MARINE ENERGY WALES

MARINE ENERGY TEST AREA (META)

Assessment:

Water Framework Directive

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Marine Energy Test Area
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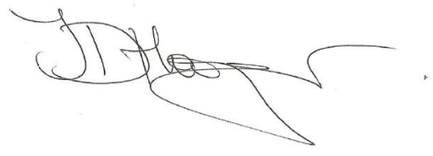
Jessica Hooper  2019-05-29

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Acronyms

Acronym	Description
AA	Appropriate Assessment
BAP	Biodiversity Action Plan
dWNMP	draft Welsh National Marine Plan
EMP	Environmental Management Plan
GPP	Guidance for Pollution Prevention
HRA	Habitat Regulations Assessment
INNS	Introduction of Non-Native Species
MCA	Maritime and Coastguard Authority
META	Marine Energy Test Area
MEW	Marine Energy Wales
MHPA	Milford Haven Port Authority
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring
MPCP	Marine Pollution Contingency Plan
NRW	Natural Resources Wales
PAHs	polyaromatic hydrocarbons
PELs	Probable Effect Levels
ROV	Remotely Operated Vehicle
SAC	Special Areas of Conservation
SPA	Special Protection Areas
SQG	Sediment Quality Guideline
SQG	Sediment Quality guidelines
SSC	Suspended Sediment Concentration
TELs	Threshold Effect Levels
THCs	Total Hydrocarbon Concentrations
WFD	The Water Framework Directive
WNMP	Welsh National Marine Plan

Units

Unit	Description
%	percent
km	kilometres
km^2	square kilometres
m	metres
m/s	meters per second
m^2	square meters
mg/L	milligrams per litre
mm	millimetres

EXECUTIVE SUMMARY

EU Directive 2000/60/EC, better known as the Water Framework Directive (WFD), established a framework for community action in the field of water policy. The WFD is transposed into United Kingdom (UK) law by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Natural Resources Wales (NRW) is the responsible authority in Wales for delivering the aim of the WFD, which is for all waterbodies to achieve "good status".

Marine Energy Wales (MEW), a Pembrokeshire Coastal Forum (PCF) Community Interest Company (CIC) led project (the Applicant) have commissioned RPS to support them with their environmental permitting requirements for the Marine Energy Test Area (META) project. RPS have been requested to undertake an assessment in accordance with the WFD.

MEW aim to provide a suite of offshore marine energy test sites within, and in proximity to, the Milford Haven Waterway (subsequently referred to as the Waterway), namely Warrior Way (site 6), Dale Roads (site 7), and East Pickard Bay (site 8) to facilitate the testing and development of marine energy projects. Activities include; scale wave and tidal device testing; full scale wave device testing; micro tidal device testing; testing of Remotely Operated Vehicle (ROV) or other monitoring equipment; site preparation methodologies; decommissioning methodologies; salvage methodologies; and tow, float and mooring solution testing for floating offshore wind technology.

The project has the potential to impact on three WFD waterbodies either directly or indirectly; namely; the transitional waterbody Milford Haven Inner and the coastal waterbodies Milford Haven Outer and Pembrokeshire South. These have current overall WFD statuses of 'moderate', 'moderate' and 'good' respectively.

A WFD assessment was undertaken in accordance with OGN 72 document '*Guidance for assessing activities and projects for compliance with the Water Framework Directive'* (NRW 2018). The guidance document stipulates a WFD assessment can comprise of up to 3 stages, screening, scoping and impact assessment.

Screening identified that proposed project activities would require scoping against WFD. A scoping exercise was then undertaken by assessing project activities against set criteria associated with several physical and biological receptors in accordance with OGN 072 guidance note namely, hydromorphology, water quality, benthic habitats, fish, priority species and WFD protected areas.

Following scoping a detailed impact assessment was undertaken on identified receptors through a range of impact pathways identified from project activities associated with installation, operation and decommissioning phases.

In conclusion the project was found not to cause deterioration to the overall WFD status of identified waterbodies and the objectives of identified protected will not be restricted from being achieved.

1. INTRODUCTION

1.1 Assessment Context

1.1.1.1 EU Directive 2000/60/EC, better known as the Water Framework Directive (WFD), established a framework for community action in the field of water policy. The WFD came into force in 2000 and requires EU Member States to ensure that all inland and coastal waters achieve 'good' water quality status by 2015. The aims of the WFD are for member states to:

- Implement the necessary measures to prevent deterioration of the status of all bodies of surface water and ground water;
- Protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015;
- Protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015; and
- Implement the necessary measures in accordance with Article 16 (1) and (8), with the aim of progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances.

1.1.1.2 The WFD was transposed into United Kingdom (UK) law by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (as amended). The 2003 Regulations were revoked in April 2017 and replaced by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The legislative framework sets out the legal requirements to protect and improve the water environment and sets out environmental objectives that must be met for all waterbodies. The foundation of this is an ecosystem-based approach that requires measures to be taken to encourage the sustainable use of water and to protect and improve surface waters (including rivers, lakes, transitional and coastal waters), and ground waterbodies, with the aim of achieving good status.

1.1.1.3 In Wales, regard to the Environment (Wales) Act 2016 and the Well-being of Future Generations (Wales) Act 2015 is to be also considered. The overarching aims of the Environment Act (2016) is to enable Wales' resources to be managed in a more proactive, sustainable, combined manner. The Well-being of Future Generations Act asks 44 Public Bodies in Wales to work in a sustainable way and consider the impact public sector work can have for people living in Wales, now and in the future.

1.1.1.4 The WFD must also be considered in the planning and licensing of all new activities in waterbodies (rivers, estuarine and coastal waters). Natural Resources Wales (NRW) is the responsible authority in Wales for delivering the aim of the WFD, which is for all waterbodies to achieve "good status". "Good status" comprises two parts. The first is "good ecological status", or "good ecological potential" for waterbodies. The second is "good chemical status". "Good ecological status/potential" includes biological, hydromorphological and physicochemical quality elements and specific pollutants. "Good chemical status" concerns a series of priority substances, including a number of priority hazardous substances. The WFD also requires that relevant protected area objectives are achieved.

1.1.1.5 Marine Energy Wales (MEW) a Pembrokeshire Coastal Forum (PCF) Community Interest Company (CIC) led project (the Applicant) have commissioned RPS to support them with their environmental permitting requirements for the Marine Energy Test Area (META) project. As part of RPS's support to Milford Haven Port Authority (MHPA), RPS have been requested to undertake an assessment in accordance with the WFD.

1.1.1.6 This WFD Compliance Assessment constitutes one of the Appendices to the Environmental Statement and should therefore be read in conjunction with the following chapters of the Environmental Statement:

- Chapter 2 – Project Description
- Chapter 5 – Coastal Processes
- Chapter 6 – Underwater Noise
- Chapter 7 – Benthic Subtidal and Intertidal Ecology
- Chapter 8 – Fish and Shellfish
- Chapter 9 – Marine Mammals, Basking Sharks and Otter

1.1.1.7 This report does not aim to repeat information provided elsewhere within the Environmental Statement. Therefore, where information is discussed in more robust detail elsewhere, a summary of the relevant information will be provided here along with the reference to the appropriate sections of the relevant Environmental Statement chapters and/or Technical Reports.

1.1.1.8 The installation of marine energy devices and associated ancillary equipment, such as test support buoy and aids to navigation, will be on a project-by-project basis and may take place throughout the lifespan of the project. It is anticipated that the first test deployments at META project sites will commence in 2020.

1.2 The Project

1.2.1.1 MEW aim to provide a suite of offshore marine energy test sites within, and in proximity to, the Waterway, to facilitate the testing and development of marine energy projects. This proposal, known as the Marine Energy Test Area project (the META project) will provide marine renewable energy device developers with pre-consented testing sites, which will reduce the consenting burden on these developers. The aim of the META project is therefore to provide a series of pre-consented, non-grid connected, marine energy test areas that will allow for the deployment and testing of devices, components and subassemblies, and ancillary activities and equipment, in support of marine energy testing, thereby de-risking marine energy projects prior to larger scale or array deployments.

1.2.1.2 The over-arching META project proposes eight sites, three of which require EIA for activities to be enabled. These are Warrior Way (site 6), Dale Roads (site 7) and East Pickard Bay (site 8). These three

sites are henceforth called “the META project”. The remaining five sites are considered under a separate set of consent and licence applications; which are accompanied by an Environmental Supporting Information report.

1.2.2 Proposed activities

1.2.2.1 Detailed information on proposed activities can be seen in chapter 2: Project Description of the Environmental Statement. In summary, the proposed META project will support the following device testing activities across three sites:

- Scale wave device testing;
- Scale tidal device testing;
- Full scale wave device testing;
- Micro tidal device testing;
- Testing of Remotely Operated Vehicle (ROV) or other monitoring equipment;
- Site preparation methodologies;
- Decommissioning methodologies;
- Salvage methodologies; and
- Tow, float and mooring solution testing for floating offshore wind technology.

1.2.3 Project location

1.2.3.1 The META project is located in the inshore waters of Pembrokeshire. Warrior Way (site 6) and Dale Roads (site 7) are located within the Waterway, and East Pickard Bay (site 8) is located on the south-western boundary of the Waterway, 500 m west of the Mean High-Water Spring (MHWS) at Freshwater West Bay. The site locations are shown in Figure 1.1.

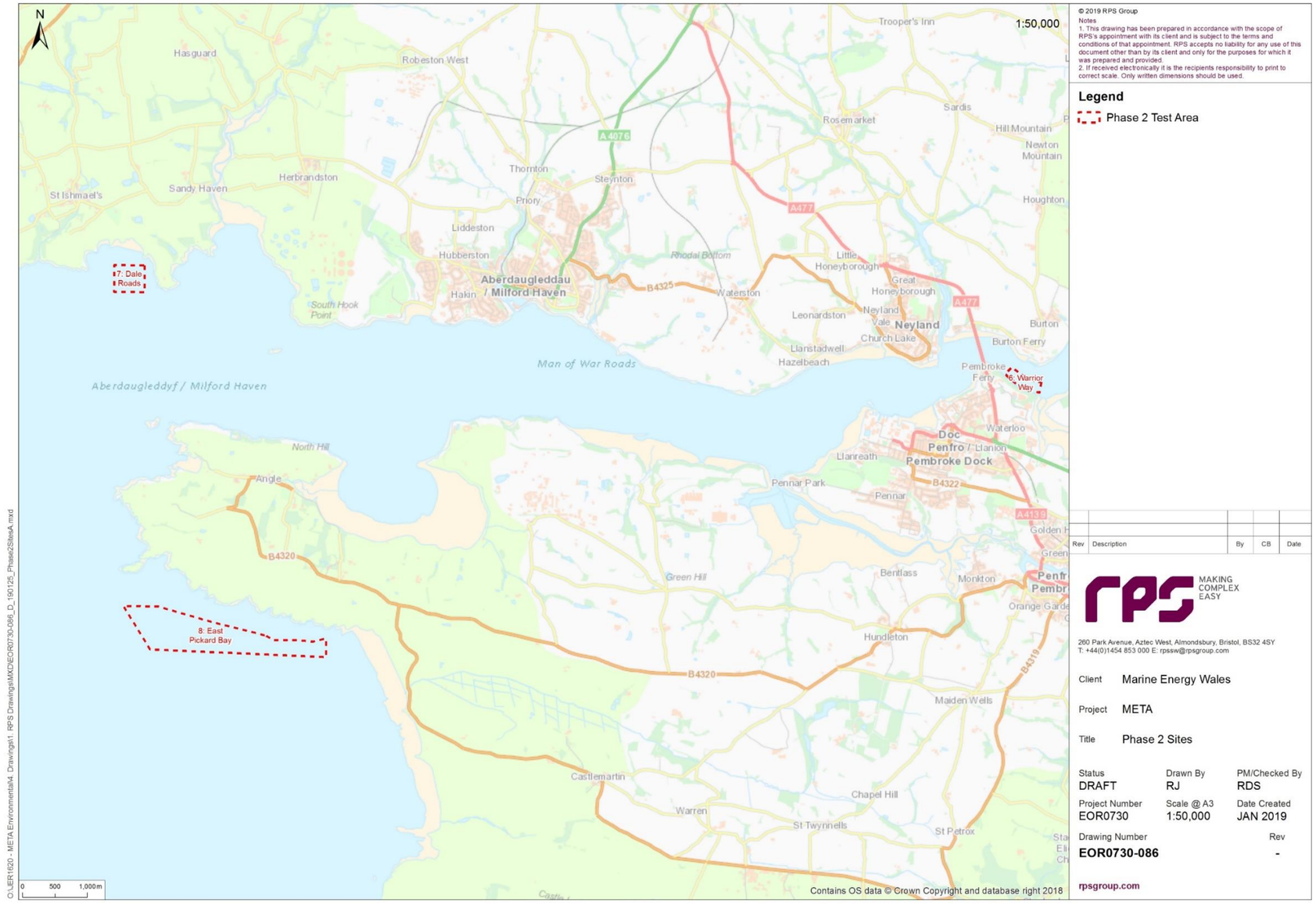

Figure 1.1: The META project site locations.

2. WFD WATERBODIES

2.1.1.1 The project has the potential to impact on three WFD waterbodies either directly or indirectly; the transitional waterbody Milford Haven Inner and the coastal waterbodies Milford Haven Outer and Pembrokeshire South (see Figure 2.1). Warrior Way (site 6) is located within Milford Haven Inner waterbody, Dale Roads (site 7) is located within Milford Haven Outer waterbody and East Pickard Bay is located within Pembrokeshire South waterbody (see Figure 2.1).

2.1.1.2 A baseline description of the biological, physico-chemical and hydromorphological quality elements, in line with the requirements of the Water Framework Directive (2000/60/EC) are provided in Table 2.1, Table 2.2 and Table 2.3 for Milford Haven Inner, Milford Haven Outer and Pembrokeshire South, respectively.

2.1.1.3 The Milford Haven Inner waterbody current overall status is 'Moderate', with ecological status as 'Moderate (very certain)' and Chemical Status as 'Fail'. Current justification for not meeting the overall status objective of 'Good' is that proposed mitigation measures are disproportionately expensive or technically not feasible (WWW, 2019).

2.1.1.4 The reason for failing to meet good ecological status is due to high levels of dissolved inorganic nitrogen and macroalgae. Justification for not achieving good status by 2015 is because mitigation measures are not in place as they are disproportionately expensive (WWW, 2019).

2.1.1.5 It is currently not specified the reasons for the chemical status of fail, and mitigation measures are currently not in place (WWW, 2019).

2.1.1.6 As such the current status objective for this waterbody is to an overall status of Good by 2027 (WWW, 2019). To aid in achieving this overall status of Good status by 2027 two research programs have been implemented:

- Building Resilience in Catchments (BRICS), in which PCF (the applicant) is involved, which aims to:
  - Improve water quality, nutrient and habitat management on farms,
  - Reduce the level of nutrients entering the Milford Haven Waterway and
  - Create a nutrient trading scheme.
- GreenSeas macroalgae harvesting which aims to
  - Harvest green algae *Ulva spp* to help reduce the effect of opportunistic colonisation of seaweed that cause detrimental impact on water oxygen levels, zoobenthic communities and native eelgrass populations within the Waterway.

Table 2.1: Milford Haven Inner waterbody WFD features and objectives (WWW, 2019)

Waterbody Parameters[1]	Description, notes or more information
WFD waterbody name	Milford Haven Inner
Waterbody ID	GB531006114100
River basin district name	Western Wales
Catchment	Cleddau and Pembrokeshire Coastal Rivers TraC
Waterbody type (estuarine or coastal)	Transitional
Waterbody total area (km^2)	21.02
Overall waterbody status (2015)	Moderate
Ecological status	Moderate
Chemical status	Fail
Target waterbody status and deadline	Good 2027
Hydromorphology status of waterbody	Supports Good
Heavily modified waterbody and for what use	No
Phytoplankton Status	High
History of Harmful Algae	Not monitored
Angiosperm Status	High
Invertebrates status	Good
Macroalgae status	Moderate
Fish status	Good
WFD protected areas within 2km	Yes

1 Waterbody information was extracted from Water Watch Wales website. Magic maps provide additional information on habitats and protected areas.

2.1.1.7 The Milford Haven Outer waterbody current overall status is 'Moderate', with ecological status as 'Moderate' and chemical status as 'Good'. Current justification for not meeting the overall status objective of 'Good' is that proposed mitigation measures are disproportionately expensive or technically not feasible (WWW, 2019).

