Morlais Project
Environmental Statement

Chapter 9: Benthic and Intertidal Ecology

Volume I

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Chapter 9: Benthic and Intertidal Ecology

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GLOSSARY OF ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
BGS	British Geological Survey
CAA	Civil Aviation Authority
CCW	Countryside Council for Wales
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
DDC	Drop Down Camera
DDV	Drop Down Video
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
EU	European Union
EUNIS	European Nature Information System
GBS	Gravity Base Structure
HDD	Horizontal Directional Drilling
ICES	International Council for Exploration of the Sea
INNS	Invasive Non-Native Species
JLDP	Joint Local Development Plan
JNCC	Joint Nature Conservation Committee
MarLIN	Marine Life Information Network
MBES	Multi Beam Echo Sounder
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MDZ	Morlais Demonstration Zone
MFE	Mass-Flow Excavator
MLW	Mean Low Water
MMO	Marine Management Organisation
MNCR	Marine Nature Conservation Review
MSFD	Marine Strategy Framework Directive
NPS	National Policy Statement
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
OEL	Ocean Ecology Limited
PfCO	Permission for Commercial Operations
RPQs	UAV Pilots
SAC	Special Area of Conservation
SCI	Site of Community Importance

SOPEP	Ship Oil Pollution Emergency Plan
SPA	Special Protected Area
S-P-R	Source-Pathway-Receptor
SSS	Side Scan Sonar
TEC	Tidal Energy Converter
TWAO	Transport and Works Act Order
UAV	Unmanned Aerial Vehicle
VER	Valued Ecological Receptors
WFD	Water Framework Directive
WNMP	Wales National Marine Plan

GLOSSARY OF TERMINOLOGY

Anthozoa	A class of marine animals including sea anemones and coral
Ascidian	A marine invertebrate - a sea quirt or tunicate
Bathymetry	Topography of the sea bed
Benthic	The lowest level of a body of water including the sediment surface
Bioaccumulation	The gradual accumulation of substances in an organism
Biogenic	Something that is produced or brought about by living organisms, such as a reef
Biotope	A region of habitat associated with a particular ecological community
Circalittoral	The region of a sea or ocean below the infralittoral zone to the maximum depth at which photosynthesis is still possible
Current	Flow of water generated by a variety of forcing mechanisms (e.g. waves, tides, wind)
Ebb tide	The falling tide, immediately following the period of high water and preceding the period of low water
Ecology	The relation of organisms to one another, and to their physical surroundings
Eulittoral	The area of the shore between the spring high and spring low tide lines.
Fetch	The distance travelled by wind or waves across open water
Flood tide	The rising tide, immediately following the period of low water and preceding the period of high water
Gravel	Loose, rounded fragments of rock larger than sand but smaller than cobbles. Sediment larger than 2mm (as classified by the Wentworth scale used in sedimentology)
Habitat	The environment of an organism and the place where it is usually found
Infralittoral	The region of shallow water closest to the shore, excluding the intertidal, dominated by algae
Intertidal	Area on a shore that lies between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Littoral	The area of a sea or lake between the high water mark and the edge of the continental shelf

Megaripples	Bedforms with a wavelength of 0.6 to 10.0m and a height of 0.1 to 1.0m. These features are smaller than sand waves but larger than ripples
Numerical modelling	Refers to the analysis of coastal processes using computational models
Offshore	Area to seaward of nearshore in which the transport of sediment is not caused by wave activity
Polychaete	A marine worm, such as a bristle worm
Sand	Sediment particles, mainly of quartz with a diameter of between 0.063mm and 2mm. Sand is generally classified as fine, medium or coarse
Scour	The erosion of sediment away from tan area as a result of the flow of water.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter
Sediment transport	The movement of a mass of sediment by the forces of currents and waves
Shallow water	Commonly, water of such depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than half the surface wave length as shallow water
Spring tide	A tide that occurs when the tide-generating forces of the sun and moon are acting in the same directions, so the tidal range is higher than average
Sublittoral	The area of a sea or ocean where sunlight reaches the sea floor, includes the infra- and circalittoral zones
Substrate	The surface or material on or from which an organism lives, grows, or obtains its nourishment.
Subtidal	An area of sea bed which lies below the level of the Lowest Astronomical Tide
Supralittoral	The area above the spring high tide line that is regularly splashed, but not submerged by ocean water
Surge	Changes in water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and the astronomical tide predicted using harmonic analysis
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension
Tidal current	The alternating horizontal movement of water associated with the rise and fall of the tide
Tide	The periodic rise and fall of the water that results from the gravitational attraction of the moon and sun acting upon the rotating earth

9. BENTHIC AND INTERTIDAL ECOLOGY

9.1. 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 commercial 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 communal infrastructure for tidal technology developers which provides a shared route to a local grid connection via nine export cable tails, an onshore landfall substation, and an onshore electrical cable route to a grid connection via a grid connection substation.

3. This chapter provides a summary description of key aspects relating to existing benthic and intertidal ecology, followed by an assessment of the magnitude and significance of the effects on the baseline conditions resulting from the construction, operation and decommissioning of the Project, as well as those effects resulting from cumulative interactions with other existing or planned projects.

4. This chapter incorporates the data collected from the 2018 subtidal and intertidal surveys conducted by Ocean Ecology Ltd (OEL) (Ocean Ecology, 2018) within the MDZ and surrounding environment. The assessment process has been informed by the following:

   - **Chapter 7, Metocean Conditions and Coastal Processes**;
   - Interpretation of survey data specifically collected for the project including intertidal survey, benthic survey and analysis of seabed sediments;
   - Consideration of the existing evidence base regarding the effects of Project infrastructure on the subtidal and intertidal environments; and
   - Application of expert-based assessment and judgement by MarineSpace Ltd.

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

9.2. 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 Chapter.

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

8. In addition to the general legislation and policy guidance set out in **Chapter 2, Policy and Legislation**, industry guidance on the generic requirements for the assessment of impacts on

benthic ecology studies associated with tidal array developments is provided by Natural Resources Wales (NRW) (Guidance Note 030) (NRW, 2018):

International:

- Habitats Directive Council (Directive 92/43/EEC) and other associated habitat regulations:
  - Birds Directive (Directive 2009/147/EC);
  - Ramsar Convention of Wetlands of International Importance;
  - Water Framework Directive (WFD) (EU Directive 200/60/EC);
  - Marine Strategy Framework Directive (MSFD); and
  - The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention 1992).

National:

- Environment (Wales) Act 2016;
- The Wildlife and Countryside Act 1981(amended by the Countryside and Rights of Way (CROW) Act 2000);
- Marine and Coastal Access Act;
- Welsh Marine Protected Area Network; and
- Draft Wales National Marine Plan (WNMP).

Regional:

- Anglesey and Gwynedd Joint Local Development Plan (JLDP).

9.2.1. National Policy Statements

9. The Project is seeking consent for a Transport and Works Act Order from the Welsh Government and a Marine Licence from Natural Resources Wales (NRW). Although this project is not seeking a Development Consent Order (DCO), 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 water and sediment quality for NSIPs are set out within National Policy Statements (NPSs) which are the principal decision-making documents for NSIPs. Those relevant to marine water and sediment quality 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).

10. Details of specific policies within EN-1 and EN-3 used to inform this assessment are provided in **Table 9-1** below. The specific assessment requirements for marine water and sediment quality are detailed, together with an indication of the paragraph numbers of the chapter where each is addressed.

Table 9-1 NPS EN-1 and EN-3 Assessment Requirements Relevant to Marine Water and Sediment Quality

NPS Requirement	NPS Reference	ES Reference
Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the IPC consider thoroughly the potential effects of a proposed project.	EN-1 Section 5.3.3	The designated sites relevant to the assessment are outlined in **Section 9.5.6**.
Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity.	EN-3 Para 2.6.67	Potential impacts of the Project on benthic and marine ecology are presented in **Section 9.6**.
Mitigation may be possible in the form of a careful design of the development itself and the construction techniques employed.	EN-3 Para 2.6.70	Embedded and additional mitigation measures are outlined in **Section 9.6.1**.
An assessment of the effects of installing cable across the intertidal zone should include information, where relevant, about: ▪ Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice; ▪ Any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice; ▪ Potential loss of habitat; ▪ Disturbance during cable installation and removal (decommissioning); ▪ Increased suspended sediment loads in the intertidal zone during installation; and ▪ Predicted rates at which the intertidal zone might recover from temporary effects.	EN-3 Para 2.6.81	The Project will use Horizontal Directional Drilling as the method of construction at landfall, which will avoid direct impacts to sensitive habitats and species. In case this is not technically feasible the worst case assessment covers trenching and/or surface laying of cables. Potential impacts of the Project on benthic and marine ecology are presented in **Section 9.6**. Potential impacts of the Project on ecology at the landfall, above Mean High Water, are presented in **Chapter 19, Onshore Ecology**
Applicants are expected to have regard to guidance issued in respect of Food and Environmental Protection Act (FEPA) [now Marine Licence] requirements.	EN-3 Section 2.6.83	Other relevant guidance, including in respect to the Marine Licence, is outlined further below in this section.
Where necessary, assessment of the effects on the subtidal environment should include: ▪ Loss of habitat due to foundation type including associated sea bed preparation, predicted scour, scour protection and altered sedimentary processes;	EN-3 Section 2.6.113	Due to the nature of the seabed within the MDZ and ECC, the preferred method of cable installation is surface laying. Potential impacts

NPS Requirement	NPS Reference	ES Reference
▪ Environmental appraisal of array cables and cable routes and installation methods; ▪ Habitat disturbance from construction vessels' extendible legs and anchors; ▪ Increased suspended sediment loads during construction; and ▪ Predicted rates at which the subtidal zone might recover from temporary effects.		of the Project on benthic and marine ecology are presented in **Section 9.6**.
Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures which the Infrastructure Planning Commission (IPC) (now the Planning Inspectorate) should expect the applicants to have considered may include: ▪ Surveying and micrositing of the export cable route to avoid adverse effects on sensitive habitat and biogenic reefs; ▪ Burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and ▪ The use of anti-fouling paint might be minimised on subtidal surfaces, to encourage species colonisation on the structures.	EN-3 Section 2.6.119	Potential construction, operation, repowering and decommissioning impacts of the Project on benthic and marine ecology are presented in **Sections 9.6.2, 9.6.3** and **9.6.4.** Details of mitigation measures are provided within each of these sections where necessary.
Activities should have been designed taking into account sensitive benthic environmental aspects and intertidal habitats.	EN-3 Para 2.6.116	Details of the existing environment are provided in Section 9.5 and mitigation measures where necessary are provided in **Sections 9.6.2, 9.6.3** and **9.6.4.**
Where adverse effects are predicted, the assessment should consider the extent to which the effects are temporary or reversible. This includes the installation and decommissioning of cables.	EN-3 Para 2.6.117	The magnitude of each impact, which includes the extent to which the effects are temporary or reversible, has been considered in **Sections 9.6.2, 9.6.3** and **9.6.4.**

9.2.2. Marine Policy Statement

11. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made in order to enable sustainable development. The MPS sets out a vision of having 'clean, healthy, safe, productive and biologically diverse oceans and seas' by supporting the development of Marine Plans. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning.

9.2.3. Wales National Marine Plan

12. By adopting the MPS, the Welsh Government committed to the requirement to introduce Marine Plans for Wales.

13. The Welsh Government is currently developing the first marine plan for Welsh inshore and offshore waters, the Welsh National Marine Plan (WNMP). The Plan is being developed in accordance with the Marine and Coastal Access Act (MCAA) 2009, the MPS and the Maritime Spatial Planning Directive, a draft version has been issued for consultation (discussed further in **Chapter 2, Policy and Legislation**).

14. Objective 10 of the WNMP, "to maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations", is of relevance to this chapter as this covers policies and commitments on the wider ecosystem, as set out in the MPS including those to do with the Marine Strategy Framework Objective Directive and the Water Framework Directive, as well as other environmental, social and economic considerations.

15. **Table 9-2** sets out other national and regional policies which are particularly relevant to the Project.

Table 9-2 National and Regional Policy Requirements Relevant to Benthic and Intertidal Ecology

Policy Description	Reference	ES Reference
MPS		
Noise resulting from a proposed activity or development in the marine area or in coastal and estuarine waters can have adverse effects on biodiversity although knowledge of the extent of impacts is limited and there are few systematic monitoring programmes to verify adverse effects. Man-made sound emitted within the marine environment can potentially affect marine organisms in various ways. It has the potential to mask biologically relevant signals; it can lead to a variety of behavioural reactions, affect hearing organs and injure or even kill marine life. Manmade sound sources of primary concern with regard to disturbance of marine life are explosions, shipping, seismic surveys, offshore construction and offshore industrial activities, for example dredging, drilling and piling, sonar of various types and acoustic deterrent devices.	Section 2.6.3.1	Indirect noise impacts arising from the Project have been assessed on fish, birds and marine mammals. Please see **Chapters 10**, **Fish and Shellfish Ecology**, **Chapter 11, Marine Ornithology** and **Chapter 12 Marine Mammals**.
The UK Administrations are committed to allowing damaged ecosystems to recover in order to realise the benefits from the marine environment. This will be achieved through integrating conservation objectives into marine planning and decision making and incorporating the requirements for specific designated conservation areas.	Section 3.1.1	Conservation importance and objectives, where applicable are discussed in **Section 9.5.5**. Designated sites are presented in **Section 9.5.6**. Protected habitats and species are discussed in **Section 9.5.7**. These are considered fully within the impact assessment (**Section 9.6**)
These are sites identified and designated under Directives and include Special Areas of Conservation (SACs)	Section 3.13	Designated sites are presented in **Section 9.5.6**.

Policy Description	Reference	ES Reference
designated under the Habitats Directive, and Special Protection Areas (SPAs) classified under the Wild Birds Directive for rare, vulnerable and migratory bird populations. The Conservation of Habitats and Species Regulations 2010, the Conservation (Natural Habitats &c) Regulations 1994 (for Scotland only), the Conservation (Natural Habitats &c) Regulations (Northern Ireland) 1995 and the Offshore Marine Conservation (Natural Habitats &c) Regulations 2007, among others, provide statutory protection for these sites64, but do not provide statutory protection for potential Special Protection Areas (pSPAs) before they have been classified as SPAs. For the purpose of considering development proposals affecting them, as a matter of policy, UK Administrations wish pSPAs to be considered in the same way as if they had already been classified. Listed Ramsar sites also receive the same protection.		These are considered fully within the impact assessment (**Section 9.6**) as well as the Information to Support HRA (**Document MOR/RHDHV/DOC/0067, Information to Support HRA**)
A number of SSSIs extend into the marine environment, primarily the inter-tidal zone. The statutory protection afforded to SSSIs, and the procedures to be followed with regard to development proposals that may affect them, are detailed in Wildlife and Countryside legislation.	Section 3.1.5	There are no SSSIs with marine components in the vicinity of the Project.
Marine energy deployments, that is wave and tidal deployments, may pose potential risks to the environment if inappropriately sited. However, the level of risk and ecological significance is largely unknown since, in particular, tidal stream and wave technologies are at a relatively early stage of development. Studies of tidal range technologies, including barrages, have indicated that these structures can have adverse impacts on migratory fish and bird species and on the hydrodynamics of the estuarine environments in which they are situated. To underpin the marine planning process further research is needed to develop a better understanding of the potential impacts that marine technologies might have on potentially sensitive environmental features. For example, adaptation and mitigation methods for such impacts may be supported by detailed monitoring programmes and co-ordinated research initiatives, including post deployment of devices.	Section 3.3.25	Impacts to hydrodynamics are considered in **Chapter 7, Metocean Conditions and Coastal Processes** and any potential impacts during the operation of the Project on benthic and intertidal ecology is considered in **Section 9.6.3.1** and **9.6.3.2**
Draft WNMP		
Proposals should demonstrate how they contribute to the protection, restoration and/or enhancement of marine ecosystems.	ENV_01: Resilient marine ecosystems	The Project will put in place mitigation to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.
Proposals should demonstrate how they: ▪ avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; ▪ have regard to the measures to manage MPAs; and ▪ avoid adverse impacts on non-marine designated sites.	ENV_02: Marine Protected Areas	Consideration of effects on MPAs is included within **Section 9.6**. Additionally, consideration of impacts to European Designated sites is provided in **Document MOR/RHDHV/DOC/0067,**

Policy Description	Reference	ES Reference
		Information to Support HRA.
Proposals should include biosecurity measures to reduce the risk of introducing and spreading invasive non-native species.	ENV_03: Invasive non-native species	As a means of mitigation, an INNS risk assessment, to be undertaken once installation vessels and construction/manufacturing ports have been identified. Development of an outline Invasive Species and Biosecurity Management Plan (ISBMP) is suggested (**Section 9.6.2.5**). An outline Invasive and Non-Native Species (INNS) Management Plan has been submitted as part of this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).
Proposals should demonstrate that they have assessed potential cumulative effects and, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be adequately addressed, proposals should present a clear and convincing justification for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	GOV_01: Cumulative effects	Cumulative impacts are assessed in **Section 9.6.5** and in **Chapter 26**
Anglesey and Gwynedd Joint Local Development Plan (JLDP)		
All impacts on landscape character, heritage assets and natural resources have been adequately mitigated, ensuring that the special qualities of all locally, nationally and internationally important landscape, biodiversity and heritage designations, including, where appropriate, their settings are conserved or enhanced	Policy ADN 3: Other Renewable Energy and Low Carbon Technologies	The impact assessment is included within **Section 9.6** and includes mitigation measures to reduce impact significance.
It does not cause unacceptable harm to: iv. the area's biodiversity interests (including European Protected Areas such as marine Special Areas of Conservation and Special Protected Areas) due to their location, scale, form, appearance, materials, noise, or emissions or due to an unacceptable increase in traffic.	Policy AMG 4: Coastal Protection	Valued Ecological Receptors are discussed in **Section 9.5.5**, designated sites **in Section 9.5.6** and protected habitats and species in **Section 9.5.7**. Potential impacts to these are assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4**.
Proposals must protect and, where appropriate, enhance biodiversity that has been identified as being important to the local area	Policy AMG 5: Local Biodiversity Conservation	The Project will put in place mitigation to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.

