MarineSpace

Making Sense of the Marine Environment ™

META Consent Variation: Environmental Statement Addendum

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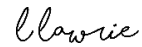
21/01/2022	Lara Lawrie	0.1	Internal Draft	
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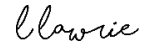
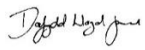
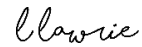
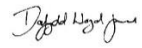
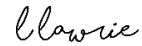
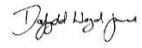
02/02/2022	Lara Lawrie	0.4	Internal Draft	
02/02/2022	Dafydd Lloyd Jones	0.5	Technical Review / Editorial Review	
04/02/2022	Lara Lawrie	0.6	Internal Draft	
04/02/2022	Dafydd Lloyd Jones	1.0	Director Sign-off / External Document	
15/02/2022	Lara Lawrie	1.1	Internal Draft - Addressing Client / Regulator Comments	
15/02/2022	Dafydd Lloyd Jones	2.0	Director Sign-off / External Document	

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Executive Summary

MarineSpace has been commissioned by Pembrokeshire Coastal Forum and Marine Energy Wales to prepare an environmental assessment to support 5 variation requests to the existing consents for the Marine Energy Test Area (META) project. Consents exist in the form of a Marine Licence issued by Natural Resources Wales and Planning Permission awarded by Pembrokeshire County Council (for Warrior Way only).

The variations, to the project design envelopes of 2 sites, Warrior Way and Dale Roads, within the META project in the Milford Haven Waterway, are as follows:

- An increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s at Warrior Way;
- An increase in the number of rotors on a single device at Warrior Way from 1 rotor to 3 rotors. The currently consented maximum diameter per rotor (≤5m) will remain the same, however the total swept area will increase from 19.63 m^2 (for one rotor) to 58.89 m^2 (for three rotors);
- An increase in the height of structures above the water surface from <2 m to <5 m within a discrete footprint of 10 m x 10 m at both Warrior Way and Dale Roads;
- An increase in the area of the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way; and
- An increase in the area of the mooring spread from 200 m^2 to 40,000 m^2 at Dale Roads.

The proposed variations have been scoped to facilitate more meaningful, technically viable and safer testing at META, and are informed by updated META market research into the current requirements of organisations looking to test and validate scale marine energy prototypes at scale test sites at Dale Roads and Warrior Way.

A scoping exercise was undertaken to identify the receptors and impacts, assessed under the original META Environmental Statement (RPS, 2019), that may be affected by the proposed variations to the consented design envelopes. The variations will only affect the operation and maintenance phase as they relate to operational parameters and are only proposed for Warrior Way and Dale Roads; no variations are proposed for East Pickard Bay.

Those receptors and impacts identified through the scoping exercise were revisited and reassessed on the basis of the proposed variations to the design envelope. All topics assessed in the original META Environmental Statement (RPS, 2019) were revisited, with the exception of socio-economic, where it was concluded the proposed variations would not result in any changes to the assessment outcomes.

The findings of the reassessment are presented in this addendum, including an updated Water Framework Directive assessment and information to inform the Habitats Regulations Assessment and Marine Conservation Zone assessment.

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1. Introduction

MarineSpace Ltd (MarineSpace) has been commissioned by Pembrokeshire Coastal Forum (PCF) and Marine Energy Wales (MEW) to prepare an addendum (this report) to the original Marine Energy Test Area (META) Environmental Statement (ES), produced by RPS in 2019. The report will support variation requests to the existing consents for the META project. This includes variations to the Project Design Envelopes (PDE) of 2 sites within the META project in the Milford Haven Waterway.

This report presents an assessment of the potential environmental impacts of the proposed variations to the META PDE, and is intended to provide sufficient information to the regulators, namely Natural Resources Wales (NRW) Marine Licensing Team and Pembrokeshire County Council (PCC), to enable them to fully assess the associated consent variation requests.

1.1. Marine Energy Test Area

The META project is a series of test areas in the Milford Haven Waterway that are suitable for marine renewable energy devices and component testing. The META project was awarded a Marine Licence in September 2018 (Marine Licence ORML1927) for Phase 1 of the Project, enabling basic component testing at 5 sites. A second Marine Licence (Marine Licence ORML1957v1; NRW, 2021) and associated onshore consent (Town & Country Planning Permission 20/0756/PA; PCC, 2021) were then issued in August 2021, for Phase 2 of the Project. Phase 2 consents cover the addition of 3 sites, (Warrior Way, Dale Roads and East Pickard Bay) for full scale marine renewable energy (wave and tidal) device testing, within an agreed PDE.

2. Variation Requests

2.1. Marine Licence

Following post-consent engagement with a number of marine renewable energy developers intending to deploy within the META site(s), a total of 5 variations to the Marine Licence (ORML1957v1), consented by NRW in August 2021, have been identified. These variations are only proposed at Warrior Way (Site 6) and Dale Roads (Site 7) (See Figure 2.1). No variations are proposed at East Pickard Bay (Site 8). These variations are:

- An increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s at Warrior Way;
- An increase in the number of rotors on a single device at Warrior Way from 1 rotor to 3 rotors. The currently consented maximum diameter per rotor (≤5m) will remain the same, however the total swept area will increase from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors);
- An increase in the height of structures above the water surface from <2 m to <5 m, within a discrete footprint of 10 m x 10 m at both Warrior Way and Dale Roads;
- An increase in the area of the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way; and
- An increase in the area of the mooring spread from 200 m^2 to 40,000 m^2 at Dale Roads.

2.2. Planning Permission

A total of 4 variations to the Planning Permission, reference 20/0756/PA, approved by PCC in August 2021, have been identified. These variations only apply at Warrior Way (Site 6) (see Figure 2.1) and include:

- An increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s at Warrior Way;
- An increase in the rotor swept area (tidal only) to allow for up to 3 rotors, an increase in total swept area from 19.63 m^2 to 58.89 m^2 (for 3 rotors) at Warrior Way;
- An increase in the height of structures above the water surface from <2 m to <5 m, within a discrete footprint of 10 m x 10 m at Warrior Way; and
- An increase in the area of the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way.

2.3. Alternatives

The Marine Licence (ORML1957v1), consented by NRW in August 2021, allows the following maximum project envelope at Warrior Way and Dale Roads. Planning Permission (20/0756/PA) consented by PCC in August 2021 relates to Warrior Way only:

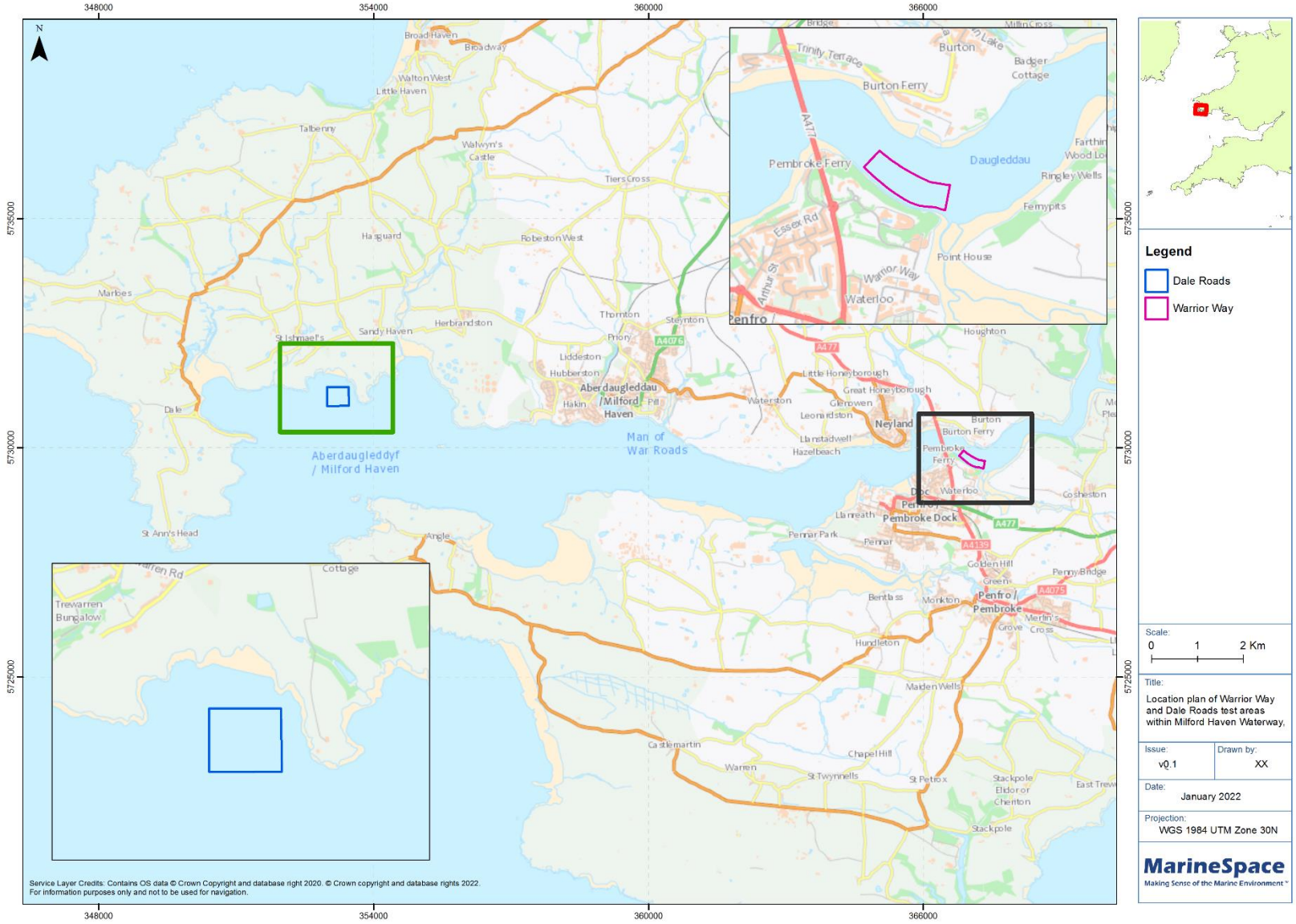
- Test device height about surface - <2 m; and
- Sea-surface area per device/component - ≤200 m^2.

The variation originally proposed increasing the height of the device above the water at Warrior Way and Dale Roads, from 2m to 5m, across the total sea surface area (≤200 m^2). This was shared with NRW Marine Licence Team (MLT) and NRW Advisory and initial feedback identified this may

adversely impact sensitive receptors, noting objections received during the original consent application, and request by PCC for supplementary seascape and visual assessment. On the basis of this feedback, the proposed design envelope variation was reviewed and refined to reduce the magnitude of impact and effect on sensitive receptors.

The alternative variation proposed within this report is for a discrete height increase from 2 m to 5 m, within a sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under Marine Licence, ORML1957v1, and Planning Permission, 20/0756/PA, at a height of 2 m over the remaining 100 m^2. This is discussed in more detail in Section 5.12.

Figure 2.1: The META Project Consent Variation Site Locations



3. Legislation and Policy Context

3.1. Welsh National Marine Plan

Welsh Government published and adopted the first Welsh National Marine Plan (WNMP) in November 2019 (Welsh Government, 2019c). Since adoption, the WNMP must be adhered to and relevant public authorities, such as NRW, Local Planning Authorities and Planning and Environment Decisions Wales (PEDW) must consider it when making decisions regarding the Welsh marine area. The WNMP covers Welsh inshore and offshore waters and seeks to ensure marine resources are used in a sustainable way in line with the high-level marine objectives over its 20- year lifespan. The WNMP sets out policies to achieve this, including both general and sector specific policies.

Developers are responsible for ensuring their plans are in accordance with the WNMP, and are encouraged to:

- Engage early across and between relevant stakeholders;
- Consider the WNMP early during project development;
- Apply the WNMP polices to help shape proposals;
- Consider sectoral marine planning and other plans in developing proposals;
- Supply information required for the relevant public authorities to assess their proposal(s) including fit with WNMP policies;
- Ensure evidence provided is sound and proportionate; and
- Help address evidence gaps by gathering and sharing relevant evidence where appropriate.

Each of the above has been considered throughout the development of the project and proposed variations and a summary of where further details can be found, relevant to the policies is provided below in Table 3.1.

Table 3.1: Summary of Welsh National Marine Plan aims and relevance to proposed works

Policy Ref	Policy text	Relevance to proposed variation
Gen_01	**Planning Policy** There is a presumption in favour of the sustainable development of the plan area in order to contribute to Wales' well-being goals.	META contributes towards developments of sustainable sources of renewable energy and is playing an important role in Wales' commitment to achieve net zero emissions by 2050.
ECON_1	**Sustainable Economic Growth** Proposals for economically sustainable activities are encouraged, particularly where they contribute to: the sustainable management of natural resources thereby supporting ecosystem resilience; a more resilient economy; employment opportunities particularly for coastal communities; protecting and creating employment	Project META and the proposed variations contribute to the long-term ambition of net zero carbon emissions by 2050. This would have a positive effect on the

Policy Ref	Policy text	Relevance to proposed variation
	at all skill levels; maintaining communities with a high-density of Welsh speakers; and/or tackling poverty by supporting deprived coastal communities.	economy of the region through the creation of jobs and opportunities.
ECON_02	**Coexistence** Proposals should demonstrate how they have considered opportunities for coexistence with other compatible sectors in order to optimise the value and use of the marine area and marine natural resources.	Coexistence with other Marine Users is described in Section 5.9 and Section 5.10.
SOC_03	**Marine Pollution Incidents** Proposals should demonstrate how they minimise their risk of causing or contributing to marine pollution incidents.	A Pollution Environmental Management Plan forms part of the Marine Licence conditions.
SOC_05	**Historic Assets** Proposals should demonstrate how potential impacts on historic assets and their settings have been taken into consideration and should, in order of preference: a) avoid adverse impacts on historic assets and their settings; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Opportunities to enhance historic assets are encouraged.	An assessment of historical assets is presented in Section 5.11.
SOC_06	**Designated Landscapes** Proposals should demonstrate how potential impacts on the purposes and special qualities for which National Parks or Areas of Outstanding Natural Beauty have been designated have been taken into consideration and should, in order of preference: a) avoid adverse impacts on designated landscapes; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Opportunities to enhance designated landscapes are encouraged.	Impact on the designation of Milford Haven Waterway Registered Landscape of Outstanding Historic Interest in Wales is assessed in Section 5.12.1.
SOC_07	**Seascapes** Proposals should demonstrate how potential impacts on seascapes have been taken into consideration and should, in order of preference: a) avoid adverse impacts on seascapes; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Opportunities to	An assessment on SLVIA is presented in Section 5.12 .