2.1.1.8 The reason for failing to meet good ecological status is due to high levels of dissolved inorganic nitrogen. Justification for not achieving good status by 2015 is because mitigation measures are not in place as they are disproportionately expensive (WWW, 2019).

2.1.1.9 As such the current status objective for this waterbody is to an overall objective of Good by 2027 (WWW, 2019). This objective in part will be supported by the implementation of research programs such as those described in paragraph 2.1.1.6.

Table 2.2: Milford Haven Outer waterbody WFD features and objectives

Waterbody Parameters[1]	Description, notes or more information
WFD waterbody name	Milford Haven Outer
Waterbody ID	GB641008220000
River basin district name	Western Wales
Catchment	Not Applicable
Waterbody type (estuarine or coastal)	Coastal
Waterbody total area (km^2)	35.39
Overall waterbody status (2015)	Good
Ecological status	Moderate
Chemical status	Good

Waterbody Parameters[1]	Description, notes or more information
Target waterbody status and deadline	Good 2027
Hydromorphology status of waterbody	Supports Good
Heavily modified waterbody and for what use	No
Phytoplankton status	High
History of Harmful Algae	Not monitored
Angiosperm status	Good
Invertebrates status	Not monitored
Macroalgae status	Good
Fish status	Not monitored
WFD protected areas within 2km	Yes

1 Waterbody information was extracted from Water Watch Wales website. Magic maps provide additional information on habitats and protected areas.

2.1.1.10 The Pembrokeshire South waterbody current overall status is 'Good', with ecological status as 'Good' and chemical status as 'Good' (WWW, 2019).

2.1.1.11 As such the current status objective for this waterbody is to an maintain overall status of Good by 2027 (WWW, 2019).

Table 2.3: Pembrokeshire South waterbody WFD features and objectives

Waterbody Parameters[1]	Description, notes or more information
WFD waterbody name	Pembrokeshire South
Waterbody ID	GB611008590003
River basin district name	Western Wales
Catchment	Not Applicable
Waterbody type (estuarine or coastal)	Coastal
Waterbody total area (km²)	413.32
Overall waterbody status (2015)	Good
Ecological status	Good
Chemical status	Good
Target waterbody status and deadline	Good Status by 2015
Hydromorphology status of waterbody	Not Designated
Heavily modified waterbody and for what use	No
Phytoplankton status	High
History of Harmful Algae	No
Angiosperm status	Not monitored
Invertebrates status	Good
Macroalgae status	Not monitored
Fish status	Not monitored
WFD protected areas within 2km	yes

1 Waterbody information was extracted from Water Watch Wales website. Magic maps provide additional information on habitats and protected areas.

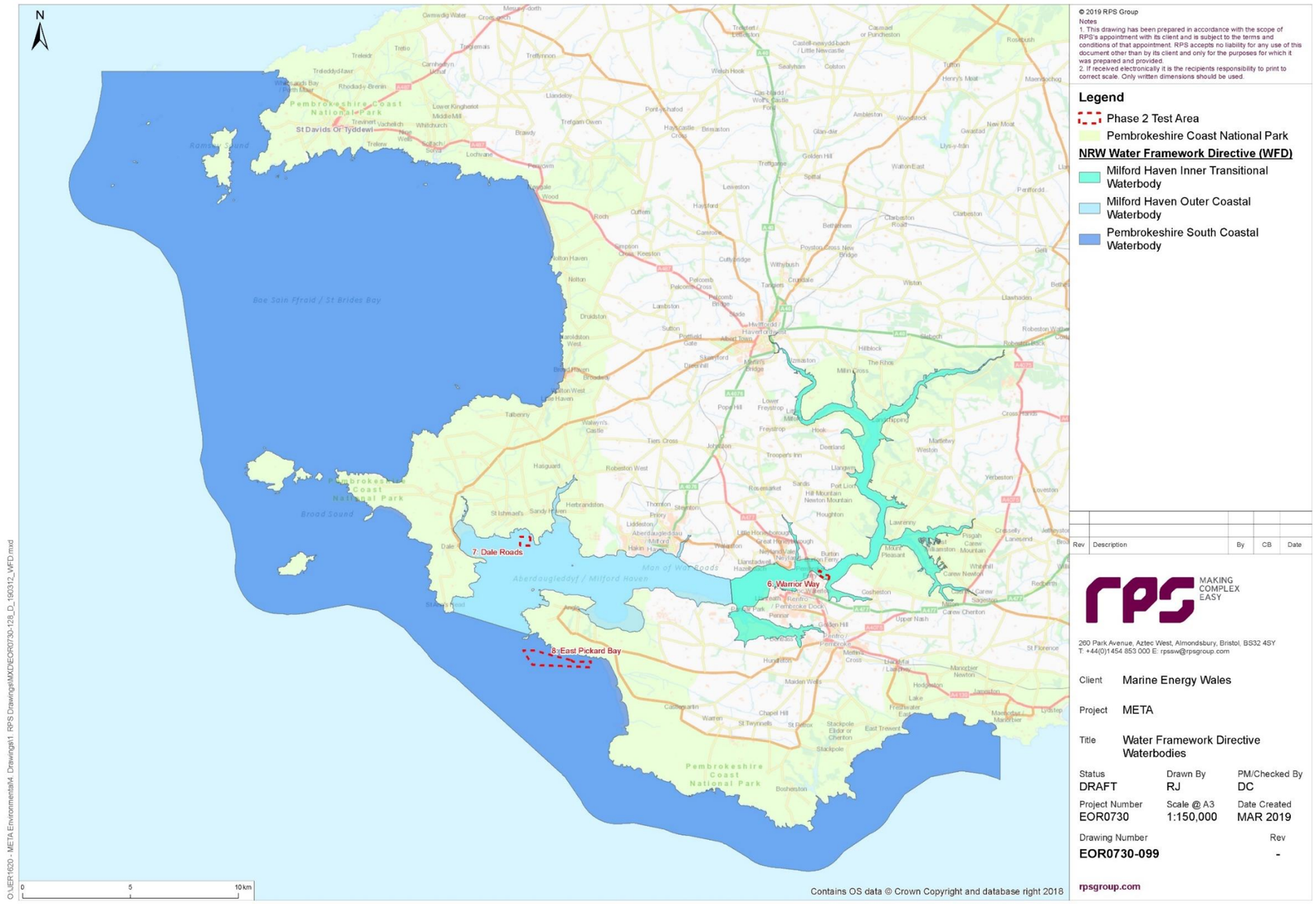

Figure 2.1: Identified waterbodies associated with each of the three META sites.

3. WFD ASSESSMENT PROCESS

3.1.1.1 WFD assessment for Wales is guided by the NRW (2018) OGN 72 document '*Guidance for assessing activities and projects for compliance with the Water Framework Directive'*. The guidance document stipulates a WFD assessment can comprise of up to 3 stages. All stages may not require completion dependent on the outcomes of each stage. The stages are:

- Stage 1: Screening - excludes any activities that do not need to go through the scoping or impact assessment stages.
- Stage 2: Scoping - identifies the receptors that are potentially at risk from proposed activities and need impact assessment (section 4).
- Stage 3: Impact assessment - considers the potential impacts of your activity, identifies ways to avoid or minimise impacts, and shows if your activity may cause deterioration or jeopardise the waterbody achieving good status (see section 5).

3.1.1.2 This WFD assessment document has been developed in accordance with guidance note OGN 072. Tables provided in the scoping section 5 are based on the '*Clearing the Waters for All*' guidance (EA, 2017) although incorporate OGN 72 guidance information where appropriate.

4. SCREENING AND SCOPING

4.1.1 Screening

4.1.1.1 The aim of the screening stage is to ensure that only those activities that may cause deterioration or prevent a waterbody from meeting its objectives are assessed further. The screening stage excludes any low risk activities that do not require a WFD scoping assessment to be undertaken and therefore associated impact assessment.

4.1.1.2 According to the Table 5 Appendix 4 of the NRW OG 072 guidance document (NRW, 2018), detailed assessment is required for the META Project as a number of the activities described in section 1.2 do not fall into any of the listed categories of activities where assessment is not required (NRW 2018).

4.1.2 Scoping

4.1.2.1 Scoping assists with identifying elements within waterbodies which may be impacted as a result of the activity, these will then progress to detailed compliance assessment (see section 5). As part of scoping, the focus is on identifying components of the activity or project that have the potential to cause an impact and the quality elements potentially impacted (NRW 2018). A scoping assessment should be undertaken for each waterbody potentially affected by the project. Waterbodies can be scoped out at this stage if it can be robustly demonstrated that there will be no impacts.

4.1.2.2 Project scoping was completed for project activities against the receptors and criteria provided in the NRW OGN072 guidance note (NRW 2018) for three waterbodies, Milford Haven Inner Milford Haven Outer and Pembrokeshire South, that were identified as being potentially impacted by the project. Receptors that project activities were assessed against included:

- Hydromorphology;
- Water quality;
- Biology: Benthic habitats;
- Biology: Fish;
- Priority Species;
- Protected areas; and
- Invasive non-native species

4.1.2.3 Results of the scoping assessment are provided in Appendix A. A summary of the scoping results are provided below in Table 4.1.

Table 4.1: Summary of results from scoping assessment undertaken and detailed in Appendix A

Receptor	Waterbody	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Milford Haven Inner	Yes	Placement of structures on the seabed at the Warrior way site has the potential to affect sediment transport pathways and tidal currents during operation phase
	Milford Haven Outer	Yes	Placement of structures on the seabed at the Dale Roads site has the potential to affect sediment transport pathways and seabed morphology during operation phase. Potential for changes to wave regime from operation of wave energy devices.
	Pembrokeshire South	Yes	Placement of structures on the seabed at the at East Pickard Bay has the potential to affect sediment transport pathways and seabed morphology during operation phase. Potential for changes to wave regime from operation of wave energy devices.
Water quality	Milford Haven Inner	Yes	Potential for disturbance of sediments resulting in increase in suspended sediment concentrations causing reduced water clarity during operation of a tidal device at Warrior Way over a period of 6 months. Potential for release of chemicals on EQSD list with levels over Cefas AL1 guideline criteria during device installation.
	Milford Haven Outer	Yes	Potential for release of chemicals on EQSD list with levels over Cefas AL1 guideline criteria during device installation.
	Pembrokeshire South	No	Sediment contaminants are highly unlikely to be present given the anthropogenically undisturbed nature of the area within which the site is found and therefore there is no impact pathway for change to water quality at this site
Biology	Milford Haven Inner	Yes	Biological Quality Elements benthic invertebrates and macroalgae receptors have been taken forward for further assessment.
	Milford Haven Outer	Yes	As above.
	Pembrokeshire South	Yes	As above.
Fish	Milford Haven Inner	Yes	Temporary increases in suspended sediment concentrations during operation could affect fish by creating a physical barrier, damaging feeding or breathing organs or reducing ability to forage. The installation of a tidal device at warrior way has the potential to cause a barrier to movement of migratory fish. Accidental Pollution event could cause chemical change.
	Milford Haven Outer	Yes	Accidental Pollution event could cause chemical change.
	Pembrokeshire South	Yes	As above
Protected areas	Milford Haven Inner	Yes	Within 2 km of the project footprint the following protected areas are found: 1. Pembrokeshire Marine Special Area of Conservation (SAC; overlaps project footprint) 2. Shellfish waters (overlaps project footprint)
	Milford Haven Outer	Yes	Within 2 km of the project footprint the following protected areas are found: 1. Pembrokeshire Marine SAC (overlaps project footprint)
	Pembrokeshire South	Yes	Within 2 km of the project footprint the following protected areas are found: 1. Pembrokeshire Marine SAC (overlaps project footprint) 2. Limestone Coast of South Wales SAC (476 m away)
Priority Habitats and Species	Milford Haven Inner	Yes	Several listed migratory and non-migratory fish species, grey seal, harbour porpoise and listed habitats exist within the waterbody. Potential impacts include: 1. Temporary habitat disturbance from installation and operation activities 2. Temporary habitat loss from presence of device. 3. Temporary increase in suspended sediments can cause impacts to respiratory and feeding organs and behaviour of priority species. 4. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species fish eggs or larvae. 5. Introduction INNS during installation and operation 6. Collision risk from vessels and device turbines 7. Underwater noise emissions during installation and operation 8. Accidental Pollution Event

Receptor	Waterbody	Potential risk to receptor?	Note the risk issue(s) for impact assessment
	Milford Haven Outer	Yes	Several listed migratory and non-migratory fish species, grey seal, harbour porpoise and listed habitats exist within the waterbody. Potential impacts include: 1. Temporary habitat disturbance from installation and operation activities 2. Temporary habitat loss from presence of device. 3. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species fish eggs or larvae. 4. Introduction INNS during installation and operation 5. Collision risk from vessels 6. Underwater noise emissions during installation and operation 7. Accidental Pollution Event
	Pembrokeshire South	Yes	Harbour porpoise and listed habitats exist within the waterbody. Potential impacts include: 1. Temporary habitat disturbance from installation and operation activities 2. Temporary habitat loss from presence of device. 3. Introduction INNS during installation and operation 4. Collision risk from vessels 5. Underwater noise emissions during installation and operation 6. Accidental pollution event
Invasive non-native species	Milford Haven Inner	Yes	The deployment of devices and vessel movements during installation and operation activities could lead to introduction of INNS
	Milford Haven Outer	Yes	As above
	Pembrokeshire South	Yes	As above

5. DETAILED COMPLIANCE ASSESSMENT

5.1.1.1 This section considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and concludes if the activity may prevent any quality element within any waterbody achieving good status/potential or may cause deterioration.

5.1.1.2 Receptors or features identified as part of the scoping stage have been brought through for detailed assessment include:

- Hydromorphology (section 5.2)
- Water Quality (section 5.3)
- Biology Benthic Habitats (section 5.4)
- Biology: Fish (section 5.5)
- Priority species (section 5.6)
- Introduction of non-native species (section 5.7)
- Protected areas (section 5.8)

5.1.1.3 Listed priority species and habitats have been included as part of section 5.4, 5.5 and 5.6. To address impacts on identified protected areas and in particular Special Areas of Conservation (SACs) within the three waterbodies, section 5.8 provides a summary of and reference to the Report to Inform Appropriate Assessment (RIAA) which forms part of the Habitat Regulations Assessment and the overall marine licence application to NRW.

5.1.1.4 Impacts identified from Warrior Way (site 6), Dale Roads (site 7) and East Pickard Bay (site 8) sites have been considered with respect to Milford Haven Inner, Milford Haven Outer and Pembrokeshire South waterbodies, respectively, due to their location within each waterbody. If it is identified that the impacts associated with a single site are likely to extend into adjacent waterbodies as well as the waterbody within which the site is located, this has also been included in the assessments below.

5.2 Hydromorphology

5.2.1 Baseline Description

5.2.1.1 Hydromorphology characteristics associated with each site have been addressed in detail in chapter 5: Coastal Processes, section 6.6 of the Environmental Statement.

5.2.1.2 The Waterway, encompassing Milford Inner and Outer waterbodies, is a deep-water macro-tidal ria believed to be created by the flooding of the Daugleddau river valley. There is limited sediment input from offshore areas and the rivers flowing into the Waterway are not thought to contribute large volumes of sediment (Halcrow, 2012). The waterway is characterised by unusually high proportion of hard substrates, flanked by areas in which there are substantial thicknesses of mud.

5.2.1.3 Warrior Way (site 6) is situated in a semi-diurnal tidal setting with a meso-tidal range. Warrior Way (site 6) experiences a large tidal range of in excess of 8 m during spring tides which give rise to peak tidal currents of 1.2 m/s during spring tide 0.5 m/s during neap tides. This stretch has a depth of between 16-19 metres chart datum[1] (CD). At this location, sediment was found to be very coarse-grained sand and gravel, with a large range of 1 mm - 64 mm, (Germano, 2012). Sediments transported in an east to west direction down river.

5.2.1.4 Dale Roads (site 7) is situated in a semi-diurnal tidal setting with a meso-tidal range, the tidal wave propagates from west to east (i.e. high tide occurs from the west and moves eastward into the estuary). Currents are predominately determined by the tide flowing in and out of the Waterway and are typically less than 0.25 m/s. The site is characterised by medium sand (0.06-0.25 mm) over silt/clay (Germano, 2012). Dale Roads (site 7) supports depths of between -8 and -12 m CD and benefits from a significant wind and wave fetch from the south and southwest with a significant wave height of 4 m and a mean value of 1.5 m. The site experiences significant suspended sediment concentrations, particularly during storm conditions both because of exposure to waves and increased fluvial sediment source within the study area with typical suspended sediment concentrations of 15 mg/l (CEFAS, 2016).

