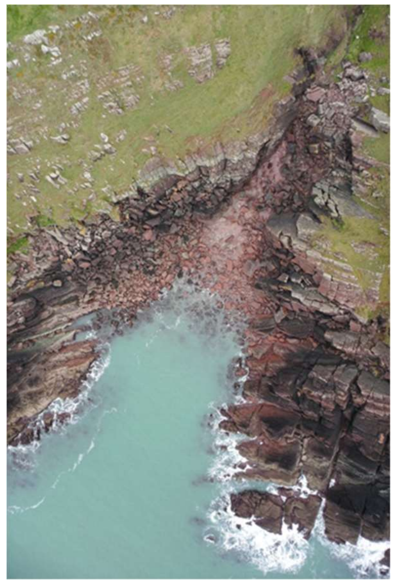
mWave Marine Energy Device and Onshore Infrastructure

ENVIRONMENTAL STATEMENT


June 2019

CHAPTER 5: Coastal Processes

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Glossary

Term	Definition
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.
Anthropogenic	Originating in human activity
Benthic habitats	Ecological region at lowest level of a water body including sediment surface and some sub-surface layers
Fetch	Length of water over which a given wind has blown
Intertidal	Area that is above water during low tide and underwater during high tide
Littoral currents	Current moving approximately parallel to a shore
Meso-tidal range	Tidal range of 2-4m
The 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.
Metocean regime	Abbreviation of meteorology and oceanography
Morphology	Study of the origin and development of coastal features
Neap tides	Tide following the first and third quarters of the moon during which the tidal range is minimum
Peninsula	Landform with water on the majority of its border while being connected to the mainland from which it extends
Rip tide	Strong, localised and narrow current of water which moves directly away from the shore
SEACAMS	The SEACAMS project is a partnership between Bangor University and Swansea University, part-funded by the European Regional Development Fund. It supports developing economic opportunities in Low Carbon, Energy and Environment through specialisation in commercial application of research and innovation in marine renewable energy
Sea caves	Cave formed primarily by the wave action of the sea
Sediment transport	Movement of solid particles (sediment) due to gravitational forces and/or the movement of the fluid in which the sediment is entrained
Semi-diurnal tide	Two high and two low tides per day
Significant wave height	Mean wave height of the highest one third of the waves
Spring tides	Tide following a new or full moon during which the tidal range is maximum
Storm surge	Similar to swell wave - rising of water level commonly associated with low pressure weather systems
Subtidal	Area that is below water during low tide
Suspended sediment	Solid particles uplifted by the fluid's flow
Subsea Umbilical Termination Unit	Underwater connection box approx 1.5m^2. mWave umbilical and ADCP will connect into unit.
Swell wave	Surface waves generated by the pressure in distant weather systems
Tidal excursion	The horizontal distance along the estuary that a particle moves during one tidal cycle of ebb and flood
Tidal flow (or *current*)	Currents resulting from the impact on sea level caused by the interaction of the Earth, sun and moon
Tidal range	Height difference between high tide ad low tide
Transboundary	Moving or having impact across a boundary or boundaries
Wind wave	Surface waves generated from wind blowing over an area of fluid surface

Acronyms

Term	Definition
ADCP	Acoustic Doppler Current Profiler
BERR	(Department for) Business, Enterprise and Regulatory Reform
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CIA	Cumulative Impact Assessment
CIRIA	Construction Industry Research and Information Association
cSAC	Candidate Special Area of Conservation
ADCP	Acoustic Doppler Current Profiler
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ES	Environmental Statement
ICE	Institution of Civil Engineers
MEECE	Marine Energy Engineering Centre of Excellence
META	Marine Energy Test Area
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring
MOD	Ministry of Defence
NPS	National Policy Statement
NRW	Natural Resources Wales
PCNPA	Pembrokeshire Coast National Park
SAC	Special Area of Conservation
SPA	Special Protection Area
SSC	Suspended sediment concentration
SSSI	Site of Special Scientific Interest
SUTU	Subsea Umbilical Termination Unit
WEC	Wave Energy Converter
ZoI	Zone of Impact

Units

Term	Definition
m/s	metres per second
m^2	metres squared
Ha	hectares
km	kilometre
mg/l	milligrams per litre
MW	megawatts
T	tonnes

5. COASTAL PROCESSES

5.1 Introduction

5.1.1.1 This chapter of the Environmental Statement presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the mWave project on Coastal Processes. This chapter considers the potential impact of the offshore components of the mWave project including the cable route to MLWS during its installation, operation and maintenance, and decommissioning phases. The assessment of the potential impact of the cable route from MLWS to the termination box, is presented in Chapter 16 Onshore Geology, Hydrology and Land Quality.

5.1.1.2 The coastal processes assessment is undertaken to inform the consideration of potential impacts on coastal processes receptors. In addition, predictions of changes to coastal process are provided to inform a range of other receptors that are assessed in other chapters of this Environmental Statement (ES) (Chapter 7: Benthic Subtidal and Intertidal Ecology, Chapter 12: Shipping and Navigation; Chapter 15: Other Users). For those effects where the receptor lies within the coastal processes topic, a full impact assessment is provided here. For those effects where the receptor is assessed in another chapter of this ES, the magnitude of change only is considered in this assessment.

5.1.1.3 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.

5.1.1.4 In particular, this Environmental Statement chapter:

- Presents the existing environmental baseline established from desk studies and field survey;
- Presents the potential environmental effects on coastal processes arising from the mWave project, based on the information gathered and the analysis and assessments undertaken;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Where appropriate, highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

5.2 Study area

5.2.1.1 As discussed in Chapter 1 Introduction, the licensing and consenting of the mWave marine energy device and its cable route 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. Whilst the mWave device is short term and of limited extent compared to the META project, the baseline information for META Site 8 has been used in the following assessment to ensure consistency of information across the two projects which will be in the consenting process at the same time.

5.2.1.2 The wider coastal processes study area for the mWave project is termed as the coastal processes study area – defined as the area inclusive of the Waterway and extends up to the 12 nautical mile limit, from St Govan's Head to Skomer Island (see Figure 5.1). This area encompasses the region over which the environmental designations are specified. The area also takes into consideration the scale of the coastal process drivers such as tidal flow, swell wave and local wind wave generation in the area.

5.2.1.3 The full scale WEC, mWave will be deployed at the eastern end of META Site 8, approximately 2.2km from its western boundary and 0.5km from the eastern boundary. It will be deployed approximately 415m from MLWS and the communication cable will run from mWave to the landfall at East Pickard Bay. East Pickard Bay is a rocky gully which is located on the south side of the Angle Peninsula approximately 2.5km from Milford Haven Waterway and 2km from Freshwater West Beach.

5.2.1.4 The area offshore of East Pickard Bay is exposed to a good wave resource benefiting from a 200 km fetch from the prevailing wind direction and the area where mWave and the cable will be located has a water depth of between 10m and 17m below chart datum (bcd), with mWave being located at a depth of around 11m bcd. The mWave deployment location, lies within the Pembrokeshire Marine/ Sir Benfro Forol SAC designated for grey seal, marine habitats, coastal lagoons, submerged or partially submerged sea caves, otter and species of migratory fish, and the West Wales Marine cSAC proposed for harbour porpoise.