Policy Description	Reference	ES Reference
Wellbeing of Future Generations (Wales) Act 2015		
A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).	A resilient Wales	The Project is assessed to have minor to negligible impacts on benthic and intertidal biodiversity (**Table 9-32**) while providing a source of renewable energy to communities.

9.3. CONSULTATION

16. Scoping and consultation have been ongoing throughout the EIA and have supported the scope of the baseline characterisation work and ensuring that the requirements of the regulators and their advisors are met. **Table 9-3** 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 9-3 Summary of Consultation Responses with Statutory Consultees Relating to Benthic and Intertidal Ecology

Consultee	Comment	Response
Planning Inspectorate	▪ *Sabellaria alveolata* and *Modiolus modiolus* reef: The Scoping Report notes the potential for *Sabellaria alveolata* and *Modiolus modiolus* reef to be present in the offshore scoping area. The Applicant should take into account NRW's response (see Appendix 1 of Scoping Opinion) stating that several areas of *Sabellaria alveolata* have developed into Sabellaria reef. Any likely significant effects on Sabellaria reef should be assessed within the ES. The ES should consider potential direct impacts from construction and also the potential impacts from maintenance activities on reef that may colonise the cables during the operational phase.	*Sabellaria alveolata* and *Modiolus modiolus* reef is considered within **Section 9.5.7** and **Sections 9.6.2, 9.6.3** and **9.6.4** of this chapter.
Planning Inspectorate	▪ Annex I habitats: The Scoping Report states that "there are no SAC or Annex I habitats identified within the offshore scoping area". NRW's response (see Appendix 1 of Scoping Opinion) states that Annex I Reef habitat is present within the zone. The ES should assess impacts to Annex I habitats where significant effects are likely to occur.	Annex I habitats are discussed within **Section 9.5.5** and considered throughout **Sections 9.6.2, 9.6.3** and **9.6.4** of this chapter.
Planning Inspectorate	▪ Section 7 marine habitats and species: Section 7 marine habitats and species which could be impacted by the Proposed Works should be acknowledged within the ES and an assessment of likely significant effects upon them should be	Marine habitats and species have been assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4**of this chapter. A differentiation between the

Consultee	Comment	Response
	undertaken. The ES should assess and differentiate between likely significant effects to intertidal and subtidal ecology.	Benthic Biological Environment and the Intertidal Biological Environment has been made within **Section 9.5.3.1**, **Section 9.5.3.2** and throughout **Impact Assessment.**
Planning Inspectorate	▪ Loss of habitat due to infrastructure footprint: It is understood that the type and locations of TEC devices within the offshore area will not be determined by the time of application. As such, the ES should consider a worst-case scenario of habitat loss. When assessing the potential impacts from loss of habitat, the ES should also give consideration to habitat loss resulting from the introduction of any scour and cable protection.	Loss of habitat due to infrastructure footprint has been assessed throughout **Sections 9.6.2, 9.6.3** and **9.6.4,** within the operational and maintenance phase and during the decommission phase of the Project. Temporary Habitat Disturbance has been assessed at all phases.
Planning Inspectorate	▪ Construction phase impacts: Potential construction phase impacts identified in Table 8-4 of the Scoping Report are equally applicable for the decommissioning phase and should be assessed as such in the ES.	Construction phase impacts are considered within **Section 9.6.2** of this chapter.
Planning Inspectorate	▪ Potential impacts: The ES should assess the likely significant effects from pollution from accidental spillages, impacts due to changes in water movements and changes in habitat type.	Release of pollutants due to accidental events is considered within **Section 9.6.2.3**.
Planning Inspectorate	▪ Impacts to benthic communities due to changes in sediment regime: Potential impacts due to change in sediment regime are included in Table 8.4. However, Table 8-2 identifies potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in coastal processes, sedimentology and hydrodynamic regime in Table 8-2. The ES should assess the likely significant effects on intertidal and subtidal benthic ecology from changes to physical process (e.g. alteration to flow conditions, waves regime and sediment transport pathways).	Increased suspended sediment concentration and sediment deposition is considered within **Section 9.6.2.2.**
Planning Inspectorate	▪ EIA Baseline Characterisation: The Applicant should consider the applicability of existing data to the Proposed Works. The Scoping Report explains that ecology characterisation surveys may potentially be required. It is recommended that the sufficiency of any existing data, and the need for any site-specific surveys, is discussed with NRW.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the impact assessment within this chapter.

Consultee	Comment	Response
	NRW's comments (see Appendix 1 of this Scoping Opinion) regarding the need for subtidal and intertidal surveys should be taken into account by the Applicant.	
Planning Inspectorate	▪ EIA Baseline Characterisation: The ES should explain how the sensitivity of benthic receptors sensitive to smothering and disturbance is determined, for example if it based on research or guidance. The ES should also take into account the sensitivity of benthic receptors to the other potential impacts identified in Table 8-4 of the Scoping Report.	The sensitivity of receptors is discussed in **Section 9.5.5**, and habitats and biotopes have been aggregated into Valued Ecological Receptors groups to allow for a streamlined assessment.
Planning Inspectorate	▪ Colonisation of structures: The ES should assess any likely significant effects from the colonisation of hard structures by non-native species.	Introduction of new habitat is considered within **Section 9.6.3.3**Operation Impact 3: Introduction of New Habitat in the Form of Project Infrastructure**.**
NRW	▪ Reference has been made to the HABMAP dataset (see Section 8.2) in relation to the benthic habitats that are within and adjacent to the Morlais demonstration zone. Whilst this is valid, it should be recognised that the confidence with which the HABMAP biotopes have been predicted is generally low to moderate. Comprehensive survey data does not exist for the demonstration zone, although there are some records in the Marine Recorder database which should be examined and incorporated into the summary. The ES must include an assessment of the confidence in the available data, as detailed in Schedule 3 of the MWR.	Survey data has been used to generate a greater understanding of the MDZ and surrounding environment, as presented throughout **Section 9.5**.
NRW	▪ There are a number of factual inaccuracies in Section 8.2.1.1 which must be corrected in the ES. Page 79 states that "there are no SAC or Annex I habitats identified within the offshore scoping area….". This is incorrect, as HABMAP predicts several rock biotopes and also coarse sediments and mixed sediments, which in some cases may form stony reef. In addition, data in Marine Recorder confirms the presence of Annex I Reef habitat within the zone. It is likely that Annex 1 rocky reef and / or stony reef will be present within the demonstration zone, and / or export cable corridor.	Following the survey conducted by OEL, all three reef Annex I habitats were observed, as discussed within **Section 9.5**.
NRW	▪ References to "*Sabellaria alveolata*" should be changed to "*Sabellaria* spp". Recent survey work by NRW TE in and around North and West Anglesey found several areas of developed Sabellaria reef.	Reference to *S. spinulosa* is used throughout this chapter, following survey data obtained by OEL.

Consultee	Comment	Response
	Video analysis, though inconclusive from a species identification point of view, appears to show a mix of both *S. alveolata* and *S. spinulosa* present in the elevated reef structures. It is therefore likely that any similar reef aggregations found within the zone will contain a mixture of Sabellaria species.	
NRW	▪ Section 7 (formerly BAP / Section 42) marine habitat records are present within or near the Morlais Demonstration Zone. These include *Musculus discor*s beds (two records to the North of Holyhead from 1996), seagrass (recent and historic records) in shallow water on the east and west sides of Holy Island (outside of the zone but potentially within the wider zone of impact) and fragile sponge and anthozoan communities both within and adjacent to the zone. Section 7 subtidal mixed muddy sediments, and subtidal sands and gravels are also predicted to occur in and adjacent to the zone, along with patches of Annex 1 rocky reef (survey records and BGS hard substrate map). The Section 7 species *Arctica islandica and Haliclystus auricular* have also previously been found in shallow waters off Holy Island (MNCR records from 1996) and may occur within the zone. These habitats and species must be acknowledged and considered in the EIA.	Section 7 marine habitat records are discussed within **Section 9.5.7.**
NRW	▪ It is difficult to comment on the potential impacts outlined in Table 8.4 due to the range of unknowns associated with such a broad PDE approach. Impacts will depend on the number, size and types of devices put in place. The table currently states “significance of impact unknown” in the “anticipated significance” column for many impact pathways. The potential impacts listed are quite broad and will need to be subdivided into specific parts for the EIA (for example, “impact to benthic communities due to the creation of sediment plumes during construction” could cause impacts both through increases in suspended sediment and also increases in sediment deposition). Some of the impact pathways that are missing include (but are not limited to) pollution from accidental spillages, impacts due to changes in water movements and changes in habitat type. A full assessment of potential impacts needs to be undertaken in the EIA.	A full assessment has been presented within **Chapter 7, Metocean Conditions and Coastal Processes**, and within **Section 9.6.2.2.**
NRW	▪ Specifically, in Table 8.4, the impact pathway identified as “impact to benthic communities due to	This impact has been assessed within **Section**

Consultee	Comment	Response
	the creation of sediment plumes during construction" is assessed as "effects unlikely to be significant". However, the comment for this impact states that the significance of impact would depend on the sensitivity of the local benthic habitats as well as the nature of sediment dispersal. In light of this fact, the significance level should be considered "unknown" until further knowledge of the benthic communities present is attained via site specific surveys.	**9.6.2.2** of this chapter following collation of survey data and extensive coastal processes modelling.
NRW	▪ We welcome the acknowledgement of potential impacts to benthic ecology interest features of designated marine and coastal sites due to changes in coastal processes, sedimentology and hydrodynamic regime in Table 8.2. We note, however, that only potential impacts due to change in sediment regime are included in Table 8.4 'Potential impacts on benthic ecology'. As noted in the Metocean Conditions and Coastal Processes section of this Opinion, we have raised some comments relating to coastal process aspects of the Scoping Report which will have consequences for benthic ecology. Specifically, we would welcome clarity on how the potential impacts to the physical processes caused by the deployment of multiple tidal energy devices and associated infrastructure will be adequately assessed using a non-numerical (conceptual model) approach, and how this will be applied in the context of potential impacts to intertidal and subtidal benthic ecology, water quality and coastal morphodynamics arising due to physical process impacts (alteration to flow conditions, waves regime and sediment transport pathways).	This impact has been assessed within **Section 9.6.2.2** of this chapter following collation of survey data and coastal processes modelling as detailed within **Chapter 7, Metocean Conditions and Coastal Processes**.
NRW	▪ The text in the EIA baseline characterisation section (Section 8.2.3) does not specifically state how further information will be obtained on the benthic habitats and species within the demonstration zone. Survey work is only mentioned as potentially being required. We advise that a targeted ground-truthing survey is carried out within the demonstration zone to properly characterise the area in terms of subtidal ecology (we understand that multibeam data already exists for the marine development area). This would reduce uncertainty as to the presence of sensitive features or receptors in the area. NRW TE can provide guidance on the interpretation and ground truthing of acoustic data (multibeam and side scan) for ecological	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.

Consultee	Comment	Response
	purposes and can advise on the scope of such surveys if required.	
NRW	▪ We note that the Offshore Scoping Zone now includes the sea area between the demonstration zone and the shore. Additional multibeam / acoustic survey and benthic ground-truthing will be needed in this area to inform the benthic impact assessment associated with the export cable route from the Lease Area if not already available.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.
NRW	▪ The intertidal ecology section (Section 8.2.1.2) is very brief. The inclusion of an intention to 'assess' CCW Phase 1 habitat survey data, as part of the applicant's data gathering exercise to inform EIA baseline characterisation, is welcomed. This information needs to be presented in a similar way to the subtidal section (see Table 8.3) and assessed against a realistic worst-case scenario for the anticipated installation method, landfall location and spatial extent of the export cables.	A Subtidal Survey (**Section 9.4.4.2**) and Intertidal Survey (**Section 9.4.4.3**) were conducted to support the Impact Assessment within this chapter.
NRW	▪ With regards to the proposed export cable landfall location, the ES must include a detailed assessment of potential impacts to the intertidal habitats present in and around the Penrhos Feilw area. We recommend that, in order to inform baseline/characterisation of the intertidal zone at the proposed landfall location, the applicant undertakes a repeat of the Phase 1 intertidal habitat survey at an appropriate scale for the planned works.	Physical disturbance to intertidal habitats and species during landfall works is assessed within **Section 9.6.2.4**.
NRW	▪ We welcome the recognition in Table 11.1 that a thorough biosecurity risk assessment should be undertaken as part of the EIA process. The ES and associated biosecurity risk assessment should include consideration of how *Didemnum vexillum* will be contained within the marina and detail any measures to mitigate the onward spread of this species. This is particularly important if, during any stage of the development (construction, operation, decommissioning), the applicant intends to use the facilities at Holyhead marina or port for berthing of vessels, materials or equipment.	Discussion of *Didemnum vexillum* is presented within **Section 9.5.8** and **Section 9.6.2.5.** An assessment of INNS has been undertaken within **Section 9.6.2.5**. As a means of mitigation, an INNS risk assessment, to be undertaken once installation vessels and construction/manufacturing ports have been identified. Development of an ISBMP is suggested. An outline INNS Management Plan has been submitted as part of this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).

9.4. METHODOLOGY

9.4.1. Impact Assessment Methodology

17. A detailed description of the methodology employed within this chapter is described within **Chapter 5, EIA Methodology.**

18. The assessment approach has adopted the following stages:

- Review of existing relevant data and information;
- Acquisition of additional project-specific data to fill any gaps;
- Formulation of a conceptual understanding of baseline conditions;
- Consultation and agreement with the regulators regarding proposed assessment approaches;
- Determination of the worst-case scenarios;
- Consideration of embedded mitigation measures; and
- Assessment of effects using data analysis, numerical modelling outputs, and expert-based judgements by MarineSpace Ltd.

19. The assessment of effects on subtidal and intertidal ecology is predicated on a Source-Pathway-Receptor (S-P-R) conceptual model, whereby the source is the initiator event, the pathway is the link between the source and the receptor impacted by the effect, and the receptor is the receiving entity.

20. An example of the S-P-R conceptual model is provided by cable installation which disturbs sediment on the sea bed (source). This sediment is then transported by tidal currents until it settles back to the sea bed (pathway). The deposited sediment could smother and have an effect on the species on this area of the seabed (receptor).

21. Consideration of the potential effects of the Project is carried out over the following spatial scales:

- Near-field: the area within the immediate vicinity (tens or hundreds of metres) of the project and along the offshore export cable corridor (ECC); and
- Far-field: the wider area that might also be affected indirectly by the project (e.g. due to disruption of waves, tidal currents or sediment pathways).