5.2.1.5 Tidal range within the East Pickard Bay site (site 8) remains relatively consistent with minimal variation throughout seasonal cycles. The predominant currents of tidal currents of 0.3 m/s run from an east to west direction through the site. East Pickard Bay (site 8) is exposed to a good wave resource benefiting from a 200 km fetch from the prevailing wind direction with significant wave height ranging from 5 m – 10 m and has a water depth of between 10 m and 29 m CD. The site is a high energy environment and as such sediments are primarily made up of coarse sediment types (gravel and sand) these are more predominant to the south of the site whilst the north west is characterised by subtidal reef. Suspended sediment levels in the area would have typical monthly averages of 1-2 mg/L in summer and 10 mg/L in winter but this may increase to 15 mg/L during storm events (CEFAS, 2016).

5.2.2 Impacts on sediment transport

5.2.2.1 Impacts on sediment transport pathways from the three sites on identified waterbodies have been addressed in detail in chapter 6, section 6.9.2 of the Environmental Statement.

[1] The level below which depths are indicated and above which heights of the tides are expressed; usually mean level of low water at a spring tide.

5.2.2.2 Foundations and placement of infrastructure used for marine energy devices may interrupt sediment transport pathways.

5.2.2.3 The Warrior Way site seabed is comprised of relatively coarse sediments (i.e. fine to coarse sand) with dominant sediment transport pathways in the north to the site. The maximum design scenario providing the maximum obstruction on the bed would be a 5 m gravity base which would constitute a reduction of <1% in the width of the pathway. Therefore, due to short-duration and local spatial extent of testing proposed at this site no restriction to sediment transport is predicted within the waterbody. The status for the Milford Haven Inner waterbody will therefore not deteriorate as a result of the project at Warrior Way (site 6).

5.2.2.4 Dale Roads (site 7) will be used for the deployment of wave energy devices. The proposed devices to be installed will be gravity based or bed mounted which would cause the largest potential obstruction to sediment transport pathways. The bed sediment at Dale Roads (site 7) is fine sand and silt and while tidal flows are low there will still be sediment transport within the bay due to the fine nature of *in situ* sediments. Due to the fine nature of the bed, sediment would be transported in suspension in addition to bed load. The largest bed structure to be proposed under the maximum design scenario is 600 m^2 which would constitute less than 0.1% of the area of the bay or a reduction of <4% in the width of the pathway. Considering the short-duration and local spatial extent of testing proposed, no restriction to sediment transport is predicted within the waterbody. The WFD status for the Milford Haven Outer waterbody will therefore not deteriorate by the project at Dale Roads site.

5.2.2.5 East Pickard Bay site will be used for the deployment of wave energy devices. A bed mounted device is proposed that will cover an area of up to 1125 m^2. At this location the principle direction of bed load sediment transport is west to east, the width of obstruction will constitute <20 m, the smallest axis of the device, which is insignificant with respect to this open coast site. The device would be tested for a maximum period of 18 months after which time normal transport pathways would be restored. Considering the short-duration and local spatial extent of testing proposed no restriction to sediment transport is predicted within the waterbody. The WFD status for the Pembrokeshire South waterbody will therefore not be affected by the project at East Pickard Bay site.

5.2.2.6 As impacts on sediment transport is not predicted to affect the hydromorphology status of identified waterbodies, an assessment of the impact of changes to sediment transport on biological receptors has not been included in sections 5.4 to 5.8.

5.2.3 Impacts on seabed morphology

5.2.3.1 Impacts on seabed morphology from the three sites on identified waterbodies have been addressed in detail in chapter 5, section 5.9.2 of the Environmental Statement.

5.2.3.2 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.

5.2.3.3 No impact pathway has been identified on seabed morphology predicted for activities at Warrior Way due to the limited nature of the installation and testing.

5.2.3.4 Site conditions in Dale Roads (site 7) indicate that the bed is mobile at the site and therefore the maximum scour depth could be twice the pile diameter (Whitehouse *et al,* 2008) provided that unlimited depths of unconsolidated material exist. For the pin piles proposed this would be in the order of 200 mm, however due to the relatively low current speeds in this area the scour would be anticipated to be of much smaller magnitude. Considering the short-duration and local spatial extent of testing proposed, deterioration in the status of the Milford Haven outer waterbody is not predicted.

5.2.3.5 Similar pin pile design is proposed for East Pickard Bay. 200 mm pin piles will potentially be used resulting in a maximum scour depth could be twice the pile diameter. However, considering the short-duration and local spatial extent of testing proposed, deterioration in the status of the Pembrokeshire South waterbody is not predicted.

5.2.3.6 As impacts on seabed morphology is not predicted to affect the hydromorphology status of identified waterbodies, an assessment of the impact of changes to seabed morphology on biological receptors has not been included in sections 5.4 to 5.8.

5.2.4 Changes to hydromorphology during operation (currents and wave exposure)

5.2.4.1 Impacts on hydromophology from the three sites on identified waterbodies have been addressed in detail in chapter 5, section 5.9.2 of the Environmental Statement.

Wave Exposure

5.2.4.2 The abstraction of wave energy can potentially alter the wave climate and disturb sediment transport regimes in an area. The maximum abstraction of energy from any wave device considered for use in the META site is 20%. It should be noted that Warrior Way (site 6) has not been considered as this site is only proposed to support testing of tidal devices.

5.2.4.3 The impact of the maximum design scenario device installed at Dale Roads (site 7) determined that a baseline 4 m significant wave height would be reduced by 0.5 m along the 30 m length of the device, and the wave front would return to uniformity within 100 m beyond the device. In the case of mean wave climate, a 1.5 m wave would be reduced by 200 mm and the wave front would return to uniformity in 50 m. The largest device considered at this site occupies less than 2% of the 1.5 km wave front and the energy extraction constitutes <0.4% of the incident mean wave energy. The wave climate would not impact on the intertidal zone. The wave climate would return to the previous situation following removal of the device (i.e. after a maximum duration of operation of 12 months). The reduction in wave energy of <0.4% and a wave field which is resolved outside of the inter-tide domain would have no significant effect on sediment transport regimes. Given the localised, temporary change to the wave climate within the waterbody, it is not predicted that there will not be a deterioration to the status of the Milford Haven Outer waterbody.

5.2.4.4 The impact of the maximum design scenario device installed at East Pickard Bay (site 8) determined that a 5 m baseline significant peak wave height would be reduced by 0.5 m along the 230 m length of the largest device and the wave front would return to uniformity 150 m beyond the device. In the case of mean wave climate, a 2 m wave would be reduced by 200 mm and the wave front would return to uniformity in 80 m. The largest device considered at this site occupies less than 5% of the 5 km wave front which enters East Pickard Bay (site 8) and the energy extraction constitutes <1% of the incident mean wave energy. The reduction in wave energy of <1% and a wave field which is resolved outside of the inter-tide domain would have no significant effect on sediment transport regimes. Given the localised, temporary change to the wave climate within the waterbody, it is not predicted that there will not be a deterioration to the status of the Milford Haven Outer waterbody.

Currents

5.2.4.5 An assessment of a 5 m diameter turbine installed at Warrior Way (site 6) determined that the sweep area of the blade constituted 0.35% of the cross-sectional area of the channel, at the mean water level. The drag co-efficient for a turbine working within optimal parameters would result in a potential reduction in the energy across the channel of <0.15%. The resulting localised reduction in current speed in the immediate sweep area was 2% which is in the order of 0.035 m/s at peak current speeds. Therefore, there would not be any change in the flow regime, with indiscernible changes in current speed outside the immediate area. Given the localised extent of changes to currents, there will not be a deterioration to the status of the Milford Haven Inner waterbody.

5.2.4.6 No turbines will be installed at Dale Roads and East Pickard Bay and so currents will not be affected by the proposed devices to be installed with associated waterbodies.

5.2.4.7 As impacts to the current regime is not predicted to impact on the hydromorphology status of Milford Haven Inner waterbody, an assessment of the impact of changes to the current regimes on biological receptors has not been included in sections 5.4 to 5.8.

5.3 Water Quality

5.3.1 Baseline Description

5.3.1.1 Water quality characteristics associated with each site have been addressed in detail in chapter 5: Coastal Processes, section 5.6 of the Environmental Statement.

5.3.1.2 The waterway experiences a high tidal range with elevated suspended sediment concentrations (SSC) a common occurrence. SSCs are commonly elevated within the Waterway, with recorded levels varying greatly between tidal state and location. Extensive sampling reported by the Milford Haven Waterway Environmental Surveillance Group (MHWESG) (Little, 2009) shows samples in excess of 100 mg/L. More commonly background levels within the Waterway are 16 mg/L, increasing to 84 mg/L upstream where fluvial sediment sources enter the Waterway.

5.3.1.3 Sediment contaminants which have the potential to impact on water quality through elutriation following disturbance have been monitored in the Waterway since 1978. A review by Little (2017) demonstrated a low to higher Total Hydrocarbon Concentrations (THCs) from the lower Waterway to the inner estuary and central tributaries. Concentrations of polyaromatic hydrocarbons (PAHs) and other contaminants (e.g. metals) have generally been shown to be elevated throughout the Waterway following disturbance by construction and dredging operations. Many of the PAHs exceeded sediment quality guidelines (SQGs; e.g. Threshold Effect Levels (TELs) and Probable Effect Levels (PELs)) in 2007 which Little *et al*. (2016) concluded was likely to have had biological effects. Since then, from 2007 to 2010 most of the sediment contaminant concentrations have generally decreased by dilution (and depuration) and have reduced to below SQG levels. Concentrations have increased between 2010 and 2012 only when sediment has continued to be disturbed and where sediment transport pathways lead to depositional sinks (Little *et al*., 2016).

5.3.2 Increases in suspended sediment concentrations (SSC) from operation of tidal device at Warrior Way (site 6)

5.3.2.1 Increases in SSC from Warrior Way (site 6) on Milford Haven Inner waterbody during operation have been addressed in detail in chapter 5, section 5.9.2 of the Environmental Statement.

5.3.2.2 The maximum design scenario at Warrior Way (site 6) proposes a turbine arrangement which occupies the majority of the water column therefore there is the potential for the disturbance of material on the seabed by the accelerated flow from movement of the turbine causing the potential to mobilise sediments. The sediments at this site vary in size from 1 mm – 64 mm so if it is assumed that 20% of the material lies within the finer range it is this fraction that could be brought into suspension. Based on the sediment characteristics and tidal currents, the finest material would travel in the order of 100 m from the site during an average tide. The coarsest material would travel less than one tenth of this distance and a large proportion would come to rest within the site and the immediate area. Therefore, the proposed effect of the turbine on increasing SSC will be restricted to the immediate vicinity of the site. Given the localised, temporary change to the SSC within the Warrior Way site, it is not predicted that there will be a deterioration to the status of the Milford Haven Inner waterbody.

5.3.2.3 As impacts from an increase in suspended sediment during operation of tidal devices at the Warrior Way site are not predicted to impact on the chemical status of Milford Haven Inner waterbody, an assessment of their impact on biological receptors such as benthic habitat and fish has not been included in sections 5.4 to 5.8.

5.3.3 Release of contaminants from seabed during installation

5.3.3.1 Release of contaminants from Warrior Way (site 6) and Dale Roads on Milford Haven Inner and Milford Have Outer waterbodies, respectively, during construction have been addressed in detail in chapter 5, section 5.9.1 of the Environmental Statement.

5.3.3.2 Contaminants including, asbestos, tin, polycyclic aromatic hydrocarbons, total petroleum hydrocarbons, tributyltin and dibutyltin, lead and hydrocarbons may be found adsorbed to sediments. These sediments can be re-suspended through anthropogenic sources and taken up by biota present in the study area. The analysis of the suspended sediment presented may be used to inform the potential for contamination due to the installation of test devices through installation of moorings and bed preparation.

5.3.3.3 Of the three sites, Warrior Way (site 6) would present the site where contaminants are found in the greatest concentrations (Little, 2009). The maximum volume of sediments which could be disturbed at Warrior Way <10 m^3 under the maximum design scenario during installation. Using standard construction techniques, the sediment material does not remain suspended for a long period or redeposit at any great distance from the site. This is due to both the small scale of the installation and small volumes disturbed and the nature of the bed material. The potential for contamination is therefore very low and will therefore not cause deterioration of the physical or biological status groups of the Milford Haven Inner waterbody during installation of activities within Warrior Way (site 6).

5.3.3.4 Far lower levels of contaminants are found at Dale Roads (site 7) (Little, 2009) as the site is located further from the industrial activity occurring in the Waterway and is well flushed and exposed to waves. The potential for contamination is therefore very low and therefore will not result in deterioration of the physical or biological status groups of the Milford Haven Outer waterbody.

5.3.3.5 No release of contaminants is predicted from East Pickard (site 8) due to the clean nature of the sediment within the site.

5.3.3.6 As impacts from the release of contaminants from disturbance of sediments are not predicted to impact on the water quality status during installation of identified waterbodies an assessment of their impact on biological receptors has not been considered in sections 5.4 to 5.8.

5.3.4 Accidental Release of Pollutants

5.3.4.1 Impacts on water quality from accidental pollution events during installation and operation of the three sites on identified waterbodies have been addressed in detail in chapter 7: Benthic Subtidal and Intertidal Ecology, section 7.11.1 and 7.11.2 of the Environmental Statement respectively.

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

5.3.4.3 This risk of pollution events will, however, be minimised by the implementation of an Environmental Management Plan (EMP). 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 Maritime and Coastguard Authority (MCA)). Furthermore, any lubricants used will be EU/internationally approved for use in marine environments. 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 waters of the Waterway.

5.3.4.4 In the unlikely event that pollutants did enter the waters of the Waterway, they would be rapidly dispersed on the surface and in the water column and subject to twice daily tidal flushing, and so any effects on water quality would likely be limited. This dispersal mechanism is likely to be higher at East Pickard Bay (site 8) which is out with the Waterway and therefore in more exposed, high energy environment.

5.3.4.5 The impact of an accidental pollution event occurring during installation activities is therefore predicted to be of local spatial extent, of short-term duration (i.e. in the unlikely event that a spillage occurs, the impact would last hours to days), intermittent, and reversible for all META sites. There is therefore no deterioration predicted to the status of all waterbodies associated with each site.

5.3.4.6 As impacts from the release of contaminants from accidental pollution events during installation and operation of the three sites are not predicted to impact on the water quality status of identified waterbodies, an assessment of their impact on biological receptors such as benthic habitat and fish described has not been included in sections 5.4 to 5.8.

5.4 Biology: Benthic Habitat

5.4.1 Baseline Description

5.4.1.1 Benthic habitat characteristics associated with each site have been addressed in detail in chapter 7, section 7.7 of the Environmental Statement.

Warrior Way (site 6)

5.4.1.2 Multibeam Backscatter Data, indicates soft sediments are likely to be present across the entire site. EUSeaMap (2016) data predict low energy infralittoral seabed sediments with data available on EMODnet indicating coarse sands that are characterised by the '*Hesionura elongata* and *Protodorvillea kefersteini* in offshore coarse sand' biotope (SS.SCS.OCS.HeloPkef). Based on the data collected the subtidal benthic habitats identified within the site have been grouped into the following community types for this site:

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets'; and
- Annex I 'Sandbanks which are slightly covered by sea water all the time' habitat.

5.4.1.3 Potential areas of hard substrate exist adjacent to the landward boundary of the site. Sample point data available on EMODnet indicate that the communities associated with these areas of rocky reef are representative of the 'cushion sponges, hydroids and ascidians on turbid tide-swept sheltered circalittoral rock' biotope (CR.MCR.CFaVS.CuSpH) which is also considered a Welsh Biodiversity Action Plan (BAP) priority habitat. This habitat has been characterised as Annex I subtidal 'Reef' habitat.

5.4.1.4 The intertidal habitat in the vicinity of Warrior Way (site 6) comprises tide-swept rock, the lower reaches of which are characterised by the '*Laminaria digitata*, ascidians and bryozoans on tide-swept sublittoral fringe rock' biotope (IR.MIR.KT.LdigT). The eulittoral zone is characterised by the '*Fucus serratus*, sponges and ascidians on tide-swept lower eulittoral rock' biotope (LR.HLR.FT.FserT) and the '*Fucus spiralis* on full salinity sheltered upper eulittoral rock' biotope (LR.LLR.F.Fspi.FS) both of which are considered a Welsh BAP priority habitat, with upper littoral fringe rock characterised by the lichen *Verrucaria maura* (NRW, 2019). These biotopes have been characterised as Annex I intertidal 'Reefs' habitat.