5.2.1.5 Figure 5.2 shows the location of mWave and the proposed routing of the marine communication cable to East Pickard Bay in relation to the surrounding environmental designated sites. mWave will be deployed approximately 100m to the north of a Ministry of Defence (MOD) Danger Area.

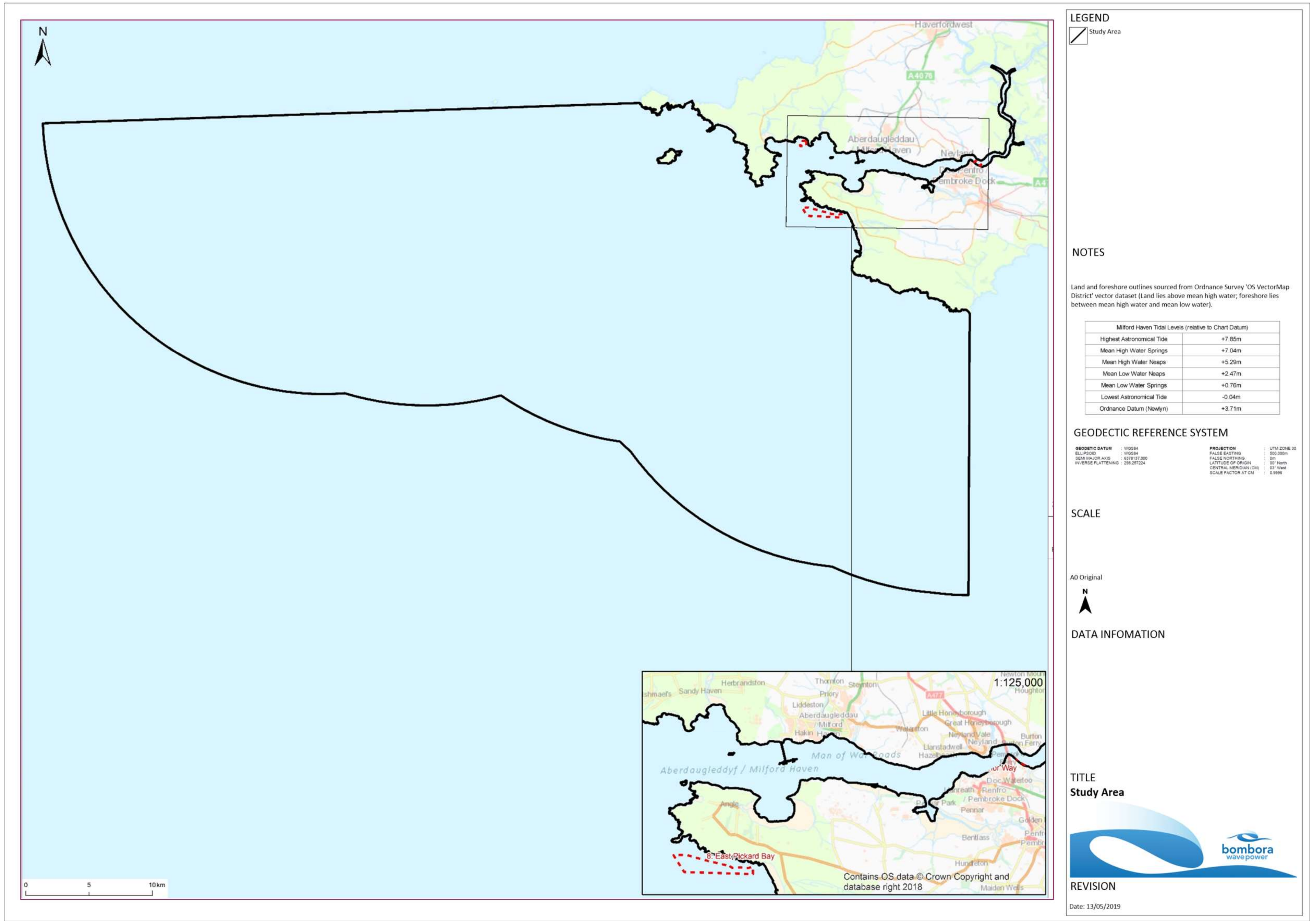

Figure 5.1: The mWave project coastal processes study area.

