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Morlais Project
Environmental Statement

Chapter 13: Offshore Archaeology and Cultural Heritage

Volume III

Applicant: Menter Môn Morlais Limited

Document Reference: PB5034-ES-013

Chapter 13: Offshore Archaeology and Cultural Heritage

Author: MarineSpace

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Environmental Statement

Appendix 13.1: Morlais Archaeological Desk Based Assessment

Volume III

Applicant: Menter Môn Morlais Limited

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Chapter 13: Offshore Archaeology and Cultural Heritage

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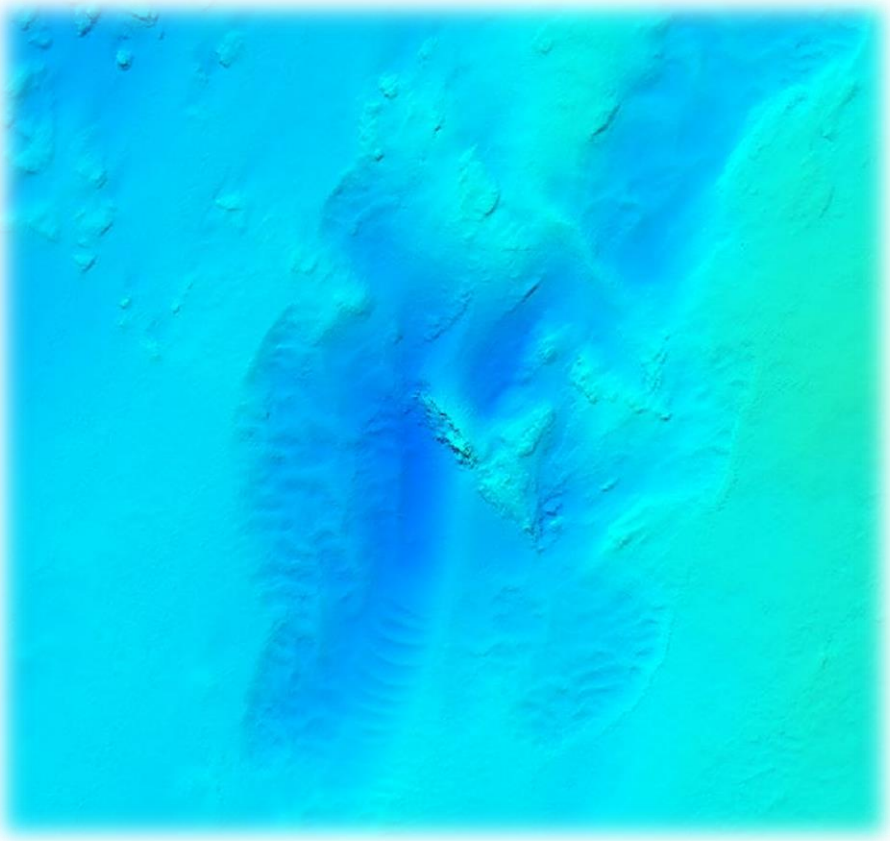
Menter Môn - Morlais Archaeological Desk Based Assessment



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Menter Môn - Morlais Archaeological Desk Based Assessment

Prepared by:

MarineSpace Ltd

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Prepared for:

Mentor Môn

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Data Licences

Executive Summary

Menter Môn Cyf (Menter Môn) is proposing the development of up to 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ), previously known as the West Anglesey Demonstration Zone (or WADZ). To reach the 240 MW target, a selection of Tidal Energy Converter (TEC) devices will be installed offshore in designated berths, still to be determined, across the site connected via inter-array cables. There will also be up to nine export cables running back to shore and associated marine infrastructure such as electrical hubs and navigation buoys.

MarineSpace Ltd (MarineSpace) and MSDS Marine (MSDS), have been commissioned to assess the potential effects of the development and associated works on the archaeological resources within the area as an archaeological Desk Based Assessment (DBA) of the MDZ by MarineSpace. This DBA is intended to act as a supporting reference for the Offshore Archaeology and Cultural Heritage Chapter in an Environmental Impact Assessment (EIA) currently being produced for the project by MarineSpace and Royal HaskoningDHV.

The baseline assessment identified a series of known sites within the MDZ and recognised the potential for a range of other archaeological remains to be present. Known sites include four wrecks within the MDZ and geophysical anomalies of potential anthropogenic origin. The assessment also identified potential for submerged prehistoric deposits in possible post-glacial channels within the western part of the site, and potential for associated prehistoric archaeological remains. Isolated prehistoric and later finds may also be present within the site. In addition to the four known wrecks there is also potential for further unrecorded wrecks and aircraft, wreck material and isolated maritime finds. Additionally, potential has been identified for remains relating to maritime and intertidal activity at Abraham's Bosom.

The sensitivity of these receptors ranges from high to negligible. While the construction details have not yet been determined, a worst-case scenario approach to assessing impacts has been adopted. This assessment identified magnitude of effect ranging from low to high, with impact significance ranging from negligible to major. Potential impacts to a number of heritage assets including known wrecks and geophysical anomalies, potential wrecks, potential post-glacial channels and potential associated archaeological material, potential isolated prehistoric and later finds, potential intertidal remains at Abraham's Bosom and potential aviation remains require mitigation actions to reduce impacts to acceptable levels.

A range of mitigation measures is proposed to reduce effects upon the marine historic environment. These measures are in line with best practice guidance, and in particular with the guidance set out within Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate 2010). These include:

- Creation of a Written Scheme of Investigation (WSI) to cover all future works within the site and to include specification for archaeological involvement;
- Implement the Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate 2014), for the duration of the project;
- Implementation of a watching brief in the intertidal zone;

- Implementation of Archaeological Exclusion Zones around known wreck sites and medium potential geophysical anomalies; and
- Geoarchaeological assessment to accompany any geotechnical investigations which may take place within the site.

There is also potential for other mitigation measures to be adopted as the details of the scheme develop, including avoidance of features within the site, or further investigation to offset the risks of uncertainties within the data, particularly in relation to potential post-glacial channel features within the western part of the site.

Any archaeological work, including the implementation of mitigation measures, should be detailed by a WSI prior to work beginning on site. The requirement for a WSI can be set out within the conditions which accompany a Marine Licence. The WSI and supporting method statements should give details of the methods to be used for mitigation, and of monitoring requirements.

The archaeological impact assessment has identified areas where impacts to the marine archaeological resource from construction of the MDZ and associated infrastructure can be anticipated. Through mitigation these impacts to known and potential heritage assets have been reduced to acceptable limits, and post-mitigation impacts can be considered not significant.

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1. Introduction

1.1. Project Background

Menter Môn Cyf (Menter Môn) is proposing the development of up to 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ), previously known as the West Anglesey Demonstration Zone (or WADZ). The MDZ was formed from an area for lease obtained by Mentor Môn from The Crown Estate in July 2014, with the purpose being to encourage and accelerate marine renewable technology development. The MDZ was identified because the area offers a viable tidal energy resource that has support and access to necessary infrastructure.

To reach the 240 MW target, a selection of Tidal Energy Converter (TEC) devices will be installed offshore in designated berths, still to be determined, across the site. The individual generating capacity of the selected devices installed will influence the total potential number of TEC devices within the MDZ. The energy generated from these devices will be exported from each berth (up to eight berths), via a series of up to nine inter-array export cables, to an export cable that links to a shared landfall and substation for onward transmission to grid. The landfall is expected to be at Penrhos Feilw, an embayment located to the south of South Stack lighthouse. The landfall and substation will be shared with the Minesto development, Deep Green, located in Holyhead Deep, to the west of the MDZ.

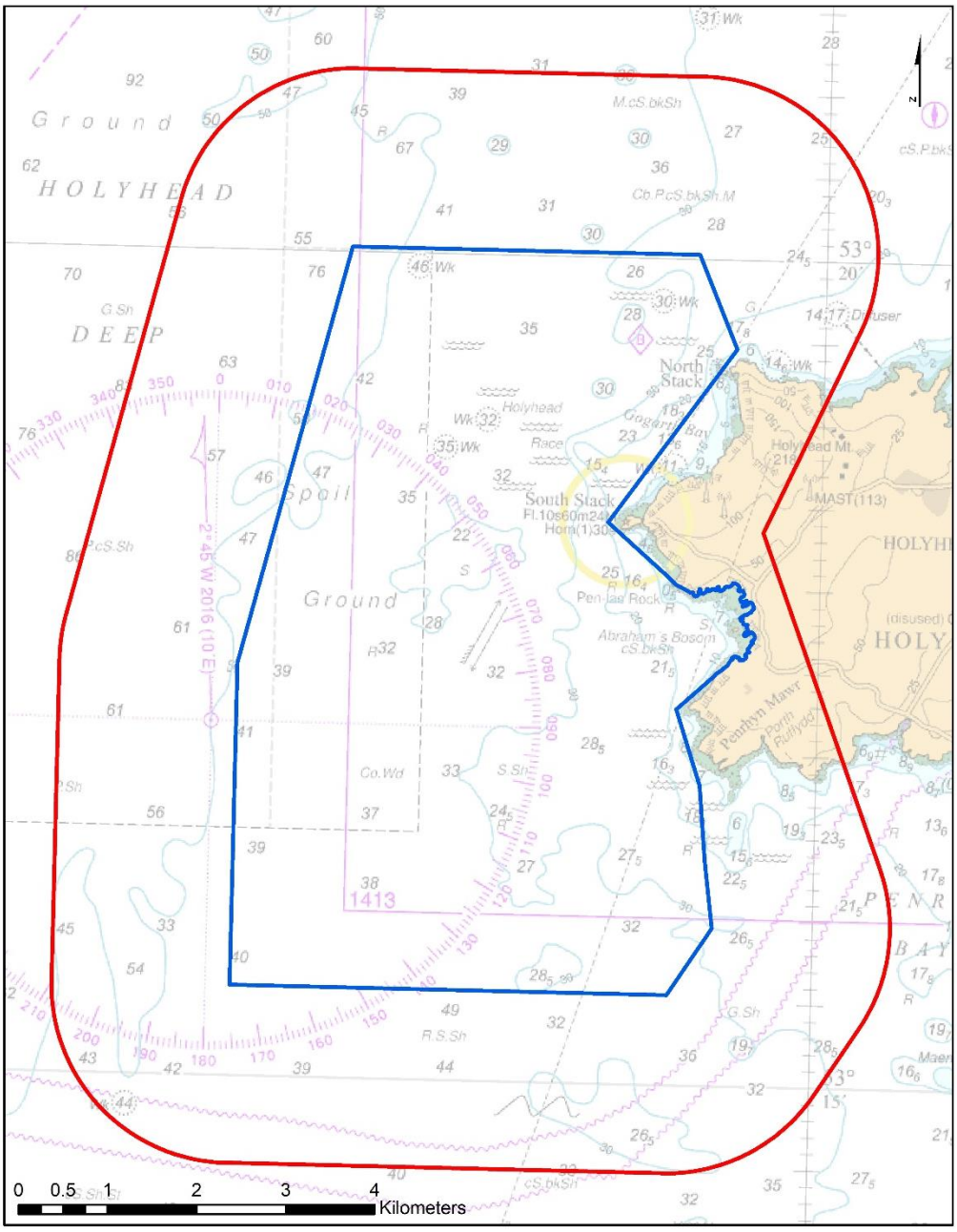
MarineSpace Ltd (MarineSpace), with the assistance of MSDS Marine Ltd (MSDS), has been commissioned to assess the potential effects of the development and associated works on the archaeological resources within the area as an archaeological Desk Based Assessment (DBA) of the MDZ. This DBA is intended to act as a supporting reference for the Offshore Archaeology and Cultural Heritage Chapter in an Environmental Impact Assessment (EIA) currently being produced for the project by MarineSpace and Royal HaskoningDHV. A single Environmental Statement (ES) will be submitted, including both offshore and onshore project components, to support a consent application to the Welsh Government. The ES will also be used to support an application for a Marine Licence (both onshore and offshore components).

The archaeological DBA describes the known prehistoric, maritime and aviation archaeology in the MDZ, and assesses the potential for discovery of currently unknown archaeological sites and materials. The report also identifies potential impacts which may arise and their related receptors, presents an impact assessment and associated results, and where applicable, proposes mitigation measures.

1.2. Study Area

For the purposes of this DBA, a study area comprising the MDZ up to the mean high-water springs (MHWS) and an additional 2 km buffer has been utilised (Figure 1). The use of a 2 km buffer allows the identification and inclusion of relevant information pertaining to archaeological sites and material in close proximity to the boundary of the demonstration zone. It also allows the inclusion of additional information from other developments nearby and provides appropriate context to inform the assessment of archaeological potential. Note, the buffer is reduced to *c.* 300 m above MHWS in the area of the landfall, as this zone has also been assessed by the terrestrial archaeology chapter.

Figure 1.1: Location of the Morlais Demonstration Zone and Study Area



1.3. Aims and Objectives

The aim of this archaeological DBA is to provide an assessment of the known and potential archaeological interests that exist within the study area, and a consideration of the risks to these resources from the effects of development. To achieve this aim, the following objectives are proposed:

- To detail the policy context for the assessment by summarising relevant legislation, policy and guidance relating to the archaeological interests that may be affected by development and works within the study area;
- To identify designated and non-designated heritage assets within the site and study area;
- To assess the potential for currently unrecorded heritage assets within the site and study area;
- To provide an assessment of these known and potential remains based on existing data records and secondary sources;
- To review and assess available geophysical survey data to identify and provide an assessment of features of archaeological interest;
- To summarise the known and potential archaeological interests that may be impacted by the development and works;
- To assess the significance of the known and potential archaeological resources;
- To identify potential impacts and provide an assessment of risk to marine archaeological resources from the proposed development and works; and
- To provide recommendations for mitigation measures and possible conditions to ensure appropriate protection and reporting of archaeological sites and material over the life span of any development.

2. Methodology

2.1. Approach

The methodology adopted for this assessment conforms to archaeological best practice and the standards detailed in the following documents:

- Code of Practice for Seabed Development (Joint Nautical Archaeology Policy Committee, 2008);
- Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011);
- COWRIE Guidance for the cumulative impacts on the historic environment from offshore renewable energy (Wessex Archaeology, 2007);
- Historic Environment Guidance for Wave and Tidal Energy (Firth, 2013);
- Managing Heritage Impact Assessment in Wales (Cadw, 2017a);
- Marine Geophysics Data Acquisition, Processing and Interpretation: Guidance Note (EH, 2013);
- Model Clauses for Archaeological Written Schemes of Investigating: Offshore Renewables Projects (The Crown Estate 2010);
- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011);
- Protocol for Archaeological Discoveries (PAD), (The Crown Estate 2014)
- Standard and Guidance for Historic Environment Desk Based Assessment (Chartered Institute for Archaeologists, 2014); and
- Welsh Government Technical Advice Note 24: The Historic Environment (Welsh Government, 2017a).

2.2. Legislation and Policy Context

Legislation, policy and guidance relating to the marine historic environment within Welsh territorial waters have been collated and assessed. The most notable and relevant examples to the project are summarised below.

2.2.1. International

- The World Heritage Convention 1972;
- United Nations Convention on the Law of the Sea 1982;
- International Council of Monuments and Sites Charter on the Protection and Management of Underwater Cultural Heritage 1996 (the Sofia Charter);
- UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001. Note although the UK has not formally ratified this convention, the UK Government has stated that it has adopted the Annex of the Convention, which governs the conduct of archaeological investigations, as best practice for archaeology;
- European Convention on the Protection of the Archaeological Heritage (Revised) 1992 (the Valletta Convention) – this was ratified by the UK Government in 2000 and came into force in 2001; and

- European Landscape Convention 2000 – adopted in the UK 1st March 2007.

2.2.2. UK

In addition to this, there are a number of Acts and policy documents that relate specifically to maritime cultural heritage within the UK that lies within the 12 nautical mile territorial limit. These are as follows:

2.2.2.1. The Protection of Wrecks Act (PWA) 1973

- Section One – Section One of the PWA 1973 enables the Secretary of State to protect wreck sites from unauthorised interference if they are of archaeological or artistic importance. Under the Act it is an offence to carry out certain activities in a defined area surrounding the site, unless a licence for those activities has been obtained from the Government.
- Section Two – this section of the PWA 1973 provides protection for wrecks that are designated as dangerous due to their contents and is administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (RoW). While Section Two of the Act is not used to designate sites because of their archaeological interest, it is possible that a dangerous wreck designated under this section might also be of archaeological interest.

2.2.2.2. The Protection of Military Remains Act (PRMA) 1996

Under the PMRA 1986, all aircraft that have crashed in military service are protected, and the Ministry of Defence (MoD) has powers to protect vessels that were in military service when they were lost. The MoD can designate named vessels as Protected Places even if the position of the wreck is not known. In addition, the MoD can designate Controlled Sites around wrecks whose position are known. In the case of Protected Places, the vessel must have been lost after 4th August 1914, whereas in the case of a wreck protected as a 'controlled site' no more than 200 years must have elapsed since loss.

For Controlled Sites or Protected Places, it is not necessary to demonstrate the presence of human remains. Diving is not prohibited at a Protected Place and it is an offence to tamper with, damage, move or remove sensitive remains. However, diving, salvage and excavation are all prohibited on Controlled Sites, though licences for restricted activities can be sought from the MoD. Additionally, it is an offence to carry out unauthorised excavations for the purpose of discovering whether any place in UK waters comprises any remains of an aircraft or vessel which has crashed, sunk or been stranded while in military service.

In November 2001, the MoD reported on the Public Consultation on Military Maritime Graves and the Protection of Military Remains Act 1986. The report recommended that a rolling programme of identification and assessment of vessels against the criteria be established to designate all other British vessels in military service when lost, as Protected Places. This process commenced in 2006, and in 2008 the scope of vessels that may be designated by the Act was widened to include merchant vessels.

2.2.2.3. The Ancient Monuments and Archaeological Areas Act 1979

This is a primarily land based Act, but in recent years it has also been used to provide some level of protection for underwater sites. Scheduled Monuments and Areas of Archaeological Importance are afforded statutory protection by the Secretary of State, and consent is required for any major works. The law is administered by Historic England and the Department of Culture, Media and Sport.

2.2.2.4. Merchant Shipping Act 1995

Within the context of the Merchant Shipping Act 1995, 'wreck' refers to flotsam, jetsam, derelict and lagan found in or on the shores of the sea or any tidal water. It includes a ship, aircraft or hovercraft, parts of these, their cargo or equipment. It may be of antique or archaeological value, such as gold coins, or a yacht or dinghy abandoned at sea, or items such as drums of chemicals, or crates of foodstuffs (Definition from the Marine and Coast Guard Agency web site).

The ownership of underwater finds recovered from the sea is decided in line with a set of procedures detailed in the Merchant Shipping Act 1995. If finds are brought ashore the salvor is required to give notice to the RoW that he/she is in possession of the material. This applies whether material has been recovered from within, or outside, UK Territorial Waters.

Ownership of unclaimed wrecks from within Territorial Waters lies with The Crown or with a person to whom rights of wreck have been granted. The Receiver has a duty to ensure that finders who report their finds receive an appropriate salvage payment. In the case of material considered being of historic or archaeological importance, a suitable museum is asked to buy the material at the current valuation and the finder receives the net proceeds of the sale as a salvage payment.

2.2.2.5. The UK Marine Policy Statement

The UK Marine Policy Statement (MPS) (HM Government, 2011) and UK High Level Marine Objectives (HLMO) set out the importance of cultural heritage as a component of delivering sustainable development in the UK through the application of a system of Marine Planning. The documents clearly identify cultural heritage as an important component of decision making and state that non-designated heritage sites should be considered subject to the same policy principles as applied to designated heritage assets (HM Government, 2011, Section 2.6.6.3). According to the MPS, the interest and significance of all heritage assets that may be affected by a proposed development should be identified and properly assessed to minimise conflict.

2.2.2.6. The Future Generations Act 2015

This defines sustainable development as 'the process of improving the economic, social, environmental and cultural well-being of Wales' with the promotion and protection of culture as part of one of its seven well-being goals.

2.2.3. Wales

There are four regional archaeological trusts in Wales that have advisory roles to Cadw. These are Glamorgan-Gwent Archaeological Trust, Dyfed Archaeological Trust, Gwynedd Archaeological Trust

and Clwyd-Powys Archaeological Trust. The Project area is covered by Gwynedd Archaeological Trust. There are a number of Acts and Policies of relevance to this project, for marine archaeology, as follows:

2.2.3.1. The Historic Environment (Wales) Act 2016

This forms part of a suite of legislation, policy, advice and guidance that makes improvements to the existing systems for the protection and sustainable management of the Welsh historic environment. The Historic Environment (Wales) Act became law on 21st March 2016. In conjunction with this, Cadw has started to prepare several policy, advice and guidance documents relating to managing the historic environment which will be subject to amendment as the provisions of the Act alter and will be subject to full public consultation before adoption. This includes Technical Advice Note 24: Historic Environment, which will provide guidance on local development plans, designated assets and archaeological remains.

2.2.3.2. The Planning (Wales) Act 2015

This Act was passed on the 6th July 2015 and makes provision for the preparation and revision of a new National Development Framework for Wales and the production of Strategic Development Plans. Although planning law only applies within the territory of local authorities, which generally extends only to Mean Low Water (MLW), Cadw is fully aware of the significance of seabed prehistory and submerged landscapes, and the importance of a seamless approach to protection.

2.2.3.3. National Planning Policy in Wales (Welsh Government, 2018) and the Historic Environment (Wales) Act 2016

Planning Policy Wales (PPW), edition 10, was published by the Welsh Government in December 2018. This document includes the principal national guidance on the importance, management and safeguarding of the historic environment within the planning process in Wales, and provides advice on all aspects of planning policy in Wales. PPW is supplemented by a series of Technical Advice Notes (TANs) and Circulars issued by the Welsh Office and the National Assembly of Wales. PPW, the TANs, Circulars and policy clarification letters comprise national planning policy in Wales.

2.2.3.4. Draft Welsh National Marine Plan (Welsh Government, 2017b): Seas, Shores and Coastal Areas: Maritime Policy (Countryside Council for Wales, 1996)

This policy covers cultural heritage, historic landscapes and amenity issues. It also stresses the need for sustainable development and holistic management.

2.3. Data Sources

A wide variety of information sources and reference materials has been consulted to inform the assessment. Information has been collated from five heritage databases, comprising:

- List of wrecks designated under the Protection of Military Remains Act, 1986;
- Cadw
    - World Heritage Sites;
    - Protected Wrecks;

    - Scheduled Monuments;
    - Listed buildings;
    - Registered Parks and Gardens; and
    - Registered Landscapes.
- The United Kingdom Hydrographic Office (UKHO)
    - Wrecks, Obstructions and Fouls records;
- Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW)
    - National Monuments Record Wales (NMRW) data;
- Gwynedd Archaeological Trust;
    - Historic Environment Record (HER) data;
- The Receiver of Wreck (RoW)
    - Record of droits relating to recoveries made from the area; and
- Secondary sources consulted include relevant literature from journals, publications and unpublished archaeological reports.

Evidence from these data sources has been collated to create a gazetteer of desk based sources. Entries have the prefix MS_DBA_000. These inform the assessment, and where relevant, are referred to within the text.

A range of site-specific geophysical survey data from the application area has been made available to inform the assessment. The primary data utilised in the assessment are therefore as follows:

- Geophysical survey data undertaken by Partrac in 2018. Including:
    - Multibeam bathymetry data;
    - Sidescan sonar data;
    - Magnetometer data; and
    - Boomer data.

These sources have been assessed and results compiled. Within the gazetteer of geophysical anomalies, entries have the prefix MS_000. These inform the assessment, and where relevant, are referred to within the text.

2.4. Geophysical Survey Assessment

MSDS Marine Ltd (MSDS) was commissioned by MarineSpace to view, and interpret for archaeological potential, the geophysical data from Morlais Demonstration Zone (MDZ). The demonstration zone lies to the west of Holy Island, Anglesey, Wales following the coast of Holy Island and extending offshore, consisting of a total area of 10.3 km x 7.4 km (including the demonstration zone and 1 km buffer).

The data are being interpreted for archaeological potential in order to inform the EIA. The works have been commissioned by Mentor Môn.

2.4.1. Data Format

The multibeam echo sounder, sidescan sonar data, magnetometer data and sub-bottom boomer data were collected by Partrac between 17th April and 19th May 2018. The data cover an area of

approximately 10.3 km x 7.4 km. Table 2.1 provides a summary of the sensors and data formats used in the assessment.

Table 2.1: Summary of Sensors and Data Formats

Survey	Sensor	System	Data Type
Partrac Spring 2018	Multibeam bathymetry	Norbit 0.9°x0.9°, 512 beam system, with integrated inertial navigation system and sound velocity correction	• Processed XYZ • Geotiff
	Sidescan Sonar	Edgetech 4200 (100/400 kHz) digital dual frequency towfish Sonardyne Scout ultra-short baseline (USBL) positioning system	• Raw JSF • Processed CSF
	Magnetometer	Geometrics G882 caesium vapour system piggybacked on the sidescan sonar tow fish	• Processed project • Geotiff
	Sub-bottom profiler (Boomer)	Applied Acoustics CSP-P300 (AAE AA200 Boomer plate & SES Hydrophone)	• Raw COD • Processed SEGY

The high frequency (400 kHz) sidescan sonar data were used for the assessment, as they are the most appropriate for archaeological interpretation.

2.4.2. Project Datum

The project was set up in WGS84 UTM Zone 30N. Where data were provided or imported in other Co-ordinate Reference Systems (CRS) they were transformed within the Geographic Information System (GIS) or with a suitable standalone program such as Franson's CoordTrans.

2.4.3. Review of Data

The sidescan sonar data and sub-bottom profiler data were replayed in Chesapeake Technology's SonarWiz version 7. On completion the sidescan sonar data were mosaicked and navigation and layback offsets were applied, where applicable. The data were assessed for horizons of interest or seabed anomalies of possible anthropogenic origin. Horizons were tagged and polygons drawn around. Anomalies were tagged and measured, and a screenshot saved.

For the geophysical seabed anomalies, an archaeological potential rating was ascribed to each contact based on the criteria listed in Table 2.2.

Table 2.2: Classification of Geophysical Anomalies

LOW	A contact potentially of anthropogenic origin but that is unlikely to be of archaeological interest
MEDIUM	A contact believed to be of anthropogenic origin but that would require further investigation to establish its archaeological potential
HIGH	A contact almost certainly of anthropogenic origin and with a high potential of being of archaeological significance

The contacts were then exported. All data were then loaded into a GIS, along with any other data including, if not previously reviewed, the multibeam bathymetry, magnetometer data and historic records, for further interpretation.

A gazetteer of correlated geophysical anomalies was produced (Appendix A). A list of wreck records and historic environmental records is provided in Appendix B. All geophysical contacts are referred to by the numbers given in this appendix, i.e. MS_0001.

2.4.4. Notes on Interpretation

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

Measurements and boundaries can be taken in SonarWiz, and whilst largely accurate, discrepancies can be noted due to a number of factors. Where there is uncertainty as to the potential of a contact a precautionary approach is always taken to ensure the most appropriate mitigation for the historic environment.

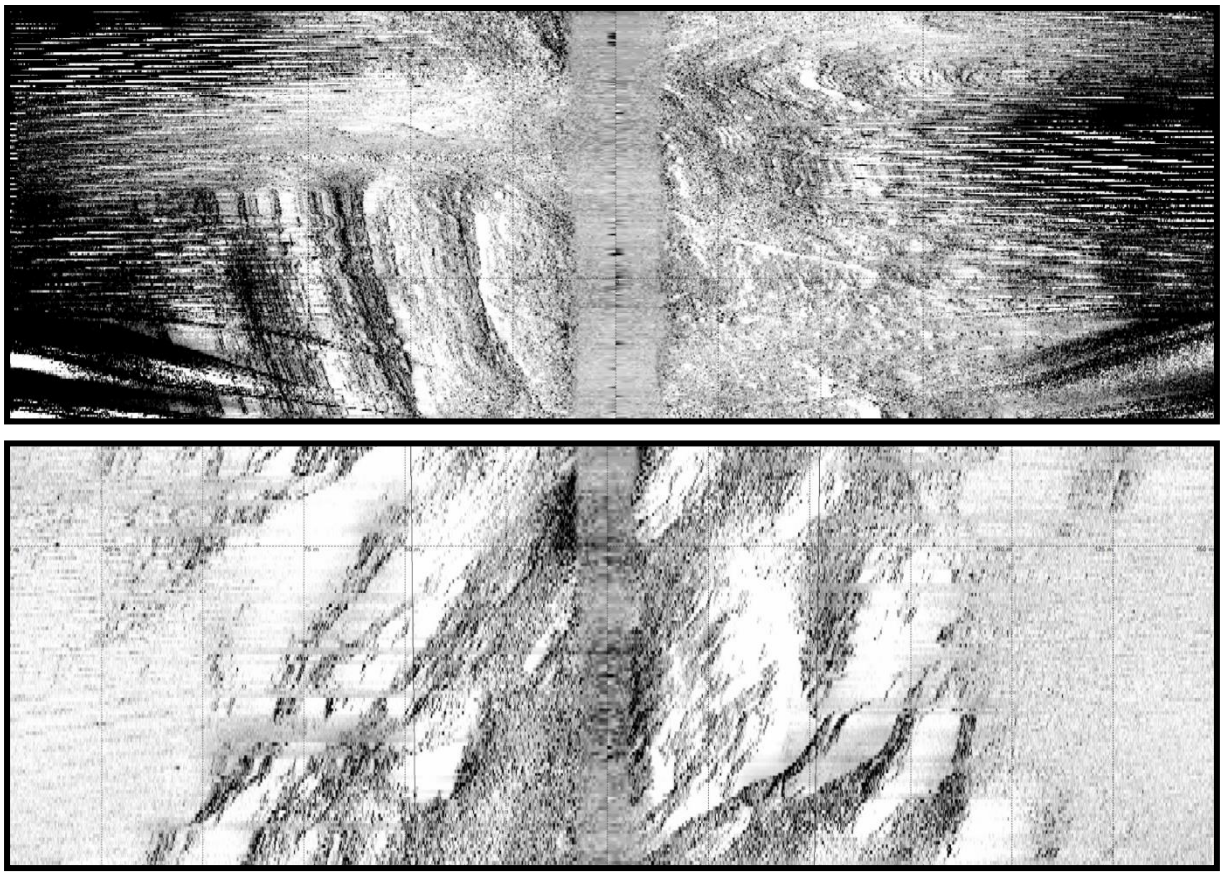
It should be noted that there may be instances where a contact may exist on the seabed but not be visible in the geophysical data, this may be due to being covered by sediment, being obscured from the line of sight from the sonar, or poor quality data.

2.4.5. Data Quality/Confidence

The supplied data were of varying quality, with some weather artefacts present in the data. An example of areas represented by poor quality data in the sidescan sonar data can be seen in Figure 2.1.

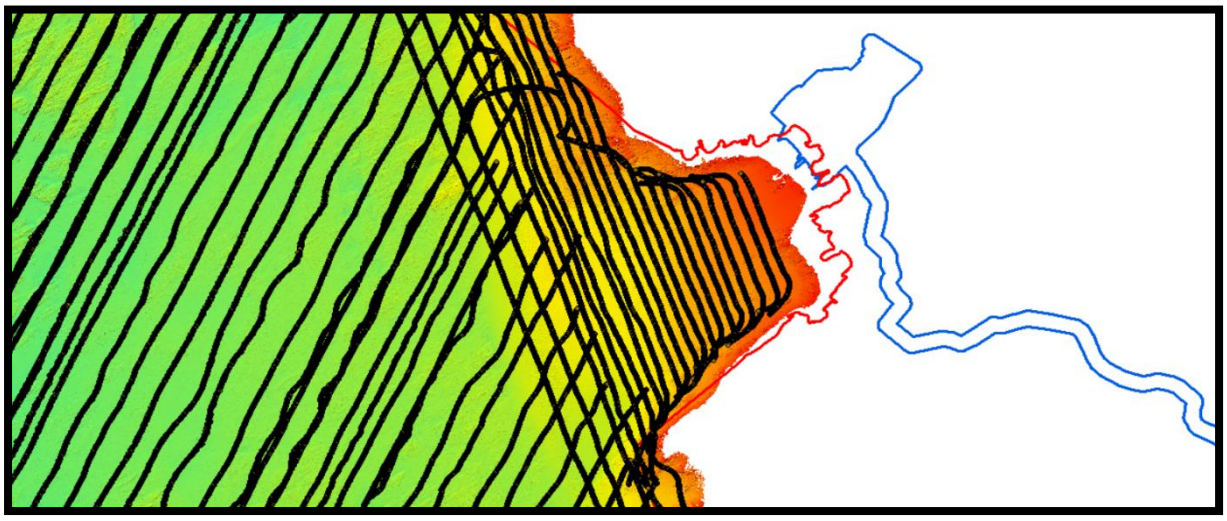
The positioning of the towed sensors was untertaken using a Sonardyne Scout Plus USBL system and is considered more accurate than positioning using layback.

Figure 2.1: Data Examples from Morlais Demonstration Area



Survey lines were defined at 125 m spacing for most of the site with a bearing of 24° (tidal flow direction). Line spacing was decreased to 50 m and 30 m nearshore (Figure 2.2). A total of five crosslines were run across the site for the multibeam bathymetry survey. For magnetometer survey this line spacing does not provide full coverage, therefore a number of known anomalies were not covered or represented by a magnetic response due to the distance from the sensor.

Figure 2.2: Example of Line Spacing, Showing the Nearshore and Offshore Areas



2.5. Desk Based Assessment

The desk based assessment has considered a study area of 2 km buffered around the proposed development site (Section 1.2). Note that the buffer is reduced to 300 m around the landfall area. This is to avoid repetition and duplication of effort, as this area is under consideration as part of the onshore archaeological assessment, which also considers a study area around the site. The size of the study area ensures that data sources provide sufficient information about the proposed development site and its surrounding landscape from which to assess known and potential impacts on the heritage resource. This in turn provides a clearer indication of the proposed development site's history, context and archaeological potential.

In order to provide an assessment of the known and potential maritime and aviation archaeological resources within the MDZ, records of known wrecks, recorded losses and casualty records, named locations, archaeological sites, isolated finds and seabed features were collated. Searches of records held in the UKHO wrecks database, RCAHMW and Gwynedd Archaeological Trust were undertaken. Additional contextual information has been collated from the RoW records of droits and information on designated heritage assets was obtained from Cadw.

UKHO data include details on wrecks and seabed obstructions that have been collated to ensure the safety of navigation at sea. As such, information on the size, position and nature of features on the seabed to ensure safety of navigation is the primary focus of the data, although in a number of cases specific historical detail is provided to establish the identity and nature of loss of a wreck or obstruction.

Data from the Gwynedd Archaeological Trust (GAT) for Historic Environmental Records (HER), Royal Commission of Ancient and Historical Monuments Wales (RCAHMW), Cadw designated sites and records from the RoW have been collected to provide information on the marine historic environment and archaeological interest of sites and features at sea. It is worth noting that some records are often also duplicated between datasets. RCAHMW data constitute records of Known Wrecks where a specific wreck location is known, Recorded Losses linked to casualty records (reports of ships or aircraft seen in distress or lost at sea rather than specific sites on the seabed), isolated Find Spots and Named Locations (records where only approximate or no location data exist). Many of these records are broadly indicative of areas of maritime archaeological potential rather than specific records of wrecks on the seabed.

Once collected, all the data records were loaded into a project GIS to enable analysis and comparison with geophysical data. In addition, a gazetteer of all the recorded maritime and prehistoric archaeological sites, features and materials has been produced. All assets are referred to by the numbers given in this appendix, i.e. MS_DBA_0001 etc.

2.6. Assessment of Impact

Following identification of the heritage assets within the site and their significance, the report identifies the proposed changes and assesses the impacts of these changes upon the historic environment. The impact assessment makes specific reference to any alterations to the evidential, historic, aesthetic and communal values of the heritage assets.

The impact assessment follows an approach to making a balanced assessment for the project, guided by Royal HaskoningDHV, MarineSpace and technical specialists using available data, new data, experience and expert judgement. Impacts are considered to include direct impacts, indirect impacts, inter-relationships between impacts, and cumulative impacts.

The approach to impact assessment is summarised here.

For each effect, the assessment identifies receptors within the study area that are sensitive to that effect and implements a systematic approach to understand the impact pathways and the level of impacts on given receptors. The process considers the following:

- The sensitivity of a receptor to the effect;
- The probability that an effect-receptor interaction will occur;
- The magnitude of the effect;
- The determination and (where possible) qualification of the level of impact on a receptor, considering the probability that the effect-receptor interaction will occur, the spatial and temporal extents of the interaction and the significance of the resulting impact; and
- The level of certainty at all stages.

2.6.1. Sensitivity of Heritage Assets

The overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance and recoverability. This is achieved through applying known research and information on the status and sensitivity of the feature under consideration coupled with professional judgement and past experience.

In summary, the sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected, and is defined by the following factors:

- Vulnerability: whether a particular effect has the ability to impact a receptor;
- Adaptability: the degree to which a receptor can avoid or adapt to an effect;
- Tolerance: the ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
- Recoverability: the temporal scale over, and extent to, which a receptor will recover following an effect; and
- Value: a measure of the receptor's conservation importance, rarity and worth.

In order to define the sensitivity of a receptor, the guidelines presented in Table 2.3 have been adopted in this ES. Note that for heritage assets direct physical impacts will be permanent and irreversible. However, indirect impacts such as changes to sedimentation may be reversible or subject to alteration following removal or decommissioning of the development. Any loss of sediment and erosion of heritage assets will not be reversible, but where heritage assets are protected by the accumulation of deeper sediment, this may be considered a reversible change.