Dale Roads (site 7)

5.4.1.5 Multibeam Backscatter Data, indicates soft sediments, potentially comprising rippled sands, are likely to be present across the majority of the site with the potential for an area of possible harder substrate in the south west corner of the site. EUSeaMap (2016) data predicts largely high energy infralittoral seabed sediments with some areas of Atlantic and Mediterranean high energy infralittoral rock. Sediment Profile Imagery (SPI) survey data, identifies the sediments within this site as a 'Poorly sorted muddy sand, shells, pebbles', 'wave rippled sand' and 'mixed rounded talus, sand mud' facies. EMODnet indicate that communities in the vicinity of Dale Roads (site 7) are characterised by the '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' biotope (SS.SSa.CMuSa.AalbNuc) which is also considered a Welsh BAP priority habitat. Based on the data collected the subtidal benthic habitats identified within the site have been grouped into the following community types for this site:

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets' (Priority habitat); and
- Annex I 'Sandbanks which are slightly covered by sea water all the time' habitat

5.4.1.6 In the vicinity of Dale Roads (site 7), the intertidal habitat is similarly rocky habitat with the sublittoral fringe communities as described above for Warrior Way (site 6) and a eulittoral zone characterised by barnacles *Chthamalus* spp. The littoral fringe rock is also similarly characterised by lichens. These rocky habitats have been characterised as Annex I intertidal 'Reefs' habitat. To the north of Dale Roads (site 7), the soft sandy sediment of Lindsway Bay is characterised by polychaetes (NRW, 2019).

East Pickard Bay (site 8)

5.4.1.7 Through the review of various datasets the majority of the seabed within East Pickard Bay (site 8) it is predicted to correspond with circalittoral coarse sediment. Data available on EMODnet 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) both of which are considered Welsh BAP priority habitats.

5.4.1.8 EUSeaMap (2016) data predict Atlantic and Mediterranean high energy circalittoral rock in the nearshore area to the north of the site boundary which overlaps with the mapped distribution of the Annex I 'reef' habitat feature of the Pembrokeshire Marine SAC in this area. This is also consistent with the multibeam backscatter data that has been collected of the area.

5.4.1.9 Offshore of the site, an area of identified Annex I habitat 'sandbanks which are slightly covered by seawater all the time' has also been identified which is also a feature of the Pembrokeshire Marine SAC. Biotopes adjacent to the site may also 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.

5.4.1.10 The intertidal habitat in the vicinity of the site is characterised by steep rocky sandstone cliffs dropping down to exposed intertidal rocky shore. At low water, the intertidal habitats are characterised by communities of '*Laminaria digitata* on the moderately exposed sublittoral fringe bedrock' biotope in the sublittoral fringes (MIR.KR.Ldig.Ldig) and the biotope '*Saccorhiza polyschides* and other opportunistic kelps on disturbed sublittoral fringe rock' (MIR.SedK.Sa). In the mid shore mussel *Mytilus edulis* and/or barnacle communities dominate are found typical of 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). This habitat has been characterised as Annex I intertidal 'Reefs' habitat and are all considered Welsh BAP priority habitats.

5.4.2 Temporary habitat loss from presence of device and/or moorings.

5.4.2.1 Removal of benthic habitats from presence of the device during operation at the three sites on identified waterbodies have been addressed in detail in chapter 7, section 7.11.2 of the Environmental Statement.

5.4.2.2 Benthic subtidal habitat loss will occur directly under all foundation structures (i.e. gravity bases or pin piles) and within the footprints of the devices/components themselves on the seabed.

5.4.2.3 Total subtidal habitat loss at any one time within the footprint of devices/components and moorings/attachments at Warrior Way has been calculated to be a maximum 200 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Warrior Way (site 6); (equating to <<0.001% of the total area of the Milford Haven Inner waterbody). For Warrior Way (site 6) there will be a maximum deployment period of 6 months.

5.4.2.4 Total subtidal habitat loss at any one time within the footprint of devices/components and moorings/attachments is calculated to be a maximum of 600 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Dale Roads (site 7) (equating to <0.001% of the total area of the Milford Haven Outer waterbody). For Dale Roads (site 7) there will be a maximum deployment period of 12 months.

5.4.2.5 Total subtidal habitat loss at any one time within the footprint of devices/components and moorings/attachments is calculated to be a maximum of 10,250 m^2 of circalittoral coarse sediment habitats at East Pickard Bay (site 8); (equating to <0.001% of the total area of the Pembrokeshire South waterbody). For East Pickard Bay (site 8) there will be a maximum deployment period of 18 months.

5.4.2.6 The maximum design scenario assumes that there may be up to 150 installation events occurring intermittently across all three META test sites over the 15-year lifetime of the project. However only 50% of deployments will require contact with the seabed.

5.4.2.7 While habitat loss associated with placement of infrastructure on the seabed is often considered as a long term/permanent impact, in the case of the META project the impact is only short-term as infrastructure will be removed within the timescales outlined. Therefore, the resilience/recoverability of the underlying communities is relevant to this impact. Habitat types identified within each site are considered to have high recoverability following removal of the infrastructure.

5.4.2.8 The impact of habitat loss to benthic subtidal habitats from the presence of devices or components on the seabed and the presence of moorings/attachment throughout the operational phase is therefore predicted to be of local spatial extent, short-term duration, intermittent over the 15-year lifetime of the project (although only a small proportion of the total area will be affected at any one time) and reversible. Therefore, there is not predicted to be any deterioration in biological status of all three waterbodies associated with each of the sites.

5.4.3 Temporary habitat disturbance during installation

5.4.3.1 Temporary habitat disturbance associated with installation activities of the three sites have been addressed in detail in chapter 7, section 7.11.2 of the Environmental Statement.

5.4.3.2 Seabed clearance activities (e.g. boulder and debris clearance) within a 5 m buffer of the device/mooring footprints at Warrior Way (site 6) and Dale Roads (site 7) and 10 m buffer at East Pickard Bay (site 8), prior to the installation of the devices and moorings, have the potential to result in the temporary disturbance of benthic habitats at each of the META test sites.

5.4.3.3 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 are likely to be largely unaffected.

5.4.3.4 Temporary habitat disturbance has been calculated to be 480 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Warrior Way (site 6; equating to <0.001% of the total area of the Milford Haven Inner waterbody).

5.4.3.5 Temporary habitat disturbance is calculated to be a maximum of 713 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Dale Roads (site 7; equating to 0.36% of the total area of the Dale Roads site).

5.4.3.6 Temporary habitat disturbance is calculated to be 123,486 m^2 of circalittoral coarse sediment habitats at East Pickard Bay (site 8; equating to 10% of the total area of the East Pickard Bay site). The majority of this disturbance results from the mooring spread for installation vessels. It has been assumed that all the habitat within the footprint of the mooring spread may be affected, however, this is considered to be a highly precautionary scenario with the actual extent of disturbance much less than this and restricted to the immediate vicinity of the anchors and lines. The most likely scenario assumes that no seabed clearance will be required at any of the META sites and, therefore, temporary habitat disturbance of up to 70,175 m^2 per test activity would be predicted to occur at East Pickard Bay (site 8) from the mooring spread required for deployment vessels only.

5.4.3.7 Habitat types identified within each site are considered to have high recoverability following disturbance.

5.4.3.8 The impact of temporary disturbance to benthic habitats from seabed clearance and vessel mooring activities during the installation phase is predicted to be of local spatial extent, restricted to be the META test sites, of short-term duration, intermittent over the 15-year lifetime of the META project (only a small proportion of the total area may be affected at any one time) and reversible. Therefore, there is not predicted to be any deterioration in biological status of all three waterbodies associated with each of the sites.

5.4.4 Temporary habitat disturbance during operation

5.4.4.1 Temporary habitat disturbance associated with operation activities of the three sites have been addressed in detail in chapter 7, section 7.11.2 of the Environmental Statement

5.4.4.2 The use of mooring spreads to anchor devices/components at the META sites has the potential to result in temporary disturbance to benthic habitats and communities for the duration of the deployment of devices/components at the META sites as a result of the movement of the mooring lines/chains on the surface of the sediment and/or anchors penetrating the substratum surface. Any 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.

5.4.4.3 Temporary habitat disturbance has been calculated to be 150 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Warrior Way (site 6; equating to <0.001% of the total area of the Milford Haven Inner waterbody).

5.4.4.4 Temporary habitat disturbance is calculated to be a maximum of 200 m^2 of Annex I 'estuaries' and Annex I 'large shallow inlets' at Dale Roads (site 7; equating to <0.001% of the Milford Haven Outer waterbody).

5.4.4.5 Temporary habitat disturbance is calculated to be 500,000 m^2 of circalittoral coarse sediment habitats at East Pickard Bay (site 8; equating to 0.1% of the total area of the Pembrokeshire South waterbody). It should however be noted that this value is highly precautionary for East Pickard Bay (site 8) as it assumes that the entire area within each of the mooring footprints associated with the maximum design scenario would be subject to disturbance, which is highly unlikely to occur. In reality, the actual extent of disturbance will be much less than this and restricted to the immediate vicinity of the anchors and mooring lines/chains. The most likely design scenario predicts a much-reduced footprint of temporary habitat disturbance during the operation and maintenance phase of up to 1,425 m^2 at any one time during the operational phase as a result of mooring spreads for devices/components.

5.4.4.6 Habitat types identified within each site are considered to have high recoverability following disturbance.

5.4.4.7 The impact of temporary disturbance to benthic habitats from seabed clearance and vessel mooring activities during the operation phase is predicted to be of local spatial extent, restricted to the META test sites, of short-term duration, intermittent over the 15-year lifetime of the META project (only a small proportion of the total area will be affected at any one time) and reversible. Therefore, there is not predicted to be any deterioration in biological status of all three waterbodies associated with each of the sites.

5.4.5 Increases in suspended sediment concentrations (SSC) and sediment deposition affecting benthic habitats

5.4.5.1 The mobilisation of sediments has a potential impact on benthic habitats through smothering effects from deposition of mobilised sediments and light attenuation affect photosynthesis. However, following an assessment of increases of suspended sediments in section 5.3 it has been identified the impact would not result in deterioration of the status of identified waterbodies. Therefore, no further assessment has been undertaken on benthic habitats within identified waterbodies. Further assessment of this impact on benthic habitats under the EIA regulations has been undertaken in 7.11.1 of the Environmental Statement.

5.4.6 Release of contaminants from seabed during installation

5.4.6.1 The mobilisation of sediments has the potential to release sediment bound contaminants following disturbance that could result in toxic effects to benthic habitats. However, following an assessment of increases of release of contaminants on water quality in section .3 it has been identified the impact would not result in deterioration of the status of identified waterbodies. Therefore, no further assessment has been undertaken from this impact benthic habitats within identified waterbodies. Further assessment of this impact on benthic habitats under the EIA regulations has been undertaken in 7.11.1 of the Environmental Statement.

5.5 Biology: Fish

5.5.1 Baseline Description

5.5.1.1 Baseline description of fish species and populations associated with each site have been addressed in detail in chapter 8: Fish and Shellfish Ecology, section 8.7 of the Environmental Statement.

5.5.1.2 The inshore waters of Pembrokeshire consist of a wide range of demersal, bentho-pelagic and pelagic fish species. Both mobile and sessile shellfish inhabit both the intertidal and subtidal regions of the area, and elasmobranchs, such as sharks, skates and rays, can be found including Tope *Galeorhinus galeus* which is listed as vulnerable on the IUCN Red List of Threatened Species and is a Welsh BAP priority species. The area is also home to other species of both commercial and conservation importance.

5.5.1.3 Surveys were undertaken in 2006 and 2007 within the Waterway. Fish assemblages recorded during the surveys were gobies *Pomatoschistus* spp, sand smelt *Atherina presbyter* and sea bass *Dicentrarchus labrax*, clupeids including sprat *Sprattus spattus* and herring *Clupea harengus* (Welsh BAP Priority Species), pollack *Pollachius pollachius,* plaice, three species of mullet; thick lipped *Chelon labrosus*, thin lipped *Liza ramada* and golden grey *Liza aurata* and Atlantic salmon *Salmo salar* (Welsh BAP Priority Species). Of these species the most abundant fish species sampled were gobies.

5.5.1.4 The area occupied by the three sites also provides a suitable spawning habitat for cod Gadus morhua, sandeel *Ammodytes americanus* (Welsh BAP Priority Species), plaice, sole *Solea solea* (Welsh BAP Priority Species), herring and sprat (Ellis *et al.,* 2012). The sheltered estuarine conditions of Warrior Way (site 6) and Dale Roads (site 7) also provide a safe environment for juvenile fish and other smaller species of fish, such as seahorses. The study area can be considered as an important nursery area for sandeel, plaice, sole, whiting *Merlangius merlangus*, herring, mackerel, spotted ray *Raja montagui*, thornback ray and tope (Ellis *et al*., 2012).

5.5.1.5 A number of migratory fish species have been designated as primary features of both the Milford Haven/ Sir Benfro Forol and the Cleddau River/Afnydd Cleddau SACs including sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa* and twaite shad *Alosa fallax*. They have the potential to occur in the area, migrating to and from the Cleddau rivers, which these species use either for spawning habitat or as a nursery area for growth and development into the adult stage (JNCC, 2017). Migratory fish species are of conservation importance as Annex II species protected under European legislation or as Welsh BAP priority species.

5.5.2 Mobilisation of suspended sediment during installation and operation

5.5.2.1 The scoping table (Appendix A) identified the mobilisation of sediments as a potential impact on fish species through creating a physical barrier, damaging feeding or breathing organs or reducing ability to forage at Warrior Way (site 6) and Dale Roads (site 7) in accordance with Guidance criteria specified in OGN072 (NRW, 2018). However, following an assessment of increases of suspended sediments in section 5.3 it has been identified the impact on Milford Haven Inner and Outer waterbody would not result in deterioration of the status of identified waterbodies. Therefore, no further assessment has been undertaken on fish receptors within this waterbody. Further assessment of this impact on fish receptors under the EIA regulations has been undertaken in 8.11.1 of the Environmental Statement.

5.5.3 Physical barrier to movement of migratory fish species due to presence of tidal device at Warrior Way (site 6)

5.5.3.1 Physical barrier effects to movement of migratory fish associated with operation activities of the three sites have been addressed in detail in chapter 8, section 8.11.2 of the Environmental Statement.

5.5.3.2 The presence of a single tidal turbine within the Warrior Way (site 6) at any time, has the potential to cause a barrier to movement of migratory fish, including displacement from known migratory routes. This could affect migratory species ability to reach breeding/ feeding grounds, and therefore may affect breeding success and population viability.

5.5.3.3 The maximum number of tidal turbines to be installed at Warrior Way (site 6) at any time is one. Tidal turbines will be scaled/micro-scale devices. The maximum rotor diameter (maximum scenario) will be up to 5 m, with tip speeds of 5 m/s or less. This equates to a swept area of 19.63 m^2 (maximum scenario). The maximum dimensions of tidal devices will be 20 m x 10 m, with the most likely scenario of 5 m x 5 m. In the context of the cross-section of sea area in the Waterway at the mid-point of Warrior Way (site 6) (11,570 m^2), this equates to 0.17% (maximum scenario) of the tidal stream cross-sectional area at this location. The maximum duration of scaled tidal device testing at Warrior Way (site 6) is 6 months.

5.5.3.4 Wilson *et al*. (2006) demonstrated that visual appearance and activity of a marine device is important in fish avoidance behaviour. The study found that fish will predominately use vision as their main stimulus and it has been observed that fish do not perform well when ambient light falls below critical levels at night time (Ryer and Olla, 2000). For instance, herring avoided stationary objects using visual stimuli during the day but collided with the same obstacle during the night (Blaxter and Batty, 1985). It has also been found that herring exhibit strong avoidance behaviours of vibrating obstacles in the dark (Blaxter and Batty, 1985).

5.5.3.5 The main species that have been found to migrate through Warrior Way (site 6) are allis shad, twaite shad, river lamprey, sea lamprey, brook lamprey, Atlantic salmon, European eel, and sea trout, however as lamprey species and European eel are known to migrate along the seabed, the main species of concern are Atlantic salmon, trout and shad species.