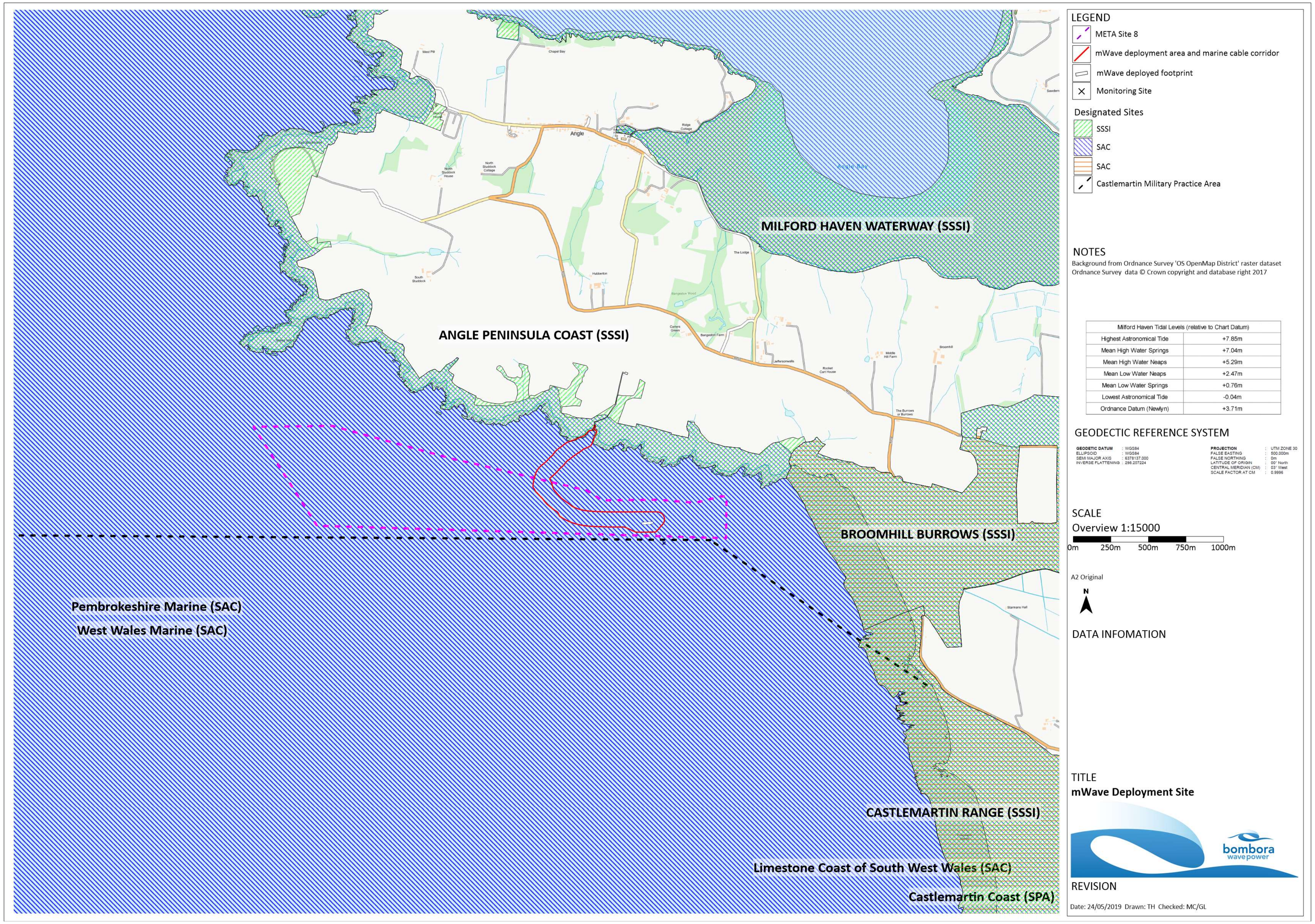

Figure 5.2: Location of mWave the marine cable corridor (to MHWS)

5.3 Policy context

5.3.1.1 A summary of national legislation and consenting policy context in Wales relevant to the consenting of the mWave project is provided in Chapter 3: Need and Alternatives, with details provided in Appendix 3.1.

5.3.2 National Policy Statements

5.3.2.1 Whilst mWave is not a Nationally Significant Infrastructure Project, planning policy on renewable energy infrastructure 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). NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment of coastal processes, whether these be through direct effects on the physical environment or indirect effects. Changes to coastal process have been considered within this chapter and the indirect effects of these changes have been considered in other relevant chapters of this Environmental Statement.

5.4 Consultation

5.4.1.1 Table 5.1 below summarises the issues raised relevant to Coastal Processes, which have been identified during consultation activities undertaken to date. Table 5.1 also indicates either how these issues have been addressed within this Environmental Statement or how the Applicant has had regard to them.

Table 5.1: Summary of key issues raised during consultation activities undertaken for the mWave project relevant to coastal processes.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
10 September 2018	NRW-Advisory, PCNPA	Location of communications cable route to shore, including areas to avoid. Ecological and landscape and visual considerations discussed.	Cable route refined to minimise potential impacts on ecological and landscape and visual receptors.
24 September 2018	National Trust	Potential impacts of cable route on National Park onshore infrastructure	Avoidance of identified car park which further refines potential cable routes to shore. Cable route avoids Freshwater West beach thereby avoiding coastal process impacts in this area.
January 2019	NRW-Advisory	Survey requirements at site and of marine cable (to MHWS) at East Pickard Bay. Confirmation that survey of marine cable is only required in reefy habitat and not sandy sediment.	On the basis of NRW's advice, drop down camera survey was undertaken of the rocky habitat at the cable landfall (Chapter 7, Benthic Subtidal and Intertidal Ecology). In addition to this bathymetric survey confirmed that the substrate within and around the mWave deployment site is sandy substrate (Section 6.5.2).
28 March 2019	NRW – Scoping Opinion	Section 6.1.5: Proposed approach to EIA it is stated in Paragraph 2 that: "Due to the relatively small scale of the devices and the temporary and short-term nature of the deployments it is anticipated that morphological beach response modelling will be required to support the EIA". We presume that this is supposed to read will not be required, and we are satisfied that beach response modelling will not be required.	As per the NRW Scoping Opinion, beach response modelling has not been undertaken for the project.

5.5 Methodology to inform the baseline

5.5.1 Desktop study

5.5.1.1 Information on Coastal Processes within the coastal processes study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 5.2 below.

Table 5.2: Summary of key desktop reports.

Title	Source	Year	Author
Wave & Flow Modelling: Conditions for Wave Energy Converter Deployment	Bombora Wave Power	2018	ABPmer Ltd et al.
Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects	Natural Resources Wales (NRW)	2018	Brooks et al, 2018
Estimates of wave climate at potential wave energy test sites around Milford Haven	SEACAMS2	2018	Yin, Y.; Fairly I. & Reeve D.
Suspended Sediment Climatologies around the UK	CEFAS	2016	CEFAS
Milford Haven Sediment hydrocarbon & Metals contamination	Milford Haven Waterway Environmental Surveillance Group	2014	Little, D.I. & Galperin, Y
Sediment-profile imaging survey of Milford Haven Waterway	Milford Haven Waterway Environmental Surveillance Group	2012	Germano & Assoc. Ltd
Lavernock Point to St Ann's Head Shoreline Management Plan		2012	Halcrow
Wave resources in South Wales & a comparison with wave climate	Marine Energy Research Group, Swansea	2012	Fairley, I.

Title	Source	Year	Author
at the wave hub	University		
Tidal Energy Resource Study for the Copeland Islands	ICE Innovative Coastal Zone Management	2011	Shannon N.R. & Laurent D.
Sediment Contaminants and Transport Review	Milford Haven Waterway Environmental Surveillance Group	2009	Little, D.I.
Guidelines in the use of metocean data through the lifecycle of a marine renewables development	CIRIA	2008	ABPmer Ltd *et al.*
Review of Cabling Techniques and Environmental Effects applicable to the Offshore Wind Farm Industry	BERR	2008	BERR
Dynamics of scour pits and scour protection - Synthesis report and recommendations		2008	Whitehouse, R.; Harris, J.; Rees, J.
Atlas of Marine Renewable Energy Resources	BERR	2008	BERR
Potential effects of offshore wind developments on coastal processes		2002	Beiboer and Cooper
Metal concentrations in Milford Haven seabed sediments	Milford Haven Waterway Environmental Steering Group	1994	Smith, J & Hobbs, G.

5.5.1.2 In addition to reports identified above, bathymetric and oceanographic surveys were commissioned by the applicant, Bombora Wavepower (Section 5.5.2). This measured field data was used to quantify baseline characteristics on tidal currents and wave climate.

Identification of designated sites

5.5.1.3 All designated sites within the coastal processes study area that could be affected by the installation, operation and maintenance, and decommissioning of the mWave project were identified using the three-step process described below for each discipline:

- Step 1: All designated sites of international, national and local importance within the coastal processes study area were identified.
- Step 2: Information was compiled on the relevant features for each of these sites.
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - e.g. a designated site directly overlaps with the mWave project; and
  - e.g. sites and associated features were located within the potential Zone of Impact (ZoI) for impacts associated with the mWave project.

5.5.1.4 The coastal processes assessment was then defined to provide information on each of these areas for each discipline. mWave is located within the Pembrokeshire Marine/ Sir Benfro Forol SAC (a Natura 2000 site) and as such are protected under the Habitats Directive (1992). The coastal processes were, therefore, examined activity to provide information for each of the relevant EIA disciplines.

5.5.2 Site specific surveys

5.5.2.1 Bathymetric (Titan 2018) and oceanographic (Titan 2019) survey data was obtained for the mWave deployment site and surrounding area. In addition to this, a drop down camera survey has been undertaken of the coastal subtidal section of the cable route (Aquatic Survey and Monitoring 2019). As such sufficient data is available to undertake an assessment of impacts from the desktop data sources along with field and modelled data.