Table 2.3: Definitions of the Sensitivity Levels for Environmental Receptors

Sensitivity	Description
High	Individual receptor has very limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to avoid, adapt to, accommodate or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

It should be noted that the sensitivity criterion is a composite one; combining value (see Section 2.6.2) with sensitivity. In some instances, the inherent value of a receptor is recognised by means of designation, and the 'value' element of the composite criterion recognises and gives weight in the assessment to that designation. However, irrespective of the recognised value, all receptors will exhibit a greater or lesser degree of sensitivity to the potential changes brought about by the proposed scheme. It should be noted that the assessment of sensitivity is a matter of judgement applied by professional experts based on the receptors within the relevant study area.

2.6.2. Receptor Value

The UK Marine Policy Statement indicates that authorities should take account of the particular nature of the interest in the (heritage) assets and the value they hold for this and future generations.

Both designated and non-designated heritage assets can hold heritage value. Value considers whether, for example, the receptor is rare, has protected status or has importance at a local, regional, national or international scale. Designated heritage assets, such as Protected Wrecks, have high value.

For non-designated assets, significance (value) is best defined by Cadw's 'Conservation Principles' (2011), which describe value as a combination of evidential value; historical value; aesthetic value; and communal value. Evidential value derives from the physical fabric of an asset and its ability to provide evidence relating to how the asset was made and used and how this changed through time. Historical value can derive from particular aspects of past ways of life, or association with notable families, persons, events or movements – it is the connection between past events and society with the present. Aesthetic value relates to the design, construction and craftmanship of an asset. It can include setting and views to and from the asset, which may have changed through time. Communal value derives from the meanings that an historic asset has for the people who relate to it, or for whom it figures in their collective experience or memory. It may be commemorative, spiritual or symbolic, such as meaning for identity or collective memory.

It is important to understand that high value and sensitivity are not necessarily linked within a particular impact. A receptor could be of high value but have a low or negligible sensitivity to an effect.

Table 2.4 provides definitions for the value afforded to a receptor based on importance with regard to legislation and guidance.

Table 2.4: Definitions of the Value Levels for Heritage Assets

Value	Definition
High	Internationally or nationally important. Within a marine or intertidal context, high value heritage assets include: World Heritage Sites and heritage assets of acknowledged international importance, or that can contribute significantly to acknowledged international research objectives. Sites designated under the Protection of Wrecks Act, Ancient Monuments and Archaeological Areas Act or Protection of Military Remains Act. Grade I and Grade II* structures designated under the Listed buildings and Conservation Areas Act Additionally, in line with the UK Marine Policy Statement, any remains which are not currently designated but have equivalent significance to a designated asset are also considered to be of high value.
Medium	Within a marine or intertidal context, medium value receptors include: Heritage assets that are not designated and that do not meet the criteria for designation (e.g. as a Protected Wreck or scheduled monument) but display evidential, historic, aesthetic or communal value as identified by Conservation Principles. Heritage assets, or groups of assets or landscapes, that contribute to regional research objectives, particularly those identified in the research framework for North West Wales.
Low	Within a marine or intertidal context, low value receptors include: Heritage assets displaying limited evidential, historic, aesthetic or communal value as identified by Conservation Principles. Heritage assets, or groups of assets, that contribute to a limited degree to regional research objectives, particularly those identified in the research framework for North West Wales.
Negligible	Heritage assets with very little or no surviving archaeological interest, and little or no evidential, historic, aesthetic or communal value as identified by Conservation Principles. Heritage assets or groups of assets that cannot appreciably contribute to acknowledged regional research objectives.
Uncertain	Heritage assets for which the importance of the resource has not been ascertained. Archaeological resources the importance of which cannot be ascertained.

2.6.3. The Magnitude of Effect

In order to predict the significance of an impact, it is fundamental to establish the magnitude and probability of an impact occurring through a consideration of (CIEEM, 2018):

- Scale or spatial extent: the area over which an effect occurs (small scale to large scale or a few individuals to most of the population);
- Duration: the time for which the effect occurs (short-term to long-term);
- Likelihood of impact occurring;
- Frequency: how often the effect occurs;
- Nature of change relative to the baseline: positive or negative; and
- Reversibility: the degree of change relative to existing environmental conditions.

Table 2.5 is in line with the wider methods used in this EIA for judging magnitude of effect, but relates specifically to heritage assets.

Table 2.5: Guidelines Used in the Determination of Magnitude of Effect

Magnitude	Description
High	Total loss of resource and/or integrity of the resource; or severe damage to key characteristics, features or elements (adverse) such that the heritage asset is lost or its significance is totally altered. Permanent/irreplaceable change, which is certain to occur. Large scale improvement of resource or attribute quality; extensive restoration or enhancement (beneficial).
Medium	Loss of, or alteration to key characteristics, features or elements; measurable change in significance, attributes, quality or vulnerability (adverse) such that the heritage asset and its significance is altered. Improvement to, or addition of key characteristics, features or elements of the resource; improvement to attribute quality (beneficial).
Low	Minor loss of, or small alterations to, one or a small number of characteristics, features or elements; noticeable change in attributes, quality or vulnerability (adverse). Minor improvement to, or addition of, one or a small number of characteristics, features or elements; very minor improvement to attribute quality (beneficial).
Negligible	No change or unquantifiable change to the receptor and its significance.

2.6.4. Impact Significance

Subsequent to establishing the sensitivity and magnitude, the impact significance is predicted by using quantitative or qualitative criteria, as appropriate, to ensure a robust assessment. The significance of the potential impacts is assessed on the scale, degree or intensity of disturbance to the baseline conditions. Four levels of magnitude are used: high; medium; low; or negligible, as defined in Table 2.5.

Impact statements carry a degree of subjectivity, as they are based on expert judgement regarding the effect-receptor interaction that occurs and on available data. As such, impact statements should be qualified appropriately. The table presented in Table 2.6 has been used to aid assessment of impact significance, combined with the application of expert judgement, to facilitate a consistent approach throughout the EIA.

By combining the magnitude of the impact and the sensitivity of the receptor in a matrix (see Table 2.6), the final significance of the impact (prior to the implementation of mitigation measures) can be obtained.

Table 2.6: Impact Assessment Matrix

		Negative Magnitude				**Beneficial Magnitude**			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Definitions of impact significance are provided in Table 2.7**,** and are defined in relation to marine legislation and policy regarding heritage assets. In the context of EIA, 'significant impacts' are taken to be those of moderate or major significance (as defined in Table 2.7) and mitigation is proposed for all

such impacts; albeit that appropriate mitigation, where available, will also be sought for all impacts. Whilst minor impacts would not be deemed to be significant in their own right, they may contribute to significant impacts through inter-relationships or cumulative impacts.

Table 2.7: Impact Significance Definitions

Value	Definition
Major Negative	Substantial harm or total loss of the value of a designated heritage asset (or asset worthy of designation) such that Development should not be consented unless substantial public benefit is delivered by the Development.
Moderate Negative	Less than substantial harm or total loss of the value of a designated heritage asset or an asset of designable quality such that the harm should be weighed against the public benefit delivered by the Development to determine consent. Harm to a non-designated heritage asset, of a greater degree than that perceived of as Slight Adverse, which should be taken into account in determining an application.
Minor Negative	Harm to a non-designated heritage asset that can be adequately compensated through the implementation of a programme of industry standard mitigation measures. Less than substantial harm to the value of a designated heritage asset, of a lesser degree than that perceived as Moderate Adverse, but which should still be weighed against the public benefit delivered by the Development to determine consent.
Negligible	No discernible change in receptor.
Minor beneficial	Development will deliver a positive contribution and/or better reveal the value of a non-designated heritage asset.
Moderate beneficial	Development will deliver a positive contribution and/or better reveal the value of a designated heritage asset (or asset worthy of designation) such that an application should be treated favourably.
Major beneficial	Development will deliver a positive contribution and/or better reveal the value of a heritage asset of recognised international value such that an application should be treated very favourably.

It should be noted that any residual impact (the impact after the implementation of mitigation) which remains at the level of 'moderate' or 'major' is regarded by the EIA Regulations as being significant.

2.6.5. Confidence

Once an assessment of a potential impact has been made, it is necessary to assign a confidence value to the assessment to assist in the understanding of the judgement. This is undertaken on a simple scale of high-medium-low, where high confidence assessments are made on the basis of robust evidence, with lower confidence assessments being based, for example, on extrapolation and use of proxies.

2.6.6. Mitigation Measures

Mitigation measures will be put in place for any significance impacts of moderate (negative) or above. Additionally, wherever possible any significance impacts where a negative outcome is expected will also be considered for mitigation.

A range of mitigation measures for impacts to heritage assets exists. Following the best practice guidance set out within the Model Clauses for Archaeological Written Schemes of Investigating: Offshore Renewables Projects (The Crown Estate 2010) and professional experience, such measures can include:

- Avoidance of impacts through use of archaeological exclusion zones (AEZs);
- Archaeological input into geotechnical investigations and geoarchaeological assessment;
- Archaeological input into geophysical investigations and archaeological review of data;
- Watching briefs;
- Archaeological investigations using divers or ROVs; and
- Protocols for Archaeological Discoveries (PADs).

Note that many of these measures also form part of the process of investigation, and can be included at any stage of the development process.

2.6.7. Residual Impacts

Where further mitigation measures are identified, the significance of the residual environmental impact (i.e. the post-mitigation impact) has been re-assessed and residual impacts described.

Where no mitigation measure is proposed, a discussion explains why the impact cannot be reduced.

3. Baseline Characterisation

3.1. Palaeoarchaeological Assessment

In the British Isles, submerged prehistoric archaeology relates to the period from the earliest known human occupation in the Lower Palaeolithic (c. 970,000 years BP) to the final inundation of the English Channel around 8000-6000 years before present (BP), when the coastline assumed roughly its current form. Evidence from this period relates to palaeoenvironmental remains indicating formerly terrestrial landscapes which were exposed at times of glacially controlled sea level regression, landscape features, or artefacts such as stone tools and faunal remains indicating human presence and use of this landscape.

The components of the potential for palaeolandscapes in the vicinity of the MDZ rely on the relationship between the solid geology (bedrock) and the Quaternary deposits. An assessment using relevant research papers and publications, alongside geophysical or geotechnical data, is undertaken in this chapter.

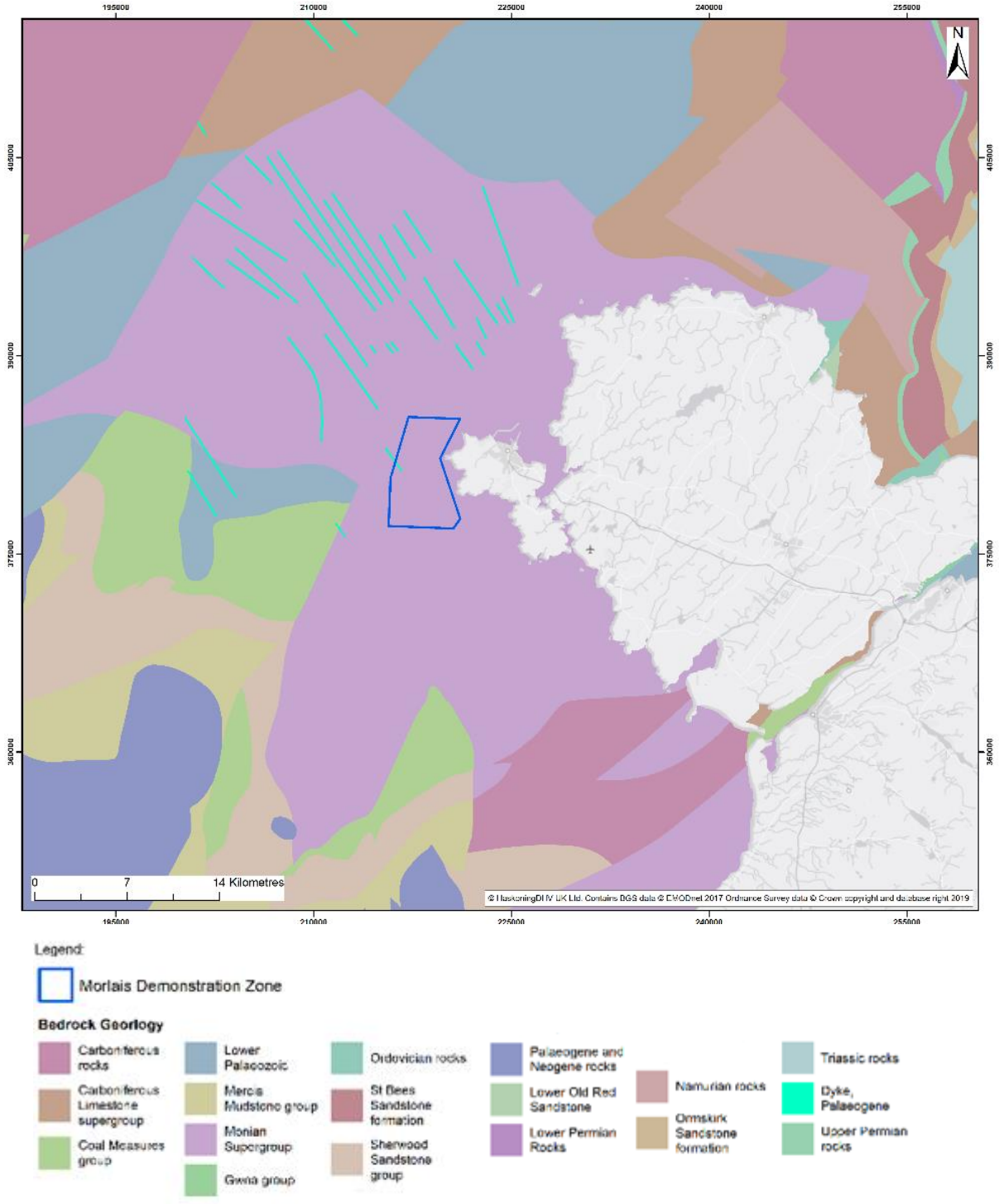
The objectives of the palaeolandscape review are to inform the assessment of the character and nature of the palaeolandscape archaeological potential of the area and the resource sediments, and to provide a baseline from which the impacts from the development can be assessed. Sub-bottom profile data over the MDZ have been reviewed to assess the presence of any potential palaeolandscape features.

3.1.1. Solid Geology (Bedrock)

The MDZ is situated west of Holy Island and Anglesey, in an offshore area known as the Holy Island Shelf. Holy Island Shelf is identified as an inlier of Pre-cambrian metamorphic bedrock fringed to the north and west southwest with Lower Palaeozoic (undivided) sedimentary strata (Jackson *et al.*, 1995). This bedrock, like the bedrock on areas of Anglesey, is part of the Monian Supergroup (Figure 3.1), comprising Holy Island, New Harbour and Gwna Groups (Mellett *et al.,* 2015). It is thought to have formed more than 570 million years (Ma) ago, although there is some debate that the formation may extend into the Cambrian (Gibbons, 1983; McIlroy and Horak, 2006). The Monian Supergroup comprises gneisses, schists and igneous rocks, overlain by extrusive igneous rocks (Jackson *et al.*, 1995). The igneous rocks are mostly volcanic-arc types, although some, as with the Gwna Group, show affinities with ocean floor basalts (Jackson *et al.*, 1995).

The Holy Island Shelf to the west and north of South Stack is cut by Anglesey dykes of Tertiary age, orientated north-northwest to south-southeast (Figure 3.1; Jackson *et al.*, 1995). These dykes are thought to be igneous in origin (Dolerite) (BGS, 2017) formed during a period of regional extension in the Palaeocene, resulting from a major north-south uplift (Jackson *et al.*, 1995) as part of the final breakup of Pangea and the early stages of the opening of the Atlantic Ocean.

Figure 3.1: Solid Bedrock Geology of the Region Surrounding the MDZ (Source: EMODnet (2019))



3.1.2. Quaternary Deposits

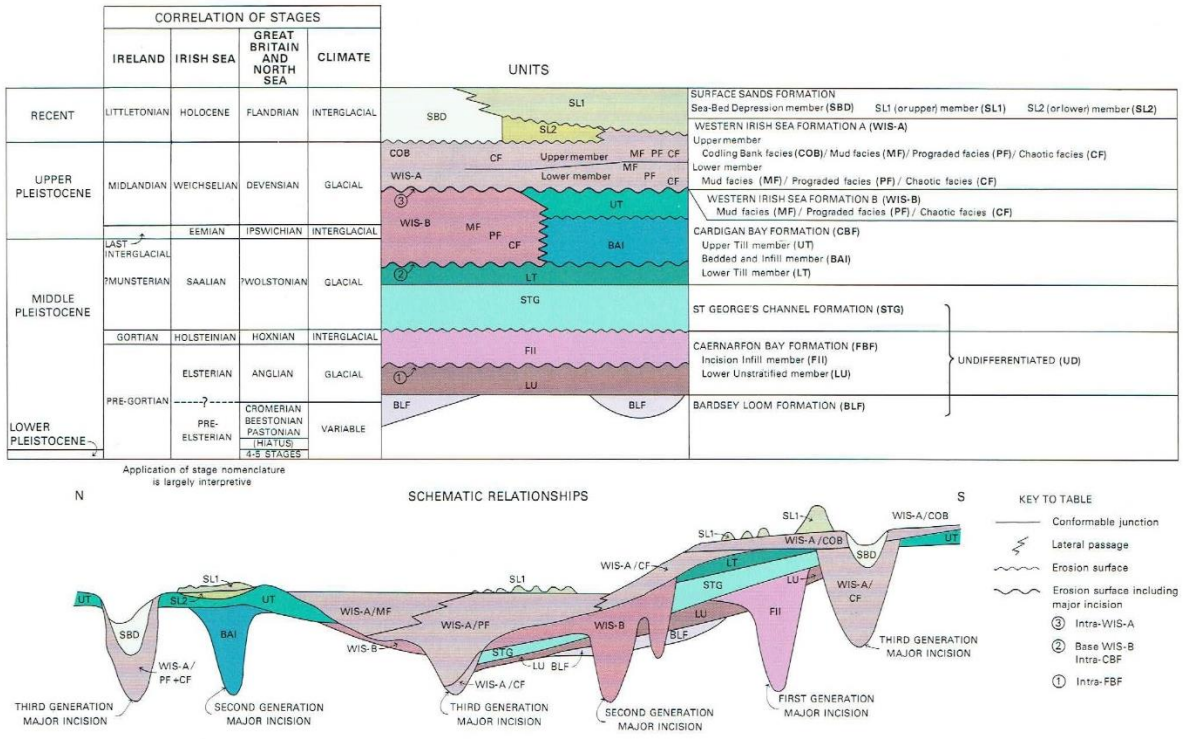
The Quaternary, covering approximately the last 2 million years, was marked by several glacial and interglacial stages which resulted in significant sea level fluctuations. Over the course of the Pleistocene, three major glaciations occurred - the Anglian (approximately 478,000 BP-423,000 BP), the Wolstonian (approximately 380,000 BP-130,000 BP) and the Devensian (approximately 100,000 BP-13,000 BP).

During glaciations, much of the current Irish Sea basin and surrounding areas would have been under thick ice sheets. Thomas (1985) reports that during the last glaciation, plus potentially most of the preceding glaciations, ice generally flowed from source areas in the north into the Irish Sea basin, and onwards in a south and southeasterly direction, carrying a significant component of far-travelled erratic rock types from mountainous source areas. This indicates a high potential for ice movement from the latest glaciation to have stripped any, or all, pre-existing sediment from the Holy Island Shelf by basal erosion. Towards the Kish Bank Basin and Caernarfon Bay Basin, there is a higher potential for pre-existing sediments to have survived subsequent glaciations, with thin layers of marine sediments separating successions of deposition, however, these are outside of the MDZ.

BGS (1994) indicates that, where present, the Quaternary geology of the area consists mainly of Late Weichselian (Devensian) to Early Holocence sediments, with a lithological description of Diamiction (till). This is confirmed by Jackson *et al.* (1995) with two formations identified as potentially present within the MDZ; the contemporaneous Cardigan Bay Formation (CBF) and Western Irish Sea Formation (WISF) (Figure 3.2). Stoker (2011) also confirms that these units were derived from ice streams sourced in southwest Scotland, northwest England, Wales and Ireland, and comprise subglacial and proglacial sediments (Roberts *et al*., 2007; Stoker *et al*., 2011).

The WISF is similar in character and geometry to deposits of the CBF, as well as other formations in the area: Caernarfon Bay and St George's Channel Formations. The two formations are described here to provide a context for the sub-bottom seismic data interpretation.

Figure 3.2: Quaternary Stratigraphy with Schematic Section for the Irish Sea Region based on BGS Quaternary Geology Sheets (Source: Jackson *et al*., 1995)



The CBF has Upper and Lower Till members formed of tabular unstratified deposits mainly comprising till, plus a bedded deposit that lies between the two Till members (Figure 3.2; Jackson *et al.*, 1995). The Lower Till member has an erosion surface at its base, with internal deposits characteristically

exhibiting discontinuous, high angle reflectors that produce a chaotic acoustic character and has been classified as a subglacial lodgement till (Jackson *et al.*, 1995). Jackson *et al.* (1995) indicate that where the Lower Till member is directly overlain with the Upper Till member, the two members are difficult to differentiate seismically. The Upper Till member comprises stiff or hard clay with clasts ranging in size from sand to cobbles and boulders up to 1 m in diameter, as identified in a number of cores (Jackson *et al.*, 1995), and is possibly linked to subglacial deposition.

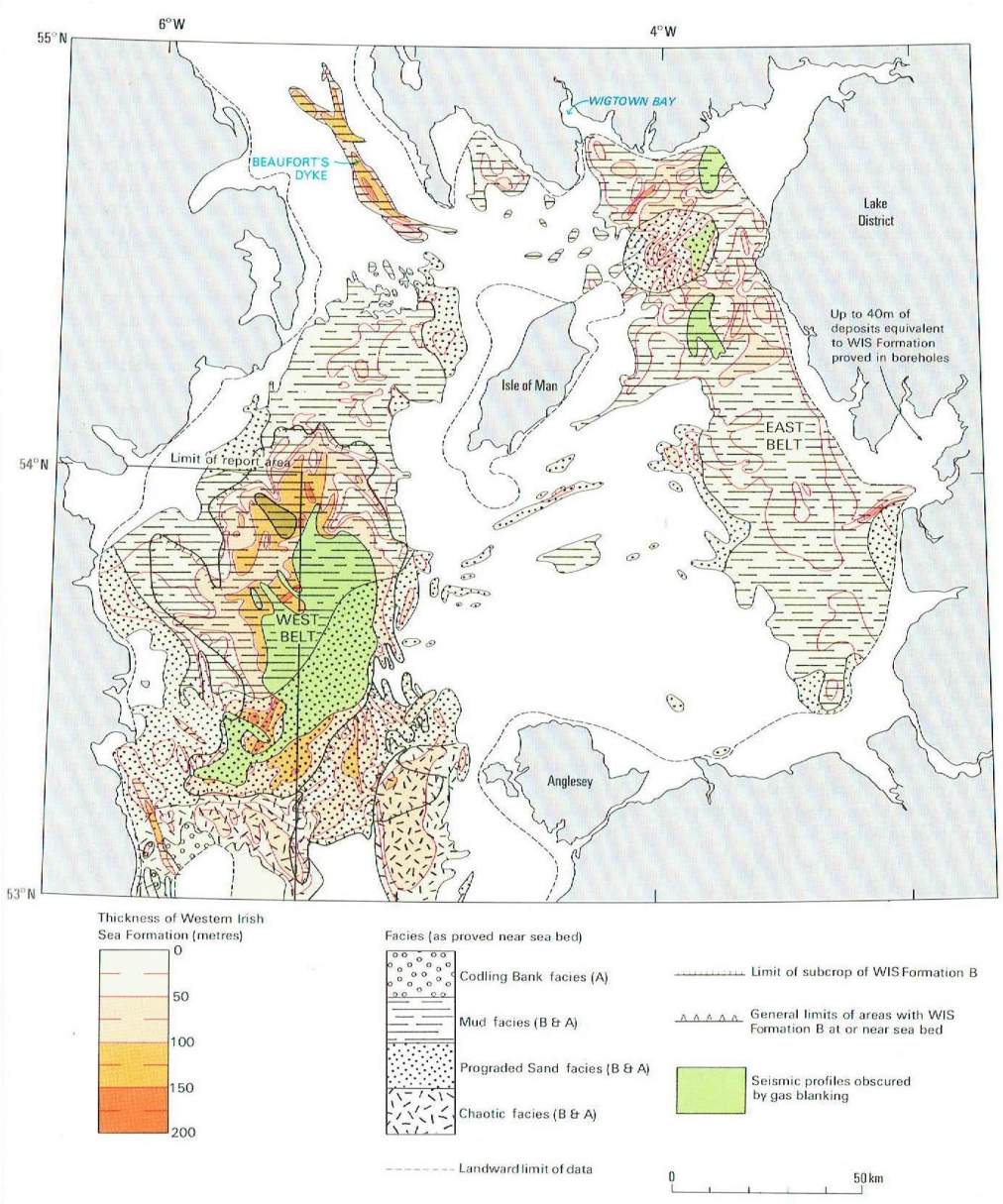
The WISF has been defined as comprising two Units; WISF A and WISF B (Figure 3.2; Jackson *et al.*, 1995). The lower unit, WISF B, comprises incision infills, with younger tabulated stratified deposits; whilst the upper unit, WISF A, sits on an erosion surface (or unconformity), which is seismically similar to the WISF B (Jackson *et al.*, 1995). The erosion surface can, locally, cut through the WISF B into older sediments to produce major incisions. Jackson *et al.*, (1995) summarised these facies as the following and the area of the MDZ is likely situated amongst chaotic facies (Figure 3.3; Mellet *et al.,* 2015):

- Chaotic facies: occur in basal parts of both major incision infills or tabular stratified deposits and are dominantly mud, sands, cobbles and boulders likely laid down during glaciation in glaciolacustrine and glaciomarine, ice proximal conditions. Typically, the acoustic signature is amorphous, lacking reflectors, or of high-angle, impersistent and irregular reflectors;
- Prograded facies: occur to the north and west of the MDZ as prograded wedges of fine-medium grained sands, displaying seismically prograding reflectors. Likely deposited in prodeltaic and glaciomarine environments, indicating ice retreat and representing the transition from ice-proximal to fully marine conditions with the onset of the Holocene transgression (X); and
- Mud facies: occur in two main belts northeast and northwest of the MDZ. They are seismically near transparent with parallel, sub-horizontal reflectors indicating tabular stratified units with occasional drop stones. Likely post-glacial Holocene sediments deposited as distal, glaciomarine and marine deposits.

The retreat of the ice sheet after the Last Glacial Maximum (LGM) and the history of the Irish Sea have been the subjects of recent study - it has been suggested that relative sea levels slowly fell in the late Pleistocene (around 14,000 years BP) before rising rapidly in the early Holocene (12,000-6,000 years BP) and slowing during the middle to late Holocene, where it is likely to have been only a few metres lower than at the present (Roberts, 2006). This indicates that the area may have been subject to a terrestrial environment in the early Holocene, with coastal and marine processes dominating from the mid-Holocene (from approx. 6,000 years BP) to present.

The latest Quaternary deposits in the region comprise the Surface Sands Formation (SSF) and include the products of Holocene and modern-day processes (Stoker *et al*., 2011). Deposits of this formation are generally absent offshore, or less than 2 m thick, unless infilling major incisions, but can be thicker in nearshore and intertidal areas. The base of the Formation is generally identified as an unconformity and partially or completely fills hollows cut into the WISF or bedrock (Jackson *et al.*, 1995). The SSF is divided into three members: the Sea Bed Depression (SBD), Lower (Sediment Layer 2 (SL2)) and Upper (Sediment Layer 1 (SL1)) members (Figure 3.2).

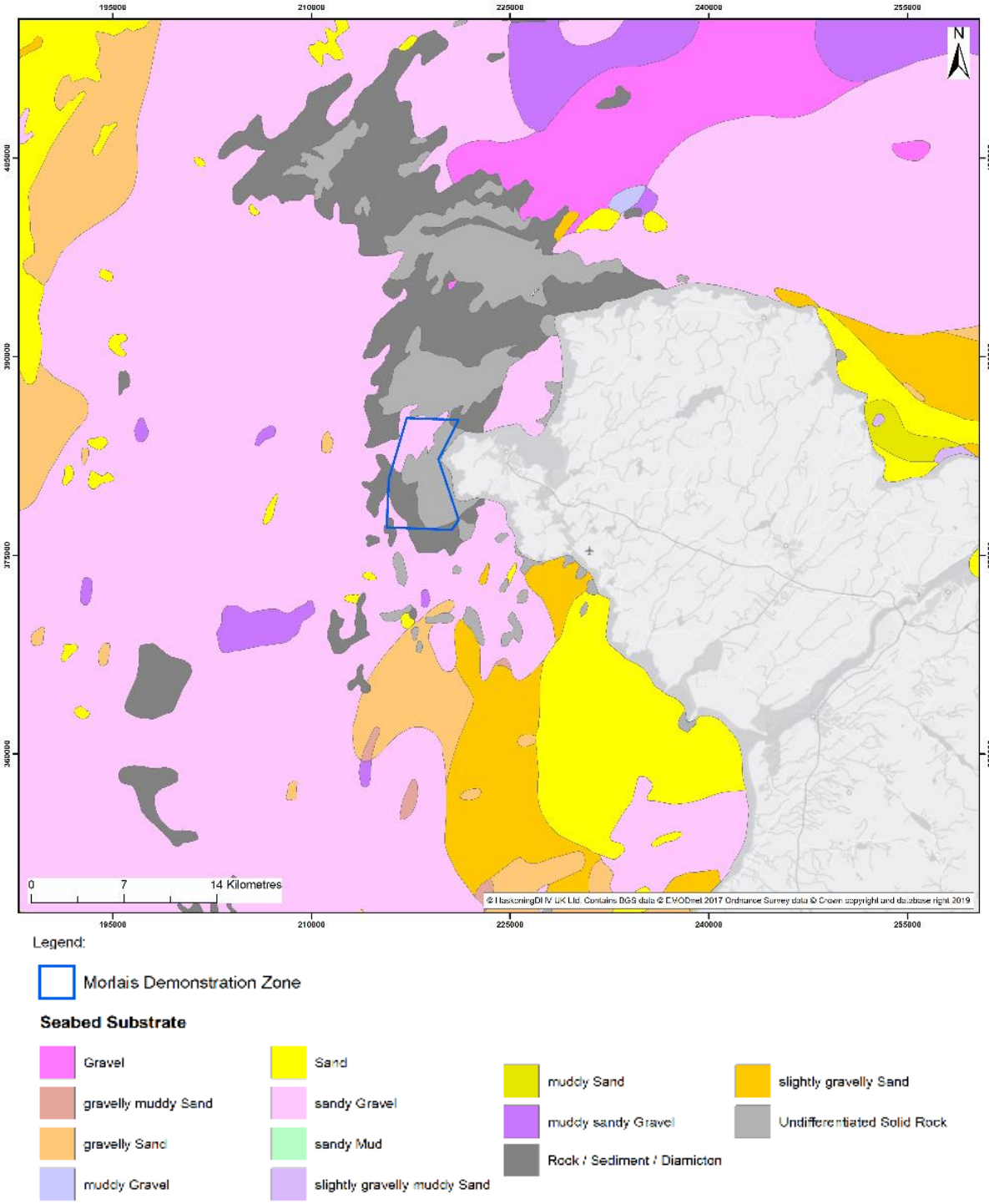
Figure 3.3: Distribution Thickness and Facies of the WISF (Source: Jackson *et al*., 1995)



The SBD is mainly identified as an infill over WISF incisions, comprising marine sediment of sandy silt with shell debris. The Lower SL2 member is diachronous and of varied lithology, and generally formed on a surface erosion during Holocene marine transgression comprising intertidal and marine sediments. The Upper SL1 member overlies an erosion surface across the SL2 member, SBD or older strata; and represents modern marine sediments (Jackson *et al.*, 1995).

The BGS (1990) Seabed Sediments chart of Anglesey is less detailed and indicates that the MDZ consists of rock substrate with local and/or intermittent cover of mobile and lag sediment in the nearshore (Figure 3.4). This is bordered by an inconsistent band from the northwest of the MDZ through the centre to the southwest, consisting of scattered rock within mobile and lag sediment cover, with some sandy Gravel areas in the offshore. The BGS (1990) indicates that offshore there is less potential for finer sediment as it is likely to have been winnowed out by strong tidal processes, leaving a coarser surficial sediment.

Figure 3.4: Seabed Substrates in the MDZ Region (Source: EMODNET – BGS)



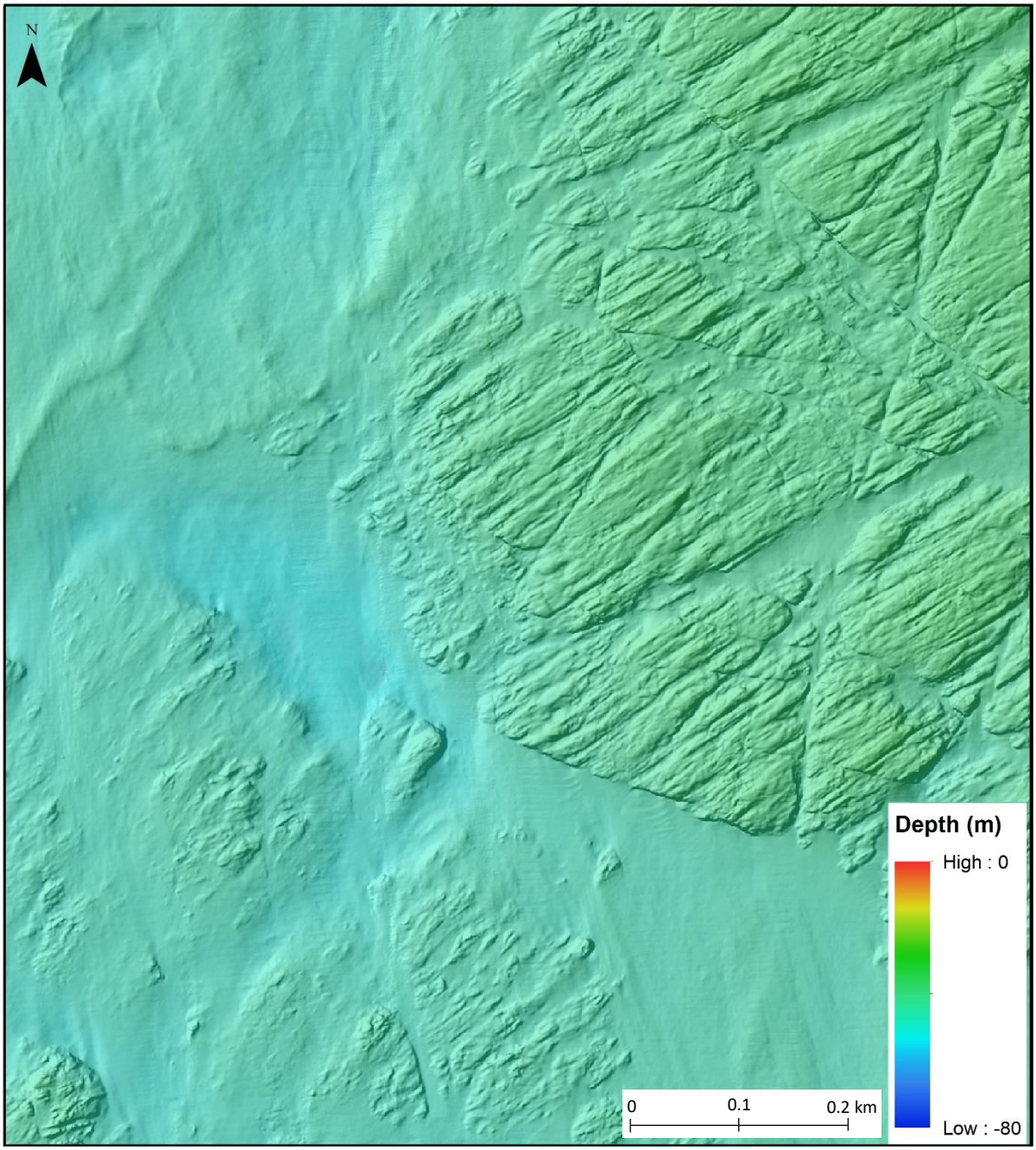
3.1.3. Morlais Development Zone

Interpretation of seismic data collected across the MDZ indicates that throughout much of the central and east of the site there is a large platform of exposed outcropping and partially covered Pre-cambrian metamorphic bedrock, forming part of the Holy Island Shelf. This bedrock platform extends up to 4 km offshore, dipping towards the west. Further smaller outcrops occur offshore, displayed in Figure 3.5. The bedrock outcrop displays defined striations, linked to the rock formation and

associated bedding planes, and incisions, likely linked to glacial processes, criss-crossing the surface (Figure 3.5**Error! Reference source not found.**).

Between the areas of outcrop, the striations and incisions have been infilled. The infill sediment is generally interpreted as glacial till, probably the tabular stratified deposits of the chaotic facies of WISF A (Jackson *et al*., 1995). However, due to the acoustic similarity of this unit with the WISF B, this identification is uncertain. A core located to the southwest of the MDZ (BGS, 2019), reaching a penetration of 0.2 m, records a shelly sand over grey boulder clay with pebbles, and appears to broadly confirm the identification of the deposit as glacial till.