Policy Ref	Policy text	Relevance to proposed variation
	enhance seascapes are encouraged.	
SOC_09	**Effects on Coastal Change and Flooding** Proposals should demonstrate how they: avoid significant adverse impacts upon coastal processes; and minimise the risk of coastal change and flooding. Proposals that align with the relevant Shoreline Management Plan(s) and its policies are encouraged.	An assessment of coastal processes is presented in Section 0.
SOC_10	**Minimising Climate Change** Proposals should demonstrate how they, in order of preference: a) avoid the emission of greenhouse gases; and/or b) minimise them where they cannot be avoided; and/or c) mitigate them where they cannot be minimised. Where significant emission of greenhouse gases cannot be avoided, minimised or mitigated, proposals for regulated activities must present a clear and convincing case for proceeding.	Project META and the proposed variations support the implementation of sustainable sources of renewable energy.
SOC_11	**Resilience to Climate Change** Proposals should demonstrate that they have considered the impacts of climate change and have incorporated appropriate adaptation measures, taking into account Climate Change Risk Assessments for Wales. Proposals that contribute to climate change adaptation and/or mitigation are encouraged.	Project META directly contributes to climate change adaptation by providing test sites for the development of marine renewable technology.
ENV_01	**Resilient Marine Ecosystems** Proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged.	Consideration of impacts to marine ecosystems is presented throughout Section 5.
ENV_02	**MPAs** Proposals should demonstrate how they: avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; have regard to the measures to manage MPAs; and avoid adverse impacts on designated sites that are not part of the MPA network.	Impacts on MPAs are considered throughout this report and in Section 6.

Policy Ref	Policy text	Relevance to proposed variation
ENV_03	**Invasive Non-native Species** Proposals should demonstrate how they avoid or minimise the risk of introducing and spreading invasive non-native species. Where appropriate, proposals should include biosecurity measures to reduce the risk of introducing and spreading of invasive non-native species.	An Invasive Non Native Species Management Plan forms part of the Marine Licence conditions.
ENV_05	**Underwater Noise** Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a) avoid adverse impacts; and/or b) minimise impacts where they cannot be avoided; and/or c) mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	An assessment of Underwater Noise is presented in Section 5.4.
ENV_06	**Air and Water Quality** Proposals should demonstrate that they have considered their potential air and water quality impacts and should, in order of preference: a) avoid adverse impacts; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	The updated Water Framework Directive assessment is presented in Section 5.14.
ENV_07	**Fish Species and Habitats** Proposals potentially affecting important feeding, breeding (including spawning and nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance should demonstrate how they, in order of preference: a) avoid adverse impacts on those areas; and/or b) minimise adverse impacts where they cannot be avoided; and/or c) mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	An assessment of Fish and Shellfish Ecology is presented in Section 5.6
GOV_01	**Cumulative Effects** Proposals should demonstrate that they have assessed potential cumulative effects and should, in order of preference: a) avoid adverse effects; and/or b) minimise effects where they cannot be avoided; and/or c) mitigate effects where they cannot be minimised. If significant adverse effects cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to positive cumulative effects are encouraged.	An assessment of Cumulative Effects is presented in Section 5.15.

Policy Ref	Policy text	Relevance to proposed variation
ELC_02a	**Low Carbon Energy (supporting) Wave** Proposals for wave energy generation will be supported where they contribute to the objectives of this plan. Proposals should comply with the relevant general policies and sector safeguarding policies of this plan and any other relevant considerations.	Project META and the proposed variations provide testing sites for wave devices and support ambitions for the UK to continue to play a global leading role in marine renewable energy.
ELC_02b	**Low Carbon Energy (supporting) Wave** In order to understand future opportunities for wave energy development, relevant public authorities and the sector are encouraged, in liaison with other interested parties, to collaborate to understand opportunities for the sustainable use of wave energy resources including identification of: natural resources that provide potential opportunity for future use; evidence to de-risk consenting for the sector; and opportunities to define and, once in place, further develop and refine Strategic Resource Areas for wave energy resource safeguarding; in order to support the sustainable development of the sector through marine planning. Relevant public authorities should make appropriate evidence available to support planning and decision making in order to support the sustainable development of the sector through marine planning, where it is appropriate to do so.	Project META and the proposed variations provide testing sites for wave devices, helping ensure sustainable marine development while avoiding environmental and other sensitivities where possible. The activity of the testing sites will directly support the implementation of renewable sources of energy in the UK.
ELC_03a	**Low carbon energy (supporting) tidal stream** Proposals for tidal stream energy generation will be supported where they contribute to the objectives of this plan. Proposals should comply with the relevant general policies and sector safeguarding policies of this plan and any other relevant considerations.	Project META and the proposed variations provide testing sites for tidal devices and support ambitions for the UK to continue to play a global leading role in marine renewable energy.

Policy Ref	Policy text	Relevance to proposed variation
ELC_03b	**Low carbon energy (supporting) tidal stream** In order to understand future opportunities for tidal stream energy development, relevant public authorities and the sector are encouraged, in liaison with other interested parties, to collaborate to understand opportunities for the sustainable use of tidal stream energy resources including identification of: natural resources that provide potential opportunity for future use; evidence to de-risk consenting for the sector; and opportunities to define and, once in place, further develop and refine Strategic Resource Areas for tidal stream energy resource safeguarding; in order to support the sustainable development of the sector through marine planning. Relevant public authorities should make appropriate evidence available to support planning and decision making in order to support the sustainable development of the sector through marine planning, where it is appropriate to do so.	Project META and the proposed variations provide testing sites for tidal devices, helping ensure sustainable marine development while avoiding environmental and other sensitivities where possible. The activity of the testing sites will directly support the implementation of renewable sources of energy in the UK.

3.2. Summary of Variation Impact Assessment Parameters

A summary of the variation values are outlined in Table 3.2. These have been used as the basis of the assessments undertaken in Section 5.

Table 3.2: Variation activity and values

Activity	Original Value (in ES)	Variation Value
Speed of moving parts at Warrior Way	<5 m/s	≤10.5 m/
An increase in the number of rotors on a single device at Warrior Way and total swept area.	1 rotor (Total swept area 19.63 m^2)	3 rotors (Total swept area 58.89 m^2)
An increase in the height of structures above the water surface from <2 m to <5 m within a discrete footprint of 10 m x 10 m at both Warrior Way and Dale Roads	<2 m (≤200 m^2 sea surface area)	<5 m (Within a discrete footprint of 10 m x 10 m)
Increase in the area of the mooring spread at Warrior Way	150 m^2	22,500 m^2
Increase in the area of the mooring spread at Dale Roads	200 m^2	40,000 m^2

4. Description of Existing Environment

4.1. Overview

This section of the report provides details of the existing environment in and around the Warrior Way (Site 6) and Dale Roads (Site 7) parts of the META Project area. The baseline information summarised here is based on data presented in the ES (RPS, 2019) and this report should be read in conjunction with the ES. Further information is presented in the ES chapters and supporting technical appendices (RPS, 2019).

4.2. Marine Physical Environment

4.2.1. Bathymetry

4.2.1.1. Site 6 – Warrior Way

Warrior Way (Site 6) covers an area of 93,000 m^2 (9.3 Ha) and supports depths of between 16-19 m. The site has a significant tidal range, with an 8 m range observed on spring tides (META ES; RPS, 2019).

4.2.1.2. Site 7 – Dale Roads

Dale Roads (Site 7) covers an area of 195,565 m^2 (19.56 Ha), benefits from a significant wind and wave fetch from the south and southwest and supports depths of between 8-12 m.

4.2.2. Tidal/Wave Regime

4.2.2.1. Site 6 – Warrior Way

Warrior Way (Site 6) is located within a semi-diurnal tidal setting with a meso-tidal range. The tidal range propagates from the mouth of the Waterway up into the estuary, with high tide moving in a west to east direction. This stretch of the estuary supports the greatest tidal resource in the Milford Haven estuary (1.2 m/s). Currents flow predominately in a westerly direction as a result of the river flow from the Eastern and Western Cleddau rivers, that form a confluence and flow into Daugleddau river, constituting the Waterway. A large tidal range, in excess of 8 m during spring tides, can be observed in Warrior Way, which give rise to peak tidal currents of 1.2m/s. However, it should be noted that during neap tides the tidal excursion is typically half that of the spring excursion, resulting in peak currents of 0.5 m/s (META ES; RPS, 2019).