5.6 Baseline environment

5.6.1 Study area

5.6.1.1 Tidal range along the East Pickard Bay coastline remains fairly consistent with minimal variation throughout seasonal cycles. The predominant current runs from an east south east to west north west direction through the site, and a strong rip tide can be found at the south of Freshwater West Bay. East Pickard Bay coastline is exposed to a good wave resource benefiting from a 200 km fetch from the prevailing wind direction.

5.6.1.2 mWave will be deployed at the eastern extent of META Site 8, approximately 0.5km from its eastern boundary. The mWave deployment site including the cable route has a water depth in the range of 10m and 17 m below CD, with mWave being deployed at a depth of around 11m below CD. The device will be located 415m from MLWS with the communication cable making landfall at East Pickard Bay, to the north east. East Pickard Bay is a rocky gully with steep cliffs (Chapter 16 Geology, Hydrology and Land Quality). The mWave deployment site is 1km from the north west edge of Freshwater West Beach, which comprises a sandy beach 0.5 km wide at low water and backed by dunes.

5.6.1.3 Oceanographic data were collected at two sites within the mWave deployment area, 175m apart (Figure 5.3), to characterise the conditions in the vicinity of mWave deployment site (Titan 2019). Data on current speed and direction, waves, water levels and suspended sediment concentration was collected between September and November 2018, the autumn period. Three significant storms hit the coastline during the survey.

5.6.1.4 The data collected over the survey period included the data on the significant wave height (Hs), which is defined as the average height of the highest one third of the waves, and the maximum wave height (H_{max}). The data showed that at the two sites the mean Hs was in the range 1.26m -1.4m, and the mean H_{max} at the two sites was in the range of 1.98m -2.11m. During the deployment phase, the survey area experienced three storm events. These were defined by the Meteorological Office as being: Storm Ali (19/09/2018) Storm Bronagh (20-21/09/2018) and Storm Callum (12-13/10/2018).

5.6.1.5 Although the effects of the storm events were evident within the data records, Storm Callum had the greatest influence. Looking at the top 5 events during the survey, the Hs waves recorded at the two sites was between 4.33m - 6.74m, with maximum waves during these 5 storm events (H_{max}) being 7.45 m - 11.26m.

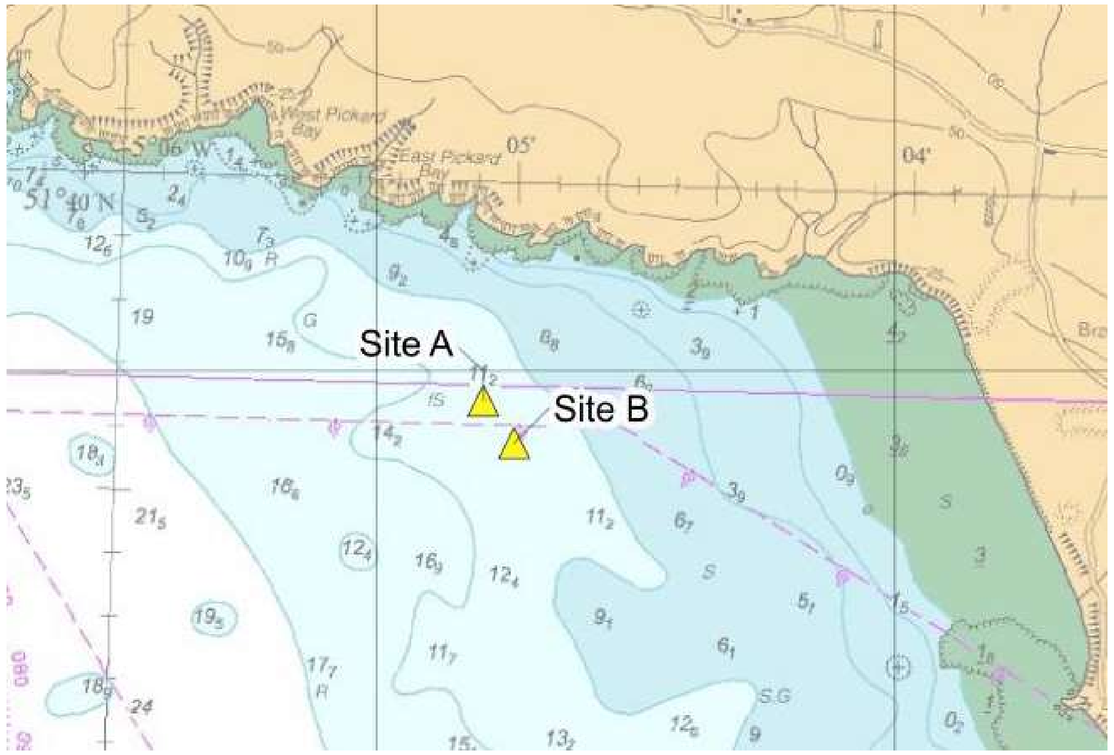

Figure 5.3: Oceanographic survey sites.

5.6.1.6 Current speeds at the two sites were generally 0.3m/s on a neap tide and slightly more (0.324 - 0.331m/s) on a spring tide. Notwithstanding this, due to the exposure of the site, wave induced flow can be significant in the area, as incoming waves from the south west sector are refracted off the cliffs. This mechanism can give rise to complex flow patterns and in significant storm events the resulting current speed can be far larger than the tidal flow component. Data from the survey confirmed this and the maximum currents recorded each month were much greater and in the range of 0.5m/s - 0.8m/s at site A and 0.46m/s - 1.136m/s at site B. Figure 5.4, extracted from wave energy modelling undertaken for the project (ABPmer 2018), illustrates the spatial variation in wave induced flows within the area, with the exact location and strength of currents varying due to environmental conditions. The site specific survey data also confirmed that at no time was there no current, with the minimum current recorded being 0.02m/s.

5.6.1.7 The geology in the area is comprised of hard, red calcareous marls with sporadic red and green sandstones. Basal beds of green marl, conglomerate and breccia are also present. The coastal waters off East Pickard Bay are a high energy environment and as such sediments are primarily made up of coarse sediment types (gravel and sand) and these are more predominant to the southeast, whilst the northwest is characterised by coastal subtidal reef which transitions into the rocky coastline.