22. Three main phases of development are considered over the life-cycle of the project, in conjunction with the present-day baseline. These are:

- Construction phase;
- Operation and maintenance phase (including repowering); and
- Decommissioning phase.

9.4.1.1. Sensitivity, Value and Magnitude

23. The sensitivity of a receptor is dependent upon its:

- Tolerance to an effect (the extent to which the receptor is adversely affected by an effect);
- Adaptability (the ability of the receptor to avoid adverse impacts that would otherwise arise from an effect); and
- Recoverability (a measure of a receptor's ability to return to a state at, or close to, that which existed before the effect caused a change).

24. In addition, a value component may also be considered when assessing a receptor. This ascribes whether the receptor is rare, protected or threatened.

25. The magnitude of an effect is dependent upon its:

- Scale (i.e. size, extent or intensity);
- Duration;
- Frequency of occurrence; and
- Reversibility (i.e. the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

26. The sensitivity and value of receptors and the magnitude of effect are assessed using expert judgement and described with a standard semantic scale. Definitions for each term are provided in **Table 9-4** to **Table 9-6**. These expert judgements of receptor sensitivity, value and magnitude of effect are guided by the conceptual understanding of baseline conditions.

Table 9-4 Definitions of Sensitivity Levels for an Ecological Receptor

Sensitivity	Definition
High	Tolerance: Receptor has very limited tolerance of effect Adaptability: Receptor unable to adapt to effect Recoverability: Receptor unable to recover resulting in permanent or long-term (greater than ten years) change
Medium	Tolerance: Receptor has limited tolerance of effect Adaptability: Receptor has limited ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the medium term (5-10 years)
Low	Tolerance: Receptor has some tolerance of effect Adaptability: Receptor has some ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the short term (1-5 years)
Negligible	Tolerance: Receptor generally tolerant of effect Adaptability: Receptor can completely adapt to effect with no detectable changes Recoverability: Receptor able to recover to an acceptable status near instantaneously (less than one year)

Table 9-5 Definitions of the Different Value Levels for an Ecological Receptor

Value	Definition
High	<u>Value</u>: Receptor is designated and/or of national or international importance for marine geology, oceanography and physical processes. Likely to be rare with

Value	Definition
	minimal potential for substitution. May also be of significant wider-scale, functional or strategic importance
Medium	Value: Receptor is not designated but is of local to regional importance for marine geology, oceanography and physical processes
Low	Value: Receptor is not designated but is of local importance for marine geology, oceanography and physical processes
Negligible	Value: Receptor is not designated and is not deemed of importance for marine geology, oceanography and physical processes

Table 9-6 Definitions of Magnitude of Effect Levels for an Ecological Receptor

Magnitude	Definition
High	Scale: A change which would extend beyond the natural variations in background conditions Duration: Change persists for more than ten years Frequency: The effect would always occur Reversibility: The effect is irreversible
Medium	Scale: A change which would be noticeable from monitoring but remains within the range of natural variations in background conditions Duration: Change persists for 5-10 years Frequency: The effect would occur regularly but not all the time Reversibility: The effect is very slowly reversible (5-10 years)
Low	Scale: A change which would barely be noticeable from monitoring and is small compared to natural variations in background conditions Duration: Change persists for 1-5 years Frequency: The effect would occur occasionally but not all the time Reversibility: The effect is slowly reversible (1-5 years)
Negligible	Scale: A change which would not be noticeable from monitoring and is extremely small compared to natural variations in background conditions Duration: Change persists for less than one year Frequency: The effect would occur highly infrequently Reversibility: The effect is quickly reversible (less than one year)

9.4.1.2. Impact Significance

27. Following the identification of receptor sensitivity and value, and magnitude of effect, it is possible to determine the significance of the impact. A matrix is presented in **Table 9-7** as a framework to guide how a judgement of the significance is determined.

Table 9-7 Impact Significance 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

28. Through use of the matrix shown in **Table 9-7** an assessment of the significance of an impact can be made in accordance with the definitions in **Table 9-8**.

Table 9-8 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation
Moderate	Intermediate change in receptor condition, which is likely to be an important consideration at a local level
Minor	Small change in receptor condition, which may be raised as a local issue but is unlikely to be important in the decision-making process
Negligible	No discernible change in receptor condition

29. For the purposes of this ES, 'major' and 'moderate' impacts are deemed to be significant (in EIA terms). In addition, whilst 'minor' impacts may not be significant, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively.

9.4.1.3. Cumulative Impact Assessment

30. Cumulative impacts are assessed through consideration of the extent of influence of changes to intertidal and benthic ecology arising from the project alone and those arising from the project cumulatively or in combination with other developments including the adjacent Deep Green (DG) Holyhead Deep Tidal Array project. The Scoping Report proposes that the export cable from the DG Holyhead Deep Tidal Array project will link with that of the Morlais Project and that both projects have a joint landfall.

9.4.2. Study Area

31. Study areas are defined for each topic at the relevant scale. These are determined by a number of factors such the distribution of receptors, footprint of potential impact, or perhaps political/management boundaries (e.g. territorial waters, ICES rectangles) and where possible these were agreed with regulators or advisors.

The MDZ is in the eastern Irish Sea, encompassing a sea bed area of approximately 39 km^2. Its nearest point is located approximately 0.5 km from the west coast of Anglesey. Export cables connect the Project across an offshore export cable corridor (ECC) to the east of the MDZ and then to the landfall at Abraham's Bosom near Penrhos Feilw (**Figure 1-1, Volume II**). The benthic and intertidal study area encompasses the entirety of the offshore site (both the development site and the export cable route), as the footprint of the Project and associated engineering works has the potential to impact benthic ecology within these areas.

9.4.3. Data Sources – Desk Study

32. Prior to site-specific surveys, a detailed desk-based study was conducted. A comprehensive review of available information was conducted to support the scope of works, survey design and

regional characterisation. The resources from which detail were extracted included, but were not limited to:

- Marine Life Information Network (MarLIN);
- Consultation responses;
- UK SeaMap data 2010 (McBreen et al., 2011);
- British Geological Survey (BGS) data; and
- Published and unpublished literature.

9.4.4. Data Sources – Site-specific Surveys and Reports

9.4.4.1. Project-Specific Benthic and Intertidal EIA Characterisation Survey

33. To characterise the benthic ecology of the offshore site and the surrounding area, and to support the identification of possible Habitats Directive Annex I/II habitats/species, subtidal and intertidal surveys were conducted capturing ecological data. These surveys were conducted by OEL and involved the collection of marine data including high resolution seabed imagery, grab samples, core samples, quadrat data and aerial imagery to enable the collation of a detailed biotope map of the MDZ.

34. Site specific surveys were conducted in summer 2018 by OEL (Ocean Ecology, 2018), which aimed to characterise the benthic and intertidal ecology. Details of these surveys are described within **Table 9-9** with survey specific details, and sample site location displayed within **Figure 7-2** (**Volume II**). Sampling stations for general seabed classification purposes were spread throughout the survey area to ensure representative coverage of all predicted habitats identified in the review of geophysical data.

Table 9-9 Summary of Site-Specific Surveys Conducted to Support the Development of this ES Chapter

Survey Date	Survey Type	Key Outputs
4/09/2018 – 06/09/2018	Subtidal survey	42 subtidal DDV sample stations collecting 277 still images and 220 minutes of video footage; and Five grab sample stations for particle size analysis and in-situ faunal analysis.
30/08/2018	Intertidal survey	UAV mapping collected 243 high resolution nadir images across 500 m wide area; and Intertidal walkover survey of the Project cable landfall area.

35. A breakdown of all grab and camera sampling is presented within **Table 9-10**. A total of 227 still images and over 220 minutes of video data were collected from 42 subtidal sampling stations within the study area. Only four grab samples were obtained from the proposed 18 target stations, due to unsuitable substrate types across the majority of the sampling array. As the intertidal zone was dominated by hard substrate, the majority of the sampling was conducted using a 0.25 m^2 quadrat with the collection of two core samples.

9.4.4.2. Subtidal Survey

36. A subtidal survey array was developed around a diamond grid of sampling stations (**Figure 7-3, Volume II**) to allow a seabed biotope map to be produced for the benthic ecology requirements

of the EIA (Hitchin et al. 2015, Turner et al. 2015). Additional stations were added and located at potential transitions between substrates at key areas of development (along the cable corridor and Abraham's Bosom), and within a 1km buffer zone up- and down-stream of the development. Selection of these areas was aided by an initial interpretation of sidescan sonar backscatter, allowing for suitable substrates to be surveyed. The proposed survey designs were further sense checked against project-specific acoustic sidescan sonar and multibeam echo sounder data collected in 2018 by Partrac (Partrac, 2018).

37. The subtidal survey was completed between the 4th and 6th September 2018 and was comprised of 42 ground truthing stations across the Project area (including the buffer area and proposed cable corridors). At each of these stations, a drop-down camera (DDC) was deployed to collect seabed imagery data. Sediment samples were proposed to be collected at 18 grab sample stations, allowing for analysis of particle size and in-situ faunal analysis to aid biotope mapping. Due to substrate types, grabs were only collected from four of these 18 stations.

Table 9-10 Grab and Drop-Down Camera Sampling Undertaken During the Morlais Demonstration Zone Benthic Ecology Characterisation 2018 Survey

Location	Grab Samples (Macrobenthic and PSF Sub-Sample)	Drop Down Camera (DDC) Stations
Morlais Demonstration Zone	1	33
Associated buffer area	2	6
South cable corridor	1	3
Total	**4**	**42**

9.4.4.3. Intertidal Survey

38. The intertidal survey was undertaken during the spring tides on the 30th August in line with guidance in the Marine Monitoring Handbook (Davies *et al*., 2001) and CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn *et al*., 2006). Biotopes were classified according to the EUNIS classification (Parry, 2015) and were also correlated to the Marine Nature Conservation Review (MNCR) biotope classification. Boundaries of biotopes were recorded in areas where this was possible. The methods described below are those described within the survey report produced by OEL (Ocean Ecology Ltd, 2018).

39. This survey was conducted in two phases around the proposed cable landfall at Abraham’s Bosom. In phase one, an Unmanned Aerial Vehicle (UAV) was flown at low tide to capture high-resolution aerial imagery which aided the generation of ortho-mosaic mapping. Each flight was planned to achieve a minimum resolution of 5 cm/pixel with an accuracy of 5-10 m and flown by qualified UAV Pilots (RPQs) under a Permission for Commercial Operations (PfCO) granted to OEL by the Civil Aviation Authority (CAA). All flights were conducted in line with relevant CAA regulations (Cap 722, 2015) with received permission from RSPB.

40. This process allowed for identification of key habitats during the Phase I intertidal walk over survey conducted during a second visit to ground-truth biotope boundaries and cryptic biotopes. For any soft sediments identified in the UAV mapping and/or walk over survey, a series of quadrat sampling stations were sampled to further inform subsequent biotope mapping.

41. Areas representative of each key hard substrate habitat at different tidal heights were assessed by recording the epibiota taxa present in randomly placed 0.04 m^2 (0.2 m x 0.2 m) quadrats. Identification was taken to species level where possible and undertaken in the field. Areas representative of each key soft sediment habitat were assessed by sampling the upper 10 cm of a 0.04 m^2 (0.2 m x 0.2 m) quadrat using a spade and screened on a 0.5 mm sieve. Any macrobenthos retained on the sieve was identified to species level where possible in the field. The quadrats were then dug to c. 30 cm depth to check for the presence of larger, burrowing species. All soft sediment samples were also subject to a visual inspection and observations of colour, smell, depth of RPD layer, texture and presence of surface features (accretions, algae, fauna, etc.) recorded.

9.5. EXISTING ENVIRONMENT

42. This section provides an overview of the baseline ecological environment in relation to the benthic and intertidal study area associated with the Project. This section provides details of species and habitats associated with the MDZ and wider area, while identifying those which may be of particular conservation concern. The characterisation of the existing environment is undertaken using the aforementioned data sources listed in **Section 9.4.3** and **Section 9.4.4** sections and the site-specific survey data, plus other relevant literature.

9.5.1. Regional Context

43. Within the wider Irish Sea, relatively shallow depths are observed of around 20-100 m over considerable areas. A deeper channel running north-south is located to the west of the Irish Sea exists, connecting the Irish Sea to the Celtic Sea via St George's Channel and the Malin Shelf via the North Channel (Vincent et al., 2004).

44. A diverse array of seabed types are observed within Irish Sea, from gravelly sediments occurring extensively across a broad central belt (usually in areas exposed to strong tidal currents); mobile sands and megaripples around the coast of the Isle of Man, Liverpool Bay, Cardigan Bay and in St George's Channel; two areas of muddy sediments in the northern half and exposed bedrock locally in the North Channel and between Anglesey and the Isle of Man (Boelens et al., 1999).

45. Around the coast of Anglesey, extensive platforms of pre-Cambrian rock expand up to 25 km offshore. The seabed in the north of Anglesey is characterised by exposed bedrock, or bedrock thinly overlain by boulders and gravels in a patchy composition (Rees, 2005). The intertidal areas around Anglesey are extensive areas of relatively undisturbed habitats comprised of high energy rocky shores, sea cliffs, coastal heathlands and coastal grazing. The west of Anglesey, where the export cable will landfall, has substantial areas of exposed shores which are largely coastal cliff headlands with beaches comprise of moderate coarse sediments. The benthic communities around the Project are typically common in the Anglesey area and the wider Welsh coastal regions. These communities are typically comprised of common polychaetes, crustaceans, molluscs and echinoderms.

46. Section 7 (formerly BAP / Section 42) marine habitat records are present within or near the MDZ. These include *Musculus discors* beds (two records to the North of Holyhead from 1996), seagrass (recent and historic records) in shallow water on the east and west sides of Holy Island (outside of the zone but potentially within the wider zone of impact) and fragile sponge and

anthozoan communities both within and adjacent to the zone. Section 7 subtidal mixed muddy sediments, and subtidal sands and gravels are also predicted to occur in and adjacent to the zone, along with patches of Annex 1 rocky reef (survey records and BGS hard substrate map). The Section 7 species *Arctica islandica* and *Haliclystus auricular* have also previously been found in shallow waters off Holy Island (MNCR records from 1996) and may occur within the zone.

9.5.2. Physical Environment

47. Water depths across the MDZ and export cable corridor vary between approximately -2 m CD at the landfall and -72 m CD in the northwest part of the MDZ (**Figure 7-1, Volume II**) (Partrac, 2018). The average depth across the MDZ is approximately 40 m.

48. Most of the sea bed comprises large areas of outcropping bedrock with minimal relief above surrounding bed levels. Secondary bathymetric features include a large, generally symmetric, sand ridge north of South Stack which extends to the northwest for approximately 1 km (within the offshore cable corridor). The crest of the ridge is about 8 m to 10 m higher than the surrounding sea bed. Several smaller ridges oriented parallel to the main ridge occur to its north-northeast. Within Abraham's Bosom (a bay towards the landfall), the bathymetry is smoother, representing the surface of an area of sediment on top of the bedrock, bounded by rock outcrops to the north and south.

49. At a more local scale the sea bed is uneven due to the presence of bedforms of various sizes. Megaripples occur close to Abraham's Bosom within the offshore cable corridor. They are up to 0.6 m high, up to 12.8 m wavelength, with crests oriented approximately west-east, indicative of north-south tidal currents. Larger fields of megaripples occur in the south and southwest parts of the MDZ, where they are up to 0.6 m high, up to 12.9 m wavelength, with crests oriented approximately west-east.

50. Given the semi-enclosed nature of the Irish Sea, most oceanic swell waves are prevented from reaching the Anglesey coastline through St George's Channel and from the north due to the shelter provided by the Isle of Man. As a result, waves arriving at the Anglesey coastline are predominantly wind generated within the Irish Sea (Royal HaskoningDHV, 2011). The fetch between Ireland and Wales is generally less than 100 km, limiting the height that waves can grow from the west. The largest fetch originates from a southwest direction, where the fetch can reach thousands of kilometres into the Atlantic Ocean. Further details of the physical details of the area surrounding the MDZ are presented within **Chapter 7, Metocean Conditions and Coastal Processes**.

9.5.2.1. Seabed Sediment Distribution

51. Throughout most of the northern, central and eastern parts of the MDZ the sea bed is dominated by outcropping bedrock with thin patches of sandy gravel, whereas the deeper western part comprises relatively uniform gravel or gravelly sand.

