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Morlais Project
Environmental Statement

Chapter 13: Offshore Archaeology and Cultural Heritage

Volume I

Applicant: Menter Môn Morlais Limited

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Chapter 13: Offshore Archaeology and Cultural Heritage

Author: Marine Space

MarineSpace
Making Sense of the Marine Environment ™

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GLOSSARY OF ABBREVIATIONS

AEZ	Archaeological Exclusion Zone
COWRIE	Collaborative Offshore Wind Research into the Environment
DBA	Desk Based Assessment
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ES	Environmental Statement
GAT	Gwynedd Archaeological Trust
HER	Historic Environment Record
JLDP	Joint Local Development Plan
MDZ	Morlais Demonstration Zone
MPS	Marine Policy Statement
NMRW	National Monuments Record of Wales
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OfDA	Offshore Development Area
PAD	Protocol for Archaeological Discoveries
RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
ROV	Remotely Operated Vehicle
RoW	Receiver of Wreck
TAN	Technical Advice Note
TWAO	Transport and Works Act Order
UKHO	United Kingdom Hydrographic Office
USAAF	United States Army Air Force
WNMP	Welsh National Marine Plan
WWII	Second World War

GLOSSARY OF TERMINOLOGY

Aviation archaeology	The remains of crashed aircraft and archaeological material associated with historic aviation activities.
Glacial	A glacial period is a period of time within an ice age that is marked by colder temperatures and glacier advances. Interglacial correspond to periods of warmer climate between glacial periods. There are three main periods of glaciation within the last 1 million years, the Anglian, the Wolstonian and the Devensian which ended about 12,000 years ago. The Holocene period corresponds to the current interglacial.
Holocene	The present epoch (late 1900s onwards)
Maritime archaeology	The remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities.
Mesolithic	10000 to 4000 BC The Middle Stone Age, falling between the Palaeolithic and Neolithic and marking the beginning of a move from a hunter gatherer society towards a food producing society.
Palaeoenvironmental analysis	The study of sediments and the organic remains of plants and animals to reconstruct the environment of a past geological age.
Palaeogeographic features	Features seen within sub-bottom profiler data (buried) and multibeam bathymetry data (sea floor) interpreted as representing prehistoric physical landscape features such as former river channels (palaeochannels).
Palaeolithic	500000 to 10000 BC The Old Stone Age defined by the practice of hunting and gathering and the use of chipped flint tools. This period is usually divided into Lower, Middle and Upper Palaeolithic.
Seabed features	Features seen on the seafloor in the sidescan sonar or multibeam bathymetry data which are interpreted to represent heritage assets, or potential heritage assets. Also includes magnetic anomalies which may represent shallow buried ferrous material of archaeological interest.
Seabed prehistory	Archaeological remains on the seabed corresponding to the activities of prehistoric populations that may have inhabited what is now the seabed when sea levels were lower.

13. OFFSHORE ARCHAEOLOGY AND CULTURAL HERITAGE

13.1. INTRODUCTION

1. Menter Môn Morlais Limited (Menter Môn) proposes the development of 240 MW of tidal generating capacity within the Morlais Demonstration Zone (MDZ). The development of the Morlais Project (the Project) will support the development of renewable energy technology objectives of the Anglesey and Gwynedd Joint Local Development Plan (JLDP), providing a consented tidal technology demonstration zone which supports installation, testing and commercial demonstrations of tidal energy devices. The Project will also provide opportunities for the local communities via direct employment and support of the local supply chain.

2. The Project will include permanent communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, a Landfall Substation, and an onshore electrical cable route to a grid connection via a Switchgear Building and Grid Connection Substation.

3. The purpose of this chapter is to provide an assessment of possible impacts which may arise through the development of the Project on offshore archaeology and cultural heritage. This chapter describes the baseline environment, identifies potential impacts which may arise and their related receptors, presents an impact assessment and associated results, and where applicable proposes mitigation measures. This chapter has been prepared by MarineSpace Ltd on behalf of Royal HaskoningDHV.

4. The Project will install multiple technology types within the MDZ, and so the consent application is based on a Project Design Envelope (also known as a Rochdale Envelope), determined through knowledge of existing technology and the direction of future developments. Hence, the potential effects on offshore archaeology and cultural heritage have been assessed conservatively using realistic ‘worst-case’ scenarios for the Project.

5. This chapter has been prepared by MarineSpace Ltd on behalf of Menter Môn.

13.2. POLICY, LEGISLATION AND GUIDANCE

6. This section outlines the relevant national and regional policy and guidance and industry guidance which has be used to support the compilation of this ES Chapter.

7. An overview of the relevant legislative context for the Project is provided in **Chapter 2, Policy and Legislation**.

13.2.1. Industry Guidance

8. Industry guidance on requirements, included in the Environmental Impact Assessment (EIA) methodology adopted (**Section 13.4**), ensures that 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);

- Collaborative Offshore Wind Research into the Environment (COWRIE) Guidance for the cumulative impacts on the historic environment from offshore renewable energy (Wessex Archaeology, 2007);
- Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw, 2011);
- Historic Environment Guidance for Wave and Tidal Energy (Firth, 2013);
- Managing Heritage Impact Assessment in Wales (Cadw, 2017a);
- Managing Conservation Areas in Wales (Cadw, 2017b);
- Marine Geophysics Data Acquisition, Processing and Interpretation: Guidance Note (English Heritage, 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 (DBA) (Institute for Archaeologists, 2014); and
- Welsh Government Technical Advice Note (TAN) 24: The Historic Environment (Welsh Government, 2017a);

13.2.2. Legislation and Policy Context

9. Assessment specific legislation and policy relating to the marine historic environment within Welsh territorial waters have been collated and assessed. The most notable and relevant examples to the Project for offshore archaeology and cultural heritage are listed below. Further detailed descriptions can be found in **Appendix 13-1** (**Volume III**).

13.2.2.1. Global Legislation and Policy

10. Relevant global policy and legislation to offshore archaeology and cultural heritage are as follows:

- 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); and
- UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001).

13.2.2.2. Relevant European Legislation and Policy

11. Relevant European policy and legislation to offshore archaeology and cultural heritage are as follows:

- European Convention on the Protection of the Archaeological Heritage (Revised) (1992) (the Valletta Convention); and
- European Landscape Convention (2000).

13.2.2.3. UK Legislation and Policy

12. Relevant UK policy and legislation to offshore archaeology and cultural heritage are as follows:

- The Protection of Wrecks Act (1973):
- Section One; and
- Section Two;
- The Ancient Monuments and Archaeological Areas Act (1979);
- The Merchant Shipping Act (1995);
- The Protection of Military Remains Act (1996); and
- The UK Marine Policy Statement (MPS) (HM Government, 2011) and UK High Level Marine Objectives (HLMO).