4.2.2.2. Site 7 – Dale Roads

Dale Roads (Site 7) is located within a semi-diurnal tidal setting with a meso-tidal range, with the tidal wave propagating from west to east (i.e. high tide occurs from the west and moves eastward into the estuary). The tide flowing in and out of the Waterway, in a semi-diurnal cycle, predominantly determines the currents speed and direction. Due to the location of this bay, to the north of the main channel, tidal currents are much smaller in magnitude than in the main channel; typically, less than 0.25 m/s. However, the area is exposed to waves approaching from the

southwest, therefore, littoral currents would be important during storm events and are not restricted to the direction of tidal flows (META ES; RPS, 2019).

4.2.3. Geology, Seabed Sediments and Sediment Transport Regime

4.2.3.1. Site 6 – Warrior Way

Predominantly purple-brown and red-brown siltstones and green-grey coarse-grained to very fine, plant-bearing sandstones constitute the bedrock of Warrior Way (Site 6). Warrior Way is located on the outside of a meander, down river and at the mouth of Cosheston Pill entrance of the Daugleddau estuary. At this location, sediment was identified to be gravel and coarse sand, with diameters ranging from of 1-64 mm (Carey *et al.,* 2015), and dependent on fluvial deposits from the river and hydrodynamic processes (fine grained sediments are winnowed by vigorous currents).

It is expected that the fluvial sediments are transported in an east to west direction, down river. Due to the high currents and fluvial sediment input, this area would experience large variations in suspended sediment concentrations, particularly following storm events (META ES; RPS, 2019).

In addition to the SPI (Sediment Profile Imaging) data presented by Carey *et al., (*2015), a preliminary review of the SEACAMS multibeam backscatter data for Warrior Way, as presented in Appendix 7.1: Benthic Ecology of the ES (META ES; RPS, 2019), indicated that finer grained sediments are likely to be present throughout the site, with no indication of any area of potential hard substrate that could correspond with reef habitats within the boundary of Warrior Way visible in this dataset. This suggests a level of contradiction to the sand and gravel described by Carey *et al., (*2015), although, this may simply indicate a mixed substrate.

A review of EUSeaMap data predicted low energy infralittoral seabed sediments coinciding with Warrior Way (EMODnet, 2016). A review of SPI survey data identified the site with a surface grain size of very coarse sand (Carey *et al.,* 2015).

4.2.3.2. Site 7 – Dale Roads

The majority of the Dale Roads (Site 7) can be characterised by very fine to fine sand (0.063-0.25 mm) over silt/clay (Carey *et al.,* 2015). A review of SEACAMS multibeam backscatter data for the site, as presented in Appendix 7.1: Benthic Ecology of the ES (META ES; RPS, 2019), indicated that sediments, potentially comprising rippled sands are highly likely to be present throughout, with an area of possible harder substrate in the southwestern corner of the site. Hard, red calcareous marls with sporadic green and red sandstones constitute the geology of much of the Waterway.

Near the mouth of the Waterway, at Dale Roads, which is subjected to significant wave energy, the seabed substrate for the intertidal and subtidal areas is largely characterised by sand and bedrock. The site will experience significant suspended sediment concentrations, during storm conditions particularly, both as a result of exposure to waves and increased fluvial sediment inputs as a result of rainfall runoff. Studies undertaken to ascertain background suspended sediment levels prior to dredging campaigns have indicated typical levels of 15 mg/l (META ES; RPS, 2019), while background levels in the approaches to the Waterway have an average annual value 5-10 mg/l (CEFAS, 2016).

A review of EUSeaMap data predicted high energy infralittoral seabed sediments coinciding with Dale Roads (EMODnet, 2016), with some areas of Mediterranean and Atlantic high energy infralittoral rock. SPI survey data from Dale Roads identified the area as containing "*Poorly sorted muddy sand, shells, pebbles*", "*wave rippled sand*" and "*mixed rounded talus, sand mud*" facies. The surface grain size classification was fine to very fine sand (Carey *et al.,* 2015).

Data available on EMODnet, which were produced as part of the Mapping European Seabed Habitats (MESH) project, from sample points gathered and investigated by the Marine Nature Conservation Review (MNCR) surveys also suggest that coarse sands may be present in this area.

4.3. Biological Environment

4.3.1. Subtidal and Intertidal Benthic Ecology

The baseline benthic ecology summary is largely drawn from information presented in META ES Chapter 7: Benthic Subtidal and Intertidal Ecology (RPS, 2019) and, where relevant, additional information has been sourced to support the assessment for the consent variation.

4.3.1.1. Site 6 – Warrior Way

Warrior Way (Site 6) overlies 'Large shallow inlets and bays' (H1160) and Annex I habitats 'Estuaries' (H1130) features, which are both primary reasons for the designation of the Pembrokeshire Marine/Sir Benfro Forol Special Area of Conservation (SAC). Both features encompass a wide range of environmental conditions found within the waterway (e.g. salinity gradients, tidal streams and seabed substrates), supporting highly species-rich communities (NRW, 2018b).

The Annex I feature 'reefs' (H1170) was further identified as a characteristic feature of the SAC and is also a primary reason for site selection (META ES; RPS, 2019). Under Article 17, NRW has predicted areas of subtidal reef in the vicinity of Warrior Way (Lle Geo-Portal, 2022a). However, a preliminary review of the SEACAMS multibeam backscatter data for the site, suggests that soft sediments are likely to be present throughout Warrior Way, with no suggestion within the consent boundary of any area of potential hard substrate that could correspond with 'reef' habitat. The presence (or absence) of subtidal reef (and other features of conservation interest) at the site is to be confirmed following targeted pre-deployment benthic surveys, as agreed under Conditions 3.28 of the META Marine Licence (NRW, 2021).

A review of the EUSeaMap (EMODnet, 2016) predicted low energy infralittoral seabed sediments are present at Warrior Way, while SPI surveys at sites that spatially coincide, have identified sediments to be "*Channel Mixed Physical*" facies. Sediment grain sizes are anticipated to comprise gravel, coarse sand and mud (Section 4.2.3). Subsequent habitat mapping assessments, based on these discussed surveys, predict that to the east of the Cleddau Bridge in the region of Warrior Way, a mix of biotopes is present, which is constituted of *Mediomastus* and *Crepidula* in variable salinity infralittoral mixed sediment and *Thyasira* and *Mysella* in mixed muddy sediments. The Invasive and Non-Native Species (INNS) American slipper limpet *Crepidula fornicata,* has become prominent throughout the Waterway since its introduction in the 1950s, with sediments providing support to large numbers of its shells on the surface (Carey *et al.,* 2015; Bohn, 2014). There are records of this INNS being observed at Warrior Way (NBN, 2022a) and across the Waterway.

The subtidal sediments at Warrior Way, and throughout the majority of the wider region of the Milford Haven Waterway are represented by the Section 7 and OSPAR protected habitat 'Mixed muddy sediments', and also the Section 7 habitat of 'Tide swept channels'. Discrete areas of Section 7 and OSPAR 'Seagrass beds' and intertidal 'Saltmarsh' habitats can be observed to the east of Warrior Way, outside the consent boundary (Lle Geo-Portal, 2022b).