52. Following the collection of video and still image data from the 42 subtidal sampling stations, only five of the 18 target sampling stations were deemed suitable for grab sampling due to the hard substrate present resulting the in the acquisition of just four grab samples. Only one sea bed

sediment sample (location 41) was recovered from the MDZ, on its eastern boundary, northwest of South Stack (Ocean Ecology, 2018). This low level of successful sediment sampling reflected the predominantly hard seabed substrate across the survey area. Two samples were collected in the buffer zone, one north of South Stack (location 15) and one to the south of the MDZ (location 20). One sample (42) was collected along the landward part of the offshore cable corridor in Abraham's Bosom (Ocean Ecology, 2018).

53. The dominant sediment type in sample 41 is gravel (73%) with 27 % sand, with a median particle size of about 3.8 mm. In samples 15 and 20, the dominant component is sand (89-93 %) with a median particle size of 0.63 mm and 0.75 mm (both coarse sand) (Folk, 1954) (**Table 9-11**). The particle size characteristics of sample 42 were dominated sand (96 %) with a median particle size of about 0.41 mm (medium sand). This sample falls within the Abraham's Bosom sediment deposition zone identified by Partrac (2018).

Table 9-11 Particle Size Characteristics of Sea Bed Sediment Samples in the MDZ and Buffer Zone. Data from Ocean Ecology (2018)

Station	Gravel (%)	Sand (%)	Mud (%)	d_{50} (mm)
41	73	27	0	3.8
15	9	89	2	0.63
20	7	93	0	0.75
42	0	96	4	0.41

9.5.3. Biological Environment

9.5.3.1. Benthic Biological Environment

54. A total of 42 subtidal sampling stations were targeted allowing for the collection of 277 still images and over 220 minutes of video footage. Of the 18 target sample stations for benthic grabs, only five were deemed suitable due to the presence of hard substrate. Therefore, only four grab samples were obtained within this survey.

55. Due to the prevalence of hard substrate across the survey area very few grab and core samples were acquired during the subtidal and intertidal surveys demonstrating the limited extent of sediment habitats across MDZ. The few samples that were acquired were seemingly impoverished with a maximum of six taxa and nine specimens recorded in any one sample.

9.5.3.2. Intertidal Biological Environment

56. The dominance of hard substrate in the intertidal zone meant that the majority of intertidal sampling involved 0.25 m^2 quadrat sampling (18 stations) and the collection of just two core samples. The UAV mapping survey resulted in the collection of 243 high resolution nadir images across a 500 m wide area of the intertidal area.

57. The intertidal survey area was found to support a wide variety of littoral rock biotopes interspersed with discrete patches of barren shingle and occasional areas of sandy sediment. Biotopes within the intertidal zone were those which are typically associated with a high energy intertidal area, such as *Mytilus edulis* and barnacles on very exposed eulittoral rock, *Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed

or vertical sheltered eulittoral rock, *Fucus* spp. on exposed to moderately exposed upper eulittoral rock and Fucoids and kelp in deep eulittoral rockpools.

9.5.4. Biotope Classification and Mapping

58. The subtidal environment within and surrounding the MDZ was found to be constituted by a complex assortment of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. A total of 28 intertidal and 15 subtidal EUNIS biotopes were mapped across the survey area based on a comprehensive synthesis of all information collected during the survey and all available existing information including geophysical data and existing biotope mapping. A summary of all intertidal and subtidal biotopes is mapped in **Figure 9-1** and **Figure 9-2** (**Volume II**), and also displayed within **Table 9-12**.

59. The deeper areas of the site were characterised by coarse sediments (A5.14) representative of Annex I stony reef habitat (as per Irving, 2009) frequently overlain by varying coverage of *Sabellaria spinulosa* tube aggregations representative of Annex I biogenic reef in some areas (as per Gubbay, 2007) (A4.22). The amount of overlying sediment was reduced in the slightly shallower waters in central, southern and northern areas where tide-swept and mixed faunal turf communities (A4.11 / A4.13) representative of Annex I bedrock reef were prevalent. Closer to shore sediment biotopes dominated grading from coarse gravels (A5.14) to subtidal sands (A5.2) in Abraham's Bosom transitioning into macrophyte dominated infralittoral rock in the shallow subtidal and sublittoral fringes across the whole area (A3.1111, A3.1112, A3.2111). **Plate 9-1** illustrates images of biotopes observed within across the MDZ survey area.

60. Due to the hard nature of the seabed across most of the subtidal survey area, biotope mapping across this zone was largely informed by the results of the seabed imagery analysis and a detailed interpretation of the MBES and SSS data available for the site. This area was found to be constituted by a complex array of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. All three Annex I reef types (bedrock, stony and biogenic) were noted across this area.

61. The intertidal area supports a wide variety of littoral rock biotopes interspersed with discrete patches of barren shingle and occasional areas of sandy sediment. The graduation down the shore followed that of other exposed to moderately exposed shores with notable lichen and barnacle bands (B3.111, A1.112, A1.1131) in the supralittoral and upper-mid shore areas, especially in the more gradually inclining areas within the main bay areas, grading into fucoid and then kelp dominated rock biotopes.

62. Impoverished shingle (A2.111) was recorded in upper shore areas within the bays overlain by a narrow strandline biotope constituted by decomposing seaweed supporting sandhopper (*Talitrid* amphipods) communities (A2.211).

63. The gradation of biotopes observed in the bays was compressed into narrow bands in the southern and northern sections of the survey area due to the steep cliffs and vertical rock faces. All areas of littoral rock biotopes within the intertidal area were representative of Annex I bedrock reef as mapped in **Plate 9-1**.

64. Similar to the subtidal zone, the intertidal survey area was largely characterised by hard substrate meaning the majority of the biotope mapping was informed by quadrat data, UAV imagery and existing biotope mapping. The intertidal survey area was found to support a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

Table 9-12 Biotopes Identified within the Survey Area (Ocean Ecology, 2018)

EUNIS Code	JNCC Marine Habitats Classification Biotope Code	Biotope Description
A1.1	LR.HLR	High energy littoral rock
A1.111	LR.HLR.MusB.MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock
A1.112	LR.HLR.MusB.Cht.Cht	*Chthamalus* spp. on exposed upper eulittoral rock
A1.1131	LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp.on exposed to moderately exposed or vertical sheltered eulittoral rock
A1.1132	LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock
A1.123	LR.HLR.FR.Him	*Himanthalia elongata* and red seaweeds on exposed to moderately exposed lower eulittoral rock
A1.125	LR.HLR.FR.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock
A1.212	LR.MLR.BF.FspiB	*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock
A1.213	LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
A1.2141	LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
A1.311	LR.LLR.F.Pel	*Pelvetia canaliculata* on sheltered littoral fringe rock
A1.3141	LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
A1.411	LR.FLR.Rkp.Cor	Coralline crust-dominated shallow eulittoral rockpools
A1.412	LR.FLR.Rkp.FK	Fucoids and kelp in deep eulittoral rockpools
A1.413	LR.FLR.Rkp.SwSed	Seaweeds in sediment-floored eulittoral rockpools
A1.444	LR.FLR.CvOv.RhoCla	*Rhodochorton purpureum* and *Cladophora rupestris* on upper to mid-shore cave walls
A1.4461	LR.FLR.CvOv.SpR.Den	Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves
A1.451	LR.FLR.Eph.Ulv	Ulva spp. on freshwater-influenced and/or unstable upper eulittoral rock
A2.111	LS.LCS.Sh.BarSh	Barren littoral shingle
A2.2	LS.LSa	Littoral sand
A2.211	LS.LSa.St.Tal	*Talitrids* on the upper shore and strand-line
A2.211	LS.LSa.St.Tal	*Talitrids* on the upper shore and strand-line
A3.1	IR.HIR	High energy infralittoral rock
A3.1111	IR.HIR.KFaR.Ala.Myt	*Alaria esculenta*, *Mytilus edulis* and coralline crusts on very exposed sublittoral fringe bedrock

EUNIS Code	JNCC Marine Habitats Classification Biotope Code	Biotope Description
A3.1112	IR.HIR.KFaR.Ala.Ldig	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock
A3.2111	IR.MIR.KR.Ldig.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe bedrock
A4.11	CR.HCR.FaT	Very tide-swept faunal communities
A4.13	CR.HCR.XFa	Mixed faunal turf communities
A4.22	CR.MCR.CSab	Circalittoral *Sabellaria* reefs (on rock)
A5.13	SS.SCS.ICS	Infralittoral coarse sediment
A5.14	SS.SCS.CCS	Circalittoral coarse sediment
A5.2	SS.SSa	Sublittoral sands and muddy sands
A5.23	SS.SSa.IFiSa	Infralittoral fine sand
B3.111	LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock
B3.1131	LR.FLR.Lic.Ver.B	*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock
B3.1132	LR.FLR.Lic.Ver.Ver	*Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock

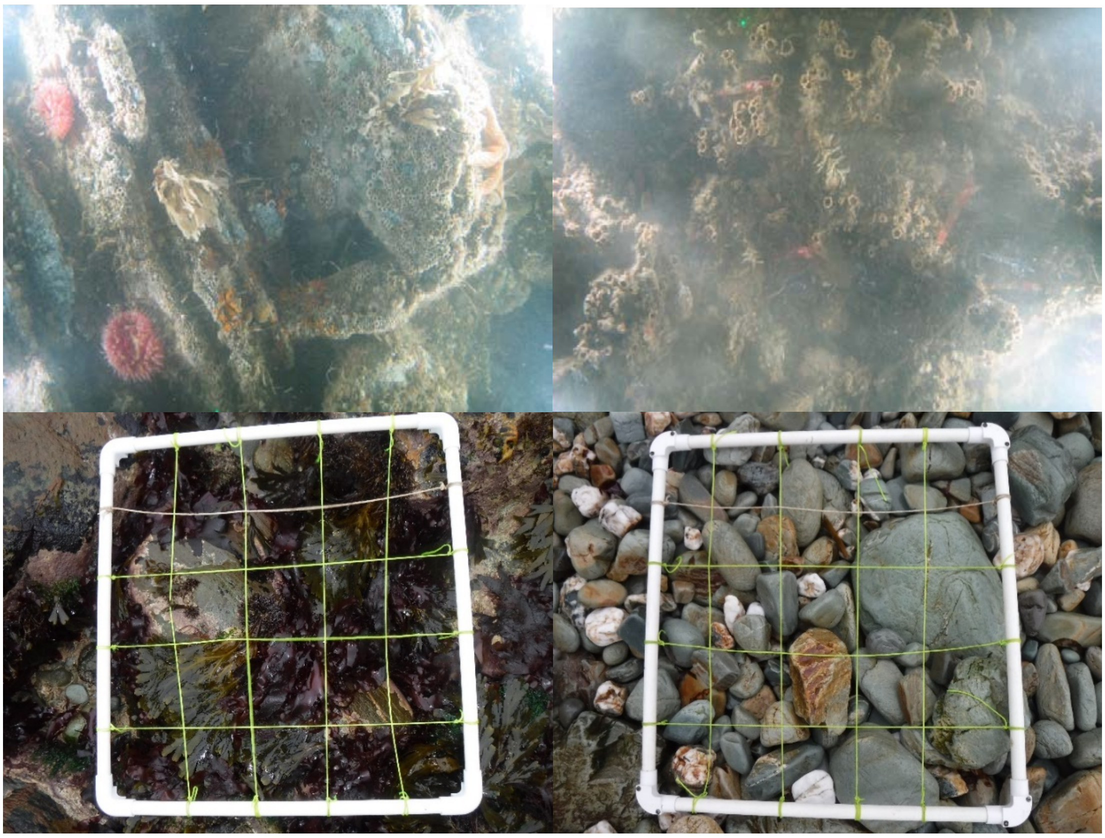


Plate 9-1 Still images representing biotopes observed across the MDZ and surrounding environment (Ocean Ecology, 2018). Top left: Very tide-swept faunal communities (A4.11); top right: Circalittoral *Sabellaria* reefs (on rock) (A5.14); bottom left: *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock (A1.2141), and bottom right: Barren littoral shingle (A2.111).

9.5.5. Valued Ecological Receptors

65. The value of ecological features is dependent upon their biodiversity, social and economic value within a geographic framework of appropriate reference (CIEEM, 2016). Identifying those habitats and species that have a specific biodiversity value recognised through international or national legislation, or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, Section 7 (formerly BAP/Section 42), existing and recommended Marine Conservation Zones (MCZ and rMCZ, respectively) is understood to be the most straightforward context for assessing ecological value. Under the existing legislative or policy framework, a very small proportion of marine habitats and species are afforded protection and therefore evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value.

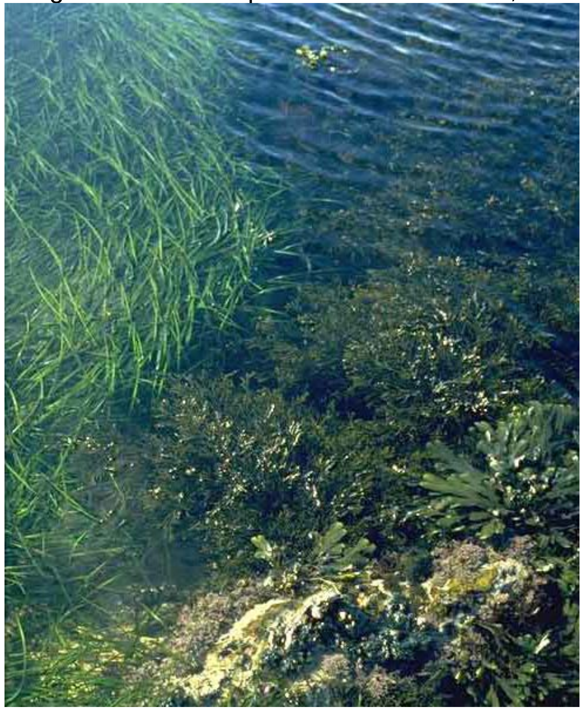
66. For the purpose of this environmental impact assessment, habitats with similar physical, biological characteristics as well as conservation status/interest have been grouped together. Consideration was also given to the inherent sensitivities of different habitats, such that habitats and species with similar vulnerability and recoverability, often as a result of similar broad sediment types and species complements, were grouped together. The biotopes and Annex I habitats within the MDZ have been split into 12 broad community and habitat types. These 12 Valued Ecological Receptors (VERs) represent the benthic and intertidal biological environment in and around the MDZ, and the impacts associated with this project have been assessed against these groups (**Table 9-13**).

67. **Figure 9-3** and **Figure 9-4** (**Volume II**) illustrate the location of the VER groups throughout the MDZ. The VER habitat groups 9 and 10 dominate the MDZ. These groups are both comprised of biotopes relating to Annex I reefs (biogenic, stony and bedrock). However, it should be noted that the VER groupings are not suggestive of definite presence, and therefore it cannot be assumed that Annex I reefs are present in all areas which are marked as habitat group 9 or 10.

Table 9-13 Criteria Valued Ecological Receptors within the Morlais Demonstration Zone (MDZ) Benthic Ecology Study Area, their Conservation Status and Importance.