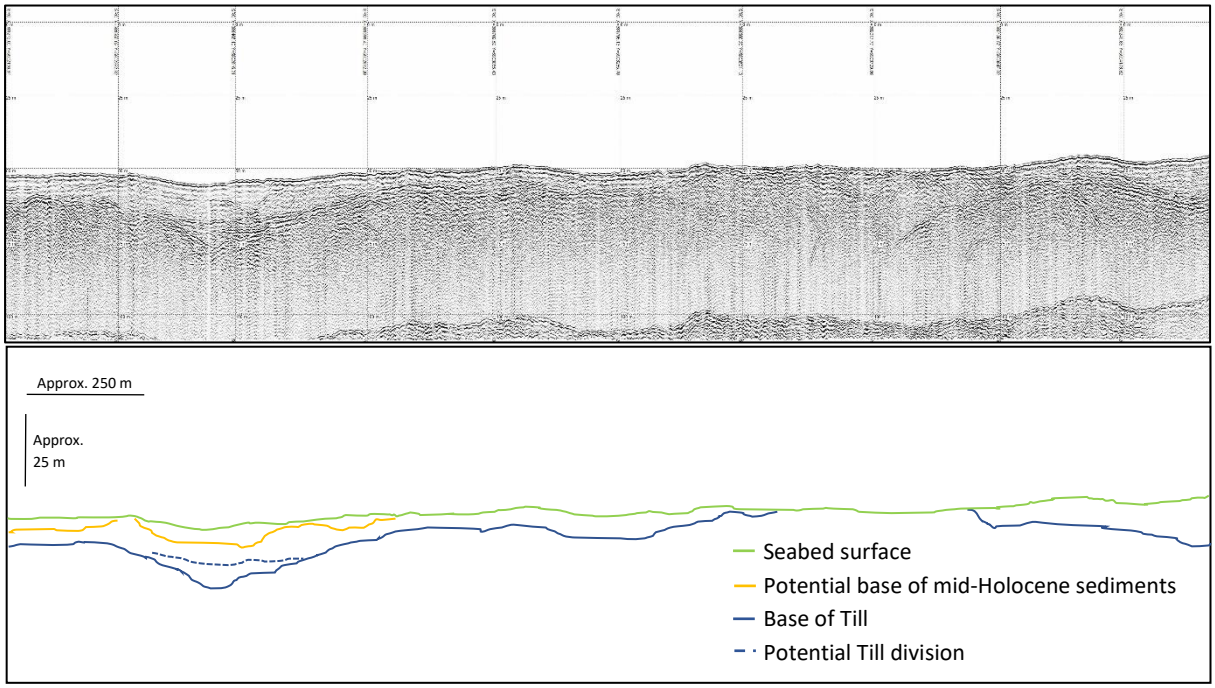
Figure 3.5: Multibeam Bathymetry Data Example of Striations and Incisions present in the Outcropping Bedrock Platform and Presence of Outcropping Bedrock Further Offshore



The deepest areas of sediment cover are found in the southwest of the MDZ, where the bedrock dips to 29 m below the seabed (Partrac, 2018). With the increase in sediment thickness, there is a change to more complex Quaternary deposits.

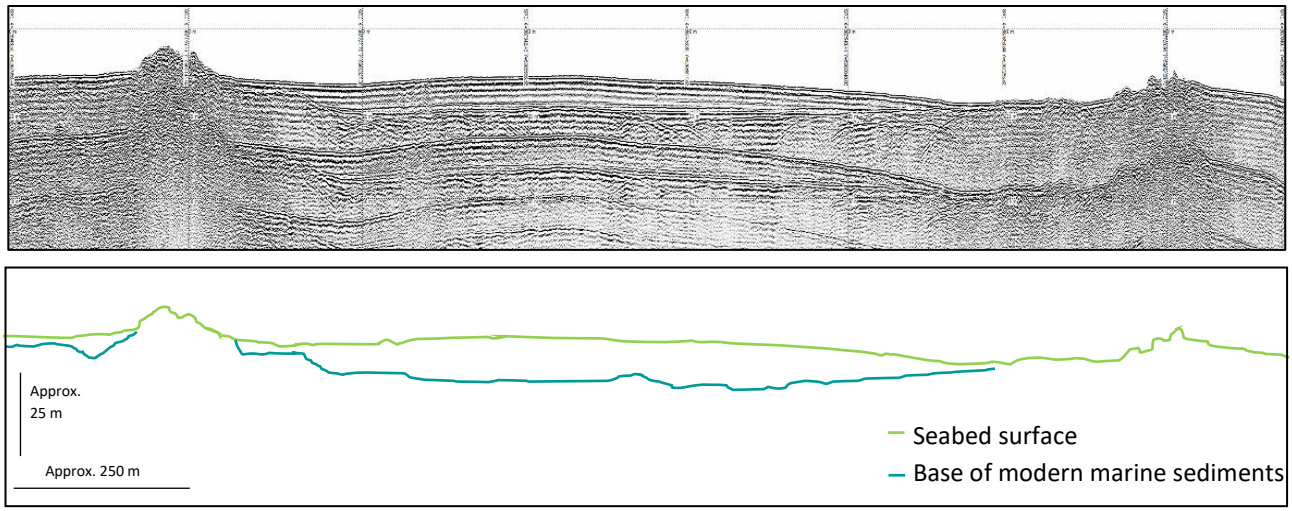
A chaotic and inferred coarser unit is situated above the bedrock, with a possible incised channel feature that may have been formed by glacial outwash however this interpretation is not certain (Figure 3.6). These incised features are infilled with tabular stratified deposits that appear slightly paler than those seen across much of the MDZ (Figure 3.6); this unit may still be associated with the WISF A, however there is potential for it to be linked to the SSF, SL2 member. While there is some uncertainty about identification of the infill, it is likely that the lower unit represents WISF A/B or the Lower or Upper Till member of the CBF. All the identified fill sediments appear to be indicative of till deposited in ice proximal conditions, either as subglacial lodgement till (CBF) or during a pro-deltaic, glaciolacustrine or glaciomarine environment (WISF), though post-glacial origins cannot be ruled out.

Figure 3.6: Sub-bottom Profiler Data Example of Possible Chaotic Incised with Tabular Stratified Sediments



Within the shallower coastal areas of the central east of the MDZ, at the entrance of the two bays: Gogarth Bay and Abraham's Bosom, sediment cover over the bedrock appears less complex. There is a clear accumulation of more recent fine-grained marine sediments around these bay areas where hydrodynamics favour deposition associated with the SSF (Figure 3.7). It is not clear that there are any remains of the SBD or SL2 members. However, due to the area being subjected to strong coastal current and wave action there is a low likelihood of survival of these formations. Partrac (2018) notes that the sediment becomes finer further inshore in Abraham's Bosom, with some large boulders along the western extent that may be associated to the erosion of the cliffs. A very large subaqueaous dune (after Ashley, 1990), with the crest extending from South Stack (south of Gogarth Bay) in a northwest-southeast orientation, along with associated bedform fields, indicates northeast-southwest sediment transport along the coast.

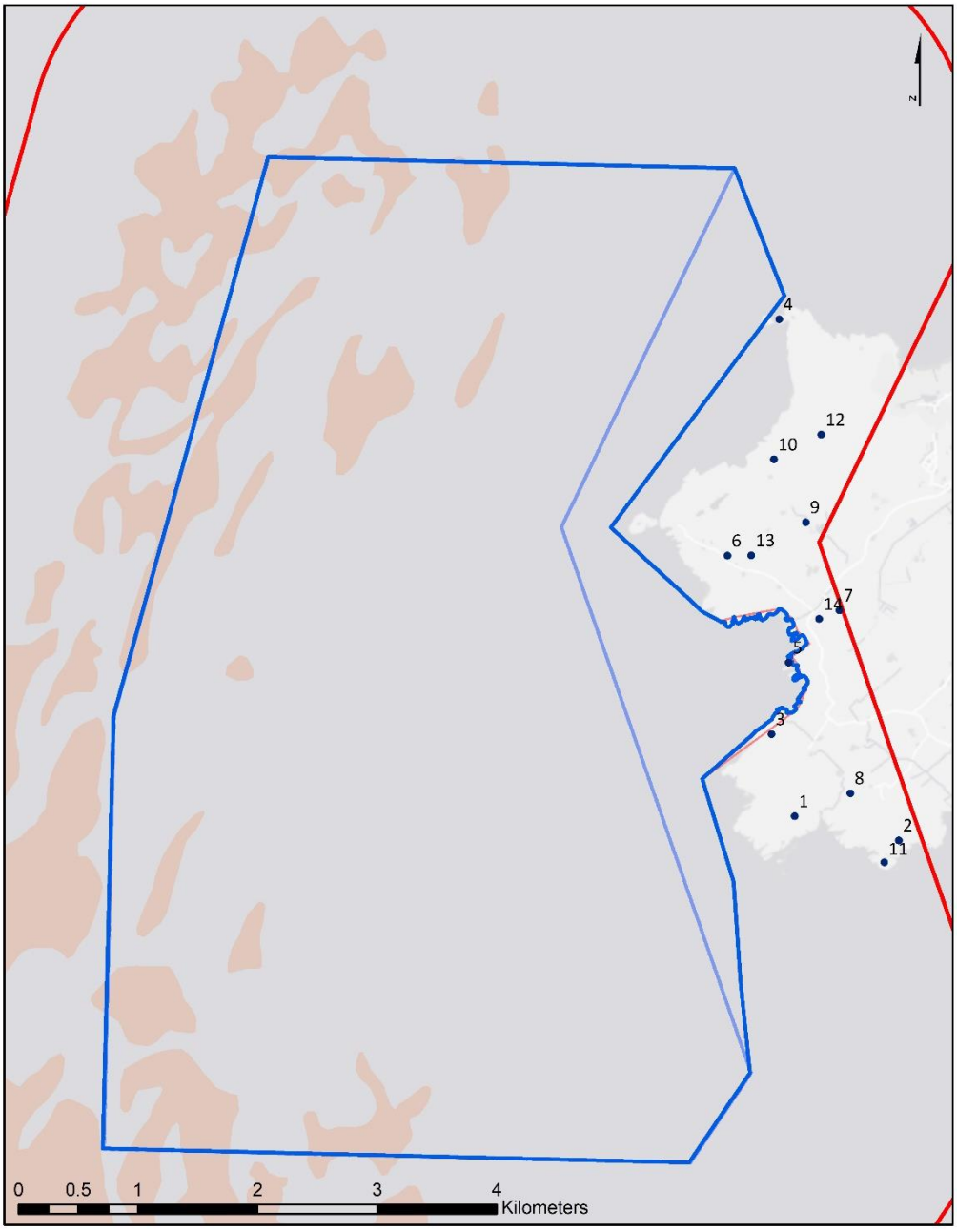
Figure 3.7: Data Example of Finer Recent Sediment Identified in the Seismic Data



Interpretation of the seismic data across the MDZ, shows no clear terracing or fluvial influence, no clear indication of terrestrial or organic deposits and all deposits and incisions appear to be linked to glacial or marine processes. There is potential for the mid Holocene sediments identified in Figure 3.6 to be of archaeological interest, these areas have been interpreted and their extent displayed in Figure 3.8. However, while these represent the most likely interpretations, there is a degree of uncertainty within the data which means that these interpretations are not definite.

The geological units present within the site are key to understanding the potential for submerged prehistoric remains, and are referred to in the following section which considers this potential.

Figure 3.8: Palaeogeographical Feature of Archaeological Potential. (note numbers refer to prehistoric and Romano-British remains listed in Appendix B (prefix: MS_DBA))



3.2. Potential Submerged Prehistoric Resource

During periods of lower sea level caused by three major glaciations (the Anglian, Wolstonian and Devensian) the site and study area would have been exposed as dry land for long periods, beyond the limits of the UK ice sheet.

Hominid and human activity throughout the Palaeolithic period is characterised in the British Isles by small bands of hunter gatherers exploiting resources within a wide variety of landscape types defined by successive periods of cold glacial and warm inter-glacial climatic conditions. These scattered bands seldom established long-term settlements, although sites have been identified that were possibly used as seasonal hunting camps.

Evidence of prehistoric activity on the seafloor is found in the form of palaeoenvironmental remains, or submerged archaeological sites and physical artefacts which can occur *in situ* or in redeposited contexts. The prehistoric archaeological record of the UK covers the period from the earliest hominin occupation, potentially as far back as 970,000 BP, to the end of the Iron Age and the Roman invasion of Britain by Claudius in 43 AD. In Wales, archaeological evidence for the Palaeolithic and Mesolithic periods in Wales spans almost 250,000 years, from the first Neanderthals, through the arrival of modern humans *c*.30,000 years ago to the emergence of ever more established farming communities, some 6,000 years ago (Walker, 2011).

The potential for submerged prehistoric remains is strongly connected to the geological sequences and deposits within an area.

3.2.1. Lower and Middle Palaeolithic (c.970,000 – 45,000 BP)

The geological make-up of the site and study area comprises Pre-Cambrian bedrock, overlain by deposits of Devensian and later date. The Devensian marks the most recent period of glaciation which occurred between c. 110,000 BP to c. 18,000 BP. There are no deposits present within the area which pre-date the last glaciation, and it is likely that any such deposits were scoured away by glacial and marine processes.

Devensian deposits within the site which pre-date the Upper Palaeolithic and Holocene relate to the glacial tills of the Cardigan Bay Formation, laid down by the glacier which occupied and receded from the area during the Devensian. During this time the site would have been under a glacier and so not inhabitable by human populations. As such, the tills of the Cardigan Bay Formation do not have potential for *in-situ* archaeological or palaeoenvironmental remains.

Redeposited Palaeolithic artefacts are known to occur in reworked deposits. However, such finds are uncommon and there are no reported finds of Palaeolithic material from the site or study area. The potential for remains of Lower and Middle Palaeolithic period to be present within the site is considered to be limited.

3.2.2. Upper Palaeolithic (c.45,000–10,000 BP) and Mesolithic (c.10,000 – 6,000 BP)

3.2.2.1. Palaeoenvironmental Remains and Potential

The Last Glacial Maximum (LGM) occurred around c.26,000 BP when sea levels would have been as much as 120 m below present levels, and the Irish Sea Ice Sheet lay over the site and extended south to the Isles of Scilly (Glasser *et al.,* 2018). There has been a series of studies investigating the retreat of the Irish Sea Ice Sheet and evidence suggests it was a relatively rapid process, retreating from the Isles of Scilly to South Wales from around 26,000BP, after which it separated from the Welsh Ice Cap (situated over mainland Wales) and by c. 22,000-20,000 BP Anglesey was free of ice (Furze *et al*., 2014; Glasser *et al.,* 2018).

The retreating ice left behind deposits associated with the Western Irish Sea Formation. In particular, the chaotic facies of WISF A are thought to have been laid down by the retreating glacier in glaciomarine and glaciolacustrine environments. These deposits, which represent an ice-proximal environment, are present within the site. They are associated with low archaeological potential and palaeoenvironmental interest due to the inhospitable environment which they represent.

Following the retreat of the ice it has been suggested that relative sea levels slowly fell in the late Pleistocene (around 14,000 years BP), and at the onset of the Holocene period sea levels were around 26 m lower than those of today (Roberts, 2006: 370). Sea levels rose rapidly by c. 22 m in the period between 11,000 BP and 7500 BP, and slowed in the middle to late Mesolithic period, at which point the sea level is likely to have been only a few metres lower than at the present (Roberts, 2006).

This indicates that the site may have seen terrestrial conditions in the Late Upper Palaeolithic and into the Holocene, with coastal and marine processes dominating from the end of the Mesolithic (from approx. 6,000 years BP) to present.

Within the western part of the site, sub-bottom profiler data indicate that the glacial deposits are incised by a series of possible channels (Figure 3.8). It is not certain from the acoustic data whether these channels relate to glacial processes, such as outwash from meltwater, or whether they represent post-glacial channel systems, potentially of Late Upper Palaeolithic or Holocene date. The former is thought to be most likely. However, features relating to the retreating ice edge can be complex and dynamic, and features which begin as outwash channels, for example, can form the basis for later, post-glacial, palaeochannels. If the channels within the western part of the site have post-glacial phases, the deposits within may contain palaeoenvironmental remains which could inform our understanding of the Late Upper Palaeolithic and Mesolithic palaeolandscape in this area.

The majority of the site is characterised by high energy conditions (Partrac, 2018) which would not be conducive to the survival of extensive deposits of fine-grained materials. It is therefore unlikely that extensive deposits of this type exist. However, their existence within the site cannot be ruled out on the basis of the existing data, thus within the western part of the site there is considered to be potential for palaeoenvironmental evidence dating to the Late Upper Palaeolithic and Mesolithic periods. The eastern and central parts of the site are characterised by exposed bedrock, till and modern marine sediments and as such are not of palaeoenvironmental interest.

3.2.2.2. Archaeological Remains and Potential

Archaeological evidence for Upper Palaeolithic activity in Wales is generally rare and focused on cave sites such as Paviland, in south Wales, where the remains of a burial have been found and dated to *c.* 29,000 BP. However, at this time the site lay beneath an ice sheet and was therefore uninhabitable.

Exposure of the site occurred at around *c.* 22,000 BP. From this point the site may have seen terrestrial conditions. However, the UK is thought to have been completely uninhabited during a cold phase known as the Dimlington Stadial which lasted from *c.* 22,000-13,000 BP. Some of the earliest evidence for the re-occupation of the UK after the Devensian glacial maximum has been found in North Wales, at Kendrick's Cave, Llandudno, where the remains of an engraved horse mandible have been found and radiocarbon dated to between *c.* 12,950 BP-11,950 BP, along with human remains dating to between 11,760 BP-12,090 BP (Rees, 2015).

A geologically short cooling event known as the Younger Dryas (Loch Lomond) Stadial interrupted the general pattern of warming between *c.* 12,900 and 11,700 BP (Carlson, 2013). During this time period evidence of human activity in the UK is extremely rare, and it is likely that the study area would have been largely uninhabited due to the unfavourable climate. However, in the intervening periods human activity within the site dating to the Late Upper Palaeolithic is possible, but not likely, given the rarity of such activity in a Welsh context and the preference for cave sites, which are not known to exist within the site and study area.

During the Mesolithic period, as in the earlier Palaeolithic, activity was characterised by small bands of hunter gatherers exploiting a range of coastal, aquatic and terrestrial resources (Mithen, 1994). In northwest Wales Mesolithic sites include the former land surfaces such as those surviving within the Menai Straits, coastal lithic scatters and shell middens. The site of Trwyn Du in Anglesey has yielded evidence of Mesolithic occupation. The site is currently overlooking the coast, but at the time of occupation 8000-9000 years ago it would have been adjacent to a river valley, with the coast *c.* 7 km away (Dyfed Archaeological Trust, n.d.). Together these sites indicate a focus on coastal areas, estuaries and river channels, as is common to Mesolithic sites across the UK.

Within the study area, along the coast of Holy Island and in particular at Penrhosfeilw Common and Porth Ruffydd concentrations of flint scatters dating to the Mesolithic period have been recorded (MS_DBA_001, 2). A possible prehistoric shell midden recorded in this area may also date from the Mesolithic period, although this is unverified (MS_DBA_003). The shell midden lies in the area adjacent to Abraham's Bosom. This embayed area is characterised by fine-grained marine sediments (equated with the SSF, likely SSF1). Wave and tidal action have likely removed any earlier deposits which may have lain within the bay, and there is no indication of deposits other than the fine-grained marine sediments.

While the coastline has altered since the Mesolithic period the evidence of activity within the study area, along the coastal strip, indicates potential for eroded remains of Mesolithic material to be present in the nearshore areas of the site. This is also true of later prehistoric remains (see Section 3.5).

This evidence also shows that Mesolithic communities were active in the area around the site. If palaeochannels were present within the site during this period they may have formed a focus for

Mesolithic activity. Therefore, if the possible channels identified in the western part of the site date to the Holocene period, prior to marine inundation, they may have potential for Mesolithic archaeological remains. However, no such remains have been identified from the marine area of the site, and thus this potential cannot be considered to be high, and the possible channels are not confirmed to be of this date. Thus, there is some uncertainty regarding the level of this potential.

3.2.3. Summary of Prehistoric Archaeological Potential

The earliest deposits within the site relate to the Devensian glaciation. The site lay under an ice sheet until *c.* 22,000BP. Thus, there is no potential for *in situ* Lower or Middle Palaeolithic archaeological remains or palaeoenvironmental evidence. Redeposited Palaeolithic remains may occur within secondary contexts within the site, however, no such remains have been identified within the site or study area and the potential for such remains to occur is considered to be limited.

A series of possible channels identified within sub-bottom profiler data within the western part of the site may be of glacial or post-glacial origin. If the latter, then there is potential for palaeoenvironmental evidence relating to the Late Upper Palaeolithic and Mesolithic periods to be present within these areas.

Late Upper Palaeolithic archaeological remains tend to be found in cave sites. While the remains from Kendrick's cave in Llandudno indicate the presence of human groups in North Wales during this period, there is no evidence of activity within the site and study area. Taking into account the absence of cave sites within the area, the potential for such remains to be present within the site is low.

Conversely, Mesolithic activity is attested within the study area. If Holocene features such as palaeochannels were present within the western part of the site these may have formed a focus for Mesolithic activity. However, due to uncertainties within the data the presence of such features is not verified. In the face of this uncertainty there remains a potential for submerged Mesolithic remains to occur in association with potential Holocene deposits. If present, these deposits could also hold palaeoenvironmental evidence.

Eroded material from coastal sites such as shell middens and flint scatters dating to the Mesolithic period may also be present within the site. Any such remains would be out of context and would likely have been affected by marine processes.

By the end of the Mesolithic period the site is likely to have been submerged, and thus all later archaeological potential relates to maritime remains and remains of eroded material. This is discussed below.

3.3. Assessing Maritime Archaeological Potential

As with submerged prehistoric remains, the potential for maritime archaeology is also connected with the geological make-up of the site. The 'Areas of Maritime Archaeological Potential 2 – Characterising the Potential for Wrecks' (AMAP2) project was undertaken by SeaZone and the University of Southampton. The project sought to provide an assessment of the environmental variables affecting the preservation of maritime archaeological remains on the seabed. The project utilised a preservation index developed for the Areas of Maritime Archaeological Potential (AMAP1) project by Dr David

Gregory (see Gregory, 2006). Wreck records and British Geological Survey data were also assessed to provide an interpretation of preservation potential in a given area based on the following parameters:

- Sediment type;
- Sediment thickness;
- Water depth; and
- Sediment transport.

The key findings of the project indicated that: finer-grained sediments offer the greatest preservation to maritime archaeological sites and features; noted a strong correlation between burial of wreck and medium to high levels of sediment transport; and identified limited potential for sediment transport and burial in gravel environments (SeaZone, 2012). However, it is also noted that maritime archaeological sites in finer-grained areas may suffer from greater exposure and degradation as sediments are more easily transported away from a site, leaving it exposed (Gregory, 2006).

The modern seabed sediments, located in the nearshore bays in the central east of the MDZ, general comprise a relatively thin veneer of sediment with a few scattered bedforms. These deposits may offer a relatively favourable environment for the preservation of maritime archaeological remains such as wrecks or aircraft. Such remains may be present either at the surface or partially buried and reworked, depending on the location over the MDZ. Across the rest of the site there is low potential for burial of archaeological sites due to the predominance of bedrock, gravels and till deposits. The high tidal velocities will also affect archaeological preservation, though isolated locations of shelter, such as gullies within the bedrock, could trap and allow for the preservation of more robust elements of wreck sites.

The subsequent sections will provide an assessment of the known sites and material and the wider archaeological potential of the Proposed Development, based on an understanding of these physical characteristics, and through assessment of site-specific geophysical data and a range of relevant documentary and data sources.

3.4. Known Maritime Archaeological Resource

Maritime archaeological sites consist of the remains of vessels and related materials that have sunk, crashed and been abandoned or lost at sea. These often come to rest on the seabed as a result of collision, battles, enemy action, accidental loss or deliberate disposal. They may be expressed on the seabed through the remains of the vessels, their contents and cargoes, or isolated artefacts which have been accidentally lost or deliberately thrown overboard. In the case of intentionally jettisoned material such as cannonball or maritime debris, these finds often act as useful indicators of historic sea routes and navigation, or historic battles.

3.4.1. Known Wrecks and Obstructions

Data for known shipwrecks and recorded shipping losses and casualty records were obtained though searches of the UKHO wrecks database. A full list of all wreck records identified in the assessment is provided in Appendix A. Data on wreck sites recorded by other datasets including the RCAHMW (NMRW) data, RoW data and HER data have also been assessed, and the results of this assessment are included in the potential maritime records section below.

3.4.1.1. Demonstration Zone

Four wrecks are recorded within the demonstration zone by the UKHO where wreck remains have been confirmed to exist at the location reported. An additional 12 records relate to wrecks known from diver reports and documentary losses, for which positions are considered inaccurate and seabed surveys associated with this project have identified no visible remains (Appendix A). These remains are discussed further in the potential maritime records section below.

The confirmed wrecks reported by the UKHO comprise the wreck of the *Maarten Cornelis*, and three unidentified wrecks, the latter all located by surveys undertaken by the UKHO in 2013.

The *Maarten Cornelis* was a motor fishing vessel lost in 1971 (UKHO identifier 7228). The UKHO surveying details indicate that the wreck lies at an approximate NNW-SSE orientation, with the bow to the east, and sitting within a scour pit. Surveys in 1979 and 2013 indicate that the wreck lies almost upright with the masts intact, protruding at least 4 m clear of the hull and superstructure.

The UKHO reported an unknown wreck in 2013 (UKHO identifier 81387), lying approximately north-east to south-west. The UKHO did not do a magnetic survey of the remains as, until post processing, it was not thought to be a wreck. The remains may include the remnants of a keel and single boilers.

The UKHO recorded a second unknown wreck in 2013 (UKHO identifier 81388). The wreck lies approximately east-west, and sits within an area of scour. It is associated with a strong magnetic anomaly. The UKHO indicates that the wreck is largely deteriorated, and may represent an old vessel, with two boilers evident on the site. Possible debris lies close to the main wreck, to the north. A droit (235/15) reported from this area is also likely to relate to this wreck. The position for the droit appears to be c. 55 m to the north but it is likely that the remains are associated with this wreck. Remains recovered include log wood, a bronze valve and a copper pipe.

The UKHO recorded a third unknown wreck in 2013 (UKHO identifier 81389). The wreck lies approximately east-south-east to west-north-west and is associated with a slight magnetic anomaly. The wreck sits upright, and the bow, which is located to the east-south-east, is partially buried and collapsed. The boiler located midships is the highest point on the wreck. The UKHO indicate that this may represent the remains of a fishing vessel.

For completeness, these vessels have been included within the DBA gazetteer, as MS_DBA_0085, 0116-0118, and have been identified in geophysical surveys associated with this project, discussed below (MS_0001, MS_0003, MS_0004, MS_0005).

3.4.1.2. Buffer Zone

Additionally, there are a further three wrecks within the 2 km buffer which have been identified by the UKHO. These comprise:

- The UKHO record the wreck of the SS *Harold,* which was constructed in 1889 and lost in 1908 (UKHO identifier 7144). The wreck lies close to shore and appears to have been first identified in 1976 by divers. The UKHO record for the following year indicates that only the boiler and stern sections remain, and there may have been recent salvage on the site. A later survey, conducted in 2013, identified debris extending to the southeast.

- The UKHO record the wreck of an unknown vessel (UKHO Identifier 7248). The wreck appears to have been first identified by divers in 1976, and located by the UKHO on subsequent surveys. The records indicate that the wreck is represented by a small magnetic anomaly, and may be an inverted part of a hull.
- In 1983 the UKHO reported a wreck (UKHO identifier 7416) lying offshore, in water of c. 50 m depth. The wreck reportedly has no scour, and is approximately 70 m in length.

These vessels have been included within the DBA gazetteer for completeness, as MS_DBA_0084, 0119-0120.

In addition, the UKHO also reports a number of loss locations and diver sightings of wrecks. The positions for these wrecks have not been confirmed by the UKHO, and as such the locations were carefully scrutinised during the geophysical assessment undertaken as part of this project.

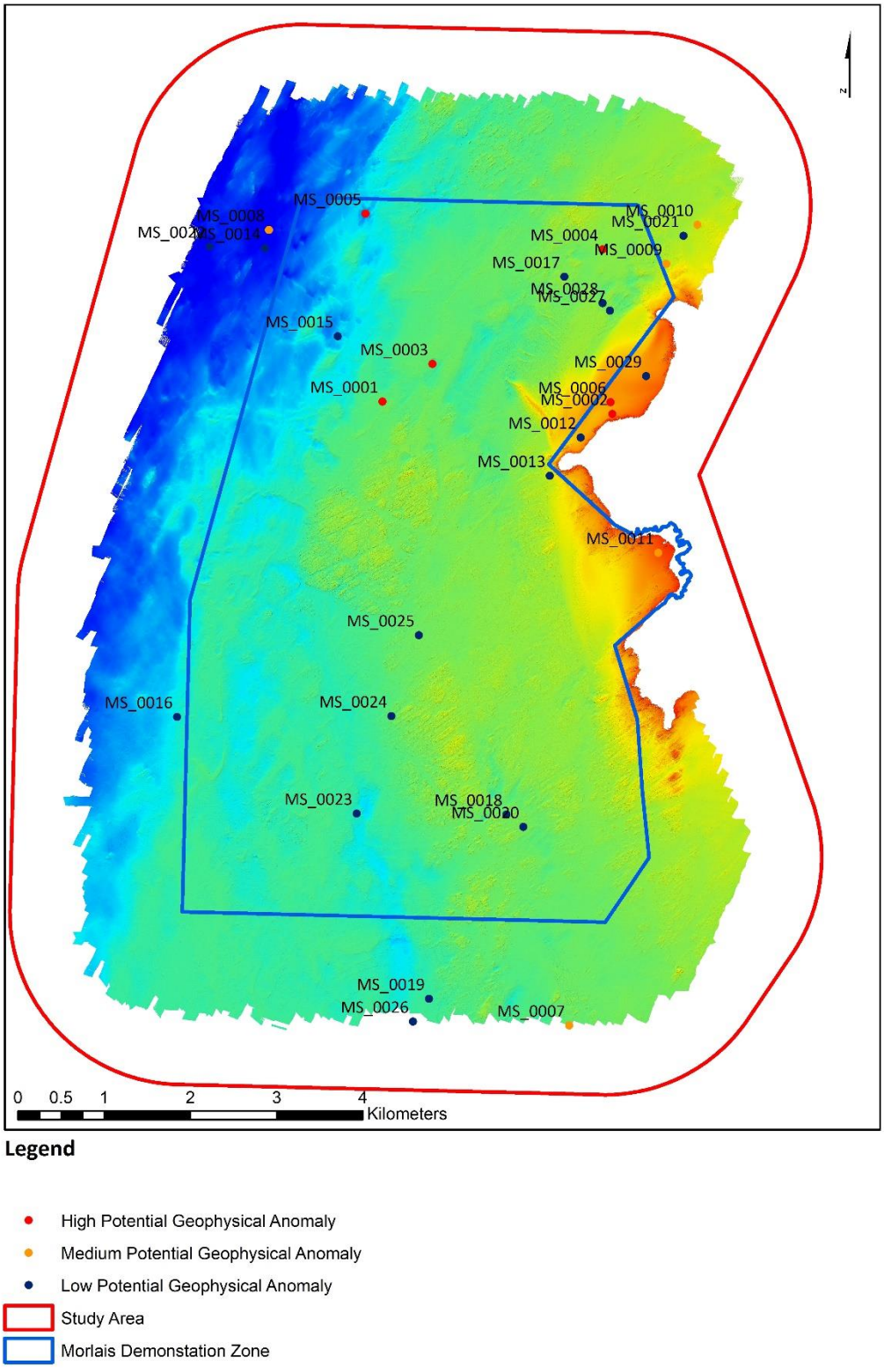
3.4.2. Geophysical Survey Data

Twenty nine contacts of archaeological potential were identified in the site and study area covered by the geophysical survey data, these can be broken down as; six high potential contacts, five medium potential contacts and eighteen low potential contacts. The results are summarised in Table 3.1 and Figure 3.9.

Table 3.1: Summary of Geophysical Anomalies

	High	Medium	Low
MDZ and cable route (site)	4	1	10
Within Study Area	2	4	8
Total	6	5	18

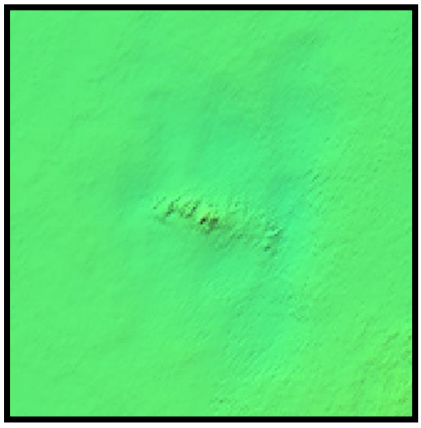
Figure 3.9: Geophysical Anomalies within the Site and Study Area



3.4.2.1. High Potential Contacts

Six contacts with high archaeological potential were identified in the geophysical dataset.

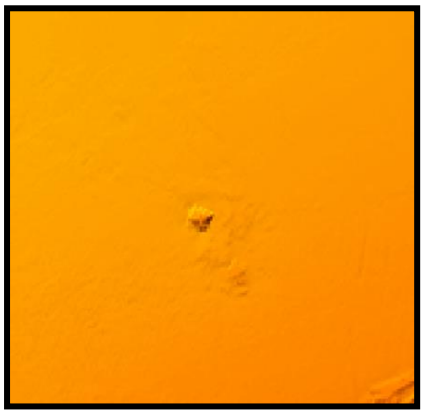
MS_0001



Contact MS_0001 is likely the remains of a wrecked vessel measuring 41.9 m x 9.8 m. The form of a wrecked vessel is apparent; however, the outline of the vessel appears to be broken suggesting a collapsed wreck. The wreck is recorded by the UKHO as an unknown vessel (UKHO Identifier 81389, see full description above). The UKHO indicates that this may represent the remains of a fishing vessel, with a boiler located midships.

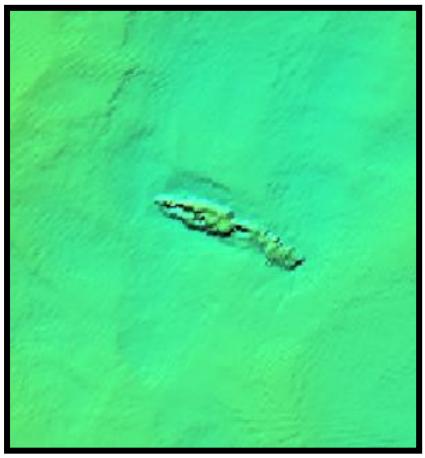
Survey lines for magnetometer did not pass over the wreck, and ran between 40-60 m away, hence the wreck is not associated with a magnetometer response.

MS_0002



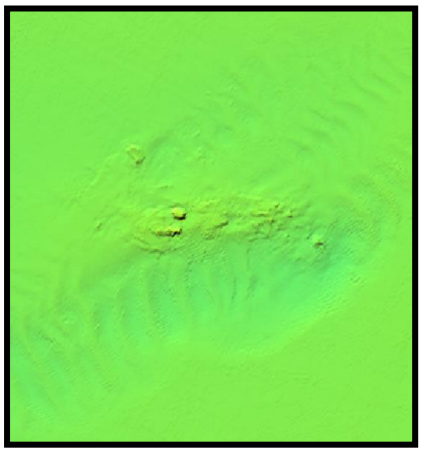
Contact MS_0002 is a cluster of anomalies with one main upstanding anomaly, covering an area 30.9 m in length and 17.8 m in width. The remains are recorded by the UKHO as those of the wreck of the *Harold*, and the site has a magnetic anomaly of -207.9 nT (UKHO Identifier 7144, see full description above).

MS_0003



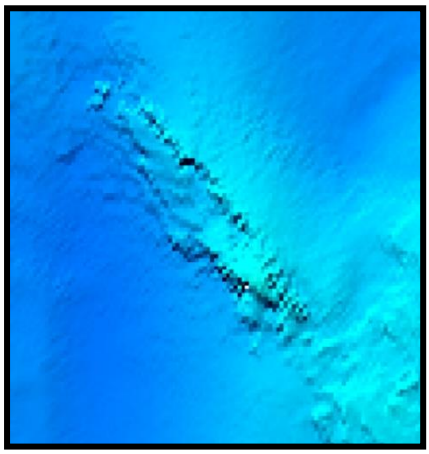
Contact MS_0003 is the remains of a wrecked vessel measuring 41.9 m x 9.8 m, sitting within a scour pit. The outline of the vessel appears to be coherent and the remains are associated with a magnetic anomaly of -54.7 nT. The form of the contact suggests a steel wreck. The wreck is recorded by the UKHO, and thought to represent the *Maarten Cornelis*, (UKHO Identifier 7228, see full description above).

MS_0004



Contact MS_0004 is likely the remains of a wrecked vessel measuring 98.3 m x 41.4 m, including the main wreck mound and surrounding debris. The wreck appears to have an area of scour along its southern edge, with a smaller area of scour to the north. The form of the wreck is incoherent with material outside the main area of wreckage, the remains are associated with a strong magnetic anomaly of - 1090.9 nT. The wreck is recorded by the UKHO (UKHO Identifier 81388, see full description above).

MS_0005



Contact MS_0005 is the remains of a wrecked vessel measuring 41.9 m x 9.8 m. The outline of the vessel is coherent, and the remains are associated with a strong magnetic anomaly of 314.1 nT. The wreck is recorded by the UKHO (UKHO Identifier 81387, see full description above).