13.2.2.4. National Policy Statements

13. The Project is seeking consent for a Transport and Works Act Order (TWAO) from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Its size (240 MW) means it is representative of a Nationally Significant Infrastructure Project (NSIP); therefore, guidance relevant to NSIPs is considered appropriate to use for this Project. Guidance that is relevant to assessing impacts on marine archaeology and cultural heritage for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to this chapter topic include:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3), July 2011 (DECC, 2011b).

14. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 13-1** below. The specific assessment requirements for offshore archaeology and cultural heritage are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 13-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Offshore Archaeology and Cultural Heritage

NPS Requirement	NPS Reference	ES Reference
"As part of the ES the applicant should provide a description of the significance of the heritage assets affected by the proposed development and the	EN-1 Paragraph 5.8.8	The significance and value of the archaeological receptors considered in this chapter of the

NPS Requirement	NPS Reference	ES Reference
contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset."		ES, including the contribution of setting to that significance is detailed throughout **Section 13.7**. Issues relating to the setting of onshore heritage assets have been considered as part of **Chapter 20, Onshore Archaeological and Cultural Heritage**.
"Where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact."	EN-1, Paragraph 5.8.9	This chapter of the ES is based upon the results of a desk-based assessment which identifies the presence of archaeological receptors within the offshore study area (see **Section 13.5.2** and **Appendix 13-1, Volume III**).
"The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets affected can be adequately understood from the application and supporting documents."	EN-1, Paragraph 5.8.10	This chapter of the ES provides an account of the potential impacts of the Project upon heritage assets and their significance (**Section 13.7**).
"Consultation with the relevant statutory consultees (including English Heritage or Cadw) should be undertaken by the applicants at an early stage of the development."	EN-3, Paragraph 2.6.140	Consultation has been undertaken with relevant statutory consultees, as outlined in **Section 13.3**, **Table 13-3**. Consultation will be on going throughout the development process.
"Assessment should be undertaken as set out in Section 5.8 of EN-1. Desk-based studies should take into account any geotechnical or geophysical surveys that have been undertaken to aid the windfarm design."	EN-3, Paragraph 2.6.141	The assessment has been undertaken in accordance with Section 5.8 of EN-1, as detailed above. Geophysical and geotechnical studies have underpinned the assessment (**Section 13.5.3** and Partrac, 2018).
"The assessment should also include the identification of any beneficial effects on the historic marine environment, for example through improved access or the contribution to new knowledge that arises from investigation."	EN-3, Paragraph 2.6.142	Any beneficial effects to the offshore archaeology and cultural heritage resource resulting from the Project have been identified and incorporated as part of **Section 13.7**.
"Where elements of an application (whether offshore or onshore) interact with features of historic maritime significance that are located onshore, the effects should be assessed in accordance with the policy at Section 5.8 of EN-1."	EN-3, Paragraph 2.6.143	Potential impacts of the Project upon onshore heritage assets have been considered in **Chapter 20, Onshore Archaeology and Cultural Heritage**.
"PINS should be satisfied that OWFs and associated infrastructure have been designed sensitively taking into account known heritage assets and their status (for example designated features)."	EN-3, Paragraph 2.6.144	Embedded mitigation measures are detailed in **Section 13.7.1.3**, and further impact-specific mitigation measures, such as the

NPS Requirement	NPS Reference	ES Reference
"Avoidance of important heritage assets, including archaeological sites and historic wrecks, is the most effective form of protection and can be achieved through the implementation of archaeological exclusion zones (AEZ) around such heritage assets which preclude development activities within their boundaries"	EN-3, Paragraph 2.6.145	implementation of AEZs are provided in **Sections 13.7.2** and **Section 13.7.3**.
"Where requested by applicants, PINS should consider granting consents that allow for micro-siting to be undertaken within a specified tolerance. This allows changing to be made to the precise location of infrastructure during the construction phase so that account can be taken of unforeseen circumstances such as the discovery of marine archaeological remains."	EN-43, Paragraph 2.6.145	Micro-siting is a mitigation measure proposed in **Section 13.7.2.1.5** to minimised impacts to known wreck sites.

13.2.2.5. Welsh Legislation and Policy

15. Relevant Welsh policy and legislation to offshore archaeology and cultural heritage are as follows:

- The Planning (Wales) Act (2015);
- The Well-Being of Future Generations (Wales) Act (2015);
- The Historic Environment (Wales) Act (2016);
- National Planning Policy in Wales (Planning Policy Wales, edition 10, 2018) (Welsh Government, 2018) and the Historic Environment (Wales) Act 2016.; and
- Draft Welsh National Marine Plan (WNMP) (Welsh Government, 2017b).

16. By adopting the MPS, the Welsh Government committed to the requirement to introduce the WNMP, which is currently under consultation (discussed further in **Chapter 2, Policy and Legislation**). The draft WNMP makes reference to policies relevant to the Project, and those specific to offshore archaeology are detailed in **Table 13-2**.

Table 13-2 National and Regional Policy Requirements Relevant to Offshore Archaeology

Policy Description	ES Reference
Draft WNMP: SOC_05 - Historic Assets	
Proposals should demonstrate how potential impacts on historic assets and their settings have been taken into consideration at an early stage and should, in order of preference: a) avoid adverse impacts on historic assets and their settings; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be adequately addressed, proposals should present a clear and	An assessment of the existing and potential maritime archaeological resources is presented in desk based archaeological assessment in **Appendix 13-1** (**Volume III**). A summary has been presented in this chapter (**Section 13.6-13.8**). The setting of onshore assets has been undertaken as part of the onshore archaeology DBA and ES **Chapter 20, Onshore Archaeology and Cultural Heritage**.

Policy Description	ES Reference
convincing justification for proceeding. Opportunities to enhance historic assets are encouraged.	Identification of the impacts and the appropriate method of avoidance, minimisation or mitigation has been discussed in **Section 13.7**.
JLDP: Policy AMG 6 - Protecting Sites of Regional or Local Significance	
Proposals that are likely to cause direct or indirect significant harm to Local Nature Reserves (LNR), Wildlife Sites (WS) 1 or regionally important geological / geomorphologic sites (RIGS) must have overriding economic and social benefit and not cause unacceptable harm	An assessment of the existing and potential palaeolandscape resources is presented in desk based archaeological assessment in **Appendix 13-1** (**Volume III**). A summary has been presented in this chapter, **Section 13.6**.