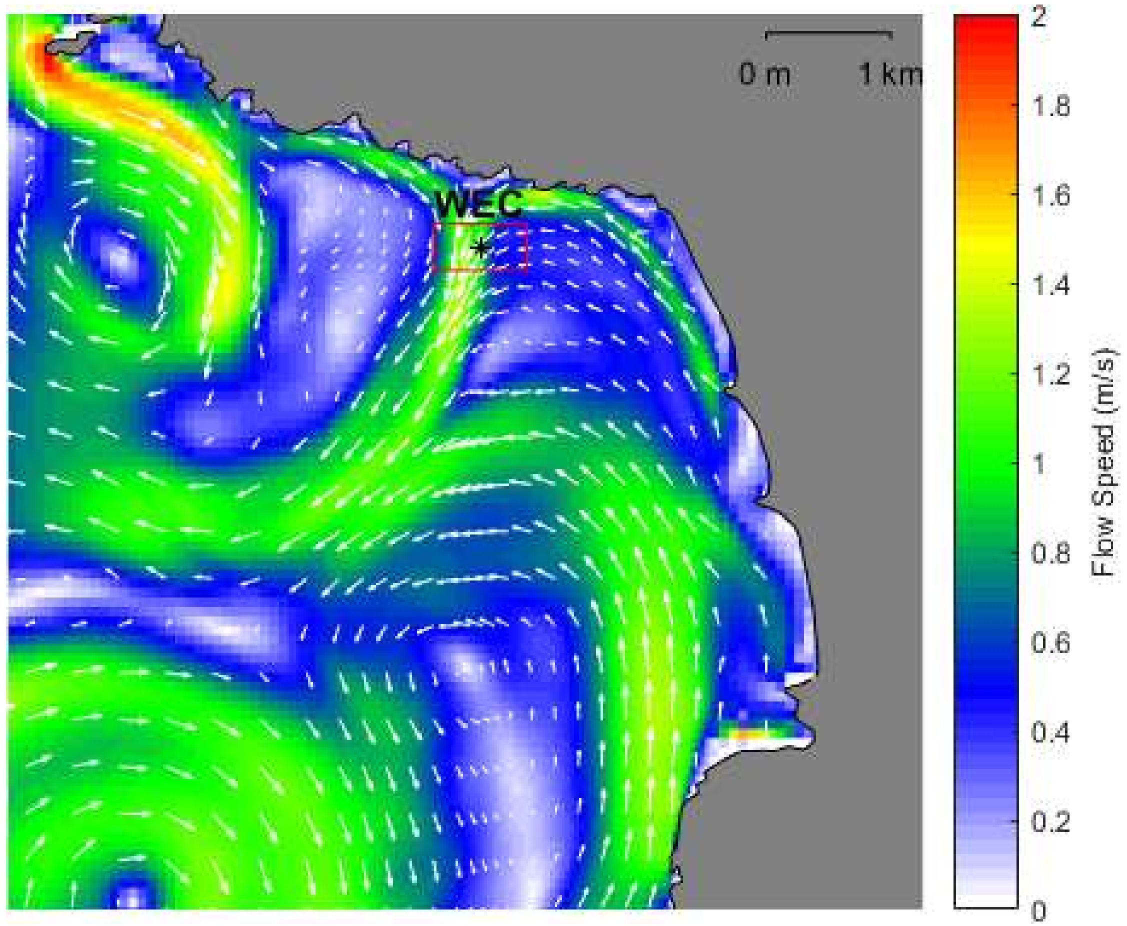

Figure 5.4: Example of spatial variation in wave induced flows.

5.6.1.8 Bathymetric survey data was collected of the mWave site and surrounding area including the cable route. The sonar data shows the seabed at the mWave site consists almost entirely of smooth, virtually featureless sands, the only bedforms identified are insignificant sand ripples lying scattered across the site (Titan 2018).

5.6.1.9 Sediment sampling at the deployment site undertaken as part of the SEACAMS2 project indicated moderately sorted fine sand, with an average of 0.2mm diameter. The detailed analysis showed that the site had 9.3% coarser sand (>0.5-1.3mm), 31.6% medium sand (>0.25mm-0.5mm) and 52.7% fine sand (>0.125-0.25mm).

5.6.1.10 Within the vicinity of East Pickard Bay, the wave climate will be the main influence on offshore sediment transport, rather than tidal currents, due to the high energy environment. Bedload sediment transport is primarily moved from west to east and deposited on Freshwater West beach. Suspended sediment levels in the area would have typical monthly averages of 1-2 mg/l in summer and 10mg/l in winter but this may increase to 15 mg/l during storm events (CEFAS, 2016).

5.6.1.11 Chapter 7: Benthic Subtidal and Intertidal Ecology, section 7.7.3 describes the sediment types and size predicted within the area off East Pickard Bay. EUSeaMap (2016) data predict Atlantic and Mediterranean high energy circalittoral rock in the nearshore area along the East Pickard Bay coastline , coinciding with the proposed cable corridor. Drop down video camera survey (Aquatic Survey and Monitoring Ltd. 2019) confirmed that the rocky substrate extends approximately 480m before becoming sand (section 7.7.3).

5.6.2 Designated sites

5.6.2.1 mWave and its marine cable are within the Pembrokeshire Marine/ Sir Benfro Forol SAC (a Natura 2000 site) and as such are protected under the Habitats Directive (1992). Therefore the coastal processes were examined for each site and activity to provide information for each EIA discipline.

5.6.3 Future baseline scenario

5.6.3.1 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.

5.6.3.2 The baseline environment for coastal processes is not static and will exhibit a degree of natural change over time. Such changes will occur with or without the proposed developments in place due to naturally occurring and ongoing processes. Any potential impacts identified due to the proposed mWave project must therefore be viewed in the context of the changes that might occur over the timescales of the project.

5.6.3.3 Whilst mWave is a short term deployment the effect of climate change and storminess are evident. Due to climate change, mean sea level is expected to rise in the 21st Century. A rise in sea level has potential to allow larger waves and therefore more wave energy to reach areas of the Waterway and the surrounding coastline that are currently exposed to notable wave energy. There may also be changes to storm surges in the future as a result of climate change, and potentially impacts on the wave regime itself, although it is noted that there are large uncertainties with respect to those changes, particularly with respect to the wave climate.

5.6.4 Data limitations

5.6.4.1 The nature of the mWave project is limited in duration and extent, using gravity foundations. This and the fact that the cable will be laid on the seabed, rather than buried, indicates that the magnitude of impacts would be small. There is a large amount of data available with the study area and environs as it has been reviewed under the Shoreline Management Plan (Halcrow, 2012). This data has been supported by site specific survey data as described above. As such, sufficient data is available to allow a proportionate impact assessment to be undertaken and there is a high level of certainty in the conclusions of the assessment.

5.7 Key parameters for assessment

5.7.1 Project design parameters

5.7.1.1 The project design parameters for the mWave project identified in Table 5.3 have been selected as those having the potential to result in the greatest effect on an aspect of coastal processes. These parameters have been selected from the details provided in the project description (Chapter 2: Project Description).

Table 5.3: Project design parameters for the mWave project.

