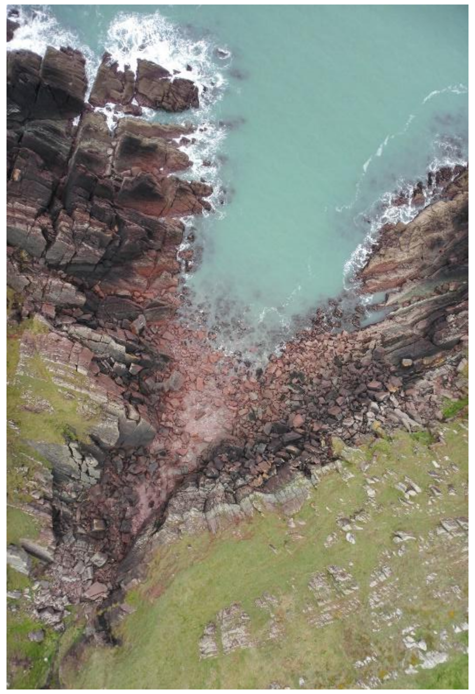
mWave Marine Energy Device and Onshore Infrastructure

ENVIRONMENTAL STATEMENT



CHAPTER 7 BENTHIC SUBTIDAL AND INTERTIDAL ECOLOGY

June 2019

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Glossary

Term	Definition
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Acoustic Doppler Current Profiler	An acoustic Doppler current profiler (ADCP) is a hydroacoustic current meter similar to sonar, used to measure waves and water current velocities over a range of depth.
Biotope	The combination of physical environment (habitat) and its distinctive assemblage of conspicuous species.
Circalittoral	The subzone of the rocky sublittoral below that dominated by algae (i.e. the infralittoral) and dominated by animals.
Epibenthic	Organisms living on the surface of the seabed.
Epifauna	Animals living on the surface of the seabed.
European site	Special Area of Conservation (SAC) or candidate SAC, a Special Protection Area (SPA) or potential SPA, a site listed as a Site of Community importance (SCI) or a Ramsar site.
Infauna	The animals living in the sediments of the seabed.
Infralittoral	A subzone of the sublittoral in which upward-facing rocks are dominated by erect algae.
META Project	The META project, located in Pembrokeshire, consists of eight test sites where a range of marine energy testing activities will be permitted over a 15 year period. The licensing and consenting of the mWave project was originally intended to be undertaken within the consenting and licensing of the META project, with mWave being deployed within META Site 8.
Intertidal	An area of a seashore that is covered at high tide and uncovered at low tide.
Mollusc	Invertebrate animal belonging to the phylum *Mollusca* that includes the snails, clams, chitons, tooth shells, and octopi.
Polychaete	A class of segmented worms often known as bristleworms.
Sublittoral	Area extending seaward of low tide to the edge of the continental shelf.
Subtidal	Area extending from below low tide to the edge of the continental shelf.
Subsea Umbilical Termination Unit	Underwater connection box approx 1.5m^2. mWave umbilical and ADCP will connect into unit.

Acronyms

Acronym	Description
ADCP	Acoustic Doppler Current Profiler
BAP	Biodiversity Action Plan
CCW (now NRWa)	Countryside Council for Wales
Defra	Department for Environment, Food and Rural Affairs
DDV	Drop Down Camera Video
EMODnet	European Marine Observation Data Network
FOCI	Features of Conservation Importance
GPP	Guidance for Pollution Prevention
IMO	International Maritime Organization
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MarESA	Marine Evidence based Sensitivity Assessment
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
META	Marine Energy Testing Area
MHWESG	Milford Haven Waterway Environmental Surveillance Group
MMO	Marine Management Organisation
NRWa	Natural Resources Wales Advisory
NRW-PS	Natural Resources Wales Permitting Services
OSPAR	Oslo-Paris Commission
PEL	Probable Effect Level
SSC	Suspended Sediment Concentrations
SUTU	Subsea Umbilical Termination Unit
TEL	Threshold Effect Level
TH	Trinity House
ZoI	Zone of Impact

Units

Unit	Description
%	Percent
ha	Hectare
km	Kilometre
l	Litres
m	Metres
m^2	Metre squared
m^3	Metre cubed
mg/l	Milligrams per litre

7. BENTHIC SUBTIDAL AND INTERTIDAL ECOLOGY

7.1 Introduction

7.1.1.1 This chapter of the Environmental Statement presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the mWave project on benthic subtidal and intertidal ecology. Specifically, this chapter considers the potential impact of the mWave project during its three phases, namely installation, operation and maintenance, and decommissioning.

7.1.1.2 The assessment presented within this chapter has interrelationships with, and/or is informed by, the following technical chapters which are cross referenced as appropriate:

- Chapter 5 - Coastal Processes;
- Chapter 8 - Fish and Shellfish Ecology,
- Chapter 10 Marine Ornithology, and
- Chapter 11 Commercial Fisheries.

7.2 Purpose of this chapter

7.2.1.1 The primary purpose of the Environmental Statement is to support the marine licence application for the mWave project, including the full scale WEC, marine communications cable up to MHWS, Acoustic Doppler Current Profiler (ADCP), Subsea Umbilical Termination Unit (SUTU) and navigational markers (if needed). The Environmental Statement will also support the planning application for the onshore section of the communication cable (from MLW), the termination box, cable anchor point and onshore control station.

7.2.1.2 This Environmental Statement chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects on benthic subtidal and intertidal ecology arising from the mWave project, based on the information gathered, site survey and the analysis and assessments undertaken;
- Identify any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which have been incorporated into the project or could be used to prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

7.3 Study area

7.3.1.1 As discussed in Chapter 1 Introduction, the licensing and consenting of the mWave project was originally intended to be undertaken within the consenting and licensing of the Marine Energy Wales META project with mWave being deployed at the eastern end of META Site 8 (East Pickard Bay). Whilst the mWave device is short term and of limited extent compared to the META project, the baseline information for the META Site 8 has been used in the following assessment to ensure consistency of information across the two projects which are likely to be in the consenting process at the same time. In addition to the META Site 8 baseline information, additional site specific data has been collected and used to inform the assessment. The potential cumulative impact of the two projects are considered in Section 7.12.

7.3.1.2 The local mWave benthic subtidal and intertidal ecology study area is defined as the seabed encompassing the META Site 8 (Figure 7.1), with the mWave device being located in its south eastern area. The local study area also includes the marine cable route (up to Mean High Water Spring (MHWS)) which landfalls at East Pickard Bay, and the intertidal area in the immediate vicinity.

7.3.1.3 To capture indirect effects such as those associated with suspended sediments for example, a wider study area is also considered. The wider study area extends to cover area up to one tidal excursion from the mouth of the Milford Haven Waterway (see Figure 7.1). The former Countryside Council for Wales (CCW; now Natural Resources Wales Advisory (NRWa)) (2009) Advice in Fulfilment of Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994, states that the tidal excursion up the Waterway is 8-10km on mean spring tides and 4 to 5km on mean neap tides. Therefore, a precautionary buffer of ten kilometres has been adopted.

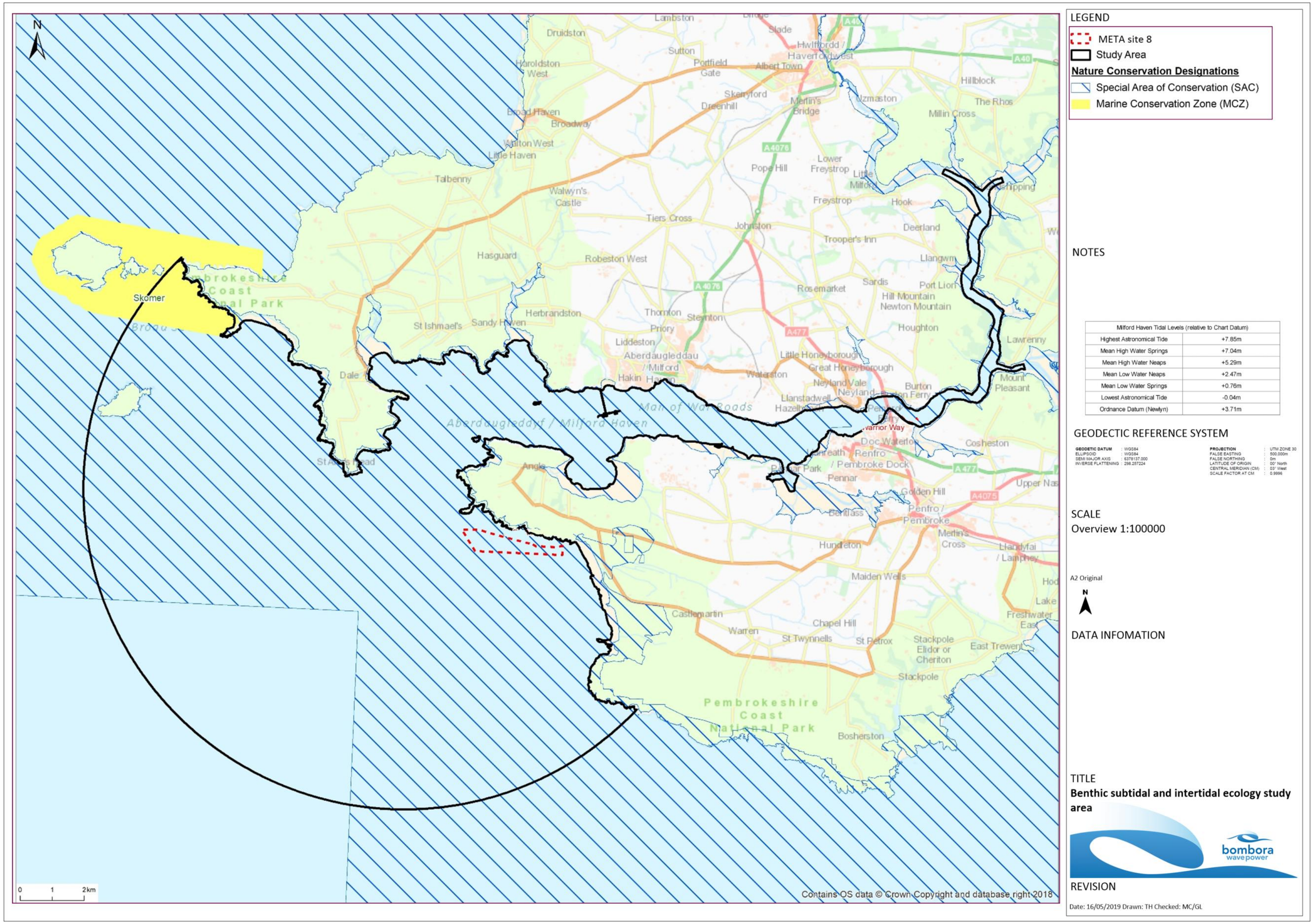


Figure 7.1: The benthic subtidal and intertidal ecology wider study areas and designated sites with relevant benthic ecology features, showing local study area (META Site 8 boundary)

7.4 Policy context

7.4.1 National Policy Statements

7.4.1.1 While it is recognised that the mWave project does not constitute a Nationally Significant Infrastructure project (NSIP), the National Policy Statements (NPS) available to support NSIPs are considered to provide useful context to the production of a benthic subtidal and intertidal ecology environmental assessment.

7.4.1.2 Planning policy on renewable energy infrastructure, specifically in relation to benthic subtidal and intertidal ecology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

7.4.1.3 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 7.1 and Table 7.2, respectively.

Table 7.1: Summary of NPS EN-1 policy framework provisions relevant to benthic subtidal and intertidal ecology.

Summary of NPS EN-01 provisions	How and where considered in the Environmental Statement
Biodiversity (Section 5.3)	
Where the development is subject to EIA the applicant should ensure that the Environmental Statement 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 (paragraph 5.3.3 in NPS EN-1).	Effects on benthic features, including habitats and species of conservation importance, including those listed as features of designated sites, are considered in sections 7.11.1 (installation phase), 7.11.2 (operation and maintenance phase) *and* 7.11.3 (decommissioning phase). Baseline information on these receptors is presented in section 7.7, with valuation of these receptors in the context of their conservation importance considered in section 7.7.6.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests (paragraph 5.3.4 in NPS EN-1).	Measure adopted as part of the mWave project to conserve benthic biodiversity are outlined in Table 7.14.
Development should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives; where significant harm cannot be avoided, then appropriate compensation measures should be sought (paragraph 5.3.7 in NPS EN-1).	Measures designed to avoid significant harm to benthic biodiversity are outlined in Table 7.14. No significant effects, in EIA terms, are predicted on benthic ecology as a result of the installation, operation and maintenance or decommissioning of the mWave project (see summary in Table 7.16).
The most important sites for biodiversity are those identified through international conventions and European Directives (paragraph 5.3.9 in NPS EN-1).	Effects on benthic features, including habitats and species of conservation importance, including those listed as features of designated sites, are fully considered in sections 7.11.1 (installation phase), 7.11.2 (operation and maintenance phase) and 7.11.3 (decommissioning phase). These effects have also been assessed within the No Significant Effects Report (NSER) for the mWave project.
Many Sites of Special Scientific Interest (SSSI) are also designated as sites of international importance; those that are not, should be given a high degree of protection (paragraph 5.3.10 of NPS EN-1).	Where SSSIs are within Natura 2000 sites these have been considered as part of that site in this chapter.
Marine Conservation Zones (MCZs) introduced under the Marine and Coastal Access Act (MCAA) 2009 are areas that have been designated to conserve marine flora and fauna, marine habitat, or features of geological or geomorphological interest. The Secretary of State is bound by the duties in relation to MCZs imposed by sections 125 and 126 of the MCAA 2009 (paragraph 5.3.12 in NPS EN-1).	The Skomer MCZ lies within the wider benthic subtidal and intertidal ecology study area has been considered within the assessment (see section 7.7.6).
Development proposals provide many opportunities for building-in beneficial biodiversity or geological features as part of good design. When considering proposals, the Infrastructure Planning Commission (IPC) now Planning Inspectorate (PINS) should maximise such opportunities in and around developments, using requirements or planning obligations where appropriate (paragraph 5.3.15 in NPS EN-1).	Designed-in measures to be adopted as part of the mWave project are presented in Table 7.14.
Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and thereby requiring conservation action (paragraph 5.3.17 in NPS EN-1).	All species and habitat receptors, including those listed under Section 7 of the Environment (Wales) Act 2016 are considered in section 7.7, with valuation of these receptors in the context of their conservation importance considered in section 7.7.6.
The applicant should include appropriate mitigation measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • during construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; • during construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; • habitats will, where practicable, be restored after construction works have finished; and • opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals (paragraph 5.3.18 in NPS EN-1).	Mitigation measures which are incorporated into the mWave project are presented in Table 7.14.

Table 7.2: Summary of NPS EN-3 policy framework provisions relevant to benthic subtidal and intertidal ecology.

Summary of NPS EN-03 provisions	How and where considered in the Environmental Statement
Biodiversity	
Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed project (paragraph 2.6.64 of NPS EN-3).	Installation, operation and maintenance, and decommissioning phases of the mWave project have been assessed in section 7.11.
Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate (paragraph 2.6.65 of NPS EN-3).	Consultation with relevant statutory and non-statutory stakeholders has been carried out from the early stages of the mWave project (see Table 7.4).

Summary of NPS EN-03 provisions	How and where considered in the Environmental Statement
Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.6.67 of NPS EN-3).	Both the positive and negative effects of the mWave project have been assessed in section 7.11.
Benthic subtidal and intertidal ecology	
Where necessary, applicants should assess the effects on the subtidal (paragraph 2.6.113 of NPS EN-3) and on the intertidal zone (paragraph 2.6.81 of NPS EN-3).	The assessment has included likely effects from temporary and long term habitat loss (see paragraphs 7.11.1.3 *et seq.* and 7.11.2.3 *et seq.* respectively) and the effects of changes in physical processes (see paragraph 7.11.1.16 *et seq.*).
Applicants should assess the effects of cable routes and installation methods (paragraph 2.6.81 of NPS EN-3).	Effects of cable and its installation method at East Pickard Bay on benthic subtidal and intertidal ecology have been assessed.
Applicants should assess the effects of increased suspended sediment loads during construction on subtidal habitats (paragraph 2.6.113 of NPS EN-3) and intertidal habitats (paragraph 2.6.81 of NPS EN-3).	Effects associated with increased suspended sediments during the installation phase are fully assessed in paragraphs 7.11.1.16 *et seq*.
Applicants should assess the predicted rates for subtidal habitat recovery (paragraph 2.6.113 of NPS EN-3) and intertidal zone recovery from temporary disturbance effects (paragraph 2.6.81 of NPS EN-3).	The likely rates of recovery of benthic species/habitats have been assessed for each impact discussed, and have been used to inform each assessment of the significance of the effect (see section 7.11).

7.4.2 Other relevant policies

The Marine Policy Statement (MPS) and the draft Welsh National Marine Plan (MMO, 2014) are also relevant to benthic ecology. Key provisions of these policies are set out in Table 7.3 along with details as to how these have been addressed within the assessment.

Table 7.3: Summary of other policies relevant to benthic subtidal and intertidal ecology.

Policy	Key provisions	How and where considered in the Environmental Statement
MPS		
MPS	MPS will facilitate and support the formulation of Marine Plans, ensuring that marine resources are used in a sustainable way in line with the high-level marine objectives. • Enable the UK's move towards a low-carbon economy, to mitigate the causes of climate change and ocean acidification and adapt to their effects; • Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and • Contribute to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.	The overarching concept behind mWave is to contribute to the reduction in climate change. The design of the device is relatively benign (Chapter 2: Project Description, Section 2.5.2), thereby minimising impacts on the marine ecosystem through all phases of the project (Section 7.11).
Draft Welsh Marine Plan		
Policy SOC_03: Marine pollution incidents	Proposals should minimise their risk of marine pollution incidents.	The Applicant has included measures as part of the project design to minimise the risk of accidental marine pollution events (see Table 7.14).
Policy ENV_02: Marine Protected Areas	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.	Designated sites within the benthic subtidal and intertidal study area are outlined in section 7.7.5 and measures adopted as part of the project to avoid adverse effects on features of these sites are outlined in Table 7.14.
Policy ENV_03: Invasive non-native species	Proposals should include biosecurity measures to reduce the risk of introducing and spreading invasive non-native species.	Measures to reduce the risk of introducing and spreading invasive non-native species have been considered as part of the project design in Table 7.14 and include an Environmental Management Plan which will an INNS assessment using NRW-PS Biosecurity Risk Assessment.
Policy GOV_01: Cumulative effects	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.	A full cumulative impact assessment has been undertaken and is presented in section 7.12.