5.5.3.6 The presence of a scaled tidal turbine at Warrior Way has the potential to pose a barrier to migrating fish species, however the fish are likely to display some avoidance behaviour in close proximity to an operating turbine. In addition, there is sufficient space for migratory species to pass the turbine and species are likely to migrate along areas of low energy i.e. in the lee of a meander, to conserve energy (Hinch, 2000). Any marine renewable device will most likely be placed in an area of relatively high energy. Any vibration coming from the turbine will most likely be far less than vessels commuting through the area and is unlikely to pose as a barrier to sensitive species such as allis and twaite shad and therefore deemed to have a low sensitivity to this impact.

5.5.3.7 Given the impact is likely to have small spatial extent, is temporary and migratory fish are expected to have some ability to detect and pass the device, no deterioration of the status of Milford Haven waterbody is predicted.

5.5.4 Tidal turbine collision risk during operation of devices installed at Warrior Way (site 6)

5.5.4.1 Tidal turbine collision risk to fish associated with operation at Warrior Way (site 6) have been addressed in detail in chapter 8, section 8.11.2 of the Environmental Statement.

5.5.4.2 Introduction of a marine tidal turbine poses a potential risk to fish receptors at Warrior Way (site 6). Device components, specifically the terminal end of the rotating blade, poses the greatest risk of potential injury in the event of a collision (Turnpenny *et al.,* 2000). Collision avoidance was associated with visual acuity and maximum swimming speeds of different species, and species-specific near-field behavioural responses in avoiding turbine blades (ABPmer, 2010).

5.5.4.3 The maximum number of tidal turbines to be installed at Warrior Way (site 6) at any time is one. Tidal turbines will be scaled/micro-scale devices. The maximum rotor diameter (maximum scenario) will be up to 5 m, with tip speeds of 5 m/s or less. This equates to a swept area of 19.63 m^2 (maximum scenario) this equates to 0.17% (maximum scenario) of the tidal stream cross-sectional area at this location. The maximum duration of scaled tidal device testing at Warrior Way (site 6) is 3-6 months.

5.5.4.4 Fish species may be vulnerable to collision with scaled, operational tidal turbines at Warrior Way (site 6). Should an animal come into close proximity to turbine blades or nacelle, it is likely that avoidance behaviour of the perceived risk will minimise potential collision (Zhang *et al.,* 2016, Wilson *et al.*, 2006). Should a collision occur, recovery is likely (Amaral, 2015). In addition, migratory species are likely to conserve energy in the lee side of a river, away from high energy environments (Hinch and Rand, 2000). As the marine renewable device is designed to generate energy from relatively high energy environments, it is likely any device will be positioned in an unfavourable environment for migratory species (Hinch and Rand, 1998; Hinch, and Rand 2000; Castro-Santos, 2005). Therefore, no deterioration is predicted to the status of the Milford Haven Inner waterbody.

5.5.5 Accidental pollution event on fish

5.5.5.1 The scoping table (Appendix A) identified the accidental pollution events as a potential impact on fish species through toxic effects from a change in water quality at all sites in accordance with guidance criteria specified in OGN072 (NRW, 2018). However, following an assessment of impacts of an accidental pollution event on water quality in section 5.3, it has been identified the impact on the status of Milford Haven Inner waterbody would not result in deterioration. Therefore, no further assessment has been undertaken on fish receptors. Further assessment of this impact on fish receptors under the EIA regulations has been undertaken in 8.11.1 and 8.11.2 of the Environmental Statement.

5.6 Biology: Other Priority Species

5.6.1.1 Priority species and habitats identified within each waterbody have been assessed in sections 5.4 to 5.5. Those not discussed in the previous sections (i.e. benthic habitats and fish) are assessed in this section.

5.6.2 Baseline Description

5.6.2.1 The following priority species are most likely to be encountered in the study area (excluding those discussed above) include:

- Harbour porpoise (*Phocoena phocoena*);
- Bottlenose dolphin (*Tursiops truncatus)*;
- Short-beaked common dolphin *(Delphinus delphis)*;
- Risso's dolphin *(Grampus griseus)*;
- Minke whale (*Balaenoptera acutorostrata*);
- Basking shark (*Cetorhinus maximus*); and
- European otter (*Lutra lutra*).

5.6.2.2 Description of the priority species listed above have been addressed in detail in chapter 9: Marine Mammals, Basking Shark and Otter, section 9.7 of the Environmental Statement.

5.6.3 Collision risk from device turbines at Warrior Way (site 6) during operation

5.6.3.1 Tidal turbine collision risk to marine mammals, basking shark or otter associated with operation at Warrior Way (site 6) have been addressed in detail in chapter 9, section 9.11.4 of the Environmental Statement.

5.6.3.2 Introduction of scaled or micro-scale marine tidal turbines poses a potential collision risk to marine mammal, basking shark or otter between a moving turbine blade which could ultimately result in death or injury.

5.6.3.3 The maximum number of tidal turbines to be installed at Warrior Way (site 6) at any time is one. Tidal turbines will be scaled/micro-scale devices with no full-scale devices to be tested. The maximum rotor diameter (maximum scenario) will be up to 5 m, with tip speeds of 5 m/s or less. This equates to a swept area of 19.63 m^2 (maximum scenario). The maximum dimensions of tidal components will be 20 m x 10 m, with the most likely scenario of 5 m x 5 m. In the context of the cross-section of sea area in the Waterway at the mid-point of Warrior Way (site 6) (11,570 m^2), this equates to 0.17% (maximum scenario) of the tidal stream cross-sectional area at this location. The maximum duration for operation of devices at this site is 6 months.

5.6.3.4 The likelihood of collision is dependent on visibility, audibility, dimensions and rotation speed of the turbine blades, how important the location is for feeding or breeding and the extent of long-range avoidance and close-range evasion.

5.6.3.5 Wilson *et al.* (2007) report that responses to the tidal devices are likely to occur on two spatial scales; at long range the marine mammals have the option to avoid the area of device placement (i.e. swim around) and at closer range they can evade the particular structures (i.e. dodge or swerve).

5.6.3.6 It is highly likely that animals within the Waterway are habituated to high levels of traffic and are adept at avoiding obstacles in the water column. In daytime and high visibility, underwater structures will be visible at ranges of tens of metres, giving sufficient warning. Collision risk is also expected to be higher in waters of high turbidity; although the Warrior Way (site 6) does not hold high sediment content and it is not likely that turbines will resuspend any sediment themselves, or where this does occur, the levels will be highly limited (see section 5.3.2).

5.6.3.7 Based on sightings data, it is predicted that short-beaked common dolphin, bottlenose dolphin, minke whale, Risso's dolphin, and basking shark would not be found as far into the Waterway as Warrior Way (site 6) and as such there is a lack of receptor-impact pathway. And it is highly unlikely that harbour porpoise would be found within the Warrior Way (site 6) site area, although sightings suggest that they do occasionally enter the Waterway.

5.6.3.8 Otters are found throughout the Waterway and as such it is assumed that individuals have the potential to enter the vicinity of Warrior Way (site 6). However, it is highly likely that otters will not come into contact with the device as the device is located > 80 m from the shore and otter tend to forage at distances less than 80 m from the shore (Kruuk and Moorhouse, 1991, Hung and Law 2016).

5.6.3.9 Based on the low numbers/ absence of cetacean species, basking shark and foraging range of otter no deterioration to the status of the waterbody is predicted.

5.6.4 Collision risk from vessels during installation and operation

5.6.4.1 Collision risk associated with installation activities of the three sites have been addressed in detail in chapter 9, section 9.11.2 and 9.11.3 of the Environmental Statement.

5.6.4.2 Increased vessel traffic during the installation phase presents an increased risk of marine mammals colliding with vessels. Wilson *et al*., (2007) identifies the main drivers in influencing the number and severity of strikes as a result of shipping as:

- Vessel type and speed;
- High levels of ambient noise resulting in difficulty in detection of approaching vessels;
- Weather conditions and time of navigation affecting the ability of crew to locate marine mammals; and
- Marine mammal behaviour, which is species-specific but appears to affect juveniles and sick individuals more often than animals in good health, as juveniles are inexperienced in how to respond to ship presence and sick animals may be unable to remove themselves from an impact situation and may be less able to recover.

5.6.4.3 Vessels travelling at 7 m/s or faster are those most likely to cause death or serious injury to marine mammals, basking sharks and otters (Wilson *et al.,* 2007). Vessels involved in the installation phase are likely to be travelling considerably slower than this, in accordance with the high levels of traffic expected within the META project area, and therefore collision risk is expected to be lower than that posed by commercial shipping activity.

5.6.4.4 Larger vessels, such as the maximum size expected at Dale Roads (site 7) and East Pickard Bay (site 8), are less likely to be involved in vessel collisions with identified species, based on their predictable movements and larger volume of noise produced, making them more detectable to marine mammals, basking shark and otter than the smaller, most likely size of vessels at Warrior Way (site 6). However, while the size of vessels at Warrior Way (site 6) are smaller, the slow speed of all vessels used in installation operations at the META project means that vessel strike is unlikely.

5.6.4.5 Considering local/regional density estimates for all cetacean species, basking shark and otter, regardless of size of vessel, few animals are expected to enter the zones of impact and thus, few, if any, will be affected by potential increased collision risk associated with increased vessel movement associated with the META project.

5.6.4.6 Therefore, no deterioration to the status of the waterbodies associated with each site is predicted.

5.6.5 Underwater noise emissions from vessels during installation and operation

5.6.5.1 Underwater noise emissions associated with installation activities of the three sites have been addressed in detail in chapter 9, section 9.11.2 and 9.11.3 of the Environmental Statement.

5.6.5.2 Marine mammals, particularly cetaceans, are capable of generating and detecting sound (Au *et al., 1974;* Bailey *et al.,* 2010) and are dependent on sound for many aspects of their lives, i.e. prey-identification; predator avoidance; communication and navigation. Increases in anthropogenic noise may consequently pose a risk within the marine environment (Parsons *et al.,* 2008; Bailey *et al.,* 2010).

5.6.5.3 Vessel noise levels will be dependent on the type of vessel. Vessels to be used during the project include:

- Anchor handling vessel;
- Installation / construction vessel (using DP);
- Support vessel / tug;
- and
- Pin Pile drilling.

5.6.5.4 An assessment to determine distance to the potential onset of injury was undertaken based on exposure levels over a 24-hour period. Results indicate that for Low Frequency (LF) cetaceans (minke whale), onset of injury could occur up to 88 m from the vessel. For Medium Frequency (MF) cetaceans (Risso's dolphin, bottlenose dolphin, short-beaked common dolphin) up to two metres from the vessel and High Frequency (HF) cetaceans (harbour porpoise) up to 46 m from the vessel.

5.6.5.5 No quantitative assessment has been undertaken to determine distance to the potential onset of injury for basking sharks or otters, as information required to estimate onset of injury distances from the project activities is currently unavailable. Both species are unlikely to be present within the study area in high numbers and therefore deterioration to the ecological objectives of the waterbody as a consequence of these activities is not predicted. Injury to otter is not predicted to occur as their sensitivity to predicted noise levels is considered low enough not to be affected. The impacts of exposure to anthropogenic sound on basking sharks is also not predicted to occur.

5.6.5.6 The potential zones of injury for vessel activities likely to be involved in this project, range from 2 m to 50 m, however this assumes that animals would remain within these ranges continuously for 24 hours, and as such it is highly likely that animals would be disturbed, resulting in them moving away from the noise impact.

5.6.5.7 For all cetacean species groups, the maximum radius of potential disturbance is 12 km (DP vessel), and the most likely is 2 km (support vessel). No quantitative assessment has been undertaken to determine distance to cause disturbance response for basking sharks or otters, as information required to estimate disturbance distance is currently unavailable. The behavioural impacts of exposure to anthropogenic sound on basking sharks could potentially disrupt normal behaviours such as feeding, mating or migrating (McFarlane *et al.,* 2008). Otters within range of increased underwater noise are likely to leave the water (Ghoul and Reichmuth, 2012). However, since the hearing acuity of otters is significantly less than for many marine mammal species, it is unlikely that disturbance ranges for otter will extend as far underwater as predicted for other marine mammals.

5.6.5.8 Low numbers of all species are likely to be present within the study area and some habituation to baseline noise levels is likely with those species that are present within the waterway.

5.6.5.9 The potential impact for all priority species is therefore predicted to be of local spatial extent, long-term duration, but intermittent (short-term individual vessel movements) with all priority species having a low vulnerability and high recoverability. No deterioration on the status of all waterbodies is therefore predicted.

5.6.6 Underwater noise emissions from turbine operation at Warrior Way (site 6)

5.6.6.1 Underwater noise emissions associated with operation of a turbine at Warrior Way (site 6) have been addressed in detail in chapter 9, section 9.11.3 of the Environmental Statement.

5.6.6.2 A noise assessment was undertaken to determine impact of noise from operation of the turbine device at Warrior Way (site 6). Noise measurements from an OpenHydro tidal turbine at the EMEC facility in Orkney (Parvin and Brooker 2008) were used as a basis for the assessment.

5.6.6.3 An assessment to determine distance to the potential onset of injury was undertaken based on exposure levels over a 24-hour period. Results indicate that for Low Frequency (LF) cetaceans (minke whale), onset of injury could occur up to 3 m from the turbine. For Medium Frequency (MF) cetaceans (Risso's dolphin, bottlenose dolphin, short-beaked common dolphin) up to 0 metres from the turbine and for High Frequency (HF) cetaceans (harbour porpoise) up to 2 m from the vessel.

5.6.6.4 No quantitative assessment has been undertaken for basking sharks or otters, as information required to estimate disturbance distance is currently unavailable. Both species are unlikely to present within the study area in high numbers but do have the potential to be present during installation and operation activities. Based on the sensitivity of otter and basking shark to underwater noise discussed in paragraph 5.6.5.5 and 5.6.5.7 only localised temporary disturbance effects from operation of tidal turbine at Warrior Way are predicted.

5.6.6.5 For all cetacean species groups, the maximum radius of potential disturbance is 0.5 km.

5.6.6.6 Low numbers of species are likely to be present or even absent within the waterbody. The likelihood of these species travelling far enough down the Waterway to enter the ZoI for injury or disturbance therefore, is highly unlikely. Considering the potential zone of the impact (injury) is very small, and the local/regional density estimates for all cetacean species are very low, few animals are expected to enter the zones of impact (ZoI) for injury. No deterioration to the status of the Milford Haven Inner waterbody is therefore predicted.

5.7 Introduction and spready of invasive non-native species (INNS)

5.7.1.1 INNS during installation and operation activities at the three sites have been addressed in detail in chapter 9, section 7.11.2 of the Environmental Statement.

5.7.1.2 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), which can, in turn, upset the ecological balance of local communities.

5.7.1.3 Installation activities at Warrior Way (site 6) and Dale Roads (site 7) are anticipated to require up to 20 vessel movements/round trips to port per site, involving up to five vessels at any one time, per year. At East Pickard Bay (site 8), up to 40 vessel movements/round trips to port may be required per year, involving up to five vessels at any one time. For all three META sites combined, this equates to a maximum design scenario of an additional 80 vessel movements/round trips to port per year. For all operational activities at the META sites 358 vessel movements/round trips to port, involving up to 15 vessels, per year are anticipated.

5.7.1.4 The current baseline level of vessel traffic within the Waterway, and in particular in the vicinity of Warrior Way (site 6) and Dale Roads (site 7), is high throughout the year with 5,004 commercial vessel movements within the Waterway per year. Much of this traffic (~58%) comprises commercial oil/chemical tankers, with the routes to the main hydrocarbon berths (South Hook LNG, Valero refinery on the south bank, and Valero Oil Terminal & Dragon LNG), Milford Haven Dock and Pembroke Dock contributing to the high-density shipping movements in the Waterway. Irish Ferries also contributes to the high levels of vessel traffic (~26% of the total commercial vessel movements). Both of these sources demonstrate the international nature of vessel movement within the Waterway. Therefore, the uplift in vessel traffic associated with META installation activities on the existing baseline levels is considered to be very small. Although current levels of vessel traffic are lower at East Pickard Bay (site 8), the vessels employed in installation activities are likely to be local to the Waterway or Wales, thereby limiting the potential for the introduction of new marine INNS to the area via this pathway. An Invasive Non-Native Species (INNS) Management Plan for the project will also be developed and agreed with NRW, in consultation with the statutory consultees, which will further reduce the risks of introduction and spread of marine INNS in the waterway as a result of vessel movements associated with the META installation activities. An outline INNS Management Plan has been provided to accompany the Environmental Statement. As set out in the INNS Management Plan, while a number of INNS are known to occur within the Waterway, including the slipper limpet *Crepidula fornicata*, which is present throughout Milford Haven, the measures set out in the INNS Management Plan will ensure that the risks of spread and introduction of INNS are minimised wherever possible.