MS_0006

Contact MS_0006 is a cluster of anomalies visible in the multibeam bathymetry data measuring *c*. 25 m x 14 m. The contact is associated with a magentic anomlay of -1598.9 nT. The visible anomalies and strength of the magnetic anomaly may indicate the presence of a buried wreck or wreckage. The contact is c. 140 m to the north of the wreck of the *Harold,* potentially indicating associated wreckage. This possible wreck is not recorded by the UKHO.

3.4.2.2. Medium Potential Contacts

Five contacts with medium archaeological potential were identified in the dataset.

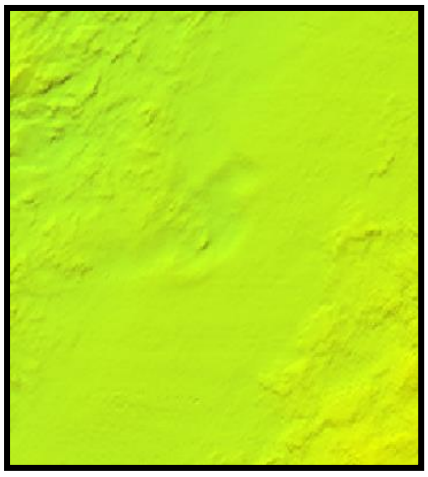
MS_0007

Contact MS_0007 is a cluster of irregular anomalies with an associated mound measuring 29.3 m x 32.6 m. Whilst potentially geological the form of the contact and the mound may indicate material, some partially buried, of anthropogenic origin. A precautionary approach means the contact has been assigned a medium potential rating until further groundtruthing is undertaken. The contact falls outside the limits of the multibeam bathymetry and magentometer surveys.

MS_0008

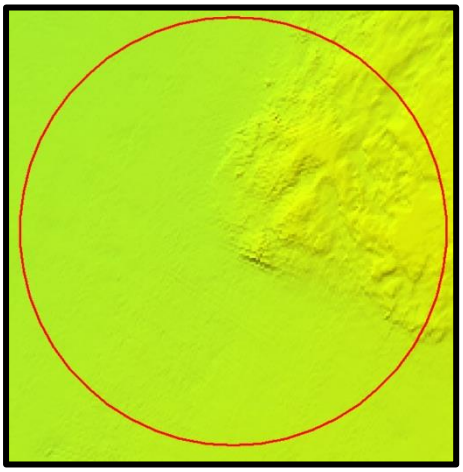
Contact MS_0008 is a mound of potentially anthropogenic material with clusters of irregular anomalies visible on the surface. The mound tapers into an elongated form at either end, with the main area of mound and cluster of anomalies measuring c.53 m x 28 m. The mound may be geological, however its form differs from other geoloigical features in the area. The form indicates material of anthropogenic origin, such as a wreck mound.

MS_0009



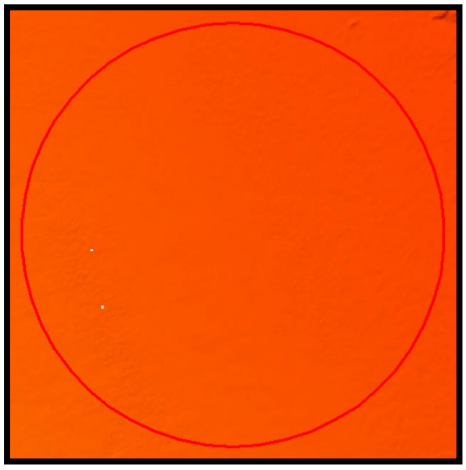
Contact MS_0009 is a series of anomalies associated with a depression in seabed in a sandy area between outcropping bedrock. The contact has a magentic anomlaly of 445.3 nT. The form of the contacts and strenth of the magnetic anomaly indicate the potential presence of a buried wreck or wreckage. The main central anomaly measures c. 4 m x 3 m, and the overall depression measures *c*.30 m x 17 m.

MS_0010



Contact MS_0010 is a magnetic anomaly of -194.2 nT within an area of outcropping bedrock. The magnetic anomaly may indicate buried wreckage or anthropogenic debris, however there are no identifiable anthropogenic contacts within 50 m of the location. Image shows a 50 m buffer around the magnetic anomaly.

MS_0011



Contact MS_0011 is a magnetic anomaly of -278.6 nT with no visible seabed remains within 50 m. The strength of the magnetic anomaly may indicate buried anthropogenic debris and therefore has been assigned a medium potential rating. Image shows a 50 m buffer around the magnetic anomaly.

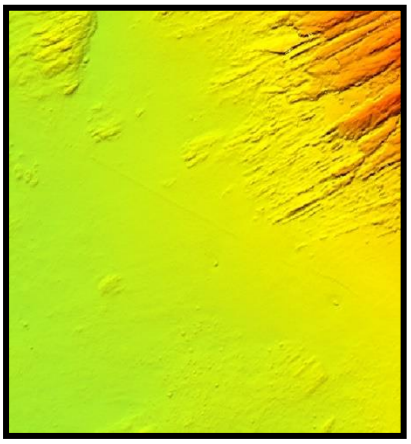
3.4.2.3. Low Potential Contacts

Eighteen contacts with low archaeological potential were identified in the dataset.

MS_0012

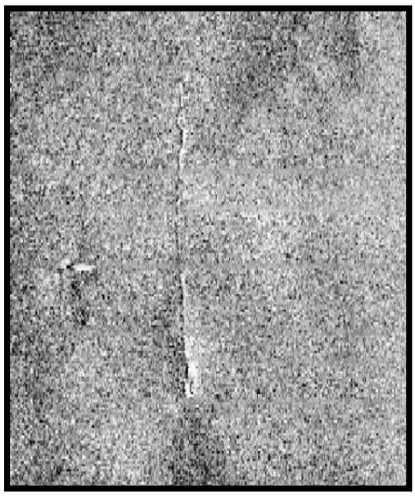
Contact MS_0012 is a cluster of anomalies, covering an area of 15.9 m in length x 9.1 m in width. The form of the contacts may indicate anthropgoenic debris.

MS_0013



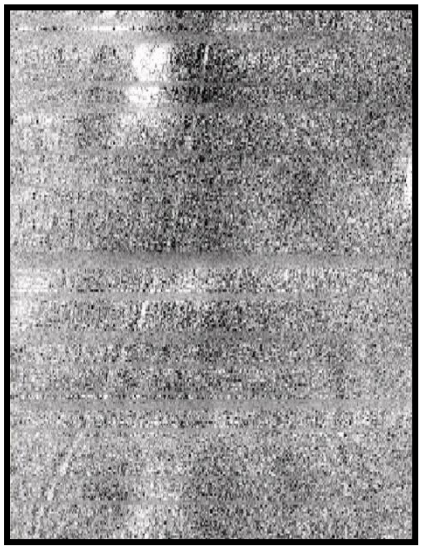
Contact MS_0013 is a linear anomaly probably representing a cable, approximately 160 m in length. Although anthropogenic in origin it is not considered to be of archaeological interest but is included for completeness.

MS_0014



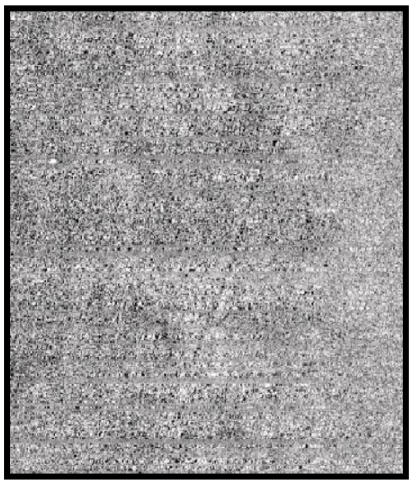
Contact MS_0014 is a linear anomaly probably representing a cable, rope or seabed scour approximately 70 m in length. There is no corresponding magnetic anomaly. Although anthropogenic in origin it is not considered to be of archaeological interest but is included for completeness.

MS_0015



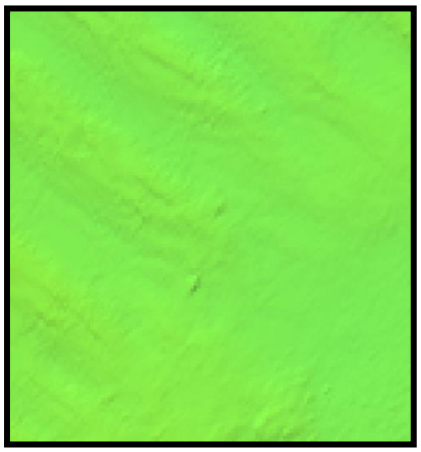
Contact MS_0015 is a linear anomaly probably representing a cable, rope or seabed scour approximately 70 m in length. There is no corresponding magnetic anomaly. Although anthropogenic in origin it is not considered to be of archaeological interest but is included for completeness.

MS_0016



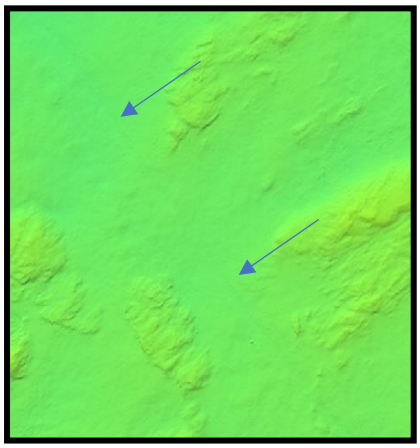
Contact MS_0016 is a linear anomaly probably representing a cable, rope or seabed scour approximately 97 m in length. There is no corresponding magnetic anomaly. Although anthropogenic in origin it is not considered to be of archaeological interest but is included for completeness.

MS_0017



Contact MS_0017 is a linear feature crossing a sand wave, measuring c. 15.1 m x 1.2 m. The form of the feature may indicate anthropogenic debris.

MS_0018



Contact MS_0018 is a very slight linear anomaly which extends 251 m as visible in the multibeam bathymetry and has a width of c. 2.4 m, however the edges of the anomaly are not clear. Probable anomaly relating to a cable, anchor drag or other anthropogenic scour. No clear magnetic anomlay, but the feature lies near to another probable buried cable with a strong anomaly which may mask weaker magnetic responses.

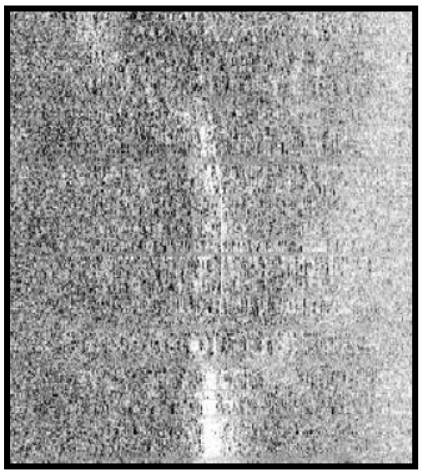
MS_0019

Contact MS_0019 is a prominent feature, 11.2 m x 5.8 m. The form of the feature indicates anthropogenic debris.

MS_0020

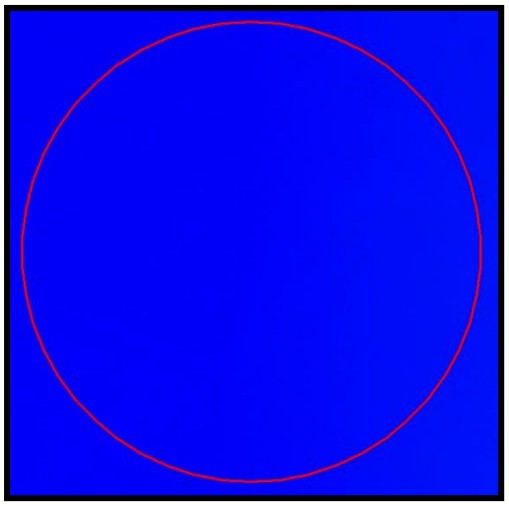
Contact MS_0020 is a linear feature probably representing a cable, rope or seabed scour approximately 97 m in length. There is no corresponding magnetic anomaly.

MS_0021



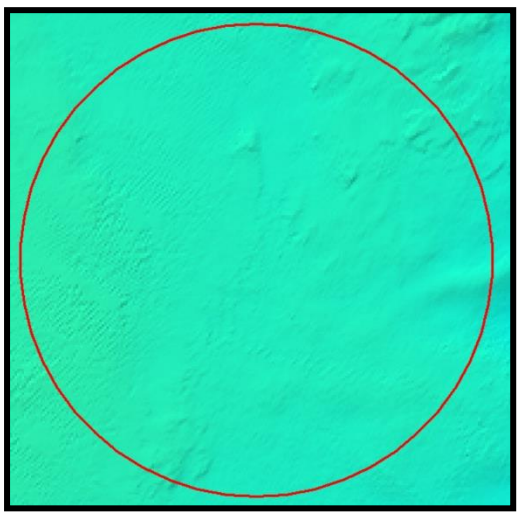
Contact MS_0021 is a linear feature probably representing a cable, rope or seabed scour approximately 91 m in length. There is no corresponding magnetic anomaly.

MS_0022



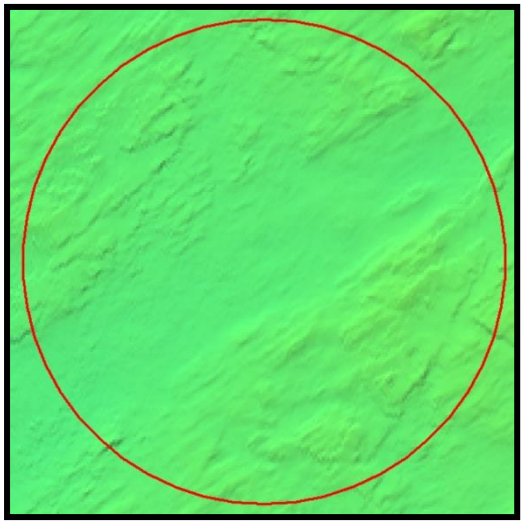
Contact MS_0022 is a magnetic anomaly of 66.1 nT with no visible seabed feature within 50 m. Uncertain origin but potentially buried athropogenic debris. Image shows a 50 m buffer around the magnetic anomaly.

MS_0023



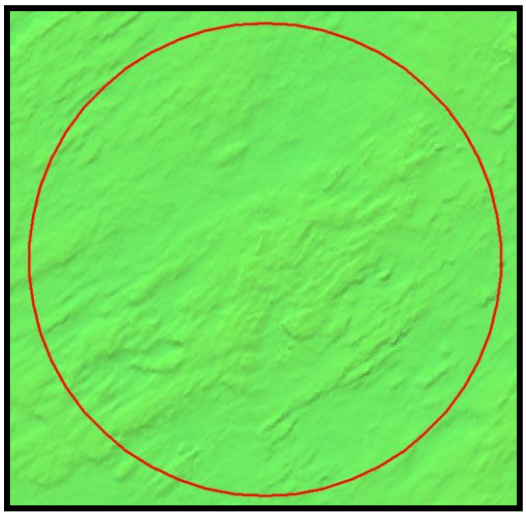
Contact MS_0023 is a magnetic anomaly of 48.8 nT in an area of slightly uneven seabed. Uncertain origin but potentially buried athropogenic debris. Image shows a 50 m buffer around the magnetic anomaly.

MS_0024



Contact MS_0024 is a magnetic anomaly of 74.9 nT in a sediment-filled depression or fissure/gully in bedrock. The anomaly may represent buried anthropogenic debris caught in the depression. Image shows a 50 m buffer around the magnetic anomaly.

MS_0025

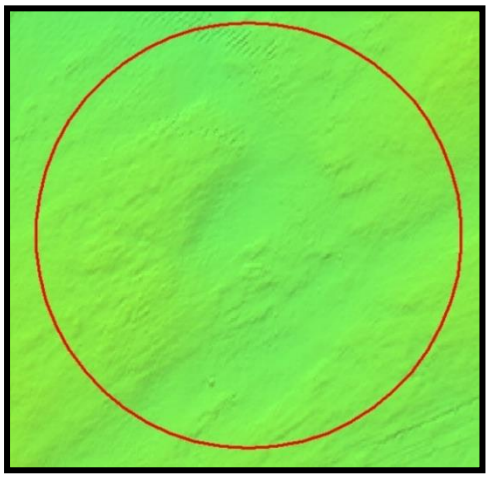


Contact MS_0025 is a magnetic anomaly of 41.3 nT in an area of outcropping bedrock. The anomaly may represent anthropogenic debris witin the area. Image shows a 50 m buffer around the magnetic anomaly.

MS_0026

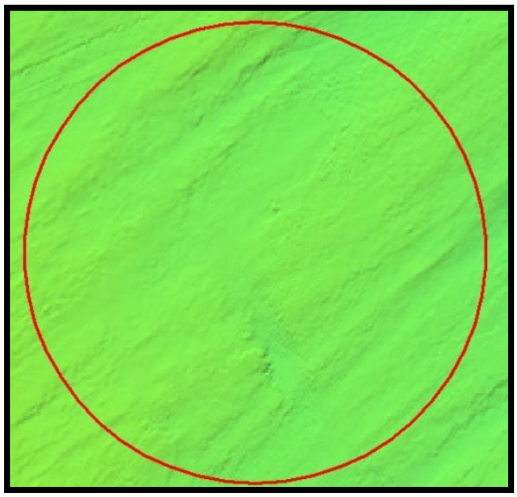
Contact MS_0026 is a magnetic anomaly of 85.0 nT beyond the extent of multibeam bathymetry and sidescan sonar survey.

MS_0027



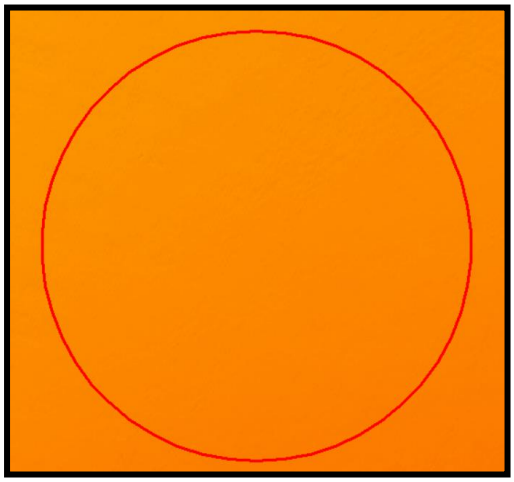
Contact MS_0027 is a magnetic anomaly of 42.6 nT in an area of outcropping bedrock. The anomaly may represent anthropogenic debris concealed by sediment between bedrock outcrops. Image shows a 50 m buffer around the magnetic anomaly.

MS_0028



Contact MS_0028 is a magnetic anomaly of 22.6 nT in an area of outcropping bedrock. The anomaly may represent anthropogenic debris concealed by sediment between bedrock outcrops. Image shows a 50 m buffer around the magnetic anomaly.

MS_0029



Contact MS_0029 is a magnetic anomaly of 51.3 nT with no visible seabed contacts. Uncertain origin but may be buried athropogenic debris. Image shows a 50 m buffer around the magnetic anomaly.

3.4.3. Geophysical Survey Data and UKHO positions

The UKHO dataset was provided for the survey area and compared against the identified contacts and with the geophysical dataset as a whole. Each UKHO position was assessed for the presence of physical remains. Table 3.2 summarises high potential archaeological anomalies identified by this assessment and indicates where UKHO records and geophysical survey assessment records correlate. For example, MS_UKHO_0001 (Appendix 2) represents the same seabed remains as MS_0003 (Appendix 1).

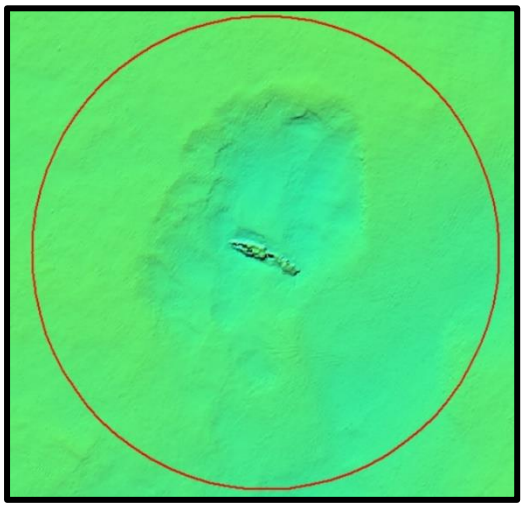
Table 3.2: Comparison of High Potential Anomalies Identified from UKHO Records and Geophysical Survey Assessment

UKHO Record	Geophysical Survey Assessment Record
7228	MS_0003
7144	MS_0002
81387	MS_0005
81388	MS_0004
81389	MS_0001
7248	Beyond survey area
7416	Beyond survey area
No UKHO record for this position	MS_0006

High potential anomalies, where wreck remains have been confirmed, form part of the UKHO dataset. Other records relate to documented losses and diver records. Divers appear to have visited the area extensively, and a large number of wrecks are known from diver sightings, which have subsequently formed the basis for some UKHO records that remain unverified. In particular, there appears to have been a large number found during the 1970s. In general, these sites are close to the shore, among rocky outcrops and boulders.

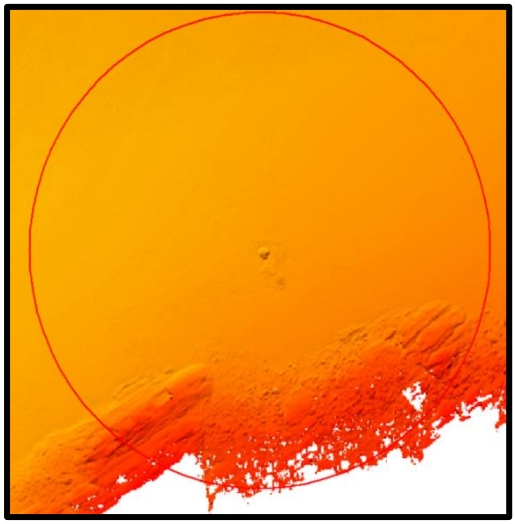
Each position is shown below with a 100 m buffer, note; these buffers do not constitute recommended exclusion zones but are for visual representation of the area. An overview of the position of these records is provided in Figure 3.10 and Figure 3.11.

UKHO Identifier 7228



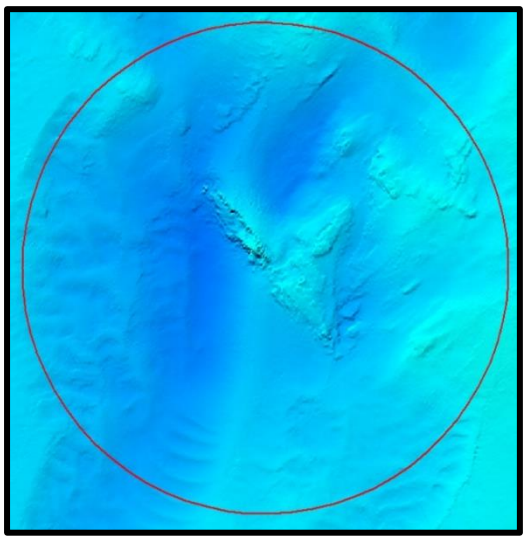
The UKHO reports a wreck, of the *Maarten Cornelis*, visible in sidescan sonar, multibeam bathymetry and magnetometer data. See gazetteer of geophysical anomalies for further information (MS_0003).

UKHO Identifier 7144



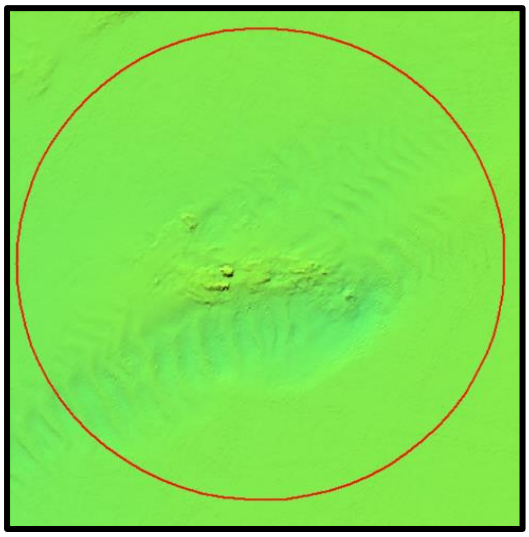
Wreck of the SS *Harold* reported by the UKHO and identified within sidescan sonar, multibeam bathymetry and magnetometer data. See gazetteer of geophysical anomalies for further information (MS_0002).

UKHO Identifier 81387



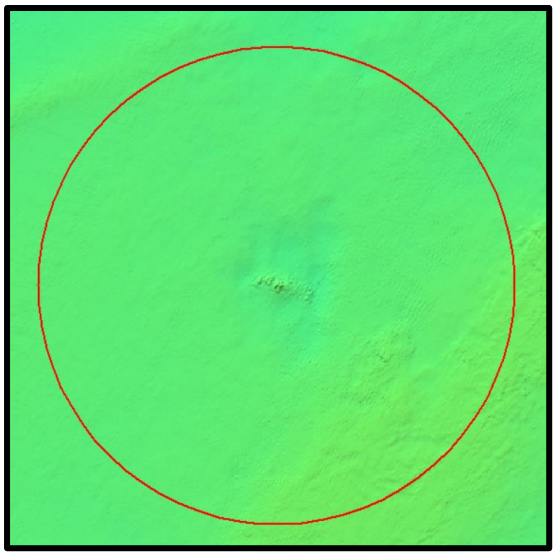
Unknown wreck reported by the UKHO and identified within sidescan sonar, multibeam bathymetry and magnetometer data associated with this project. See gazetteer of geophysical anomalies for further information (MS_0005).

UKHO Identifier 81388



Unknown wreck reported by the UKHO and identified within sidescan sonar, multibeam bathymetry and magnetometer data associated with this project. See gazetteer of geophysical anomalies for further information (MS_0004).

UKHO Identifier 81389



Unknown wreck reported by the UKHO and identified within sidescan sonar and multibeam bathymetry data associated with this project (between magnetometer lines and not identified in this dataset probably due to line spacing). See gazetteer of geophysical anomalies for further information (MS_0001).

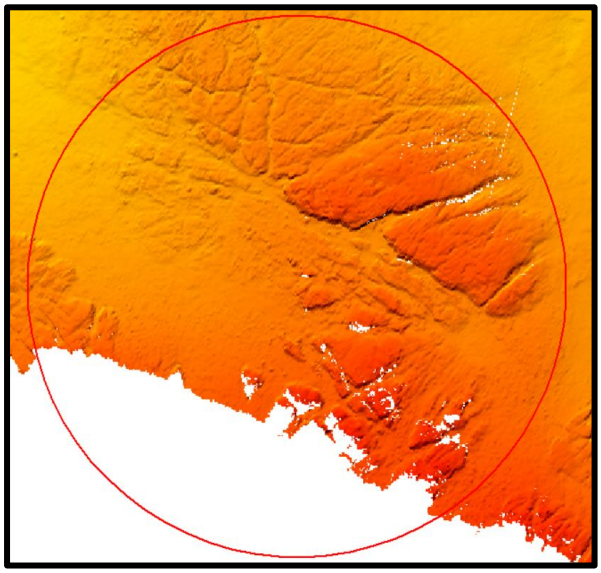
UKHO Identifier 7248

The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976 and located on subsequent surveys. It lies beyond the area of the geophysical surveys associated with this project, but within the study area.

UKHO Identifier 7416

The UKHO reports a charted wreck. Outside of the geophysical survey area boundaries for this project, but within study area.

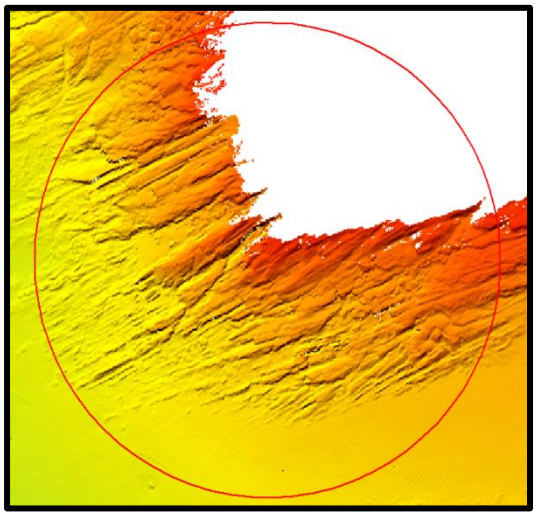
UKHO Identifier 7249



The UKHO reports the wreck of a liberator bomber aircraft following diver sightings. Subsequent surveys did not identify this wreckage and the record was amended to dead (MS_DBA_0091). Remains may be extant somewhere within the study area.

No seabed remains were identified in the geophysical survey data.

UKHO Identifier 7210



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'Live', the UKHO indicates the position is for filing only.

UKHO Identifier 7187

The UKHO report the sinking of the sailing vessel (barque), *Tenby Castle* in 1889. The wreck reportedly broke up c. 500 ft from the shore. This area is within the study area but beyond the extent of the geophysical surveys conducted in association with this project, and so seabed remains have not been assessed.

The wreck is live and positions are from diver sightings, reported in 1976. Remains reported in this location by divers in 1976 include a large pile of wire-rope, possibly from the rigging of a sailing ship, which lies on the seabed, along with several bricks and timbers. Muntz-metal hull sheathing has also been reported. These remains may represent the *Tenby Castle* or an unnamed wreck (MS_DBA_0044).

UKHO Identifier 7189

The UKHO reports diver sightings of a cannon lodged in a rock ledge, reported in 1974. This area is within the study area but beyond the extent of the geophysical surveys conducted in association with this project, and so seabed remains have not been assessed.

The cannon is considered a 'live' record and positions are from diver sightings (MS_DBA_0128).

UKHO Identifier 7186

The UKHO reports the presence of the wreck of the *SS Kyle Firth*, reported by diver sightings close inshore in the centre of Penrhos Point, and comprising a broken vessel with the stern section intact. The vessel was sunk in 1940 and has reportedly been the subject of salvage. This area is within the study area but beyond the extent of the geophysical surveys conducted in association with this project, and so seabed remains have not been assessed.

The wreck is 'live' and positions are from reported diver sightings.

RCAHMW records the position for the *Kyle Firth* c. 200 m away from the UKHO position for the same wreck. The record indicates that the wreckage lies scattered in a small cove to the west of the Fangs. The propeller, thrust bearings, stern post and the remains of the rudder are identifiable. Nearby, a section of iron girders stands 2 m high. A boiler lies further to the west (MS_DBA_0087, 88). There are no visible remains of wreckage in this location, and the position relates to an area of exposed bedrock. It is possible that disarticulated wreckage may be present within nearby gullies, though no visible remains were observed within the data.

UKHO Identifier 7185

The UKHO reports the presence of a wreck thought to be the sailing vessel *Niagara*, sunk in 1875 and reported by diver sightings in 1977. The bell has been recovered. This area is largely beyond the extent of the geophysical surveys conducted in association with this project, and so seabed remains have not been able to be fully assessed for the precise location. The nearest areas with survey data have been examined and no visible wreckage has been identified. The wreck is 'live' and positions are from recorded diver sightings.

RCAHMW records the wreck located c. 100 m away from the UKHO position for the same wreck, and is described as a wooden sailing vessel surrounded by concreted piles of muntz-metal fittings, lead sheets, copper bars (fastenings) and sheathing tacks, with a pile of old anchor chain lying 50 m further offshore. This places the wreck within the geophysical data, however no visible remains are apparent at this location. The position falls in an area of exposed bedrock. The bell of the *Niagara* (lost 1875) was recovered from this vicinity in 1979, identifying the wreck (MS_DBA_0047, 48).

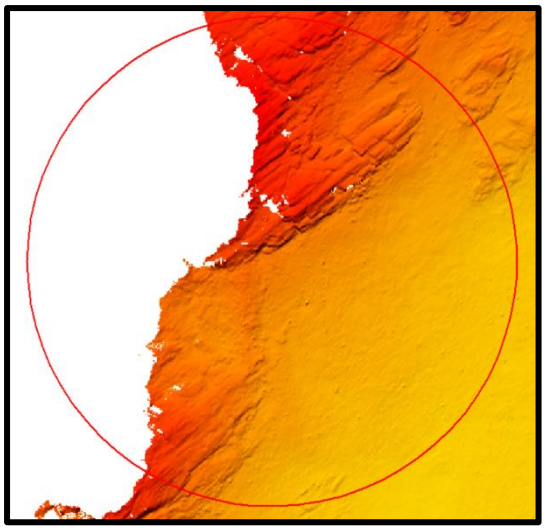
UKHO Identifier 7183

The UKHO reports the remains of a sailing vessel with cannons. The site has been surveyed and subject to salvage by Merseyside BSAC and Liverpool Museum from 1967. Little remains, with the exception of scattered cannons. Droits reported from this area include pieces of copper sheathing, copper nails, a total of 80 cannonballs ranging in size from 8 pounds, 6 pounds and 4 pounds, as well as musket shot (Droit 410/09). Reports associated with the *City of Richmond* may relate to this vessel (NPRN 217871).

The *City of Richmond* was a wooden barque built in Quebec in 1864. The vessel ran ashore 2 miles south of the South Stack on 3rd February 1881. Sources suggest that the site was surveyed and artefacts recovered by Liverpool Museum Service working with Merseyside BSAC from 1967 onwards (MS_DBA_0046, 0129).

This area is within the study area but beyond the extent of the geophysical surveys conducted in association with this project, and so seabed remains have not been able to be assessed. The wreck is 'live' and positions are from reported diver sightings.

UKHO Identifier 7184

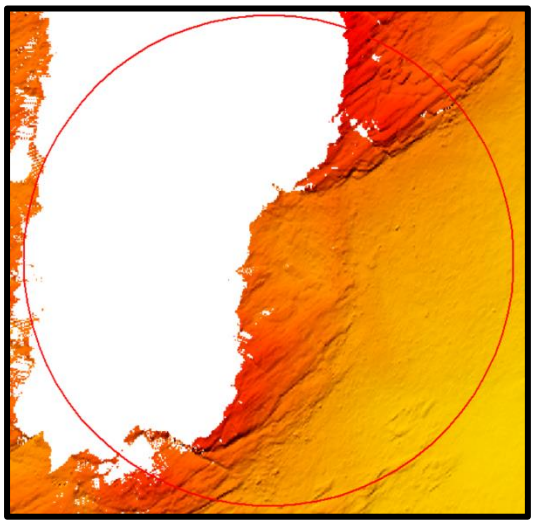


The UKHO reports diver sightings of the wreck of the *SS Mersey* which stranded on Penrhos Point rocks in 1894. The remains are reportedly badly broken up; some close inshore and some parts scattered in deeper areas, with the propeller and shaft reported 100 yds to the northwest of the wreck (MS_DBA_0045).

No clear seabed remains were identified in the geophysical survey data, though scattered anomalies in the area could represent wreckage they may more likely be boulders. The wreck is considered 'live' by the UKHO, on the basis of reported diver sightings.

The geophysical survey data do not extend to the high-water mark, and therefore remains may exist beyond the area surveyed. This area does not lie within the site.

UKHO Identifier 7190



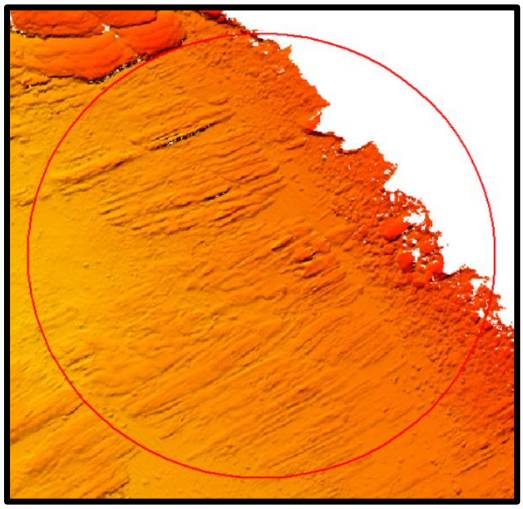
The UKHO reports diver sightings of the wreck of the SS *Editor* which stranded on Penrhos Point in 1897.

The remains are reportedly broken up and lying on a rocky seabed spread across three bays, between the Fangs and Tide Rip Rock. Remains are stated to include a double bottom, large anchor, deadeyes and boilers standing up to 3 m in height. The RoW holds records of droits from the *Editor* (A/1812) for two deadeyes (MS_DBA_0042, 43).

No clear seabed remains where identified in the geophysical survey data, though scattered anomalies in the area could represent wreckage they may more likely be boulders. The wreck is considered 'live' by the UKHO.

The geophysical survey data do not extend to the high-water mark, and therefore remains may exist beyond the area surveyed. This area does not lie within the site.