7.5 Consultation

7.5.1.1 As identified in 7.3.1.1, the mWave project was originally intended to be consented within the META Project with mWave being deployed at Site 8 (East Pickard Bay). As such, consultation on META Site 8 also included the mWave communication cable route and the mWave device. A summary of the key issues raised during consultation specific to benthic subtidal and intertidal ecology at Site 8 and the mWave project, is outlined below, together with how these issues have been considered in the production of this Environmental Statement chapter in Table 7.4.**Error! Reference source not found.**

Table 7.4: Summary of key consultation issues raised during consultation activities undertaken relevant to benthic subtidal and intertidal ecology.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
10 January 2019	NRW advisory – discretionary advice service.	Regulation 37 package for the Pembrokeshire Marine Special Area of Conservation (SAC) should be used to provide further clarification on the ecology and designations of the SAC as well as the Conservation Objectives for the habitat features.	The Regulation 37 package has been used to inform the benthic subtidal and intertidal ecology characterisation presented in section 7.7 and will also be used in No Significant Effects Report (NSER) for the project.
		The East Pickard Bay site (META Site 8) boundary should be revised to avoid the designated reef feature and instead focus the area on sand substrate only.	On the basis of NRW's advice, the boundary of the META Site 8 has been revised to avoid the designated reef feature at this location. mWave is located on sandy substrate at the south eastern end of META Site 8. Site survey has confirmed this habitat at the deployment location.
		Drop-down camera surveys are proposed for the cable route which we consider will be sufficient for micro siting of the cable lay.	Drop-down camera survey has been undertaken of the communication cable route for mWave. Information from this survey has been used to inform the assessment within this chapter.
		For the intertidal ~~and terrestrial~~ section the cable lay itself would be unlikely to have any impacts upon the biological features of the SSSI. However given the potential for increased activity and construction in the area adjacent to the cable lay we suggest a phase 1 survey is undertaken as a precaution.	Phase 1 survey data is available for the coastline as a whole (NRWa 2018). A site visit has been undertaken to review and update, where necessary, the intertidal phase 1 survey map within East Pickard Bay cable landfall area.
19 January 2019	Pembrokeshire County Council (PCC)	Concern relating to the lack of marine surveys undertaken to support the proposals and that further surveys are not being proposed. No seabed drop down or marine surveys have been undertaken of the three marine test sites. Without knowing what species and habitats are present within the sites it is not possible to undertake any kind of impact assessment. Are there areas of reef, a feature of the Pembrokeshire Marine SAC within the East Pickard Bay site? The presence or otherwise of these features has not been established so it is not possible to assess the extent to which the proposed developments may cause harm.	The baseline characterisation for benthic subtidal and intertidal ecology, presented in section 7.7, has been supported with a comprehensive desktop review of existing data sources as well as site specific field surveys both intertidal and subtidal. The data collected from these surveys have been used in the assessment within this chapter. The results of the DDV survey confirmed that the habitats and communities across the bedrock reef at East Pickard Bay were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval.
21 January 2019	ABPmer	Potential impacts on benthic ecology from underwater noise will need to be considered, with a particular focus on SAC qualifying habitat features.	mWave will be deployed on sandy substrate distant from Annex I habitat features. Underwater noise has been scoped out for benthic ecology; see Table 7.10 for a full justification.
21 January 2019	NRW	Drop-down video surveys should be undertaken to identify the habitats affected by the project, in particular for sites encompassing Annex I habitats. These should be informed by bathymetric data.	DDV camera survey and bathymetric surveys have been undertaken for the mWave Project. The results of the DDV survey confirmed that the habitats and communities across the bedrock reef at East Pickard Bay were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval
		The description of the baseline environment within the three test areas is quite limited at present and we would expect to see more detail in the final Environmental Statement informed by the proposed site-specific monitoring.	A full description of the benthic baseline is presented in section 7.7 based on a comprehensive desktop review and site-specific survey.
		Loss of habitat should be included as an impact, not just disturbance.	Loss of benthic habitat during the operation of devices at mWave project is fully assessed in paragraph 7.11.2.3 *et seq.*
		Cable impacts should be considered in the impact pathways such as the cable burial and protective measures (armouring, clam shell weights).	The cable will be laid on the surface of the seabed and the potential effects have been assessed in Section 7.11.
		Construction impacts associated with debris and accidental pollution should also be included.	Effects associated with accidental pollution events are assessed in paragraphs 7.11.1.48 *et seq*. for installation, paragraph 7.11.2.32 *et seq*. for operation and maintenance and paragraph 7.11.3.6 for decommissioning.
		Effects of accidental pollutants on benthic habitats has been scoped out. We would expect further detail on this before being able to scope it out.	Effects associated with accidental pollution events are assessed in paragraphs 7.11.1.48 *et seq*. for installation, paragraph 7.11.2.32 *et seq*. for operation and maintenance and paragraph 7.11.3.6 for decommissioning.
		Multiple impact pathways identified have the potential to affect designated habitat features.	Features of designated sites have been identified and included as VERs (see Table 7.8) and assessed as appropriate within section 7.11.
		Impact pathways that have been scoped out have not been included so it is difficult to determine if everything has been considered.	Impacts scoped out for benthic subtidal and intertidal ecology are outlined and justified in Table 7.10.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
01 April 2019	NRW/MMO Scoping Response	More detailed information on the baseline environment must be presented in the ES.	A full description of the benthic baseline is presented in section 7.7 based on a comprehensive desktop review and site-specific surveys.
		Site specific subtidal survey data is likely to be require. The survey work should characterise the test sites to identify the habitats potentially affected by the project, in particular for areas encompassing Annex I habitats (all of Warrior Way and Dale Roads, partial for East Pickard Bay). Up to date evidence must be presented in the ES.	DDV camera survey and bathymetric surveys have been undertaken for the mWave Project. The results of the DDV survey confirmed that the habitats and communities across the bedrock reef at East Pickard Bay were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval
		The following impact pathways must be assessed in the EIA/ES: • Loss of habitat (not just disturbance). This is especially important for sensitive habitats with low resilience and recoverability; • Impacts from repeated device deposits and removals, including the repeated loss and disturbance of habitat; • Cable impacts such as cable burial and protective measures (armouring, clam shell weights); • Effects of accidental pollutants;	Loss of habitat is assessed in para 7.11.2.3 *et seq*. The effects of repeated habitat disturbance are discussed and assessed in paragraph 7.11.1.14 and 7.11.2.5. The impact of the cable route has been included in the detailed assessment within section 7.11.1. Effects on benthic receptors associated with accidental pollution events are assessed in para 7.11.1.48 *et seq*. for installation, paragraph 7.11.2.32 et seq. for operation and maintenance and paragraph 7.11.3.6 for decommissioning.

7.6 Methodology to inform the baseline

Desktop study and site specific survey work has been used to inform the baseline environment.

7.6.1 Desktop study

7.6.1.1 The mWave project is located on the south coast of the Angle peninsula, to the south east of Milford Haven Waterway. Data and knowledge on benthic subtidal and intertidal ecology is readily available and has been acquired for a desktop study. These are summarised in Table 7.5 below.

Table 7.5: Summary of key desktop reports.

Title	Source	Year	Author
Intertidal ecology			
Countryside Council for Wales (CCW) Phase 1 Intertidal habitat mapping survey between 1996 and 2005.	http://lle.gov.wales/	2019	NRWa
Intertidal site visit of proposed landfall for the Bombora temporary communications cable at East Pickard Bay.	Bombora Wave Energy	2019	G. Lock *pers. comm.*
Subtidal ecology			
Seasearch 2018 dive summaries for two survey site clusters south of Angle Peninsula.	Pers. Comm.	2019	Blaise Bullimore
Pembrokeshire Marine SAC Regulation 37 Document	NRWa	2018a	NRWa
Pembrokeshire Marine SAC Indicative site level feature condition assessments 2018	NRWa	2018b	NRWa
Bombora camera drop down video survey	SEACAMS	2018	SEACAMS Ltd.
Bombora, geophysical and oceanographic survey.	Bombora WavePower Ltd	2018	Titan Environmental Surveys Ltd
Bombora camera drop down video camera survey	Bombora WavePower Ltd	2019	Aquatic Survey and Monitoring Ltd
EUSeaMap broad-scale predictive model.	http://www.emodnet.eu/seabed-habitats	2016	EUSeaMap
Sediment contaminant surveillance in Milford Haven Waterway.	Environmental Monitoring and Assessment: 2016, 1881(1): 34	2016	Little *et al.*
EUNIS Habitat maps from the Mapping European Seabed Habitats (MESH) project.	http://www.emodnet.eu/seabed-habitats	2008	MESH Project

7.6.2 Site specific surveys

7.6.2.1 As identified in Table 7.4, NRWa recommended that a drop down camera survey be completed of the subtidal cable route to allow sufficient information to micro site the cable. The drop down video camera survey was undertaken on 26 March 2019 (Aquatic Survey and Monitoring Ltd. 2019). In addition to this a site visit was undertaken in 19 March 2019 of the intertidal area to be affected by the communication cable. The objective of the survey was to confirm the Phase 1 survey data which was available from NRWa and to identify the presence of any notable species. Further information can be found in Section 7.7 Baseline environment.

Identification of designated sites

7.6.2.2 All designated sites within the benthic subtidal and intertidal ecology study area with qualifying interest features that could be affected by the installation, operation and maintenance, and decommissioning of the mWave project were identified. The sites included those which may be directly (e.g. by temporary and/or short-term habitat loss) or indirectly (i.e. by changes in suspended sediment concentrations and/or sediment deposition as determined by the assessment presented in Chapter 5: Coastal Processes).

- Step 1: All designated sites of international, national and local importance within the benthic subtidal and intertidal ecology study area were identified using a number of sources. These included international, national and local designations including SACs, SSSIs and LNRs identified by examining the Joint Nature Conservation Committee's (JNCC's) website, the Department for Environment, Food and Rural Affairs (Defra) MAGIC interactive map applications (http://magic.defra.gov.uk/) and the Wales Marine Planning Portal interactive map application (http://lle.gov.wales/apps/marineportal).
- Step 2: Information was compiled on the relevant benthic subtidal and intertidal features for each of these sites as follows:
  - The known occurrence of benthic subtidal and intertidal habitats within the mWave project area was based on the relevant desktop information on the benthic subtidal and intertidal communities of the benthic subtidal and intertidal study area.
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the mWave project, including the cable route (up to MHWS);
  - Sites and associated features were located within the potential Zone of Impact (ZoI) for impacts associated with the mWave project (e.g. habitat loss/disturbance, increase in suspended sediments and deposition);
  - Notified interest species features of a designated site were either recorded as present during historic surveys within the mWave project area, or identified during the desktop study as having the potential to occur within the mWave project area;
  - Where national and locally designated sites (i.e. SSSIs, MCZs, NNRs and LNRs) fall within the boundaries of an internationally designated site (e.g. SAC), only the international site has been considered, as potential effects on the integrity and

conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken). In some cases, however, where a national site forms a component of an international site, but the latter designation does not list a qualifying interest feature that is present on the SSSI citation, the individual SSSI will be taken forward for further assessment for that particular feature or the species;

– Where a national site falls outside of an international site, but within the benthic subtidal and intertidal ecology study area, the national site will be taken forward for further assessment for a particular feature; and
– Skomer MCZ is the only MCZ designated in Wales waters and as such is the only one considered for assessment.

7.7 Baseline environment

7.7.1.1 This section characterises the existing environment within the benthic subtidal and intertidal ecology study area as illustrated in Figure 7.1 and outlined in section 7.3. A description is provided for the benthic subtidal and intertidal ecology in the wider study area and then a more detailed description is provided for the local study area.

7.7.2 Subtidal benthic ecology wider study area

7.7.2.1 The wider study area as a whole falls within Pembrokeshire Marine Special Area of Conservation (SAC). Starting to the immediate north, Carey (2015) compiled a detailed map of the sedimentary habitats within the Waterway from images of the sea floor collected in 2012 using sediment-profile and plan-view imaging (SPI/PV) survey techniques. Overall the sediments within the Waterway are highly variable ranging from cobbles within the central channel near Pembroke Dock to silts/clays in the Pembroke River. The channel at the mouth of the Waterway is characterised by medium to very coarse sand and gravel, while the surrounding subtidal banks and intertidal flats grades from very fine sand, to very fine sand over silt/clay to silt clay.

7.7.2.2 The Waterway contains large numbers of shells on the surface, generally of the non native slipper limpet *Crepidula fornicata*. In addition to *C. fornicata*, other macrofauna and macroflora found throughout the channel included lugworm *Arenicola marina*, sand mason worm *Lanice conchilega*, anemones *Cerianthus* sp., eelgrass *Zostera* sp., sea lettuce *Ulva lactuca*, Montagu shell *Kurtiella bidentata* and clams *Thyasira* sp.

7.7.2.3 Extensive areas of sublittoral *rocky reefs, w*hich qualify as the Annex I 'reef' habitat feature of the Pembrokeshire Mari*ne SA*C, start within the western area of the Waterway (Figure 7.2) and stretch offshore from the west Pembrokeshire coast an*d around* the islands and many small rocky islets (NRW, 2018a). This is also reflected in the EuSeaMap (2016) data which was generated as part of the MESH project from sample points collected and analysed by the Marine Nature Conservation Review (MNCR) surveys. The data predicts high energy circalittoral rock extending out from the mouth of the Waterway. West Dale Bay and the south-eastern coast of Freshwater West predominantly comprise reef habitat (see Figure 7.2). Subtidal reef habitat is typically characterised by algae and bivalves; for example, the biotope red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles (SS.SMp.KSwSS.LsacR.CbPb) has been recorded at reef habitat near the Cleddau bridge.

7.7.2.4 The Skomer MCZ at the north western extent of the wider study area, has the best studied reef habitat within the benthic subtidal and intertidal ecology study *area. The steep subt*idal walls off the north coast of Skomer are covered with soft corals including *Alcyonium digitatum* and *A. glomeratum*, pink sea-fans *Eunicella verrucosa* (a biodiversity action plan species), and turfs of seamats, hydroids, sponges and anemones. On the south side of Skomer Island, large silted boulders and rock plateaux display rich sponge communities and the nationally scarce scarlet and gold star coral *Balanophyllia regia*.

7.7.2.5 Sea caves are also widely distributed throughout the Pembrokeshire Marine SAC and qualify as the Annex I habitat '*Submerged or partially submerged sea caves*'. Sea caves are predominantly a feature of exposed coasts, and within the benthic subtidal and intertidal ecology study area. Sea caves are concentrated around the coast of Skomer Island and on the headlands around the mouth of the Waterway, including the Angle Peninsular coast to the north of the East Pickard Bay site (see Figure 7.2). Some of the Welsh sea caves are used as pupping sites by grey seals *Halichoerus grypus* (see Chapter 9: Marine Mammals). Very little is known about the benthic species colonising sea caves, but populations will include those tolerant of scour, of extreme wave surge and cryptic, apparent cave specialist species, including the rare snail *Palludinella littorina* (NRW, 2018a).

7.7.2.6 The circalittoral rock that extends from the mouth of the Waterway, as described above, grades into circalittoral coarse sediments with increasing distance from the shore (EUSeaMap, 2016). To the southwest of the Angle Peninsula, an area of this coarse sediment corresponds with an area of identified Annex I habitat 'sandbanks which are slightly covered by seawater all the time' which is a feature of the Pembrokeshire Marine SAC (see Figure 7.2). As outlined in the NRW Regulation 37 advice for the site (NRW, 2018a), the sandbank features of the Pembrokeshire Marine SAC are of sub-types gravelly and clean sands, and muddy sands.

7.7.3 Subtidal benthic ecology local study area

7.7.3.1 Detailed bathymetric and oceanographic survey work for the mWave project was undertaken in 2018 (Titan 2018). The survey area encompassing the site of the proposed mWave (wave energy converter), lies in the NE corner of Freshwater West. The survey area extends for about 2 kilometres seaward (west) from the foreshore and is about 600m N-S. Approximately, the southern third of the survey area lies within the active Castlemartin Firing Range danger zone. Complete swathe bathymetry and sonar coverage was achieved, whilst sub-bottom profiler and magnetometer data was collected on primary profiles at a nominal 40m interval with cross lines at about 120m intervals.

7.7.3.2 The sonar data shows the seabed in survey area to consist almost entirely of smooth, virtually featureless sands. This was confirmed by a small grab sampling programme. The only bedforms identified are insignificant sand ripples lying scattered across the site. The ripples are most obvious inshore of the 3m isobath and immediately below the edge of the wave cut rock platform along the northern limit of coverage. No significant megaripples or sand waves have been identified in the area.

7.7.3.3 A wave cut rock platform lies along the northern edge of the site, approximately 200m from mWave deployment area, and it grades into the intertidal area. There are small isolated outcrops in the western half of coverage extending to the NE corner of the mWave deployment site. The rock forming the continuous wave cut platform is expected to be hard sandstone, whilst the isolated outcrops close to the northern edge of the microsite are expected to be hard shales (BGS). Away from the nearshore northern exposures, bedrock lies at an average depth of about 3-4m below seabed

7.7.3.4 A preliminary review of the SEACAMS multibeam backscatter data for undertaken for the META Site 8 project, as presented in Appendix 7.1: Multibeam Backscatter Data, indicates predominantly soft sandy sediments are likely to be present across the entire META Site 8 area.

7.7.3.5 EUSeaMap (2016) data predict Atlantic and Mediterranean high energy circalittoral rock in the nearshore area to the north of the East Pickard Bay, coinciding with the proposed cable corridor, which overlaps with the mapped distribution of the ‘possible’ Annex I ‘reef’ habitat feature of the Pembrokeshire Marine SAC. The results of the bathymetric survey confirms that rocky substrate does not extend offshore to coincide with the mapped extent of ‘possible’ Annex I reef habitat (see Table 7.3), but transitions to relatively featureless sand. Further details of the subtidal substrate and ecology was obtained through the drop down video survey and an overview can be found in paragraphs 7.7.3.11 *et seq*.

7.7.3.6 Data available on EMODnet which was generated as part of the MESH project from sample points collected and analysed by the MNCR surveys indicate that biotopes in the area may include the ‘Foliose red seaweeds on exposed lower infralittoral rock’ biotope (IR.HIR.KFaR.FoR), *Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock (IR.MIR.KR.Lhyp.Pk) biotope and the ‘Bryozoan turf and erect sponges on tide-swept circalittoral rock’ (CR.HCR.XFa.ByErSp) biotope.

7.7.3.7 The Seasearch diver surveys undertaken in 2018 at Pickard Point recorded a dominance of dense short bryozoan turfs with both *Scrupocellaria* spp and abundant *Crisia spp*. on the vertical faces of old red sandstone bedrock outcrops. Large patches of encrusting sponges with occasional erect sponges and cushion sponges including yellow staghorn sponge, *Axinella dissimilis* and mash potato sponge *Thymosia gurnei* were also recorded (Bullimore pers. comm. 2019). In the gullies between the ridges, boulders and coarse sand and pebbles were recorded, sometimes devoid of marine life and in other places characterised by ascidian turf and in particular teapot seaquirt *Polycarpa scuba* and *Mogula* sp. The Devonshire cup coral *Caryophyllia smithii* was prolific and the cup coral barnacle *Adna anglica* and ginger tiny anemone *Isozoanthus sulcatus* were found on silty ledges in high abundances. The horizontal surfaces varied, some were heavily encrusted with similar life to the vertical rocks and occasional red algae, whilst other areas were heavily silted and very little life present.

7.7.3.8 The 2018 Seasearch dive surveys south east of Sheep Island recorded red algae meadows on the upward facing bedrock interspersed with bryozoans, occasional boring sponge *Cliona celata*, common urchin *Echinus esculentus* and bloody Henry *Henricia oculata*. The vertical steep faces were densely packed with bryozoan turf and erect sponges, as described above for Pickard Point and the bryozoan *Pentapora foliacia* (Bullimore pers. comm. 2019).