Potential impact	Project design parameter	Justification
Installation phase		
Increases in SSC and deposition of disturbed sediment to the seabed	Total area of disturbance <1900m^2, including gravity base (1032 m^2), penetration depth 1m, ADCP, SUTU, communication cable and scour protection (668 m^2) if needed.	Sediment disturbance may arise from installation activities such as installation of gravity foundation and scour protection. (Note scour protection if needed would be installed during operation but has been included in area for a worst case assessment). Elevations in SSC and subsequent deposition of disturbed sediments have the potential to result in adverse and indirect impacts on a variety of receptor groups.
Operational phase		
Changes to the wave regime, with associated impacts on adjacent coastline	Positioned on seabed, with localised shallowing resulting from the height of the device. Dimensions 75m (L) x 17m (W) x 7m (h). Water above mWave 4.2m MLWS 7.35m mid tide 10.5m MHWS	The presence of mWave may result in a change in the wave energy. This in turn has the potential to impact upon the adjacent coastline.
Scour of seabed sediments	Scour around base of mWave device .	Interaction between the metocean regime (wave, sand and currents) and mWave has the potential to cause localised scouring of seabed sediments leaving a depression around the structure.
Impacts to sediment transport and sediment transport pathways	Gravity base 1032 m^2 with penetration depth 1m, installed for up to 18 months.	Foundation used for marine energy devices may interrupt sediment transport pathways.
Decommissioning phase		
Increases in SSC and deposition of disturbed sediment to the seabed at mWave deployment site	As for installation phase	Removal of mWave project including marine cable may result in re-suspension of sediments.

Table 5.4: Impacts scoped out of the assessment for Coastal Processes

Potential impact	Justification
Installation phase	
Release of contamination adsorbed to sediments disturbed, on ecological receptors	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 section 5.9.1 below, 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. No further assessment of contamination is proposed.
Operation phase	
Increases in SSC and deposition of disturbed sediment to the seabed	During the operation and maintenance phase, taking into consideration how mWave operates, it is unlikely that the presence of mWave would re-suspend sediment on the seabed. As such this has not been considered further within this impact assessment.
Decommissioning phase	
Release of contamination adsorbed to sediments disturbed, on ecological receptors	As for installation

5.8 Impact assessment methodology

5.8.1 Overview

5.8.1.1 The Coastal Processes EIA has followed the methodology set out in Chapter 4: Environmental Impact Assessment Methodology. The scale and nature of mWave is well defined and as such by using the design parameters for the project, this reduces uncertainty from the assessment.

5.8.1.2 In the case of some of potential impacts considered in this chapter, coastal processes are not in themselves receptors. However, changes to coastal processes arising due to the development have the potential to indirectly impact other receptors in the marine environment. For example, increases in suspended sediments during the installation may lead to the settling of these sediments (and smothering of benthic habitats). As such, this coastal process assessment has been undertaken to inform a range of other technical assessments presented across the Environment Statement. The pathways assessed are:

- Increases in SSC and deposition of disturbed sediment to the seabed (installation and decommissioning phase);
- Release of contamination adsorbed to sediments disturbed, on ecological receptors (installation and decommissioning phase);
- Increases in SSC and deposition of disturbed sediment to the seabed (operational and maintenance phase).

5.8.1.3 In the case of these impact pathways, the coastal process assessment evaluates the likely process changes and their magnitude and does not present a sensitivity or significance of impact. The potential significance of impacts of these changes are assessed in the following receptor chapters (with sensitivity of receptor also being presented in these chapters):

- Benthic Subtidal and Intertidal Ecology (Chapter 7);
- Fish and Shellfish (Chapter 8);
- Marine mammals (Chapter 9);
- Marine Ornithology (Chapter 10);
- Commercial Fisheries (Chapter 11);
- Marine Archaeology (Chapter 13); and
- Other Users (Chapter 15).

5.8.1.4 Whilst coastal processes can largely be considered pathways, a number of coastal process receptors have also been identified and are assessed in this chapter. A full impact assessment is presented within this coastal process assessment for these receptors. These are:

- Changes to the wave regime, with associated impacts on adjacent coastlines;
- Increases in SSC and deposition of disturbed sediment to the seabed.
- Scour of sea bed sediments; and
- Impact on sediment transport and sediment transport pathways.

5.9 Assessment of significance

5.9.1 Installation phase

5.9.1.1 The impacts of the offshore installation of the mWave project have been assessed on coastal processes. The potential impacts arising from the installation of the mWave project are listed in Table 5.3, along with the project design scenario against which each impact has been assessed. Finally, a conclusion of the scale of effect has been made.

5.9.1.2 A description of the potential effect on coastal processes caused by each identified impact is given below.

Increases in SSC and deposition of disturbed sediment to the seabed

5.9.1.3 Sediment disturbance may arise from installation activities, such as the deployment of the device or placement of scour protection. The geophysical survey data for the site (Titan 2018) shows the seabed at the mWave site consists almost entirely of smooth, virtually featureless sands, the only bedforms identified are insignificant sand ripples lying scattered across the site (Titan 2018). As such site no preparation is required prior to the installation of mWave, which will significantly reduce any impacts with respect to suspended sediments.

Magnitude of impact

5.9.1.4 In the case of the mWave device, the gravity base would be deployed without the need for levelling. The mWave device would be floated to site and then one end would be gently lowered to the seabed through using controlled buoyancy of the mWave. 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). 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.

5.9.1.5 In order to gain an understanding of the distance any disturbed sediments could travel, an estimation can be 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.

5.9.1.6 To illustrate this an intrusive installation method has been reviewed, namely levelling with a backhoe. It is assumed that the area of the dimension of the gravity base was levelled to a depth of 0.25m and material was spilt at half the average water depth. Of the 1032 m^2 area of marine sand the finest material (1 mm) 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. For any finer material (0.06 mm) this would travel in the order of 600m during an average tide based on the average site current speed.

5.9.1.7 The plume generated from such an activity would give rise to an average increase in SSC of 70 mg/l. 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. Based on this intrusive method of installation, which has been used as an example only, the impact on SCC is predicted to be temporary in nature and of minor magnitude.

5.9.1.8 As mentioned previously, the installation of mWave does not require any seabed preparation, and as such there will be negligible magnitude of impact. Even if site preparation was required, due to the limited extent of works, the effect would be of minor magnitude.

Sensitivity of Receptor and Significance of Impact

5.9.1.9 No assessment of sensitivity of receptor or significance of impact is provided for this coastal processes impact pathway as these are assessed by the associated receptor group assessment (see section 5.8.1.3).

Future monitoring

5.9.1.10 No monitoring is considered necessary with regards to the installation phase impact assessment.

5.9.2 Operational and maintenance phase

5.9.2.1 The impacts of the offshore operation and maintenance of the mWave project have been assessed on coastal processes. The potential environmental impacts arising from the operation and maintenance of the mWave Project are listed in Table 5.3 against which each operation and maintenance phase impact has been assessed.

5.9.2.2 A description of the potential effect on coastal processes caused by each identified impact is given below.

Changes to the wave regime, with associated impacts on adjacent coastline

5.9.2.3 The presence of a wave energy device on the seabed may potentially alter the wave climate and disturb sediment transport regimes in its localised area.

Magnitude of impact

5.9.2.4 The mWave device will be deployed at 11m below Chart datum, which will provide a water clearance above the device of between 4.2m - 10.5m between MLWS and MHWS. The mWave device has maximum dimensions of 75m by 17m (length and width) with a height of 7m. The device will cause localised shallowing of water, which may result in breaking waves over the device at certain sea states and states of the tide. The predominant direction of the incoming waves at East Pickard Bay is from the south west therefore any disruption of waves passing mWave would occur between mWave and the adjacent coastline to the north of the site and would not affect waves approaching Freshwater West Bay.