17. Within Wales, there are four regional archaeological trusts that have advisory roles to Cadw; Cadw is the Welsh Government's historic environment service. These are Glamorgan-Gwent Archaeological Trust, Dyfed Archaeological Trust, Gwynedd Archaeological Trust and Clwyd-Powys Archaeological Trust. Gwynedd Archaeological Trust (GAT) cover the region for this Project and provided advice as part of the Gwynedd Archaeological Planning Service.

13.3. CONSULTATION

18. **Table 13-3** summarises relevant consultation responses on the offshore elements of the Project received prior to and during preparation of the ES and which were considered in this Chapter. A full list of consultation responses and how they have been taken into account in finalising the Project is presented in **Chapter 6, Consultation**.

Table 13-3 Consultation Responses

Consultee	Date/Document	Comment	Response
Planning Inspectorate	2018 Summary of Scoping Opinion	Impacts to historic wrecks and submerged military aviation heritage: The Scoping Report has not identified physical disturbance to artefacts within the marine area. As noted by Cadw (see Appendix 1 of this Scoping Opinion), the locations of historic wrecks and submerged vessels on maps may not be accurate. Therefore the assessment should consider the potential for submerged archaeological remains and vessels, particularly along the cable route where the potential for physical disturbance is at its highest.	The physical disturbance of artefacts has been assessed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**. The assessment has considered the potential for submerged archaeological remains, this has been captured in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**.
Planning Inspectorate	2018 ▪ Summary of Scoping Opinion	Indirect disturbance from sediment: In addition to assessing the potential impacts of changes to sediment during operation, the ES should consider the potential for indirect effects from	Indirect disturbance of sediment is discussed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.7**.

Consultee	Date/Document	Comment	Response
		sediment during construction and decommissioning.	
Cadw and NRW	2018 ▪ Summary of Scoping Opinion	It is noted that the locations of historic wrecks and submerged vessels are likely to be imprecise and therefore it cannot be assumed that the locations provided on maps are accurate. The study needs to take account of this and consider potential for submerged archaeological remains and vessels – particularly along the cable route where potential for physical disturbance is at its highest. The Royal Commission on the Ancient and Historic Monuments should be consulted for advice regarding the choice and application of survey techniques suitable for establishing the potential for maritime heritage impacts.	Historic records have been assessed as well as recent geophysical data to provide a combined assessment; results are discussed in **Appendix 13-1** (**Volume III**) and summarised in **Section 13.6**.
Cadw	▪ 2018 ▪ Summary of Scoping Opinion	The Royal Commission on the Ancient and Historic Monuments of Wales is the primary source of information for marine historic assets.	The Royal Commission on the Ancient and Historic Monuments of Wales were consulted, see **Appendix 13-1** (**Volume III**) and summarised in **Section 13.5.2, 13.6.2** and **13.6.3**.
Royal Commission for Ancient and Historic Monuments Wales	▪ 2019 ▪ Email Correspondence	The potential for scouring to destabilise sites at some distance from the installation would remain at concern to take forward into the post construction monitoring proposals. The methodology for determining the AEZ extent should be included in the ES and in the WSI.	Potential for scouring is covered within **Chapter 7, Metocean Conditions and Coastal Processes.** Future monitoring is noted and will be included in the WSI. The methodology for determining the AEZ extent is explained in **Section 13.7.2.1.5** and **Appendix 13-1** (**Volume III**)**.** Noted to also be included in the WSI.

13.5. METHODOLOGY

13.5.1. Study Area

19. For the purposes of this assessment, a study area comprising the offshore MDZ and export cable corridor (ECC), which are comprised by the Offshore Development Area (OfDA), with an additional 2 km buffer up to the mean high water springs (MHWS) has been utilised (**Figure 13-1 and 13-2, Volume II**). 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 1 km study area around the onshore infrastructure (**Chapter 20, Onshore Archaeology and Cultural Heritage**).

20. The size of the study area ensures that data sources provide sufficient information about the Project proposed development site and its surrounding landscape from which to assess known and potential impacts on the heritage resource. This in turn provided a clearer indication of the Project proposed development site's history, context and archaeological potential.

13.5.2. Data Sources – Desk Study

21. A wide variety of information sources and reference materials have been consulted to inform the assessment of the nature, extent and significance of the known and potential heritage resource. Information has been collated from five heritage databases, comprising:

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

22. Evidence from these data sources have been collated and used in inform this assessment. A list of relevant data can be found in **Appendix 13-1** (**Volume III**)**.**

13.5.3. Data Sources – Site-Specific Surveys and Reports

23. A site-specific geophysical survey across the MDZ has been undertaken to inform the assessment. The primary data utilised in the assessment is as follows:

- Geophysical survey undertaken by Partrac in 2018 (Partrac, 2018) of the MDZ plus a 1 km buffer. Including:
  - Multibeam bathymetry data;
  - Sidescan sonar data;
  - Magnetometer data; and
  - Sub-bottom profiler (boomer) data.
- Subtidal grab sample survey undertaken by Ocean Ecology in 2018 (Ocean Ecology, 2018);
- Offshore Archaeological Desk Based Assessment (**Appendix 13-1, Volume III**);
- Heritage records mentioned above; and
- Secondary sources consulted include relevant literature from journals, publications and unpublished archaeological reports, as well as recent assessments and geophysical work in the region.

24. Gazetteers of all sites, finds and geophysical anomalies from the offshore study area are presented in Offshore Archaeology Desk Based Assessment (DBA) (**Appendix 13-1, Volume III**).

25. All cultural heritage assets have been allocated a unique reference number with a ‘MS’ prefix and illustrated on the accompanying figures. Further discussion and details for all the entries can be found in the accompanying technical appendix (**Appendix 13-1, Volume III**).

26. Cultural heritage assets within the intertidal part of the offshore site study area have been assigned a number from MS_UKHO_ or MS_DBA_0001 upwards.

27. Chronology in this report is presented as years Before Present (BP) and, where relative dates are available, as BC/AD calendar dates.

13.5.4. Impact Assessment Methodology

28. The EIA Methodology stated in **Chapter 5, EIA Methodology** has been used and adapted for the assessment of historic assets. Further detail is provided below on the method and significance criteria used for impact assessment within this chapter.

29. Following identification of the heritage assets within the site and their significance, the review 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.

30. The approach to making balanced assessments for the Project has been 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.

31. 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.

13.5.5. Sensitivity of Heritage Assets

32. 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.

33. 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.

34. In order to define the sensitivity of a receptor, the guidelines presented in **Table 13-4** 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.

35. 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 13-4 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.