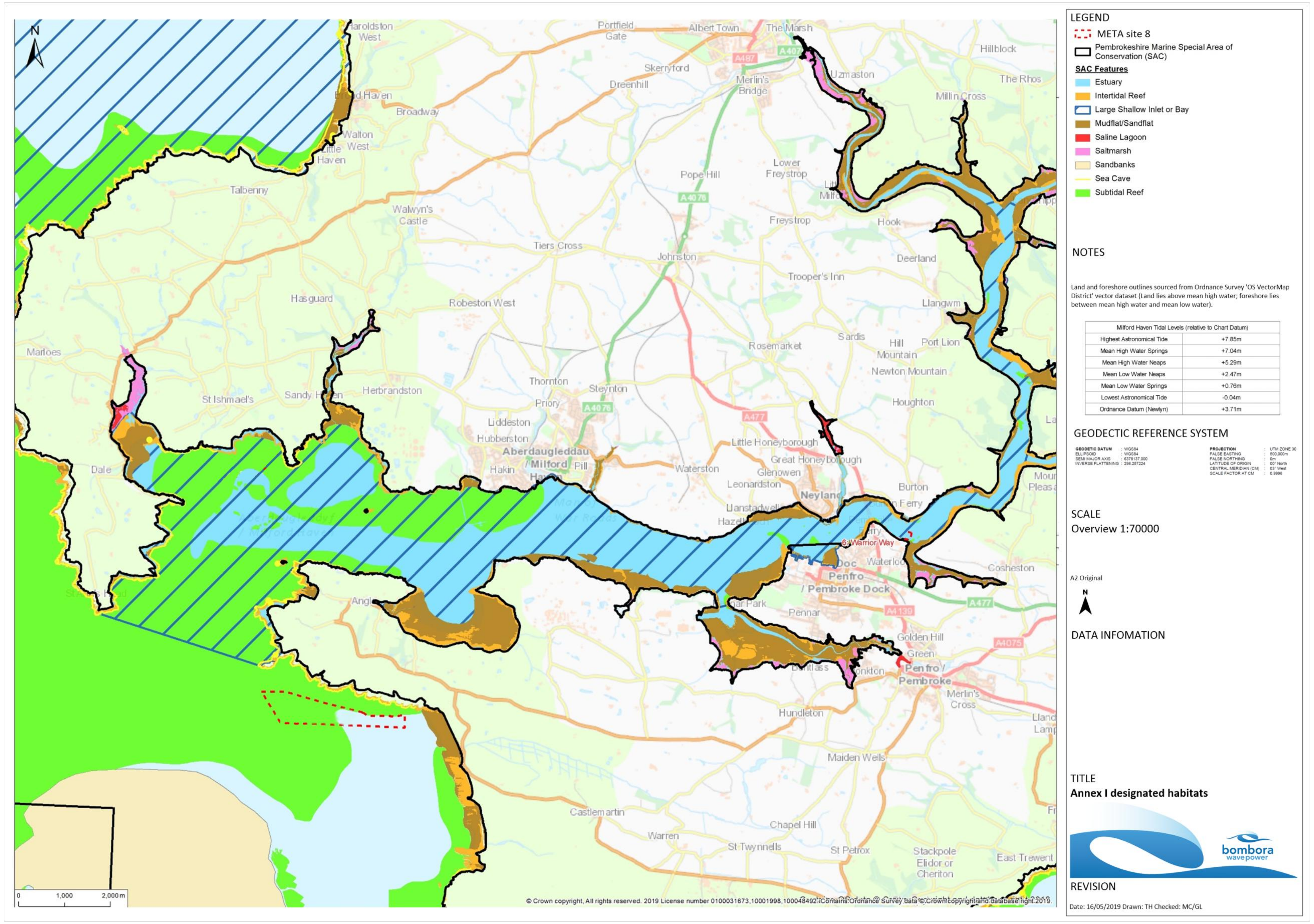


Figure 7.2: Annex I designated habitats of the Pembrokeshire Marine SAC

7.7.3.9 Data available on EMODnet which was generated as part of the MESH project from sample points collected and analysed by the MNCR surveys indicate that the coarse sands in this area are characterised by the *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand' biotope (SS.SSa.IFiSa.NcirBat) and the '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' biotope (SS.SSa.IMuSa.FfabMag). This correlates with the observations from baited drop-down video surveys undertaken at META Site 8 by SEACAMS in 2018 to identify fish species in the area (which are described in full in Chapter 8: Fish and Shellfish), which confirms the presence of sediments rather than rocky reef within META Site 8.

Sediment contamination

7.7.3.10 Milford Haven Waterway to the north, has been a major oil port since 1960 with up to four refineries, associated jetties and pipelines, and one of the largest UK terminals for crude oil, diesel, gasoline, and jet fuel (Little *et al.*, 2016). As such the benthic communities of the Waterway have been exposed to historical sources of contamination for many decades. East Pickard Bay, off the south coast of the Angle Peninsula, is located on open coast distant from the Waterway, industry and other potential sources of contamination. As identified in Chapter 5, Coastal Processes no contamination has been documented at this location, but due to its remote exposed nature, levels of contamination are likely to be low compared to other areas such as the Waterway.

Drop down video camera survey

7.7.3.11 Drop down video camera survey was undertaken on the 29 March 2019. The aim of the survey was to provide sufficient information on the subtidal habitats and communities present within the planned cable route corridor for assessment of the cable's likely effects on those habitats and communities. In this way the cable can be laid in an area that would avoid damaging any protected features, if present. As identified above the mWave device will be deployed on sandy substrate. The cable route will pass from this sandy substrate to the rocky habitat closer to shore. Drop-down video survey was undertaken at 30 locations within the area of the cable route corridor that overlaps subtidal rocky reef; capturing enough high-quality footage and stills to allow characterisation of the reef habitats and communities (Figure 7.3).

7.7.3.12 The results of the survey confirmed that south facing old red sandstone bedrock cliffs, which form the extremely wave exposed coastline continues into the subtidal and extends 300m from the coast. Here it is present as an eroded bedrock platform with frequent criss-crossing gullies and fissures, gradually descending to a silty sandy sediment plain at 16m below chart datum (bcd). East Pickard Bay itself, where the cable will make landfall, is a narrow gully with steep bedrock sides. The gully floor is very heterogeneous, with many boulders and cobbles, but with areas of gravel and pebbles, some quite broad. Most rock surfaces are scoured by the combination of wave energy and sand/gravel/pebbles and while this moderates with depth it is present across the whole reef.

7.7.3.13 Siltation and sediment incursion are other important environmental factors. Silt is abundant and siltation increases with depth as the wave energy decreases. Below 8m below chart datum (bcd) silt was thickly coating most surfaces, accumulating in upward facing hollows and forming drifts on the gully floor. Soft sediment movement across the reef and into the gullies is likely to vary considerably, with more incursion during summer months.

7.7.3.14 The combination of frequent scour and heavy siltation have resulted in a relatively low diversity of fauna and flora on much of the reef. Scour has limited the development of marine life on any surfaces that are not raised or otherwise shielded from it, while siltation has greatly limited the development of sessile filter feeding animals, particularly on upward facing surfaces. Thus, foliose algae are most abundant on the upper surfaces of bedrock and large boulders that are sufficiently raised, while most animals are limited to steeply sloping, vertical and overhanging surfaces that are both raised / shielded from scour and do not accumulate the smothering effects of silt. Species that are resistant to both scour and frequent smothering, e.g. encrusting coralline algae, dominate. The biotopes recorded during the survey are discussed further below and are illustrated on Figure 7.4.

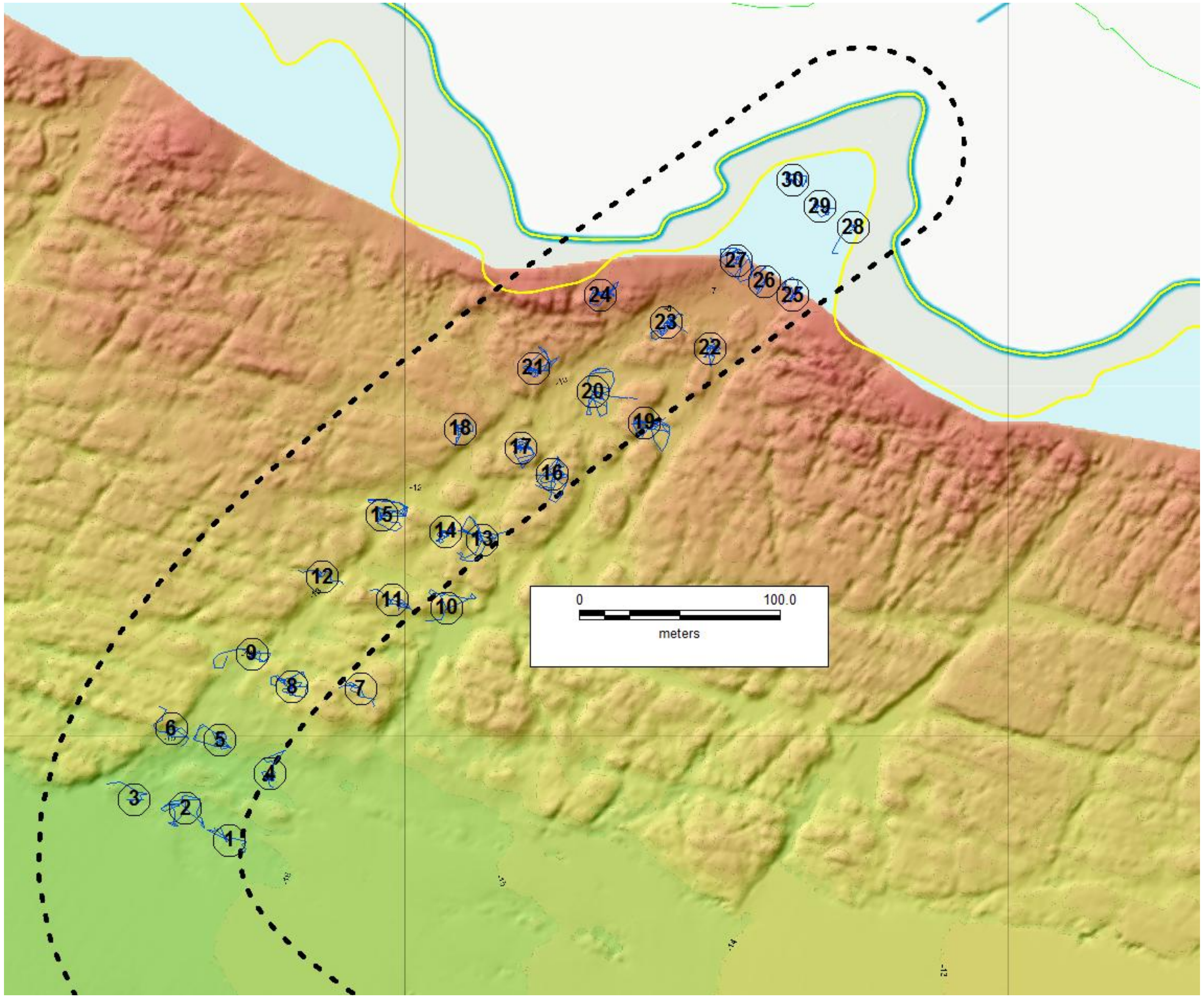
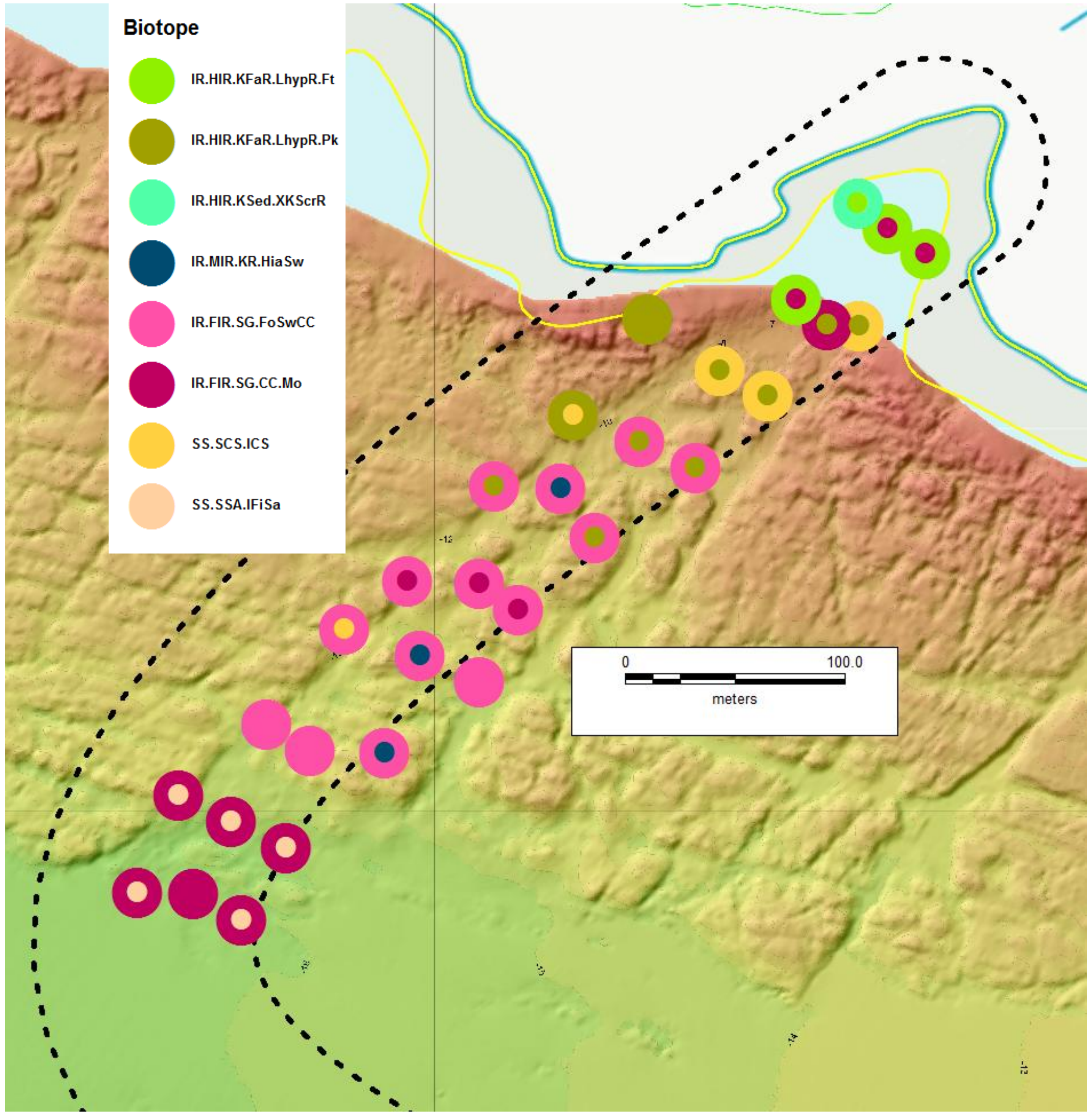


Figure 7.3 Drop down video camera locations on rocky habitat of cable route corridor



Biotope	Biotope title (National)
IR.HIR.KFaR.LhypR.Ft	Laminaria hyperborea forest with dense foliose red seaweeds on exposed upper infralittoral rock
IR.HIR.KFaR.LhypR.Pk	Laminaria hyperborea park with dense foliose red seaweeds on exposed lower infralittoral rock
IR.HIR.Ksed.DesFilR	Dense Desmarestia spp. with filamentous red seaweeds on exposed infralittoral cobbles, pebbles and bedrock
IR.HIR.KSed.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
IR.HIR.KFaR.FoR	Foliose red seaweeds on exposed lower infralittoral rock
IR.FIR.SG.CC.Mo	Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies
SS.SCS.ICS SS.SSA.IFiSa	Infralittoral coarse sediment Infralittoral fine sand

Figure 7.4 **Biotopes (based on JNCC 2015) assigned to each station: primary (larger outer circles) and secondary (smaller inner circles).**

Kelp forest (2 to 5m bcd, stations 27 to 30, IR.HIR.KFaR.LhypR.Ft)

7.7.3.15 *Laminaria hyperborea* kelp forest on upward facing bedrock and large boulders with a patchy understorey of foliose red and brown algae (including *Dilsea carnosa*, *Cryptopleura ramosa*, *Heterosiphonia plumosa*, *Plocamium*, *Corallina*, and *Desmarestia*). Rock surfaces covered in pink encrusting coralline algae and some patches of dark red encrusting algae. Very little fauna except occasional *Gibbula* top shells and blue rayed limpets *Patella pellucida* grazing on the algae.

Kelp park (5 to 10m bcd, Stations 16 to 26, IR.HIR.KFaR.LhypR.Pk)

7.7.3.16 Similar to the kelp forest, but *Laminaria hyperborea* and foliose algae less abundant, while sponges (mainly orange and yellow crusts) were more abundant. Surfaces becoming increasingly silted with depth.

Desmarestia and other ephemeral algae on scoured boulders (4 to 6m bcd, Stations 25 & 26, IR.HIR.Ksed.DesFilR)

7.7.3.17 Relatively dense stands of *Desmarestia* and some red algae on scoured boulders lying in the gully; with pink encrusting coralline algae. Typically, a seasonal biotope that develops during summer months, but managed to survive here over the winter in a few places.

Scoured mixed kelp forest, Station 30 (0 to 3m bcd, Station 30, IR.HIR.KSed.XKScrR)

7.7.3.18 Scoured mixed kelp forest (*Laminaria hyperborea* and *Saccharina latissima*) with a sparse understorey of *Dilsea carnosa*, *Phyllophora*, *Polyides*/*Furcellaria* and small foliose species such as *Chondrus crispus*. Underlying rock covered in pink encrusting coralline algae.

Foliose red and encrusting coralline algae on silty bedrock (8 to 12m bcd, Stations 7 to 20, IR.HIR.KFaR.FoR)

7.7.3.19 Foliose red and encrusting coralline algae was the dominant biotope on upward facing surfaces of raised bedrock and large boulders in the central section of the reef. Colonised by varying amounts of foliose red algae (including *Delesseria sanguinea*, *Cryptopleura ramosa*, *Dilsea carnosa* and *Plocamium sp*), generally decreasing in abundance with depth and the effects of scour. Pink encrusting coralline algae covering much of the underlying rock, where it could be seen under the silt, but with occasional sponges. Sponges, particularly orange and yellow encrusting species with less frequent *Cliona celata* and *Pachymatisma johnstonia*, were mostly found on steep rock surfaces, less prone to siltation. Other fauna generally rare but included *Caryophyllia smithii* cup corals frequent on some vertical or near vertical surfaces.

Encrusting coralline algae on mobile boulders and cobbles (3 to 16m bcd, many Stations across whole reef, IR.FIR.SG.CC.Mo)

7.7.3.20 Boulders and cobbles on the gully floor were typically mobile and very scoured, with increasing cover of silt in deeper area. Many were completely barren, but many were partly colonised by pink encrusting coralline algae. Other scour resistant species were present on some, particularly the calcareous tube worm *Spirobranchus* and rare barnacles. In the deepest parts of the reef the scoured low-lying bedrock was also assigned to this biotope.

Mobile gravel and pebbles (5 to 10m bcd, Stations 21 to 26, SS.SCS.ICS)

7.7.3.21 Mobile sandstone gravel and pebbles covered areas of the gully floor in the central section of the reef, becoming increasingly covered in a veneer of silt in deeper parts. Sometimes formed in waves, it was barren of conspicuous life.

Fine silty sand (12 to 16m bcd, Stations 1 to 6, SS.SSA.IFiSa)

7.7.3.22 Fine sand, usually with a thick veneer of silt, was present between rocky substrata in the deepest parts of the reef. It was barren of conspicuous life.

Summary of survey

7.7.3.23 The results of the survey confirmed that the habitats and communities across the bedrock reef approaching East Pickard Bay cable landfall point were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval.

7.7.4 Intertidal ecology

7.7.4.1 The exposed intertidal lower rocky shore in the vicinity of the cable landfall (see Figure 7.5), is characterised by communities of *L. digitata* in the sublittoral fringes and the '*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock' (IR.HIR.KFaR.Ala.Ldig) biotope. With progression up the shore these communities transition through to mussel *Mytilus edulis* and/or barnacle dominated communities in the mid shore and the '*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock' (LR.HLR.MusB.Sem) biotope. In the upper shore, yellow and grey lichens dominate on supralittoral rock (NRW, 2019).