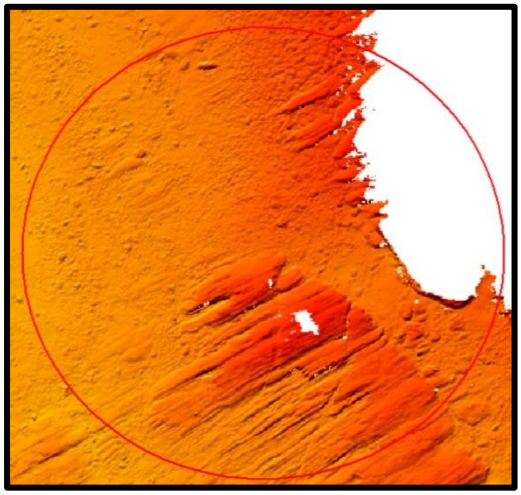
UKHO Identifier 7207



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

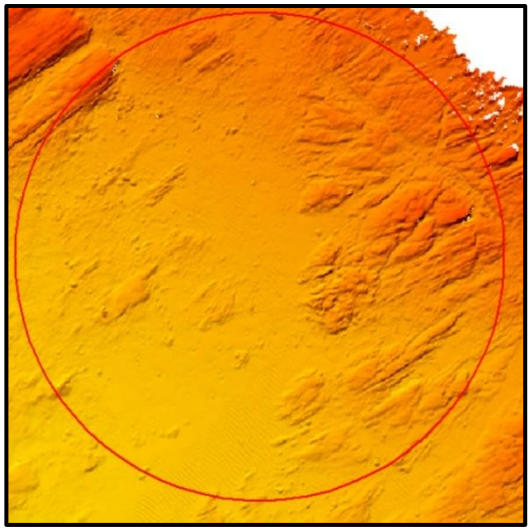
UKHO Identifier 7202



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

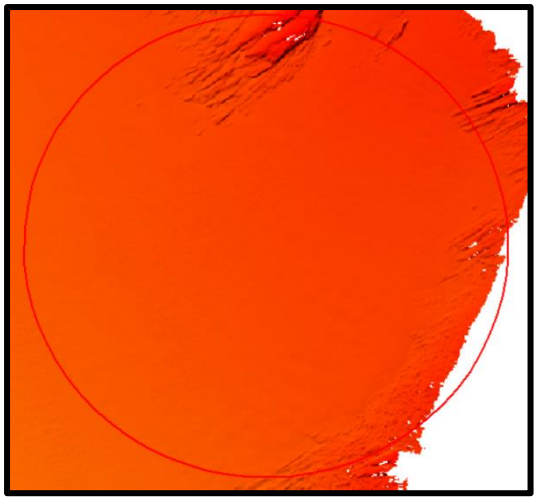
UKHO Identifier 7201



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

UKHO Identifier 7200

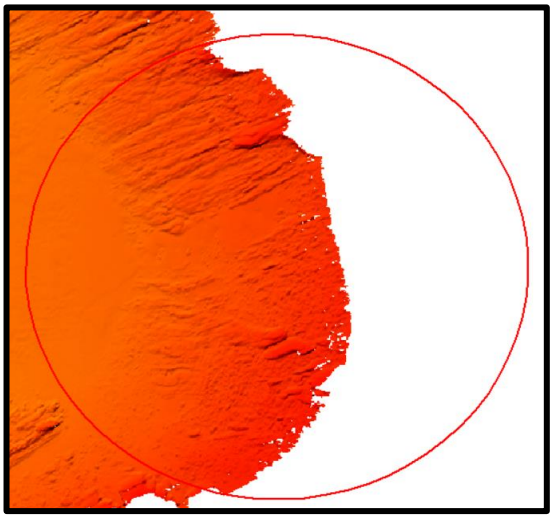


The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

A magnetic anomaly, Mag_16, was identified by Partrac (2018) c. 80 m to the west-northwest of the UKHO position for this diver sighting, however, this contact appears to relate to the southern end of a linear feature and is not considered associated.

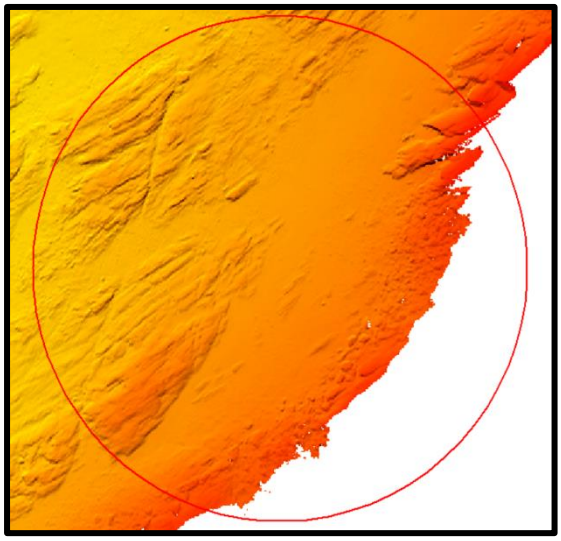
UKHO Identifier 7197



UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

UKHO Identifier 7194

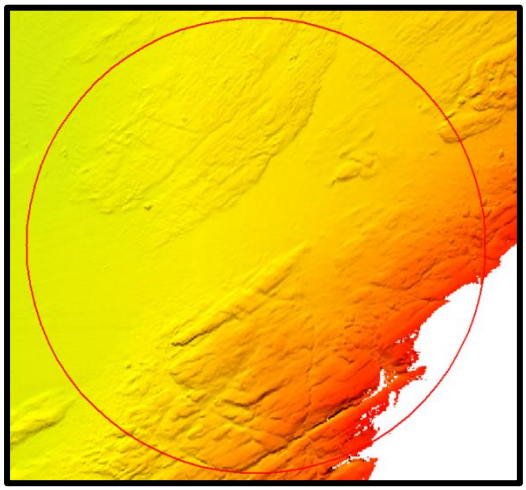


The UKHO reports the wreck of a four-masted iron barque, the *Primrose*, lost on Penrhos Rock in 1900. The wreck is reportedly very broken up with areas covered by sand and small stones. The wreck is reported to lie with its keel orientated east-west, and is broken up over a sloping seabed. Iron ribs and sections of rivetted iron plate lie scattered around, along with a section of tubular mast. Remains recovered from this area and reported to the RoW include the ship's chronometer, five brass portholes, part of helm, clay pipes, a toast rack, cutlery, an earthenware serving dish, an oil lamp, a storage jar,

a brass cherub, the ship's log, a binnacle cover, some stair tread, bottles, a candle snuffer and knife handles (droit A/2658) (MS_DBA_0089).

In the geophysical data, the magnetometer lines covered half of the area and reported no notable contacts present. No visible remains were identified on multibeam bathymetry or sidescan sonar data.

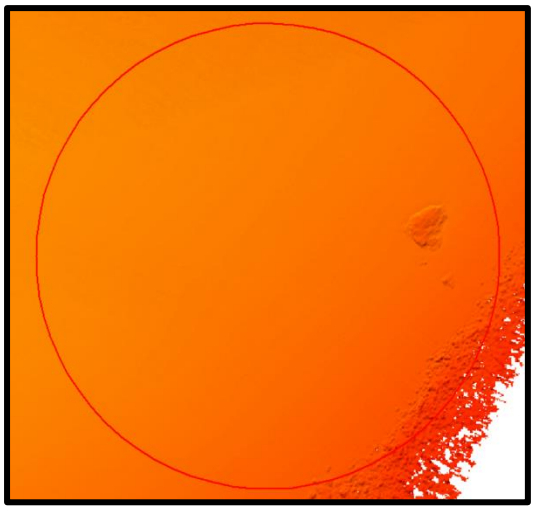
UKHO Identifier 7193



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

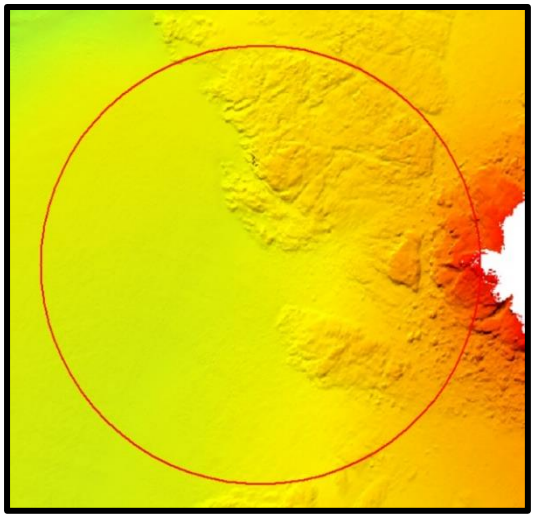
UKHO Identifier 7224



The UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976 but not recorded by two subsequent surveys, so amended to 'dead'.

No indication of wreck material was identified on the multibeam bathymetry or sidescan sonar associated with this project. Slightly higher magnetic variation was present in the southeast of the area but was thought to be associated with the geology (boulders).

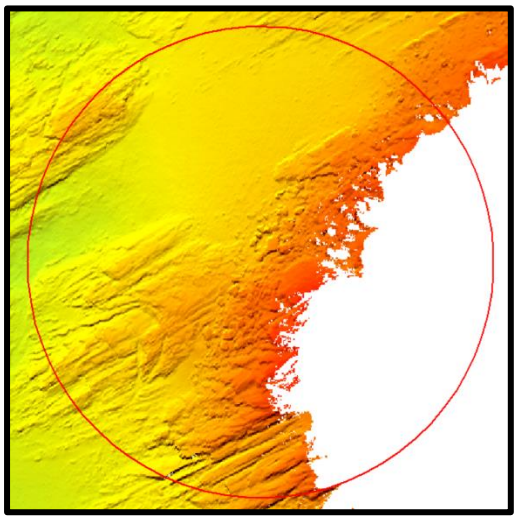
UKHO Identifier 7246



The UKHO reports a cannon in this area, initially reported by a diver in 1976 but not recorded by two subsequent surveys, so amended to 'dead'.

No indication of wreck material was present in the multibeam bathymetry or sidescan sonar data associated with this project. The magnetic data in this area were affected by a linear feature passing nearby and are therefore unable to be utilised.

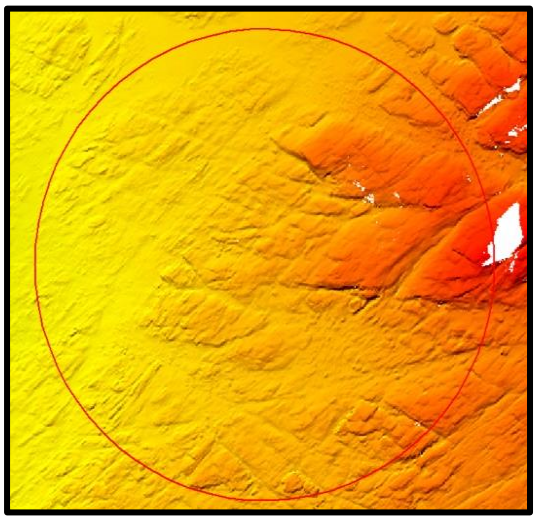
UKHO Identifier 7212



The UKHO reports the sinking of the *SS Holyhead* in 1883, off South Stack. The direction of the stack is not known and the position is considered unreliable.

No seabed remains were identified in the geophysical survey data covering the area and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

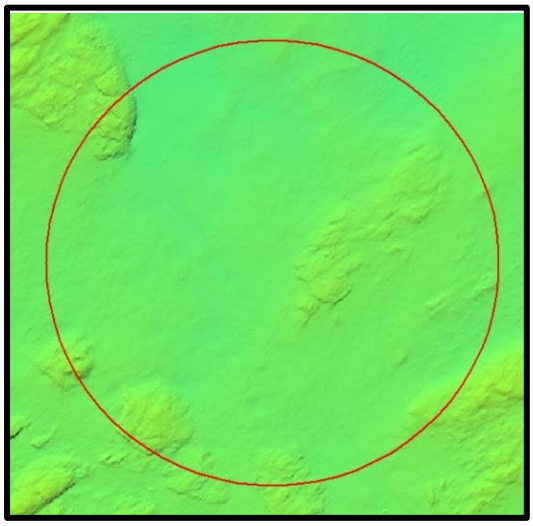
UKHO Identifier 7219



The UKHO reports the sinking of the fishing vessel *Valkyrie* in this location in 1968.

No seabed remains were identified in the geophysical survey data and although the wreck is considered 'live', the UKHO indicates the position is for filing only.

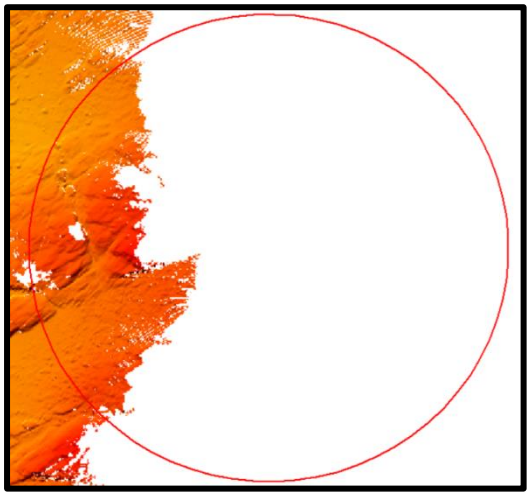
UKHO Identifier 7435



The UKHO reports the sinking of the fishing vessel *Ocean Gain* in this location in 1988. The UKHO surveying details indicate that the vessel was not located by a subsequent survey and the rocky outcrops in the area make a target of this size (21 m in length) difficult to identify.

No seabed remains were identified in the geophysical survey data.

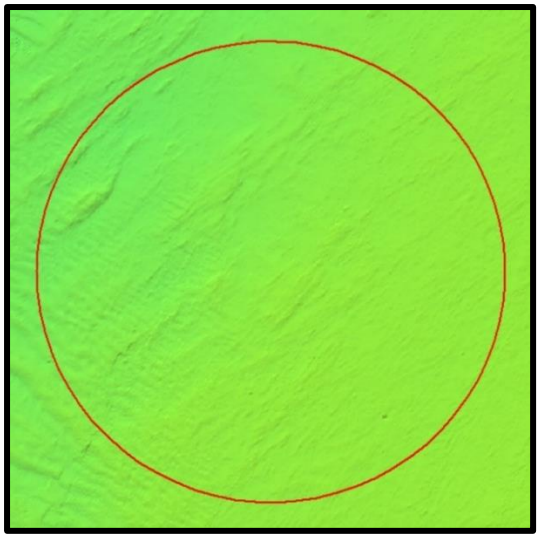
UKHO Identifier 7423



The UKHO reports the wreck of a barge in Abraham's Bosom, with a cargo of copper ingots, thought to have been lost during the 1940s. However, the position given is not for Abraham's Bosom, but for an area further south off Penrhyn Mawr. Therefore, the position is considered inaccurate (MS_DBA_0090).

The position of this record and most of the area around, lie beyond the survey area for geophysical data associated with this project.

UKHO Identifier 7405



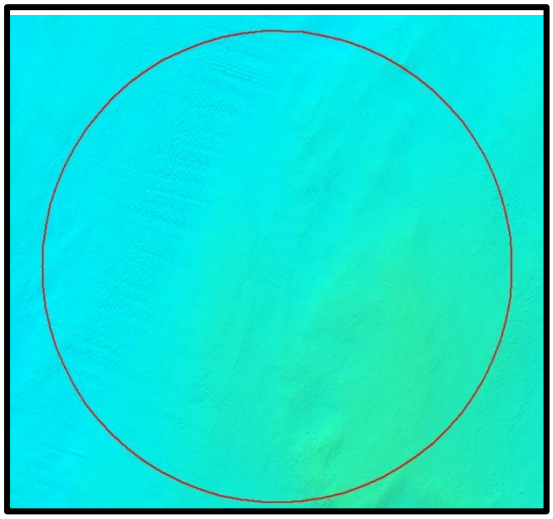
UKHO reports the loss of a fishing vessel, the *Diadem,* in 1980. The vessel was not located by subsequent surveys but the UKHO considers the searches inadequate to have disproved the record as a sidescan sonar could not be used to the south or east because of the proximity to the coastline (too shallow and rocky for towed sensors).

No visible remains were identified in this location in the geophysical data associated with this project.

UKHO Identifier 7244

The UKHO reports a 'dead' wreck, SS *Pochard,* documented sinking (in 1884), that was not found in subsequent surveys. This wreck is outside of the geophysical survey area boundaries for this project and therefore not able to be assessed.

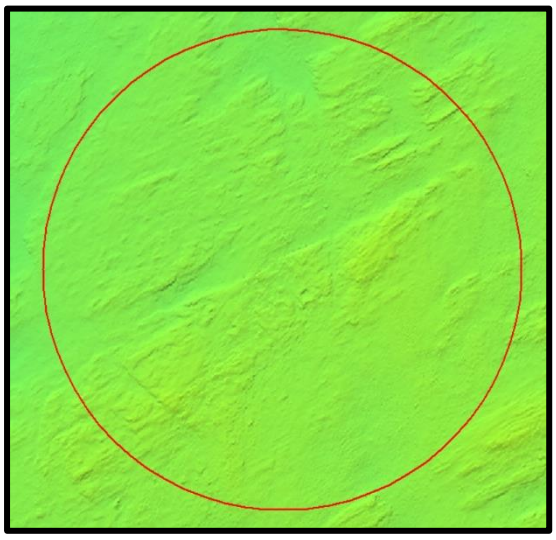
UKHO Identifier 7203



The UKHO records the sinking position of the *SS Cognac* in 1898, off the western side of South Stack. The position was surveyed by UKHO but identified no anomalies. Position amended to dead.

No indication of wreck material was identified in the geophysical data associated with this project.

UKHO Identifier 7245



The UKHO reports the sinking of the *SS Maiorese* in this location in 1913, after striking South Stack. The UKHO surveying details indicate that the vessel was not located by a subsequent survey.

No seabed remains were identified on the geophysical survey data.

Figure 3.10: UKHO Wrecks and Obstructions Within the Site Boundaries

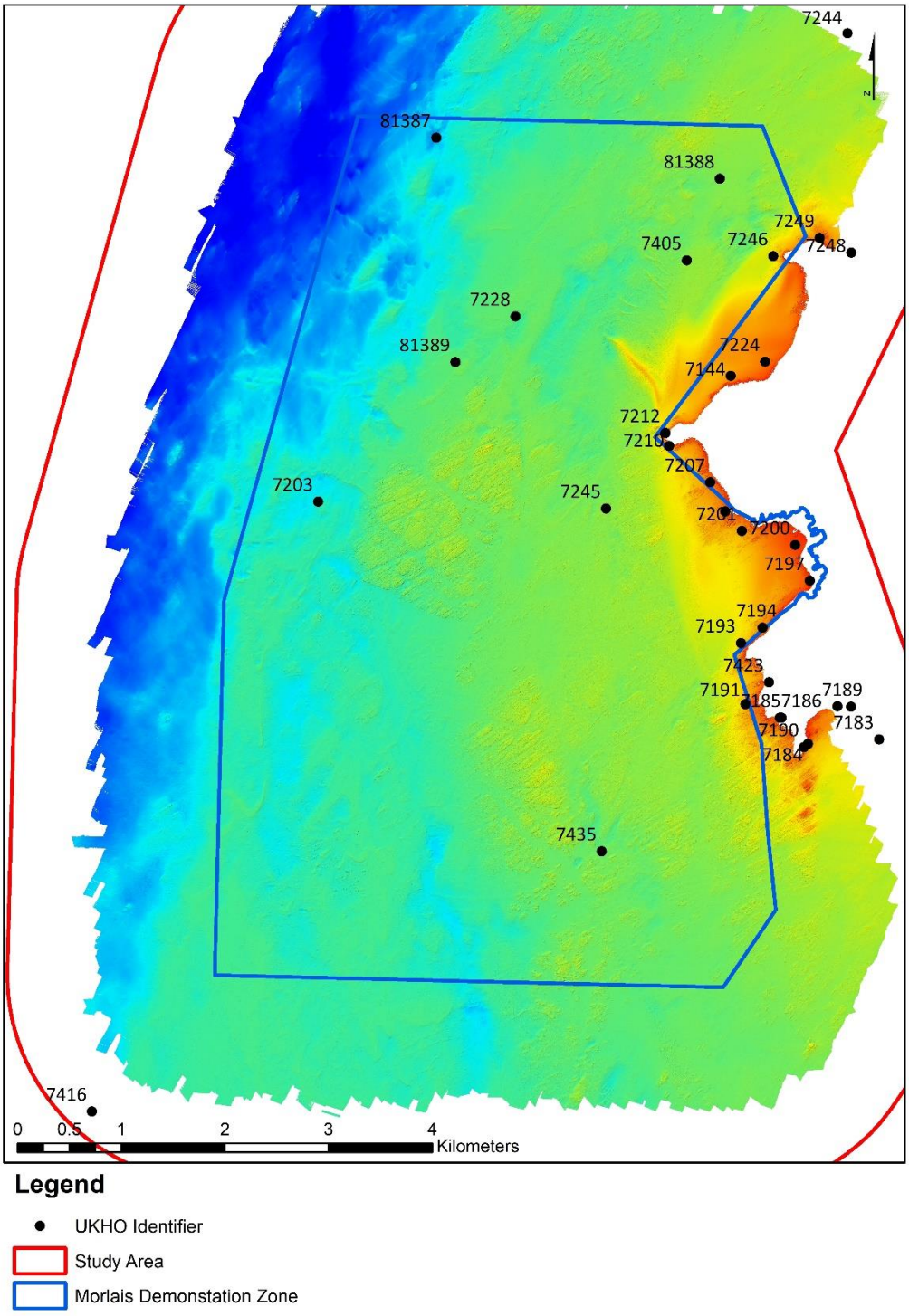
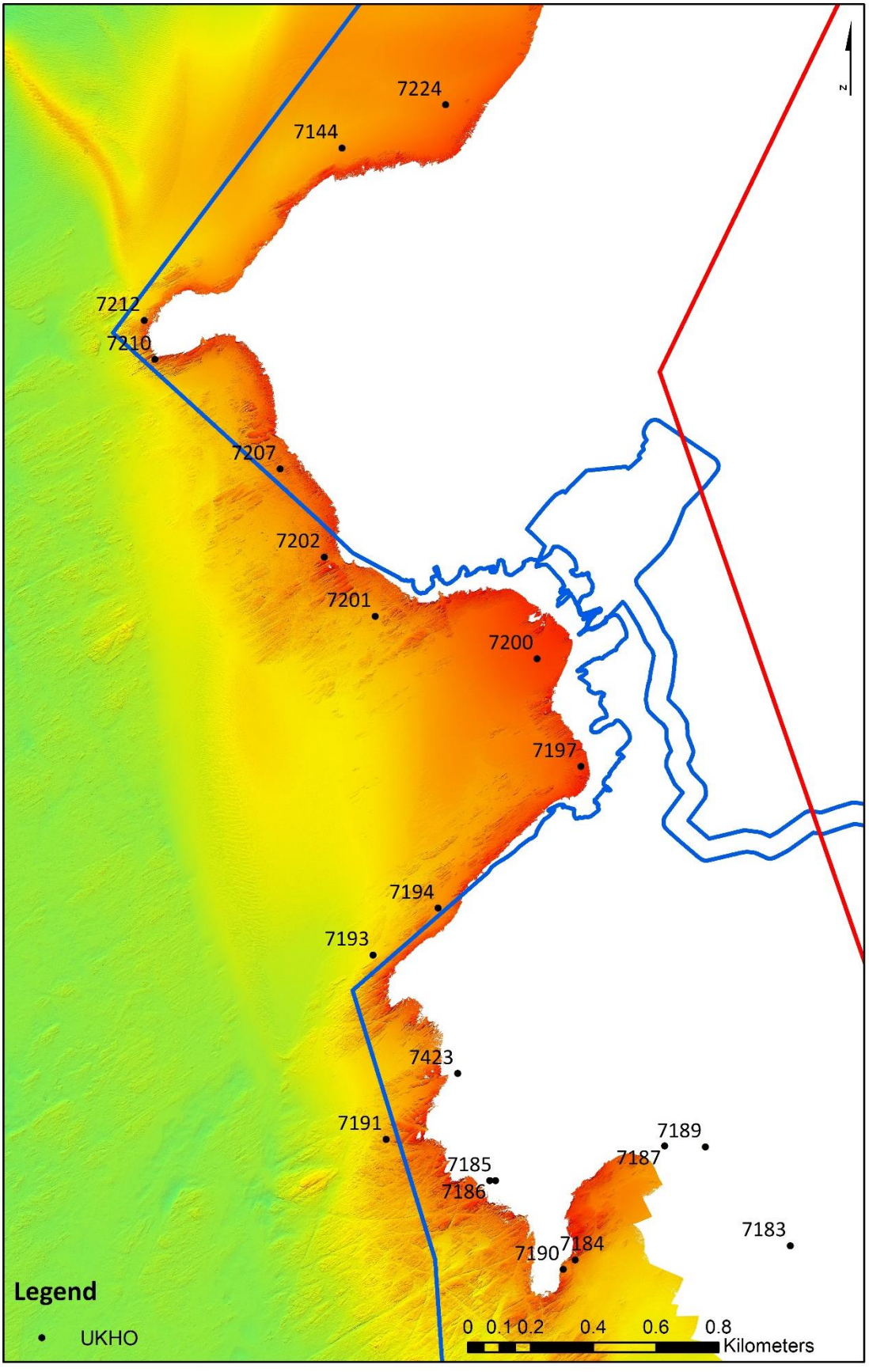


Figure 3.11: UKHO Wrecks and Obstructions Within the Site Boundaries, close up: Abraham's Bosom



3.4.3.1. Summary of Known Wrecks and Contacts Within the Site

A number of the contacts identified within the geophysical survey data are present within the site boundaries. Anomalies identified in geophysical survey data that are within the site boundaries are listed in Table 3.3 and comprise 4 high potential anomalies, 1 medium potential anomaly and 10 low potential anomalies:

Table 3.3: Summary of Wrecks and Geophysical Anomalies Within the Site

MS Identifier	UKHO Identifier	Name	Potential	Length	Width	East	North
MS_0001	81389	Unknown wreck	High	28.7m	8.7m	384627.4	5908447
MS_0003	7228	*Maarten Cornelis*	High	33.4m	6.8m	385206.3	5908885
MS_0004	81388	Unknown wreck	High	98.3m	41.4m	387178.1	5910211
MS_0005	81387	Unknown wreck	High	41.9m	9.8m	384431.8	5910625
MS_0011	-		Medium	-	-	387823.5	5906694
MS_0013	-		Low	160m	1.0m	386566	5907588
MS_0015	-		Low	306m	-	384108.7	5909204
MS_0017	-		Low	15.1m	1.2m	386734	5909894
MS_0018	-		Low	251.3m	2.4m	386064.8	5903662
MS_0020	-		Low	81.6m	1.4m	386258.2	5903519
MS_0023	-		Low	-	-	384328.1	5903675
MS_0024	-		Low	-	-	384730.4	5904803
MS_0025	-		Low	-	-	385047.5	5905742
MS_0027	-		Low	-	-	387262.7	5909502
MS_0028	-		Low	-	-	387177.7	5909588

Based on UKHO records of diver accounts and documented losses it is also likely that further disarticulated remains of wrecked vessels and potentially wrecked aircraft may survive within the site boundaries. This potential will be considered further below.

3.4.4. Receiver of Wreck Droits and Royal Commission Ancient Historical Monuments Wales Data

In addition to these UKHO records, the Receiver of Wreck (RoW) and RCAHMW hold records for wreck related material. The position of one RoW Droit lies *c*. 55 m to the north of a known wreck site reported by the UKHO:

- The RoW records one log of wood, one bronze valve and one copper pipe, possibly from the wreck of the Pochard (MS_DBA_0125). The position for this material is c. 55 m to the north of a confirmed wreck site, recorded by the UKHO and visible in the geophysical survey data associated with this project (MS_0004; MS_DBA_0117; UKHO Identifier 81388). The *SS Pochard* was documented sinking in 1884 (MS_DBA_0051), however the correlation between this documented loss and the wreck is not confirmed.

Although the positions for many of the other RoW and RCAHMW records may be imprecise or inaccurate, and no seabed remains have been identified at the locations, the records provide a general indication of the wreck resource and archaeological potential of the area. These include a wide range of wreck-related objects, including ship's parts, cargo, artefacts relating to life on board and personal items. A full list is included within Gazetteer 2.

- RoW record (Droit 054/14), 1 x large wooden fid, salvaged from the wreck site of the sailing barque 'Primrose Hill' (built in 1886 by Sir Thomas Bland Royden & Sons of Liverpool and owned by William Price and Co of Liverpool). This position appears on the coast, but remains are likely to have been recovered from the site of the Primrose (MS_DBA_0086);
- Divers reported 1 x cannon ball. 1 x grape shot. 1 x potential ink well south of South Stack (MS_DBA_0121);
- Records of the find, a porthole and steam gauge, were recovered from a small coaster off Anglesey. The porthole measures 7 in and the steam gauge 7 in diameter (MS_DBA_0122);
- Find spot of one cast iron cannon probably representing the site of a wreck (MS_DBA_0123);
- Droits for approx. 100 x copper nails, 2 x keel pins, 2 x musket balls, not from a known wreck (MS_DBA_0124);
- Pieces of ship's bell, parts of a sextant, small decorative brass cannon, hand-made copper nails and section of iron chain (MS_DBA_0126);
- One cannon ball (good condition - undergoing treatment), 1.5 small lead ingots from a concretion close to the remains of a wreck salvaged in 1970s (MS_DBA_0127)
- Debris or seabed obstruction measuring some 7 m in length, 0.7 m in width and standing 0.6 m above the seabed (MS_DBA_0130)
- A large iron casting was located in some 10 m of water close to the southern side of the North Stack. It is believed to be a knee-rider and is indicative of a shipwreck (MS_DBA_0141); and
- A sports diver reported a sunken barge carrying copper ingots in Abraham's Bosum bay in July 1985. UKHO reports a different position for this wreck (MS_DBA_0131).

Only one of the records is in the area of a known wreck site (MS_0004, MS_DBA_0117, MS_DBA_0125). However, the remainder give an indication of the archaeological potential of the area.

3.5. Potential Maritime Archaeological Resource

It is important to acknowledge that the survival of the physical remains of shipwrecks on the seabed correlates strongly with sedimentary burial within the substrate (see Section 3.3, and Ward *et al.*, 1999). As noted above, the coarser sediments present within the application area have lower potential for the preservation and recovery of buried archaeological materials.

Other factors also affect the presence and survival of wreck remains. Within the study area navigational hazards such as the rocky coastline of Holy Island are likely to have resulted in the wrecking of vessels. This is borne out in the historical records of documented losses of shipwrecks, and in diver sightings of wreck sites which are focused around the coast. Although some positions derived from documents and diver sightings may be imprecise or inaccurate, as a whole they demonstrate the higher potential for wreck remains around the coast of Holy Island.

Within the study area, more sheltered locations such as gullies between bedrock outcrops may also have a higher potential for wreck remains, due to the improved chances of survival in locations more sheltered from high energy hydrodynamic processes. However, any remains situated in gullies are likely to represent more robust items of wreckage rather than coherent structures.

While this section is focused on the potential maritime remains, it also reviews evidence for each period chronologically within the study area. Terrestrial sites can give an indication as to potential maritime activity within the area, and can also result in the presence of eroded remains within the marine zone. This is referred to where relevant.

3.5.1. Early Prehistoric (Palaeolithic and Mesolithic)

Whilst no evidence of watercraft from the Palaeolithic has been discovered in Western Europe to date, this should not be viewed as evidence of a lack of activity from the period. The technology and expertise required to construct boats from hollowed out logs, or animal hides and skins stretched over wooden frames was certainly available at the time. However, as no remains have been discovered, the potential for any such evidence to be present within the site is extremely limited.

Evidence of Mesolithic maritime travel is rare but comes from direct evidence such as log boats and associated remains such as paddles, as have been found at Starr Carr in Yorkshire and on the submerged prehistoric site of Bouldnor Cliff on the Isle of Wight (Momber *et al*., 2011), and indirect evidence of trade networks or remains of deep water fish which hint at maritime activities. The possibility of deep-sea fishing conducted from boats has been raised in relation to Mesolithic remains at Ynys Enlli (Bardsey Island), off the Llŷn peninsula in Wales (Lillie, 2015: 246).

However, no remains are known from within the study area or region and the potential for such remains to occur within the site is considered to be very low.

3.5.2. Neolithic and Bronze Age (c.4,000 – 700 BC)

Sea levels are thought to have reached -2 m below Ordnance Datum during the Neolithic, by around 5000 BP. The separation of Anglesey from the mainland is thought to have occurred between *c*. 5600-4800 BP with the formation of the tidal channel which exists today, following sea level rise through

the Holocene (Roberts, 2006). Marine conditions are likely to have characterised the majority of the site from the beginning of this period.

The Neolithic to early Bronze Age in Wales is characterised by a gradual transition from hunter-gatherer lifestyle to more settled societies concerned with agriculture and pastoralism. The period also saw an increase in the importance placed on the treatment of the dead with burials and ritual sites becoming an important facet of the archaeological record. Archaeological sites and monuments from this period in Wales therefore tend to be associated with funerary and ritual activities, rather than domestic settlement (Burrows, 2010). This is attested to within the study area by records of Bronze Age burials (MS_DBA_007-8).

From the middle Bronze Age (*c*. 1,500 BC - c. 1,100 BC) through to the late Iron Age (*c*. 400 BC - AD 43) settlement evidence and the associated evidence for agricultural practices and land division becomes more visible in the archaeological record, alongside evidence for widespread woodland clearance and associated degradation of upland soils due to increased run-off and podsolisation (Johnston and Griffith Roberts, 2003).

From the middle Bronze Age, settlement became more permanent; usually as single farmsteads. A typical settlement of this period may include buried evidence for at least one roundhouse in the form of a hut circle or platform and associated features such as an enclosure ditch, ditched fields, paddocks, field clearance cairns/banks of stones, lynchets and trackways. Settlements of this period in Wales are often enclosed or defended, and in the late Bronze Age and Iron Age large fortified hillforts were also being constructed.

Flint scatters dating to the Neolithic period have been identified along the coast (MS_DBA_001). As with earlier periods, there is potential for eroded remains to be present in the nearshore areas of the site.

Evidence of maritime activity from these periods is generally rare, but an increasing number of finds from Bronze Age vessels are coming to light. Within Wales, evidence of Neolithic and Bronze Age waterborne transport includes a possible log boat from Monmouth, dated to 3120 BC, Bronze Age sewn plank vessels from Goldcliff and Caldicot (Bell and Neumann, 1997), and log boats such as the recent example from Milford Haven which has been dated to c. 1420 BC. However, there is no recorded evidence of Neolithic or Bronze Age maritime activity within the study area and given the rarity of such remains the potential is considered limited.

3.5.3. Iron Age and Roman Period (c.700 BC – AD 410)

The increase in settlement evidence which begins during the middle Bronze Age continued throughout the Iron Age, along with increases in associated evidence for agriculture and land division. Settlements of this period in Wales are often enclosed or defended, and in the late Bronze Age and Iron Age large fortified hillforts were also being constructed. Within the study area a number of later prehistoric settlement sites have been identified, with characteristic roundhouses and associated field systems such as at Holyhead Mountain, and promontory forts of Iron Age or prehistoric date are also present, for example at Dinas and Caer y Twr (MS_DBA_0010-14).

Of particular interest are the remains identified at Pen-y-Bonc (MS_DBA_0014), which include hut circles and associated evidence of occupation, probably dating to the Late Iron Age and Romano-

British periods. This settlement is within 200 m of the high-water mark and lies in close proximity to the onshore development area. Within the marine and intertidal part of the site associated eroded remains may be present, redeposited and thus not *in situ.*

Many of the Iron Age settlements within the study area also have evidence of continued activity into the Romano-British period. The earliest evidence of Roman settlement activity in northwest Wales dates from 48 AD, marking the start of the military campaigns in the area (Waddington, 2013: 19). The Roman road network is thought to have been established in order to link newly emergent military outposts and the supporting market and crafting centres. A Roman Fort was cited at Holyhead during this period, and it is suggested that this fort formed part of a network which defended the west coast against Irish sea-raiders. The fort is associated with a probable watch tower, constructed on the Iron Age remains at Caer y Twr (MS_DBA_0012). The watch tower may have been used during the 4th Century as a lookout post for raiders (Arnold and Davies, 2000).

Like the Bronze Age, Iron Age maritime activity is attested by the physical remains of vessels and by indirect evidence including trade networks and marine exploitation. During this period trade networks extended from Britain to continental Europe. Archaeological evidence of maritime activities also comes from log boats dating to the period, such as the 3rd Century example from Poole Harbour (dated to the 3rd Century BC) (McGrail, 2004).

Wrecks from the Romano-British period are rare. A river boat has been identified dating to this period in a Welsh context at Barland's Farm (Nayling *et al*., 1994), and others are known from further afield at sites such as Blackfriars (Marsden, 1994) and Southampton water. Other wreck sites of this period have been attested to by the presence of cargoes, such as the Pudding Pan wreck, identified on the basis of concentrations of Roman pottery on the seabed (Walsh, 2017).