36. It should be noted that the sensitivity criterion is a composite one; combining value (see **Section 13.5.6**) 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.

13.5.6. Receptor Value

37. The UK MPS 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.

38. 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.

39. For non-designated assets, significance (value) is best defined by Cadw's 'Conservation Principles' (2011), which describes 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.

40. 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.

41. 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 13-5** provides definitions for the value afforded to a receptor based on importance with regard to legislation and guidance.

Table 13-5 Definitions of the Value Levels

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.

13.5.7. Magnitude of Effect

42. 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:

- 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.

43. **Table 13-6** is in line with the wider methods used in this EIA for judging magnitude of effect but relates specifically to heritage assets.

Table 13-6 Generic 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.

13.5.8. Impact Significance

44. 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 13-6**.

45. 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. Where possible the matrix presented in **Table 13-7** has been used to aid assessment of impact significance, combined with the application of expert judgement, to facilitate a consistent approach throughout the EIA.

46. However, for each topic within the EIA, best practice methodology (based on the latest available guidance) has been followed and hence, when more appropriate, an alternative approach to the use of a matrix may be used.

47. By combining the magnitude of the impact and the sensitivity of the receptor in a matrix (see **Table 13-7**), the final significance of the impact (prior to the implementation of mitigation measures) can be obtained.

Table 13-7 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

48. Definitions of impact significance are provided in **Table 13-8** 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 13-8** below) 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 13-8 Impact Significance Definitions

Value	Definition
Major Adverse	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 Adverse	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 Adverse	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.

49. It should be noted that any residual impact (the impact after the implementation of mitigation; see **Section 13.5.10** below) which remains at the level of 'moderate' or 'major' is regarded by the EIA Regulations as being significant.

13.5.9. Confidence

50. 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.

13.5.10. Mitigation Measures

51. 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.

52. A range of mitigation measures for impacts to heritage assets exist. 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:

- Archaeological Exclusion Zones (AEZs);
- Archaeological input into geotechnical investigations and geo-archaeological assessment;
- Archaeological input into geophysical investigations and archaeological review of data;
- Watching briefs;
- Archaeological investigations using divers or Remotely Operated Vehicles (ROVs); and
- Protocols for Archaeological Discoveries (PADs).

53. 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.

13.5.11. Residual Impacts

54. 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.

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

13.5.12. Cumulative Impact Assessment

56. Cumulative impacts are assessed through consideration of the extent of influence of changes to offshore heritage assets arising from the Project alone and those arising from the Project cumulatively or in combination with other developments including the 80 MW Minesto Holyhead Deep Green project. It is proposed that the export cable from the Minesto project links with that of the Project and that both projects have a joint landfall.

13.6. EXISTING ENVIRONMENT

57. The following section provides a summary of the existing environment, highlighting any known and potential archaeological and cultural resources in the offshore study area (**Figure 13-1 and 13-2, Volume II**). Further detail is provided in **Appendix 13-1** (**Volume III**)**.**

58. Whilst relevant data sources have been consulted there are limitations when using this data to provide a review of the baseline environment. These include the following:

- There are limited studies of the glacial evolution of the study area and surrounding region, and due to the nature of the area as a complex site, the interpretation will not provide a

complete record of the marine historic environment and does not preclude the subsequent discovery of further elements that are, at present, unknown; and

- Heritage record data, listed in **Section 13.5.2**, are limited to the information provided by the reporter, positions may not be accurate, and descriptions may vary.

13.6.1. Baseline Resource: Submerged Prehistory

59. 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 8,000-6,000 years BP, when the coastline assumed roughly its current form. Evidence from this period relates to palaeoenvironmental remains indicating formerly terrestrial landscapes that were exposed at times of glacially controlled sea level regression, including landscape features, or artefacts such as stone tools and faunal remains indicating human presence and use of this landscape.

60. North Wales has a complex history of repeated advances and retreats of ice sheets, with the corresponding changes sea level, erosional and depositional environments. The timescales between the retreat of the ice sheet after the Last Glacial Maximum (LGM) and the inundation of the Irish Sea region is debated, however there would have been a short length of time in the middle Holocene where regions between St George's Channel and the current coast line would have been exposed to the terrestrial environment.

13.6.1.1. Known Submerged Prehistoric Cultural Heritage Assets

61. No known submerged prehistoric sites exist in the study area. A palaeogeographical assessment was undertaken comprising a review of the marine geophysical data acquired in 2018 (Partrac, 2018) in conjunction with existing data on the known geology of the area (further detail can be found in **Appendix 13-1, Volume III**).

62. The sub-bottom profiler data indicated the presence of thin or infilled units of glacial till above outcropping and sub-cropping bedrock in the central and east of the MDZ. In the west of the MDZ more complex Quaternary deposits appear to be present, one unit appears to infill incised sections of the glacial till; 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.

63. 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 feature 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 palaoeolandscape in this area. **Figure 13-1** (**Volume II**) displays the extent of the feature across the study area.

64. The majority of the site is characterised by high energy conditions (see **Chapter 7, Metocean Conditions and Coastal Processes**) 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.

13.6.1.2. Potential for Further Unknown Submerged Prehistoric Cultural Heritage Assets

65. The earliest deposits within the site relate to the Devensian glaciation. The site lay under an ice sheet until c.22,000 BP. 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.

66. 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.

67. 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.

68. 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.

69. 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.

70. 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 (**Section 13.6.2**).

13.6.2. Baseline Resource: Maritime Archaeology

71. Maritime archaeology spans all seafaring activities that cover the extent of human occupation of Britain. These activities range from early coastal settlers in the region during the prehistoric period, to Roman vessels supplying or defending the Fort at Holyhead and watch tower at Caer y Twr, to large wooden sailing ships assisting in the transport of copper from the mines on Anglesey through to modern day vessels. Over this time, sizable shipping activity is likely to have passed through the MDZ, and with the nature of the surrounding environment, there is potential for a number of losses en-route; further details are presented in the Offshore

Archaeology DBA (**Appendix 13-1, Volume III**). 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.

72. A maritime site is one which comprises of a vessel (whole or complete) and/or associated debris. Debris can comprise a single artefact through to an entire scatter of material, either associated with a wreck, or accidently or deliberately lost from a vessel.

73. 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.

13.6.2.1. Known Maritime Cultural Heritage Assets

74. There are a number of items of potential archaeological interest located within the study area, identified using the geophysical data, these have been allocated archaeological potential and are summarised in **Table 13-9**. **Figure 13-2** (**Volume II**) displays the location of these items across the study area.