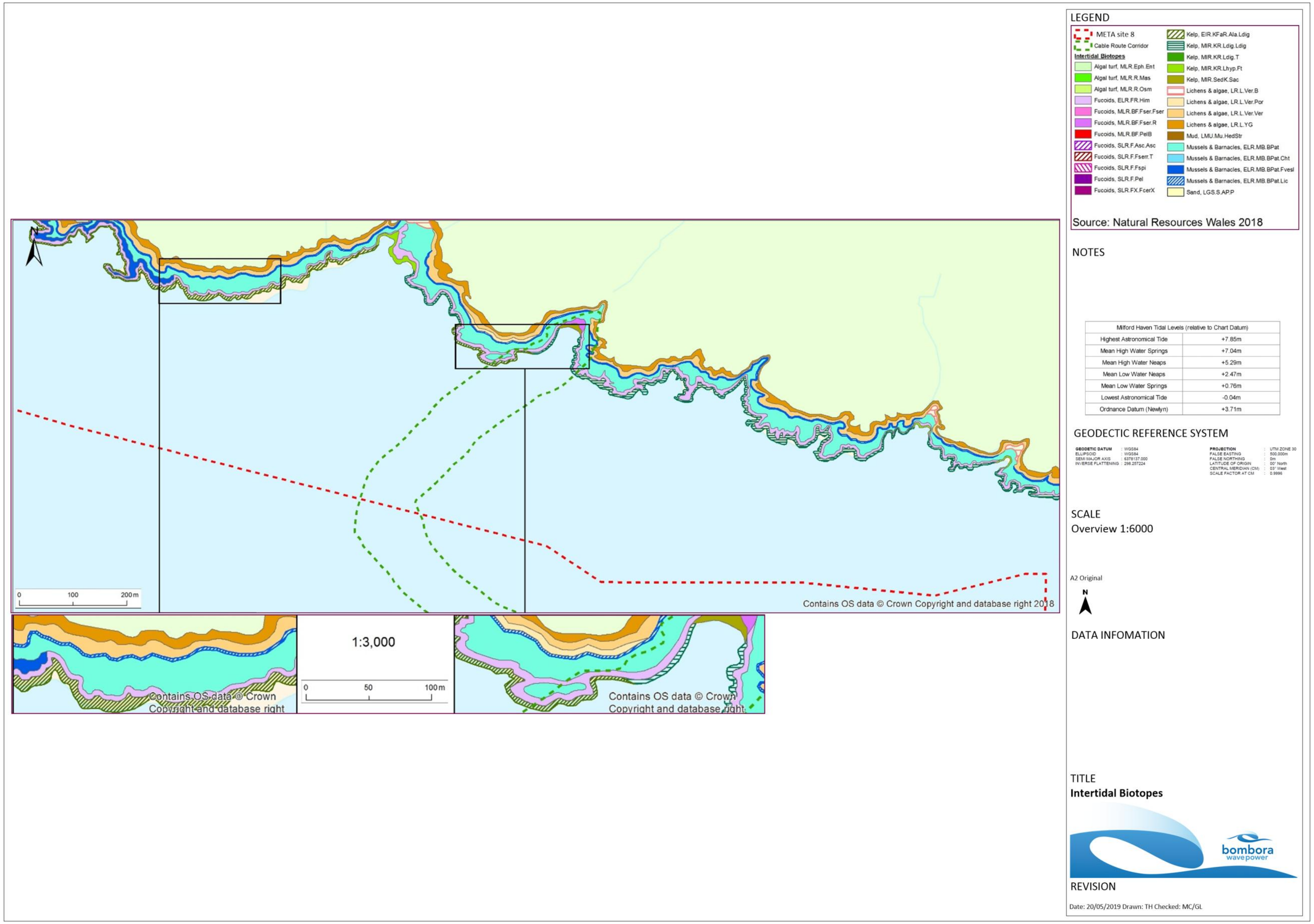


Figure 7.5: Intertidal biotopes within the benthic subtidal and intertidal ecology study area, as mapped by NRWa.

Intertidal Survey

7.7.4.2 A site visit was undertaken on 19th March 2019 to review the intertidal Phase 1 data in the vicinity of the cable route at East Pickard Bay. The bay is characterised by steep rocky sandstone cliffs dropping down to exposed intertidal rocky shore. Within the bay there are scattered red sandstone boulders and stones on the floor (Photos 1 and 2) and a small freshwater stream flows down the main gully and across the intertidal area.

Photo 1 Intertidal area looking up (north) East Pickard Bay

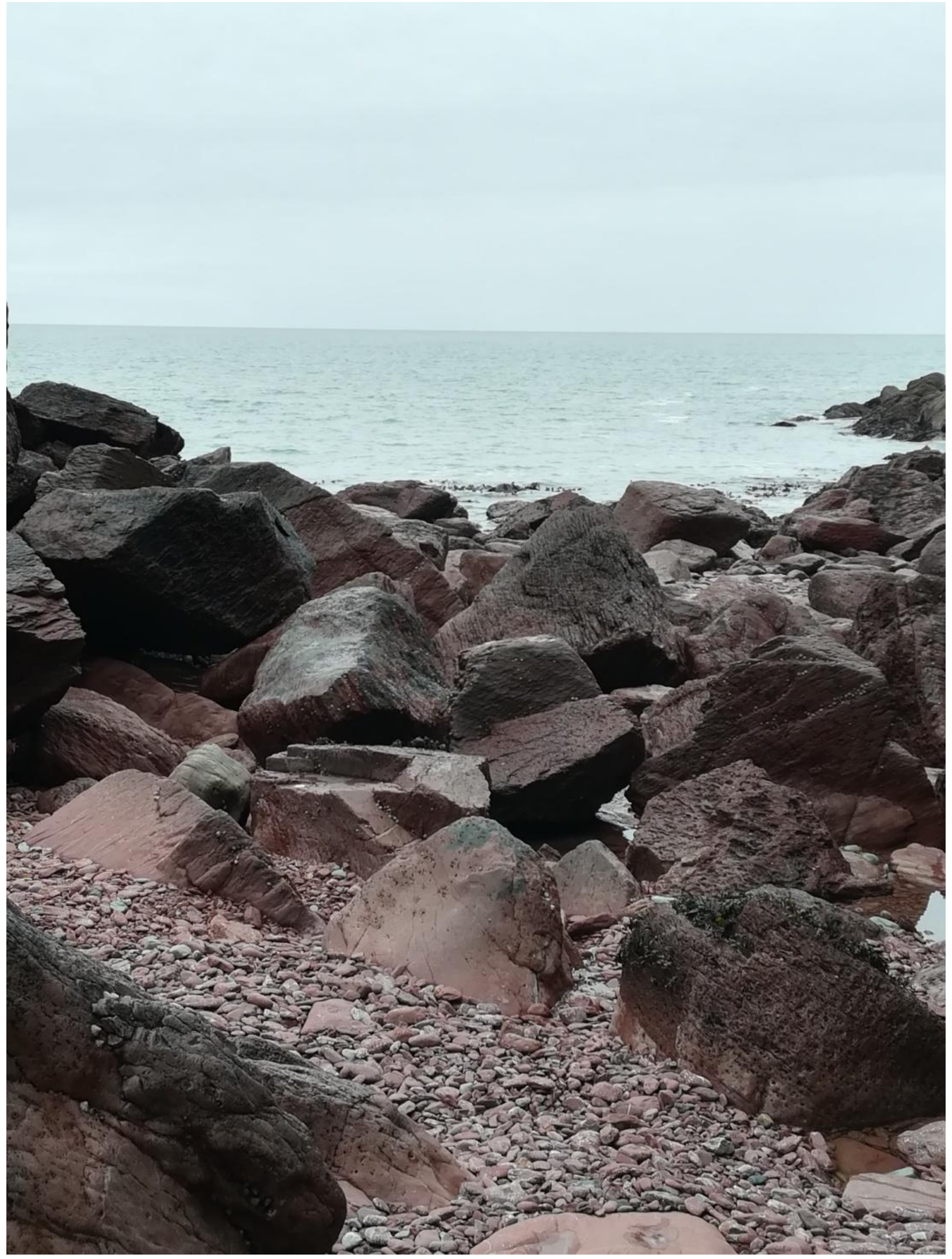


Photo 2 Intertidal area looking down (south) East Pickard Bay

7.7.4.3 At low water the north side of East Pickard Bay is characterised by communities of *Laminaria digitata* on the moderately exposed sublittoral fringe bedrock in the sublittoral fringes (MIR.KR.Ldig.Ldig) (see Figure 7.5). Within the centre of the bay at MLWS the biotope *Saccorhiza polyschides* and other opportunistic kelps on disturbed sublittoral fringe rock (MIR.SEDK.Sac) is found. In amongst the scattered boulders and stones, there was limited presence of algae, possibly due to the time of year, although on top of medium to large boulders were the fucoids and red algae characteristic of the MLR.BF.Fser.R biotope (*Fucus serratus* and red seaweeds on moderately exposed lower).

7.7.4.4 Other species noted included *Osmundea pinnatifida, Lomentaria articulata, Palmaria palmata, Gigartina stellata*, *Chondrus crispus,* articulated coralline algae and *Ceramium rubrum*. Within rockpools and on the sides of rocks or under overhangs were snakelock anemone (*Anemonia sulcata*), breadcrumb sponge (*Halichondria panicea*), Edible crab (*Cancer pagurus),* Limpets *(Patella vulgata),* Dog whelks *(Nucellus lapillus,* flat top shell *(Gibbula* umbilicalis). With progression further up the shore littorina species, the beadlet anemone and young fucoids.

7.7.4.5 As identified on the phase 1 habitat survey map (Figure 7.5), these communities transition through to mussel *Mytilus edulis* and/or barnacle dominated communities in the mid shore and the 'Semibalanus balanoides on exposed to moderately exposed or vertical sheltered eulittoral rock' (LR.HLR.MusB.Sem) biotope. In the upper shore, yellow and grey lichens dominate on supralittoral rock which included the species *Caloplaca* (NRW, 2019).

7.7.5 Designated sites

7.7.5.1 Designated sites, which have relevant benthic notified interest features, identified for the mWave project benthic subtidal and intertidal ecology chapter are described in Table 7.6 below. Those which are a feature of the designated site, but are not present in the vicinity of mWave have been italicised.

Table 7.6: Designated sites and relevant qualifying interest features for the mWave project benthic subtidal and intertidal ecology chapter.

Designated Site	Distance to mWave	Qualifying Interest Feature to be considered
Pembrokeshire Marine/ Sir Benfro Forol SAC	0	Annex I habitats: *Estuaries;* *Large shallow inlets and bays;* **Reefs;** *Sandbanks which are slightly covered by sea water all the time;* *Mudflats and sandflats not covered by seawater at low tide;* *Coastal lagoons (*Priority feature);* Atlantic salt meadows (Glauco-Puccinellietalia maritimae); and *Submerged or partially submerged sea caves.*
Limestone Coast of South West Wales SAC/Arfordir Calchfaen de Orllewin Cymru	0.75	Annex I habitats: Submerged or partially submerged sea caves.
Skomer MCZ	14	*Infaunal sediment communities* *Epifaunal mixed sediment communities* *Zostera marina population* *Sponge assemblages* *Nudibranch species assemblages* *Pentapora foliacea (ross coral) population* *Lusitanian anthozoan populations (pink sea fan Eunicella verru* *fingers Alcyonium glomeratum, yellow cluster anemone Parazo* *axinellae, cup corals Balanophyllia regia and Caryophyllia smit* *Rocky reef faunal communities* *Algal communities associated with major sublittoral habitat* *Littoral communities on bedrock shores* *Littoral communities on boulder shores* *Rock-pool communities* *Nationally rare and scarce hydroid populations* *Echinus esculentus population* *Algal species of recognised importance*

7.7.6 Valued Ecological Receptors

7.7.6.1 An assessment of the ecological effects of a proposed development focuses on 'valued ecological receptors' (VERs) (CIEEM, 2016; 2018). These are species and habitats that are valued in some way and could be affected by a proposed development; other valued ecological features may occur on or in the vicinity of the site of a proposed development but do not need to be considered because there is no potential for them to be affected significantly.

7.7.6.2 The value of ecological features is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM, 2016). The most straightforward context for assessing ecological value is to identify those species and habitats that have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, Oslo-Paris Commission (OSPAR), BAP habitats and species, priority habitats and species under Section 7 of the Environment (Wales) Act 2016 and habitats/species listed as features of MCZs. However, only a very small proportion of marine habitats and species are afforded protection under the existing legislative or policy framework 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. Table 7.7 shows the criteria applied to determining the ecological value of VERs for the mWave project.

Table 7.7: Valued Ecological Receptors categorisation for benthic subtidal and intertidal ecology.

Value of VER	Criteria to define value
Very high	• Internationally designated sites. • Habitats and species protected under international law (i.e. Annex I habitats within an SAC boundary).
High	• Nationally designated sites. • Species protected under national law. • Annex I habitats not within an SAC boundary. • Nationally important populations of a species (particularly within the context of habitats/species

Value of VER	Criteria to define value
	that may be rare or threatened within the UK[a]) that occur within the benthic subtidal and intertidal study area such as: UK BAP priority species and habitats that continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework; MCZ features (species classified as features of conservation importance and broad scale habitats) or priority habitats and species under Section 7 of the Environment (Wales) Act 2016. • Habitats and species that are features of MCZs (i.e. broad-scale habitats and Features of Conservation Importance (FOCI)).
Medium	• Regionally important populations of a species (particularly within the context of habitats/species that may be rare or threatened within the UK) that occur within the benthic subtidal and intertidal ecology study area such as: UK BAP priority species and habitats that continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, MCZ features (species classified as features of conservation importance and broad scale habitats) or priority habitats and species under Section 7 of the Environment (Wales) Act 2016. • Habitats or species that provide important prey items for other species of conservation or commercial value.
Low	• Habitats and species which are not protected under conservation legislation which form a key component of the benthic assemblages within the benthic subtidal and intertidal ecology study area.

[a] Measured against criteria such as OSPAR threatened/declining species and IUCN Red List of threatened species.

7.7.6.3 Based on the EIA baseline characterisation described in section 7.7, the habitats and species present within the mWave project's local benthic subtidal and intertidal ecology study area have been grouped in four broad habitat/community types as presented in Table 7.8. These VERs have been used to assess impacts associated with the installation, operation and maintenance and decommissioning of the mWave project, including the marine cable, on benthic subtidal and intertidal ecology within the benthic subtidal and intertidal ecology study area.

Table 7.8: Benthic subtidal and intertidal ecology VERs in the benthic subtidal and intertidal ecology study area.

Benthic subtidal and intertidal ecology VERs	Representative habitats/biotopes/species	Value within the study area	Justification
Intertidal VERs			
Annex I intertidal '*Reefs'* habitat	• IR.MIR.KT.LdigT • MIR.KR.Ldig.Ldig • LR.HLR.FT.FserT • LR.LLR.F.Fspi.FS • Intertidal underboulder communities	Very high	Annex I habitat protected under international legislation and designated feature of the Pembrokeshire Marine SAC. Component feature are features of Skomer MCZ. UK BAP Priority habitat. Priority habitat under Section 7 of the Environment (Wales) Act 2016.
Subtidal VERs			
Annex I subtidal '*Reef*' habitat	• SS.SMp.KSwSS.LsacR.CbPb • Estuarine rocky habitats • Fragile sponge and anthozoan communities on subtidal rocky habitats • Subtidal mixed muddy sediments • Tide swept channels	Very high	Annex I habitat protected under international legislation and designated feature of the Pembrokeshire Marine SAC. Component feature are features of Skomer MCZ. UK BAP Priority habitat. Priority habitat under Section 7 of the Environment (Wales) Act 2016.
Circalittoral coarse sediment		Medium	UK BAP Priority habitat. Priority habitat under Section 7 of the Environment (Wales) Act 2016.

7.7.7 Future baseline scenario

7.7.7.1 The (Marine Works (EIA) Regulations 2007 (as amended)) requires that *"a description of the relevant aspects of the current state of the environment (baseline scenario), and an outline of the likely evolution thereof without implementation of the project, as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the Environmental Statement.

7.7.7.2 In the event that the mWave project does not go ahead, an assessment of the future baseline conditions has been carried out and is described within this section. Variability and long-term changes on physical influences may bring direct and indirect changes to benthic habitats and communities in the mid to long-term future (UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3), 2016). A strong base of evidence indicates that long-term changes in the benthic ecology may be related to long-term changes in the climate or in nutrients (OESEA3, 2016), with climatic process driving shifts in abundances and species composition of benthic communities (Marine Climate Change Impacts Partnership (MCCIP), 2015). Studies of the benthic ecology over the last three decades have shown that biomass has increased by at least 250 to 400%; opportunistic and short-lived species have increased; and long-living sessile animals have decreased (Krönke, 1995; Krönke, 2011). Modelling sea surface temperature in relation to climate change in the UK has shown that the rate of temperature increase over the previous 50 years has been greater in waters off the east coast of the UK compared to the west and this is predicted to continue for the next 50 years (MCCIP, 2013). As such, the baseline in the mWave benthic subtidal and intertidal study area described in section 7.7 can only be considered as a 'snapshot' of the present benthic ecosystem within a gradual yet continuously changing environment. Any changes that may occur during the duration of deployment of mWave should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

7.7.8 Data limitations

7.7.8.1 As discussed in section 7.6, a number of suitable data sources were available for the Pembrokeshire coastline. In addition to this, subtidal and intertidal site specific surveys were undertaken in 2018 and 2019 (SEACAMS, 2018 and Aquatic Survey and Monitoring Ltd. 2019) to characterise the benthic subtidal and intertidal ecology baseline for the purposes of undertaking the EIA (see Chapter 4: Environmental Assessment Methodology). As such a robust data set is available to undertake an assessment of potential effects of the mWave Project.

7.8 Key parameters for assessment

7.8.1.1 The design parameters (from Chapter 2: Project Description) identified in Table 7.9 have been selected as those most likely to have the potential to result in the greatest effect on an identified receptor or receptor group. The benthic subtidal and intertidal ecology assessment has been informed by the assessment presented within Chapter 5: Coastal Processes and will, in turn, be used to inform the following assessments:

- Chapter 8: Fish and Shellfish Ecology;
- Chapter 9: Marine Mammals; and
- Chapter 10: Marine Ornithology.

7.8.2 Impacts scoped out of the assessment

On the basis of the baseline environment and the project description outlined in Chapter 2: Project Description, a number of impacts have been scoped out of the assessment for benthic subtidal and intertidal ecology. These impacts are outlined, together with a justification for scoping them out, in Table 7.10.

Table 7.9: mWave Design Parameters considered for the assessment of potential impacts on benthic subtidal and intertidal ecology.