5.7.1.5 The impact of introduction of marine INNS associated with vessel traffic is therefore predicted to be of local spatial extent and low magnitude given the relatively small uplift in vessel movements associated with the META project. However, the risks of introduction and spread of INNS will be minimised by the implementation of measures outlined in the INNS Management Plan, such that the project is unlikely to cause a deterioration in the status of identified waterbodies.

5.8 Protected Areas

5.8.1.1 In accordance with WFD assessment guidance document OGN072 and assessment is required to undertaken for WFD protected areas within 2 km of each site location. WFD protected areas include:

- special areas of conservation (SAC);
- special protection areas (SPA);
- shellfish waters;
- bathing waters; and
- nutrient sensitive areas.

5.8.1.2 Table 5.1 provides a list of the WFD protected areas and associated features within 2 km of the META sites. Maps showing the location of the protected areas is shown in chapter 7, Figure 7.1 and chapter 8, Figure 8.5.

Table 5.1: WFD protected areas located within 2km of either Warrior Way (site 6), Dale Roads (site 7) and East Pickard Bay (site 8).

Protected Area	Species Group	Features	Distance to Warrior Way (site 6) in km	Distance to Dale Roads (site 7) in km	Distance to East Pickard Bay (site 8) in km
Pembrokeshire Marine/Sir Benfro Forol SAC	Benthic 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*) Submerged or partially submerged sea caves	0	0	0
	Migratory Fish	Twaite shad *Alosa fallax* Sea lamprey *Petromyzon marinus* River lamprey *Lampetra fluviatilis* Allis shad *Alosa alosa*			

Protected Area	Species Group	Features	Distance to Warrior Way (site 6) in km	Distance to Dale Roads (site 7) in km	Distance to East Pickard Bay (site 8) in km
	Marine Mammal	Grey seal *Halichoerus grypus* Otter *Lutra lutra*			
Limestone Coast of South West Wales SAC/Arfordir Calchfaen de Orllewin Cymru SAC	Benthic Habitats	Submerged or partially submerged sea caves	0	0	0
Milford Haven Cleddau designated shellfish waters	Shellfish	Native oysters *Ostrea edulis*	0	13.3	11.1

5.8.2 Pembrokeshire Marine SAC and Limestone Coast of South West Wales SAC

5.8.2.1 To assess the potential effects of the project on the SAC features a Report to Inform Appropriate Assessment (RIAA) was undertaken and developed as a standalone report attached as an appendix to the Environmental Statement.

5.8.2.2 Potential likely significant effects to identified qualifying features included:

- Impacts to benthic habitats from:
  - Temporary loss from device installation, operation and removal;
  - Increases in SSC and release of contaminants from sediment mobilisation during device installation;
  - Installation and operation activities facilitating the introduction of marine INNS; and
  - Accidental pollution events during device installation, operation and removal activities.
- Impacts to migratory fish from:
  - Temporary habitat loss from device installation, operation and removal;
  - Underwater noise from installation activities and device operation;
  - Turbine collision risk at Warrior Way (site 6);
  - Barrier effects from the presence of devices located at Warrior Way (site 6); and
  - Accidental pollution events during device installation, operation and removal activities.
- Impacts to marine mammals from:
  - Underwater noise from installation activities and device operation;
  - Increases in during installation;
  - Vessel collision at all site and turbine collision risk at Warrior Way (site 6);
  - Entanglement risk;
  - Changes in hydrodynamic regime
  - Accidental pollution events during device installation, operation and removal activities.

5.8.2.3 It was found that all potential likely significant effects on site features were concluded to not result in adverse effects on integrity of the relevant SACs, and there would be no restriction to achieving each of the conservation objectives with site integrity maintained across all sites.

5.8.3 Milford Haven / Cleddau designated shellfish waters

5.8.3.1 Detailed information on Milford Haven Cleddau designated shellfish waters and potential adverse impacts from proposed activities at Warrior Way (site 6) is provided in chapter 8, section 8.7 and 8.11 8 of the Environmental Statement respectively.

Baseline Description

5.8.3.2 Warrior Way (site 6) is located within the Milford Haven / Cleddau designated shellfish water within the Milford Haven Inner Waterbody with all other sites located at distances >2 km from this designated shellfish water. Within the protected area, shellfish populations include native oysters (*Ostrea edulis*). Wild stocks of mussels (*Mytilus spp.*) are present in patches on raised beds or on rocks between Cleddau Bridge, Picton point Coedcanlas and Sprinkle Pill. Cockle beds are also found at Coedcanlas, Sprinkle Pill and east of Lawrenny Quay. Pacific oysters (*Crassostrea gigas*) were also formally cultured with operations ceasing ten years ago. As a consequence, they are now found naturally in the waterbody mainly within the Creswell/ Carew side channel and adjacent reaches of the main Cleddau channel up to Carron Pill (Cefas, 2012).

Temporary loss of shellfish habitat

5.8.3.3 The maximum scenario associated with total temporary subtidal habitat disturbance of anchoring and presence of devices on the seabed at Warrior Way (site 6) is 480 m^2. The potential impact of temporary habitat changes from installation activities is therefore predicted to be of local spatial extent, short/medium term duration, intermittent and reversible as identified species are able to recover rapidly following disturbance. No significant impact is therefore predicted to identified shellfish waters from the temporary loss of shellfish habitat.

Temporary increases in suspended sediments

5.8.3.4 Temporary increases in suspended sediments may affect sessile organisms (e.g. mussels, oysters) and filter-feeders, potentially damaging feeding and breathing organs.

5.8.3.5 All activities proposed at Warrior Way (site 6) are of a temporary and intermittent nature with devices and ancillary equipment such as navigational marker buoys and marine energy devices placed in the marine environment; up to four device deployments in a 12-month period. Due to the meso-tidal range of Warrior Way (site 6) it can be expected that any suspended sediments will quickly dissipate and disperse according to the sites' hydrological regimes.

5.8.3.6 Temporary increases in suspended sediments due to placement of devices or anchoring is therefore considered to be occasional and of very short duration. While species within the protected area are considered to be highly sensitive to increases in sediment the duration of suspended sediment events will be short resulting in no significant impact to the species of the protected area.

Accidental Pollution Event

5.8.3.7 The quantities and types of material that might enter the marine environment at Warrior Way (site 6) are limited to substances used in vessels, ancillary equipment and marine renewable devices, as well as machines used in close proximity to the water.

5.8.3.8 The magnitude of this impact is entirely dependent upon the quantities and nature of the spillage, the dilution and dispersal properties of the waters and the bio-availability of the contaminant to species. The more toxic components of fuel spills are volatile and relatively short-lived. Heavier hydrocarbons, while less toxic, may persist for longer in the marine environment. Warrior Way (site 6) is located within relatively high energy environment. Should any pollutants be accidentally released, dilution and the local hydrodynamic regime will aid in dispersal to levels below that of biological toxicity.

5.8.3.9 Species associated with the protected area have been found to be highly sensitive to pollution. However, recovery is likely to be very high as any impact will be of very short-term duration and of limited extent.

5.8.3.10 Accidents, by definition, are unknown, and with the implementation of an MPCP, the likelihood of a potential effect occurring is considered extremely unlikely. Therefore, no significant impact is predicted from an accidental pollution event at (Warrior Way site 6).

5.9 Cumulative impacts

5.9.1.1 Other developments (projects/plans) that could result cumulative effects associated with the proposal and have been brought forward for detailed compliance assessment following scoping (Appendix 1) include:

- Draft National Welsh Marine Plan (dWNMP) (Welsh Government, 2017) – Marine planning associated with inshore region (0-12 nautical miles) and offshore region (beyond 12 nautical miles) of Wales
- Neyland Yacht Haven ltd - Dredge and dredge disposal activities - DML1743.
- Milford Haven Port Authority – Maintenance Dredging within Milford Haven - DML1646
- Neyland Yacht Haven ltd - Dredge disposal site - LU190.
- Greenlink Interconnector Ltd. – Ground Investigations - RML1827.
- University College of Swansea – Removal of Marker Buoys and monitoring equipment - DEML1845.
- Mixed use developments - Redevelopment of 26,266 m^2 of waterfront including commercial, hotel, leisure, retail and fishery related floorspace - Local Planning Authority Reference: 14/0158/PA.
- Greenlink Interconnector Ltd. - 500MW subsea electricity interconnector linking the power markets in Ireland and Great Britain - Government reference: qA1296053.
- Bombora Wave Energy - mWave device installation and operation.
- Ministry of Defence Castlemartin Range - training of military personnel (Army) in the firing of a range of munitions at land-based targets.
- Milford Haven Port Authority - Redevelopment of Pembroke Dock - SC1810.
- Marine Energy Wales - Testing of initial stage marine renewable devices - DEML1875.
- Tethys Oysters - oysters farm where oysters are grown in baskets on metal supports
- Pembrokeshire Scallops - system of weighted ropes will be deployed for growing scallops and mix species of native algae.

5.9.1.2 Project locations are shown in Figure 5.1 below.

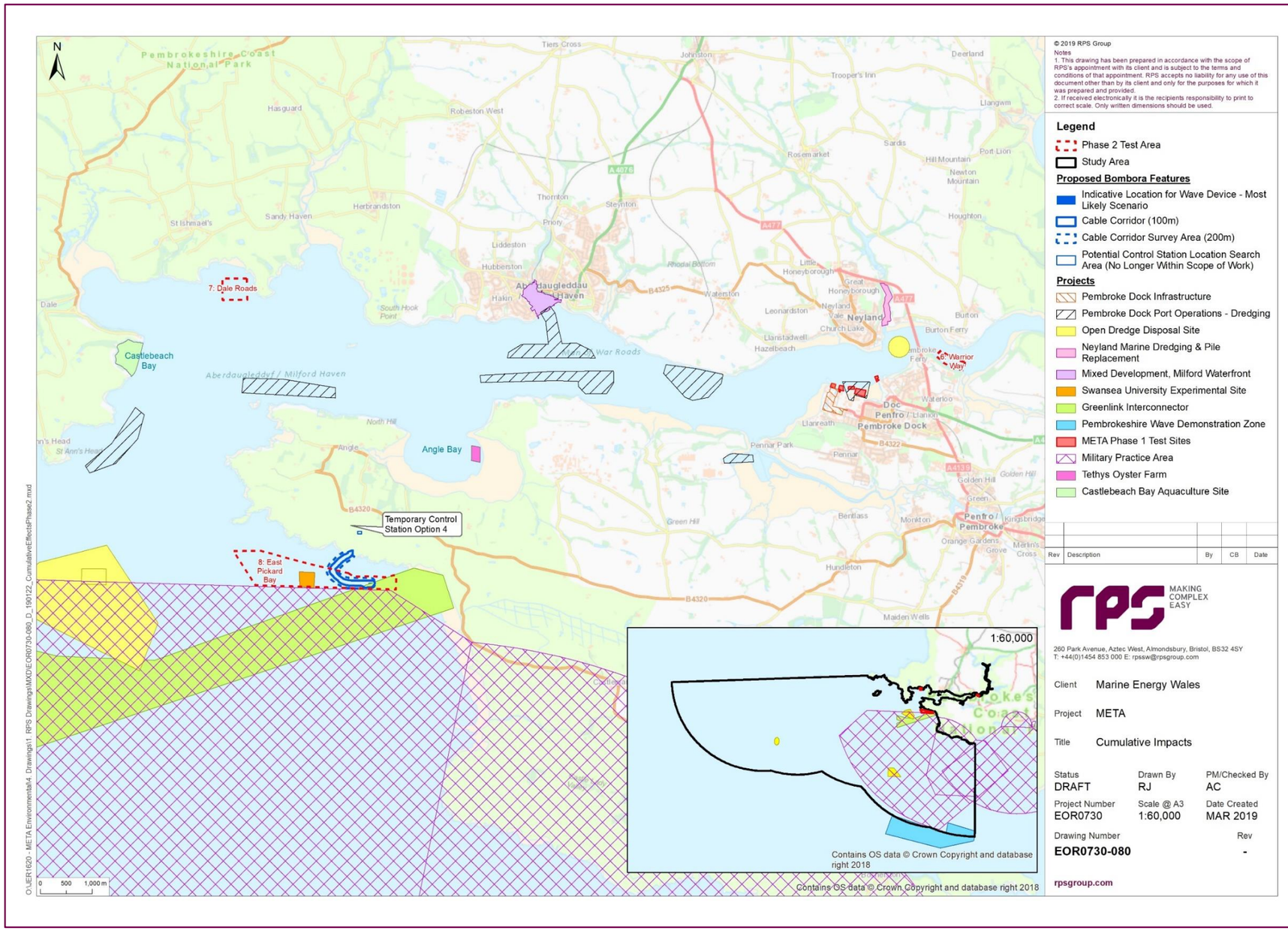

Figure 5.1: Location other projects / plans brought forward to asses in-combination / cumulative impacts associated with the META project.

5.9.1.3 The potential impact pathways assessed in 5.2 to 5.8 (inclusive) have been considered, and the cumulative assessment undertaken is presented below.

5.9.1.4 The dWNMP undertook a Habitat Regulations Assessment (HRA) of the proposed plans included within the dWNMP. It was concluded within the dWNMP HRA Appropriate Assessment (AA) that it would be necessary to rely on implementation of general cross-cutting protective policies within the WNMP to safeguard European sites during future assessment of specific schemes/projects. However, it was considered that there would be no adverse effect on site integrity due to the implementation of the policies due to measures that are in place. Therefore, no further cumulative assessment has been undertaken.

5.9.2 Hydromorphology

5.9.2.1 No cumulative impacts associated with the project and other plans on hydromorphology were identified in chapter 5, section 5.10.2 of the Environmental Statement as there was no impact pathway identified.

5.9.3 Water Quality

5.9.3.1 Cumulative impacts associated with the project and other plans on water quality have been addressed in detail in chapter 5, section 5.10.2 of the Environmental Statement.

5.9.3.2 There is the potential for cumulative increases in SSCs and sediment deposition within the study area as a result of installation/decommissioning activities associated with the META project together with construction activities associated with the Pembroke Dock Marine project, dredging and disposal activities in the Waterway, installation of a temporary marine cable and wave energy device associated with the proposed Bombora project, and the Greenlink Interconnector project. In all cases the aspect of water quality which may be affected is the potential increase in SSC.

5.9.3.3 Following assessment of other plans and projects it was identified that all activities that caused an increase in SSC were either of short duration and/ or localised in their extent and therefore were very unlikely to interact either temporally or spatially with the META project resulting in to significant effects to water quality or the deterioration of the status of relevant waterbodies.

5.9.4 Benthic Habitats

5.9.4.1 Cumulative impacts associated with the META project and other plans/ project on benthic habitats have been addressed in detail in chapter 7, section 7.12.2 of the Environmental Statement.

5.9.4.2 There is the potential for cumulative habitat loss/disturbance may affect benthic ecology; Cumulative increases in SSC and sediment deposition have not been considered further as impacts are not considered significant as detailed in section 5.9.3.

5.9.4.3 Temporary habitat loss and/or disturbance as a result of installation and operational activities associated with the META project together with activities associated with the following projects/activities: META Phase 1, Bombora Wave Energy offshore works, the Pembroke Dock redevelopment project, Wave Hub, dredging and disposal activities in the Waterway, the Greenlink Interconnector project (and associated surveys), and research undertaken by Swansea University.

5.9.4.4 Following assessment of other plans and projects against the project it was identified that all activities that resulted in habitat loss and/or disturbance were either temporary, had a small footprint, and / or spatially restricted to the project footprint ensuring no spatial overlap with the META project. When habitat sensitivity (including recovery potential) was considered, no significant impacts were predicted, such that these projects would not result in the deterioration of the status of all three waterbodies.

5.9.5 Fish

5.9.5.1 Cumulative impacts associated with the project and other plans/ project on fish have been addressed in detail in chapter 8, section 8.13 of the Environmental Statement.

5.9.5.2 There is the potential for cumulative increases in SSC and sediment deposition may affect fish populations in accordance with the impacts identified within scoping assessment (Appendix A) and guidance note OGN72. However, given impacts on water quality from increases in SSC have been assessed as insignificant, this has not been considered further within this assessment for fish receptors (section 5.9.3).