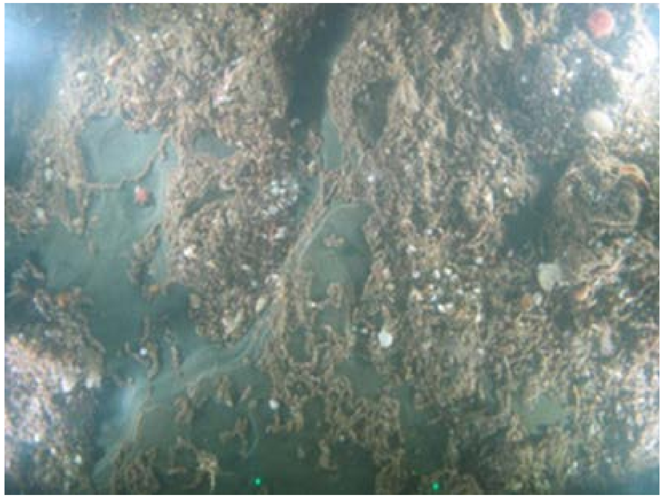
VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 1: High energy littoral rock	▪ LR.HLR ▪ LR.HLR.MusB.MytB ▪ LR.HLR.MusB.Cht.Cht ▪ LR.HLR.MusB.Sem.Sem ▪ LR.HLR.MusB.Sem.FvesR ▪ LR.HLR.FR.Him ▪ LR.HLR.FR.Mas	Contains sub-features of Annex I habitats: larger shallow inlets and bays, and reefs.	Not a designated feature of North Anglesey Marine SAC	Image of LR.HLR.MusB.Sem.FvesR from MarLIN, copyright JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 2: *Fucus spp.* on exposed to moderately exposed upper eulittoral rock	▪ LR.MLR.BF.FspiB ▪ LR.MLR.BF.FvesB ▪ LR.MLR.BF.Fser.R	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC	Image of LR.MLR.BF.FspiB from MarLIN, © JNCC. 
Habitat Group 3: *Pelvetia canaliculata* on sheltered littoral fringe rock and *Ascophyllum nodosum* on full salinity mid eulittoral rock	▪ LR.LLR.F.Pel ▪ LR.LLR.F.Asc.FS	Contains sub-features of Annex I reef habitat and biotopes previously listed as UK BAP habitats.	Not a designated feature of North Anglesey Marine SAC Contains biotopes previously UK BAP	Image of LR.LLR.F.Pel from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 4: Coralline crust, Fucoids and kelps in eulittoral rockpools	▪ LR.FLR.Rkp.Cor ▪ LR.FLR.Rkp.FK ▪ LR.FLR.Rkp.SwSed	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC	Image of LR.FLR.Rkp.SwSed from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 5: Upper to mid-shore cave walls and wave-surged overhanging lower eulittoral bedrock and caves	▪ LR.FLR.CvOv.RhoCla ▪ LR.FLR.CvOv.SpR.Den	Contains sub-features of Annex I reef habitat and biotopes previously listed as UK BAP habitats.	Not a designated feature of North Anglesey Marine SAC Contains biotopes previously UK BAP	Image of LR.FLR.CvOv.RhoCla from MarLIN, © JNCC. 
Habitat Group 6: Ulva spp. on freshwater-influenced and/or unstable upper eulittoral rock	▪ LR.FLR.Eph.Ulv	Contains sub-features of Annex I reef habitats.	Not a designated feature of North Anglesey Marine SAC.	Image of LR.FLR.Eph.Ulv from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 7: Barren littoral shingle	▪ LS.LCS.Sh.BarSh	N/A	N/A	Image of LS.LCS.Sh.BarSh from MarLIN, © JNCC. 
Habitat Group 8: Littoral sand with Talitrids	▪ LS.LSa ▪ LS.LSa.St.Tal	N/A	N/A	Image of LS.LSa.St.Tal from MarLIN, © JNCC. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 9: High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef	▪ SS.SCS.CCS ▪ CR.HCR.FaT ▪ CR.HCR.XFa ▪ IR.MIR.KR.Ldig.Ldig ▪ IR.HIR ▪ IR.HIR.KFaR.Ala.Myt ▪ IR.HIR.KFaR.Ala.Ldig	Annex I Habitats Directive	Group containing possible Annex I Habitats (stony/bedrock reef) protected by Annex I Habitats Directive. Not a designated feature of North Anglesey Marine SAC	Image from the OEE 2018 survey. 
Habitat Group 10: Circalittoral Sabellaria reefs – Annex I biogenic reefs	▪ CR.MCR.CSab	Annex I Habitats Directive OSPAR	Group containing possible Annex I Habitat (biogenic reef) protected by Annex I Habitats Directive Not a designated feature of North Anglesey Marine SAC	Image from the OEE 2018 survey. 

VER Group	Representative Biotopes	Protection Status	Conservation Interest	Image
Habitat Group 11: Sublittoral and infralittoral sands and muddy sands	▪ SS.SSa ▪ SS.SSa.IFiSa	N/A	N/A	Image from the OEE 2018 survey. 
Habitat Group 12: Yellow and grey lichens on supralittoral rock	▪ LR.FLR.Lic.YG ▪ LR.FLR.Lic.Ver.B ▪ LR.FLR.Lic.Ver.Ver	N/A	N/A	Image of LR.FLR.Lic.YG from MarLIN, © JNCC. 

9.5.6. Designated Sites

68. Due to the diverse array of habitats present within Anglesey and the wider area, the region hosts a variety of designated sites, illustrated within **Figure 9-5** (**Volume II**) and described within **Table 9-14**. These include Special Areas of Conservation (SAC), Special Protected Areas (SPA) and Ramsar sites.

69. There are no MCZs within close proximity to, or potentially impacted by, the proposed Project. The closest MCZ is over 100 km to the north east of the proposed site. There are three SACs with marine components on the west coast of Anglesey relevant to benthic ecology, and one offshore SAC. The MDZ is located within one of these, the North Anglesey Marine SAC. This SAC runs from the northern coast of the Isle of Anglesey into the Irish Sea and has been identified as an important area for harbour porpoise. Covering an area of 3,249 km^2, this site spans water depths which range from the Mean Low Water (MLW) level down to 100 m along the western boundary, though much of the site is 50 m or shallower. The North Anglesey Marine SAC overlaps a range of other habitats including coarse and sandy sediments, rock, and mud.

70. The MDZ also sits within the Anglesey Terns SPA, a site which extends around most of the east, north and west coasts of Anglesey, from the mean high water mark out to between 10 km and 20 km from shore. This site is primarily designated to protect the classified population of foraging terns during the breeding season.

71. The distance of these designations and primary reason for their designation are displayed in **Table 9-14.**

Table 9-14 Designated Sites Within the MDZ and Surrounding Area (up to 100 km)

Site Name	Designation	Distance from Project (km)	Site Features
North Anglesey Marine/ Gogledd Môn Forol	SAC	0	North Anglesey Marine SAC has been identified as an area of importance for harbour porpoise. North Anglesey Marine SAC overlaps a range of other habitats including coarse and sandy sediments, rock, and mud. Encompassed within the site is the Croker Carbonate Slabs SCI which was designated for submarine structures made by leaking gases.
Bae Cemlyn/ Cemlyn Bay	SAC	13.98	Coastal lagoons; Perennial vegetation of stony banks.
Glannau Môn: Cors heli/ Anglesey Coast: Saltmarsh	SAC	16.84	Annex I habitats are the primary reason for selection of this site such as Salicornia and other annuals colonizing mud and sand, and Atlantic salt meadows.
Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay	SAC	27.76	The site is designated for Annex I habitats such as sandbanks which are slightly covered by seawater all the time; mudflats and sandflats not covered by seawater at low tide; and limestone reefs.
Croker Carbonate Slabs	Site of Community	29.83	This site is characteristic of the habitat ‘submarine structures made by leaking gases’ under the subtype “bubbling reefs”. These

Site Name	Designation	Distance from Project (km)	Site Features
	Importance (SCI)		structures form a complex seabed topography providing a diverse habitat for a range of marine life. In other parts of the site, thin slabs form 'pavements', which are often overlain with a thin veneer of mobile sand and gravel
Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau	SAC	32.22	Annex I habitats: sandbanks which are slightly covered by seawater all the time, estuaries, coastal lagoons, large shallow inlets and bays, reefs. Additional Annex I habitats present - Mudflats and sandflats not covered by seawater at low tide, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows, submerged or partially submerged sea caves. Annex II species, not primary reason for site selection: Bottlenose dolphin, otter and grey seal
West Wales Marine/ Gorllewin Cymru Forol	SAC	33.51	West Wales Marine SAC has been identified as an area of importance for harbour porpoise. The area included within the site covers important summer habitat for harbour porpoise, while part of the site in Cardigan Bay was also identified as important during the winter.
Dee Estuary/ Aber Dyfrdwy	SAC	85.64	Annex I habitats: mudflats and sandflats not covered by seawater at low tide, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows. Additional Annex I habitats present – Estuaries, annual vegetation of drift lines, vegetated sea cliffs of the Atlantic and Baltic Coasts, Embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria*, fixed coastal dunes with herbaceous vegetation, humid dune slacks. Annex II species; not primary reason for site selection: Sea lamprey, river lamprey and Petal wort.
Shell Flat and Lune Deep	SAC	105.32	Shell Flat is considered to be an excellent example of Annex I sandbank Habitat. In terms of sediment type, the bank comprises a range of mud and sand sediments from silts and clays through to coarse sands. Shell Flat is characterised by its low biodiversity, high biomass and is noted as an important foraging ground for many over wintering bird species.
Morecambe Bay	SAC	124.81	Designated for Annex I habitats: estuaries, mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays amongst several others.
Anglesey Terns/ Morwenoliaid Ynys Môn	SPA	0	Largest tern colony in Wales (500-900 breeding pairs) of roseate, sandwich, common and arctic. Series of islands about 1km out to sea
Liverpool Bay/ Bae Lerpwl	SPA	28.07	Marine site supports red-throated diver, common scoter and little gull.

Site Name	Designation	Distance from Project (km)	Site Features
Traeth Lafan/ Lavan Sands, Conway Bay	SPA	37.86	Local Nature Reserve; supports wintering waterbirds, especially oystercatchers and great crested grebes found here for their autumn moult.
Irish Sea Front	SPA	35.51	The site regularly supports a population of European importance for Manx shearwater (*Puffinus puffinus*), which are likely to use the area as a foraging location during the breeding season. The Irish Sea Front SPA is the third largest marine aggregation of breeding Manx shearwaters identified in the UK.
Northern Cardigan Bay/ Gogledd Bae Ceredigion	SPA	47.97	Qualify as a SPA for its wintering population of red throated diver. Although this is a proposed new SPA, most of the site lies within the existing Pen Llŷn a'r Sarnau Special Area of Conservation.

72. A shadow Habitats Regulations Assessment (HRA) has been compiled to inform the assessment as to whether the Project has the potential to have an adverse effect on the integrity and features of a Natura 2000 site. In summary however, no adverse effects on integrity of any European designated sites are predicted by the Project. Information to support the HRA is provided in **Document MOR/RHDHV/DOC/0067**.

9.5.7. Protected Habitats and Species

73. Within the Ocean Ecology (2018) survey report (**Appendix 9.1, Volume III**), the presence of several habitats of conservation importance in the wider survey area were recorded, including the three Annex I reef habitats: bedrock reef, biogenic reef and stony reef. All of these reefs are extremely variable, both in structure and in the communities they support. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. These three reef habitats are afforded protection under the Habitats Regulations.

74. In the UK, the main species that form biogenic reefs are blue mussel *Mytilus edulis*, horse mussel *Modiolus modiolus*, Ross worm *Sabellaria spinulosa*, honeycomb worm *Sabellaria alveolata*, the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*. As noted within the MDZ, the relatively common tube-dwelling polychaete Ross worm *S. spinulosa* was recorded in the surveys conducted by OEL.

75. *S. spinulosa* can form areas of biogenic reef which are highly varied in nature and include reefs which stand up to 30cm high of the surrounding seabed and can extend for hundreds of metres. When considering the potential of an area to qualify as possible *S. spinulosa* reef, several criteria are required to be used to assess the given area of interest. These include elevation, area and patchiness (**Table 9-15**).

Table 9-15 Criteria for Determining *Sabellaria spinulosa* Reefiness (Gubbay, 2007)

Measure of Reefiness	Not classed as a reef	Low	Medium	High
Area (m^2)	<25	25-10,000	10,000-1,000,000	>1,000,000
Elevation (tube height in cm)	<2	2-5	5-10	>10
Patchiness (% cover)	<10	10-20	20-30	>30

76. Within the survey conducted by OEL, (2018), biogenic reefs were observed across 16 stations, (1, 2, 3, 4, 5, 6, 8, 9, 16, 17, 21, 22, 23, 24, 33, 36: Appendix XI of Ocean Ecology Limited (2018)). The quality of the reefs and the levels of 'reefiness' varied between these sample stations, however typically present in 'low' to 'medium' levels of reefiness. The stills of several of these recorded reefs are presented within Appendix XI of the OEL 2018 survey report (Ocean Ecology Limited, 2018).

77. Bedrock and stony reefs are both types of rocky reef which occur where the bedrock or stable boulders and cobbles arise from the surrounding seabed. A stony reef is defined as an area which is comprised of coarse sediments with a diameter of greater than 64 mm (cobbles and boulders) that provide a hard substratum. A reef is defined as having relief from the seafloor and elevation is used as a criterion in its classification. Epifaunal communities of a potential reef are also key in the determination of reefiness, with percentage cover of fauna used as a determination criterion. Irving (2009) classification of reef requires an area of potential stony reef habitat to be greater than 25 m^2 to be classified as a reef.

78. Unlike biogenic and stony reefs, there is currently no specific criteria defined to determine if an area constitutes Annex I bedrock reef. Within the EU directives interpretation, a bedrock reef is defined as:

"*Reef can be either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions*."

79. These bedrock reefs create a habitat that is colonised by many different marine animals and plants to many species such as corals, sponges and sea squirts as well as giving shelter to fish and crustaceans such as lobsters and crabs. Rocky reefs can be very variable in terms of both their structure and the communities that they support.

80. Within the surveys conducted for the MDZ, extensive areas of both stony reef and bedrock reef were recorded. The north east spreading along the eastern central area of the site to the south west of the MDZ were dominated by stony reefs, while the central and north east area of the site were recorded as bedrock reef areas. Within the south east of the site, there were several areas of patchy bedrock reef observed, and likewise in the southwest there were areas of patch stony reefs. Within the intertidal zone, the immediate seabed is covered by an expanse of bedrock reef, tailing into stony/bedrock reef in the north east and south east of the site.

9.5.8. Invasive Non-Native Species

81. Invasive Non-Native Species (INNS) are species that have been introduced, either intentionally or unintentionally, to areas outside their natural range. Although many of these non-native species cause no apparent adverse impact, some cause negative impacts on native species and ecosystems due to competition and gradual replacement. There are over forty non-native species reported to occur within Welsh waters (Marine Evidence Working Group, CCW (2012)), seven of which are considered invasive with negative effects, these are:

- *Elminius modestus* – an Australasian intertidal barnacle;
- *Eriocheir sinensis* – Chinese mitten crab;
- *Botrylloides violaceus* – a colonial ascidian native to north-west Pacific;
- *Crassostrea gigas* – Pacific oyster;
- *Crepidula fornicata* – American slipper limpet;
- *Didemnum vexillum* – colonial ascidian commonly known as the carpet sea squirt; and
- *Sargassum muticum* – wireweed/japweed.

82. Further, Anglesey is considered a focal point for INNS due to a high number of hotspots around its coast, including Holy Island and the Menai Strait. The colonial ascidian *Didemnum vexillum*, was recorded in Holyhead Port in September 2008, representing the first confirmed record of the species on the British mainland (Griffith et al., 2009). This is a great concern for both Welsh waters and the waters of the UK due to its ability to successful invade and establish.

9.6. IMPACT ASSESSMENT

83. The following assessment provides a summary of all impacts identified during scoping study and those which have been noted as the EIA has progressed. Each impact is not necessarily 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.

84. Impacts are classified as follows:

- Direct impacts: these may arise from impacts associated with the construction, operation and maintenance, or decommissioning of the project;
- Indirect impacts: these may be experienced by a receptor that is removed (e.g. in space or time) from the direct impact;
- Inter-relationships between impacts; or Cumulative impacts: these may occur as a result of the project in conjunction with other existing or planned projects within the study area for each receptor.

9.6.1. Embedded Mitigation

85. 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.

86. 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. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process (see **Chapter 4, Project Description** for further details). 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.

9.6.1. Worst Case Parameters

9.6.1.1. Temporary Habitat Disturbance

87. During all project phases, temporary habitat disturbance will occur to seabed habitats via device, hubs and cable installation and also anchor deployments for installation barges. Based on information provided in **Chapter 4, Project Description**, the values in **Table 9-16** have been calculated to define the worst-case parameters for temporary habitat disturbance . These are defined in terms of project phase, as different amounts of temporary seabed disturbance are predicted to arise in each phase.

88. 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.

89. 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.