Potential impact	Design Parameter	Justification
Installation phase		
Temporary habitat disturbance due to installation activities, may affect benthic ecology.	• Temporary disturbance from pre-installed moorings required for installation, 200m x 200m = 40,000m^2 (effect from mWave components are assessed under operation).	Six temporary moorings will be positioned in advance of vessels moving to site to deploy mWave. Two additional temporary moorings will be required for the cable laying vessel at East Pickard Bay. Whilst the mooring spread will be of the order 40,000m^2, the actual area affected will be much less (each mooring comprising an 4m x 4m anchor and 65m of 4.4cm chain) for mWave and smaller moorings for the cable laying vessels. As such this assessment is worst case.
Temporary increases in suspended sediment concentrations (SSCs) and associated sediment deposition due to installation activities, may affect benthic ecology.	• Temporary habitat disturbance arising from mWave gravity base (1032m^2) and ADCP and SUTU (4m^2) and navigational marker buoys if required. • Cable will initially cross sandy substrate and as such there will be temporary disturbance of sediments (approx 210m^2). • Use of four rock bags to stabilise the offshore section of cable route.	No site preparation work is required in advance of deploying mWave. The offshore cable footprint as a whole is 210m^2, of which some will be across rocky substrate. As such these parameters are considered to represent the worst case design scenarios with respect to effects on benthic receptors associated with increased SSC and sediment deposition during installation. Note chain ballast will be placed in tray on mWave and as such will not affect sediments.
Risk of installation activities facilitating the introduction of marine invasive non-native species (INNS).	• A total of 3 vessels, including guard boat, will be required for the deployment of mWave over a 3 day period. • One vessel will be required over 3 days for cable laying and placement of 4 rock bags. • Installation of chain ballast - 14 vessel trips over 5 days (50m max length, 6m draught).	These parameters are considered to represent the worst case scenarios with respect to effects on benthic receptors associated with the introduction of INNS as a result of an increase in vessel movements during the installation phase.
Accidental release of pollutants (e.g. accidental spillage) during installation activities.	• As per installation activities outlined above for the risk of installation activities facilitating the introduction of marine INNS, increased vessel activity has the potential to increase the risk of accidental release of pollutants.	As outlined above for the introduction of marine INNS.
Operational phase		
Habitat loss through presence of infrastructure on the seabed resulting in potential effects on benthic ecology.	• Total footprint for up to 18 months <1900m^2 comprising: – Up to 1032m^2 habitat loss arising from mWave gravity base foundation. – Up to 210 m^2 of subtidal habitat loss from cabling associated with the surface laying of 1,400 m of cable of 0.15 m diameter seaward of mean low water springs. – Total intertidal habitat loss of up to 6.75 m^2 associated with the surface laying of 45 m of cable of 0.15 m diameter between MLWS and MHWS. – ADCP and SUTU - 4m^2 – Use of four rock bags to stabilise the offshore section of cable route – Scour protection (approx 668m^2) - whilst not anticipated an allowance of 2m area around the edge of mWave.	These parameters are considered to represent the worst case design scenario with respect to effects on benthic receptors from habitat loss during the operational phase. Whilst scour protection is not predicted to be required an allowance has been made within the assessment. Scour protection, if required, would constitute rock bags around mWave of devices, assuming up to 100 rock bags around 2m edge of mWave increasing area by approx 668m^2.
Temporary habitat disturbance during the operational phase, may affect benthic ecology.	• Temporary moorings deployed for O&M. Moorings for visiting vessel will comprise four 4m x 4m anchors and 65m of 4.4cm chain. 24 moored visits over 12 month period to same area. Worst case assumption would be anchor spread area of 200m by 200m as for installation. • No temporary intertidal habitat disturbance.	These parameters are considered to represent worst case scenario with respect to effects on benthic receptors from temporary habitat disturbance during the operational phase resulting from the presence of moorings from visiting vessels. The worst case scenario assumes that there is the potential for temporary habitat disturbance within the whole area of the anchor spread, although this is over-precautionary.
Alteration of seabed habitats arising from changes in physical processes, including scour effects and changes to sediment transport, may have effects on benthic ecology.	• Temporary habitat disturbance arising from mWave gravity base (1032m^2) and ADCP and SUTU base (4m^2). • Device gravity foundation will penetrate seabed by 1m. mWave height above seabed 7m. • Cable will initially cross sandy substrate and as such there will be temporary disturbance of sediments (approx 210m^2). • Scour protection (approx 668m^2) - whilst not anticipated an allowance of 2m area around the edge of mWave.	These parameters are considered in Chapter 5: Coastal Processes to represent the worst case scenarios with respect to effects on the metocean regimes and sediment transport pathway
Risk of operational activities facilitating the introduction of marine INNS.	• Physical presence of 76 vessel movements/round trips to port, involving 12 visits once per month with up to 3 vessels, associated with O&M • Deployment of scour protection if needed, 10 vessel visits over 5 days.	These parameters are considered to represent the worst case scenario with respect to effects on benthic receptors associated with the introduction of INNS as a result of an increase in vessel movements during the operational phase.
Accidental release of pollutants (e.g. accidental spillage) on benthic species and	• 76 vessel movements/round trips to and from port, a one visit per month with up to 3 vessels, associated with O&M over a maximum 12 month period.	These parameters are considered to represent the worst case scenario with respect to effects on benthic receptors associated with the potential release of pollutants as a result of an increase in vessel movements during the

Potential impact	Design Parameter	Justification
habitats.	• Deployment of scour protection if needed, 10 vessel visits over 5 days.	installation phase.
Decommissioning phase		
Temporary habitat disturbance due to decommissioning activities, may affect benthic ecology.	• Retrieval scenarios: • Temporary disturbance from pre-installed moorings 200mx200m = 40,000m^2 • Temporary habitat disturbance arising from mWave gravity base (1032m^2). • Temporary habitat disturbance arising from removal of subtidal cable (approx 210m^2). • Temporary habitat disturbance arising from removal of intertidal cable up to 6.75 m^2 associated with the surface laying of 45 m of cable of 0.15 m diameter between MLWS and MHWS. • Temporary disturbance from removal of ADCP/SUTU.	These parameters are considered to represent the worst case scenario with respect to effects on benthic receptors from temporary habitat disturbance during decommissioning activities. Temporary habitat disturbance is only anticipated to arise as a result of the removal of infrastructure from the seabed (including cable) and from mooring spreads for retrieval vessels. •
Temporary increases in SSCs and associated sediment deposition due to decommissioning activities, may affect benthic ecology.	• As per installation activities outlined above for increased SSC and sediment deposition.	These parameters are considered to represent the worst case scenario with respect to effects on benthic receptors associated with increased SSC and sediment deposition during decommissioning.
Risk of decommissioning activities facilitating the introduction of marine INNS.	• As per installation activities outlined above for introduction of INNS.	These parameters are considered to represent the worst case scenario with respect to effects on benthic receptors associated with the introduction of INNS as a result of an increase in vessel movements during the decommissioning phase.
Accidental release of pollutants (e.g. accidental spillage) on benthic species and habitats.	• As per installation activities outlined above for accidental release of pollutants.	As outlined above for the introduction for accidental release of pollutants

Table 7.10: Impacts scoped out of the assessment for benthic subtidal and intertidal ecology.

Potential impact	Justification
Installation phase	
Underwater noise associated with vessels and drilled pin piling during installation may have effects on benthic ecology.	Understanding of the potential effects of underwater noise on invertebrates is relatively underdeveloped (Hawkins *et al*., 2015). There is, however, increasing evidence to suggest that benthic invertebrates are sensitive to particle motion (Roberts *et al.,* 2016; Spiga *et al.,* 2016; Tidau and Briffa, 2016). The vibration levels at which these responses have been observed, however, generally correspond to levels measured near anthropogenic operations such as pile driving and up to 300 m from explosives testing (blasting) (Roberts *et al*., 2016). However, population level and mortality effects are considered unlikely. No blasting, site clearance, trenching or piling will be undertaking during installation. In addition to this the installation phase for mWave is short (up to 3 days) whilst the cable laying will also be up to 3 days, with cable being laid on the seabed. Whilst there will be an increase in noise as a result of vessels on site, this will be short term and unlikely to have a significant effect on the benthic ecology. This impact has been scoped out of the benthic ecology assessment.
Sediment disturbance leading to the potential for resuspension of contaminated sediments may affect benthic ecology.	Whilst the Milford Haven Waterway has a notable industrial history, with major petrochemical and port development along its banks contributing to sediment contamination, the exposed coastal area to the south of the Angle peninsular, where mWave will be deployed, is remote and undeveloped. As such the potential for significant sediment contamination to be present in this area is highly unlikely. As identified in Chapter 2, section 2.5.2, and as assessed in Chapter 5: Coastal Processes, section 5.9.1, the installation method for mWave will require no site preparation, with mWave just being lowered onto, and then its gravity foundation sinking into, the seabed. As such the potential for increase in sediments is negligible and the resulting risk in terms of release of contaminants is also negligible thereby minimising the risk of contaminants to benthic ecology. No further assessment of contamination is proposed.
Operational phase	
Underwater noise associated with operation of wave and tidal devices may have effects on benthic ecology.	This impact has been scoped out of the benthic ecology assessment; see justification provided above for installation phase.
Alteration of intertidal habitats arising from changes in the wave regime associated with wave devices.	The effects of mWave on wave climate has been considered in Chapter 5: Coastal Processes. mWave will sit on the seabed reducing the water depth directly above it to a minimum of 4.2m at MLWS. As such, whilst mWave is predicted to have a localised effect on the wave climate, this localised shallowing should only be discernible under significant storm conditions. The larger waves may break more readily over mWave in storm conditions due to reduced depth, but the wave climate is predicted to return to background inshore of the device, reflecting the local depth. The intertidal ecology in the area is acclimatised to the exposed nature of the coastline, as such, no significant impact is predicted on the intertidal zone and associated benthic receptors for the short duration of deployment.
Decommissioning phase	
Underwater noise associated with vessels during decommissioning may have effects on benthic ecology.	This impact has been scoped out of the benthic ecology assessment; see justification provided above for installation phase.

7.9 Impact assessment methodology

7.9.1 Overview

7.9.1.1 The benthic subtidal and intertidal ecology EIA has followed the methodology set out in Chapter 4: Environmental Impact Assessment Methodology. Specific to the benthic subtidal and intertidal ecology EIA, the following guidance documents have also been considered:

- Guidelines for Ecological Impact Assessment (EcIA) in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018); and
- Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland. Part Four – Wave and Tidal Annex (EMEC and Xodus, 2010).

7.9.1.2 In addition, the benthic subtidal and intertidal ecology EIA has considered the legislative framework as defined by the Wildlife and Countryside Act 1981 (as amended), the EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the Habitats Directive), the Marine and Coastal Access Act, 2009, and the Conservation of Habitats and Species Regulations 2017 (consolidates and updates the Conservation of Habitats and Species regulations 2012).

7.9.2 Impact assessment criteria

7.9.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those which are described in further detail in Chapter 4: Environmental Assessment Methodology.

Magnitude

7.9.2.2 The criteria for defining magnitude in this chapter are outlined in Table 7.11 below.

Table 7.11: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	Large scale or major improvement or resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics, features or elements (Adverse).
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability, minor loss or, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	Very minor benefit to, or positive addition of one or more characteristics, features or elements (Beneficial).
No change	No loss or alteration or characteristics, features or elements; no observable impact in either direction.

Sensitivity

7.9.2.3 The criteria for defining sensitivity in this chapter are outlined in Table 7.12 below.

7.9.2.4 The sensitivity of benthic subtidal and intertidal ecology VERs has been defined as a product of the likelihood of damage (termed intolerance or resistance) due to a pressure and the rate of (or time taken for) recovery (termed recoverability or resilience once the pressure has abated or been removed. Information on these aspects of sensitivity of the benthic subtidal and intertidal ecology VERs to given impacts has been informed by the best available evidence following environmental impact or experimental manipulation in the field and evidence from analogous activities such as those associated with aggregate extraction and Oil and Gas industries. Where applicable, the outputs of the Marine Evidence based Sensitivity Assessment (MarESA) has been drawn upon to support the assessments of sensitivity. These assessments have been combined with the assessed status (i.e. the level of designation/importance) of the affected receptor as defined in Table 7.7 and as presented in Table 7.8.

Table 7.12: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Definition
Very High	VER of Very High or High value with high vulnerability and no ability for recovery.
High	VER of Medium value with high vulnerability and no ability for recovery. VER of Very High or High value with high vulnerability and low recoverability.
Medium	VER of Low value with high vulnerability and no ability for recovery. VER of Medium value with medium to high vulnerability and low recoverability. VER of Very High or High value with medium vulnerability and medium recoverability.
Low	VER of Low value with medium to high vulnerability and low recoverability. VER of Medium value with medium vulnerability and medium to high recoverability. VER of Very High or High value with low/medium vulnerability and high recoverability.
Negligible	VER is not vulnerable to impacts regardless of value/importance. VER of Low value with low vulnerability and medium to high recoverability. VER of Medium value with low vulnerability and high recoverability.

Significance

7.9.2.5 The significance of the effect upon benthic subtidal and intertidal ecology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 7.13. Where a range of significance of effect is presented in Table 7.13, the final assessment for each effect is based upon expert judgement.

7.9.2.6 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Table 7.13: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact				
Sensitivity of receptor		No change	Negligible	Minor	Moderate	Major
	Negligible	Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
	Low	Negligible	Negligible or minor	Negligible or minor	Minor	Minor or moderate
	Medium	Negligible	Negligible or minor	Minor	Moderate	Moderate or major
	High	Negligible	Minor	Minor or moderate	Moderate or major	Major or substantial
	Very high	Negligible	Minor	Moderate or major	Major or substantial	Substantial

7.9.3 Designated sites

7.9.3.1 Where Natura 2000 sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within section 0 of this chapter (with the assessment on the site itself deferred to the NSER for the mWave project).

7.9.3.2 With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site and where notified interest features of the Natura site are also qualifying interest features of the nationally designated sites (e.g. SSSIs which under-pin a Natura 2000 site), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken). However, where a nationally designated site falls outside the boundaries of an international site, but within the benthic subtidal and intertidal ecology study area, an assessment of the impacts on the overall site is made in this chapter using the EIA methodology.

7.9.3.3 The Report to Inform Appropriate Assessment has been prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2016) and will be submitted as part of the Marine Licence application.

7.10 Measures adopted as part of the mWave Project

7.10.1.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on benthic subtidal and intertidal ecology (see Table 7.14). As there is a commitment to implementing these measures, they are considered inherently part of the design of the mWave project and have therefore been considered in the assessment presented in section 7.11 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 7.14: Designed-in measures adopted as part of the mWave project.

Measures adopted as part of the mWave project	Justification
Deployment site located on flat sand substrate and cable route along area of low diversity.	Minimises potential impact on sensitive habitats.
Flat sandy seabed. No requirement for seabed preparation in advance of deployment (section 2.5.2)	Minimises disturbance during installation, potential for increased suspended sediments and noise.
Gravity foundation, simple installation, requires no moorings (section 2.5.2).	Minimises potential for collision, disturbance from noise and suspended sediments.
Cable laid on surface and not trenched offshore (Section 2.5.3).	Minimises disturbance during installation and potential for suspended sediments.
Deployment of mWave on seabed with limited vessel activity during installation and operation.	Minimises potential for collision and pollution incidents.
No external moving parts which may cause impact to marine life (only the membranes at the top of the device inflating and deflating to move air within the device) (section 2.5.2).	Minimises potential for collision and impact on marine ecology.
Due to design (no moorings which create noise or cavitation noise due to mWave operating in air at subsonic speeds) noise levels are anticipated to be lower than conventional WEC (see Chapter 6, Offshore Noise)	WEC design will minimise potential for noise. In addition, gravity foundation with no need for mooring lines reduces noise.
EMP - Environmental Management Plan. The Environmental Management Plan (EMP) will cover both the offshore and onshore elements of the project.	The marine section of EMP will include planning for accidental spills, including measures to reduce the risk of an incident. In addition to this it will include an INNS assessment using NRW-PS Biosecurity Risk Assessment.
EMMP - Environmental Monitoring and Mitigation Plan. The EMMP will cover both the offshore and onshore elements of the project.	Linked closely to the EMP, this document will provide details of any requirements identified within this chapter to minimise potential effects on ecology prior to installation, as well as any recommended monitoring.

7.11 Assessment of significance

7.11.1 Installation phase

7.11.1.1 The impacts of the installation of the mWave project have been assessed on benthic subtidal and intertidal ecology. The potential impacts arising from the installation of the mWave project are listed in Table 7.9, and each installation impact has been assessed in the following section. An overall conclusion of significance of effect is then provided.

7.11.1.2 A description of the potential effect on benthic subtidal and intertidal ecology receptors resulting from each identified impact in Table 7.9 is given below.

Temporary habitat disturbance due to installation activities, may affect benthic ecology

7.11.1.3 The result of the bathymetric survey confirmed that the mWave deployment site is sandy and relatively even in form. As such no pre-installation works are required. As identified in Table 7.9, there will be temporary habitat disturbance as a result of mooring spreads for the two vessels employed in the installation of mWave and for the cable laying vessel at East Pickard Bay.

7.11.1.4 This disturbance of benthic habitats is likely to constitute abrasion/disturbance of the surface of the substratum. Any small epifaunal or other sessile species present on the surface of the seabed may potentially be damaged or destroyed although infauna species within the sandy areas are likely to be largely unaffected.

7.11.1.5 Habitat loss associated with the actual footprint of the mWave, the marine cable and any scour protection, if required at a later date, for the duration of its deployment, is considered separately as an operational phase impact. Temporary habitat disturbance associated with moorings/anchors for the operation and maintenance of the mWave is also assessed separately as an operational impact.

Magnitude of impact

7.11.1.6 As outlined in Table 7.9, the total area within the pre- installed mooring system used for the deployment of mWave and temporary mooring for the cable laying vessel is up to 40,000 m^2. The actual moorings will be of lesser extent, namely for mWave 6 moorings comprising an 4m x 4m anchor and 65m of 4.4cm chain. Bathymetric survey has confirmed that the deployment site and surrounding area is clean sand, which will be of lower species diversity. Drop down video camera survey at East Pickard Bay confirmed that there are no species or features of notable marine nature conservation importance and none of the habitats and species seen were considered especially vulnerable or sensitive to the expected physical effects of the cable deployment.

7.11.1.7 The impact of temporary disturbance to benthic habitats from vessel mooring activities during the installation phase is predicted to be of local spatial extent, of short-term duration and reversible. It is predicted that the impact will affect the benthic receptors directly. The magnitude is therefore, considered to be minor (adverse).

Sensitivity of the receptor

7.11.1.8 The benthic subtidal VERs with the potential to be affected by temporary habitat disturbance during installation activities are Annex I subtidal reef and circalittoral coarse sediment habitat. As discussed in Section 7.7.3 et *seq*. the mWave site does not overlap with Annex I reef habitat and the cable route is across a rocky area of low species diversity and abundance.

Annex I subtidal reef VER

7.11.1.9 With respect to the Annex I reef VER as discussed previously the predominant subtidal biotope which is likely to be present in association with the Annex I subtidal reef VER is the CR.HCR.XFa.ByErSp biotope. It is anticipated that the benthic epifloral and epifaunal species associated with the rocky substrate would be temporarily lost within the footprints of the temporary mooring points and therefore the resistance of these habitats is considered to be none (high vulnerability).

7.11.1.10 On the basis that the extent of the temporary habitat loss associated with the moorings for the marine cable laying will be of limited spatial extent and large areas will remain unaffected in the vicinity, local recruitment, augmented by dormant resistant stages and asexual reproduction, is likely to result in rapid recovery of the dominant bryozoan species, hydroids, probably within 12 months. Colonial ascidians would probably recover their original cover with two years, while sponges and anemones may take longer to recover but would probably regain original cover within five years (Readman, 2016a). On this basis, resilience/recoverability is assessed as medium following the removal of the moorings from the seabed.

7.11.1.11 The Annex I subtidal reef VER is deemed to be of high vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be medium.

Circalittoral coarse sediment VER

7.11.1.12 As identified in Table 7.8, Circalittoral coarse sediment is a UK BAP Priority habitat of Medium value. Within the study area the Circalittoral coarse sediment (SS.SCS.CCS) is likely to be characterised by the biotopes SS.SSa.IFiSa.NcirBat and SS.SSa.IMuSa.FfabMag.

7.11.1.13 *A* review of the MarESA assessment for the pressure '*abrasion/disturbance of the surface of the substratum or seabed'* for these biotopes concludes that the overall sensitivity for all to temporary habitat disturbance of this nature is cons*idered to be low (Tillin and Budd, 2016; Tillin and Ashley, 2016;* De-Bastos and Marshall, 2016; Tillin and Rayment, 2016a; Tillin, 2016). This is on the basis that many of the characterising species of these sediments are infaunal and will therefore be largely unaffected by disturbance of the seabed surface from moorings. Any epifauna and epiflora may, however, be damaged/displaced by vessel anchoring and resistance is therefore likely to be medium. The resilience/recovery of these biotopes following cessation of the disturbance is likely to be high (i.e. recovery within two years) for these communities as opportunistic species will likely recruit rapidly back to disturbed areas and some damaged characterising species may recover or recolonise.