5.9.2.5 In general, a wave will start to break when it reaches a water depth of 1.3 times the wave height. Looking at the water depth above mWave at the various states of the tide, the approximate size of wave which would break over the device at a particular state of the tide can be calculated.

Table 5.5: Breaking wave height over mWave at various states of tide

	MLWS	Mid tide	MHWS
Depth of water	4.2m	7.35m	10.5m
Height of wave	3.16m	5.53m	7.89m

5.9.2.6 Using the wave heights in Table 5.5 above, an assessment can be made as to whether the waves recorded during the site specific survey would generally be expected to have broken over mWave.

Table 5.6: Assessment of potential for breaking waves over mWave

	Wave height	Wave break over device MLWS (4.2m)	Wave break over device Mid tide (7.35m)	Wave break over device MHWS (10.5m)
All data over 3 period month autumn				
Mean Hs	1.26m	No	No	No
	1.4m	No	No	No
Mean Hmax	1.98m	No	No	No
	2.11m	No	No	No
Top five storm events				
Hs	4.33m	Yes	No	No
Hs	6.74	Yes	Yes	No
Hmax	7.45m	Yes	Yes	No
Hmax	11.26m	Yes	Yes	Yes

5.9.2.7 Looking at Table 5.6 above, the data shows that for the mean H_s and mean H_{max} wave recorded over the three month autumn period, mWave would not generally be expected to result in the waves breaking above the device. In terms of the five largest waves during Storm Callum, there would be a potential for waves to break over mWave, at some states of the tide.

5.9.2.8 Putting this information in context, the area of mWave is small (75m by 17m) in comparison to the coastal area where it is situated. During the significant storm event, 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. The magnitude of the impact on wave climate is therefore considered to be minor.

Sensitivity of Receptor

5.9.2.9 With the increase in water depth as soon as the wave passes over mWave, in all situations identified in Table 5.6, the wave would have ceased breaking until it got closer to the coast and natural water depth came into effect. Any effect from mWave would therefore be very localised and would not affect the coast. The sensitivity of the receptor is therefore deemed to be low.

Significance of the effect

5.9.2.10 Overall, the sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

Scour of seabed sediments

5.9.2.11 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 structure. The magnitude of the potential scouring is both site and device specific; particularly where the structure occupies part of the water column.

5.9.2.12 The presence or amount of scour depends on a number of parameters; the structure i.e. its shape, the width presented to the oncoming flow and the height of the structure with respect to the water column. It also depends on the flow characteristics i.e. current speed and orientation. Finally, it depends on the bed material; the sediment size, cohesion and depth.

Magnitude of impact

5.9.2.13 Introducing mWave into the current and wave flow will obstruct the flow pattern in the vicinity of the structure which will cause localised scour. In time, scour pits will form in and around the edges of the structure which will then backfill and then repeatedly scour. For a given sea state there is an equilibrium scour pit size and shape. The varying sea states which occur off East Pickard Bay will cause the scour pit to fluctuate in size and shape due to natural backfill processes. The likelihood of the edge scour developing into tunnel erosion underneath the device is considered very low given the size of the device.

5.9.2.14 When dealing with local scour, only the maximum scour depth in the equilibrium phase is relevant. Scour can be divided into global/general scour and localised scour. These two processes have different length and time scales. The time scale of global scour is generally longer than that for local scour. Global scour relates to a macro change in the global seabed level due to scour caused by a gradual modification to the stable flow regime conditions. Both types can be caused by waves and currents.

5.9.2.15 Global scour is not considered an issue for the mWave demonstrator given its isolation and 1 year operational life. The timescales for localised scour are negligible compared to the design life of the system. If a 1 year extreme event occurs within the first week then the scour pits associated with that event will form within the storm duration. Therefore it can be assumed that at some point full edge scour pits (associated with the one year operation period will form if scour prevention methods are not employed. However, due to the relatively coarse bed material in this area the scour would be anticipated to be reduced.

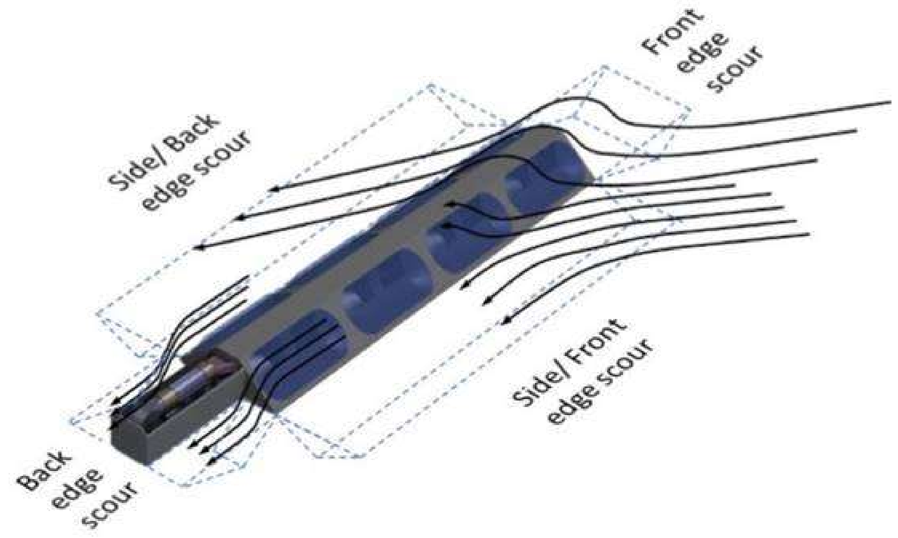

Figure 5.5: Scour effects of mWave

5.9.2.16 Around the device itself scour is split into two different types, namely, front/back edge scour and side edge scour as illustrated in Figure 5.5. Calculations have been undertaken for the scour defined above and it is anticipated that any scour will be concentrated along the edge of the device. For the period of the mWave installation, worst case scour is expected to occur to a depth of up to 1.4m with a width of up to 4.8m, with the profile shown below.

5.9.2.17 As identified through site specific survey, the tide driven currents in the area tend to be relatively low 0.3m/s and as such scour formation is not likely to be an issue under average conditions. During major storm events the wind driven currents are significantly greater and it will be during these events that there is the potential for worst case scour to occur around the device. Notwithstanding this, considering the short-duration and local spatial extent of testing proposed, the magnitude of the impact of scour on the seabed is considered to be minor.

Sensitivity of Receptor

5.9.2.18 Scour pockets will form along the edge of mWave and will only occur in the immediate vicinity of the structure. The flow regime will return to that previously experienced on removal of the mWave. The sensitivity of the receptor is therefore deemed to be low.

Significance of the effect

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

Further mitigation and residual effect

5.9.2.19 A video camera will be positioned on the device to monitor the formation of scour during the deployment. Time and date stamped photos will be taken of gauge painted onto the device to allow assessment of sediment depth during the deployment. Should it be identified that scour protection be required, this will be deployed as identified in Chapter 2, Section 2.5.2.