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

Table 9-16 Summary of Worse-Case Scenario Temporary Habitat Loss during Construction, Operation (repowering) and Decommissioning Phases

Project Component	Worse Case (240 MW)	Unit	Notes
Construction Phase:			
Post-lay burial of cable	27,259	m^2	Area of sandwave field where post-lay burial via Mass-Flow Excavator (MFE) may be required
Deployment of anchor blocks by barges during cable installation	100,240	m^2	Up to 8 x 25 m^2 (5x5) m anchor blocks for a single barge = a total footprint per anchor deployment of 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) 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 kW devices) Assumed that deployment of each device requires 2 x anchor deployments from barge (2 x 200 m^2 = 400 m^2) Therefore, total 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 n = 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
Construction Phase TOTAL		**423,499 m^2 (0.42 km^2)**	
Operational Phase:			
(Repowering) 50 % of tenants infrastructure (Foundations; TEC's; hubs' array cables; monitoring equipment) removed and replaced with new	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

Project Component	Worse Case (240 MW)	Unit	Notes
(different) tenant infrastructure			Subsequent re-installation (re-powering) of tenant infrastructure from 50 % of berths ▪ 50 % of anchor block value (above) for inter-array cables only (203.5/2 * 0.4) = 40,700 m^2 ▪ 50 % of anchor block value of tidal device installation = 124,000 m^2 ▪ 50 % of anchor block value for hub installation = 24,000 m^2 Sub-Total = 188,700 m^2
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
Operational Phase TOTAL		**380,400 m^2 (0.38 km^2)**	
Decommissioning Phase:			
Decommissioning Phase		**TOTAL 423,499 m^2 (0.42 km^2) –** same worst-case as per construction phase due to same activities needed to remove infrastructure	

91. The installation of project infrastructure, including anchor systems for TEC devices, seabed mounted devices, hubs and cables/cable protection, will all result in permanent habitat loss. Based on information provided in **Chapter 4, Project Description**, the following values have been calculated to define the worst-case parameters for permanent habitat loss via project infrastructure (**Table 9-17**). The majority of these effects will only occur in the operational phase. The exception is the value of 7,400 m^2 related to the trench for up to nine cables at landfall. Trenching of cables will only be undertaken if HDD works (preferred method) are not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if trenching, and subsequent backfill of the trench(es) would be possible. If it was, this would represent a temporary disturbance on intertidal habitats. However, to ensure a precautionary approach, it has been concluded that trenching/surface-laying of the landfall cables would lead to permanent habitat loss and is included below.

Table 9-17 Summary of worse-case scenario: permanent habitat loss via project infrastructure (including repowering)

Project Component	Worse Case (240 MW)	Unit	Notes
Main operational phase			
Gravity Base Structures (GBS)	74,790	m^2	Max value across entire project. Based on anchor mooring systems for floating devices. Includes hubs.
Swept Area of Catenary Cables	2,055,000	m^2	Based on: 30 devices having swept area of 9,500 m^2 (large floating devices (Orbital, Magallanes)

Project Component	Worse Case (240 MW)	Unit	Notes
			140 devices having swept area of 7,500 m^2 floating devices (Tocardo UFS, Aquantis) & hubs 240 devices having swept area of 3,000 m^2 small floating devices (Instream, SME PLATO)
Export Cable Footprint (cables; protection systems; rock bags)	11,745	m^2	Up to 40.5 km of export cables (with split-pipe protection/shells and rock bags)
Array Cable Footprint (cables; protection system; rock bagss)	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	Based on 9 x tails of 620 m length
Trench for 9 x landfall cables	7,400	m^2	740 m long trench x 10 m width
Footprint of Navigation Marker Buoys	540	m^2	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
Permanent habitat loss (initial operational phase: 2,180,072 m^2 (2.18 km^2)			
Repowering Phase			
New tenant infrastructure in 50 % of berths	52,504	m^2	
Permanent habitat loss (repowering of 50 % of berths): 52,504 m^2			
Permanent Habitat Loss: Total of 2,232,576 m^2 (2.23 km^2)			

9.6.1.2. Construction Programme

92. The construction of offshore works (for installation of tidal devices and associated cabling and infrastructure) would be phased over a period of several years, taking: up to 15 days per device or hub; and up to 1.5 days for each inter-array cable; up to 20 days for each offshore cable; and up to 12 days for each phase of cable protection. Up to eight separate cable laying and protection campaigns are possible. The HDD at the landfall would be completed over a 10 month period with 2 months for offshore cable tail installation.

9.6.2. Potential Impacts during Construction

9.6.2.1. Construction Impact 1: Physical Disturbance to Benthic Habitats and Species and Temporary Habitat Disturbance

93. Throughout the various stages of construction, there will be possible disturbance and temporary habitat loss to benthic species within the MDZ. Under the worst-case scenario, an area of up to 423,499 m^2 (0.42 km^2) would be temporarily disturbed due to construction associated activities

such as post-lay burial of cable through the large sandwave feature present in the site and installation of an anchor barge to allow for device installation.

94. The proposed total area of the MDZ and export cable corridor (ECC) is 39.75 km^2, comprised of 35 km^2 within the offshore development site, an ECC area of 4.75 km^2, of which 0.01 km^2 falls within the intertidal region (MLWS to MHWS). Therefore, given that the worst-case construction scenario, seabed footprint of the project could result in the temporary loss of up to 423,499 m^2, a worst-case scenario design would result in the temporary disturbance of a 1.06 % of the seabed within the MDZ and ECC.

95. Based on the biotope mapping conducted by OEL (Ocean Ecology, 2018), the site is covered by a high percentage of the biotopes CR.HCR.FaT, CR.HCR.XFa, CR.MCR.CSab and SS.SCS.CCS. Following the process of assigning each biotope to a VER group, habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs) were the most frequently occurring groups in the subtidal region. These groups contain possible Annex I reef habitats (biogenic, bedrock and stony). In the OEL survey report, observations of Annex I stony reef habitat (as per Irving 2009) frequently overlain by varying coverage of *S. spinulosa* tube aggregations (representative of Annex I biogenic reef were observed in deeper areas of the survey site (as per Gubbay 2007)). The amount of overlying sediment was reduced in the slightly shallower waters in central, southern and northern areas where tide-swept and mixed faunal turf community representative of Annex I bedrock reef were prevalent. Within this assessment of temporary habitat loss, VER habitat group 9 and VER habitat group 10 have been assessed.

96. Given the high percentage coverage of similar habitat types available within the MDZ and the low level of overall temporary habitat disturbance or loss that will occur in the construction phase, this impact is of a scale which would be barely noticeable from monitoring and would occur only occasionally. Therefore, the magnitude of this effect has been assessed as low.

97. Habitat group 10 represents the group which contains possible areas of biogenic Annex I reef (*Sabellaria* spp.). Within the MarLIN assessment for abrasion and disturbance assessment, this habitat is assessed with a medium sensitivity, as abrasion at the surface of *S. spinulosa* reefs is considered likely to damage the tubes and result in sub-lethal and lethal damage to the worms. However, it should be noted that this assessment was suggested as relatively precautionary and it should be noted the degree of resilience will be mediated by the character of the impact. The recovery of small areas of surficial damage in thick reefs is likely to occur through tube repair and may be relatively rapid.

98. Considering the current knowledge of *S. spinulosa* reef ecology it is evident that such habitat follows a cycle of evolution and degradation within periods of months (evolution of functioning reefs has been recorded within a 6-month period) and demonstrates a high degree of recoverability following direct impacts (Pearce et al., 2007; Hendrick et al., 2011; Last et al., 2011).Therefore, it is unlikely that if any reef is impacted, that the consequent direct impacts will be long-lived i.e. the reef habitat demonstrates a high recoverability.

99. Based on advice provided by Natural England (Advice on Operations) for The Wash and North Norfolk Coast SAC (as this site contains Annex I stony reef), stony reefs are associated with a medium sensitivity in relation to cable laying activities. Within this assessment, no assessments

on sensitivity were available for bedrock and a low sensitivity has been concluded. An overall medium sensitivity has been assessed for VER habitat group 9 and VER habitat group 10.

100. As the VERs have been assessed with an overall medium sensitivity and the magnitude of the impact is low, physical disturbance and overall temporary disturbance of subtidal habitats is likely to result in a **minor adverse** impact.

9.6.2.1.1. Mitigation

101. Topic-specific mitigation will be conducted to ensure minimal disturbance and loss of habitats and species during construction. Following consent, pre-construction surveys could be carried out to check for the presence of any rare or protected habitats and species e.g. *S. spinulos*a reefs. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible.

9.6.2.1.2. Residual Impact

102. The impact will remain of minor adverse significance (**Table 9-18**).

Table 9-18 Summary of Construction Impact 1: Physical Disturbance to Benthic Habitats and Species and Temporary Habitat Disturbance

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Group 9 and 10	Medium	Low	Minor Adverse	Mitigation will be conducted to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.	Minor Adverse

9.6.2.2. Construction Impact 2: Increased Suspended Sediment Concentration and Sediment Deposition

103. The following assessment is supported by the information presented within **Chapter 7, Metocean Conditions and Coastal Processes**.

104. Throughout the construction phase there is potential for foundation installation activities within the Project to disturb sediments, either from the seabed surface or from below the seabed (depending on foundation type). This disturbance can release sediment into the water column as a plume which may then be deposited within or around the MDZ. Suspended sediment concentrations can increase in the water column, making it more turbid, until the plume becomes

dispersed by tidal current action and the sediments settle once again on the sea bed. This could then interact with the subtidal environment and cause smothering of sensitive sessile species.

105. The principal causes of disturbance during foundation installation would be:

- The preparatory works for foundation installation, including boulder clearance;
- Placement of bed-mounted gravity base foundations on the sea bed;
- Installation of anchor points for floating systems;
- Pre-drilling of rock sockets for piled foundations (e.g. monopiles or pin piles); and
- Cable post-lay burial.

106. Within the MDZ there is a paucity of surface sediment, with tide-swept bedrock prevailing. Where sediment does exist in these areas, it is sparse, and predominantly gravel, cobbles and rock boulders. These particle sizes are so large that they either cannot be suspended in the water column or will drop from suspension within a few centimetres from location of disturbance. In effect they will not form part of a sediment plume even if disturbed during construction. Therefore, release of sediments from pre-drilling below the sea bed is of greater potential significance. This would be associated with the installation of piled foundation (for hubs) that may be required for the Project and has been considered as the worst-case scenario for this impact.

107. In practice, the pre-drilling work required for the hub foundations will progress sequentially over time (rather than being instantaneous). Therefore, the realistic worst-case scenario is sediment release from one foundation location at a time. Under this scenario, any plume that is generated would disperse well before the potential exists for its coalescence with plumes from adjacent (or any other) pre-drill locations.

108. The total volume of sediment released from pre-drilling for hub foundation installation would be extremely small (340 m^3 per foundation, as discussed within **Chapter 7, Metocean Conditions and Coastal Processes**), likely to result in peak increases in suspended sediment concentration of typically less than 10 mg/l within the points of release, rapidly reducing to less than 1 mg/l at only a short distance from each release point. This low (barely measurable) effect is partly due to the low volume of sediment released from drilling at the location of each release point; and partly because any fine material released would be rapidly dispersed by the strong tidal currents along the axis of tidal flow.

109. The maximum envisaged effect associated with sediment plumes arising from the foundation installation activities will cause only very minor enhancements in suspended sediment concentration (typically less than 1 mg/l a short distance from the release point) over only a small geographical area (a few hundred metres). This very minor enhancement of suspended sediment concentration over a small geographic area (typically less than 1 mg/l within short distances from release point) would be temporary and return to very low background concentrations rapidly upon cessation of the construction activity.

110. Any sediment that becomes entrained within the plume generated by foundation installation will have the potential to deposit on the sea bed at some distance from its point of release. Based upon a realistic worst case of sediment release from a single piling activity at a time, the sediment deposition on the sea bed will be extremely small in thickness. It is envisaged that in the

immediate vicinity of the release point, deposition depths of no more than 0.1 m will be observed. These sediments are then highly likely to become re-entrained by currents during the peak velocities of the following tide and transported further away in small concentrations.

111. MFE/jetting will be employed to bury the cable across any sandwave features. As part of this process the sediment will be mobilised, creating a very localised sediment plume that re-settle 10-100 metres from the source of jetting and will remain in the system.

112. Therefore, based on the assessments presented in **Chapter 7, Metocean Conditions and Coastal Processes**, changes in the suspended sediment concentration and sediment deposition arising from the construction phase of the Project would be negligible and a **negligible** magnitude has been assessed.

113. The 'light smothering and siltation rate changes' and 'changes in suspended solids' MarLIN pressures were used to inform this assessment. It is noted that the impacts of increased suspended sediment concentrations and deposition on benthic and epibenthic communities will vary greatly in relation to species present. Filter feeders are likely to be more sensitive to potential adverse effects, whereas deposit feeders may benefit from a sediment influx. Within this assessment, the sensitivity assessment was conducted against the VER habitat group 10 (Circalittoral *Sabellaria* reefs – Annex I biogenic reefs) due to its designation as an Annex I habitat and high coverage of the MDZ.

114. Due to the natural ecology of *Sabellaria* spp., there is a reliance on a supply of suspended solids and organic matter in order to filter feed and build protective tubes and so they are often found in areas with high levels of turbidity. Studies such as Davies, et al. (2009) have shown that at high and intermediate sediment regimes (~71 mg/l) *S. spinulosa* maintained a cumulative growth rate. This supports the view that availability of suspended particles is necessary for *S. spinulosa* development and that tolerance of elevated levels is likely (Davies et al., 2009). Further, studies have provided evidence which indicate that *S. spinulosa* can survive short-term (32 days), periodic sand burial of up to 7 cm (Last et al., 2011). Within the MDZ, it is expected that suspended sediment concentration will rise to less than 10mg/l within the points of release, rapidly reducing to less than 1 mg/l at only a short distance from each release point. Likewise, it is envisaged that in the immediate vicinity of the release point, deposition depths of no more than 0.1 m will be observed and will be rapidly reduced following a tidal flow over the area.

115. Sediment deposition in association with cable lay post-burial activity will be restricted to the footprint of the sandwave features. The benthos associated with these features are adapted to living within sediments and are not sensitive to deposition of sediments and smothering effects.

116. Therefore, it is unlikely that there will be impacts to this VER group or other benthic groups, and a low sensitivity has been assessed for increased sediment plumes and deposition. As the magnitude of effect is deemed to be negligible and the sensitivity as low, an overall **negligible** impact is predicted.

9.6.2.2.1. Mitigation

117. As the impact assessment for potential increased suspended sediments and smothering is **negligible**, no specific mitigation is proposed.

9.6.2.2.2. Residual Impact

118. As no mitigation is proposed, the impact will remain of **negligible** significance (**Table 9-19**).

Table 9-19 Summary of Construction Impact 2: Increased Suspended Sediment Concentration and Sediment Deposition

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 2: Increased suspended sediment concentration and sediment deposition	VER Group 10	Low	Negligible	Negligible	None required	Negligible

9.6.2.3. Construction Impact 3: Release of Pollutants Due to Accidental Events

119. Although the probability of an oil spill occurring within the MDZ during construction is deemed to be negligible, the impacts of such an event are assessed further.

120. Within all project phases, there is the risk of potential accidental release of pollutant discharges from the hydrocarbon inventories carried by installation and maintenance vessels, and other harmful substances. This accidental spill may occur due to poor weather, collision or equipment failure. The exact worse-case scenario of potential pollutants is not possible to calculate as vessels have not been planned for works, however an estimate of a total of up to 444,000 litres of oils for gearboxes and transformers; grease for bearings and seals, and hydraulic fluid has been assigned for this assessment (based on 240 x 1 MW drivetrains).

121. Marine pollution would be restricted to matters related to leakage of lubricants and the type of paint or coating that the subsurface structures would use to prevent excessive growth of marine organisms. Any leak is not likely to result in the discharge of more than 1,000 litres of oil based hydraulic fluid. Discharges from installation and O&M vessels may occur (such as cooling water) however, this will be restricted by maritime standards and regulations.

122. Therefore, given that the possibility of an oil spill is very low and would result in a temporary change, the likelihood and therefore magnitude of this event occurring have been assessed as low.

123. Spilled oils have the potential to affect the subtidal and intertidal benthic ecology in numerous ways, from suffocation, poisoning, bioaccumulation, modification of habitats and other indirect routes. An environments sensitivity to oil pollution varies greatly between habitats and species, and is also linked to sediment types, substrates and the exposure of an area. Given that the Project being developed is a tidal energy demonstration zone, the MDZ is a very exposed area with a high tidal energy range. This highly energetic environment will therefore react in a less sensitive way to an oil spill than would an environment comprised of low energy soft sediments.