Table 13-9 Summary of Items of Archaeological Potential Identified Within the Study Area

Archaeological Potential	Description	Total within study area	Within OfDA
High	A contact almost certainly of anthropogenic origin and with a high potential of being of archaeological significance	6	4
Medium	A contact believed to be of anthropogenic origin but that would require further investigation to establish its archaeological potential	5	1
Low	A contact potentially of anthropogenic origin but that is unlikely to be of archaeological interest	18	10
Total		29	15

75. All items of high archaeological potential were identified as wrecks. Historic records were also used to identify any areas of potential and were cross referenced with these items. A total of five of the six high archaeological potential items were found to correlate to positions of recorded known and unknown wrecks; four of those, with associated records, were located within the MDZ (**Figure 13-2, Volume II**). Further details can be found in **Appendix 13-1** (**Volume III**).

76. The items of medium archaeological potential were identified as mounds, debris and magnetic anomalies; the one item of medium archaeological potential located within the ECC and MDZ was classified as a magnetic anomaly with no surficial expression indicating potential buried anthropogenic debris. The remaining items were located within the study area but outside of the OfDA. The items of low archaeological potential include items that were classified as debris, linear features some potentially cable, rope or scour and magnetic anomalies, and were identified across the study area.

77. A number of historic records of diver accounts and documented losses were located within the study area, mainly along the nearshore border of the MDZ and ECC, either were not seen in the

geophysical data or were just outside the geophysical data coverage and indicate potential that further disarticulated remains of wrecked vessels and potentially wrecked aircraft may survive within the site boundaries (**Section 13.6.2.2**).

13.6.2.2. Potential for Further Unknown Maritime Cultural Heritage Assets

78. As noted above (**Section 13.6.1.1**), 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.

79. 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.

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

13.6.3. Baseline Resource: Aviation

81. 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.

82. 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.

83. A guidance note published by English Heritage entitled Military Aircraft Crash Sites (English Heritage, 2002) outlined a case for recognising the importance of aircraft crash sites, specifically with regard to existing and planned development proposals which may have an impact on such sites. The guidance note argues that aircraft crash sites not only have significance for remembrance and commemoration, but they also have an implicit cultural value as historic

artefacts, providing information on the aircraft itself and also the circumstances of its loss (English Heritage, 2002). 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.

84. Site survival is largely determined by the cause of loss. With a few exceptions, aircraft come to be on the seabed as a result of an in-flight accident or enemy action and remains are often highly fragmented and widely dispersed as a result of mid-air explosion or the high impact of hitting the water at speed. Aircraft which come to rest on the seabed as a result of controlled ditching are more likely to be better preserved. The factors which determine the survival of an aircraft crash site are not yet fully understood, although marine environments generally offer favourable conditions for the preservation of artefacts, enhancing the potential for the survival of aircraft crash sites on the seabed.

85. Recently, an increasing number of aircraft wrecks have been discovered during aggregate dredging operations and survey work associated with offshore renewable energy development around the UK (Wessex Archaeology, 2008a) and it is now clear that these remains not only survive on the seabed but are widespread.

13.6.3.1. Known Aviation Cultural Heritage Assets

86. No confirmed and charted aircraft crash sites are recorded in the study area; however, a review of national and local historical records indicate a total of seven aircraft losses are recorded within the site and study area (**Section 13.6.3.2**).

87. 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; recent surveys confirm the absence of an identifiable site. Separate reports indicate that aircraft wreckage has been identified off North Stack, and the propeller recovered and now forms part of a memorial monument. No position is recorded for this, however the description and UKHO record tally indicating that evidence of the aircraft wreckage may survive in this area of the seabed. Further detail is presented in **Appendix 13-1** (**Volume III**).

13.6.3.2. Potential for Further Unknown Aviation Cultural Heritage Assets

88. A total of seven recorded aircraft losses are recorded within the site and study area, all relate to WWII, with one a post-WWII plane. The documentary evidence indicates that a number of planes have been lost off South Stack and Holyhead Mountain, the loss locations are not confirmed but provide a general region of loss and indicate that these remains may have fallen within the site. Further detail on the recorded air craft losses is presented in **Appendix 13-1** (**Volume III**).

89. 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.

13.7. IMPACT ASSESSMENT

13.7.1. Overview of Potential Impacts

90. Following the EIA methodology as detailed in **Section 13.4**, the following section lists and discusses the impacts and any mitigation required.

13.7.1.1. Impact Receptors

91. The potential risks (impacts) to marine archaeology and heritage resources from the proposed development have been considered. As already demonstrated in **Section 13.6**, 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. Potentially sensitive archaeological receptors can be summarised under the themes and sub categories listed in **Table 13-10**.

Table 13-10 Archaeological Receptor Themes and Sub Categories Utilised in this Impact Assessment

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	

13.7.1.2. Worst Case Scenario

92. The offshore project area consists of the offshore cable corridor with landfall at Penrhos Feilw and the Project within the MDZ. The final design (including numbers of devices, layout configuration, requirement for scour protection etc.) has not yet 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 (see **Chapter 4, Project Description**). The realistic worst-case scenarios used for offshore archaeology and cultural heritage are described in the sections below.

93. 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.

94. Indirect impacts upon the setting of coastal heritage assets from the Project's offshore infrastructure are captured in **Chapter 20, Onshore Archaeology and Cultural Heritage.**

95. The nature of these effects, and the types of impact that may occur during the construction (**Section 13.7.2**), operation, maintenance and repowering (**Section 13.7.3**) and decommissioning (**Section 13.7.4**) are discussed below. This accompanies the description of the worst-case scenario for archaeology and cultural heritage in accordance with the Project Design Envelope approach.

13.7.1.2.1. Direct Impacts

96. 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.

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

98. 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.

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

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

100. The worst-case scenario for seabed impact upon cultural heritage assets is summarised from permanent impacts and temporary impacts on the seabed as whether the impact is permanent or temporary both impact the cultural heritage asset. These have been separated into impacts that make contact with the seabed surface (**Section 13.7.1.2.1.1**;**Table 13-11**) and that cause a seabed disturbance below the seabed surface (**Section 13.7.1.2.1.2**; **Table 13-12**).

13.7.1.2.1.1. Contact with the Seabed

101. The installation of project infrastructure, including anchor systems for Tidal Energy Converter (TEC) devices, seabed mounted devices, hubs and cables/cable protection, will all result in seabed impacts. Also, during all project phases, contact with the seabed will occur to the seabed via device, hubs and cable installation and also anchor deployments for installation barges. 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. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for contact with the seabed.