7.11.1.14 To conclude, the circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore considered to be low.

Significance of the effect

VER	Sensitivity	Magnitude	Overall significance
Circalittoral coarse sand	Low	Minor	Negligible
Annex I subtidal 'reef'	Medium	Minor	Minor
Annex I intertidal 'reef	N/A	N/A	N/A

7.11.1.15 The overall effect on circalittoral coarse sand from the installation of mWave will, therefore, be of **negligible significance**, which is not significant in EIA terms.

Temporary increases in SSCs and associated sediment deposition due to installation activities, may affect benthic ecology

7.11.1.16 Sediment disturbance may arise from a range of installation activities within the site, such as gravity base installation and cable laying (see Table 7.9). The placement of the ADCP and SUTU, rock bags for stabilising the cable, navigational marker buoys (if required), and vessel movements in shallower water (cable laying) may also lead to very short-term increases in SSC.

7.11.1.17 This sediment disturbance has the potential to result in temporary changes in the levels of suspended sediment within the water column (i.e. increased turbidity levels) which, under certain conditions, have adverse effects on the marine flora and fauna. Increased SSC can affect filter feeding organisms through clogging and damaging feeding and breathing apparatus (Frid and Caswell, 2017). Disturbance of sediments will also cause some sediment deposition potentially resulting in the smothering of benthic species and habitats.

Magnitude of impact

7.11.1.18 As identified in Chapter 2 Project Description, bathymetry data for the deployment site (Titan 2018) confirmed that it is flat uniform sand. No site preparation will therefore be required in advance of deployment. The mWave device would be floated to site and then one end would be gently lowered to the seabed on a winch. Once one end is on the seabed, the process will be repeated with the other end of the device (Chapter 2, section 2.5.2). The marine communication cable will be laid on the seabed and four rock bags will be used as weights to maintain the cables position within sandy sediment. These installation activities are short term (three days each) and sediment disturbance from these activities will be of very limited extent and of short duration. As such, it is anticipated that the increase in suspended solids during installation activities will be minimal. Likewise if scour protection were required at some time during the deployment period, a one-off placement of rock bags on the seabed around the mWave would cause short term localised increases in sediments.

7.11.1.19 In order to gain an understanding of the distance any disturbed sediments could travel, an estimation was approximated by examining a theoretical volume of material mobilised, the current speed and the bed material which is dominated by medium to fine sandy material. The precise extent of any sediment movement would be controlled by the tidal conditions at the time of disturbance (see Chapter 5: Coastal Processes).

7.11.1.20 To illustrate this an intrusive installation method was reviewed. The results showed that the 1 mm sand material would travel in the order of 50m from the site during an average tide. The coarsest material would travel less than one fifth of this distance prior to settling and any finer material (0.06 mm) would travel in the order of 600m during an average tide based on the average site current speed. The coarser material would settle within a relatively short period after the works are complete i.e. < 1 hour with the finer fractions settling in around 2 hours.

7.11.1.21 The installation of mWave does not require any seabed preparation or cable trenching, and as such there will be negligible magnitude of impact from increased suspended solids.

7.11.1.22 It is therefore concluded that the impact of temporary increases in SSC and associated sediment deposition as a result of installation activities is predicted to be of local spatial extent and short-term duration. It is predicted that the impact will affect the receptors indirectly, but the extent will be limited. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

7.11.1.23 The subtidal benthic VER with the potential to be affected by temporary increases in SSC and sediment deposition during mWave installation activities are circalittoral coarse sediment habitats off East Pickard Bay and Annex I Reef VERs.

Annex I subtidal reef VER

7.11.1.24 With respect to the Annex I subtidal reef VER, the predominant subtidal biotope which is likely to be present in association with the Annex I subtidal reef VER is the CR.HCR.XFa.ByErSp biotope. (Note: drop down camera survey of the cable route which crossed a section of subtidal reef indicated that the habitats and communities in this rocky area were relatively low in diversity due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval.)

7.11.1.25 It is predicted that the benthic communities potentially associated with the rocky substrate in the vicinity of East Pickard Bay will have a low resistance (high vulnerability) and medium recoverability to temporary increases in SSCs. Characterising species such as bryozoans (e.g. *F. foliacea*) are suspension feeders that may be adversely affected by increases in suspended sediment, due to clogging of their feeding apparatus although many encrusting sponges appear to be able to survive in highly sedimented conditions (Readman, 2016a). As this habitat tends to occur in areas of high energy, an increase in suspended sediment will result in an increase in scour. While some sponges and Flustra are probably resistant of scour, other fragile sponges, and bryozoans may be removed. Smothering is likely to cause limited mortality amongst some of characterising species, particularly the smaller sponges. However, due to the moderate to strong water movement at East Pickard Bay, the removal of the deposited sediment is likely to be rapid.

7.11.1.26 Overall, the Annex I subtidal 'reefs' VER is deemed to be of medium to high vulnerability, medium to high recoverability and very high value. The sensitivity of the receptor is therefore, considered to be low.

Annex I intertidal reef VER

7.11.1.27 As discussed previously, the predominant intertidal biotopes which are likely to be present in association with the Annex I intertidal reef VER are the IR.HIR.KFaR.Ala.Ldig/ MIR.KR.Ldig.Ldig and LR.HLR.MusB.Sem biotopes. The MarESAs for these biotopes (Perry and d'Avack, 2015; d'Avack and Marshall, 2015a; Stamp, 2015; Tillin and Hill, 2016) indicates the resistance/vulnerability is medium and recoverability high. Increased SSC can reduce the photosynthetic capacity of algal species and, in turbid waters the feeding apparatus of suspension feeders (e.g. barnacles and limpets) may become clogged. However, once baseline conditions return to normal, photosynthesis and growth rates of fucoids and kelps will resume.

7.11.1.28 With respect to sensitivity to smothering, fucoids are attached to the substratum by a holdfast and are thus not able to relocate in response to increased sedimentation and smothering of bedrock can impede attachment of *Fucus* embryos as well as decrease survival and growth of juveniles. However, the state of the tide and the coastal topography will determine the extent of the impact. For instance if smothering occurs at low tide when the algae are lying flat on the substratum, then most of the organism as well as the associated community will be covered by the deposition of fine material However, if the topography of the coastal area is rocky or steep (as at East Pickard Bay) then the algae are less likely to be smothered as they hang down from rocks. If smothering occurs whilst the alga is submerged standing upright then the photosynthetic surfaces of adult plants will be left uncovered (Perry and d'Avack, 2015; d'Avack and Marshall, 2015a).

7.11.1.29 Overall, the Annex I intertidal 'reefs' VER is deemed to be of low vulnerability, high recoverability and very high value. The sensitivity of the receptor is therefore, considered to be low.

Circalittoral coarse sediment VER

7.11.1.30 As identified in Table 7.8, Circalittoral coarse sediment (SS.SCS.CCS) is a UK BAP Priority habitat of Medium value which is present within the mWave deployment site. A review of the *MarES*A assessment for the pressures 'changes in suspended solids (water clarity) and 'smothering and siltation rate changes (light)' for biotopes associated with sandy substrate concludes that the overall sensitivity for all to increased SSC and smothering is low (Tillin and Budd, 2016; Tillin and Ashley, 2016; De-Bastos and Marshall, 2016; Tillin and Rayment, 2016a; Tillin, 2016). This is on the basis that many of the characterising species of these sediments and habitats are infaunal and will therefore be largely unaffected by changes to the water clarity. For instance polychaetes are deposit feeders and are therefore unlikely to be affected in changes in the light penetration in the water column and would recover rapidly following changes to food availability. The bivalves of the SS.SSa.CMuSa.AalbNuc and SS.SSa.IMuSa.FfabMag biotopes are tolerant of short-term increases in turbidity following sediment mobilisation by storms and other events for example (Tillin and Budd, 2016; Tillin and Rayment, 2016a) and so are considered likely to be tolerant of the short term increases in SSC. Resistance/vulnerability to increased SSC is considered to be low and recoverability high following a return to baseline conditions.

7.11.1.31 With respect to sediment deposition, as the local hydrodynamic conditions are not predicted to be affected by the installation works, it is expected that fine particles will be removed by wave or tidal action. Furthermore, most infaunal bivalves and polychaete species are capable of burrowing through sediment to feed and although there may be an energetic cost to species as a result of this, is not likely to be significant (Tillin and Budd, 2016; Tillin and Rayment, 2016a). Resistance/vulnerability to increased SSC is considered to be low and recoverability high following a return to baseline conditions.

7.11.1.32 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of the effect

VER	sensitivity	Magnitude	Overall significance
Circalittoral coarse sand	Low	Negligible	Negligible
Annex I subtidal 'reef'	low	Negligible	Negligible
Annex I intertidal 'reef	Low	Negligible	Negligible

7.11.1.33 The overall effect of the temporary increase in suspended solids as a result of installation of the mWave project will, therefore, be of **negligible significance**, which is not significant in EIA terms.

Risk of installation activities facilitating the introduction of marine INNS

7.11.1.34 There is a risk of the introduction and spread of marine INNS during installation activities as a result of increased vessel movements. Vessels can act as a vector for INNS by allowing the colonisation of species from other geographical areas either as marine fouling on the vessel hull or following entrainment into the vessel through seawater intakes (for ballast water) that can in turn upset the ecological balance of local communities.

Magnitude of impact

7.11.1.35 As outlined in Table 7.9, the installation of mWave is anticipated to require up to 3 vessel movements/round trips to port over a three day period, 14 vessel trips over 5 days for chain ballast, with the cable requiring one vessel over three days.

7.11.1.36 As presented in Chapter 12: Shipping and Navigation, whilst the current baseline level of vessel traffic within the Waterway is high (where the installation vessels will be originating), and vessels routinely transit both north and south out of the Waterway, the current levels of vessel traffic are lower off East Pickard Bay.

7.11.1.37 The vessels employed in installation activities will be local to the Waterway, thereby limiting the potential for the introduction of new marine INNS to the area via this pathway. Vessels (commercial and recreational) from the Waterway routinely traverse southwards along the coast, and as such the additional few vessel trips for the installation of mWave should be barely perceptible with respect to vessel movements and potential for transference of INNS. In addition to this, as detailed in Table 7.14, an Biosecurity Risk Assessment following NRW-PS guidance will be will also be prepared for the project, which will further reduce the likelihood of a marine INNS being taken from the Ports within the Waterway to East Pickard Bay.

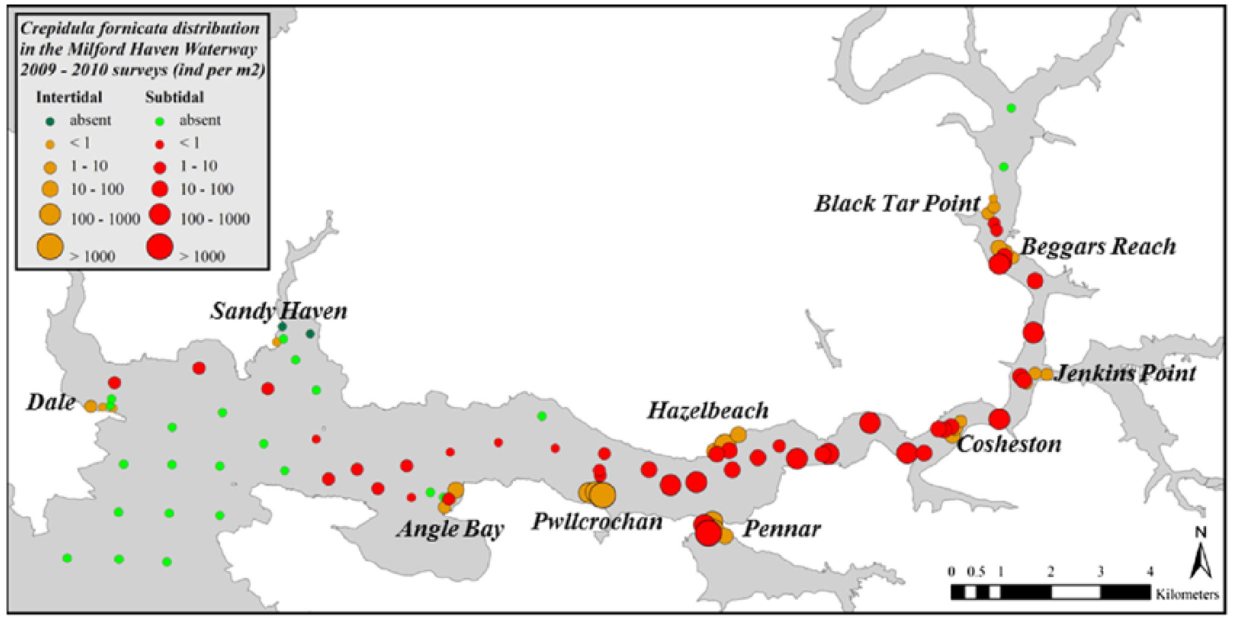
7.11.1.38 The impact of introduction of marine INNS associated with vessel traffic is therefore predicted to be of local spatial extent, will have a limited potential to occur (few vessel movements) and if transference of species does occur, it will be of short-term duration and irreversible. It is predicted that the impact will affect the receptors indirectly. The magnitude is therefore considered to be no change to negligible.

Sensitivity of the receptor

All benthic subtidal VERs outlined in Table 7.8 have the potential to be affected by the introduction of marine INNS during installation activities to varying degrees.

7.11.1.39 The GB non native species secretariat[1] identifies that the slipper limpet, *C. fornicata*, can be found on a range of seabed types, most abundant in areas of muddy seabed, with hard surfaces such as shells and cobbles. It states that it prefers areas sheltered from wave action such as inlets, bays and estuaries but also will occur on hard substrates and exposed areas in lower densities, both intertidally and below the low-water mark.

7.11.1.40 The image below, from surveys undertaken in 2009 - 2010, shows that slipper limpet is well established, particularly in the inner reaches of the Waterway (Bohn *et al.*, 2015). Interestingly, slipper limpet was absent from the entrance of the Waterway possibly due to the lack of suitable settlement substrate.



[1] http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1028

7.11.1.41 Earlier research also showed that whilst the slipper limpet (*C. fornicata)* was recorded in the Waterway as early as 1953 (Cole and Baird 1953), natural expansion from the area has been extremely slow and limited in extent (Bohn, 2014). It was considered that a combination of factors including prevailing environmental conditions, the species' physiological tolerances and biotic interactions will determine the geographic range of a species. With respect to the presence of substantial populations in the Waterway, the data suggests that slipper limpet population growth and potential expansion in Welsh coastal waters is not fully limited by prevailing environmental conditions in the region, but that other processes may affect its local distribution.

7.11.1.42 As such, although the sensitivity of the component biotopes present in the area to INNS on MarESA is considered to be high, on the basis of their low resistance (i.e. high vulnerability) and very low resilience/recoverability to colonisation by slipper limpet, the additional risk posed by other INNS is considered to be low.

7.11.1.43 As identified above the slipper limpet appears limited in its extent within the Waterway, and whilst is can occur on hard substrates and exposed areas it will be in lower densities.

7.11.1.44 Taking this into consideration, the Annex I 'subtidal and subtidal reefs' VER is deemed to be of high vulnerability (as it is not a preferred habitat), very low recoverability and very high value. The sensitivity of the receptor is therefore, considered to be high. In terms of the circalittoral coarse sediment VER, this is deemed to be of high/very high vulnerability, very low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of the effect

VER	sensitivity	Magnitude	Overall significance
Circalittoral coarse sand	medium	negligible	Negligible
Annex I subtidal 'reef'	high	negligible	Negligible or minor
Annex I intertidal 'reef	high	negligible	Negligible or minor

7.11.1.45 The potential effect of spreading INNS as a result of the installation of the mWave project we, therefore, be of **negligible to minor significance**, which is not significant in EIA terms.

7.11.1.46 As identified in Table 7.9, whilst only a limited number of vessels will be required for the mWave installation phase, measures will be put in place to minimise the spread of INNS. An Biosecurity risk assessment will be prepared and will form part of the EMP (Table 7.14).

Future monitoring

7.11.1.47 No benthic ecology and subtidal ecology monitoring to test the predictions made within the installation phase impact assessment is considered necessary.

Accidental release of pollutants (e.g. accidental spillage) during installation activities

Magnitude of impact

7.11.1.48 There is the potential for the accidental release of pollutants and debris into the marine environment during installation works, as a result of accidental spillage or leakage for example. Pollution may include diesel oil from installation vessels, chemicals and lubricants.

7.11.1.49 This risk of pollution events will, however, be minimised by the implementation of an EMP during installation. As outlined in Table 7.14, the EMP will include planning for accidental spills via a Marine Pollution Contingency Plan (MPCP), which will address all potential contaminant releases and include key emergency contact details (e.g. NRW, MHPA and MCA). Furthermore, any lubricants used will be EU/internationally approved for use in marine environments (Chapter 2: Project Description). Adherence to the measures outlined in the EMP, as well as standard best practice guidance and Guidance for Pollution Prevention (GPP), would significantly reduce the likelihood of an accidental pollution incident occurring and impacting the coastal waters off East Pickard Bay. Measures adopted as part of the mWave project to reduce the potential for impacts on shipping and navigation (see chapter 12: Shipping and Navigation), such as the issue of Notices to Mariners and vessels complying with the International Regulations for Preventing Collisions at Sea (COLREGs) will further reduce the likelihood of an accident between vessels resulting in an accidental diesel spill during installation activities.

7.11.1.50 During the installation phase, there will be up to 3 vessels (including guard boat) required for the installation of mWave over 3 days, 14 trips vessel trips over 5 days for chain ballast, and one vessel for cable laying over a maximum of 3 days. As mWave will be towed around the coast from Milford Haven Waterway, the sea conditions for installation will have to be good, with good visibility. Overall, with the limited number of vessels involved in installation phase, the use of a guard boat and the slow moving nature of the activity, the potential of an accidental pollution event occurring is considered to be unlikely. In the unlikely event that pollutants did enter the coastal waters off East Pickard Bay, they would be rapidly dispersed on the surface and in the water column so any effects on water quality would likely be limited.

7.11.1.51 The impact of an accidental pollution event occurring during installation activities is therefore predicted to be of local spatial extent, of short-term duration and reversible. It is predicted that the impact will affect the receptors indirectly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

7.11.1.52 All benthic subtidal and intertidal VERs outlined in Table 7.8 have the potential to be affected by an accidental spill event during installation activities. The sensitivity of most benthic receptors to the range of contaminants likely to occur during accidental pollution has been described previously.

Annex I subtidal reef VER

7.11.1.53 The Annex I 'reef' VER is deemed to be of low vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be low.

Annex I intertidal reef VER

7.11.1.54 The Annex I intertidal 'reef' VER is deemed to be of medium vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be medium.

Circalittoral coarse sediment VER

7.11.1.55 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of effect

VER	Sensitivity	Magnitude	Overall Significance
Annex I subtidal 'reef'	Low	Negligible	Negligible
Annex I intertidal 'reef	Medium	Negligible	Minor
Circalittoral coarse sand	Low	Negligible	Negligible

7.11.2 Operational and maintenance phase

7.11.2.1 The impacts of the operation and maintenance of the mWave project has been assessed on benthic subtidal and intertidal ecology. The environmental impacts arising from the operation and maintenance of the mWave Project are listed in Table 7.9 against which impacts have been assessed and a conclusion of significance of effect is provided.

7.11.2.2 A description of the potential effect on benthic subtidal and intertidal ecology receptors resulting from each identified impact is given below.

Habitat loss through presence of infrastructure on the seabed resulting in potential effects on benthic ecology

7.11.2.3 Benthic subtidal and intertidal habitat loss will occur directly under the mWave gravity foundation, within the footprints of the ADCP monitoring device, SUTU connector and within the footprint of the marine cable and associated rock bags. Whilst scour protection is not anticipated to be required, and allowance for rock bags around the edge of mWave has been included within the assessment.