5.9.5.3 Aquaculture sites at Castlebeach Bay and Angle Bay are designed to grow shellfish and algae for commercial harvesting. These sites may act as a source site for further shellfish recruitment within the Waterway which could potential have a beneficial impact to ecological status of associated waterbodies.

5.9.6 Other Priority Species

5.9.6.1 Cumulative impacts associated with the project and other plans on priority species (marine mammals and otter) have been addressed in detail in chapter 9, section 9.13 of the Environmental Statement.

5.9.6.2 The potential cumulative impacts identified for marine mammal and otter are:

- Increased underwater noise emissions; and
- Vessel collision.

5.9.6.3 The following potential cumulative impacts have not been further assessed as these have already been identified as not significant in previous sections such as:

- Increase in SSC (see section 5.9.3); and
- Changes to fish and shellfish communities (see section 5.9.4).

5.9.6.4 Increased underwater noise emissions may occur as a result of dredging operations at Neyland Yacht Haven, and MHPA in proximity to Warrior Way (site 6), and dredge disposal at dredge disposal sites LU170 and LU180 in proximity to East Pickard Bay (site 8). Research activities are not considered likely to result in potential for cumulative noise impacts. Pile replacement at Neyland Marina is scheduled to have completed by the time the META project is installed therefore there is no potential for cumulative impact. Installation of the Greenlink Interconnector and Bombora Wave Energy temporary communications cable may result in very short-duration increases in underwater noise in proximity to East Pickard Bay (site 8).

5.9.6.5 The impact ranges from installation vessels for other projects are likely to be of a similar scale as predicted for the META project and therefore the scope for cumulative impact is minimal since each project will have minimal potential to cause injury or disturbance, and uplift in noise emissions is therefore expected to be low.

5.9.6.6 The potential cumulative impact of a small number of projects resulting in small potential injury or disturbance zones due to increased underwater noise might make a slightly larger proportion of suitable habitat unavailable for particular marine mammal species, basking shark or otter to use. However, the local/regional density estimates for all marine mammal, basking shark and otter are very low. The geographic ranges of marine mammals using the local marine study area are large, and as a result it is unlikely that cumulative impacts will cause increased temporary disturbance.

5.9.6.7 The potential for behavioural disturbance as a result of vessel noise activity of the META projects is likely to extend out to a maximum of 2 km. Whilst this may overlap with noise emissions resulting in behavioural disturbance from other projects, such as Pembroke Dock Port Operations (MHPA), the overall impact is not considered significant, with no deterioration to the status of identified waterbodies.

5.9.6.8 A cumulative increased risk of collision with vessels may occur as a result of interactions with projects that spatially or temporally overlap with the META project. Installation and maintenance vessels for all projects assessed will be slow moving, and the number of vessels involved will be low, particularly in comparison the existing levels of traffic within the waterbodies. Animals are likely to show some degree of habituation to already high levels of existing traffic therefore a small cumulative increase in vessels is considered unlikely to result in an increased number of collisions. In addition, local/regional density estimates for all marine mammal species, basking shark and otter are low and therefore the impact on marine mammals, basking shark and otter is predicted to be of local spatial extent, long-term duration but intermittent (short-duration of vessel movements) and reversible. No cumulative impacts from vessel collision are therefore predicted and therefore there will be no deterioration to the status of the identified waterbodies as a result of META, cumulatively with other projects.

6. REFERENCES

ABPmer (2010). Collision Risk of Fish with Wave and Tidal Devices. RPS Group plc on behalf of the Welsh Assembly Government.

Amaral, S. V., Bevelhimer, M. S., Čada, G. F., Giza, D. J., Jacobson, P. T., McMahon, B. J., & Pracheil, B. M. (2015). Evaluation of behavior and survival of fish exposed to an axial-flow hydrokinetic turbine. *North American journal of fisheries management*, *35*(1), 97-113.

Au, W.W.L., Floyd, R.W., Penner, R.H., and Murchison, A.E. (1974) Measurement of echolocation signals of the Atlantic bottlenose dolphin, *Tursiops truncatus* Montagu, in open waters. *Journal of the Acoustical Society of America,* 56, 1280– 1290.

Bailey, H., Senior, B., SimmonS, D., Rusin, J., Picken, J., and Thompson, P. M. (2009) Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine Pollution Bulletin,* 60, 888–897.

Blaxter, J.H.S., and Batty, R.S. (1985). Herring Behaviour in the dark: Responses to stationary and continuously vibration obstacles. Journal of the Marine biological Association UK 65:1031-1049.

Bohn, K., Richardson, C.A. and Jenkins, S. R. (2015). The distribution of the invasive non-native gastropod Crepidula fornicata in the Milford Haven Waterway, its northernmost population along the west coast of Britain. *Helgoland Marine Research* 2015, 69:439

Castro-Santos, T. (2005). Optimal swim speeds for traversing velocity barriers: an analysis of volitional high-speed swimming behavior of migratory fishes. Journal of Experimental Biology, 208(3), 421-432.

CEFAS (2016) *Suspended Sediment Climatologies around the UK*

Cefas, 2012. Guidance for assessing activities and projects for compliance with the Water Framework Directive. Sanitary Survey report. Milford Haven. EC Regulation 854/2004.

Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N., and Brown, M. J. (2012). Spawning and nursery grounds of selected fish species in UK waters. *Sci. Ser. Tech. Rep., Cefas Lowestoft*, *147*, 56.

Environment Agency (2017). Clearing the Water for All. https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters. Accessed 15/05/19.

EUSeaMap (2016). EUSeaMap (2016). EUSeaMap broad-scale predictive model. Available online: http://www.emodnet.eu/seabed-habitats.

Germano & Assoc. Ltd (2012) Sediment-profile imaging survey of Milford Haven Waterway Report to Milford Haven Waterway Environmental Surveillance Group.

Ghoul and Reichmuth, 2012, Sound Production and Reception in Southern Sea Otters (*Enhydra lutris nereis*), The Effects of Noise on Aquatic Life 730, pp157-159.

Halcrow (2012). Lavernock Point to St. Ann's Head Shoreline Management Plan SMP2. January 2012. Available online: https://www.npt.gov.uk/ldpexamination/SWW03%20Shoreline%20Management%20Plan%202%20Main%20Document%20(2012).pdf

Hinch, S. G., & Rand, P. S. (2000). Optimal swimming speeds and forward-assisted propulsion: energy-conserving behaviours of upriver-migrating adult salmon. *Canadian Journal of Fisheries and Aquatic Sciences*, *57*(12), 2470-2478.

Hinch, S.G., and Rand, P.S. (1998). Swim speeds and energy use of upriver-migrating sockeye salmon (Oncorhynchus nerka): role of local environment and fish characteristics. Can. J. Fish. Aquat. Sci. 55: 1821–1831.

JNCC (2017). Natura 2000: Cleddau River/Afnydd Cleddau SACs. Joint Nature Conservation Committee.

Kruuk H. Moorhouse A. (1991) The spatial organization of otters (Lutra lutra) in Shetland. Journal of Zoology 224, 41 – 57.

Hung, N. and C. J. Law (2016) Lutra lutra. Species, 48, 940, 109–122.

Little, D. I. (2017). *Sediment contaminant concentrations in Milford Haven waterway: data conversion and timeline*. Report to the Milford Haven Waterway Environmental Surveillance Group.

Little, D.I. (2009) Sediment Contaminants and Transport Review Report to Milford Haven Waterway Environmental Surveillance Group.

Little, D.I., Bullimore, B., Galperin, Y. and Langston, W.J. (2016). Sediment contaminant surveillance in Milford Haven Waterway. *Environ. Monit. Assess*. 2016 Jan;188(1):34.

McFarlane *et al.,* 2008, Assessment of information used to develop a recovery potential assessment for basking shark *Cetorhinus maximus* (Pacific population) in Canada, Canadian Science Advisory Secretariat.

NRW (2019). Intertidal Phase 1 Habitat Survey. Available from http://lle.gov.wales/catalogue/item/MarineIntertidalPhase1HabitatSurvey/?lang=en. [Accessed 12 February 2019].

NRW. (2018). Guidance for assessing activities and projects for compliance with the Water Framework Directive. OGN 72.

Parsons, E.C.M., Dolman, S.J., Wright, A.J., Rose, N.A., Burns, W.C.G. (2008) Navy sonar and cetaceans: Just how much does the gun need to smoke before we act? Marine Pollution Bulletin 56, 1248–1257.

Parvin, S. J., and A. G. Brooker. 2008. “Measurement and Assessment of Underwater Noise from Crest Energy / OpenHydro Tidal Turbine at the EMEC Facility, Orkney.” 812R0101. Subacoustech Ltd.

Ryer, C.H. and Olla, B.L. (2000). Avoidance of an approaching net by juvenile walleye pollack *Theragra chalcogramma* in the laboratory: the influence of light intensity. Fisheries research 45:195-199.

Turnpenny, A.W.H, Clough, S., Hanson, K.P., Ramsay, R. and McEwan, D. (2000). Risk assessment for fish passage through small, low-head turbines. Fawley aquatic Research Laboratories Ltd, report to the Energy Technology Support Unit (ETSU), Harwell, Didcot, Oxfordshire, OX11-ORA, Contractor’s Report No. ESTU H/06/00054/REP.

Whitehouse, R., Harris, J. M., & Rees, J. (2008). Dynamics of Scour Pits and Scour Protection: Synthesis Report and Recommendations (Milestones 2 and 3): a Report for the Research Advisory Group: Final Report, 2008. Department of Energy and Climate Change.

Wilson, B., Batty, R. S., Daunt, F. and Carter, C. (2007) Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban.

Wilson, B., Batty, R. S., Daunt, F., & Carter, C. (2006). Collision risks between marine renewable energy devices and mammals, fish and diving birds: Report to the Scottish executive.

WWW, 2019. Water Watch Wales. The Natural Resources Wales Water Watch Map Gallery http://waterwatchwales.naturalresourceswales.gov.uk/en/, accessed 14/05/19.

Zhang, J., Kitazawa, D., Taya, S., & Mizukami, Y. (2017). Impact assessment of marine current turbines on fish behavior using an experimental approach based on the similarity law. Journal of Marine Science and Technology, 22(2), 219-230.

MARINE ENERGY WALES

MARINE ENERGY TEST AREA (META)

Water Framework Directive: Appendices

Appendix A – Scoping Assessment

EOR0730

Marine Energy Test Area

Rev: 02

May 29, 2019

Appendix A - Scoping tables for proposed project

A.1.1.1 The scoping assessment for the project has been undertaken in accordance with NRW guidance note OGN072. Findings from the assessment have been undertaken with respect to three identified waterbodies that could be potentially affected by the project:

- Warrior Way (site 6) is located within Milford Haven Inner waterbody;
- Dale Roads (site 7) is located within Milford Haven Outer waterbody; and
- East Pickard Bay (site 8) is located within Pembrokeshire South waterbody.

Your activity	Description, notes or more information
Applicant name	Marine Energy Wales
Application reference number (where applicable)	Not applicable
Name of activity	Marine Energy Test Area
Brief description of activity	Deployment and testing of wave, tidal and wind energy components, subassemblies and devices on the seabed, in the water column and on the sea surface of the following: 1. Micro tidal device (Warrior Way); 2. Scale tidal device testing (Warrior Way); 3. Site preparation methodologies (Warrior Way); 4. Decommissioning methodologies (Warrior Way); 5. Salvage methodologies (Warrior Way); 6. Scale wave device (Dale Roads, East Pickard Bay); 7. Full scale wave device (Dale Roads East Pickard Bay); 8. Tow, float and mooring solution for floating offshore wind technology (East Pickard Bay); and 9.
Location of activity (central point XY coordinates or national grid reference)	Warrior Way: X198068, Y204491 Dale Roads: X184235, Y206076 East Pickard Bay: X185498, Y200557
Footprint of activity (m^2)	Warrior Way: 480 m^2 Dale Roads: 713 m^2 East Pickard Bay: *123,*486 m^2
Timings of activity (including start and finish dates)	Gravity or bed mounted based deployment up to 18 months. Tow testing over a period of 3 months with in water use 50% of the time. Devices may remain installed throughout the year (will not be seasonally restricted) and operation will not be restricted to daylight hours, however installation, deployment and retrieval, and maintenance activities will be restricted to daylight hours.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	No discharges predicted. Temporary disturbance from deployment of devices on seabed and mooring activities. Movement of turbines at Warrior Way. No turbines associated with other two sites.
Use or release of chemicals (state which ones)	No

Specific risk information

A.1.1.2 Potential risks of the project activities were considered for each of the following receptors: hydromorphology, biology (fish), water quality, priority habitats, priority species, invasive non-native species (INNS) and protected areas within each identified waterbody. Cumulative Impacts have also been assessed.

Section 1: Hydromorphology

A.1.1.3 Consider if hydromorphology is at risk from your activity.

A.1.1.4 Use the waterbody summary table to find out the hydromorphology status of the waterbody, if it is classed as heavily modified and for what use.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s) to Milford Haven Inner Waterbody	Hydromorphology risk issue(s) to Milford Haven Outer Waterbody	Hydromorphology risk issue(s) to Pembrokeshire South Waterbody
Changes the physical form or alters the process of sediment transport (erosion, deposition or transfer)	Requires impact assessment	Impact assessment not required	Yes. Requires Impact Assessment. Placement of gravity base device structures may interrupt sediment transport pathways during operation.	Yes. Requires Impact Assessment. Placement of gravity base or bed mounted device structures may interrupt sediment transport pathways and impact on seabed morphology during operation	Yes. Requires Impact Assessment. Placement of bed of bed mounted device structures may interrupt sediment transport pathways and impact on seabed morphology during operation
Have a significant impact on the hydromorphology conditions of a waterbody, for example changes to: 1. depth variation, the seabed and intertidal zone structure; 2. tidal patterns, for example dominant currents, freshwater flow and wave exposure.	Requires impact assessment	Impact assessment not required	Yes. Requires Impact Assessment. Placement of structures on the seabed at the Warrior way site has the potential to affect sediment transport pathways and tidal currents during operation phase	Yes. Requires Impact Assessment. The interaction of operational marine energy devices at Dale Roads and associated infrastructure and the wave regime may result in a reduction to wave energy and therefore wave exposure of certain areas of adjacent coastlines.	Yes. Requires Impact Assessment. The interaction of operational marine energy devices at East Pickard Bay and associated infrastructure may impact on wave regime through reduction of wave energy and therefore wave exposure of certain areas of adjacent coastlines.
Has a physical footprint greater than 1% of the area of a surface waterbody or greater than 0.5km², then it should be scoped in for hydromorphology	Requires impact assessment	Impact assessment not required	No. Impact Assessment not required. Footprint <1% and <0.5 km². Waterbody area = 21,023,035.66 m².	No. Impact Assessment not required. Footprint <1% and <0.5 km². Waterbody area = 35,391,696.99 m².	No. Impact Assessment not required. Footprint <1% and <0.5 km². Waterbody area = 413,318,151.16 m².
Is in a waterbody that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	No. Impact assessment not required	No. Impact assessment not required	No. Impact assessment not required

Section 2: Water quality

A.1.1.5 A scoping assessment has been undertaken on water quality and how physicochemical parameters could be affected by the project is provided in the table below:

Consider if your activity:	Yes	No	Water quality risk issue(s) to Milford Haven Inner Waterbody	Water quality risk issue(s) to Milford Haven Outer Waterbody	Water quality risk issue(s) to Pembrokeshire South Waterbody
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	Impact assessment not required	Yes. Requires impact assessment. Potential for disturbance of sediments resulting in increase in suspended sediment concentrations causing reduced water clarity during operation of a tidal device at Warrior Way over a period of up to 6 months.	No. Impact assessment not required. Potential for changes to water quality are not predicted by wave devices proposed for Dale Roads located within this waterbody for a period of more than 14 days.	No. Impact assessment not required. Potential for changes to water quality are not predicted by wave devices proposed for East Pickard Bay located within this waterbody for a period of more than 14 days.
Is in a waterbody with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	No. Phytoplankton status is classified as high. Impact assessment not required	No phytoplankton status is classified as high. Impact assessment not required	No phytoplankton status is classified as high. Impact assessment not required
Is in a waterbody with a history of harmful algae	Requires impact assessment	Impact assessment not required	No. Impact assessment not required	No. Impact assessment not required	No. Impact assessment not required

A.1.1.6 Potential for release or disturbance of chemicals has been considered in the table below:

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s) to Milford Haven Inner Waterbody	Water quality risk issue(s) to Milford Haven Outer Waterbody	Water quality risk issue(s) to Pembrokeshire South Waterbody
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	Yes. Requires impact assessment. Potential for release of contaminants from disturbed sediments during installation of a tidal device at Warrior Way.	Yes. Requires impact assessment. Potential for release of contaminants from disturbed sediments during installation of a wave device at Dale Road.	No. Impact assessment not required. Sediment contaminants are highly unlikely to be present given the anthropogenically undisturbed nature of the area within which the site is found.
It disturbs sediment with contaminants above Cefas Action Level 1.	Requires impact assessment	Impact assessment not required	Yes potentially; requires impact assessment. Sediments could display contaminant concentrations above Cefas Action Level 1.	Yes potentially; requires impact assessment. Sediments potentially contain contaminant concentrations above Cefas Action Level 1.	No. Impact assessment not required. Sediment contaminants are highly unlikely to contain concentrations above Cefas Action Level 1 given the anthropogenically undisturbed nature of the area within which the site is found.
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	Requires impact assessment	Impact assessment not required	No	No	No
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	Impact assessment not required	No. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.	No. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.	No. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.