102. For the purpose of defining impact assessment parameters for the repowering phase, an assumption has been made that 50 % of the tenants will undertake repowering, i.e. for 50 % of the tenants, their infrastructure will be removed and replaced (potentially with different infrastructure by a different tenant). For the other 50 % of tenants, their infrastructure will remain over the lifetime of the Project.

103. In terms of impact assessment parameters, the repowering process has, therefore, been defined as per below:

- Initial temporary seabed disturbance via deployment of barge anchors to remove foundations, TEC's, hubs, inter-array cables and monitoring equipment for 50 % of the Tenants (berths);
- Further temporary seabed disturbance via re-installation (repowering) of foundations, TEC's, hubs, inter-array cables and monitoring equipment for the same 50 % of Tenants (berths); and
- Additional permanent habitat loss (over and above that via initial construction phase), due to placement of re-installed (repowered) foundations/TECs in different areas to where originally installed.

104. The operational phase values also include the temporary seabed disturbance that would arise from up to ten cable repair events.

Table 13-11 Worst Case Scenario for Seabed Surface Impact

Item	Worst Case (240 MW)	Unit	Comments
Construction Phase			
Foundations (Two options: Piled or gravity base)			
Foundations: Piled			
Piled foundations (devices)	3,675	m^2	21 m^2 per device (4 drills of 2.6 m diameter each) x 80 devices 4.5 m^2 per device (4 drills of 1.2 m diameter each) x 120 devices 15.9 m^2 per device (3 drills of 2.6 m diameter each) x 90 devices
Piled foundations (hubs)	2,214	m^2	15.9 m^2 per hub (3 drills of 2.6 m diameter each) x 60 hubs 21 m^2 per hub (4 drills of 2.6 m diameter each) x 60 hubs
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. Disposal of material *in-situ.*
Foundations: Gravity Base			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.

Item	Worst Case (240 MW)	Unit	Comments
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	m^2	740 m length trench x 10m width – worst case scenario
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 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
Anchors			
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5 x 5 m) anchor blocks for a single barge = a total footprint per anchor deployment of 200 m^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 temporary seabed disturbance occurs (via the anchor blocks)

Item	Worst Case (240 MW)	Unit	Comments
			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 500 m (0.5 km), or 400 m^2 every 1 km, and assumes all cables are installed using anchor barges Temporary 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 MW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total temporary 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
Operational Phase (including Repowering and Cable Repairs)			
50 % of tenants' infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new (different) tenant infrastructure *(Temporary seabed disturbance)*	377,400	m^2	Initial <u>removal</u> 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 <u>re-installation (re-powering)</u> 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
New tenant infrastructure in 50 % of berths *(Permanent habitat loss)*	52,504	m2	

Item	Worst Case (240 MW)	Unit	Comments
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). Using same value of 400 m^2 temporary seabed disturbance per 1 km of cable works (400 x 7.5) = 3,000 m^2

105. 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 (**Chapter 4, Project Description**). Assuming worst case scenario for seabed impact, the same impact is assumed for decommissioning.

106. 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.

13.7.1.2.1.2. Disturbed Sub-surface Seabed Sediments

107. Where installation, operation or decommissioning require disturbing the seabed sediments these actions also have a potential impact. These sub-surface impacts could impact on remains including potential palaeolandscape deposits. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for seabed sediment disturbance.

108. The operational phase values include the seabed disturbance that would arise via repowering of up to 50 % of all devices and also up to 10 cable repair events, as discussed in **Section 13.7.1.2.1.1**.

Table 13-12: Summary of Worse-Case Scenario Disturbance of the 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)

Item	Worst Case (240 MW)	Unit	Comments
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). Using same value of 400 m^2 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

13.7.1.2.2. Indirect Impacts

109. 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 as set out in **Chapter 7, Metocean Conditions and Coastal Processes**.

110. 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.

13.7.1.3. Embedded Mitigation

111. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. These impacts are not relevant to all stages of the Project, and thus impacts have been assessed within the stage of the Project at which they will occur (construction, operation and decommissioning). Further, these impacts are comprised of both direct and indirect impacts.

112. Menter Môn has committed to several techniques and engineering designs/modifications inherent as part of the Project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible (see **Chapter 4, Project Description**). Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process. A range of different information sources has been considered as part of embedding mitigation into the design of the Project including engineering preference, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

13.7.2. Potential Impacts during Construction

13.7.2.1. Construction Impact 1: Direct Physical Impact on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

13.7.2.1.1. Submerged Prehistory

113. Submerged prehistory encompasses both localised discrete sites and broader landscapes that may encompass a wider region. Each feature incurs different approaches in assessment of the sensitivity and magnitude of any effect, as well as the probability of its occurrence on those particular features. These features can be sorted into the following categories:

- **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; and
- **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.

114. The in situ palaeoenvironmental remains have been assessed with a potential of a medium archaeological value as they may be able to further our understanding of past environments. Any such remains would have no ability to recover from physical impacts, but they may cover an area broader than an individual location and therefore the overall sensitivity is considered to be medium. If *in situ* archaeological sites are associated with these potential channels, their early date and potential evidential value indicates that they could be of high archaeological value, with a high level of sensitivity due to them being discrete and localised. Impacts from the foundations within the areas of the possible channels would result in the loss of restricted areas of sediment from within the channels. This partial loss of discrete locations within an area with such palaeoenvironmental potential would result in a medium magnitude of change. Therefore, providing a significance of **moderate adverse impact**. If archaeological sites or isolated finds are present in association with the possible 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 and would result in an impact significance of **major adverse impact**.

115. Redeposited remains 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. All redeposited remains have been assessed with a potential of a medium level of value. Additionally, as the redeposited material is already out of context, there is potential tolerance to accommodate removal from its current context. The overall sensitivity of these assets is considered to be medium. Redeposited isolated finds may also be disturbed by the construction of foundations or cable installation during construction. These impacts may result in further movement or removal of finds out of secondary situ, which are permanent and irreversible. However, the key aspects of significance of these finds relates to the physical properties of the artefacts rather than contextual information. The impacts will not alter these characteristics, and as such there is a low magnitude of change, which results in a **minor adverse impact.**

13.7.2.1.2. Known Maritime Cultural Heritage Assets

116. The baseline assessment identified four confirmed wreck sites within the MDZ, and two within the remainder of the study area. The original identities of the wrecks are unknown, with the potential association of one with the *Maarten Cornelis* (not definitively proven). Any wreck sites dating from pre-1815 are likely to be of high archaeological value and significance based on the rarity of surviving vessels from this period.

117. A further five items of (medium) archaeological potential were identified in the geophysical data; one within the MDZ and four outside of the MDZ but within the study area. These items may be part of a wider debris site or isolated items. 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.