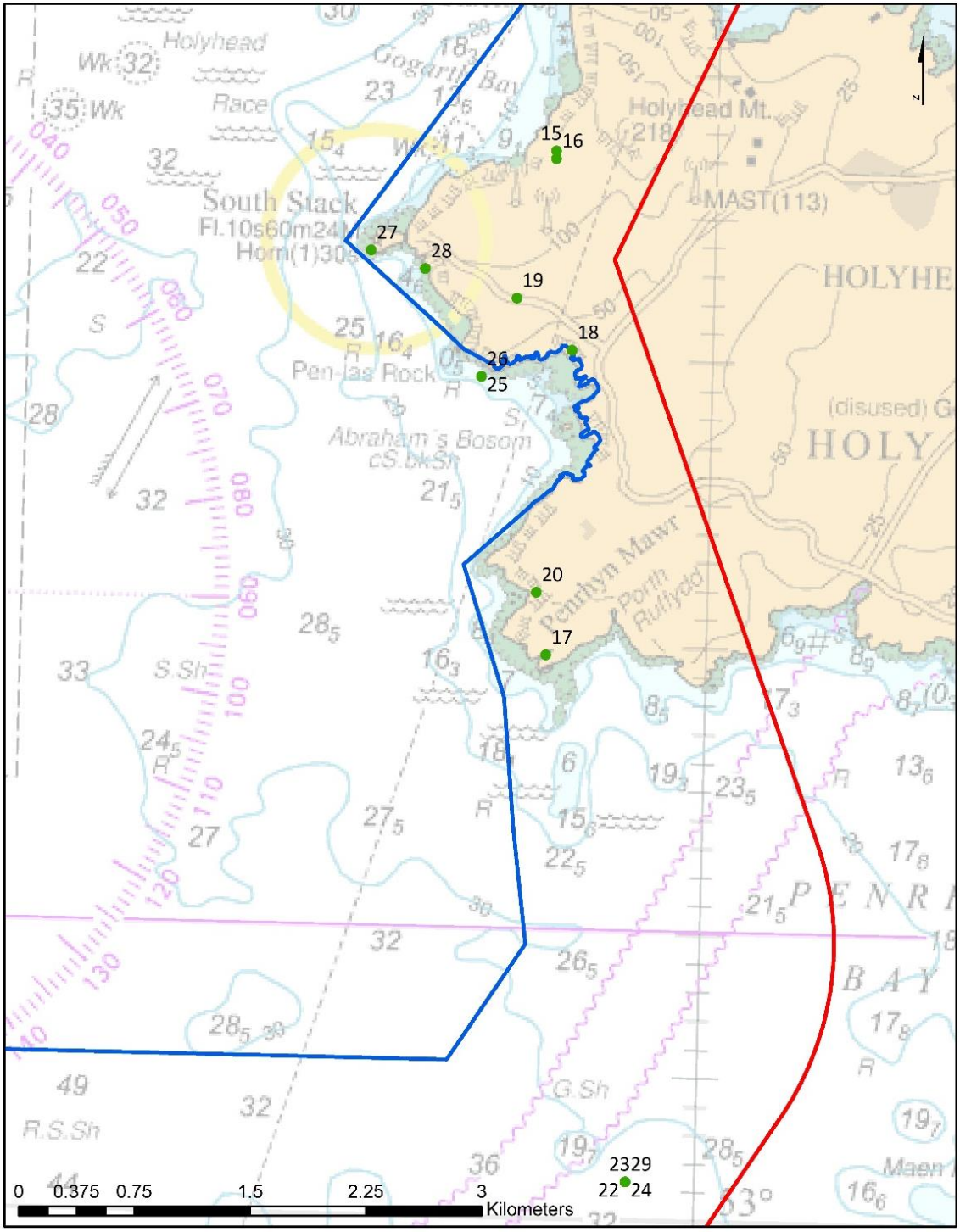
Maritime activity within the study area may have occurred within the Romano-British period, as indicated by the presence of the Fort at Holyhead and watch tower at Caer y Twr. However, there have been no records of wreck material or possible cargoes dating to this period from within the study area, and given the rarity of such remains the potential is considered limited.

3.5.4. Early Medieval and Medieval Periods (AD 410 – 1508)

Archaeological evidence of early medieval activity is generally rare, both in marine and terrestrial contexts. The Romano-British fort at Holyhead later formed the focus for a 6th Century monastic site, established by St Cybi. The Viking incursions into the British Isles also left their mark, and historical records indicate Viking attacks on Anglesey in the 9th and 10th Centuries AD. Holyhead is thought to have been used as a port during the medieval period (Jones, 2010). Remains within the study area dating to this time relate to a chapel site, find spot of a coin and field boundary of possible medieval date (MS_DBA_0015-17) suggesting the coastal strip probably formed part of the wider agricultural and rural hinterland to nearby medieval settlements such as Holyhead.

A marine site dating to this period has been identified at the Smalls reef, off the coast of Pembrokeshire in south Wales, where an 11th-Century Viking sword hilt was identified in the 1990s. Other remains of vessels dating to this period tend to come from ship burials such as at Sutton Hoo.

Figure 3.12: Medieval and Post-medieval Remains Recorded Within the Study Area. (For full details see Appendix B. Numbers are prefixed by MS_DBA_)



Legend

- Medieval and Post-Medieval Remains
- Study Area
- Morlais Demonstation Zone

Evidence for maritime activity increases during the medieval period, with the expansion of maritime trade and defence networks. Within Wales, evidence of waterborne activity comes from remains such as the Magor Pill wreck, a 13th-Century vessel (Nayling, 1998), and the Newport Ship, a 15th-Century sailing vessel. Maritime activity within the vicinity of the site is likely to have focused on the emerging medieval settlement and port of Holyhead. The coastline within the study area presents some navigational hazards which may have threatened shipping during this period, as in earlier times. However, there are no known records of vessels lost within the study area during this period. Whilst it is possible that remains reported to the RoW by divers could relate to medieval vessels (see Section 3.4.4), it is much more likely that these remains relate to post-medieval and modern wreck sites, which are much more numerous. Vessels of medieval date remain rare in the UK making the potential for such remains to occur within the site low.

3.5.5. Post- medieval Period (AD 1508 – 1800)

The growth of commercial maritime trade continued and rapidly expanded in the post-medieval period as opportunities for travel to the New World developed. The period is characterised by the development of the Age of Sail, the dominance of global trade and travel by large wooden sailing ships. During the period the levels of maritime traffic traversing the study area would have increased dramatically.

Holyhead retained its position as a port town throughout the post-medieval period, however between the period of *c.*AD 1500-1700 few documents shed more detailed light on the area's history, beyond reference to the overseas links between Ireland and Holyhead (Jones, 2010). After 1700 the importance of the area increased drastically in connection with the development of a copper mine on Parys Mountain, which became the largest copper mine in the world before its rapid demise following a decrease in demand for copper at the end of the Napoleonic war. The development of mining in the area, and the close contact with Ireland, lead to the emergence of Holyhead as Anglesey's main port.

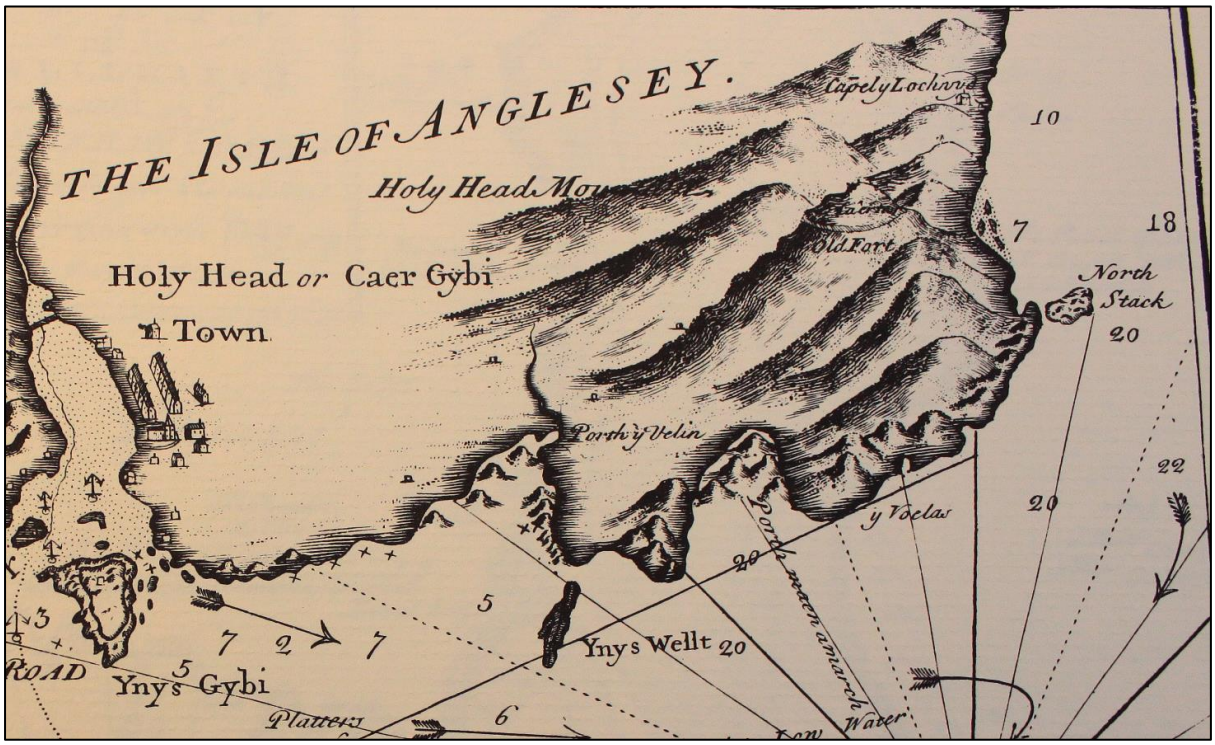


Figure 3.13: Lewis Morris' Chart of the Area Dated to 1748, Showing the Main Port of Holyhead. The northern part of the site is shown to the top right of the image, with North Stack depicted. From Morris, L. 1748. *Plans in St George's Channel*. Facsimile, 1987.

The general advancement of maritime activity during this period, and the development of the port of Holyhead, led to an increase in shipping in the area, reflected in the historical accounts and reports of wrecks along the coast of Holy Island. Although charting and navigation improved drastically during the periods (see Morris' chart, 1748; Figure 3.13), key landmarks such as North and South Stack, and other promontories, continued to pose navigational hazards to shipping. In recognition of this Henborth Old Harbour may have been used as a location from which rescue boats could be launched to reach vessels wrecked on the stacks of the west coast of Holy Island (MS_DBA_0018) and may also have been used to bring goods ashore. These activities may have been associated with features and structures in the intertidal zone, though none are recorded.

A number of sailing vessels were reported as losses during this period, with the locations of their loss reported in a way which may indicate their presence within the study area (MS_DBA_0022-29). For example, two brigs were lost in 1795 at the back of Holyhead (MS_DBA_0025-26) and a number of other wooden sailing vessels are documented losses (MS_DBA_0022 -24, 27). However, as with all documented loss records, positions are notoriously inaccurate, and records thus provide a general understanding of the archaeological potential of the wider area rather than denoting specific sites of interest.

Divers have also recovered material dating to this period, including Spanish silver coins dated 1790, a bronze coin, greenheart wood, a compass case, silver cutlery, brass dividers, uniform buttons, bronze manillas, cannon balls, a bronze cup weight, buckles and lead ingots. Some of these objects date from the post-medieval period, though some may be later. However, while the position ascribed to these

remains falls within the study area, the record comprises a finds report which has been assigned to a named location (off Anglesey), and the position is considered inaccurate (MS_DBA_0021).

The assessment of data from the UKHO and RoW indicates the presence of numerous wrecks reported by divers around the coast of Holy Island and focused on key navigational hazards such as promontories. While assessment of geophysical survey data in these locations has indicated that some of the recorded positions do not correlate with identifiable seabed remains, this is likely due to imprecision of diver positions. Thus, given the number of positive diver identifications and RoW records the nearshore areas around the coast of Holy Island are considered to have potential for the remains of wrecked vessels.

This potential is focused in areas where the environment would allow for preservation. In particular, wreckage may be found in gullies in bedrock, other sheltered location and areas where fine-grained sediment has been deposited, particularly in the bays.

3.5.6. Modern (Post 1800)

The early-19th century saw the introduction of iron and steel vessels, of steam propulsion and further large increases in the volume of traffic utilising British waters for trade and military purposes. Traditional wooden vessels were still utilised in this period as fishing vessels and industrial barges and hulks. The late 19th and 20th century saw further expansion in maritime activity with significant increases in the production and use of metal hulled vessels. In particular, the modern period was characterised by the significant levels of military activity associated with two World Wars.

The increase in shipping went hand-in-hand with an increase in the number of vessels lost. To counter this, navigational aids became more numerous around the UK's coastline. Within the study area this is reflected by the presence of the South Stack lighthouse and associated signalling features (MS_DBA_0031-33, 0035), in addition to lifeboat houses (MS_DBA_0034).

The 19th-century Tithe Map does not indicate the presence of any features within the intertidal zone (Figure 3.14), though a road terminates in the bay at Abraham's Bosom, indicating the probable use of the bay as an embarkation and landing point. Although no intertidal features are depicted on the map it is possible that structures relating to the use of the bay as a landing point, and evidence of maritime remains such as watercraft, may be present within the intertidal area.

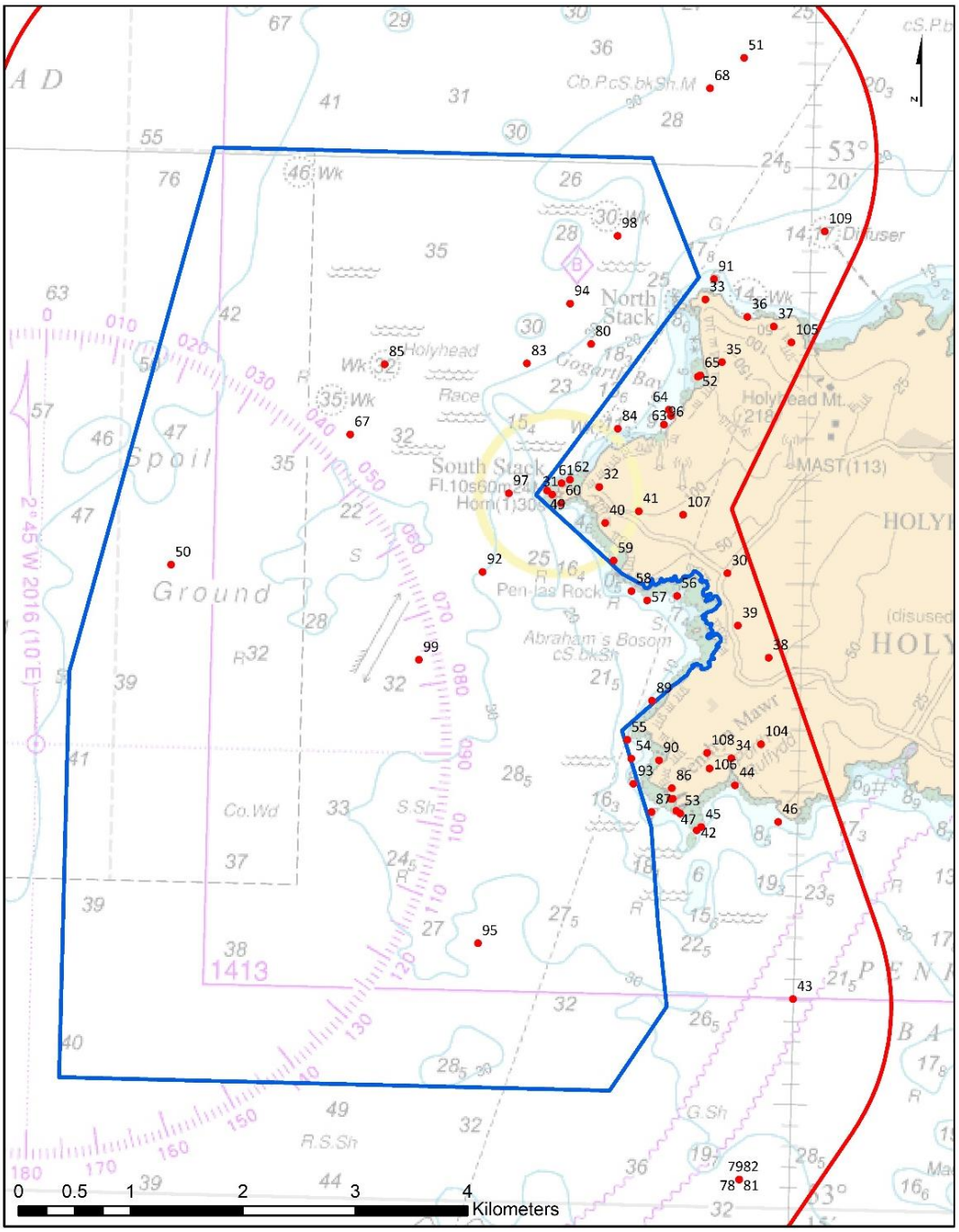
Figure 3.14: Extract from the 19th century Tithe Map of Holyhead Parish. From the website of the National Library of Wales.

The increase in features of the maritime cultural landscape onshore is mirrored by the presence of wrecks and related remains offshore. It is important to note that 19th and 20th century iron and steel vessels are typically more visible on the seabed than their wooden predecessors (see MS_0001, 0003, 0004 and 0005, identified by the geophysical surveys within the site). This is a result of an increase in their numbers, and also in the reporting of losses at sea brought about by the creation of the Lloyds of London List of shipping casualties, but also by their high visibility in bathymetric and sidescan sonar survey data. A number of wreck sites dating to this period are present within the site and study area. Those identified on geophysical surveys have confirmed positions (see Section 3.4).

The losses of a large number of vessels are recorded in this period (MS_DBA_0042-0096). Reports indicate that some of these vessels have been identified by divers including the wreck of the SS *Editor*, which stranded on Penrhos Point in 1897. The remains are reportedly broken up, and lying on a rocky seabed spread across three bays, between the Fangs and Tide Rip Rock, with remains including a double bottom, large anchor, dead eyes and boilers standing up to 3m in height. The RoW holds records of droits from the Editor (A/1812) for two deadeyes. The position given appears to be located some distance away but is likely inaccurate and associated with this site. The position for the site was investigated on the geophysical survey data but no remains could be seen (see Section 3.4, UKHO Identifier 7190), indicating that it too may be inaccurate or the remains have since been dispersed or buried, or are not visible within the data (MS_DBA_0042).

The sailing barque, *Tenby Castle*, was also reported sinking in 1889 (MS_DBA_0044). The wreck reportedly broke up c. 500 ft from the shore. Remains were reported in the loss location by divers in 1976. A large pile of wire-rope, possibly from the rigging of a sailing ship, reportedly lay on the seabed, along with several bricks and timbers. Muntz-metal hull sheathing has also been reported. These remains may represent the *Tenby Castle* or an unnamed wreck. This area is beyond the extent of the geophysical surveys conducted in association with this project and so seabed remains could not be assessed.

Figure 3.15: Modern remains recorded within the study area. For full details see Appendix B. Numbers are prefixed by MS_DBA_



The UKHO also report diver sightings of the wreck of the *SS Mersey* which stranded on Penrhos Point rocks in 1894. The remains are reportedly badly broken up, some close inshore and parts scattered in deeper areas, with the propeller and shaft reported 100 yds to the northwest of the wreck. No clear seabed remains are visible in any of the geophysical survey data, though scattered anomalies in the area could represent wreckage they may more likely be boulders. This area lies beyond the site boundaries (MS_DBA_0045).

The *City of Richmond* was also lost in this period. The vessel was a wooden barque built in Quebec in 1864. She ran ashore 2 miles south of the South Stack on 3 February 1881. Sources suggest that the site was surveyed and artefacts recovered by Liverpool Museum Service working with Merseyside BSAC from 1967 onwards (MS_DBA_0046).

The wreck of a wooden sailing vessel surrounded by concreted piles of muntz-metal fittings, lead sheets, copper bars (fastenings) and sheathing tacks, with a pile of old anchor chain lying 50m further offshore is also recorded by the RCAHMW and the UKHO. The bell of the *Niagara* (lost 1875) was recovered from this vicinity in 1979 (MS_DBA_0047). This area is largely beyond the extent of the geophysical surveys conducted in association with this project and so seabed remains have not been assessed for the precise location.

The locations of all wrecks reported by divers has been scrutinised within the geophysical survey data. While the majority did not correlate with identifiable seabed remains, there continues to be potential for archaeological evidence of these vessels to be present within the area.

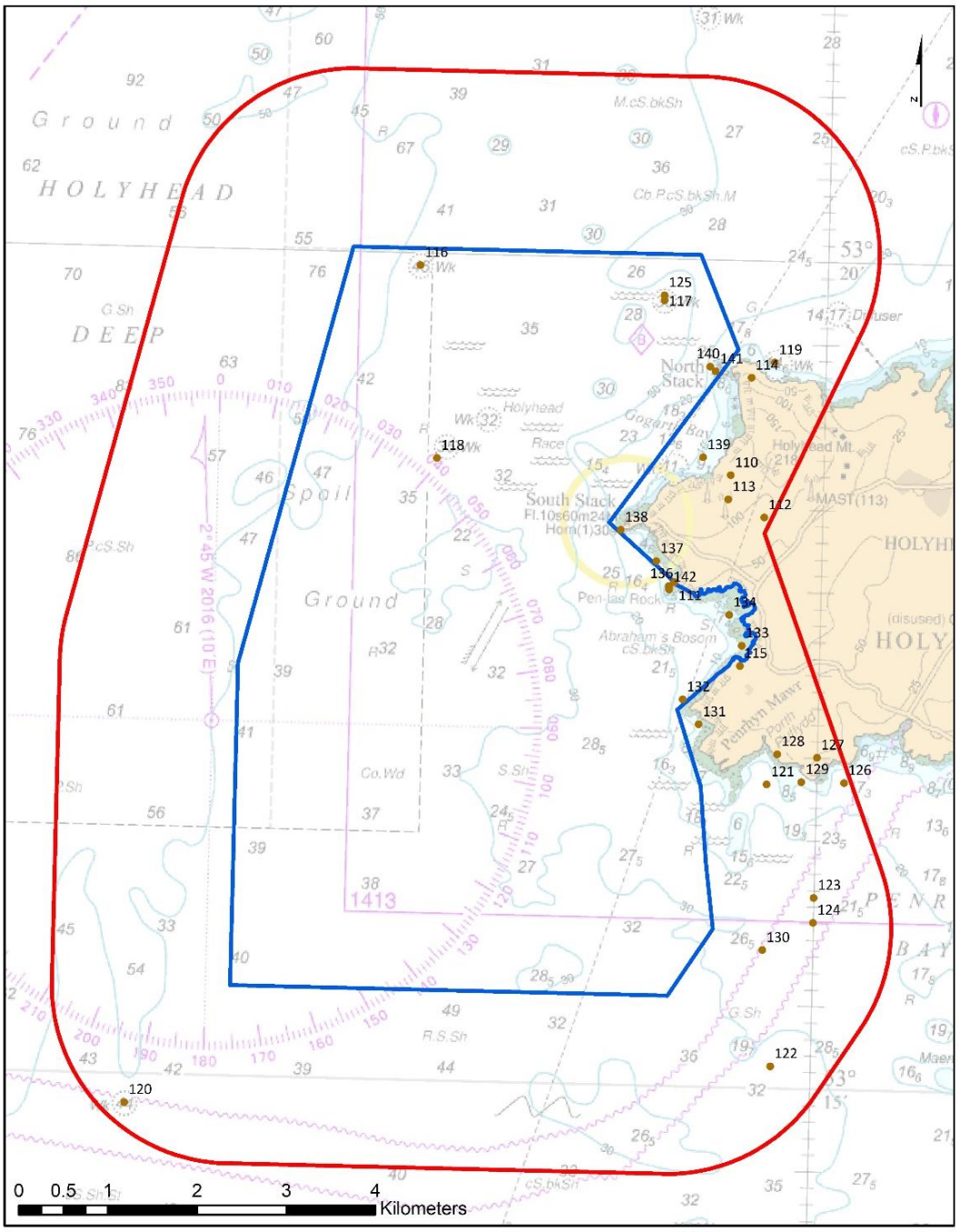
A large number of other vessels, ranging from wooden schooners, barques, sloop, fully-rigged ships, brigs, yachts and steamships were also lost in this period (MS_DBA_0052-82).

As with earlier periods, there is particular potential for remains to be found in areas where the environment would allow for preservation. In particular wreckage may be found in gullies in bedrock, other sheltered location and fine-grained sediment in the bays.

3.5.7. Undated Remains

A number of undated remains have also been identified. These remains reflect the general archaeological background of the area, and include a number of wrecks for which the identities are unknown. These include wrecks identified by the UKHO and geophysical surveys associated with this project, in addition to wrecks reported by divers, the positions for which have been investigated with the use of geophysical survey data collected for this project (see Section 3.4).

Figure 3.16: Undated Remains Recorded Within the Study Area. (For full details see Appendix B. Numbers are prefixed by MS_DBA_)



3.5.8. Summary of Maritime Archaeological Potential

The assessment demonstrates that there is potential for the recovery of a variety of maritime archaeological material from within the study area, with particular potential for wrecks of post-medieval and modern date. Any wreck sites dating from pre-1815 are likely to be of high archaeological significance based on the rarity of surviving vessels from this period. Wrecks dating from 1816 to the present day may still be considered to be of high archaeological significance where they specifically contribute to understanding of technological developments or particular events, people and places (See Wessex Archaeology, 2008b).

It is important to note that the areas of exposed bedrock and coarser deposits within the application area have lower potential for the preservation of previously unknown shipwreck and maritime archaeological material. High energy areas are also less likely to result in the survival of articulated remains.

A relatively large number of diver records of wrecks are known within the study area. These records are generally focused around the nearshore area, and although the majority have not been located by geophysical surveys the potential for wreckage in the nearshore area remains relatively high, particularly given the number of documented losses reported for the area. This potential may be highest in sheltered locations such as gullies and in bays beneath sediment, in areas of lower energy where bedrock is not exposed.

In addition to the potential for wreck remains, there is also potential for maritime and related intertidal features and structures in Abraham's Bosom, relating to the use of the area as an embarkation and landing point from at least the post-medieval period.

There is also potential for eroded remains relating to prehistoric sites in the area (see also Section 3.2).

3.6. Known Aviation Archaeological Resource

Since the birth of air transportation in the early 20th Century many thousands of military and civilian aircraft casualties have occurred in UK waters. The bulk of these are casualties of World War II. RAF Valley which lies approximately 10 km to the east-south-east of the MDZ, was constructed in 1940 as a military airfield, responsible for defending the north-west of England including the key centres of industry, and protecting shipping in the Irish Sea. From 1943 it was used extensively by the United States Army Air Force (USAAF). The presence of this airfield in the vicinity of the site is likely to have influenced the potential for archaeological remains of aircraft in the area.

The ephemeral nature of aircraft wrecks ensures that many sites remain unknown and unrecorded and although records of aircraft losses at sea are extensive, they are seldom tied to an accurate position (James *et al.*, 2010). There is therefore a significant discrepancy between the large number of reported losses of aircraft and the number of confirmed and charted sites on the seabed.

3.6.1. Known Aircraft Crash Sites

No confirmed and charted aircraft crash sites are recorded in the study area. A total of seven recorded aircraft losses (MS_DBA_0097-102, 104) are recorded within the site and study area by the NMRW, and the UKHO records a diver account of the wreckage of a liberator bomber on the seabed within

the study area, to the north-east of North Stack, but outside of the site boundaries. This aircraft was not found on subsequent geophysical surveys and the UKHO amended their records to dead (UKHO identifier 7249; MS_DBA_0091). Additionally, surveys conducted as part of this project found no evidence of the wreckage. However, online news reports indicate that aircraft wreckage has been identified off North Stack, and the propeller from a wreck thought to be that of 36th Bomber Squadron USAAF B24 has been recovered from the area and brought ashore, now forming part of a memorial monument[1]. No position is recorded for this, however the description, off North Stack, is in the area of the aircraft recorded by divers on the UKHO database (UKHO identifier 7249; MS_DBA_0091), providing an indication that although repeat geophysical surveys have not detected these remains, evidence of the aircraft wreckage may survive in this area of the seabed.

3.7. Potential Aviation Archaeological Resource

The area around the site has potential for the recovery of crashed aircraft and in particular material associated with military conflict during WWII, following the construction of RAF Valley which lies a few kilometres to the east-south-east of the site.

The seven aircraft losses which are recorded within the study area all relate to WWII, and in one case a post-WWII plane. The loss locations are vague, including two Vickers Wellingtons, lost in the sea near South Stack (MS_DBA_0097, 99), a B-24 Liberator 42-51232 lost off Holyhead Mountain (MS_DBA_0098), and a series of aircraft including a Hawker Henley III L3301 and two De Havilland Queen Bee's lost 'off Anglesey' (MS_DBA_0100-102). The later aircraft, a De Havilland Sea Vampire FB9 WP993, was flying a formation loop when it crashed at Capelboch, Anglesey (MS_DBA_0104).

Identification and discovery of coherent aviation archaeological sites in a marine context is challenging. Most modern aircraft are constructed from fragile and lightweight materials; for example, aluminium was commonly used in the WWII due to its lightness and strength, and wood was commonly used for WWI aircraft (Wessex Archaeology, 2008a). Aircraft constructed from these materials normally disperse over a wide area of seabed due to break up upon landing. As they sink through the water column remains are further dispersed by the effect of tides and currents.

The preservation potential of an aircraft crash site is, however, dependent on a far greater variety of factors. This may include the nature of the physical seabed environment on which they come to rest, the effect of tides and currents, and the nature of the loss in terms of the speed of impact.

As for other wreck sites, fine-grained sediment represents the best preservation environment and high energy environments are typically the least conducive to the preservation of archaeological remains. However, even in high energy environments disarticulated wreckage, and particular metals, can survive trapped in gullies, or other sheltered locations. The geology of the site is dominated by outcropping bedrock with coarse sediments such as gravel, and frequent boulders. Gullies are evident within the bedrock, which may shelter wreckage swept in by the strong currents. Finer-grained sediment is also present within the bay areas of Abraham's Bosom, and in the bay to the north of South Stack, which may mask and protect wreck remains.

[1] http://www.anglesey.info/usaaftragedy.htm

All military aircraft lost at sea are automatically protected under the terms of the Protection of Military Remains Act (1986) and may not be disturbed without a licence from the Ministry of Defence.

3.7.1. Summary of Aviation Archaeological Potential

There are no confirmed remains of aircraft wreckage within the site, and although documents and divers indicate the presence of remains within the area, there are no definitive locations for these remains.

However, based on the documented losses and diver accounts there is considered to be potential for the remains of aircraft wreckage to be located within the site. Diver accounts indicate the presence of seabed remains in the study area, and although these have not been located by subsequent geophysical surveys the remains from aircraft have been lifted from the area and thus are known to exist somewhere in the vicinity. The documentary evidence further indicates that a number of planes have been lost off South Stack and Holyhead Mountain, and these remains may have fallen within the site.

As with maritime archaeological material the survival of the physical remains of crashed aircraft on the seabed relates to the existence of favourable preservation conditions (Ward *et al*., 1999). The majority of the site is characterised by outcropping bedrock, gravelly substrate with frequent boulders, in a high energy environment. Finer-grained sediments in the bay areas in Abraham's Bosom and to the north of South Stack may represent the best preservation environments available within the site. Remains are most likely to survive in these areas, though disarticulated wreckage could also survive within gullies and other isolated sheltered locations within the site.

4. Impact Assessment

4.1. Introduction

As already demonstrated in Section 3 of this report, marine archaeological sites in the study area may comprise prehistoric archaeology in the form of artefacts, palaeoenvironmental remains and cultural land surfaces, or the physical remains of maritime or aviation sites, features and isolated finds. Maritime archaeological sites generally comprise the remains of shipwrecks, their contents or cargoes, including material which has been accidentally lost or deliberately jettisoned. Aviation sites represent the remains of aircraft that have crashed or ditched on the sea surface due to fire or technical malfunction. These remains fall into the following sub-categories (Table 4.1).

Table 4.1: Categories of Archaeological Material

Prehistoric Archaeology	Maritime Archaeology	Aviation Archaeology
In situ prehistoric archaeological material	Known, charted wreck sites	Known, charted aircraft crash sites
Palaeoenvironmental evidence	Recorded losses – uncharted maritime shipping casualties	Recorded aircraft losses – uncharted aviation sites
Isolated prehistoric finds	Unknown, uncharted shipwrecks	Isolated aviation archaeological finds
	Isolated maritime finds	
	Remains relating to maritime activity including intertidal remains	

4.2. Types of Impacts Addressed

The offshore project area consists of the offshore cable corridor with landfall at Penrhos Feilw and the Project within the MDZ. Their detailed designs (including numbers of devices, layout configuration, requirement for scour protection etc.) will not be determined until after the Transport and Works Act Order has been determined. Therefore, realistic worst-case scenarios in terms of potential impacts/effects on offshore archaeology and cultural heritage are adopted to undertake a precautionary and robust impact assessment. The realistic worst-case scenarios used are described in the sections below.

Cultural heritage assets can be affected by offshore tidal energy development in two ways:

- From the direct effect of the physical siting of the development; and
- From indirect changes to the physical marine environment.

Indirect impacts to the setting of heritage assets from the development have not been captured as part of this assessment.

The nature of these effects, and the types of impact that may occur during the construction, operation and maintenance (O&M), repowering and decommissioning are discussed below. This accompanies the description of the worst-case scenario for archaeology and cultural heritage in accordance with the Rochdale Envelope approach.

4.2.1. Direct impacts

Cultural heritage assets may be buried within seabed sediments or may rest upon the sea floor, either with or without height. As such, direct impacts to cultural heritage assets can occur during any development or related activity that makes contact with the sea floor or cuts through seabed deposits. Cultural heritage assets with height, such as wrecks, may also be impacted by development or activities that occur within the water column.

These impacts may occur during construction, installation, operation and maintenance, however, most impacts are anticipated to arise during the construction and installation phases, when physical impacts such as foundation and cable laying are in progress. Impacts associated with vessel mooring and operation can be incurred at any phase.

Direct impacts may have a significant effect upon both the receptor itself (archaeological deposits and material) and to the relationships between receptors and their wider environment (the physical setting or context of receptors). The examination of these relationships is often crucial to developing a full understanding of an asset.

The worst-case scenario for potential direct impacts to cultural heritage assets is associated with:

- The greatest potential area of contact with the sea floor; and
- The greatest volume of disturbed seabed sediments.

Table 4.2 includes summaries worst-case scenario for all seabed impacts. These impacts may affect cultural heritage receptors if any are present on the seabed at the same location as the impact and no mitigation is undertaken. The operational phase values include the seabed disturbance that would arise via repowering of up to 50 % of all devices (removal and reinstallation of foundations, TEC's, hubs, inter-array cables and monitoring equipment, and additional placement) and also up to ten cable repair events.

Table 4.2: Worst-case Scenario for Seabed Impact

Item	Worst Case (240 MW)	Unit	Comments
Installation			
Foundations (Two options: Piled or gravity base)			
Foundations: Piled			
Piled foundations (devices)	3,675	m2	21 m^2per device (4 drills of 2.6 m diameter each) x 80 devices 4.5 m^2per device (4 drills of 1.2 m diameter each) x 120 devices 15.9 m^2per device (3 drills of 2.6 m diameter each) x 90 devices

Item	Worst Case (240 MW)	Unit	Comments
Piled foundations (hubs)	2,214	m2	15.9 m^2per hub (3 drills of 2.6 m diameter each) x 60 hubs 21 m^2per hub (4 drills of 2.6 m diameter each) x 60 hubs
Drill arisings	117,780	m2	Maximum across entire Project if assumed sediment when deposited covered an area the same as the total sediment recovered. Disposal of material in-situ.
Gravity Base Foundations			
Gravity Base Structures (GBS)	74,790	m2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.
Cables			
Export Cable Footprint (cables and protection systems)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)
Array Cable Footprint (cables and protection systems)	30,040	m^2	Up to 204.5 km of array cables (with split-pipe protection/shells and rock bags)
Cable Tails	120	m^2	Total seabed footprint (cables and protection systems) Based on 9 x tails of 620 m length
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) or dredger may be required
Trench for 9 x landfall cables	7,400 0	m^2	740 m length trench x 10 m width – second choice to Horizontal Directional Drilling (HDD)
Floating Cables			
Swept Area of Catenary Cables	2,055,000	m^2	For floating systems using seabed mounted foundations this is the area that could be subject to cable drag. Based on: • 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes)) • 140 devices having swept area of 7,500 m^2 (medium floating devices (Tocardo UFS, Aquantis) & hubs) • 240 devices having swept area of 3,000 m^2 (small floating devices (Instream, SME PLATO))
Buoys and Markers			
Footprint of Navigation Marker Buoys	540	m2	3 m diameter square gravity anchor (9 m^2) per anchor x 60 anchors/buoys
Footprint of ADCP moorings	280	m^2	7 m^2 per ADCP mooring x 40 (54) units
Footprint of seabed mounted environmental monitoring units	112	m^2	14 m^2 per env monitoring unit x 8 units
Footprint of mooring for floating environmental monitoring units	45	m^2	9 m^2 per mooring x 5 units

Item	Worst Case (240 MW)	Unit	Comments
Anchors			
Deployment of anchor blocks by barges during cable installation	100,240	m^2	"Up to 8 x 25 m^2 (5x5 m) anchor blocks for a single barge = a total footprint per anchor deployment of 200m^2 (8 x 25 m^2) Assumed that these types of anchor barges generally deploy a spread every 500 m. So, for every 500 m of cable installation a footprint of 200 m^2 of temp seabed disturbance occurs (via the anchor blocks) Combining all potential export, array and cable tails the total length of cables (full 240 MW) is 250.6 km Assumes the footprint of 200 m^2 every 500m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temp disturbance impact of (400 m^2 x 250.6) = 100,240 m^2 (0.10 km^2) "
Deployment of anchor blocks by barges during TEC device installation	248,000	m^2	"Max. no of devices set at 620 x small (0.3 kw devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temp. seabed disturbance = 620 x 400 m^2 = 248,000 m^2"
Deployment of anchor blocks by barges during hub installation	48,000	m^2	Max. no of seabed mounted hubs set at = 120 Assumed that deployment of each hub requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temp. seabed disturbance = 120 x 400 m^2 = 48,000 m^2
Operations			
Repowering and Repairs			
50% of tenants' infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure	377,400	m2	Initial removal of tenant infrastructure from 50% of berths • 50% of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50% of anchor block value of tidal device installation = 124,000 m^2 • 50% of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2 Subsequent re-installation (re-powering) of tenant infrastructure from 50% of berths • 50% of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 • 50% of anchor block value of tidal device installation = 124,000 m^2

Item	Worst Case (240 MW)	Unit	Comments
			• 50% of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
New tenant infrastructure in 50% of berths	52,504	m2	
Cable repairs	3,000	m2	Up to 10 major cable repairs (5 days each) may be required throughout the project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total). Using same value of 400 m2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2

The total area impacted, assuming worst case scenario for seabed impact, by surface area for installation is 2,652,450 m^2 with use of piled foundations or 2,603,571 m^2 with use of gravity base foundations. However, it must also be noted that there are different impacts dependent on the type of foundation used. Pile foundations will include impact on the seabed, but also the removal of sub-surface sediment and replacement *in situ*, whilst gravity base foundations will only impact the surficial seabed. It is also acknowledged that these worst scenarios do not assume any overlap. Assuming the worst case scenario for seabed impact, the same impact is expected for decommissioning.