The mapped extent of the Annex I 'reef' habitat feature within the Pembrokeshire Marine SAC is adjacent to the landward extent of the Warrior Way consent boundary (Lle Geo-Portal, 2022a). However, it is important to note that the site does not directly overlap with the mapped extent of reef habitat in this area, which was purposely avoided in the demarcation of the site boundary. This is also consistent with a review of the SEACAMS multibeam backscatter data for Warrior Way, which indicates potential areas of hard substrate adjacent to the landward boundary of the site. A review of sample point data available on EMODnet suggests that the communities associated with these areas of rocky reef are representative of the biotope 'ascidians, hydroids and cushion sponges on turbid tide-swept sheltered circalittoral rock'.

There are inconsistent records of the Section 7 and OSPAR (species and habitat) native oyster *Ostrea edulis* in Milford Haven. A review of a recent 2017 native oyster survey in Milford Haven, indicated that of the 4 stations that overlapped Warrior Way, 2 were identified as having *O. edulis* occurrence (review by NRW, 2021). The presence (or absence) of the INNS Pacific oyster *Magallana gigas* (also known to be present in the waterway, NBN (2022b)), and *O. edulis* is still to be confirmed at Warrior Way, following the targeted pre-deployment benthic surveys, as agreed under Condition 3.28 of the META Marine Licence (NRW, 2021).

Annex I intertidal 'reef', as reported under Article 17, occurs throughout the intertidal zone in the region of Warrior Way. The site contains tide-swept rock, and the lower reaches can be characterised by the biotope 'ascidians, bryozoans and *Laminaria digitata* on tide-swept sublittoral fringe rock'. The eulittoral zone can be characterised by the 'ascidians, sponges and *Fucus serratus* on tide-swept lower eulittoral rock' biotope and the '*Fucus spiralis* on full salinity sheltered upper eulittoral rock' biotope. The upper littoral fringe rock can be characterised by the lichen, *Verrucaria maura* (NRW, 2019). Annex I intertidal sandflats and mudflats (and Section 7 and OSPAR intertidal mudflats) have not been identified with the Warrior Way consent boundaries as the site is exclusively subtidal but occur significantly along the shore to the east and west of Warrior Way.

4.3.1.2. Site 7 – Dale Roads

Similar to Warrior Way (Site 6), Dale Roads (Site 7) overlaps the mapped distribution of the Annex I habitats 'large shallow inlets and bays' and 'estuaries', and also the extensive areas of Section 7 and OSPAR 'mixed muddy sediments' (Lle Geo-Portal 2022a; 2022b). A review of NRW data also indicated that the site overlaps with the possible occurrence of Annex I 'reef' habitat; However, it should be noted that there is poor confidence in this data. This may, although, be consistent with a review of the multibeam backscatter data, which indicates an area of harder/coarser substrate in the southwestern corner of the site. A review of the Joint Nature Conservation Committee (JNCC) data available on EMODnet indicated that communities in the vicinity of Dale Roads can be characterised by the '*Nucula nitidosa* and *Abra alba* in slightly mixed sediment or circalittoral muddy sand' biotope.

There is no evidence of the occurrence of Section 7/OSPAR 'Seagrass beds', or *O. edulis* at Dale Roads to date. However, the presence (or absence) of these features of conservation importance is to be confirmed following the targeted pre-deployment benthic surveys, as agreed under Condition 3.28 of the META Marine Licence (NRW, 2019). Of the two main populations of subtidal common seagrass *Zostera marina* in the Milford Haven waterway, the closest population remains distant from Dale Roads, located 2.8 km away. Although, a smaller bed (0.96 ha) has been observed approximately <1 km east of Dale Roads, located around the headland at Longoar Bay (Lle Geo-Portal, 2022b).

The intertidal zone can be characterised as rocky habitat, with the sublittoral fringe communities in the vicinity of Dale Roads, as similarly described for Warrior Way, while the eulittoral zone can be characterised by the occurrence of barnacles *Chthamalus* spp, all of which are representative of Annex I intertidal 'Reef' (Lle Geo-Portal, 2022a). Annex I 'Submerged or partially submerged seacaves' (H8330), commonly associated with 'Reefs' have also been predicted to occur along the coast to the east of the Dale Roads (LLe Geo-Portal, 2022a). The littoral fringe rock can also be characterised by lichens, while to the north of Dale Roads, the soft sandy sediment of Lindsway Bay can be characterised by polychaetes (NRW, 2019).

4.3.2. Fish and Shellfish Ecology

The inshore waters of Pembrokeshire coasts provide habitat to a range of pelagic, bentho-pelagic and demersal fish species, including Atlantic herring *Clupea harrengus*, cod *Gadus morhua* and European plaice *Plueronectes platessa*. Sessile and mobile shellfish occur within both the subtidal and intertidal regions of the coast, while elasmobranchs, such as rays, skates and sharks have also been observed foraging for prey. The inshore waters provide habitat for species of both conservation and commercial importance, as for example, the Waterway has been designated for its migratory fish and is a spawning and nursery ground for several species (META ES; RPS, 2019).

Drop-down video (DDV) surveys, undertaken in June 2018, near to the mouth and within the Waterway, recorded assemblages of primarily demersal fish species of Triglidae (including bottom-feeding fish, gurnards and sea robins), common dab *Limanda limanda*, European plaice and Pleuronectidaem (includes flounders). The elasmobranch Scyliorhinidae and small-spotted catshark *Scyliohinus canicular* were also observed (META ES; RPS, 2019).

Seasonal otter trawl and seine netting surveys (2006 and 2007), mid-way up the Waterway, recorded assemblages of gobies (*Pomatoschistus* spp.); sand smelt *Atherina presbyter* and sea bass *Dicentrarchus labrax*; clupeids including sprat *Sprattus spattus* and herring; 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* (META ES; RPS, 2019). Of these assemblages, the most abundant species of fish observed were gobies, with 400 individuals recorded in one trawl. Elasmobranch species that were observed were the small-spotted catshark and thornback ray *Raja clavata* (META ES; RPS, 2019).

The fish and shellfish study area provides ideal spawning habitat for plaice, cod, sandeel *Ammodytes americanus*, herring, sole *Solea vulgaris*, and sprat (Ellis *et al*., 2012). The sheltered estuarine conditions also provide a safe environment for juvenile fish and other smaller species of fish, and can

be considered as an important nursery area for mackerel, sandeel, plaice, sole, whiting *Merlangius merlangus*, herring, spotted ray *Raja montagui*, tope and thornback ray (Ellis *et al*., 2012).

Historically, the inshore waters of Pembrokeshire has been harvested for Pacific oyster *Crassostrea gigas* and cockles. In recent years, permits have included the harvest of native oysters *Ostrea edulis*, carpet shell clams *Venerupis corrugate* and razor clams *Pharidae* spp. The diverse sediment types, marine habitats and relatively large area and has resulted in the occurrence of a variety of shellfish species, including the edible mussels *Mytilus edulis*, native oyster, prawn *Palaemon serratus* and lobsters *Homarus gammarus*. Pawson *et al*. (2002) described the Pembrokeshire coast as a valuable potting ground, while lobsters can be found as high up-stream as Lawrenny Quay and have been noted as breeding, with evidence of the populations extending as far as Lundy in the Bristol Channel.

4.3.3. Marine Mammals

Mainly, inshore waters (<80 m deep) constitute the regional marine mammal, basking shark and otter study area as defined in the original META ES (RPS, 2019). Western areas however contain deeper water habitats of the Celtic Sea (up to 145 m deep), supporting a more diverse cetacean community in comparison with coastal waters (Hammond *et al*., 1995; Reid *et al*., 2003; Evans *et al*., 2003; Baines and Evans, 2012). The Celtic Deep contains areas of particularly deep water (<145 m deep) and this area, along with waters off the western end of the Llŷn peninsula and Anglesey, supports the highest cetacean species diversity in Welsh waters (Baines and Evans, 2012).