Impacts to sediment transport and sediment transport pathways

5.9.2.20 Gravity foundations used for marine energy devices may interrupt sediment transport pathways. The scale of this disruption will depend firstly on whether a pathway exists in the site of deployment and secondly the proportion of the pathway obstructed. It should be noted that the mWave deployment is temporary, it has shallow gravity foundations (up to 1m) and after decommissioning the pathway will be restored.

Magnitude of impact

5.9.2.21 East Pickard Bay coastline is well suited to wave energy conversion devices with a significant fetch from the south west. The mWave device uses a gravity foundation with an area of 1032m^2, however, mWave is four times the width than its length; with the long axis aligned to the incident wave. At the deployment site, that is approximately east-west with 90 % of waves approaching from the south and south-west sectors.

5.9.2.22 The principle direction of bed load sediment transport in this area is roughly west to east therefore the width of obstruction will be the smallest axis of the device at < 20 m which is insignificant with respect to this open coast site. The mWave device would be tested for a period of 6-12 months, but may be in the water for longer (18 months) to allow for decommissioning. After its removal normal transport pathways would be restored.

5.9.2.23 Considering the short-duration and local spatial extent of testing proposed, the magnitude of the impact on sediment transport pathways is considered to be minor.

Sensitivity of receptor

5.9.2.24 The reduction in sediment pathway along the East Pickard Bay coastline is not significant and at no location is a pathway blocked to any significant extent, i.e. material is free to move around the device. There would be no significant effect on sediment transport beyond the immediate vicinity of mWave. The deployment of mWave is temporary and when the device is decommissioned, bed sediment transport would return to the previous situation. The sensitivity of the receptor is therefore deemed to be low.

Significance of the effect

5.9.2.25 Overall, the sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms.

Future monitoring

5.9.2.26 As discussed previously a video camera will be positioned on the device to monitor the formation of scour during the deployment. Time and date stamped photos will be taken of gauge painted onto the device to allow assessment of sediment depth during the deployment. Should it be identified that scour protection be required, this will be deployed as identified in Chapter 2, section 2.5.2. In addition to this, an ADCP will be located to the south east of the device. Data on waves, currents, tidal height and temperature will be collected throughout the deployment.

5.9.3 Decommissioning phase

5.9.3.1 The effects of decommissioning activities associated with mWave are expected to be the same or similar to the effects from installation in that suspended sediment may be increased for a short period. Overall the impacts are considered short term and localised and as such are insignificant in EIA terms.

5.10 Cumulative Impact Assessment methodology

5.10.1.1 The Cumulative Impact Assessment (CIA) takes into account the impact associated with the mWave project together with other projects and plans as detailed in Table 5.7. The projects and plans selected as relevant to the CIA presented within this chapter are based upon the results of a preliminary screening exercise which considered the full range of projects as detailed in Table 4.1 in Chapter 4, Environmental Assessment Methodology. 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.

5.10.1.2 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, especially since mWave is of relatively short duration. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact with the mWave (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are less certain to contribute to such an impact, due to the short timescale of the mWave project.

Table 5.7: 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 m^3.	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 m^3.	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.

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
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 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.

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
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 Maintenance	Pembrokeshire Scallops	6.5	Temporal overlap	The scallop farm is located within Castlebeach Bay, 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	Jan 2019 – Q4 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.
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. An assessment of the maximum META project design (two WECs) 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

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Consideration required?	Justification
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.

5.10.2 Cumulative Impact Assessment

5.10.2.1 There is the potential for cumulative increases in SSCs and sediment deposition within the coastal processes study area as a result of installation/decommissioning activities associated with the mWave project together with the use of the offshore area of META Site 8 project and the Greenlink Interconnector project. In all cases the aspect of coastal processes which may be affected is the potential increase in SSC. In addition to this there is a potential cumulative effect on wave climate as a result of wave energy devices being deployed in META Site 8 at the same time as mWave.

Magnitude of impact

5.10.2.2 In terms of the potential cumulative impact from two deployments at the META Site 8 with one of them being mWave, given that the increases in SSC associated with the mWave project only occur during the installation/decommissioning phases which are of very limited nature and for short periods of time (a few days) they are very unlikely to interact either temporally or spatially.

5.10.2.3 The Greenlink Interconnector project outlines ploughing and trenching operations to install the cable and the placement of cable protection material on the seabed (Intertek, 2016). This may cause very localised increases in SCC for short durations and are unlikely to interact with the mWave project.

5.10.2.4 In terms of potential effects on wave climate, META Site 8 would be used for the full-scale wave devices and floating offshore wind component testing. However only minor changes may be seen in bed transport due to the open bay location and device alignment. The largest wave device considered for META Site 8 may reduce the incident wave energy by less than 1% along the shoreline, and the wave climate is restored to uniformity prior to reaching the intertidal zone, even for the largest waves. Any deployment at the META Site 8 is temporary for a maximum of 18 months and any effects would be transitory and wave climate and sediment transport would return to previous levels. In term of mWave, there would be no reduction of energy as the device is positioned on the seabed. An assessment of wave climate confirmed that there would be a potential for breaking of waves offshore over the device only in significant storms. Any effect would be localised, above the device, with the waves cease breaking when the water depth increases adjacent to the device.

5.10.2.5 Cumulative impacts are therefore predicted to be unlikely and if they do occur they will be of temporary, short term nature. The magnitude of cumulative impacts are therefore considered to be minor.

5.11 Transboundary effects

5.11.1.1 All effects identified during the course of the Coastal Processes impact assessment have been minor in nature and limited to the immediate vicinity of the mWave project site under consideration. Therefore, there is no potential for significant transboundary effects with regard to coastal processes from the mWave project upon the interests of other EEA States.

5.12 Conclusion and summary

5.12.1.1 The impact from the installation, operation and decommissioning of mWave was investigated at East Pickard Bay.

5.12.1.2 Only minor changes may be seen in bed transport due to the open bay location and device alignment. These impacts are summarised in Table 5.5. As the deployment is temporary for a maximum of 18 months, any effects would be transitory and sediment transport would return to previous levels.

5.12.1.3 In conclusion, due to the limited size of device and the temporary nature of deployment the impacts of the mWave project activities on its own or in combination would be minor and not significant in EIA terms.

Table 5.5: Summary of potential environment effects, mitigation and monitoring mWave Project.

Description of impact		Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Installation and Decommissioning Phases							
Increases in SSC and deposition of disturbed sediments to the seabed	N/A	Negligible	N/A	N/A	N/A	N/A	N/A
Operational Phase							
Changes to the wave regime, with associated impacts on adjacent coastlines	Wave device	Minor	Low	Minor (not significant in EIA terms)	None	N/A	ADCP monitor waves, currents, tidal height.
Scour of seabed	Gravity foundation	Minor	Low	Minor (not significant in EIA terms)	Monitoring of scour and implementation of scour protection if need be.	N/A	ADCP monitor waves, currents, tidal height. Video camera positioned to record any formation of scour.
Impacts to sediment transport and sediment transport pathways	Gravity foundation/Bed mounted device	Minor	Low	Minor (not significant in EIA terms)	None	N/A	None

5.13 References

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