124. The rocky and hard substrates observed within and around the MDZ are less sensitive to oil spills (than sediment systems), and these hard substrates aid in the breaking up of oils into smaller droplets thereby increasing surface area and increasing biodegradation rates. However, the coasts around Anglesey are varied and several types of habitat and sediment types could be impacted. This coupled with the generally high sensitivity benthic receptors display in relation to oil spills has concluded a high sensitivity to this impact.

125. Based on a low magnitude score due to the very unlikely possibility of such an event occurring, and the high sensitivity of the impact of this event, an overall **moderate adverse impact** is predicted.

9.6.2.3.1. Mitigation

126. To minimise the risk of a pollution event occurring within the MDZ, several mitigation measures will be implemented as part of the project embedded mitigation (**Chapter 4, Project Description**):

- Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA;
- Development of a Marine Pollution Contingency Plan and Vessel Management Plan, which would include the following measures:
  - Notice to Mariners to be issued to reduce collision risks;
  - Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs;
  - Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and
  - Where possible, vessels will avoid working in poor weather conditions.

9.6.2.3.2. Residual Impact

127. Given the suggested mitigation to reduce and lessen risk due to guidance and mitigation plans, the impact will be reduced but will remain of **minor adverse** significance (**Table 9-20**).

Table 9-20 Summary of Construction Impact 3: Pollution of Water and Sediment through Accidental Events

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 3: Pollution of water and sediment through accidental events	Benthic habitats within MDZ	High	Low	Moderate	▪ Development of an Emergency Response Co-operation Plan; ▪ Development of a Marine Pollution	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
					Contingency Plan and Vessel Management Plan ▪ Notice to Mariners; ▪ Compliance with IMO/MCA codes/ on board SOPEPs; ▪ On-board oil and chemical spill mop up kits; and ▪ Where possible, avoid working in poor weather conditions.	

9.6.2.4. Construction Impact 4: Physical Disturbance to Intertidal Habitats and Species during Landfall Works

128. As described above, the worst-case scenario for benthic and intertidal impacts at landfall would be as a result of the export cables being installed in a cut trench. This would result in the temporary disturbance of all sessile species and habitats within up to 7,400 m^2 to the trench for up to nine cables at landfall in the intertidal and near shore subtidal zones.

129. Trenching of cables will only be undertaken if HDD works (preferred method) are not possible/viable. Without detailed geotechnical analysis it is not currently possible to state if trenching, and subsequent backfill of the trench(es) would be possible. If it was, this would represent a temporary disturbance on intertidal habitats.

130. Within the surveys conducted to support this assessment, an intertidal survey was conducted and the habitat across the area described as supporting a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

131. Following the biotope mapping and assignment of VER groups, VER habitat group 1 (high energy littoral rock) and habitat group 12 (yellow and grey lichens on supralittoral rock) were observed to dominate the intertidal area of the MDZ. However, group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) has been used as the

receptor in the assessment as several areas of this habitat were observed in the intertidal site, and this is the most valued group containing habitats which are designated as Annex I habitat.

132. The intertidal area of the MDZ equates to 10,000 m^2 and the temporary disturbance of 7,400 m^2 equates to 74 % of the MDZ intertidal area. Although a very high percentage of temporary disturbance, a medium magnitude has been applied. This is due to the scale of the impact, which will cause a change which will be noticeable from monitoring, and due to the reversibility of the effect.

133. Due to the exposed nature of the offshore site to wave regimes, habitats and species of the intertidal are not likely to be sensitive to disturbance and therefore a medium sensitivity is considered appropriate for this impact despite the possible presence of Annex I bedrock reef due to the possible level of temporary disturbance that may occur. Therefore, given that a medium magnitude and a medium sensitivity have been assigned, an overall **moderate adverse** impact is predicted via temporary disturbance to the intertidal zone due to temporary habitat loss.

9.6.2.4.1. Mitigation

134. If it is not possible to conduct cable-lay via the preferred HDD method, then prior to the excavation of the trench and installation of the cables, a detailed installation methodology would be produced. This will outline how the substratum will be reinstated with the right stratification of layers and will describe how physical impacts will be kept to a minimum, for example restricted working corridors for vehicles and personnel. Larger boulders would be moved sideways out of the cable trench corridor to an equivalent area of the shore, prior to trenching work commencing. These boulders would then be used as the upper layer after backfilling the trench.

9.6.2.4.2. Residual Impact

135. Given the suggested mitigation to reduce and lessen the impact on the intertidal area from cable laying, the impact will be reduced to **minor adverse** (**Table 9-21**).

Table 9-21 Summary of Construction Impact 4: Physical Disturbance to Intertidal Habitats and Species During Landfall Works

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 4: Physical disturbance to intertidal habitats and species during landfall works	VER Group 1, 9, 12	Medium	Medium	Moderate	Agree work method with NRW to minimise disturbance.	Minor adverse

9.6.2.5. Construction Impact 5: Potential Introduction/Spread of Invasive Non-Native Species

136. During the construction stages of the MDZ, there is the potential for the introduction and spread of invasive non-native species (INNS), particularly as Anglesey is considered a focal point for INNS due to a high number of hotspots around its coast. The colonial ascidian *Didemnum vexillum*, was recorded in Holyhead Port in September 2008, representing the first confirmed record of the species on the British mainland. This record sparked concern due to the potential vigorous growth which could occur in both artificial aquaculture facilities and in the natural environment.

137. There are several mechanisms by which vessels associated with the project may introduce INNS to waters within and around the MDZ:

- Attached to equipment such as anchors/anchor chains;
- Fouling on hulls;
- Seawater in pipework; and
- Ballast water and within sediment within ballast tanks.

138. Introductions may present themselves from vessels from foreign waters, and from within Wales. Therefore, there is the potential for the introduction of both new INNS and an increased range for those which are established within the marine environment within Wales.

139. Given the complex interaction between the introduction of a non-native species into an environment and establishment within the MDZ or Wales, the magnitude of the impact has been assessed with caution as medium.

140. Based on the above, the introduction/spread of invasive non-native species within the MDZ and around Anglesey is plausible, however it is unlikely that this will lead to alterations in the benthic habitats or communities due to the current high level of hard substrate naturally available. Therefore, the project associated infrastructure does not present a novel environment within the MDZ, as it would if it was to be placed within a soft sediment area. It is therefore unlikely that the level of risk associate with the new infrastructure and/or the project construction activities will lead to significantly greater levels of INNS.

141. Given the current possible risk held by the receptor (the benthic habitats within the MDZ), the sensitivity has been assessed as medium**.** Overall, a **moderate adverse impact** is predicted via he potential introduction/spread of INNS.

9.6.2.5.1. Mitigation

142. Project embedded mitigation measures are proposed to minimise the risk of INNS and their successful invasion within the MDZ and wider region (**Chapter 4, Project Description**), including compliance with relevant guidance regarding ballast water and INNS risk assessment prior to each deployment to identify mechanisms behind risk identified and appropriate mitigation measures. This can be undertaken once installation vessels and construction / manufacturing ports have been identified through maintenance of an Invasive Species and Biosecurity

Management Plan (ISBMP). An outline INNS Management Plan has been provided with this application (**Document MOR/RHDHV/DOC/0075, INNS Management Plan**).

9.6.2.5.2. Residual Impact

143. If the above mitigation is followed and measures put in place to assess the possible likelihood of INNS invasion based on project vessels, the likelihood of introducing INNS to the MDZ and wider area will be reduced to and re-assessed to **minor adverse** significance (**Table 9-22**).

Table 9-22 Summary of Construction Impact 5: Potential Spread of Non-Native

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Construction						
Impact 5: Potential spread of non-native	Benthic habitats within MDZ	Medium	Medium	Moderate	Compliance with guidelines, risk assessment of project vessels for INNS and further mitigation measures if required.	Minor Adverse

9.6.3. Potential Impacts during Operation

9.6.3.1. Operational Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering

144. Due to the initial placement of project infrastructure directly on the seabed, a direct long-term habitat loss will occur for the duration of the operation phase of the Project. In addition to that initial impact, repowering of up to 50 % of the berths may take place. Repowering is defined in **Chapter 4, Project Description** as being ‘the removal of a tenant’s infrastructure at the end of a demonstration period and replacement with the infrastructure of a new tenant, including the removal of devices (including foundations, TECs, support/super structure, inter-array cables, hubs and monitoring equipment) and reinstallation via the original construction methods. For the purpose of this assessment it has been assumed that any new (repowered) infrastructure would be deployed in a new area, i.e. an additional loss of habitat.

145. Under the worst-case scenario, an area of up to 2,180,072 m^2 (2.18 km^2) of seabed would be lost due to the initial placement of project infrastructure. This includes a maximum design and worst case scenario of a loss of a possible 2,055,000 m^2 due to the swept area of the catenary cables, based on 30 devices with a swept area of 9,500 m^2 each, 140 devices with a 7,500 m^2 swept area and 240 devices with a 3,000 m^2 swept area.

146. As a result of repowering, an additional 52,504 m^2 of permanent habitat loss would occur (although it should be recognised that in areas where original infrastructure has been removed, these seabed habitats will no longer be "lost" and will begin a process of recovery). Therefore, the combined permanent habitat loss from initial installation and then repowering amounts to 2,232,576 m^2 (2.23 km^2).

147. The proposed total area of the MDZ and export cable corridor (ECC) is 39.75 km^2, comprised of 35 km^2 within the offshore development site, and an ECC area of 4.75 km^2, of which an intertidal region (MLWS to MHWS) is 0.01 km^2. Therefore, given that the worst-case scenario seabed footprint for a maximum design of the MDZ within the construction period of the project could result in the loss of up to 2,232,576 m^2, a worst-case scenario design would result in the loss of a 5.61 % of the seabed within the MDZ and ECC area.

148. The subtidal area of the MDZ is dominated by the biotopes CR.HCR.FaT, CR.HCR.XFa, CR.MCR.CSab and SS.SCS.CCS which fall within the Valued Ecological Receptors habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs), while the intertidal zone is dominated by the VER habitat group 1 (high energy littoral rock) and habitat group 12 (yellow and grey lichens on supralittoral rock).

149. It has not been possible to provide an accurate calculation of the loss of each VER due to the current unknown location of devices and therefore VERs which will be impacted. Although there is a high percentage coverage of similar habitat types within the MDZ available, the scale of the change would be noticeable due to an overall habitat loss of 5.61 %. This impact will occur at a scale which would be noticeable from monitoring but would remain within the range of natural variations of background conditions. Further, the effect is slowly reversible following decommissioning (5-10 years) and therefore has a medium level magnitude has been assigned.

150. Based on MarLIN assessments, as discussed within Construction Impact 1, medium sensitivity has been applied to the most sensitive receptors (VER habitat group 9 and 10) and the most frequently occurring within the intertidal zone (VER habitat group 1 and 12).

151. Therefore, as a medium magnitude and a medium sensitivity to the receptors, an overall **moderate adverse** impact is predicted for the permanent loss of habitat due to the placement of infrastructure from the Project.

9.6.3.1.1. Mitigation

152. Given that a moderate significant impact is predicted for the permanent loss of habitat arising from the placement of project infrastructure, topic-specific mitigation will be conducted to ensure minimal loss of habitats and species within the operational phase. Following consent, pre-construction surveys will be carried out to check for the presence of any rare or protected habitats and species, including Annex I habitats which may be classified as reef features. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and areas which infrastructure should not be placed.

9.6.3.1.2. Residual Impact

153. The mitigation measures would ensure the minimal possible infrastructure footprint during the operational phase of the project; allow for the impact level to be adjusted to a **minor adverse** impact (**Table 9-23**).

Table 9-23 Summary of Operational Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 1: Long term loss of benthic habitat via placement of project infrastructure	VER Habitat Group 1, 9 and 12	Medium	Medium	Moderate	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse

9.6.3.2. Operational Impact 2: Changes in Hydrodynamic and Inter-Related Effects on Benthic Ecology

154. There is the potential of alteration to local hydrodynamics within the MDZ which would link to changes in the sediment type and structure and therefore the benthic species composition. An interaction between tidal driven flows and cylindrical piles or structure creates an array of hydrological phenomena including water flow contractions, 'horse-shoe' vortices and turbulent lee-wake vortices (Hoegald and Hald, 2005). This leads to the net removal of sediments in soft sediment areas, and ultimately the creation of scour pits around the base of the infrastructure. Within the MDZ, there are few areas of soft sediment and the site is dominated by hard substrates. Therefore, it is unlikely that scour pits will develop and thus there is little chance of vast changes to sediment compositions within the area.

155. Due to the small scale of the Project, perceptible changes on the wider water flow regime and sediment compositions, possible impacts to benthic communities would be very small and localised. Coastal process modelling concluded that even within the worst cases of seabed deployment, the magnitude of reduction in tidal current flow (up to 0.8 m/s) results in a residual current flow at high speeds, because the baseline flow conditions in these most affected areas are typically greater than 2 m/s.

156. Subsequently, the near-field magnitude of effect was assessed as low-medium, and the far field effect as negligible.

157. Due to the sensitivities discussed in relation to changes in suspended sediment within **Section 9.6.2.2**) and the naturally exposed nature of the site, a low sensitivity has been assessed for all

benthic receptors in relation to changes in hydrodynamics. Therefore, a **minor adverse** significant impact is predicted.

9.6.3.2.1. Mitigation

158. No mitigation is proposed.

9.6.3.2.2. Residual Impact

159. As no mitigation is proposed, the impact will remain minor adverse (Table 9-24).

Table 9-24 Summary of Operational Impact 2: Changes in Hydrodynamic and Inter-Related Effects on Benthic Ecology

Potential Impact	**Receptor**	**Sensitivity**	**Magnitude**	**Significance**	**Mitigation**	**Residual Impact**
Operation and Maintenance						
Impact 2: Changes in hydrodynamic and inter-related effects on benthic ecology	Benthic habitats within MDZ	Low	Medium	Minor Adverse	None required	Minor Adverse

9.6.3.3. Operation Impact 3: Introduction of New Habitat in the Form of Project Infrastructure

160. The development of infrastructure within the site presents new surface areas for colonisation by a variety of species, including INNS. This therefore has potential to alter the benthic species and communities in the offshore site.

161. Although it is hard to predict the species that will potentially colonise these structures, they will likely be similar to those that are already within the various biotopes across the MDZ subtidal area, as the hard structures will be similar to the hard bedrock and stony reefs within the area. Therefore, the impacts of introduction of hard substrates into an already largely hard sediment dominated area will not be as significant as the impacts of the introduction of hard substrates into a predominately soft sediment environment.

162. As discussed within the PTEC benthic ecology assessment (PTEC, 2014), monitoring of the impacts of the SeaGEN device within Strangford Lough, Northern Ireland (Royal HaskoningDHV, 2011a) concluded that the colonisation on the infrastructure largely replaced that of which was lost during the installation of the foundations. These results also represent a hard, rocky reef environment, within a high energy environment.

163. Total new surface area of hard substrates from the introduction of hard substrates are not currently available due to the possible variances in the project development. However, the effect would be highly localised around each installed structure and therefore the magnitude of the impacts of the introduced substrate on the existing communities is considered to be negligible.

164. In the absence of sufficient information, a cautionary medium sensitivity of all benthic VER groups has been applied. A negligible magnitude and medium sensitivity have concluded an assessment of **minor adverse impact**.

9.6.3.3.1. Mitigation

165. No mitigation is suggested for this impact.

9.6.3.3.2. Residual Impact

166. As no mitigation is suggested, a **minor adverse** significance remains for this impact (**Table 9-25**).

Table 9-25: Summary of Operational Impact 3: Introduction of New Habitat in the Form of Project Infrastructure

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 3: Introduction of new habitat in the form of project infrastructure	Benthic habitats within MDZ	Medium	Negligible	Minor Adverse	None required	Minor Adverse

9.6.3.4. Operational Impact 4: Temporary Physical Disturbance of Seabed Caused by Maintenance Activities and Repowering

167. As with other marine energy infrastructures, there will be a requirement for planned and unplanned maintenance activities throughout the operation phase of the Project. These activities may vary in nature, however the maintenance activities considered likely to cause disturbance impacts are cable repairs and repowering works.