118. Maritime assets are typically discrete sites that typically do not cover a large area of the seabed (a wreck or crash site with associated debris field). Discrete archaeological sites of this nature are easily impacted by activities that disturb the seabed and have a low ability to tolerate such impacts as they are usually permanent and irreversible. Due to the discrete nature of these cultural heritage assets, they are considered to have a low ability to tolerate adverse physical impact; therefore, are judged to have a high degree of sensitivity and magnitude of change. Any physical impact upon these types of cultural heritage assets would therefore be considered to be of **major adverse impact**.

13.7.2.1.3. Unknown Maritime Cultural Heritage

119. The baseline assessment identifies a relatively large number of diver records of wrecks and reports of wreck material to the Receiver of Wreck across the study area providing an indication of the archaeological potential of the area. There is also potential for maritime and related intertidal features and structures in Abrahams Bosom, relating to the use of the area as an embarkation and landing point from at least the post-medieval period. While the value of such remains is dependent upon period, rarity and a range of other factors, overall 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. As the impacts would be permanent and irreversible, activities related to the worst-case scenario of the development could result in a high magnitude of change and would result in an impact significance of **major adverse impact**.

13.7.2.1.4. Unknown Aviation Receptors

120. 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.

121. 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 of the any such remains is high. Activities related to the worst case scenario of the development would create impacts that would be permanent and irreversible. These activities could result in a high magnitude of change. This would result in a **major adverse impact**.

13.7.2.1.5. Mitigation

122. Mitigation for direct physical impacts during construction includes:

- **Creation of a Written Scheme of Investigation (WSI)** to cover all future works within the site and to include specification for archaeological involvement prepared in consultation, once the final layout details of the development site and offshore cable corridor is established. This document should be incorporated into the final Construction Environmental Management Plan (CEMP). The WSI would set out the design and implementation of a programme of detailed mitigation works, which will include future monitoring of the assets. This would comply with guidance current at the time of its development (presently Wessex Archaeology, 2007);
- **Mitigation by micro-siting and 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 AEZs listed in **Table 13-15** (also **Appendix 13-1, Volume III**) 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;
- **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). The 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 micro-siting and avoidance or modification** of construction foundation design for potential channel areas should be carried out (unless reporting is able to be undertaken or the archaeological value confirmed as low). Avoidance, limiting contact or development 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;
- **Implement the Protocol for Archaeological Discoveries (PAD)**, as part of the WSI, for Offshore Renewables Projects (The Crown Estate 2014), for the duration of the Project life. 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 are 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 wreck, aviation and unknown archaeological remains and isolated finds; and
- **A watching brief** should also be conducted in the intertidal zone. This is primarily to mitigate impacts upon potential maritime and intertidal remains. It would allow archaeological input in case any such remains are found and also serve to record any isolated or eroded finds from the coast. This would be particularly valuable due to the noted potential for eroded remains identified from those already listed within the recorded finds, for example, any that may be associated with the Late Iron Age and Romano-British settlement, which lies c. 200 m above the high-water mark (for further details refer to MS_DBA_0014; **Appendix 13-1, Volume III**).

123. It should be noted that potential impacts to items of low archaeological potential do not require mitigation. However, developers should maintain an operational awareness of the positions of low potential anomalies throughout their work and avoid were possible.

13.7.2.1.6. Residual Impact

124. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **negligible** significance.

13.7.2.2. Construction Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

125. Possible indirect impacts during construction comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in the sediment movements which further bury and preserve cultural heritage assets, such as the deposition from piled foundations (dependent on sediment type). Negative effects would result from increased scour and exposure of potential cultural heritage assets enabling further degradation and destruction of the potential cultural heritage asset; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands). As discussed in **Section 13.7.2.1**, known and unknown cultural

heritage assets all assets are considered to have a medium to high value. Using the precautionary method, impacts are assumed to be of medium to high magnitude, leading to a **major adverse impact**.

13.7.2.2.1. Mitigation

126. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the construction phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.2.2.2. Residual Impact

127. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.3. Potential Impacts During Operation (and Repowering)

13.7.3.1. Operational Impact 1: Direct Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

128. During the operational phase of the Project, ongoing maintenance works, repowering and replacement of the devices will be required. Though it is anticipated that these will occur within the already disturbed footprint of the development, using the worst case scenario, there is possibility for direct impacts upon cultural heritage assets through the anchoring of maintenance vessels and repairing of cables. Effects and impacts are the same as discussed in **Section 13.7.2.1**, and any direct impact upon known or unknown cultural heritage assets is judged to have a potential **major adverse impact**.

13.7.3.1.1. Mitigation

129. For direct physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the operation phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.3.1.2. Residual Impact

130. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.3.2. Operational Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

131. Similar to the construction phase (**Section 13.7.2.2**), possible indirect impacts during operation are possible. Indirect impacts comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in sediment movements which further bury and preserve archaeological cultural heritage assets, which due to the nature of the area burial outside of the nearshore areas, where bedforms are present, is unlikely (**Chapter 7, Metocean Conditions and Coastal Processes** and **Chapter 8, Marine Water and Sediment Quality**). Negative effects would result from increased scour and exposure of potential archaeological cultural heritage assets, enabling further degradation and destruction of the potential resource; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands) (**Chapter 7, Metocean Conditions and Coastal Processes)**.

132. As discussed in **Section 13.7.2.1**, known and unknown archaeological cultural heritage assets, all assets are considered to have a medium to high value. Using the precautionary method, impacts are assumed to be of medium to high magnitude, leading to a **major adverse impact**.

13.7.3.2.1. Mitigation

133. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the operation phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.3.2.2. Residual Impact

134. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.4. Potential Impacts During Decommissioning

13.7.4.1. Decommissioning Impact 1: Direct Physical Impact on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

135. During the decommissioning phase of the Project, possible direct impacts are currently assessed to be in line those identified with the construction phase. Though it is anticipated that these will likely occur within the already disturbed footprint of the development, using the worst case scenario, there is possibility for direct impacts upon cultural heritage assets through the removal of devises and cables and anchoring of vessels. Effects and impacts are the same as discussed in **Section 13.7.2.1**, and any direct impact upon known or unknown cultural heritage assets is judged to have a potential effect of **major** significance.