Section 3: Biology

A.1.1.7 Annex V of the Directive sets out Biological Quality Elements (BQEs) which are used to classify ecological status using five classes from high to bad including elements such as fish, invertebrates or algae.

Quality Element	Pressure Description
Phytoplankton	Nutrient enrichment
Macroalgae	Nutrient enrichment, hazardous chemicals
Angiosperms	Nutrient enrichment, morphological alterations
Benthic invertebrates	Organic pollution, hazardous chemicals and some morphological alterations
Fish (transitional only)	Organic enrichment (dissolved oxygen), habitat destruction

A.1.1.8 Following consideration of the proposed project activities and the pressure descriptions for each receptor, benthic invertebrates and macroalgae receptors have been taken forward for further assessment. The project will not cause nutrient enrichment of the waterbody that could potentially impact on phytoplankton, and the nearest seagrass (angiosperms) beds are located at sufficient distances from each project site to not be affected to changes to seabed morphology from the installation of the proposed devices.

Section 3: Fish

A.1.1.9 A scoping assessment has been undertaken on whether fish could be potentially affected by the project and the results are provided in the table below:

Consider if your activity:	Yes	No	Biology fish risk issue(s) to Milford Haven Inner Waterbody	Biology fish risk issue(s) to Milford Haven Outer Waterbody	Biology fish risk issue(s) to Pembrokeshire South Waterbody
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	Impact assessment not required	Yes. Requires impact assessment. Temporary increases in suspended sediment concentrations during operation could affect fish by creating a physical barrier, damaging feeding or breathing organs or reducing ability to forage. The installation of a tidal device at Warrior Way has the potential to cause a barrier to movement of migratory fish. Accidental Pollution event could cause chemical change.	Yes. Requires impact assessment. Accidental Pollution event could cause chemical change.	Yes. Requires impact assessment. Accidental Pollution event could cause chemical change.

Consider if your activity:	Yes	No	Biology fish risk issue(s) to Milford Haven Inner Waterbody	Biology fish risk issue(s) to Milford Haven Outer Waterbody	Biology fish risk issue(s) to Pembrokeshire South Waterbody
Could cause mechanical injury or death to fish through: 1) Entrainment, e.g. fish being drawn into cooling water systems or turbines 2) Impingement, e.g. fish trapped against debris screens	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. Fish could be entrained by the tidal device installed at the Warrior Way site.	No; impact assessment not required. Dale Roads does not include an impact pathway by which fish can be impinged or entrained by the proposed devices.	No; impact assessment not required. East Pickard Bay does not include an impact pathway by which fish can be impinged or entrained by the proposed devices.
Is in a transitional waterbody and could affect fish or is outside of the transitional waterbody but could impact upon migratory fish	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Device footprint is located within the Milford Haven Inner Waterbody which is characterised as transitional	Yes; requires impact assessment. Device could potentially impact migratory fish associated with the waterbody.	Yes; requires impact assessment. Project could potentially impact migratory fish associated with the waterbody.

Section 4: WFD protected areas

A.1.1.10 An assessment of the following WFD protected areas have been considered at risk if they are located within located 2 km of each site location and contain features where there is the potential for likely significant effect.:

- special areas of conservation (SAC)
- special protection areas (SPA)
- shellfish waters
- bathing waters
- nutrient sensitive areas

Consider if your activity is:	Yes	No	Protected areas risk issue(s) to Milford Haven Inner Waterbody	Protected areas risk issue(s) to Milford Haven Outer Waterbody	Protected areas risk issue(s) to Pembrokeshire South Waterbody
Within 2km of any WFD protected area	Requires impact assessment	Impact assessment not required	Yes. Requires impact assessment. Warrior Way is located within or 2 km from Pembrokeshire Marine SAC and Shellfish Waters for Native Oysters and prohibited Area for Clams, Cockles, Mussels, Native Oysters, Pacific Oysters & Scallops.	Yes. Requires impact assessment. Dale Roads is located within Pembrokeshire Marine SAC and West Wales Marine SAC.	Yes. Requires impact assessment. East Pickard Bay is located within or 2 km from Pembrokeshire Marine SAC, Limestone Coast of South Wales SAC, West Wales Marine SAC.

Section 5: Priority habitats and species

A.1.1.11 An assessment of whether the project to cause impacts on priority habitats and species under Environment (Wales) Act 2016.

Consider if:	Yes	No	Priority species and habitat risk associated with Milford Haven Inner Waterbody	Priority species and habitat risk associated with Milford Haven Outer Waterbody	Priority species and habitat risk associated with Pembrokeshire South Waterbody
There are priority species and habitats within identified waterbody	Go to next question	No further scoping is required	Yes. Several listed migratory and non-migratory fish species and harbour porpoise exist within the waterbody. Several listed habitats also occur.	Yes. Several listed migratory and non-migratory fish species and harbour porpoise exist within the waterbody. Several listed habitats also occur.	Yes. Several listed migratory and non-migratory fish species and harbour porpoise exist within the waterbody. Several listed habitats also occur
Impact on identified priority species	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Temporary habitat disturbance from installation and operation activities. Temporary habitat loss from presence of device. Temporary increase in suspended sediments can cause impacts to respiratory and feeding organs and behaviour of priority species. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species, fish eggs or larvae. Introduction or spread of INNS during installation and operation. Collision risk from vessels and device turbines. Underwater noise emissions during installation and operation. Accidental Pollution Event.	Yes; requires impact assessment. Temporary habitat disturbance from installation and operation activities. Temporary habitat loss from presence of device. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species, fish eggs or larvae. Introduction or spread of INNS during installation and operation. Collision risk from vessels. Underwater noise emissions during installation and operation. Accidental Pollution Event.	Yes; requires impact assessment. Temporary disturbance from installation and operation activities. Temporary habitat loss from presence of device. Introduction or spread of INNS during installation and operation. Collision risk from vessels. Underwater noise emissions during installation and operation. Accidental Pollution Event.

Consider if:	Yes	No	Priority species and habitat risk associated with Milford Haven Inner Waterbody	Priority species and habitat risk associated with Milford Haven Outer Waterbody	Priority species and habitat risk associated with Pembrokeshire South Waterbody
Impact on identified priority habitats	Requires impact assessment	Impact assessment not required	Yes; requires impact assessment. Temporary habitat disturbance from installation and operation activities. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species. Permanent habitat removal from presence of device.	Yes; requires impact assessment. Temporary habitat disturbance from installation and operation activities. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species. Permanent habitat removal from presence of device.	Yes; requires impact assessment. Temporary habitat disturbance from installation and operation activities. Potential for release of contaminants from disturbance of sediments potential to cause toxicity to priority benthic species. Permanent habitat removal from presence of device

Section 6: Invasive non-native species (INNS)

A.1.1.12 An assessment was undertaken to determine whether the project could introduce or spread INNS.

A.1.1.13 Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other waterbodies
- activities that help spread existing INNS, either within the immediate waterbody or other waterbodies

Consider if your activity could:	Yes	No	INNS risk issue(s) to Milford Haven Inner Waterbody	INNS risk issue(s) to Milford Haven Outer Waterbody	INNS risk issue(s) to Pembrokeshire South Waterbody
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	Yes: The deployment of devices and vessel movements during installation and operation activities could lead to introduction of INNS.	Yes: The deployment of devices and vessel movements during installation and operation activities could lead to introduction of INNS.	Yes: The deployment of devices and vessel movements during installation and operation activities could lead to introduction of INNS.

Section 7: Cumulative Assessment

A.1.1.14 The projects and plans selected as relevant to the cumulative assessment of the project presented are based upon the results of a scoping exercise. Each project has been considered on a case by case basis for scoping in or out based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Construction	Further Assessment required?	Taken further for assessment
Dredging sites									
Installation/ Operation and Maintenance	Neyland Yacht Haven ltd. - DML1743	1.1	12.3	10.5	No spatial overlap with consented areas. Potential for temporal overlap.	Dredge and disposal from Neyland Marina - annual volume 5,500 m^3.	13/12/2017-12/12/2020	Yes	Vessel operation and therefore potential for collision risk and increased underwater noise, may present potential cumulative impacts with the META project. Sediment plumes generated from placement of material in identified disposal ground and dredging activities may present potential cumulative impacts with the META project.
Installation/ Operation and Maintenance	Milford Haven Port Authority - DML1646	1.3	1.5	2.5	No spatial overlap with consented areas Temporal overlap with all sites.	Maintenance dredging throughout the Milford Haven. Annual volume 362,500 m^3.	09/03/2017-08/03/2022	Yes	
Dredge disposal sites									

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Construction	Further Assessment required?	Taken further for assessment
Installation/ Operation and Maintenance	Neyland dredge disposal site - LU190	0.5	12.4	10.5	No spatial overlap with any of the consented areas. 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	Yes	Vessel operation and therefore potential for collision risk and increased underwater noise, may present potential cumulative impacts with the META project. Sediment plumes generated from placement of material in identified disposal ground may present potential cumulative impacts with the META project.
Installation/ Operation and Maintenance	Milford Haven Two dredge disposal site - LU169	26.7	20	15	No spatial overlap with any of the consented areas. No temporal overlap.	Location: To the south of Milford Haven dredge disposal grounds, unknown diameter x 50 m depth. Status: Open	Not applicable	No	Dredge disposal site is located at its closest 15 km from the META project, it is therefore highly unlikely to have any impact overlap.
Installation/ Operation and Maintenance	Milford Haven Three dredge disposal site - LU169	48.9	36	34.7	No spatial overlap with any of the consented areas. No temporal overlap.	Location: To the west of Milford Haven dredge disposal grounds, 1 nm diameter x unknown depth. Status: Open	Not applicable	No	Dredge disposal site is located at its closest 34.7 km from the META project, it is therefore highly unlikely to have any impact overlap.
Research									
Installation	Greenlink Interconnector Ltd. - RML1827	10.4	6	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap with East Pickard Bay (site 8).	Ground investigations	07-2018 - no end date given	Yes	Research operations are likely to have vessels present, with equipment for undertaking ground truthing surveys. Vessels may present potential cumulative impacts for collision risk and both vessels and ground investigation equipment may present potential cumulative impacts for increased underwater noise and Increased prop wash may result in increase in suspended sediments affecting benthic habtiats, fish or marine mammals
Installation	University College of Swansea - DEML1861	~4-5	~8-9	~6-7	Location is assumed to be by the Pembroke Power station. No spatial overlap with any of the consented areas. Temporal overlap.	Pembroke Power bubble barrier experiment Investigation into the effectiveness of bubble curtains in sediment management	Band 2 licence issued 12/12/2018 - three-year study	No	Due to the nature of the research operations, it is highly unlikely to present overlap with impacts assessed above.
Installation	University of Swansea - DEML1845	12.7	5.4	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap with East Pickard Bay (site 8).	Deposition and subsequent removal of marker buoys with environmental monitoring and mid-water settlement plates.	30/08/2018-29/08/2019	Yes	Vessels and equipment will be required for the placement of marker buoys. It is highly likely to have overlap with impacts. Vessel operation and therefore potential for collision risk and increased underwater noise, may present potential cumulative impacts with the META project
Infrastructure									
Installation/ Operation and Maintenance	Neyland Yacht Haven Ltd - CML1658	1.1	12.3	10.5	No spatial overlap with consented areas Temporal overlap with Warrior Way (site 6)	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 the META project. No CIA is therefore required

Phase	Developer - Reference	Distance from Warrior Way (site 6) (km)	Distance from Dale Roads (site 7) (km)	Distance from East Pickard Bay (site 8) (km)	Spatial/temporal overlap with the META project	Details	Date of Construction	Further Assessment required?	Taken further for assessment
Installation/ Operation and Maintenance	Mixed use developments - Local Planning Authority Reference: 14/0158/PA	7.3	5.3	5.6	No spatial overlap with any consented areas. Temporal overlap remains unknown due to insufficient information on start and end dates.	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	Yes	Given the distance from the project and likely impact pathways, there is potential for cumulative impacts to affect marine mammals, basking shark and otter due to increased vessel movements and increased underwater noise Affect fish and shellfish due to increased suspended sediment and/or changes in habitat availability.
Installation/ Operation and Maintenance/ Decommissioning	Greenlink Interconnector Ltd. - Government reference: qA1296053	10.4	6	0	Spatial overlap with East Pickard Bay (site 8). Temporal overlap will occur throughout the duration of the META project	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 to the south of the mouth of the Waterway.	07/2018 - ongoing	Yes	There is the potential for cumulative effects on marine mammals, basking shark and otter due to increased suspended sediment and/or changes in habitat availability. There is the potential for cumulative impacts on benthic and fish receptors due to increased suspended sediment and habitat loss/disturbance
Installation/ Operation and Maintenance/Decommissioning	Bombora Wave Energy	11.6	5.0	0	Spatial overlap with East Pickard Bay in intertidal area. Potential for temporal overlap	Bombora on- and off-shore infrastructure and deployment of Bombora mWave device at East Pickard Bay. This is to include device deployment (mWave device), installation of temporary communications cable between mWave device and temporary onshore control station to be located above East Pickard Bay, and installation and operation of temporary control station onshore. Laying of marine cable to shore and through intertidal area at East Pickard Bay to involve up to 3 days cable laying below MHWS using cable lay vessel and up to four vessels, including guard boat. Cable to be laid on seabed and kept in place in sandy sediment using rock bags. Where the marine cable traverses potential reefy habitat, it will follow natural rock channel. In the intertidal area, the cable will be laid through a natural gully, or up the vertical gully side and attached to the semi-vertical rock face with rock bolts using hand held tools. JCB will pull the cable through the intertidal area from a location above MHWS.	Q1 2020	Yes	There is the potential for spatial overlap in the intertidal area at East Pickard Bay, and temporal overlap with all META project sites, therefore this project cannot be excluded from further consideration in the CIA. Vessel operation and therefore potential for collision risk and increased underwater noise, may present potential cumulative impacts with the META project
Ministry of Defence Sites									
	Ministry of Defence	8.1	5.5	0.0	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)	N/A	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 META project. Vessel operation and therefore potential for collision risk and

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						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).			increased underwater noise, may present potential cumulative impacts with the META project
Aquaculture Projects									
Installation/ Operation and Maintenance	Tethys Oysters	8.9	2.6	5.1	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)	Yes	Installation of an oyster farm may result in fish aggregation and as a source recruitment site.
Installation/ Operation and Maintenance	Pembrokeshire Scallops	15.3	1.8	3.9	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)	Yes	As above.
Pembroke Dock Marine Projects									
Installation/ Operation and Maintenance	Milford Haven Port Authority - SC1810	2	11.3	8.8	No spatial overlap with consented sites. 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.	Oct-18	Yes	Port activity as a result of Pembroke Dock Port operations could cause an increase in vessels and underwater noise emissions, increased potential for suspended sediments, and impacts on shipping and navigation.
Installation/ Operation and Maintenance/Decommissioning	Marine Energy Wales - DEML1875	1.7	11.7	9.4	No spatial overlap with any of the consented areas. 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	Yes	Vessel use, and some testing activities could result in an increase in vessels and underwater noise and in an increase in SSCs or reduction in benthic habitats and could impact on fish receptors.
Installation/ Operation and Maintenance/Decommissioning	Wave Hub Ltd. - SC1082	31.4	31.1	25.8	No spatial overlap with any consented areas.	Demonstration zone Scoping Report submitted	Jul-18	No	This project will not be taken forward in as no spatial overlap with the META project has been identified.

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					Potential for temporal overlap as the projects are linked.	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.			