168. Cable repairs will result in localised and temporary disturbance of the seabed up ten times throughout the project life, each requiring around 5 days of repair work. This equates to a total of a possible 3,000 m^2 of temporary disturbance occurring due to project maintenance works throughout the project life, equal to around 0.007 % of the MDZ total area.

169. As a worst-case scenario, repowering works of 50 % of the berths is predicted, which will involve removal of existing tenant infrastructure and the re-installation of new infrastructure.

170. Based on the values in **Table 9-16**, a total area of 377,400 m^2 is predicted to be subject to additional temporary seabed disturbance via repowering. Therefore, a total of 380,400 m^2 (0.38 km^2) of seabed will be temporarily disturbed for cable repairs and repowering. All this activity will take place within the main MDZ array site (35 km^2), meaning that 1.1 % of the MDZ array area will be affected.

171. Due to the low frequency of these activities the magnitude of the effect is judged to be negligible as the amount of predicted temporary habitat disturbance will cover a very small extent of the development site (far less than the seabed footprint), for very short, discrete periods.

172. The MarLIN pressure factor relevant to this impact and used to inform this assessment is 'physical disturbance and abrasion'. As discussed within Impact 1, the dominant and most sensitive receptors within the MDZ are VER habitat group 9 (High energy infralittoral and circalittoral rock/ coarse sediment with Annex I stony/bedrock reef) and VER habitat group 10 (Circalittoral Sabellaria reefs – Annex I biogenic reefs). These groups contain possible Annex I reef habitats (biogenic, bedrock and stony), and were both assigned a medium sensitivity.

173. The most sensitive receptors (VER habitat group 9 and 10) have a medium sensitivity to physical disturbance and abrasion, and an overall negligible magnitude. Therefore, a **minor adverse** impact on these receptors during operational phase maintenance and/or repowering activities.

9.6.3.4.1. Mitigation

174. As it was concluded that the impact was of minor adverse significance no mitigation measures are proposed. Efforts shall be made to minimise operation and maintenance works undertaken to reduce impacts beyond the worst case assessed here.

9.6.3.4.2. Residual Impact

175. No mitigation is proposed. The residual impact remains of **minor adverse** significance (**Table 9-26**).

Table 9-26 Summary of Operational Impact 4: Temporary Physical Disturbance of Seabed Caused by Maintenance and Repowering Activities

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Operation and Maintenance						
Impact 4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	VER Habitat Group 9 and 10	Medium	Negligible	Minor Adverse	None required	Minor Adverse

9.6.4. Potential Impacts during Decommissioning

9.6.4.1. Decommissioning Impact 1: Physical Disturbance to Habitats and Species and Temporary Habitat Loss

176. Within the decommissioning phase, temporary disturbance and habitat loss will occur due to the removal of the project related infrastructure. The removal of infrastructure and cabling from the seabed will result in a temporary loss of habitat and physical disturbance and therefore can be assessed in the same way as for construction which was adjudged to be of low magnitude (**Section 9.6.2.1**).

177. In the event that the cables on the intertidal zone are trenched and not laid via HDD methods, the decommissioning phase would require re-opening of the trench to extract the cable in a similar process to the construction phase. This trench would also be back filled with the removed material as within the construction phase.

178. The impacts are predicted to be similar or less than those which occurred within the construction phase and will be localised and for a short duration. Therefore, the magnitude of impact has been assessed as low. Given that the habitats and species which will be disturbed are predicted to be similar to those which will be disturbed within the construction phase, a medium sensitivity has been assigned for the benthic biotopes which will be disturbed. An overall **minor adverse** impact is assigned for the potential disturbance and temporary loss of habitats within the decommissioning phase.

9.6.4.1.1. Mitigation

179. Topic-specific mitigation will be conducted to ensure minimal loss of habitats and species within the operational phase. Following consent, pre-construction surveys would be carried out to check for the presence of any rare or protected habitats and species. Following these surveys, micro-siting of the cable would be used to mitigate impacts to these receptors where possible. This would inform areas which should be avoided and therefore minimal loss of important or protected habitats will occur.

9.6.4.1.2. Residual Impact

180. Although the impacts will be lessened, a **minor adverse** impact will remain for this activity (**Table 9-27**).

Table 9-27 Summary of Impact 12: Physical Disturbance to Habitats and Species and Temporary Habitat Loss

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 12: Physical disturbance to habitats and species and temporary habitat loss	VER Habitat Group 9 and 10	Medium	Low	Minor Adverse	Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse

9.6.4.2. Decommissioning Impact 2: Increases in Suspended Sediment Concentration and Subsequent Deposition

181. Throughout the decommissioning phase there is potential for decommissioning activities such as drilling to disturb sediments, either from the sea bed surface or from below the sea bed

(depending on foundation type) and release them into the water column as a plume which may then be deposited within or around the MDZ.

182. However, the disturbance of sediments on the sea bed and release of them into the water column as a plume is lower than the effects arising from installation of foundations within the construction phase. This is primarily because the removal activities will cause less direct interference (i.e. no pre-drilling) and the Project substrate is largely characterised by bedrock with little surface sediment other than occasional gravel, cobbles and boulders, which would not form a plume.

183. Therefore, it is unlikely that there will be impacts to any of the identified VER groups within the MDZ, and a low sensitivity has been assessed for increased sediment plumes and deposition. As the magnitude of effect is deemed to be negligible and the sensitivity as low, an overall **negligible** impact is predicted.

9.6.4.2.1. Mitigation

184. As the impact assessment for potential increased suspended sediments and smothering is **negligible**, no specific mitigation is proposed.

9.6.4.2.2. Residual Impact

185. An overall **negligible** significance remains as no mitigation is required (**Table 9-28**).

Table 9-28 Summary of Impact 13: Increases in Suspended Sediment Concentration and Subsequent Deposition

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 13: Increases in suspended sediment concentration and subsequent deposition	Benthic habitats within MDZ	Low	Negligible	Negligible	None required	Negligible

9.6.4.3. Decommissioning Impact 3: Permanent Loss of Habitat

186. Within the decommissioning phase, the hard substrates which have been placed within the subtidal area of the MDZ will be removed and therefore a loss of habitat will occur for those species which may have colonised it over the project lifetime. However, this loss of species and habitat will be balanced by the re-exposure of seabed habitats within the offshore site that can then be recolonised, therefore the impact is **negligible.**

9.6.4.3.1. Mitigation

187. As the impact assessment for permanent habitat loss during decommissioning is **negligible**, no specific mitigation is proposed.

9.6.4.3.2. Residual Impact

188. An overall **negligible** significance remains as no mitigation is required (**Table 9-29**).

Table 9-29 Summary of Impact 14: Permanent Loss of Habitat

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Decommissioning						
Impact 14: Permanent loss of habitat	Benthic habitats within MDZ	Negligible	Negligible	Negligible	None required	Negligible

9.6.5. Cumulative Impacts

As observed within the above assessments, the majority of impacts which are associated with benthic ecology are restricted to the immediate footprint of the Project. Therefore, it is only projects that will affect the same area of seabed, or more generally, the same local resource of benthic habitats that require consideration. The only identified project is Minesto's Holyhead Deep project, an 80 MW installation of tidal energy devices, delivered in a phased manner, located a short distance due west of the MDZ Project.

9.6.5.1. Potential Cumulative and In-Combination Impacts during Construction

189. The main potential cumulative and in-combination impacts during construction and installation relate to the direct physical disturbance and habitat loss caused by the installation of Project infrastructure on the seabed. Construction activities of the Project with the Minesto project may overlap on a temporal scale as the construction and installation of the Minesto project is following a phased approach and their seabed footprints should be considered in the overall footprint of habitat loss in the region.

190. The temporal overlap of construction activities presents a possible risk of elevated suspended sediment concentrations within the region beyond a level which would occur for individual project construction activities. However, as discussed within **Chapter 7, Metocean Conditions and Coastal Processes**, there is no possibility of changes in tidal flow interacting between projects, due to the alignment of flood and ebb flows off the coast of Anglesey (i.e. the two projects are not upstream/downstream of each other). The predicted impacts of Minesto's Holyhead Deep project on coastal processes have been assessed as being not significant in their own right (Minesto, 2016), and this conclusion is considered equally valid when both projects are considered in combination.

191. In comparison to the amount of comparable habitat identified in the survey area, the overall area of habitat that will be impacted by the Minesto project and the Project is small and it is predicted that no significant impacts should occur. Further, Minesto and Morlais may in future investigate options to share the future export cable; which will reduce the footprint of both projects and ensure that any habitat loss associated with these upcoming projects is kept to a minimum.

192. Although there is an increased risk of the introduction of INNS to the marine environment due to an increased amount of vessel traffic in the area and thus an increased window of opportunity, if

all projects abide to agreed mitigation measures and follow relevant guidelines then the probability will remain low. Therefore, the likelihood of simultaneous construction cumulatively impacting vulnerable benthic communities and receptors within the wider area is extremely low and is considered not significant.

9.6.5.2. Potential Cumulative and in-Combination Impacts during Operation and Maintenance

193. During the operational and maintenance phase, there is potential for impacts to act in-combination with other developments within the area. The two main impact pathways are:

- Modified hydrodynamic regime and sediment regime; and
- New hard substrates and their potential for INNS.

194. The small scale of the Project and the lack of impact this has on the environment within the MDZ makes it unlikely to interact with other developments within the region. The Minesto project is also of a small scale and is unlikely to have an impact on the hydrodynamics within its project space. Therefore, it is unlikely that there will be a significant alteration to the hydrodynamics in a regional context. Due to both of these projects being situated within areas of hard substrate and low levels of soft sediments, it is unlikely that scour pits will form around either projects infrastructure, and thus unlikely for an interaction to occur between the two projects.

195. Both the Project and the Minesto project involve introduction of hard substrate into a marine environment, which presents a risk of colonisation, inward migration and the settlement of species. Further, this hard substrate presents a substrate which could be utilised by INNS. However, as both of these projects are located within predominately hard substrate areas, the effects of possible colonisation of the infrastructure will not be as pronounced as those which would occur if the infrastructure was to be placed within soft sediments, as this would lead to the colonisation of an environment by species which are not typically found in this area. Further, due to the large level of available natural hard substrate (stony reef, bedrock etc), a large sink will occur to these readily available habitats.

196. The current dominance of hard substrates within the MDZ and the wider region suggests additional hard substrate through infrastructure will not present a vastly different environment for INNS than already within the region. Therefore, it is unlikely that the new infrastructure and additional hard substrates within the region will lead to a significant impact.

9.6.5.3. Potential Cumulative and in-Combination Impacts During Decommissioning

197. The main impact with any potential for cumulative effects at the decommissioning stage is direct physical disturbance and habitat loss. It is unlikely that the other projects will be decommissioned at the same time as the Project. Even if it is, the potential cumulative/in-combination impacts will be comparable to those during construction.

9.6.6. Inter-Relationships

198. **Table 9-30** lists out the inter-relationships between this chapter and other chapters within the ES.

Table 9-30 Inter-Topic Relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Metocean Conditions and Coastal Processes	Chapter 7	Section 9.6.2	Both chapters consider the potential effects of the project on sediment concentrations in the water column

199. Habitat loss and disturbance is also discussed separately in a number of other chapters, including **Chapter 8, Marine Water and Sediment Quality** and **Chapter 10, Fish and Shellfish Ecology.**

9.6.7. Interactions

200. 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 9-31**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 9-31 Potential Interaction Between Impacts

Potential interaction between impacts					
Construction	1: Physical disturbance and temporary habitat loss	2: Increased suspended sediment concentration	3: Pollution of water and sediment	4: Physical disturbance (intertidal)	5: Potential spread of non-native
1: Physical disturbance to habitats and species and temporary habitat loss	-	Yes	Yes	Yes	Yes
2: Increased suspended sediment concentration and sediment deposition	Yes	-	No	Yes	No
3: Pollution of water and sediment through accidental events	Yes	No	-	Yes	No
4: Physical disturbance to intertidal habitats and species during landfall works	Yes	Yes	Yes	-	Yes
5: Potential spread of non-native	Yes	No	No	Yes	-

Operation	1: Long term loss of benthic habitat	2: Changes in hydrodynamic and inter-related effects	3: Introduction of new habitat	4: Temporary physical disturbance
1: Long term loss of benthic habitat via placement of project infrastructure	-	Yes	Yes	Yes

Potential interaction between impacts				
2: Changes in hydrodynamic and inter-related effects on benthic ecology	Yes	**-**	Yes	Yes
3: Introduction of new habitat in the form of project infrastructure	Yes	Yes	**-**	Yes
4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	Yes	Yes	Yes	-

Decommissioning	1: Physical disturbance to habitats	2: Increases in suspended sediment concentration	3: Permanent loss of habitat
1: Physical disturbance to habitats and species and temporary habitat loss	**-**	Yes	Yes
2: Increases in suspended sediment concentration and subsequent deposition	Yes	**-**	No
3: Permanent loss of habitat	Yes	No	-

9.7. SUMMARY

201. This chapter provides 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 the benthic and intertidal ecology of the MDZ.

202. **Table 9-32** collates the determinations of each of the impacts assessed and is presented as a summary of the determinations. It is evident that the majority of the impacts to the benthic and intertidal ecology throughout the various stages of development are likely to be of minor adverse significance, even when assessed with the worse-case scenario. Therefore, the effects on the benthic and intertidal ecology are unlikely to cause long-term changes to the MDZ environment and surrounding region, either through direct changes in the species composition or due to changes in sediment structure.

Table 9-32 Summary of potential impacts for the benthic ecology receptors associated with the development of the project

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Construction						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Group 9 and 10	Medium	Low	Minor Adverse	▪ Mitigation will be conducted to ensure minimal disturbance to and loss of habitats and species during construction via pre-construction surveys and micro-siting.	Minor Adverse
Impact 2: Increased suspended sediment concentration and sediment deposition	VER Group 10	Low	Negligible	Negligible	▪ None required	Negligible

Impact 3: Pollution of water and sediment through accidental events	Benthic habitats within MDZ	High	Low	Moderate	▪ Development of an Emergency Response Cooperation Plan (ERCoP) with guidance set out by MCA in MGN 371, issued and approved by MCA;
					▪ Development of a Marine Pollution Contingency Plan and Vessel Management Plan, which would include the following measures:
					  ▪ Notice to Mariners to be issued to reduce collision risks;
					  ▪ Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs;
						Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
					▪ Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and ▪ Where possible, vessels will avoid working in poor weather conditions.	
Impact 4: Physical disturbance to intertidal habitats and species during landfall works	VER Group 1, 9, 12	Medium	Medium	Moderate	▪ Agree work method with NRW to minimise disturbance, using excavated materials to backfill, and to safeguard some boulders from top layer pre trench excavation, for replacement at end of backfilling.	Minor Adverse
Impact 5: Potential spread of non-native	Benthic habitats within MDZ	Medium	Medium	Moderate	▪ Compliance with guidelines, risk assessment of project vessels for INNS and further mitigation measures if required.	Minor Adverse
Operation and Maintenance						
Impact 1: Long Term Loss of Benthic Habitat via (a) Initial Placement of Project Infrastructure and (b) Repowering	VER Habitat Group 1, 9 and 12	Medium	Medium	Moderate	▪ Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse
Impact 2: Changes in hydrodynamic and inter-related effects on benthic ecology	Benthic habitats within MDZ	Low	Medium	Minor Adverse	▪ None required	Minor Adverse
Impact 3: Introduction of new habitat in the form of project infrastructure	Benthic habitats within MDZ	Medium	Negligible	Minor Adverse	▪ None required	Minor Adverse

Potential Impact	Receptor	Sensitivity	Magnitude	Significance	Additional Mitigation Measures	Residual Impact
Impact 4: Temporary physical disturbance of seabed caused by maintenance and repowering activities	VER Habitat Group 9 and 10	Medium	Negligible	Minor Adverse	▪ None required	Minor Adverse
Decommissioning						
Impact 1: Physical disturbance to habitats and species and temporary habitat loss	VER Habitat Group 9 and 10	Medium	Low	Minor Adverse	▪ Following consent, pre-construction surveys and possible micro-siting will be conducted to allow for identification of important areas of habitat.	Minor Adverse
Impact 2: Increases in suspended sediment concentration and subsequent deposition	Benthic habitats within MDZ	Low	Negligible	Negligible	▪ None required	Negligible
Impact 3: Permanent loss of habitat	Benthic habitats within MDZ	Negligible	Negligible	Negligible	▪ None required	Negligible

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