The worst-case scenario for seabed sediment disturbance upon cultural heritage assets is summarised in Table 4.3. These sub-surface impacts could impact on remains including potential palaeolandscape deposits. The operational phase values include the seabed disturbance that would arise via repowering of up to 50% of all devices and also up to ten cable repair events. The total area impacted, assuming worst case scenario for seabed impact, by surface area during operation of the Project due to repowering and repairs is 432,904 m^2.

Table 4.3: Summary of Worse-case Scenario Disturbance of the Sub-surface Seabed

Item	Worst Case (240 MW)	Unit	Comments
Drill arisings	117,780	m^2	Maximum across entire Project if assumed sediment when deposited covered an area the same as the total sediment recovered (in m^3). Disposal of material in-situ.
Trench for 9x landfall cables - installation	7,400	m^2	740 m long trench x 10 m width in intertidal region (same sediment disturbed for recovery)
Trench for 9x landfall cables - recovery	7,400	m^2	As above
Post-lay burial of cable (Installation)	27,259	m^2	Area with a sandwave feature where post-lay burial via Mass-Flow Excavator (MFE) or dredger may be required
Excavation of cable (Decommission)	27,259	m^2	Possibly via MFE or dredger (impact counted twice due to potential migration of bedforms)
Cable repairs	3,000	m^2	Up to 10 major cable repairs (5 days each) may be required throughout the Project life. It is assumed that up to 750 m of cable will be subject to repair works per event (7,500 m in total).

Item	Worst Case (240 MW)	Unit	Comments
			Using same value of 400 m2 temp seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2
New tenant infrastructure in 50% of berths	52,504	m^2	
Total	**242,602**	m^2	Sub-surface area impacted during Installation, Operations and Decommissioning

4.2.2. Indirect Impacts

Indirect impacts may occur as a result of changes to prevailing physical processes caused by the development. In general, receptors exposed to marine processes will deteriorate faster than those buried within seabed sediments. As such, the assessment of the effect of indirect impacts from changes to physical processes is directly relevant to the assessment of marine physical processes (captured as part of the Environmental Statement; RHDHV and MarineSpace, in prep).

Very little mobile sediment exists on site, with sand areas existing only in the southwest or nearshore bays of the MDZ; scouring and/or sediment transport is not considered to be significant aspect of the development and therefore is not considered as an adverse effect.

4.3. Consideration of the Potential Effects on Prehistoric Archaeological Receptors from Seabed Removal

During periods of lower sea level caused by three major glaciations (the Anglian, Wolstonian and Devensian) the site and study area would have been exposed as dry land for long periods, beyond the limits of the UK ice sheet.

The baseline assessment demonstrates that the earliest deposits within the site relate to the Devensian glaciation, and the site lay under an ice sheet until c. 22,000 BP. There is no potential for *in situ* Lower or Middle Palaeolithic archaeological remains or palaeoenvironmental evidence. Redeposited Palaeolithic remains may occur within secondary contexts within the site, however, no such remains have been identified within the site or study area and the potential for such remains to occur is considered to be limited.

A series of possible channels identified within sub-bottom profiler data within the western part of the site may be of glacial or post-glacial origin. If the latter, then there is potential for palaeoenvironmental evidence relating to the Late Upper Palaeolithic and Mesolithic periods to be present within these areas.

The potential for associated Late Upper Palaeolithic archaeological material is low, due to its rarity and absence of any activity from this period in the study area. However, Mesolithic activity is attested within the study area. If Holocene features, such as palaeochannels, were present within the western part of the site these may have formed a focus for Mesolithic activity. However, due to uncertainties within the data the presence of such features is not verified. In the face of this uncertainty there remains a potential for submerged Mesolithic remains to occur in association with potential Holocene deposits.

Eroded material from coastal sites such as shell middens and flint scatters dating to the Mesolithic period may also be present within the site. Any such remains would be out of context and would likely have been affected by marine processes.

Additionally, a series of prehistoric and later sites within the study area suggests the potential for eroded remains of all periods. In particular, the remains identified at Pen-y-Bonc (MS_DBA_0014), including Late Iron Age and Romano-British settlement, lie *c*. 200 m from the high-water mark, and eroded remains from this site may be present within the marine and intertidal zone.

Sites of archaeological potential can be divided as follows:

- **Potential *in situ* remains** including potential post-glacial fluvial systems within the western part of the site and potential for remains of Mesolithic date to be associated with fluvial systems, if post-glacial;
- **Potential redeposited remains** including limited potential for redeposited Lower and Middle Palaeolithic remains, and potential for eroded material dating to the Mesolithic period and later.

4.3.1.1. Sensitivity of Receptors

Potential *in situ* remains: The potential for *in situ* remains relates to the possibility that channel systems in the western part of the site may be post-glacial. If present, deposits and potential archaeological remains could address research questions identified within the Palaeolithic and Mesolithic Research Framework for the Archaeology of Wales. In particular, palaeoenvironmental deposits could address questions relating to the survival of deposits from these periods, and could provide evidence which allows Mesolithic sites to be better related to the environmental record in the coastal zone. Additionally, the remains would have the potential to contribute to questions in the Maritime Research Framework for the Archaeology of Wales, such as how the welsh coastline altered during early prehistoric periods. While the likelihood is that these features are glacial, the possibility that they are of Late Upper Palaeolithic and Mesolithic date cannot be discounted. Thus, taking into account their potential evidential value, the palaeoenvironmental remains could be of medium archaeological value. Any such remains would have no ability to recover from physical impacts, and their overall sensitivity is considered to be **medium.** If archaeological sites are associated with these channels, their early date and potential evidential value indicates that they could be of high archaeological value, with a **high** level of sensitivity**.**

Potential redeposited remains: In general, redeposited material can provide some evidence for the activities of past populations, however, without *in situ* contextual information this evidential value is limited, though secondary contexts can in some cases hold some evidential value. Earlier remains may have more to contribute to our understanding of the past, and redeposited Palaeolithic material in particular would improve understanding of this period due to the general rarity of such finds in a Welsh context. However, there is limited potential for such remains to occur within the site. Mesolithic and later remains which may have eroded out of the adjacent coasts are more likely to occur within the site, and would provide some evidence allowing us to understand activities at the time. Redeposited remains such as this would be considered to have a medium level of value. Additionally, redeposited material is already out of context, and as such has tolerance to accommodate removal from its current context. The overall sensitivity of these assets is considered to be **medium**.

4.3.1.2. Magnitude of Effect and Impact Significance

Potential *in situ* remains: The possible channels lie within the western part of the site which may be subject to impacts associated with the demonstration zone. The potential palaeoenvironmental remains and prehistoric archaeological receptors which may be associated with possible post-glacial channels may be physically impacted by the laying of foundations and cables. This represents a worst-case scenario, and some of the construction options, such as gravity based foundations, may not impact the remains. Additionally, the layout has not yet been fixed and channel features may not fall within the final area of impacts. However, in the worst-case scenario the impacts arising from construction activities could lead to the loss and disturbance of sediment around the foundations and cables. The footprints of the impacts would be restricted. However, these impacts would be permanent and irreversible. They would occur at the time of construction and installation.

If these impacts were to occur within the areas of the possible channels they would result in the loss of restricted areas of sediment from within the channels. This partial loss of restricted areas with such palaeoenvironmental potential would result in a **medium** magnitude of change. This would result in an impact significance of **moderate negative** effect which will require mitigation.

If archaeological sites are present and associated with the post-glacial channel this may result in a loss of these sites. This loss could affect an entire prehistoric site, and could result in a **high** magnitude of change. This would result in an impact significance of **major negative** effect which will require mitigation.

Potential redeposited remains: Redeposited isolated finds may also be disturbed by the construction of foundations or cable installation. These impacts may result in the movement or removal of finds which are not *in situ*. These impacts would be permanent and irreversible. They would occur at the time of construction. The key aspects of significance of these finds relate to the physical properties of the artefacts rather than contextual information. The impacts will not alter these characteristics, and as such the magnitude of change would be **low**. This would result in a **minor negative** effect.

4.3.1.3. Mitigation

It is recommended that the following measures are adopted:

- **Creation of a Written Scheme of Investigation** to cover all future works within the site and to include specification for archaeological involvement;
- **Implement the Protocol for Archaeological Discoveries** (PAD): Offshore Renewables Projects (The Crown Estate 2014), for the duration of the project. This protocol provides a system for identifying, recording, reporting and investigating any unexpected discoveries made during the course of the project, including prehistoric material. If material is found, there is a range of next-step mitigation options including creation of temporary or permanent exclusion zones around areas in which archaeological sites or remains may exist. Implementation of the PAD would mitigate impacts upon channel features, potential unknown associated archaeological remains and isolated finds.
- **Geoarchaeological assessment** should accompany any geotechnical campaigns which may take place within the site. Geoarchaeological work should follow best practice guidance set out in Offshore Geotechnical Investigations and Historic Environment Analysis: guidance for

the renewable energy sector (Cowrie 2011), and Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate 2010). Assessment should include review of core logs to determine the potential for deposits of palaeoenvironmental and archaeological interest, and follow a staged process which should be determined by the results of the assessment and may include analysis, reporting and publication. This assessment would mitigate impacts to potential channel areas.

- Where possible, **mitigation by avoidance or by construction foundation design** would also be an option for channel areas. Avoidance, limiting contact or design resulting in no or low impact to the potential channels would provide mitigation such that there would be no significant effect on these potential channel features and any associated palaeoenvironmental and archaeological remains.
- A **watching brief** should also be conducted in the intertidal zone. This is primarily to mitigate impacts upon potential intertidal remains, however, it would also serve to record any isolated or eroded finds from the coast. This would be particularly valuable due to the potential for eroded remains associated with the Late Iron Age and Romano-British settlement which lies *c.* 200 m above the high-water mark.

4.3.1.4. Confidence Assessment

The evidence upon which this assessment is based represents a detailed appraisal of the potential effects of the construction of the MDZ on prehistoric archaeological receptors. The assessment identified the potential for palaeoenvironmental and archaeological remains, as well as isolated finds. While such remains may survive within the site, their existence is not proven, and the data do not allow for a confident dating or characterisation of the potential channel features. As such the confidence in these elements is **low**.

However, the impact assessment for these features represents a worst-case scenario. Additionally, assessment has taken a precautionary approach to dealing with archaeological potential and sensitivity. The mitigation strategy has also been designed to adequately mitigate the potential impacts at their worst, upon the highest potential level of sensitivity of receptors. Thus, the risks to the archaeological resource have been mitigated and, despite the low level of confidence within the data, the measures put in place for mitigation would lead to an affect which is not significant.

4.4. Consideration of the Potential Effects on Maritime Archaeological Receptors from Seabed Removal

The baseline assessment demonstrated that by the end of the Mesolithic period the majority of the site was inundated. The assessment identified:

- Known wreck sites with the MDZ;
- Potential for wreck remains within the MDZ; and
- Potential for maritime and related intertidal remains within the MDZ.

The baseline assessment identified four confirmed wreck sites within the development area, and one medium potential geophysical anomaly, in addition to 10 low potential anomalies.

4.4.1.1. Sensitivity of Receptors

One of the wrecks is thought to represent the remains of the *Maarten Cornelis*, a motor fishing vessel lost in 1971 (UKHO identifier 7228; MS_0003; MS_DBA_0085). The UKHO surveying details indicate that the wreck lies at an approximate NNW-SSE orientation, with the bow to the east, and sitting within a scour pit. Surveys in 1979 and 2013 indicate that the wreck lies almost upright with the masts intact, and protruding at least 4 m clear of the hull and superstructure. The vessel is of a late date, and as such its archaeological interest is more limited than that of other wreck sites. However, the UKHO surveying details do not indicate that the identity of the wreck has been confirmed. Thus, while it is thought to represent the remains of the *Maarten Cornelis* this identification is based on a correlation between the location of the wreck remains and the reported loss position. It appears likely that the wreck does represent the *Maarten Cornelis,* however, as this has not been confirmed the wreck could represent the remains of an unknown vessel.

Three other unidentified wrecks are recorded within the MDZ. These include an unknown wreck recorded by the UKHO in 2013 (UKHO identifier 81387; MS_0005; MS_DBA_0116), lying approximately north-east to south-west. The remains may include the remnants of a keel and single boilers.

The UKHO recorded a second unknown wreck in 2013 (UKHO identifier 81388; MS_0004; MS_DBA_0117). The wreck lies approximately east-west, and sits within an area of scour. It is associated with a strong magnetic anomaly. The UKHO indicates that the wreck is largely deteriorated, and may represent an old vessel, with two boilers evident on the site. Possible debris lies close to the main wreck, to the north. A droit (235/15) reported from this area is also likely to relate to this wreck, and remains recovered include log wood, a bronze valve and a copper pipe.

The UKHO recorded a third unknown wreck in 2013 (UKHO identifier 81389; MS_0001; MS_DBA_0118). The wreck lies approximately east-south-east to west-north-west and is associated with a slight magnetic anomaly. The wreck sits upright, and the bow, which is located to the east-south-east, is partially buried and collapsed. The boiler located midships is the highest point on the wreck. The UKHO indicates that this may represent the remains of a fishing vessel.

The identity of these wrecks is unknown, and the identity of the *Maarten Cornelis* is assumed, but not definitively, proven. Wreck sites can be designated under the Protection of Wrecks Act 1973, or as Scheduled monuments under the Ancient Monuments and Archaeological Areas Act, 1979. The value assigned to a particular wreck is case specific, depending on its historical importance, rarity and level of survival. Any wreck sites dating from pre-1815 are likely to be of high archaeological significance based on the rarity of surviving vessels from this period. Wrecks dating from 1816 to the present day may still be considered to be of high archaeological significance where they specifically contribute to understanding of technological developments or particular events, people and places (See Wessex Archaeology, 2008b). As the identity of these wrecks is unknown, or not proven, the remains could be of up to high archaeological value. Additionally, the remains would have no ability to recover from physical impacts, as such the overall sensitivity of the wreck sites is considered to be **high.**

A relatively large number of diver records of wrecks and reports of wreck material to the RoW are known within the study area. Only one of the records is in the area of a known wreck site (MS_0004, MS_DBA_0117, MS_DBA_0125). However, the remainder give an indication of the archaeological

potential of the area. These records are generally focused around the nearshore area, and although the majority have not been located by geophysical surveys the potential for wreckage in the nearshore area remains relatively high, particularly given the number of documented losses reported for the area. This potential may be highest in sheltered locations such as gullies and in bays beneath sediment, in areas of lower energy where bedrock is not exposed. The remains were not visible on geophysical surveys and as such are unlikely to represent coherent wreck sites, with disarticulated remains being more likely. While the value of such remains is dependent upon period, rarity and a range of other factors, the likely disarticulated nature of the remains indicates their evidential value may be more limited, and a medium level of value is most likely. Any such remains would also have no ability to recover from physical impacts, as such the overall sensitivity of these potential remains is **medium.**

The assessment also identified a magnetic anomaly in the nearshore area (MS_0011). The strength of the magentic anomaly may indicate buried anthropogenic debris. The origin of the debris is unknown, however it could represent disarticulated wreckage, which could hold evidential value. The remains may have medium archaeological potential. It is also likely that the remains would not have the ability to recover from physical impacts. The overall sensitivity of the anomaly, thought to represent buried anthropogenic debris, is **medium.**

A total of ten anomalies identified within the geophysical survey data (MS_0013, 15, 17, 18, 20, 23-25, 27, 28) may represent possible anthropogenic debris and cables. These remains are not likely to be considered of archaeological interest, and they have been ascribed a low archaeological value. Though such remains would not have the ability to recover from physical impacts their low level of value indicates that their overall sensitivity is considered to be **negligible.**

In addition to the potential for wreck remains, there is also potential for maritime and related intertidal features and structures in Abraham's Bosom, relating to the use of the area as an embarkation and landing point from at least the post-medieval period. Such remains may hold evidential value relating to the use of this bay as an historic landing place, and could be of medium archaeological value. Such remains would not have the ability to recover from physical impacts, and their overall level of sensitivity is considered to be **medium.**

4.4.1.2. Magnitude of Effect and Impact Significance

The known wreck sites all lie within the northern area which may be subject to impacts associated with the demonstration zone. The wrecks may be physically impacted by the laying of foundations and cables and associated anchoring of vessels during construction, operation, maintenance and decommissioning. This represents a worst-case scenario, and some of the construction and layout options may not impact the remains. In the worst-case scenario the impacts arising from construction activities could lead to the loss and disturbance of parts of the wrecks. These impacts would be permanent and irreversible. They would primarily occur at the time of construction, although impacts may be incurred from mooring vessels and anchoring throughout the operation, maintenance and decommissioning phases. If these impacts were to occur on the wreck sites they would result in the loss and disturbance of parts of the wreck remains. This would result in a **high** magnitude of change. This would result in an impact significance of **major negative** effect which will require mitigation.

Potential wreck remains may also be impacted by construction activities. Potential wreck remains could be physically impacted by the laying of foundations and cables, and by mooring and anchoring

of vessels. These impacts would be permanent and irreversible. They would primarily occur at the time of construction, although impacts may be incurred from mooring vessels and anchoring throughout the operation, maintenance and decommissioning phases. These activities could result in a **high** magnitude of change. This would result in an impact significance of **major negative** effect which will require mitigation.

Anomalies of possible anthropogenic debris of negligible sensitivity may also be physically impacted by the laying of foundations and cables, and by mooring and anchoring of vessels. In the worst-case scenario the impacts arising from construction activities could lead to the loss and disturbance of parts of the anomalies. These impacts would be permanent and irreversible. They would primarily occur at the time of construction, although impacts may be incurred from mooring vessels and anchoring throughout the operation, maintenance and decommissioning phases. If these impacts were to occur they would result in a **medium** magnitude of change. This would result in an impact significance of **negligible** effect.

The magnetic anomaly, of medium sensitivity, lies within the area which may be impacted by cable installation and the mooring and anchoring of vessels. In the worst-case scenario the impacts arising from construction activities could lead to the loss and disturbance of the anomaly. These impacts would be permanent and irreversible. They would primarily occur at the time of construction, although impacts may be incurred from mooring vessels and anchoring throughout the operation, maintenance and decommissioning phases. These activities could potentially result in a **high** magnitude of change. This would result in an impact significance of **major negative** effect which will require mitigation.

The potential intertidal remains at Abraham's Bosom may be impacted by cable installation. In the worst-case scenario the impacts arising from construction activities could lead to the loss and disturbance of potential intertidal features. These impacts would be permanent and irreversible. They would occur at the time of construction. These activities could potentially result in a **high** magnitude of change, depending on the construction option chosen. This would result in an impact significance of **major negative** effect which will require mitigation.

4.4.1.3. Mitigation

It is recommended that the following measures are adopted:

- Creation of a Written Scheme of Investigation to cover all future works within the site and to include specification for archaeological involvement;
- Adoption of archaeological exclusion zones (AEZs) around known wreck sites and contacts of high and medium potential identified in the geophysical data. No activities or development work are to take place within the AEZs and no devices, cables (including catenary cables) or other structures may extend to within the exclusion zones. The extent of each exclusion zone comprises a recommended footprint on the seabed and the water column above. The extent of the AEZs reflects the likely extent of the wreck with an appropriate buffer, determined by an expert using their knowledge and experience. The following AEZs (Table 4.4) are recommended based on the size of the contact, known dimensions of wrecks and any outlying debris, the potential significance of the contact, the likely impact of the development and the seabed dynamics within the area. Exclusion zone radii have been determined from the centre

point of the item or cluster of items. The exclusion zones defined for the MDZ have been given slightly larger buffers than would be usual, due to the uncertainty in some of the development plans and potential for angular movement of the devices or cables in the water column (though not on the seabed) with the shifting tides. Exclusion zones have been defined in order to ensure that no equipment, vessels or other sources of potential impact stray in the vicinity of the items of potential archaeological significance during the construction, operation or decommissioning of the development.

- Implement the Protocol for Archaeological Discoveries (PAD): Offshore Renewables Projects (The Crown Estate 2014), for the duration of the project. This protocol provides a system for identifying, recording, reporting and investigating any unexpected discoveries made during the course of the project, including any wreck material. If material is found, there is a range of next-step mitigation options including creation of temporary or permanent exclusion zones around areas in which archaeological sites or remains may exist. Implementation of the PAD would mitigate impacts upon potential wreck remains;
- Implementation of a watching brief in the intertidal zone. The purpose of this watching brief would be to mitigate impacts to potential maritime or intertidal remains identified at Abraham's Bosom, and to allow archaeological input in case any such remains are found;
- Potential impacts to low potential anomalies do not require mitigation. However, developers should maintain an operational awareness of the positions of low potential anomalies throughout their work.

Table 4.4: Summary of Recommended Archaeological Exclusion Zones from a Central Reference

Name	MSDS reference	UKHO reference	Location (WGS884 UTM 30 N)		Exclusion zone (metres)	Area of MDZ
			Easting	Northing		
Probable wreck of *Maarten Cornelis*	MS_0003 (MS_DBA_0085)	7228	385206.3	5908885.0	100	Offshore
Unknown wreck	MS_0005 (MS_DBA_0116)	81387	384431.8	5910625.0	100	Offshore
Unknown wreck	MS_0004 (MS_DBA_0117)	81388	387178.1	5910210.8	125	Offshore
Unknown wreck	MS_0001 (MS_DBA_0118)	81389	384627.4	5908447.1	100	Offshore
Magnetic anomaly	MS_0011	-	387823.5	5906694.4	25	Cable route (RLB)

4.4.1.4. Confidence Assessment

The evidence upon which this assessment is based represents a detailed appraisal of the potential effects of the construction of the MDZ on known and potential maritime archaeological receptors. The assessment identified known wrecks and geophysical anomalies, the potential for wrecks, and the potential for intertidal features. For wrecks and anomalies identified in geophysical survey data, the confidence in the assessment is **high**.

However, a conflict between datasets is present in places. Geophysical surveys undertaken for this project do not show many of the wreck remains reported by divers within and adjacent to the site. This conflict may arise from positional errors within diver accounts. As such, confidence in the

assessment of the positions of potential wreck remains as **medium**. However, the assessment has taken a precautionary approach to the assessment of impacts and the effects identified are considered to represent a worst-case scenario. The risks to the archaeological resource have been mitigated and, despite the medium level of confidence within the data, the measures put in place for mitigation would lead to an affect which is not significant.

4.5. Consideration of the Potential Effects on Aviation Archaeological Receptors from Seabed Removal

There are no confirmed remains of aircraft wreckage within the site, and although documents and divers indicate the presence of remains within the area, there are no definitive locations for these remains.

However, based on the documented losses and diver accounts there is considered to be potential for the remains of aircraft wreckage to be located within the site. Diver accounts indicate the presence of seabed remains in the study area, and although these have not been located by subsequent geophysical surveys the remains from aircraft have been lifted from the area and thus are known to exist somewhere in the vicinity. The documentary evidence further indicates that a number of planes have been lost off South Stack and Holyhead Mountain, and these remains may have fallen within the site. As with maritime archaeological material the highest potential is for remains to occur within areas of fine-grained sediment, in gullies and other sheltered locations.

4.5.1.1. Sensitivity of Receptors

Remains of aircraft can automatically fall under the Protection of Military Remains Act, 1986. As such they represent archaeological remains of high value. The remains would have no ability to recover from physical impacts, as such the overall sensitivity is **high.**

4.5.1.2. Magnitude of Effect and Impact Significance

Potential aircraft wreckage may be impacted by construction activities. Potential remains could be physically impacted by the laying of foundations and cables and by mooring and anchoring of vessels. These impacts would be permanent and irreversible. They would primarily occur at the time of construction, although impacts may be incurred from mooring vessels and anchoring throughout the operation, maintenance and decommissioning phases. These activities could result in a **high** magnitude of change. This would result in an impact significance of **major negative** effect which will require mitigation.

4.5.1.3. Mitigation

It is recommended that the following measures are adopted:

- Creation of a Written Scheme of Investigation to cover all future works within the site and to include specification for archaeological involvement; and

- Implement the Protocol for Archaeological Discoveries (PAD): Offshore Renewables Projects (The Crown Estate 2014), for the duration of the project. This protocol provides a system for identifying, recording, reporting and investigating any unexpected discoveries made during the course of the project, including any aviation material. If material is found, there is a range of next-step mitigation options including creation of temporary or permanent exclusion zones around areas in which archaeological sites or remains may exist. Implementation of the PAD would provide a mechanism by which impacts upon potential aviation remains can be mitigated.

4.5.1.4. Confidence Assessment

The evidence upon which this assessment is based represents a detailed appraisal of the potential effects of the construction of the MDZ on aviation losses. The assessment identified the potential for remains of wrecked aircraft. A conflict between datasets is present. Geophysical surveys undertaken for this project do not show aircraft remains within the site, while diver accounts indicate they are present. This conflict may arise from positional errors within diver accounts. As such, confidence in this assessment is **medium**. However, the assessment has taken a precautionary approach to the assessment of impacts and the effects identified are considered to represent a worst-case scenario. The risks to the archaeological resource have been mitigated and, despite the medium level of confidence within the data, the measures put in place for mitigation would lead to an affect which is not significant.

4.6. Impact Assessment and Mitigation Summary

Whilst a range of potentially significant impacts to archaeological receptors are anticipated from the effect of the development, once mitigation measures are applied any residual impacts are considered to fall within acceptable limits. The receptors' impacts and proposed mitigation measures are summarised in Table 4.5.

Table 4.5: Summary of Impact Assessment and Mitigation

Receptor	Sensitivity	Magnitude of Effect	Impact Significance	Mitigation	Residual Effect	Confidence
Potential post-glacial palaeochannels	Medium	Medium	**Moderate Negative**	The proposed mitigation would reduce adverse effects upon the potential channel features and potential associated remains though recording or micro-siting/avoidance/modification, where possible. This would mitigate the adverse impact, resulting in an effect which is not significant in EIA terms.	**Not significant**	Low
Potential submerged prehistoric sites in association with post-	High	High	**Major Negative**	Protocol for Archaeological Discoveries would allow for recovery and recording of any finds associated with any potential prehistoric sites. This would also allow for the	**Not significant**	Low

Receptor	Sensitivity	Magnitude of Effect	Impact Significance	Mitigation	Residual Effect	Confidence
glacial channels				implementation of any further mitigation as required. This would mitigate the adverse impact, resulting in an effect which is not significant in EIA terms. Avoidance of channel areas would also lead to likely avoidance of any associated archaeological material, and thus would mitigate impacts to any potential material leading to an effect which is not significant in EIA terms.		
Potential redeposited prehistoric and later finds	Medium	Low	**Minor Negative**	Protocol for Archaeological Discoveries and the watching brief within the intertidal zone would allow for recovery and recording of any redeposited finds. This would mitigate the adverse impact, resulting in an effect which is not significant in EIA terms.	**Not significant**	Low
Wreck of the probable *Maarten Cornelis* (UKHO identifier 7228; MS_0003; MS_DBA_0085)	High	High	**Major Negative**	Implementation of an Archaeological Exclusion Zone of 100 m around the wreck will result in mitigation of all adverse impacts through avoidance, leading to no effect on the wreck.	**Not significant**	High
Unknown wreck (UKHO identifier 81387; MS_0005; MS_DBA_0116)	High	High	**Major Negative**	Implementation of an Archaeological Exclusion Zone of 100 m around the wreck will result in mitigation of all adverse impacts through avoidance, leading to no effect on the wreck.	**Not significant**	High
Unknown wreck (UKHO identifier 81388; MS_0004; MS_DBA_0117)	High	High	**Major Negative**	Implementation of an Archaeological Exclusion Zone of 125 m around the wreck will result in mitigation of all adverse impacts through avoidance, leading to no effect on the wreck.	**Not significant**	High
Unknown wreck (UKHO identifier 81389; MS_0001; MS_DBA_0118)	High	High	**Major Negative**	Implementation of an Archaeological Exclusion Zone of 100 m around the wreck will result in mitigation of all adverse impacts through avoidance, leading to no effect on the wreck.	**Not significant**	High
Potential wreck remains	Medium	High	**Major Negative**	Protocol for Archaeological Discoveries and the watching brief would allow for recovery and recording of any wreck	**Not significant**	Medium

Receptor	Sensitivity	Magnitude of Effect	Impact Significance	Mitigation	Residual Effect	Confidence
				remains, and will provide the opportunity to implement exclusion zones wherever appropriate. This would mitigate the adverse impact, resulting in an effect which is not significant in EIA terms.		
Magnetic anomaly representing potential anthropogenic debris (MS_0011)	Medium	High	**Major Negative**	Implementation of an Archaeological Exclusion Zone of 25 m around the anomaly will result in mitigation of all adverse impacts through avoidance, leading to no effect on the anomaly.	**Not significant**	High
Ten anomalies (MS_0013, 15, 17, 18, 20, 23-25, 27, 28) representing possible anthropogenic debris and cables.	Negligible	Medium	**Negligible**	This effect does not require mitigation; however, developers should maintain an operational awareness of the positions of low potential anomalies throughout their work.	**Not significant**	High
Potential maritime and intertidal features in the intertidal zone at Abraham's Bosom	Medium	High	**Major Negative**	A watching brief in the intertidal zone would allow for the identification and recording of any potential maritime and intertidal features within Abraham's Bosom, and would allow archaeological input to determine if further work is necessary if remains are found. This will result in mitigation of all adverse impacts through avoidance, leading to no significant effect on the potential remains.	**Not significant**	High
Potential aircraft wreckage	High	High	**Major Negative**	Protocol for Archaeological Discoveries and the watching brief would allow for the identification of any remains associated with crashed aircraft and will provide the opportunity to implement exclusion zones wherever appropriate. This would mitigate the adverse impact, resulting in an effect which is not significant in EIA terms.	**Not significant**	Medium

Any archaeological work, including the implementation of mitigation measures, should be detailed by a Written Scheme of Investigation (WSI) prior to work beginning on site.

4.7. Monitoring

The WSI and supporting method statements should set out requirements for monitoring, to be agreed by the client and archaeological curators.

The Protocol for Archaeological Discoveries should be in place and operational for the duration of the project. The PAD will be implemented in line with the guidance set out in Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate, 2014). All relevant staff should be informed of the specifics of the PAD, including how to recognise archaeological materials, and the chain of communication, should any material be identified. Any finds made under the PAD will be reviewed by a marine archaeologist, and, if necessary, recommendations for any further investigation and mitigation will be made. This may include the creation of new temporary or permanent Archaeological Exclusion Zones.

Provision for monitoring of all Archaeological Exclusion Zones should be set out within a method statement to be agreed by the client and archaeological curators, in line with the guidance set out in Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate, 2010).

The watching brief within the intertidal zone should monitor all ground-breaking activities in that area. Watching briefs should be conducted in accordance with the CIfA Standard and guidance for an archaeological watching brief (CIfA, 2014). A suitably qualified and experienced archaeologist should undertake this work, and record any features or finds which are identified. Where appropriate, if significant remains are encountered the client, in consultation with archaeological curators, should make provision for the archaeological contractor to undertake a programme of investigation commensurate with the significance of the evidence discovered.

4.8. Cumulative Impacts

The impacts incurred on marine heritage receptors are restricted to the immediate footprint of the development. Therefore, it is only projects which affect the same area, or more generally the same receptors, that require consideration. A list of other projects within proximity to the MDZ which may lead to cumulative impacts are listed below:

Table 4.6: Other Projects with which Cumulative Impacts may Arise

Project Name	Developer	Distance from MDZ	Description of Project	Status of Project
Holyhead Deep	Minesto	<2 km	▪ 80 MW Tidal kite installation off the coast of Holyhead, plus on land elements and grid connection. ▪ The site is located in the southern half of the former 'Holyhead Deep' licensed dredge disposal site. ▪ Currently one device in water. ES and HRA available:	In April 2017, a Marine Licence was granted for the first 0.5 MW installation. This was successfully installed in 2018.

			http://minesto.com/projects/holyhead-deep	

4.8.1. Cumulative Impact Assessment

The development would not affect known archaeological sites within the MDZ, and there are no anticipated cumulative impacts to known sites including wrecks and geophysical anomalies.

The main potential cumulative impacts relate to the potential for these schemes to affect areas of palaeolandscape or unknown archaeological sites which may also be present and impacted by the MDZ. Following mitigation, there are no significant impacts posed to this potential receptor by the MDZ. The Minesto development likewise identified potential palaeogeographic features which may be impacted by development. Following mitigation, the impacts upon these features were considered to be not significant. Thus, the cumulative effects of these developments on potential palaeolandscape features are considered to be **not significant**.

No other known projects were deemed to overlap with the Morlais development.

4.8.2. Mitigation

No additional mitigation measures are required to deal with cumulative impacts upon marine heritage.

5. Conclusions

5.1. Summary of Baseline Assessment

The baseline assessment identified a series of known sites within the MDZ and recognised the potential for a range of other archaeological remains to be present. Known sites include four wrecks within the MDZ and geophysical anomalies of potential anthropogenic origin.

The assessment also identified potential for submerged prehistoric deposits in possible post-glacial channels within the western part of the site, and potential for associated prehistoric archaeological remains. Isolated prehistoric and later finds may also be present within the site. In addition to the four known wrecks there is also potential for further unrecorded wrecks and aircraft, wreck material and isolated maritime finds. Additionally, potential has been identified for remains relating to maritime and intertidal activity at Abraham's Bosom.

5.2. Summary of Impact Assessment

The sensitivity of these receptors ranges from high to negligible. While the construction details have not yet been determined, a worst-case scenario approach to assessing impacts has been adopted. This assessment identified magnitude of effect ranging from low to high, with impact significance ranging from negligible to major. Potential impacts to a number of heritage assets including: known wrecks and geophysical anomalies; potential wrecks; potential post-glacial channels and potential associated archaeological material; potential isolated prehistoric and later finds; potential intertidal remains at Abraham's Bosom; and potential aviation remains, require mitigation actions to reduce impacts to acceptable levels.

5.3. Summary of Mitigation Measures

A range of mitigation measures is proposed to reduce effects upon the marine historic environment. These measures are in line with best practice guidance, and in particular with the guidance set out within Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate, 2010). These include:

- Creation of a Written Scheme of Investigation to cover all future works within the site and to include specification for archaeological involvement;
- Implement the Protocol for Archaeological Discoveries: Offshore Renewables Projects (The Crown Estate 2014), for the duration of the project;
- Implementation of a watching brief in the intertidal zone;
- Implementation of Archaeological Exclusion Zones around known wreck sites and medium potential geophysical anomalies;
- Geoarchaeological assessment to accompany any geotechnical investigations which may take place within the site; and
- Where possible, avoidance or design modification to limit contact with potential channel areas, unless further data become available.

There is also potential for other mitigation measures to be adopted as the details of the scheme develop, including avoidance of features within the site, or further investigation to offset the risks of uncertainties within the data, particularly in relation to potential post-glacial channel features within the western part of the site.

Any archaeological work, including the implementation of mitigation measures, should be detailed by a WSI prior to work beginning on site. The requirement for a WSI can be set out within the conditions which accompany a Marine Licence. The WSI and supporting method statements should give details of the methods to be used for mitigation, and of monitoring requirements.

5.4. Concluding Remarks

The archaeological impact assessment has identified areas where impacts to the marine archaeological resource from construction of the MDZ and associated infrastructure can be anticipated. Through mitigation these impacts to known and potential heritage assets have been reduced to acceptable limits, and all post-mitigation impacts can be considered not significant.

