cable, or rope	10.6	6.8	nmh	
MOR23_148	Low	000° 45.9475' W	56° 32.7958' N			Fishing gear	48.9	0.7	0.3	
MOR23_151	Low	000° 31.9283' W	56° 30.5544' N			Potential debris	5.2	0.3	0.1	
MOR23_154	Low	000° 42.5995' W	56° 29.3648' N			Debris	0.8	0.4	0.1	87.0
MOR23_155	Low	000° 35.0128' W	56° 32.9511' N			Debris	3.7	2.9	0.2	73.0
MOR23_157	Low	000° 56.4096' W	56° 35.3120' N			Debris	1.7	1.2	0.2	59.0

A. 5: Gazetteer of anomalies in both Morven North Marine Archaeology Study Area and Morven South Marine Archaeology Study Area

Name	Potential	Longitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_011	Low	000° 53.2271' W	56° 34.8751' N			Potential debris	8.8	1.1	0.1	
MOR23_029	Low	000° 51.1655' W	56° 35.9257' N			Potential debris	3.5	1.5	0.4	
MOR23_110	Low	000° 51.1438' W	56° 36.7863' N			Potential debris	2.7	1.5	0.4	

Name	Potential	Longitude	Latitude	UKHO	NRHE	Description	L	W	H	Mag. (nT)
MOR23_133	Low	000° 53.7134' W	56° 34.0613' N			Potential debris	40.6	6	0.3	
MOR23_135	Medium	000° 53.6851' W	56° 34.2693' N			Potential debris	29	12.6	0.4	
MOR23_142	Low	000° 45.6141' W	56° 38.6294' N			Chain, cable, or rope	11.6	6.4	0.1	
MOR23_145	Low	000° 46.0561' W	56° 39.9042' N			Likely geological	3.7	2.5	0.7	
MOR23_157	Low	000° 56.4096' W	56° 35.3120' N			Debris	1.7	1.2	0.2	59.0