Magnitude of impact

7.11.2.4 As outlined in Table 7.9, the maximum footprint of mWave device/components/cables is up to 1,900 m^2. Of this, approximately 1,032m^2 would be as a result of the footprint of the mWave device, and potentially 2m width of scour protection around the edge of mWave, with the remainder being as a result of the marine cable, SUTU and ADCP monitoring device. Therefore, only a very small proportion of the seabed will be affected. It is also important to note that testing is anticipated to be for 6 -12 months, whilst the marine licence is being sought for 18 months to allow for installation and decommissioning. As such, the habitat loss during the operation/testing of the devices will only be short-term and temporary.

7.11.2.5 As described in Table 7.9, up to 210 m^2 of subtidal habitat loss is predicted associated with the surface laying of 1,400m of cable seaward of MLWS. The surface laying of 45 m of cable in the intertidal area between MLWS and MHWS is predicted to result in habitat loss of up to 6.75 m^2. This habitat loss is also predicted to be a one-off, short-term event with the maximum design scenario for the duration of this infrastructure on the seabed being up to 18 months (see Table 7.9).

7.11.2.6 The impact of habitat loss to benthic subtidal and intertidal habitats from the presence of mWave and associated infrastructure on the seabed is predicted to be of very local spatial extent, of short-term duration and reversible. It is predicted that the impact will affect the benthic receptors directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

7.11.2.7 The benthic subtidal VER with the potential to be affected by habitat loss during device/component operation at the mWave site is Annex I reef habitat and circalittoral coarse sediment habitats. There is not anticipated to be any direct impacts on the submerged or partially submerged sea caves VER on the basis that the cable will avoid such areas. In terms of the cable route to shore the drop down video camera survey confirmed that the habitats and communities across the bedrock reef approaching East Pickard Bay cable landfall point were relatively low in diversity, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval.

Annex I subtidal reef VER

7.11.2.8 With respect to the Annex I reef VER as discussed previously the predominant subtidal biotope which is likely to be present in association with the Annex I subtidal reef VER is the CR.HCR.XFa.ByErSp biotope. It is anticipated that the benthic epifloral and epifaunal species associated with the rocky substrate would be temporarily lost within the footprints of the infrastructure and therefore the resistance of these habitats is considered to be none (high vulnerability).

7.11.2.9 The MarESA for this biotope (Readman, 2016a) describes that the majority of the bryozoan and hydroid species within this biotope have short-lived pelagic larvae, with limited powers of dispersal, resulting in good local recruitment. Bryozoans and hydroids are often opportunistic, fouling species, that colonise and occupy space rapidly. Hydroids would probably recolonise within three months and return to their original cover rapidly, while *Bugula* species of hydroids have been reported to colonise new habitats within six to twelve months. However, *Bugula* has also been noted to be absent from available habitat even when large populations are nearby, therefore recruitment may be more sporadic (Readman, 2016a).

7.11.2.10 On the basis that the extent of the temporary habitat loss associated with mWave marine cable will be of limited spatial extent and large areas will remain unaffected in the vicinity, local recruitment, augmented by dormant resistant stages and asexual reproduction, is likely to result in rapid recovery of the dominant bryozoan species, hydroids, probably within 12 months. Colonial ascidians would probably recover their original cover with two years, while sponges and anemones may take longer to recover but would probably regain original cover within five years (Readman, 2016a). On this basis, resilience/recoverability is assessed as medium following the removal of the infrastructure from the seabed.

7.11.2.11 The Annex I subtidal reef VER is deemed to be of high vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be medium.

Annex I intertidal reef VER

7.11.2.12 As discussed previously the predominant intertidal biotopes which are likely to be present in association with the Annex I intertidal reef VER at the landfall of the marine cable are the IR.HIR.KFaR.Ala.Ldig and LR.HLR.MusB.Sem biotopes. The MarESAs for these biotopes (Stamp, 2015; Tillin and Hill, 2016) indicates the resilience/recoverability once the infrastructure is removed from the substrate is predicted to be medium. Most of the characterising animal species of the mussel dominated communities produce pelagic larvae and, as these are common, widespread species, and the footprint of the impact is relatively small, larval supply from adjacent populations is predicted to support recolonisation (Tillin and Hill, 2016).

7.11.2.13 The kelp species *Alaria esculenta*, occurring in the sublittoral fringe, is an opportunistic colonising species which often appears early in algal succession and in kelp clearance experiments *Laminaria digitate* has been shown to have re-established within two years (Tillin and Hill, 2016). Common understory species such as encrusting coralline algae and *Corallina officinalis* turf are also capable of colonising substratum quickly (Tillin and Hill, 2016). The resilience/recoverability of these communities is therefore considered to be high.

7.11.2.14 The Annex I intertidal reef VER is deemed to be of high vulnerability, high recoverability and very high value. The sensitivity of the receptor is therefore, considered to be low.

Circalittoral coarse sediment VERs

7.11.2.1 As identified in Table 7.8, Circalittoral coarse sediment is a UK BAP Priority habitat of medium value. Within the study area the Circalittoral coarse sediment (SS.SCS.OCS) is characterised by the biotope SS.SSa.IFiSa.NcirBat and SS.SSa.IMuSa.FfabMag.

7.11.2.2 However, whereas impacts such as habitat loss are often considered as a permanent impact, in the case of the mWave project the impact is only short-term (up to 18 months). Therefore, the resilience/recoverability of the underlying communities is relevant to this impact. The resilience/recoverability of the component biotopes of the affected VERs is as described previously for temporary habitat disturbance during the installation phase i.e. recoverability is likely to be high following removal of the infrastructure.

7.11.2.3 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of the effect

VER	Sensitivity	Magnitude	Overall Significance
Circalittoral coarse sand	Low	Negligible	Negligible
Annex I subtidal 'reef'	Medium	Minor	Minor
Annex I intertidal 'reef	Low	Minor	Minor

7.11.2.4 Overall, the effect of installation of the mWave project on cicalittoral coarse sediment will, therefore, be of **negligible to minor significance**, which is not significant in EIA terms.

Temporary habitat disturbance during the operational phase, may affect benthic ecology

7.11.2.5 As outlined in Table 7.9, the use of mooring spreads to anchor vessels visiting the site has the potential to result in temporary disturbance to benthic habitats and communities for the duration of the deployment of mWave. The disturbance of benthic habitats is likely to constitute abrasion/disturbance of the surface of the substratum. Any small epifaunal or other sessile species present on the surface of the seabed may potentially be damaged or destroyed although infauna species are likely to be largely unaffected.

Magnitude of impact

7.11.2.6 As outlined in Table 7.9, moorings for visiting vessel will comprising two 4m x 4m anchors and 65m of 4.4cm chain there will be three vessels (not all requiring mooring) visiting over 2 days once a month for the duration of the testing, which will be 6 - 12 months.

7.11.2.7 The impact of temporary disturbance to benthic habitats from vessel mooring activities during the installation phase is predicted to be of local spatial extent, of short-term duration and reversible. It is predicted that the impact will affect the benthic receptors directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

7.11.2.8 The benthic subtidal VERs with the potential to be affected by temporary habitat disturbance during the operational phase are the same as those described previously for the installation phase activities i.e. circalittoral coarse sediment habitats. The mWave site is situated on sandy sediments and as such does not overlap with Annex I reef habitat.

Circalittoral coarse sediment VERs

7.11.2.9 The sensitivity of the VERs to temporary habitat disturbance as a result of moorings is as described in previously under installation impacts.

7.11.2.10 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of the effect

VER	Sensitivity	Magnitude	Overall Significance
Circalittoral coarse sand	Low	Minor	Negligible
Annex I subtidal 'reef'	N/A	N/A	N/A
Annex I intertidal 'reef	N/A	N/A	N/A

Alteration of seabed habitats arising from changes in physical processes, including scour effects and changes to sediment transport, may have effects on benthic ecology

Magnitude of impact

7.11.2.11 As outlined in Chapter 5: Coastal Processes, interaction between the metocean regime (wave, sand and currents) and marine energy devices has the potential to cause localised scouring of seabed sediments leaving a depression around the structures.

7.11.2.12 The mWave WEC has been designed to sit on the seabed, using a gravity foundation which will settle into the sand up to 1m to keep it in place. Initial calculations have been undertaken for the scour defined above and it is anticipated that any scour will be concentrated along the edges of the device. The predictions calculate that scour could occur up to a maximum depth of up to 1.4m and a maximum width of up to 4.8m at the deepest point then graduating up to normal seabed level. As such any effects will be localised.

7.11.2.13 In terms of sediment transport pathways, gravity foundations used for marine energy devices may interrupt sediment transport pathways. At the mWave deployment site, the principle direction of bed load sediment transport in this area is west to east and therefore the width of obstruction will be the smallest axis of the device namely < 20 m.

7.11.2.14 This is insignificant with respect to this open coast site. In addition to this it should be noted that the mWave deployment is temporary, and after decommissioning with the removal of the device the pathway will be restored.

7.11.2.15 In terms of wave climate, there will be a localised reduction in water depth above the mWave device, with a minimum water depth of 4.2m at MLWS. An assessment of the potential for waves to break above mWave was undertaken in Chapter 5 Coastal Processes. The results demonstrated that the reduction in water depth above mWave would not generally be expected to result in the waves breaking above the device. However, during significant storm events, whilst waves would be expected to break passing over mWave, the sudden increase in depth of water (increased by 7m) adjacent to mWave is likely to limit the extent of breaking to the immediate area of the device.

7.11.2.16 Overall in respect to changes to sediment transport pathways and wave climate, based on the scale of mWave, that the deployment will be temporary and, after decommissioning, the pathway will be restored, the coastal processes assessment concluded that the magnitude of the impact on sediment transport pathways is considered to be minor.

7.11.2.17 The impact of changes to physical processes on benthic receptors is therefore predicted to be of local spatial extent, of short-term duration and reversible. It is predicted that the impact will affect the receptors indirectly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

7.11.2.18 Due to the limited extent of effect from the mWave device both in terms of sediment transport and wave climate, the Annex I reef located some 200m to the north of mWave will not be affected by any localised effects. As such, the benthic subtidal VER with the potential to be affected by changes in physical processes during the operational phase will be the circalittoral coarse sediment habitats.

Circalittoral coarse sediment VERs

7.11.2.19 As discussed in the baseline, Section 7.7.3, data available on EMODnet which indicate that the coarse sands in this area are characterised by the *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand' biotope (SS.SSa.IFiSa.NcirBat) and the '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand' biotope (SS.SSa.IMuSa.FfabMag).

7.11.2.20 According to the MarESA assessments for these biotopes, the benthic infaunal and epifaunal species associated with these sediments are not sensitive to local changes in water flow at the benchmark level (which is a change in peak mean spring bed flow velocity of between 0.1 m/s to 0.2 m/s for more than one year) (Tillin and Budd, 2016; Tillin and Ashley, 2016; De-Bastos and Marshall, 2016; Tillin and Rayment, 2016; Tillin, 2016). These biotopes typically occur in areas naturally subject to moderately strong and weak water flows and resistance to changes in flow is likely to be high.

7.11.2.21 The circalittoral coarse sediment VER is deemed to be of low vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be negligible.

Significance of the effect

VER	Sensitivity	Magnitude	Overall Significance
Circalittoral coarse sand	Negligible	Negligible	Negligible
Annex I subtidal 'reef'	N/A	N/A	N/A
Annex I intertidal 'reef	N/A	N/A	N/A

Risk of operational activities facilitating the introduction of marine INNS

7.11.2.22 There is a risk of the introduction and spread of marine INNS during operational activities associated with mWave. In particular, that infrastructure placed on the seabed has the potential to act as ecological 'stepping stones' facilitating the spread of pelagic larval particles that would otherwise have been lost offshore and allowing the transgression of natural biogeographical boundaries (Adams *et al*., 2014)

Magnitude of impact

7.11.2.23 As outlined in Table 7.9, mWave will be deployed off East Pickard Bay for a short duration (18 months) which will limit the opportunity for the device to facilitate the introduction/spread of INNS.

7.11.2.24 In terms of vessel movements during operation, it is anticipated that there will be around 76 vessel movements/round trips to port, involving up to 3 vessels, during the testing period (6-12 months). In addition, if scour protection is installed this would entail around 10 vessels trips over 5 days. Although this is more than that required during installation, the vessels employed in operation and maintenance activities are likely to be local and originating from Milford Haven Waterway. This will therefore, limit the potential for the introduction of new marine INNS to the area via this pathway.

7.11.2.25 The impact of introduction of marine INNS associated with the operational phase is therefore predicted to be of local spatial extent and, if it occurs, of short-term duration, continuous and irreversible. It is predicted that the impact will affect the receptors indirectly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

7.11.2.26 As discussed previously, slipper limpet has been present in the Waterway for many decades (since 1953) but its geographical extent appears to be generally limited to within the Waterway. Whilst vessels have been operating from the Waterway over this period there are limited records of slipper limpet along the wider coast indicating that slipper limpet population growth and potential expansion in Welsh coastal waters is not fully limited by prevailing environmental conditions in the region, but that other processes may affect its local distribution.

7.11.2.27 The Annex I 'subtidal and intertidal reefs' VER is deemed to be of high/very high vulnerability, very low recoverability and very high value. The sensitivity of this receptor is therefore, considered to be high.

7.11.2.28 The circalittoral coarse sediment VER is deemed to be of high/very high vulnerability, very low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of the effect

VER	Sensitivity	Magnitude	Overall Significance
Circalittoral coarse sand	Medium	Minor	**Negligible**
Annex I subtidal 'reef'	High	Negligible	**Minor**
Annex I intertidal 'reef	High	Negligible	**Minor**

7.11.2.29 The potential effect of spreading INNS as a result of the operation of the mWave project is therefore, of **negligible to minor significance**, which is not significant in EIA terms.

7.11.2.30 As identified in Table 7.9, whilst the operation and maintenance phase will only be for 6 - 12 months, requiring only a limited number of vessels, measures will be put in place to minimise the spread of INNS. As detailed in Table 7.14, an Biosecurity Risk Assessment following NRW-PS guidance will be prepared for the Project which will further reduce the likelihood of a marine INNS being introduced to the area.

Future monitoring

7.11.2.31 No benthic subtidal and intertidal ecology monitoring to test the predictions made within the operational phase impact assessment is considered necessary.

Accidental release of pollutants (e.g. accidental spillage) during operation and maintenance activities

Magnitude of impact

7.11.2.32 There is the potential for the accidental release of pollutants and debris into the marine environment during operation and maintenance works, as a result of accidental spillage or leakage for example. Pollution may include diesel oil from maintenance vessels and chemicals/lubricants from the devices/components themselves during deployment.

7.11.2.33 As discussed previously in paragraph 7.11.1.48 *et seq*. for the installation phase, the risk of pollution events will be minimised by the implementation of an EMP during the operation and maintenance phase. As outlined in Table 7.14, the EMP will include planning for accidental spills via a MPCP and any lubricants used will be EU/internationally approved for use in marine environments (Chapter 2: Project Description). Adherence to the measures outlined in the EMP, as well as standard best practice guidance will significantly reduce the likelihood of an accidental pollution incident occurring and impacting the coastal waters.

7.11.2.34 Whilst vessel movements during the operational and maintenance phase increases up to 76 within the year, it is anticipated that there will be only one visit per month with three vessels over a 2 day period, during good sea conditions. As such the potential for accidental pollution incident is reduced compared to the installation phase.

7.11.2.35 The impact of an accidental pollution event occurring during operation and maintenance activities is therefore predicted to be of local spatial extent, short-term duration, intermittent and reversible. It is predicted that the impact will affect the receptors indirectly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

7.11.2.36 The sensitivity of benthic VERs to an accidental spill event during operation and maintenance activities is as described previously for impacts during the installation phase and summarised below.

Circalittoral coarse sediment VER

7.11.2.37 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Annex I subtidal reef VER

7.11.2.38 The Annex I ‘reef’ VER is deemed to be of low vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be low.

Annex I intertidal reef VER

7.11.2.39 The Annex I intertidal ‘reef’ VER is deemed to be of medium vulnerability, medium recoverability and very high value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of effect

VER	Sensitivity	Magnitude	Overall Significance
Circalittoral coarse sand	Low	Negligible	**Negligible**
Annex I subtidal ‘reef’	Low	Negligible	**Negligible**
Annex I intertidal ‘reef	Medium	Negligible	**Minor**

7.11.3 Decommissioning phase

7.11.3.1 The impacts of the decommissioning of the mWave project has been assessed on benthic subtidal and intertidal ecology. The environmental effects arising from the decommissioning of the mWave project are listed in Table 7.9, against which each decommissioning phase impact has been assessed and a conclusion of significance of effect is provided.

7.11.3.2 A description of the potential effect on benthic subtidal and intertidal ecology receptors caused by each identified impact is given below.

Temporary habitat disturbance due to decommissioning activities, may affect benthic ecology

7.11.3.3 The magnitude of the impact associated with temporary habitat disturbance as a result of decommissioning activities is predicted to be the same or similar to that associated with installation activities as described in paragraph 7.11.1.3 *et seq*. The sensitivity of the VERs affected by temporary habitat disturbance during decommissioning is also the same as described previously in paragraphs 7.11.1.8 *et seq*. The significance of effect is therefore **negligible** for all VERs affected.

Temporary increases in SSCs and associated sediment deposition due to decommissioning activities, may affect benthic ecology

7.11.3.4 The magnitude of the impact associated with temporary increases in SSC and sediment deposition as a result of sediment disturbance during decommissioning activities is predicted to be the same or similar to that associated with installation activities as described in paragraph 7.11.1.16 *et seq*. The sensitivity of the VERs affected by temporary increases in SSC and sediment deposition during decommissioning is also the same as described previously in paragraphs 7.11.1.20 *et seq*. The significance of effect during the decommissioning phase is therefore **negligible** for all VERs affected.

Risk of decommissioning activities facilitating the introduction of marine INNS

7.11.3.5 The magnitude of the impact associated with the introduction of marine INNS during decommissioning activities is predicted to be the same or similar to that associated with installation activities as described in paragraph 7.11.1.25 *et seq*. The sensitivity of the VERs to the introduction of INNS during decommissioning is also the same as described previously in paragraphs 7.11.1.29 *et seq*. The significance of effect during the decommissioning phase is therefore **negligible to minor adverse** for all VERs affected.

Accidental release of pollutants (e.g. accidental spillage) during decommissioning activities

7.11.3.6 The magnitude of the impact associated with the potential release of pollutants during decommissioning activities is predicted to be the same or similar to that associated with installation activities as described in paragraph 7.11.1.48 *et seq*. The sensitivity of the VERs to accidental pollution during decommissioning is also the same as described previously in paragraphs 7.11.1.39 *et seq*. The significance of effect during the decommissioning phase is therefore **negligible to minor adverse** for all VERs affected (see paragraphs 7.11.1.43 *et seq*).

Future monitoring

7.11.3.7 No benthic subtidal and intertidal ecology monitoring to test the predictions made within the decommissioning phase impact assessment is considered necessary.

7.12 Cumulative Impact Assessment

7.12.1 Methodology

7.12.2 Screening of other projects and plans into the Cumulative Impact Assessment

7.12.2.1 The Cumulative Impact Assessment (CIA) takes into account the impact associated with the mWave project together with other projects and plans. The projects and plans selected as relevant to the CIA presented within this chapter are based upon the results of a screening exercise. Each project has been considered on a case by case basis for scoping in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

7.12.2.2 In undertaking the CIA for the mWave project, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the mWave project. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are unlikely to contribute to such an impact, due to the short duration of the mWave project (18 months).

7.12.2.3 The specific projects scoped into the CIA for benthic subtidal and intertidal ecology are outlined in Table 7.15.

Table 7.15: List of other projects and plans considered within the CIA.