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7. Appendix A: Gazetteer of Geophysical Anomalies

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0001	High	Contact MS_0001 appears to be the remains of a wrecked vessel measuring 41.9 m x 9.8 m. The outline of the vessel appears to be broken. The wreck is recorded by the UKHO (Identifier 81389). Survey lines for magnetometer did not pass over the wreck (lines are between 40 and 60 m away).	28.7	8.7	384627.4	5908447.1
MS_0002	High	Contact MS_0002 is a cluster of anomalies with one main upstanding anomaly, covering an area 30.9 m in length and 17.8 m in width. The remains are recorded by the UKHO (Identifier 7144) as those of the wreck of the *Harold*, and the site has been identified as a magnetic contact (Mag_08) with a resistivity of -207.92nT.	30.9	17.8	387291	5908304
MS_0003	High	Contact MS_0003 appears to be the remains of a wrecked vessel measuring 41.9 m x 9.8 m, sitting within a scour pit. The outline of the vessel appears to be coherent and the remains are associated with a strong magnetic anomaly of -54.7 nT (Mag_12). The wreck is recorded by the UKHO (Identifier 7228).	33.4	6.8	385206.3	5908885.0

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0004	High	Contact MS_0004 appears to be the remains of a wrecked vessel measuring 98.3 m x 41.4 m, including the main wreck mound and surrounding debris. The wreck appears to have an area of scour along its southern edge, with a smaller area of scour to the north. The outline of the vessel appears to be broken and the remains are associated with a strong magnetic anomaly of - 1090.9 nT (Mag_09). The wreck is recorded by the UKHO (Identifier 81388).	98.3	41.4	387178.1	5910210.8
MS_0005	High	Contact MS_0005 appears to be the remains of a wrecked vessel measuring 41.9 m x 9.8 m. The outline of the vessel is coherent and the remains are associated with a strong magnetic anomaly of 314.08 nT (identifier Mag_02 in survey report). The wreck is recorded by the UKHO (Identifier 81387).	41.9	9.8	384431.8	5910625.0
MS_0006	High	Contact MS_0006 represents a cluster of anomalies and area of disturbed seabed sediment visible on multibeam bathymetry. Survey report identified this as Mag_07, with a signal of -1598.9nT. The visible remains and strenth of the magnetic signature indicates the probable presence of a buried wreck or wreckage. Position taken from multibeam bathymetry. Anomaly is c. 140 m to the north of the wreck of the Harold, potentially indicating associated wreckage.	25.0	16.0	387269.1	5908441.0

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0007	Medium	Contact MS_0007 represents a cluster of irregular anomalies with associated mound. May be geological but multibeam bathymetry and Mag do not cover this area to confirm. Thus taking a precautionary approach anomalies are considered to be potential anthropogenic debris. If anthropogenic the remains could represent a mound of wreck material.	29.3	32.6	386791.8	5901219.5
MS_0008	Medium	Contact MS_0008 represnts a mound of material with clusters of irregular anomalies within. The mound tapers into an elongated form at either end, with the main area of mound and cluster of anomalies measuring c.53 m x 28 m. The mound may be geological however its form differs slightly from other geoloigical mounds in the area, and thus a anthropogenic origin, such as a wreck mound, is possible. Lies within the vicinity of a buried cable but there may be a separate magnetic anomaly for this mound.	53.0	28.5	383308.2	5910437.3
MS_0009	Medium	Contact MS_0009 represents anomalies associated with a depression in seabed in a sandy area between outcropping bedrock. Survey report identified this as Mag_10, with a signal of 445.3nT. The visible remains and strenth of the magnetic signature indicates the possible presence of a buried wreck or wreckage. Position taken from multibeam bathymetry.			387919.1	5910043.0

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0010	Medium	Contact MS_0010 represents a magnetic anomaly in an area of outcropping bedrock. The anomaly may represent anthropogenic debris. Survey report identified this as Mag_11, with a signal of -194.2nT. Strength of signal may indicate buried wreckage or anthropogenic debris.	-	-	388279.1	5910495.8
MS_0011	Medium	Contact MS_0011 represents a magnetic anomaly with no visible seabed remains. Uncertain origin but may be buried athropogenic debris. Survey report identified this as Mag_16, with a signal of -278.6nT. Anomaly is close inshore. Position from magnetic anomaly.	-	-	387823.5	5906694.4
MS_0012	Low	Contact MS_0012 is a cluster of anomalies, covering an area of 15.9 m in length by 9.1m in width. Possible anthropogenic debris.	15.9	9.1	386924	5908031
MS_0013	Low	Contact MS_0013 is a linear anomaly probably representing a cable, approximately 160 m in length. The anomaly coincides with a magnetic signature, and the survey report indicated it is probably a disused cable. Position represents visible centre point on multibeam bathymetry.	160.0	1.0	386566	5907588

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0014	Low	Contact MS_0014 is a linear anomaly probably representing a cable, rope or seabed scour approximately 70 m in length. There is no corresponding magnetic anomaly. Position represents visible centre point on multibeam bathymetry.	70.0	0.7	383265	5910224
MS_0015	Low	Contact MS_0015 is a linear anomaly probably representing a cable, rope or seabed scour approximately 70 m in length. There is no corresponding magnetic anomaly. Position represents visible centre point on multibeam bathymetry.	306.0		384108.7	5909204.3
MS_0016	Low	Contact MS_0016 is a linear anomaly probably representing a cable, rope or seabed scour approximately 97 m in length. There is no corresponding magnetic anomaly. Position represents visible centre point in sidescan sonar.	97.4	0.9	382244.9	5904792.7
MS_0017	Low	Contact MS_0017 is a linear anomaly crossing a sand wave. Possible anthropogenic debris.	15.1	1.2	386734.0	5909894.2

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0018	Low	Contact MS_0018 is a very slight linear anomaly which extends 251 m as visible in the multibeam bathymetry and has a width of c. 2.4 m, however the edges of the anomaly are not clear. Probable anomaly relating to a cable, anchor drag or other anthropogenic scour. No clear magnetic anomlay, but the feature lies near to another probable buried cable with a strong anomaly which may mask weaker magnetic responses.	251.3	2.4	386064.8	5903661.6
MS_0019	Low	Contact MS_0019 represents potential anthropogenic debris.	11.2	5.8	385166.8	5901526.8
MS_0020	Low	Contact MS_0020 is a linear anomaly probably representing a cable, rope or seabed scour approximately 97 m in length. There is no corresponding magnetic anomaly. Position represents visible centre point in sidescan sonar.	81.6	1.4	386258.2	5903518.8
MS_0021	Low	Contact MS_0021 is a linear anomaly probably representing a cable, rope or seabed scour approximately 91 m in length. There is no corresponding magnetic anomaly. Position represents visible centre point in sidescan sonar.	91.9	0.4	388117.0	5910369.2

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0022	Low	Contact MS_0022 is a magnetic anomaly with no visible seabed remains. Uncertain origin but may be buried athropogenic debris. Survey report identified this as Mag_01, with a signal of 66.1 nT. Position from magnetic anomaly.	-	-	382624.415173	5910243.19813
MS_0023	Low	Contact MS_0023 is a magnetic anomaly in area of slightly uneven seabed. Uncertain origin but may be buried athropogenic debris. Survey report identified this as Mag_03, with a signal of 48.8 nT. Position from magnetic anomaly.	-	-	384328.1	5903674.6
MS_0024	Low	Contact MS_0024 is a magnetic anomaly in a sediment-filled depression or fissure/gully in bedrock. The anomaly may represent anthropogenic debris caught in the depression. Survey report identified this as Mag_04, with a signal of 74.9 nT. Position from magnetic anomaly.	-	-	384730.4	5904802.7
MS_0025	Low	Contact MS_0025 is a magnetic anomaly in an area of outcropping bedrock. The anomaly may represent anthropogenic debris caught in the depression. Survey report identified this as Mag_05, with a signal of 41.3 nT. Position from magnetic anomaly.	-	-	385047.5	5905741.7

Feature Name	Type	Comments	Length (m)	Width (m)	WGS84 UTM30N	
					Easting(m)	Northing (m)
MS_0026	Low	Contact MS_0026 is a magnetic anomaly beyond the extent of multibeam bathymetry and sidescan sonar survey. Survey report identified this as Mag_06, with a signal of 85nT. Position from magnetic anomaly.	-	-	384978.9	5901263.9
MS_0027	Low	Contact MS_0027 is a magnetic anomaly in an area of outcropping bedrock. The anomaly may represent anthropogenic debris concealed by sediment between bedrock outcrops. Survey report identified this as Mag_13, with a signal of 42.6nT. Position from magnetic anomaly.	-	-	387262.7	5909501.5
MS_0028	Low	Contact MS_0028 is a magnetic anomaly in an area of outcropping bedrock. The anomaly may represent anthropogenic debris concealed by sediment between bedrock outcrops. Survey report identified this as Mag_14, with a signal of 22.6nT. Position from magnetic anomaly.	-	-	387177.7	5909588.0
MS_0029	Low	Contact MS_0029 is a magnetic anomaly with no visible seabed remains. Uncertain origin but may be buried athropogenic debris. Survey report identified this as Mag_15, with a signal of 51.3 nT, and an elongated magnetic response. Position from magnetic anomaly.	-	-	387682.9	5908743.7

8. Appendix B: Gazetteer of Heritage Assets

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0001	Flint scatter, Penrhosfeilw and Porth Ruffydd. Numerous flint scatters have been found in this area. Test pits have also been excavated to investigate the flint scatters. Position is a general position for multiple findspots of flint.	Finds	Mesolithic to Neolithic and prehistoric		HER PRNs 38285; 38271-38285; 1749; 67851; Test pit 38286	221532	379814		
MS_DBA_0002	Possible Mesolithic chert core.	Finds	Mesolithic		HER PRN 24041	222400	379600		
MS_DBA_0003	A small shell midden was seen after fire over this area. The vegetation has now regenerated so there is nothing to see. Also a single flint flake was recovered. The shells were in slight hollow near a small boulder.	Site	Prehistoric?		HER PRN 38287	221347	380503		
MS_DBA_0004	Findspot of flint blade	Finds	Prehistoric		HER PRN 24116	221460	383970		

[2] British National Grid – Ordnance Survey Great Britain 1936, British National Grid

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0005	Site of a cist burial recorded near Porth y Gwyddel during the 19th Century. No remains identified in this position today.	Documents	Prehistoric		HER PRN 3796	221500	381100		
MS_DBA_0006	'Meini Moelion'; a group of numerous erect rounded stones, and a line or wall of others, at the S base of the precipice beneath the summit of Holyhead Mountain.	Site	Prehistoric		HER PRN 3797	221000	382000		
MS_DBA_0007	Bronze Age burial found AD 1828 with grave goods. No further information available, and known only from the 19th Century source and finds.	Documents	Bronze Age		HER PRN 3802	221930	381530		
MS_DBA_0008	Possible site of a prehistoric burial chamber at Plas Feilw. Known only from a C19th reference. Not located since. Probably it was just a natural outcrop or erratic, which has since been cleared away.	Documents	Prehistoric		HER PRN 3800	222000	380000		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0009	Bronze Age remains including a hoard and palstaves found in different locations on Holyhead Mountain. Approximate position given.	Finds	Bronze Age		HER PRN 1758, 3803, 3801	221660	382270		
MS_DBA_0010	Prehistoric hut circles and enclosure on Holyhead mountain, and Gogarth Bay prehistoric round cairn.	Site	Prehistoric		HER PRN 1753, 7162, 3804; NMRW 275609, 403437; SM AN133, AN147	221400	382800		
MS_DBA_0011	Dinas Promontory Fort. Possible example of native fort: promontory is surrounded by precipitous cliffs and almost isolated from mainland.	Site	Prehistoric and Romano-British	Scheduled	SM AN121; HER PRN 807, 1748; NMRW 308070	222276	379420		
MS_DBA_0012	Caer y Twr comprises an Iron Age hillfort situated on the top of Holyhead Mountain. Prehistoric cairns are associated with the location, and may have been used as a later Roman watch tower. Other Roman remains including	Site	Iron Age and Romano-British	Scheduled	HER PRN 1760, 15691, 15692, 3809; NMRW 93839, 308080; SM AN019	221800	383000		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	finds have been recorded from the area.								
MS_DBA_0013	Holyhead Mountain Circles and Enclosed Hut Circle Settlement at Capel Llochwydd. An area of later prehistoric settlement features, generally stone founded roundhouses, occupying a natural shelf or terrace below the south-eastern flank of Holyhead Mountain, with associated field systems and boundaries. Roman coins have also been found in the area.	Site	Iron Age and Romano-British	Scheduled	HER PRN 1755, 1756; 17115; 1757; NMRW 308078, 93837; SM AN016 and AN133	221200	382000		
MS_DBA_0014	Evidence of probable Late Iron Age and Romano-British settlement. A hut group at Pen-y-Bonc, almost obliterated by cultivation consisted of two hut circles, 40 ft and 15 ft in diameter and a rectangular building, excavated in c. 1870 when iron slag, grinding stones and Romano British pottery were found.	Site	Iron Age to Romano British		HER PRN 3808; NMRW 300867	221760	381460		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0015	Chapel site. Capel Lochwydd.	Site	Medieval		HER PRN 1752; NMRW 43570	221400	382810		
MS_DBA_0016	A half-florin of Edward III (1327-77) was found in the ruins (of the chapel) in the 19th Century.	Finds	Medieval		HER PRN 1754	221400	382760		
MS_DBA_0017	Remains of an eroded field boundary bank of possible medieval date.	Site	Medieval?		HER PRN 38288	221284	379546		
MS_DBA_0018	Henborth Old Harbour. A small, rocky bay from which a rescue boat could be launched to reach vessels wrecked on the North and South Stack, which might also have been used from bringing goods onshore.	Site	Post-medieval		NMRW 41256	221483	381517		
MS_DBA_0019	Plas Nico Outbuildings.	Site	Post-medieval		NMRW 31095	221130	381860		
MS_DBA_0020	Mining adit presumed to be a trial copper mine adit.	Site	Post-medieval	-	HER PRN 38291	221229	379952		
MS_DBA_0021	A large number of items were recovered off Anglesey, including	Finds	18th Century		NMRW 240765	221751	376123		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	Spanish silver coins dated 1790, a bronze coin, greenheart wood, a compass case, silver cutlery, brass dividers, uniform buttons, bronze manillas, cannon balls, a bronze cup weight, buckles and lead ingots.								
MS_DBA_0022	Documented loss of the Sally, a wooden sailing vessel lost near Anglesey in 1789.	Documents	18th Century		NMRW 271791	221751	376123		
MS_DBA_0023	Documentary loss of the Jane, a wooden sailing vessel lost near Anglesey in 1789.	Documents	18th Century		NMRW 271828	221751	376123		
MS_DBA_0024	Documented loss of the Jenny, a wooden sailing vessel lost in 1792 on Anglesey.	Documents	18th Century		NMRW 271819	221751	376123		
MS_DBA_0025	Documented loss. A report printed in Lloyds List on 30th October 1795 noted that two brigs had been lost on the 24th October 1795 'at the back of Holyhead'.	Documents	18th Century		NMRW 271832	220893	381356		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0026	Documented loss. A report printed in Lloyds List on 30th October 1795 noted that two brigs had been lost on the 24th October 1795 'at the back of Holyhead'.	Documents	18th Century		NMRW 506428	220893	381356		
MS_DBA_0027	Documented loss of the Polly, a wooden sailing vessel lost on 'Stack Rock on South Side of Holyhead' on 24th April 1768.	Documents	18th Century		NMRW 271816	220190	382185		
MS_DBA_0028	Documented loss of the Scythia.	Documents	Post-medieval		NMRW 240447	220539	382060		
MS_DBA_0029	Documented loss of the Abigail.	Documents	Post-medieval		NMRW 544373	221751	376123		
MS_DBA_0030	Modern OS mapping notes a 'Pillar Trinity House 1809' in the corner of a field, possibly a leading light for landing place.	Site	19th Century		NMRW 519103	221723	381527		
MS_DBA_0031	South Stack Lighthouse and associated structures. The lighthouse and associated enclosure walls, storeholes, oil store and bridge towers are all	Site	19th Century	Grade II (x5)	HER PRNs 3810; 66973; 66975; 66977; 66980;	220170	382250		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	Grade II Listed. The structures and lighthouse were all built in the 19th Century. The lighthouse was first lit in 1809.				NMRW 41288; Cadw LBs 5284; 18032 - 35				
MS_DBA_0032	Flagstaff possibly associated with lighthouse signalling system.	Site	19th Century		HER PRN 69841; NMRW 525376	220592	382312		
MS_DBA_0033	Fog signalling station and associated structures on North Stack. Built in 1861 by Trinity House.	Site	19th Century	Grade II	LB 20076; HER PRNs 66979, 7163; NMRW 15767, 309769.	221560	383970		
MS_DBA_0034	Lifeboat house, Porth Ruffydd, built by 1900.	Site	19th Century		HER PRN 38292; NMRW 506818	221735	379877		
MS_DBA_0035	Liverpool and Holyhead Telegraph Station, first used in 1827.	Site	19th Century		HER PRN 3811; NMRW 300822 and 300834	221700	383410		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0036	Quarry site and associated remains. Probably quarrying for granite, ruined machinery was scattered on the beach. Probably operational in the 20th Century. Not on 1918 25 inch map or earlier maps.	Site	19th and 20th Century		HER PRN 31699, 61479	221933	383808		
MS_DBA_0037	Powder house for nearby quarries.	Site	19th and 20th Century		HER PRN 7164; NMRW 525375	222166	383720		
MS_DBA_0038	A probable cottage located adjacent to the road, noted on the Penrhos estate maps of 1810 and 1817.	Documents	19th Century		HER PRN 61474	222080	380770		
MS_DBA_0039	Buildings of unknown date shown on the Ordnance Survey map of 1889.	Documents	19th Century		HER PRN 28930	221810	381060		
MS_DBA_0040	Ellins Tower, constructed in 1868 as a folly.	Site	19th Century	Grade II	HER PRN 7160; NMRW 22993; Cadw LB 5713	220640	381990		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0041	The findspot of a possible Victorian locket plate.	Find	19th Century		HER PRN 32782	220940	382090		
MS_DBA_0042	UKHO report diver sightings of the wreck of the SS *Editor* which stranded on Penrhos Point in 1897. The remains are reportedly broken up, and lying on a rocky seabed spread across three bays, between the Fangs and Tide Rip Rock, with remains including a double bottom, large anchor, dead eyes and boilers standing up to 3m in height. The Receiver of Wreck holds records of droits from the Editor (A/1812) for two deadeyes. The position given appears to be located some distance away but is likely inaccurate and associated with this site.	Divers	19th Century		UKHO 7190; NMRW 272076	221418	379241		
MS_DBA_0043	Droits from the *SS Editor*. Position likely inaccurate.	Finds	19th Century		RoW Droit A/1812			53.26667	-4.66667

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0044	UKHO report the sinking of the sailing vessel (barque), *Tenby Castle* in 1889. The wreck reportedly broke up c. 500 ft from the shore. Remains reported in this location by divers in 1976. A large pile of wire-rope, possibly from the rigging of a sailing ship, lies on the seabed, along with several bricks and timbers. Muntz-metal hull sheathing has also been reported. These remains may represent the Tenby Castle or an unnamed wreck.	Documents and divers	19th Century		UKHO 7187; NMRW 506820	221764	379637		
MS_DBA_0045	UKHO report diver sightings of the wreck of the SS *Mersey* which stranded on Penrhos Point rocks in 1894. The remains are reportedly badly broken up, some close inshore and parts scattered in deeper areas, with the propeller and shaft reported 100 yds to the northwest of the wreck.	Documents and divers	19th Century		UKHO 7184; NMRW 271882	221457	379270		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0046	The City of Richmond was a wooden barque built in Quebec in 1864. The vessel ran ashore 2 miles south of the South Stack on 3rd February 1881. Sources suggest that the site was surveyed and artefacts recovered by Liverpool Museum Service working with Merseyside BSAC from 1967 onwards.	Site	19th Century	-	NMRW 271871	222144	379306		
MS_DBA_0047	The wreck of a wooden sailing vessel surrounded by concreted piles of muntz-metal fittings, lead sheets, copper bars (fastenings) and sheathing tacks, with a pile of old anchor chain lying 50 m further offshore. The bell of the Niagara (lost 1875) was recovered from this vicinity in 1979. UKHO records the position for this wreck c. 100 m away.	Site	19th Century?		NMRW 506821	221238	379417		
MS_DBA_0048	UKHO reports the presence of a wreck thought to be the sailing vessel *Niagara*, sunk in 1875 and reported by diver sightings in	Site	19th Century		UKHO 7185; NMRW 507016 (for			53.28248	-4.68336

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	1977. The bell has been recovered. NMRW records a position for this wreck c. 100 m away.				documented loss)				
MS_DBA_0049	Documented loss. UKHO reports the sinking of the SS Holyhead in 1883, off South Stack. The direction off the stack is not known and the position is considered unreliable.	Documents	19th Century		UKHO 7212			53.30692	-4.70114
MS_DBA_0050	The UKHO records the sinking position of the SS Cognac in 1898, off the western side of South Stack. Position surveyed by UKHO reported no anomalies, and no magnetic anomaly.	Documents	19th Century		UKHO 7203			53.30025	-4.75113
MS_DBA_0051	UKHO reports a dead wreck (SS Pochard, sunk 1884), documented sinking but not found on surveys.	Documents	19th Century		UKHO 7244			53.34192	-4.67614
MS_DBA_0052	Documented loss of the Marie Moller, a steamship lost on the northwest coast of Holy Island.	Documents	Modern		NMRW 240451	221485	383283		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0053	Documented loss of the wooden schooner, the Jane, sunk in 1895 following stranding near Penrhos Point/ Porth Rhuffydd.	Documents	19th Century		NMRW 272228	221273	379393		
MS_DBA_0054	Documented loss of the Alert. The Alert was a wooden barque belonging to the port of St Johns, New Brunswick. The barque was wrecked on Penrhyn Point on 28th November 1897 on its outward bound voyage from Preston.	Documents	19th Century		NMRW 240446	220844	379888		
MS_DBA_0055	Documented loss of the iron-hulled sailing barque, Tenby Castle, in 1889. The barque was trying to find the South Stack lighthouse to establish its position when it ran onto rocks off Penrhos Point. The UKHO have connected this loss with seabed remains identified by divers in another location.	Documents	19th Century		NMRW 272057	220810	380056		
MS_DBA_0056	Documented loss of the Anne Catherine, which went ashore in 1876 off Black Point, Aberffraw,	Documents	19th Century		NMRW 525289	221272	381331		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	near Holyhead. Note position does not match description and so remains of the brig in this area are unlikely.								
MS_DBA_0057	Documented loss of the Constant trade, a wooden sloop lost in 1817 at the back of Holyhead.	Documents	19th Century		NMRW 271501	221004	381296		
MS_DBA_0058	Documented loss of the Cecilia, a wooden sailing vessel lost in 1806 'at the back of Holyhead'.	Documents	19th Century		NMRW 271490	220867	381380		
MS_DBA_0059	Documented loss. Lloyds List printed a report of a sloop being lost 'at the back of Holyhead' on the 18th December 1809.	Documents	19th Century		NMRW 271494	220710	381653		
MS_DBA_0060	Documented loss of the Matilda, a wooden sailing vessel lost on South Stack in 1853.	Documents	19th Century		NMRW 271946	220250	382171		
MS_DBA_0061	Documented loss of the Glory, a wooden schooner lost on South Stack in 1853.	Documents	19th Century		NMRW 271942	220256	382349		
MS_DBA_0062	Documented loss. An article in Blackwood's Magazine dated to	Documents	19th Century		NMEW 507201	220331	382380		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	February 1831 referred to the loss of an American vessel around 1790 between the South Stack and the mainland.								
MS_DBA_0063	Documented loss of the John Bannerman, a wooden fully-rigged ship, lost during the 19th Century.	Documents	19th Century		NMRW 271963	221239	382936		
MS_DBA_0064	Documented loss of an unnamed sloop lost near the Ogo'r Llochwydd escarpment/cleft in 1808.	Documents	19th Century		NMRW 507203	221221	382992		
MS_DBA_0065	Documented loss of the Union a wooden sloop which went ashore near Holyhead mountain in March 1811.	Documents	19th Century		NMRW 240040	221506	383293		
MS_DBA_0066	Documented loss of the Sully, a wooden barque lost in 1857 at the back of the Head.	Documents	19th Century		NMRW 271965	383542	271965		
MS_DBA_0067	Documented loss of the Vixen, a small wooden steam yacht, lost in	Documents	19th Century		NMRW 274812	218379	382810		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	1891 off the South Stack Lighthouse								
MS_DBA_0068	Documented loss of the Pochard, an iron-hulled steamship lost in 1884 1 mile north of North Stack.	Documents	19th Century		NMRW 272039	221629	385850		
MS_DBA_0069	Documentary loss of the Beredina, a wooden schooner lost in 1878 off Anglesey.	Documents	19th Century		NMRW 272021	221751	376123		
MS_DBA_0070	Documentary loss of the Prosperous, a wooden sailing vessel lost in 1806 off Anglesey.	Documents	19th Century		NMRW 272379	221751	376123		
MS_DBA_0071	Documented loss of the Margaret and Mary, a wooden sailing vessel lost in 1827 off Anglesey.	Documents	19th Century		NMRW 272163	221751	376123		
MS_DBA_0072	Documented loss of the Rebecca and Mary, a wooden sailing vessel lost in 1800 off Anglesey.	Documents	19th Century		NMRW 271486	221751	376123		
MS_DBA_0073	Documented loss of the John, a wooden sailing vessel lost in 1807 off Anglesey.	Documents	19th Century		NMRW 272391	221751	376123		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0074	Documented loss of the Margaret, a wooden sailing vessel lost in 1807 off Anglesey.	Documents	19th Century		NMRW 272390	221751	376123		
MS_DBA_0075	Documented loss of the Arrow, a wooden smack lost off Anglesey in 1842.	Documents	19th Century		NMRW 272374	221751	376123		
MS_DBA_0076	Documented loss of the Hector, a wooden sailing vessel lost in 1812 on Anglesey.	Documents	19th Century		NMRW 271499	221751	376123		
MS_DBA_0077	Documented loss of the Durus, a wooden snow lost in 1861 on the coast of Anglesey.	Documents	19th Century		NMRW 271912	221751	376123		
MS_DBA_0078	Documented loss of the Thomas and Mary, a wooden sloop lost between Holyhead and Caernardfon Bar in 1811.	Documents	19th Century		NMRW 272368	221751	376123		
MS_DBA_0079	Documented loss of the William, a wooden sailing vessel lost in 1811 on Anglesey.	Documents	19th Century		NMRW 272365	221751	376123		
MS_DBA_0080	Documented loss of the Cedric, a brig lost between North and South Stack in 1827.	Documents	19th Century		NMRW 507202	220537	383586		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0081	Documented loss of the Aurora which went ashore in a storm in 1821 at Anglesey.	Documents	19th Century		NMRW 240061	221751	376123		
MS_DBA_0082	Documented loss of the Benjamin, lost in 1824 at Anglesey.	Documents	19th Century		NMRW 240107	221751	376123		
MS_DBA_0083	Documented loss of the Trefriew Trader which foundered in the Holyhead race in 1847.	Documents	19th Century		NMRW 524879	219963	383422		
MS_DBA_0084	Wreck of the SS *Harold* lost in 1908 reported by the UKHO and NMRW (note position for NMRW data is to the southwest, but remains of the *Harold* have been confirmed at the UKHO position so records have been consolidated to reflect the UKHO position.)	Site	20th Century		UKHO 7144; NMRW 272141			53.312	-4.69187
MS_DBA_0085	UKHO reports a wreck, of the *Maarten Cornelis*, a motor fishing vessel.	Site	Modern		UKHO 7228; NMRW 272154			53.3167	-4.72323
MS_DBA_0086	Receiver of Wreck record, 1 x large wooden fid, salvaged from the wreck site of the sailing	Finds	19th Century		RoW Droit 054/14			53.28333	-4.6835

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	barque 'Primrose Hill' (built in 1886 by Sir Thomas Bland Royden & Sons of Liverpool and owned by William Price and Co of Liverpool). This position appears on the coast, but remains are likely to have been recovered from the site of the Primrose.								
MS_DBA_0087	Possible wreck of the Kyle Firth lost in 1940. Wreckage lies scattered in a small cove to the west of the Fangs. The propeller, thrust bearings, stern post and the remains of the rudder are identifiable. Nearby a section of iron girders stands 2 m high. A boiler lies further to the west. UKHO record the position for this wreck c. 200 m away.	Documents and divers	20th Century		NMRW 272138	221017	379410		
MS_DBA_0088	Possible wreck of the Kyle Firth lost in 1940. Wreckage lies scattered in a small cove to the west of the Fangs. The propeller, thrust bearings, stern post and the remains of the rudder are	Documents and divers	20th Century		UKHO 7186	221017	379410		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	identifiable. Nearby a section of iron girders stands 2 m high. A boiler lies further to the west.								
MS_DBA_0089	The UKHO reports the wreck of a four-masted iron barque, the *Primrose*, lost on Penrhos Rock in 1900.The wreck is reportedly very broken up with areas covered by sand and small stones. The wreck is reported to lie with its keel orientated east-west, and is broken up over a sloping seabed. Iron ribs and sections of rivetted iron plate lie scattered around, along with a section of tubular mast. Remains recovered from this area and reported to the Receiver of Wreck include the ship's chronometer, 5 brass portholes, part of helm, clay pipes, toast rack, cutlery, earthenware serving dish, oil lamp, storage jar, brass cherub ship's log, binnacle cover, stair	Documents and divers	20th Century		UKHO 7194; RoW Droit A/2658; NMRW 240327	221036	380400		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	tread, bottles, candle snuffer, knife handles (droit A/2658).								
MS_DBA_0090	The UKHO reports the wreck of a barge in Abraham's Bosom, with a cargo of copper ingots, thought to have been lost during the 1940s. However, the position given is not for Abraham's Bosom, but for an area further south off Penrhyn Mawr. Position considered inaccurate.	Documents	20th Century		UKHO 7423			53.28553	-4.6853
MS_DBA_0091	The UKHO reports the wreck of a liberator bomber aircraft following diver sightings. Subsequent surveys did not identify this wreckage and the record was amended to dead.	Documents and Divers	20th Century		UKHO 7249			53.32414	-4.67947
MS_DBA_0092	UKHO reports the sinking of the iron-hulled steamship *SS Maiorese* in this location in 1913, after striking South Stack. The UKHO surveying details indicate that the vessel was not located by a subsequent survey.	Documents	20th Century		UKHO 7245; NMRW 272210	219542	381569		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0093	UKHO reports the sinking of the fishing vessel Valkyrie in this location in 1968.	Documents	20th Century		NMRW 507014; UKHO 7191	220860	379664		
MS_DBA_0094	UKHO reports the loss of a fishing vessel, the *Diadem,* in 1980 which was not located by subsequent surveys but UKHO consider searches inadequate to have disproved the record	Documents	20th Century		UKHO 7405			53.32192	-4.69864
MS_DBA_0095	UKHO reports the sinking of the fishing vessel *Ocean Gain* in this location in 1988. The UKHO surveying details indicate that the vessel was not located by a subsequent survey and the rocky outcrops in the area make a target of this size (21 m in length) difficult to identify.	Documents	20th Century		UKHO 7435			53.27054	-4.70891
MS_DBA_0096	Documented loss of the Margaret Lewis a sailing smack lost in 1904 between the North and South Stacks.	Documents	20th Century		NMRW 272095	221176	382860		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0097	Documented loss of a Vickers Wellington DV442 assigned to 15 Operational Training Unit which crashed into the sea near the South Stack in 1942.	Documents	20th Century		NMRW 240132	219786	382267		
MS_DBA_0098	Documented loss of a B-24 Liberator 42-51232 in 1944 off Holyhead Mountain.	Documents	20th Century		NMRW 240170	220786	384546		
MS_DBA_0099	Documented loss of a Vickers Wellington, Z1172, which crashed into the sea off the South Stack near Holyhead in 1942.	Documents	20th Century		NMRW 240138	218963	380795		
MS_DBA_0100	Documented loss of a Hawker Henley III L3301 off Anglesey in 1942	Documents	20th Century		NMRW 515448	221751	376123		
MS_DBA_0101	Documented loss of a De Havilland Queen Bee P4793 off T Croes, Anglesey, in 1941.	Documents	20th Century		NMRW 515526	221751	376123		
MS_DBA_0102	Documented loss of a De Havilland Queen Bee P4805 off Anglesey, in 1943.	Documents	20th Century		NMRW 515534	221751	376123		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0103	Documented loss of the Carmelite, lost off Anglesey in 1918.	Documents	20th Century		NMRW 240719	221751	376123		
MS_DBA_0104	Aircraft crash site of a De Havilland Sea Vampite FB9 WP993. Approximate position and no known remains at this location. Lost in 1957 and pilot killed. If remains are located they would be under the Protection of Military Remains Act.	Documents	20th Century	-	NMRW 516175	222000	380000		
MS_DBA_0105	Rifle Range.	Site	20th Century		HER PRN 58730	222322	383576		
MS_DBA_0106	Rifle Range.	Site	20th Century		HER PRN 38290	221540	379789		
MS_DBA_0107	Grade II Listed Tan-y-Cytiau and garden.	Site	20th Century	Grade II	HER PRN 66970; LB number 20081; NMRW 415051, 86550	221336	382054		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0108	Penrhyn Mawr Practice Trenches.	Site	20th Century		HER PRN 402769, 58727	221520	379930		
MS_DBA_0109	Obstruction – diffusers.	-	Modern		UKHO 65119			53.32817	-4.66483
MS_DBA_0110	Holy well. Undated.	Documents	Undated		HER PRN 32072	221400	382760		
MS_DBA_0111	Possible Earthwork, Ynys Penlas, South Stack.	Site	Undated		HER PRN 3805	220750	381570		
MS_DBA_0112	Small corbelled structure.	Site	Undated		HER PRN 6606	221770	382280		
MS_DBA_0113	Undated field boundary.	Site	Undated		HER PRN 7161	221370	382490		
MS_DBA_0114	Rectangular Structure, North Stack. May be connected with the fog signal station.	Site	Undated		HER PRN 5899	221650	383850		
MS_DBA_0115	Feature with orthostat near Porth y Gwyddel, undated.	Site	Undated		HER PRN 38289	221475	380618		
MS_DBA_0116	Unknown wreck reported by the UKHO.	Site	Undated		UKHO 81387			53.33202	-4.73532

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0117	Unknown wreck reported by the UKHO. RoW droit (235/15) reported from c. 55 m to the north. Remains recovered include 1 x Log wood. 1 x Bronze valve. 1 x Copper pipe. Images provided.	Site	Undated		UKHO 81388			53.32907	-4.69412
MS_DBA_0118	Unknown wreck reported by the UKHO, possible fishing vessel.	Site	Undated		UKHO 81389			53.31263	-4.73177
MS_DBA_0119	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976 and located on subsequent surveys.	Site	Undated		UKHO 7248; NMRW 506419	221912	384017		
MS_DBA_0120	UKHO reports a charted wreck. The wreck lies with its keel orientated 045/225 degrees and has a length of 70 m, breadth of 20 m and a height of 7 m above the seabed.	Site	Undated		UKHO 7416; NMRW 506994	214500	375824		
MS_DBA_0121	Divers reported 1 x cannon ball. 1 x grape shot. 1 x ink well (?) south of South Stack.	Finds	Undated	-	RoW Droit A/1767; NMRW 240776	221756	379286		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0122	Records of the find, a porthole and steam gauge, was recovered from a small coaster off Anglesey. The porthole measures 7 in and the steam gauge 7 in diameter.	Finds	Undated		NMRW 240903	221751	376123		
MS_DBA_0123	Find spot of one cast iron cannon probably representing the site of a wreck.	Finds	Undated		RoW Droit A/4037; NMRW 240089	222264	378005		
MS_DBA_0124	Droits for approx 100 x copper nails, 2 x keel pins, 2 x musket balls, not from a known wreck.	Finds	Undated		RoW Droit A/2268			53.26667	-4.66667
MS_DBA_0125	Receiver of Wreck record, 1 x Log wood. 1 x Bronze valve. 1 x Copper pipe. Possibly of Pochard.	Finds	Undated		RoW Droit 235/15			53.32957	-4.69412
MS_DBA_0126	Pieces of ship's bell, parts of a sextant, small decorative brass cannon, hand-made copper nails and section of iron chain.	Finds	Undated	-	RoW droit 167/99			53.28083	-4.662
MS_DBA_0127	One cannon ball (good condition - undergoing treatment), 1.5 Small lead ingots from a concretion	Finds	Undated	-	RoW droit 733/99			53.28333	-4.66667

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
	close to the remains of a wreck salvaged in 70s.								
MS_DBA_0128	UKHO reports diver sightings of a cannon lodged in a rock ledge, reported in 1974.	Finds	Undated		UKHO 7189; NMRW 507017			53.28359	-4.67336
MS_DBA_0129	UKHO reports the remains of a sailing vessel with cannons. Remains lying in a narrow gulley covered by shingle. The site has been surveyed and subject to salvage by Merseyside BSAC and Liverpool Museum from 1967. Little remains with the exception of scattered cannons though reports of scattered timbers are known from the site. Droits reported from this area include pieces of Copper sheathing, Copper nails. 80 x Cannonballs ranging in size from 8 pounds, 6 pounds and 4 pounds, musket shot (Droit 410/09). Reports associated with the CITY OF RICHMOND may relate to this vessel (NPRN 217871).	Site	Undated		UKHO 7183; NMRW 506819			53.28081	-4.66919

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0130	Debris or seabed obstruction measuring some 7 m in length, 0.7 m in width and standing 0.6 m above the seabed.	Site	Undated		NMRW 516166	221680	377429		
MS_DBA_0131	A sports diver reported a sunken barge carrying copper ingots in Abraham's Bosom bay in July 1985. UKHO report a different position for this wreck.	Site	Undated		NMRW 507015	221001	379971		
MS_DBA_0132	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976.	Site	Undated		UKHO 7193; NMRW 506427	220826	380253		
MS_DBA_0133	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.	Site	Undated		UKHO 7197; NMRW 506426	221497	380846		
MS_DBA_0134	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.	Site	Undated		UKHO 7200; NMRW 506425	221362	381192		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0135	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.	Site	Undated		UKHO 7201; NMRW 506424	381335	506424		
MS_DBA_0136	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976.	Site	Undated		UKHO 7202; NMRW 506423	220689	381526		
MS_DBA_0137	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.	Site	Undated		UKHO 2707; NMRW 506421	220551	381809		
MS_DBA_0138	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976. No further records are known.	Site	Undated		UKHO 7210; NMRW 506422	220157	382165		
MS_DBA_0139	UKHO reports the wreck of an unknown vessel, initially reported by a diver in 1976 but not recorded by two subsequent surveys, so amended to dead.	Site	Undated		UKHO 7224; NMRW 506412	221095	382965		

Identifier	Description	Type	Period	Designation	References	British National Grid[2]		WGS84	
						Eastings	Northings	Latitude	Longitude
MS_DBA_0140	UKHO reports a cannon in this area, initially reported by a diver in 1976 but not recorded by two subsequent surveys, so amended to dead.	Site	Undated		UKHO 7246; NMRW 506420	221189	383981		
MS_DBA_0141	This find, a large iron casting, was located in some 10 m of water close to the southern side of the North Stack. It is believed to be a knee-rider and is indicative of a shipwreck.	Site	Undated		NMRW 507204	221250	383927		
MS_DBA_0142	Unnamed wreck, no further details known	Site	Undated		NMRW 506822	220693	381487		