Grey seal *Halichoerus grypus* are widely distributed in Welsh waters, with breeding colonies observed in northwest Pembrokeshire, particularly on Ramsey Island, extending southwards to Skomer Island and northwards to southern Ceredigion (Baines and Evans, 2009). Small concentrations are present around the Llŷn peninsula and the coast of Anglesey. These breeding colonies act as haul-out sites in the non-breeding season. Approximately 5,000 grey seals use habitats on the Welsh coast, with colonies in north Pembrokeshire and Skomer Island being the most important breeding colonies for grey seal in the south of the UK (SCOS, 2017).

Basking shark *Cetorhinus maximus* have been recorded feeding within the Celtic Deep, and tag geolocations indicate that individual basking sharks spend considerable time in the Celtic Sea, conducting persistent ranging movements near the Celtic Sea front (Sims *et al*., 2005). Sightings of basking sharks and tagged basking sharks indicate that individuals occur in the waters off the Pembrokeshire coast, within the regional marine mammal, basking shark and otter study area (Miller *et al*., 2015; Witt *et al*., 2012). This can be further supported by West Wales Biodiversity Information Centre (WWBIC) sightings data (WWBIC, 2019) used to inform the original META ES (RPS, 2019).

The Milford Haven Waterway SSSI supports nationally important numbers of otter *Luttra luttra* (NRW – Marine character Areas MCA 21 Milford Haven). In 2004, the population estimate for otter in Wales was given as 762 (JNCC, 2007). WWBIC sightings data indicate that otter have been sighted throughout the local marine mammal, basking shark and otter study area, up into the Cleddau rivers, with sightings predominantly occurring within a few metres of MLWS (WWBIC, 2019).

4.3.4. Marine Ornithology

The study area defined within the original META ES (RPS, 2019) falls in the vicinity of a number of seabird colonies, some of which constitute classified populations of Special Protection Areas (SPAs).

Bird species identified within a review of the European Seabirds at Sea (ESAS) dataset comprised both pelagic and diving species, namely razorbill *Alca torda*, guillemot *Uria aalge*, puffin *Fratercula arctica*, northern fulmar *Fulmarus glacialis*, European shag *Phalacrocorax aristotelis*, northern gannet *Morus bassanus*, kittiwake *Rissa tridactyla*, and Manx shearwater *Puffinus puffinus*. Additionally, five gull species were also observed (great black backed gull *Larus marinus*, lesser black backed gull *Larus fuscus*, black headed gull *Chroicocephalus ridibundus*, common gull *Larus canus* and herring gull *Larus argentatus*), as well as Arctic tern *Sterna paradisaea* and common tern *Sterna hirundo* (Lle-Geo Portal, 2022c).

Twelve wader species were recorded within the British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) data search, which include bar-tailed godwit *Limosa lapponica*, black-tailed godwit *Limosa limosa*, turnstone *Arenaria* spp., ringed plover *Charadrius* spp., snipe *Gallinago* spp., oystercatcher *Haematopus* spp., golden plover *Pluvialis apricaria*, lapwing *Vanellus* spp., redshank *Tringa* spp., greenshank *Tringa nebularia*, dunlin *Calidris alpina*, and curlew *Numenius* spp.. A review of desk study data (RPS, 2019) indicated that wading birds utilise sections of the marine ornithology data search study area, defined within the original META ES (RPS, 2019) at both high and low tide across the year, with numbers peaking in winter. Greenshank and golden plover were the only wader species recorded at nationally important numbers in the marine ornithology data search study area at, 39 and 5,000 individuals respectively.

8 waterbird/wildfowl species were recorded within the BTO WeBS data search, which were mallard *Anas platyrhynchos*, light-bellied brent goose *Branta bernicla*, Eurasian wigeon *Mareca penelope*, Northern shoveler *Spatula clypeata*, common teal *Anas crecca*, Northern pintail *Anas acuta*, shelduck *Tadorna* spp. and greater scaup *Aythya marila*. The desk study data (RPS, 2019) indicate that wildfowl use sections of the marine ornithology data search study area at both high and low tide across the year, with numbers peaking in winter. Teal, wigeon and light-bellied brent goose were recorded at nationally important numbers in the marine ornithology data search study area; at 3,818; 8,703; and 90 individuals respectively.

Classified populations are discussed in greater detail in Section 4.3.5 of the META ES, Chapter 10 (RPS, 2019).

4.3.5. Marine Nature Conservation

There are several designated nature conservation sites that may be relevant to the location and extent of the proposed works (Table 4.1).

Table 4.1: Designated nature conservation sites and qualifying features in the vicinity of META sites Warrior Way and Dale Roads

Designated Site	Qualifying features for designation	Distance from Warrior Way (Site 6) (km)	Distance from Dale Roads (Site 7) (km)
Pembrokeshire Marine/Sir Benfro Forol SAC	Presence of the Annex I habitats: estuaries; large shallow inlets and bays; reefs; sandbanks which are slightly covered by sea water all the time; mudflats and sandflats not covered by sea water at low tide; coastal lagoons; Atlantic salt meadows; and submerged or partially submerged sea caves. Annex II species also present as a qualifying feature: sea lamprey, river lamprey; allis shad; grey seal; and otter.	0	0
Limestone Coast of South West Wales /Arfordir Calchfaen de Orllewin Cymru SAC	Designated for the presence of Annex I habitat: submerged or partially submerged sea caves	10	6.5
Skomer MCZ	Designated for the presence of: infaunal sediment communities; epifaunal mixed sediment communities; *Zosteramarina* population; sponge assemblages; Nudibranch species assemblages; *Pentapora foliacea* (ross coral) population; Lusitanian anthozoan populations; rocky reef faunal communities; algal communities with major sublittoral habitat; littoral communities on bedrock shores; king scallop; crawfish; and sunfish.	20.3	6.6
Cleddau Rivers/Afonydd Cleddau SAC	Presence of Annex II species that qualify and are a primary reason for designation: brook lamprey; river lamprey; bullhead; sea lamprey; and otter.	11	16

Designated Site	Qualifying features for designation	Distance from Warrior Way (Site 6) (km)	Distance from Dale Roads (Site 7) (km)
Milford Haven Waterway SSSI	Designated for oyster beds on shallow subtidal muddy sediment and supporting nationally important numbers of otter. The saltmarsh and mudflats within the Haven support significant numbers of over-wintering wildfowl and waders, including curlew, dunlin, little grebe, shelduck, teal and wigeon	0	<0.1
West Wales Marine/Gorllewin Cymru Forol SAC	Designated for the presence of Annex II species: harbour porpoise *Phocoena phocoena*.	13	0
Bristol Channel Approaches/ Dynesfeydd Mor Hafren SAC	Designated for the presence of Annex II Species: harbour porpoise *Phocoena phocoena*.	20	20
Lleyn Peninsula and the Sarnau/Pen Llyn a'r Sarnau SAC	Designated for the presence of Annex II species: bottlenose dolphin *Tursiops truncatus*; and grey seal *Halichoerus grypus*.	91	98
Cardigan Bay/Bae Ceredigion SAC	Designated for the presence of Annex II species: bottlenose dolphin *Tursiops truncatus*; and grey seal *Halichoerus grypus*.	43	47
Pembrokeshire Bat Sites and Bosherston Lakes SAC	Designated for the presence of Annex II Species: otter *Lutra lutra*.	8	15.7
North Anglesey Marine/Gogledd Mon Forol SCI	Designated for the presence of Annex II Species: harbour porpoise *Phocoena phocoena*.	170	170
North Channel SAC	Designated for the presence of Annex II Species: harbour porpoise *Phocoena phocoena*.	277	275
Lundy Island SAC	Designated for the presence of Annex II Species: grey seal *Halichoerus grypus*.	59.2	64.8