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
Dredging sites							
Installation/ Operation and Maintenance	Neyland Yacht Haven ltd. - DML1743	11.5	No spatial overlap. Potential for temporal overlap.	Dredge and disposal from Neyland Marina - annual volume 5500 m3.	13/12/2017-12/12/2020	No	Dredging impact forms part of baseline and mWave project has no dredging or disposal associated with it. Distant from mWave and therefore highly unlikely to have any impact overlap. No further consideration .
Installation/ Operation and Maintenance	Milford Haven Port Authority - DML1646	4.5	No spatial overlap Potential for temporal overlap.	Maintenance dredging throughout the Milford Haven. Annual volume 362500 m3.	09/03/2017-08/03/2022	No	Dredging impact forms part of baseline and mWave project has no dredging or disposal associated with it. Distant from mWave project and therefore highly unlikely to have any impact overlap. No further consideration.
Dredge disposal sites							
Installation/ Operation and Maintenance	Neyland dredge disposal site - LU190	11.5	No spatial overlap. Potential for temporal overlap	Location: South of Neyland within the central channel of the Milford Haven, 0.22 nm diameter x 5 m depth Status: Open	Not applicable	No	Disposal impact forms part of baseline and mWave project has no dredging or disposal associated with it. Distant from mWave project and therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and Maintenance	Milford Haven dredge disposal site - LU170	5	No spatial overlap. No temporal overlap as site is closed.	Location: South of St Ann's Head at the mouth of the Milford Haven estuary, unknown diameter x 30 m depth. Status: Closed	Not applicable	No	Dredge disposal site is not in use therefore no further consideration required.
Installation/ Operation and Maintenance	St Ann's Head dredge disposal site - LU180	5	No spatial overlap. No temporal overlap as site is closed	Location: Within the Milford Haven dredge disposal site, unknown diameter x 30 m depth. Status: Closed	Not applicable	No	Dredge disposal site is not in use therefore no further consideration required.
Installation/ Operation and Maintenance	Milford Haven Two dredge disposal site - LU169	16	No spatial overlap No temporal overlap.	Location: To the south of Milford Haven dredge disposal grounds, unknown diameter x 50 m depth. Status: Open		No	Dredge disposal site is located approximately 16 km from the mWave project. Disposal impact forms part of baseline and mWave project has no dredging or disposal associated with it. It is therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and Maintenance	Milford Haven Three dredge disposal site - LU169	37	No spatial overlap No temporal overlap.	Location: To the west of Milford Haven dredge disposal grounds, 1 nm diameter x unknown depth. Status: Open		No	Dredge disposal site is located at its closest 37 km from the mWave project, Disposal impact forms part of baseline and mWave project has no dredging or disposal associated with it. Project is highly unlikely to have any impact overlap. No further consideration.
Research							
Installation	Greenlink Interconnector Ltd. - RML1827	0	Potential spatial overlap Temporal overlap	Ground investigations		Yes	Research operations are likely to have vessels present, with equipment for undertaking ground truthing surveys therefore this project cannot be excluded from further consideration in the CIA.
Installation	University College of Swansea - DEML1861	7	Location is assumed to be by the Pembroke Power station. No spatial overlap. Temporal overlap.	Pembroke Power bubble barrier experiment Investigation into the effectiveness of bubble curtains in sediment management	07-2018 - no end date given Band 2 licence issued 12/12/2018 - three-year study	No	Distant from mWave project and therefore highly unlikely to have any impact overlap. No further consideration.
Installation	University College of Swansea - DEML1845	1.5	Potential spatial overlap Temporal overlap	Deposition and subsequent removal of marker buoys with environmental monitoring and mid-water settlement plates.	30/08/2018-29/08/2019	No	Vessels and equipment will be required for the placement of marker buoys. Whilst the ML is currently valid, it is unlikely to have temporal with mWave activities, as ML finishes in August 2019. No further consideration.
Installation/ Operation and Maintenance	Neyland Yacht Haven Ltd - CML1658	11.5	No spatial overlap. No temporal overlap.	Pile replacement in Neyland Marina.	21/11/2016-20/11/2019	No	Pile replacement is currently ongoing until 2019, which does not overlap with the installation and operational phases of mWave. Given the distance from mWave project

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
							it is therefore highly unlikely to have any impact overlap. No further consideration
Installation/ Operation and Maintenance	Mixed use developments - Local Planning Authority Reference: 14/0158/PA	10	No spatial overlap. Temporal overlap remains unknown.	Undetermined planning application. Demolition of several existing buildings and the mixed-use redevelopment of Milford Waterfront comprising up to 26,266 m2 of commercial, hotel, leisure, retail and fishery related floorspace. Up to 190 residential properties, up to 70 additional marina berths, replacement boat yards, landscaping, public realm enhancements, access and ancillary works. A decision on this application is yet to be made by the local planning authority.	EIA screening decision was returned on the 30/04/2018 - no further information has been provided	No	Given the distance from mWave project it is therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and Maintenance/ Decommissioning	Greenlink Interconnector Ltd. - Government reference: qA1296053	0	Spatial overlap at edge of deployment area. Temporal overlap	The Project is a 500MW subsea electricity interconnector linking the power markets in Ireland and Great Britain and is planned for commissioning in 2023. As an EU Project of Common Interest, it is one of Europe's most important energy infrastructure projects. The interconnector is planned to make Landfall at Fresh Water West beach	07/2018 - ongoing	Yes	Given potential for temporal and spatial overlap with mWave this project cannot be excluded from further consideration in the CIA.
Installation/ Operation and Maintenance/ Decommissioning	Valereo - Welsh Government reference: qA1312073		No overlap with the mWave project. Onshore is remote from mWave control station site.	Development of a cogeneration facility to supplement electrical power and steam demands of the refinery all within the refinery boundaries on land.	07/12/2017 - Nationally significant project (ongoing)	No	Project is assumed to have no marine elements to the project. Onshore is remote from mWave control station site (inner face of Haven), therefore there will be no impact overlap. No further consideration.
Installation/ Operation and Maintenance	EGNEDOL Wales Ltd	N/A	Potential temporal overlap	EGNEDOL propose to create an environmentally sustainable centre of excellence in Milford Haven, at the Waterston and Blackbridge sites. The proposal includes providing business units and refurbishing a jetty to serve as a primary supply link to the EGNEDOL electricity generation plan, and for export of products. The land-based green energy scheme may generate up to 350 MW.	Not available	No	Planning permission for the EGNEDOL project was refused on 19/10/2018, therefore it is considered highly unlikely that this project will overlap temporally with the mWave project. No further consideration.
Ministry of Defence sites							
	Ministry of Defence	0.1	Temporal overlap	The Castlemartin Range is located immediately south of the entrance to the Waterway and extends for up to 12 NM from the coast between Little Furznip (at the southern extent of Freshwater West) and St Govan's Head (Milford Haven Port Authority 2019). The southern boundary of the East Pickard Bay (Site 8) site is located adjacent to the northern boundary of the Castlemartin Military Practice Area D113A. The range at Castlemartin supports the training of military personnel (Army) in the firing of a range of munitions at land based targets. The seaward danger area provides a safety zone for overfire and shrapnel which may result from the striking of targets (RPS, 2010). The Castlemartin Range is used every day of the week and on some weekends (RPS, 2010).	Not applicable	Yes	There is a high level of uncertainty as to timing of MOD activities at the MOD site, however on-going activity is likely therefore there is the potential for cumulative impacts with the mWave project.
Aquaculture projects							
Installation/ Operation and Maintenance	Tethys Oysters	3	Temporal overlap	The oyster farm is located on the eastern side of Angle Bay, whereby oysters are grown in baskets on metal supports. The farm will be serviced from the shore by foot	Oct 2017 – Oct 2020 (possible renewal of licence)	No	Whilst there is potential for temporal overlap with the mWave project, it is distant and therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and	Pembrokeshire Scallops	6.5	Temporal overlap	The scallop farm is located within Castlebeach Bay,	Jan 2019 – Q4 2020	no	Whilst there is potential for temporal overlap with the

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
Maintenance				whereby a system of weighted ropes will be deployed for growing scallops and mix species of native algae. The farm will be serviced by vessels and divers	(possible renewal of licence)		mWave project, it is distant and therefore highly unlikely to have any impact overlap. No further consideration.
Pembroke Dock Marine Projects							
Installation/ Operation and Maintenance	Milford Haven Port Authority - SC1810: Pembroke Dock Infrastructure	10	No spatial overlap. Potential for temporal overlap	Pembroke Dock redevelopment. Scoping Report submitted. The intention of the Project is to create a flexible and efficient port-related office, industrial, warehousing and distribution, and ancillary operations infrastructure. This will involve the redevelopment of its existing space to incorporate increased deep-water access, internal and external heavy fabrication areas, construction of MEECE and Education/Skills Facility and the construction of a heavy lift facility.	Q3 2019 – Q3 2023	No	Port activity as a result of Pembroke Dock Port operations is distant and therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and Maintenance	META Project, Site 8	0	Spatial overlap Temporal overlap will occur throughout the duration of the mWave project	The META project will allow the deployment and testing of marine renewable devices in the waters off East Pickard Bay. The maximum scenario is for up to two devices at Site 8. An assessment of the maximum META project design has been undertaken in the ES supporting the consents.	In consenting	Yes	Given potential for temporal and spatial overlap with mWave this project cannot be excluded from further consideration in the CIA
Installation/ Operation and Maintenance/Decommissioning	Marine Energy Wales - DEML1875	9.4	No spatial overlap Potential for temporal overlap	Marine Energy Test Area - Phase 1 Band 2 application submitted. The Project aims to create pre-consented test areas within the Pembroke Dock area. The test areas will have licensable activities to suit testing of initial stage marine renewable devices. These include testing of non-operating components and subassemblies. No full-scale testing is to be support within the test areas	21/04/2019-21/04/2029	No	Project is distant and therefore highly unlikely to have any impact overlap. No further consideration.
Installation/ Operation and Maintenance/Decommissioning	Wave Hub Ltd. - SC1082	20	No spatial overlap No temporal overlap	Demonstration zone Scoping Report submitted The Project entails the development of 90 km2 of seabed with water depths of approximately 50 metres and a wave resource of approximately 19 kW/m; to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Consent for this Project could be achieved in 2022, infrastructure could be built by 2024 and the first technology could be installed in 2025.	2024	No	No temporal overlap with the mWave project. No further consideration.

7.12.2.4 In terms of potential cumulative impacts it is considered very unlikely, due to the short installation duration of mWave (3-4 days) and the infrequent visits during operation (once per month) that there will be a cumulative impact from vessels on site. The potential impacts identified for assessment as part of the benthic ecology and subtidal ecology cumulative impacts assessment (CIA) are therefore*:*

- Cumulative habitat loss/disturbance may affect benthic ecology; and
- Cumulative increases in SSC and sediment deposition may affect benthic ecology.

7.12.3 Cumulative Impact Assessment

7.12.3.1 A description of the significance of cumulative impacts upon benthic subtidal and intertidal ecology receptors arising from each identified impact is given below.

Cumulative habitat loss/disturbance may affect benthic ecology

7.12.3.2 Temporary habitat loss/disturbance may occur as a result of cumulative impacts arising from projects that spatially or temporally overlapping with the mWave project, as listed in Table 7.15.

Magnitude of impact

7.12.3.3 There is the potential for cumulative temporary habitat loss and/or disturbance within the benthic subtidal and intertidal ecology study area as a result of installation and operational activities associated with the mWave project together with activities associated with META Site 8 and the Greenlink Interconnector project.

7.12.3.4 The META Phase 2 project, which will occur over 15 years once consented, will be consent for up to two deployments at East Pickard Bay at any time. META Site 8 consented area does not affect any Annex I reef habitat. As such, there will be no cumulative loss of features of the SAC as a result of this project and the META project.

7.12.3.5 The Greenlink Interconnector project has also submitted a Scoping Report for the UK marine route (Intertek, 2016) which outlines that temporary habitat loss may occur as a result of cable burial and maintenance activities. Although a detailed assessment was not available at the time of writing this ES, the Scoping Report concludes that it is likely that any impacts to species and habitats will be localised and short-term, and once installed, the substratum will be reinstated over the cable.

7.12.3.6 The cumulative impact is predicted to be of local spatial extent, short duration (due to the short deployment of mWave), intermittent and reversible. It is predicted that the impact will affect the benthic receptors directly. The magnitude is therefore, considered to be minor.

Sensitivity of receptor

7.12.3.7 The benthic subtidal VERs with the potential to be affected by cumulative habitat loss/disturbance are the same as previously described in paragraph 7.11.1.8 *et seq*..

7.12.3.8 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of the effect

7.12.3.9 The sensitivity of circalittoral coarse sand is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **negligible significance**, which is not significant in EIA terms.

Cumulative increases in SSC and sediment deposition may affect benthic ecology

7.12.3.10 Temporary effects to benthic receptors from elevated SSCs and sediment deposition may occur as a result of cumulative impacts arising from projects that spatially or temporally overlap with the mWave project, as listed in Table 7.15.

Magnitude of impact

7.12.3.11 There is the potential for cumulative increases in SSCs and sediment deposition to benthic receptors within the benthic subtidal and intertidal ecology study area as a result of installation/decommissioning activities associated with the mWave project together with offshore installation activities at META Site 8 and the Greenlink Interconnector project.

7.12.3.12 As discussed above mWave would be located in the eastern end of META Site 8 for its temporary deployment. Due to the methods used for installation (use of gravity foundation with no site levelling and laying cable on seabed) and the short duration of installation/decommissioning, any cumulative impacts in terms of increased SSC are anticipated to be minor.

7.12.3.13 The Scoping Report for the Greenlink Interconnector project outlines that smothering of benthic species may occur as a result of ploughing and trenching operations to install the cable and through the placement of cable protection material on the seabed (Intertek, 2016). However, it is likely that any impacts will be of short duration and temporary and any impacts to benthic habitats from smothering will be highly localised to the immediate vicinity of the cable trench.

7.12.3.14 The cumulative impact is therefore predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the benthic receptors indirectly. The magnitude is therefore, considered to be minor.

Sensitivity of receptor

7.12.3.15 As the mWave device will not affect Annex I subtidal and intertidal reef, then there is no potential for a cumulative impact with the projects identified above.

7.12.3.16 The circalittoral coarse sediment VER is deemed to be of medium vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low.

Significance of effect

7.12.3.17 Overall, the sensitivity of circalittoral coarse sand is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **negligible significance**, which is not significant in EIA terms.

Future monitoring

7.12.3.18 No benthic subtidal and intertidal ecology monitoring to test the predictions made within the CIA is considered necessary.

7.13 Transboundary effects

7.13.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to benthic subtidal and intertidal ecology from the mWave project upon the interests of other EEA States.

7.14 Inter-related effects

7.14.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. For the short term temporary deployment of mWave these are considered to be:

- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic subtidal and intertidal ecology, such as habitat loss/disturbance and sediment plumes may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

7.14.1.2 A description of the likely inter-related effects arising from the mWave project on benthic subtidal and intertidal ecology is provided in here.

7.14.2 Receptor-led effects

7.14.2.1 It is considered that the greatest potential for inter-related impacts for the mWave project is predicted to arise through the interaction of temporary habitat loss/disturbance during installation/decommissioning and operation from anchor spreads on the seabed during vessel visits.

7.14.2.2 These individual impacts were assigned a significance of minor adverse as standalone impacts and although potential combined impacts may arise (i.e. spatial and temporal overlap of direct habitat disturbance), it is predicted that this will not be any more significant than the individual impacts in isolation. This is because the combined amount of habitat potentially affected would be very limited, and, where temporary disturbance occurs, full recovery of the benthic receptors is predicted once mWave is decommissioned. In addition, any effects due to changes in SSC and deposition will be limited in extent and also in magnitude, with benthic ecology receptors having low sensitivity to the scale of the changes predicted. As such, these interactions are predicted to be no greater than the individual effects assessed in isolation.

7.15 Conclusion and summary

7.15.1.1 Installation activities associated with the mWave project have the potential to result in a range of potential impacts on benthic ecology. These include the disturbance of sediments associated with installation resulting in temporary habitat disturbance and increased SSC, associated deposition, as well as the potential introduction of INNS. Table 7.16 provides a summary of the potential impacts, mitigation measures and residual effects during the installation phase with respect to benthic ecology. These impacts are predicted to result in effects on benthic receptors, including benthic features of designated sites, of negligible or minor adverse significance (not significant in EIA terms).

7.15.1.2 The operation and maintenance of the mWave project may affect benthic subtidal and intertidal ecology through the presence of mWave and associated cable on the seabed resulting in temporary habitat loss and through the presence of mooring spreads resulting in temporary disturbance. Operation and maintenance activities may also facilitate the introduction/spread of INNS. Table 7.16 provides a summary of the potential impacts, mitigation measures and residual effects during the operation and maintenance phase with respect to benthic ecology. These impacts are predicted to result in effects on benthic receptors and designated features of nature conservation sites of negligible or minor adverse significance (not significant in EIA terms).

7.15.1.3 Decommissioning activities are predicted to have effects of negligible or minor adverse significance (not significant in EIA terms) on benthic subtidal and intertidal ecology.

7.15.1.4 Cumulative impacts upon benthic subtidal and intertidal ecology from the mWave project have been considered together with the impacts predicted to arise from the META project, Site 8, as well as from the construction of the Greenlink Interconnector. Overall, the cumulative impacts on benthic receptors and designated features of nature conservation sites will be of minor adverse significance (not significant in EIA terms).

7.15.1.5 A screening of transboundary impacts has been carried out which has identified that there is no potential for significant transboundary effects with regard to benthic subtidal and intertidal ecology from the Wave project upon the interests of other EEA States.

Table 7.16: Summary of potential environment effects, mitigation and monitoring at the mWave project.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Installation Phase							
Temporary habitat disturbance due to installation activities, may affect benthic ecology.		Minor	Low to Medium	Negligible to Minor (not significant in EIA terms)	None	n/a	None
Temporary increases in SSCs and associated sediment deposition due to installation activities, may affect benthic ecology.		Negligible	Low	Negligible (not significant in EIA terms)	None	n/a	None
Risk of installation activities facilitating the introduction of marine INNS.	Biosecurity Risk Assessment following NRW-PS guidance	Negligible	Medium to high	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None
Accidental release of pollutants (e.g. accidental spillage) during installation activities.	EMP (Appendix 2.2)	Negligible	Low to Medium	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None
Operational Phase							
Habitat loss through presence of infrastructure on the seabed resulting in potential effects on benthic ecology.		Negligible to Minor	Low to Medium	Negligible to Minor (not significant in EIA terms)	None	n/a	None
Temporary habitat disturbance during the operational phase, may affect benthic ecology.	.	negligible	Low	Negligible (not significant in EIA terms)	None	n/a	None
Alteration of seabed habitats arising from changes in physical processes, including scour effects and changes to sediment transport, may have effects on benthic ecology.	-	Negligible	Negligible	Negligible (not significant in EIA terms)	None	n/a	None
Risk of operational activities facilitating the introduction of marine INNS.	Biosecurity Risk Assessment following NRW-PS guidance	Negligible to Minor	Medium to high	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None
Accidental release of pollutants (e.g. accidental spillage) during operation and maintenance activities.	EMP	Negligible	Low to Medium	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None
Decommissioning Phase							
Temporary habitat disturbance due to decommissioning activities, may affect benthic ecology.	-	Minor	Low	Negligible (not significant in EIA terms)	None	n/a	None
Temporary increases in SSCs and associated sediment deposition due to decommissioning activities, may affect benthic ecology	-	Negligible	Low	Negligible (not significant in EIA terms)	None	n/a	None
Risk of decommissioning activities facilitating the introduction of marine INNS	Biosecurity Risk Assessment following NRW-PS guidance	Negligible	Medium to High	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None
Accidental release of pollutants (e.g. accidental spillage) during decommissioning activities.	EMP	Negligible	Low to Medium	Negligible to Minor adverse (not significant in EIA terms	None	n/a	None

7.16 References

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