13.7.4.1.1. Mitigation

136. For direct physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the decommissioning phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.4.1.2. Residual Impact

137. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.4.2. Decommissioning Impact 2: Indirect Physical Impacts on Known and Unknown Maritime, Aviation and Submerged Prehistoric Cultural Heritage Assets

138. Possible indirect impacts during decommissioning comprise either increased protection to, or deterioration of, cultural heritage assets due to changes in the processes acting upon them and their physical setting. Potential beneficial effects could result in the sediment movements which further bury and preserve cultural heritage assets. Negative effects would result from increased scour and exposure of potential cultural heritage assets enabling further degradation and destruction of the potential cultural heritage asset; this has greater potential to occur in the nearshore areas amongst recent marine sediments (sands). As discussed in **Section 13.7.2.1**, known and unknown cultural heritage assets all assets are considered to have a **medium** to **high** value. The aim of decommissioning is return the seabed to its original state, therefore there should be a lower magnitude than assessed during construction, leading to a minor adverse impact.

13.7.4.2.1. Mitigation

139. For indirect physical impacts upon submerged prehistoric, known and unknown maritime and aviation cultural heritage assets during the decommissioning phase, mitigation will be the same as **Section 13.7.2.1.5**; including adherence to and use of AEZs, as defined in Model Clauses for Archaeological Written Schemes of Investigation (The Crown Estate 2010), and onsite reporting of archaeological finds discovered during the operational phase via PAD.

13.7.4.2.2. Residual Impact

140. The successful adoption and implementation of the mitigation measures detailed above will reduce the impact significance and result in residual impacts of **minor** and/or **negligible** significance.

13.7.5. Cumulative Impacts

141. Of the projects listed in **Chapter 27, Cumulative and In-combination Effects**, the only one which could potentially have a cumulative or in-combination effect with the Project in respect of known and unknown cultural heritage assets is judged to be Minesto's Holyhead Deep project, which lies immediately to the west of the MDZ. All other projects listed are either too remote

from the Project for interactions between direct or indirect impacts or are located on land and thus do not affect the marine cultural heritage (see **Chapter 20, Onshore Archaeology and Cultural Heritage**).

142. A single 0.5 MW device was installed by Minesto in summer 2018 and an EIA scoping report was submitted to NRW in 2017 for an up to 80MW installation of tidal energy devices, delivered in a phased manner, located a short distance due west of the MDZ Project (the Holyhead Deep project). Based upon the geographical configuration of the Minesto Project Development Area (PDA) with respect to the Project, there is no cumulative direct impact on the known archaeological sites within the MDZ.

143. The main potential cumulative impact relates to the potential for these schemes to affect areas of palaeolandscape which may also be present and impacted by the Project. Following mitigation, there are no significant impacts posed to this potential receptor by the Project. The Minesto development likewise identified potential palaeogeographic features, which may be impacted by development. Following mitigation advised in the Minesto ES, 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**.

13.7.6. Inter-Relationships

144. **Table 13-13** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 13-13 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Onshore Archaeology and Cultural Heritage	Chapter 20	Section 13.4.1	Both chapters consider the potential effects on known and unknown finds, including maritime, aviation and submerged prehistoric cultural heritage assets. Both chapters consider the mitigation required throughout the Project. **Chapter 20, Onshore Archaeology and Cultural Heritage** also considers the heritage specific viewpoints, which are not covered in this chapter.

13.7.7. Interactions

145. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity the areas of interaction between impacts are presented in **Table 13-14**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 13-14 Potential Interaction Between Impacts

Potential interaction between impacts		
Construction/Decommissioning	1 Direct physical impact	2 Indirect physical impact
1 Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	-	Yes
2 Indirect physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Yes	-
Operation	1 Direct physical impact	2 Indirect physical impact
1 Direct physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	-	Yes
2 Indirect physical impact on known known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Yes	-

13.8. SUMMARY

146. This chapter has provided an overview on the potential impacts which may occur within the several stages associated with the development of the Project: construction, operation and maintenance, and decommissioning to offshore archaeology and cultural heritage assets within the MDZ.

147. **Table 13-16** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. The offshore archaeological and cultural heritage impact assessment has identified areas where impacts to the marine archaeological resource from construction of the Project and associated infrastructure can be anticipated. A list of AEZs identified during the DBA are provided in **Table 13-15** and displayed in **Figure 13-3 (Volume II)**. Through mitigation these impacts to known and potential heritage assets have been reduced to acceptable limits, and post-mitigation impacts can all be considered to be not significant.

Table 13-15 Summary of AEZs

Name	**MSDS reference**	**UKHO reference**	**Location (WGS884 UTM 30 N)**		**Exclusion zone (metres)**	**Area of OfDA**
			Easting	**Northing**		
Maarten Cornelis	MS_0003	7228	385206.3	5908885.0	100	Offshore
Unknown wreck	MS_0005	81387	384431.8	5910625.0	100	Offshore
Unknown wreck	MS_0004	81388	387178.1	5910210.8	125	Offshore
Unknown wreck	MS_0001	81389	384627.4	5908447.1	100	Offshore

Name	MSDS reference	UKHO reference	Location (WGS884 UTM 30 N)		Exclusion zone (metres)	Area of OfDA
			Easting	Northing		
Magnetic anomaly	MS_0011	-	387823.5	5906694.4	25	Cable route (ECC)

Table 13-16 Summary of Potential Impacts on Offshore Archaeology and Cultural Heritage Assets Associated with the Development of the Project

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
Construction Phase						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
2. Indirect physical impacts on known and unknown maritime, aviation and	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
submerged prehistoric cultural heritage assets	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
Operational Phase (including repowering)						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
					Watching brief	
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
2. Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
					Watching brief (intertidal)	
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
Decommissioning						
1. Direct physical impact on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Medium	Medium	Moderate Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Medium	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	High	High	Major Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Medium	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	High	High	Major Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant

Potential Impact	Receptor	Effect Magnitude	Receptor Sensitivity	Significance	Additional Mitigation Measures	Residual Impact
2. Indirect physical impacts on known and unknown maritime, aviation and submerged prehistoric cultural heritage assets	Submerged palaeolandscapes	Low	Medium	Minor Adverse	WSI Reporting by geoarchaeological assessment Where possible, micro-siting and avoidance or design modification	Not significant
	Discrete submerged prehistoric receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Micro-siting and avoidance (AEZs)	Not significant
	Potential redeposited prehistoric and later finds	Low	Low	Minor Adverse	WSI Reporting protocol (PAD) Watching brief	Not significant
	Known maritime receptors	Low	High	Moderate Adverse	WSI Micro-siting and avoidance (AEZs) Reporting protocol (PAD)	Not significant
	Unknown maritime receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant
	Unknown aviation receptors	Low	High	Moderate Adverse	WSI Reporting protocol (PAD) Watching brief (intertidal)	Not significant

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