Designated Site	Qualifying features for designation	Distance from Warrior Way (Site 6) (km)	Distance from Dale Roads (Site 7) (km)
Skomer, Skokholm and the seas off Pembrokeshire/ Sgomer, Sgogwm a Moroedd Penfro SPA	Designated for relevant marine bird interest features: Atlantic puffin; European storm petrel; lesser black-backed gull; Manx shearwater; razorbill; common guillemot; and black-legged kittiwake.	6.5	4.5
Grassholm SPA	Designated for relevant marine bird interest features: gannet *Morus bassanus*.	36	22
Aberdaron Coast and Bardey Island/Glannau ac Ynys Enlli SPA	Designated for relevant marine bird interest features: Manx shearwater *Puffinus puffinus.*	116	117
Irish Sea Front SPA	Designated for relevant marine bird interest features: Manx shearwater *Puffinus puffinus*.	212	211
Lambay Island SPA	Designated for relevant marine bird interest features: fulmar *Fulmarus glacialis*.	212	205
Saltee Islands SPA	Designated for relevant marine bird interest features: fulmar *Fulmarus glacialis*.	123	110
Rathlin Island SPA	Designated for relevant marine bird interest features: fulmar *Fulmarus glacialis*.	405	400
Broomhill Burrows SSSI	Lapwings breed within the dune slacks	8.6	7.5

Designated Site	Qualifying features for designation	Distance from Warrior Way (Site 6) (km)	Distance from Dale Roads (Site 7) (km)
Castlemartin Range SSSI	Outside the breeding season, significant numbers of waders and gulls roost and feed in the sandy bays at Frainslake and Bluckspool. These often include up to several hundred lesser black-backed gulls, and smaller flocks of oystercatcher *Haematopus ostralegus,* curlew *Numenius arquata*, dunlin *Calidris alpina* and grey plover *Pluvialis squatarola*. Migratory flocks of whimbrel *N. phaeopus* and other wader species regularly occur along the coast and, in winter, large numbers of lapwing *Vanellus vanellus* and golden plover *P. apricaria* feed and roost within the Range.	10.8	7.4

4.4. Human Environment

4.4.1. Commercial Fisheries

The baseline summarised here for commercial fisheries is largely drawn from information presented in the META ES Chapter 11: Commercial Fisheries (RPS, 2019) and, where relevant, additional information has been sourced to support the assessment for the consent variation.

Species predominantly caught within the commercial fisheries study area are shellfish and demersal fish species. Pelagic species are primarily caught out with of the commercial fisheries study area, as defined in the original META ES (RPS, 2019) although there are small scale fisheries within the Waterway for some pelagic species. Migratory species are caught in low number by sea anglers within the Waterway.

Consultation with local stakeholders (undertaken as part of the META ES Chapter 11: Commercial Fisheries; RPS, 2019) has revealed high fishing activity (predominantly pots) present at the mouth of the Waterway, which decreases further up-stream. Warrior Way (Site 6) and Dale Roads (Site 7) have been shown to have bedrock, gravel, sands and muddy substrates (META ES Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019), and although these substrates do not represent preferred potting grounds, these sites are still used to some extent by the local potting fisheries.

Historically, the Waterway has been harvested for wild cockles (Cardiidae) and Pacific oyster *Crassostrea gigas* and, in recent years, the fisheries market has grown to include permits for carpet shell clam *Ruditapes decussatus,* razor clam Pharidae spp. and native oyster *Ostrea eduli* (Cefas, 2012). Overall, the large area, diverse marine habitats and sediment types of the Waterway has resulted in colonisation by a variety of shellfish species and, in addition to those species mentioned

above, mussel *Mytilus edulis*, lobster *Homarus gammus* and prawn *Palaemon serratus* also occur in the region, some of which have conservation and commercial interests.

Warrior Way is located within the Upper Cleddau designated shellfish waters, under the EC Shellfish Waters Directive (79/923/EEC) (META ES; RPS, 2019).

4.4.1.1. Warrior Way

Feedback from Welsh Marine Fisheries Advisory Group (WMFAG), West Wales Shellfisherman's Association (WWSFA) and the Welsh Fishermen's Association (WFA) indicated that Warrior Way (Site 6) has limited fishing and is used predominately by shore-based sea anglers during the night. There is no boat-based commercial fishing at Warrior Way due to tidal activity. Although Warrior Way (Site 6) does not directly overlap with any potting fisheries, it is located approximately 160 m northwest of a lobster and crab potting site, and approximately 145 m southwest of a prawn potting site (META ES, Chapter 11: Commercial Fisheries; RPS, 2019).

4.4.1.2. Dale Roads

Feedback from WMFAG, WWSFA, and the WFA indicated that Dale Roads (Site 7) has a high volume of coastal fishing activity within the vicinity, mostly shellfish pots. Although Dale Roads (Site 7) does not directly overlap with any potting fisheries, it is located approximately 15 m southwest and 144 m southwest of lobster and crab potting sites, respectively (META ES, Chapter 11: Commercial Fisheries; RPS, 2019). The Welsh Federation of Sea Anglers (WFSA) confirmed that fishing activity is common at Soldier Rock, on the western side of Lindsway Bay (approximately 550 m west of Dale Roads (Site 7) (META ES, Chapter 11: Commercial Fisheries; RPS, 2019).

4.4.2. Shipping and Navigation

The baseline summarised here for shipping and navigation is largely drawn from information presented in the META ES Chapter 12: Shipping and Navigation (RPS, 2019) and, where relevant, additional information has been sourced to support the assessment for the consent variation.

The Waterway is managed by the Port of Milford Haven, which is responsible for pilotage and conservancy on the Waterway. Warrior Way (Site 6) and Dale Roads (Site 7) are within the Milford Haven Statutory Harbour Authority (SHA) and Competent Harbour Authority (CHA) areas, which are managed by Milford Haven Port Authority (MHPA). MHPA provides a Vessel Traffic Service (VTS) which actively monitors the Waterway below the Cleddau Bridge (META ES, RPS, 2019).

No formal (i.e., designated) anchorage areas exist in any of the META project sites. There are no military exercise areas within the Waterway. There are no existing marine renewable energy installations within the META test areas or wider Waterway. There are numerous subsea cables and pipelines within the Waterway, however none is located within the META sites.

Commercial vessels within the Waterway, including tankers and cargo vessels, were recorded by Automatic Identification System (AIS) (collated during the summer and winter of 2018 for the original assessment); these vessels were recorded on clear in and out bound routes, passing some distance to the south of Dale Roads (Site 7), with no evidence of interaction. Some smaller vessels were recorded using the anchorage to the south of Dale Roads (Site 7). No commercial vessel

transits were recorded above the Cleddau bridge and, therefore, no vessels were recorded in the vicinity of the Warrior Way (Site 6) site (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

The majority of passenger ferry AIS tracks, recorded to the south of Dale Roads (Site 7), are represented by the Irish Sea ferry, which routinely makes 2 departures/arrivals per day from Pembroke Dock. Other passenger ferry tracks (likely to include seasonal sight-seeing trips) were recorded in the vicinity of Warrior Way and Dale Roads sites, notably during the summer, however few tracks were recorded passing through the test site areas. Few fishing vessel AIS tracks were recorded within, or in the vicinity of, the Warrior Way and Dale Roads test site areas. Tracks were mainly recorded passing from Milford Haven Docks to sea, with no evidence of active fishing. This aligns with feedback from stakeholder consultation, although small scale potting may take place in all test site areas (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

High-speed craft (likely to be commercial vessels) were recorded in both the summer and winter AIS datasets. These were generally recorded on passage. Occasional tracks were recorded passing through the Warrior Way (Site 6) site in both seasons. No tracks were recorded passing through the Dale Roads (Site 7) site in either season. Tugs and other services vessels were rarely recorded in any of the test sites in either season. Tracks were recorded passing the Warrior Way (Site 6) site to the north, and a significant number of tracks (representing ship towage tugs) were recorded passing well to the south of Dale Roads (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

Consultation has advised that Warrior Way (Site 6) is the most intensively used of the 2 sites for leisure navigation. In particular, the area is frequently used for youth sail training and other water-based activities (including coasteering). Many leisure navigators in small craft access the area from the slipways at Llanion cove, at the southeast of the site. Recreational AIS vessel tracks in the summer were mainly recorded passing to the north of the site boundary, with few tracks recorded within the site, with the exception of the northern corner (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

Consultation has advised that the Dale Roads site (Site 7) is also a popular leisure area. Very few AIS tracks were recorded passing through the area in the summer (though many tracks were recorded passing relatively close to the site boundaries), and no tracks were recorded passing through the site in the winter. Stakeholder consultation confirmed that the density of traffic using Dale Roads (Site 7) was much lower than Warrior Way (Site 8), although it was noted that the Dale Roads area is occasionally used for power boat training exercises (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

4.4.3. Archaeology

4.4.3.1. Warrior Way (Site 6)

A review of marine archaeological data had indicated no designated sites within Warrior Way (Site 6). However, 2 non-designated heritage assets were recognised, which include Areas 46 and 45 (coinciding with Warrior Way) of Dyfed Archaeological Trust's 'Milford Haven Waterway Ports and Harbours' survey. Area 46 shows the occurrence of prehistoric deposits within the local area. This was identified as an area of possible sediment with medium archaeological potential, an acoustic

survey has been conducted in this area which indicates that some sediment may survive of Palaeolithic/Mesolithic interest.

4.4.3.2. Dale Roads (Site 7)

A review of marine archaeological data has returned no designated sites within the Dale Roads (Site 7). However, several non-designated heritage assets were recognised, which include Areas 23, 34 and 25 of Dyfed Archaeological Trust's 'Milford Haven Waterway Ports and Harbours Project' survey. Area 23 was identified as an area of possible sediment with medium archaeological potential. An acoustic survey has been conducted within this area which indicates some sediment of Palaeolithic/Mesolithic interest may survive. Area 34 (Major Bay/Landing Point) was deemed to be of high archaeological potential for material culture associated with the use of Dale Roads as a major bay/landing point in the post-Medieval and Modern periods, however, low archaeological potential for the early pre-historic and post-Medieval period is assessed for the site due to distance to Dale Roads bay itself. This area was not covered by surveys or boreholes, but sediment survival is considered likely. Area 25 (Lindsway Bay) is deemed to be of medium archaeological potential for the early Prehistoric, post-Medieval and Modern periods as a small sandy bay, without easy access and therefore likely to have seen little use. Levels suggest possible sediment survival, but the area has not been surveyed or boreholed (META ES, Chapter 13: Marine Archaeology; RPS, 2019).

4.4.4. Other Marine Users

The Waterway is utilised through several different activities and interests, which include fishing, recreational activities, commercial shipping, port activities, pipelines, subsea cables, dredging and disposal. These activities are regulated on a day-to-day basis through the Milford Haven Port Authority, in collaboration with community stakeholders and partner organisations. Coexistence is achieved through established communications and operating procedures (including by-laws, Notices to Mariners, and Water Ranger patrols). The level of recreational activity varies depending on the season, with most of the activity in the Waterway being seasonal (increasing from April to August and then declining in September). Recreational activities include kayaking, power-boating, jet skiing, water skiing, wake boarding, sailing, rowing and coasteering. Consultation has advised that Warrior Way (Site 6) is the more intensively used of the 2 META project consent variation sites for leisure navigation (META ES, Chapter 14: Other Users; RPS, 2019).

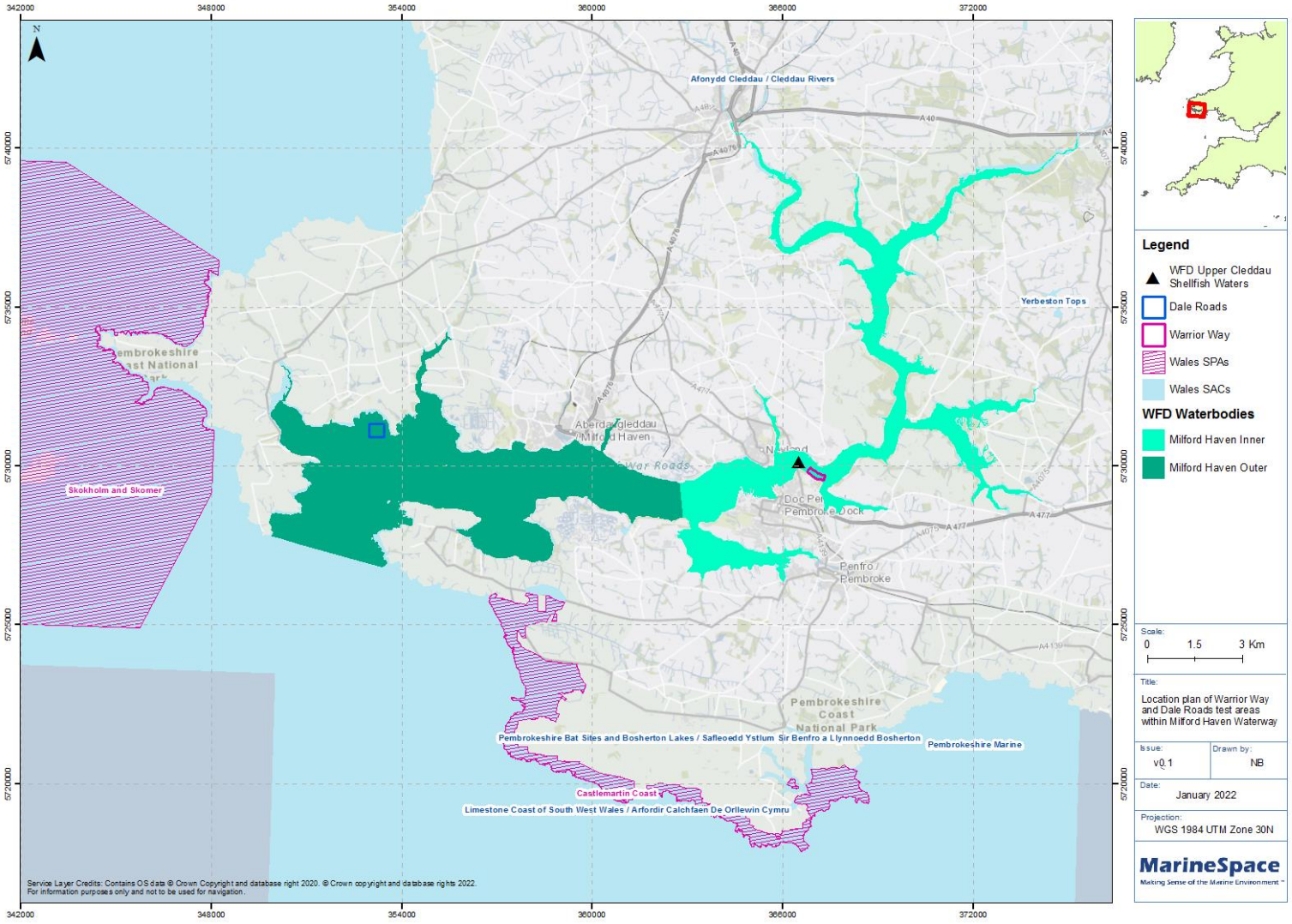
4.4.5. Water Framework Directive

The Water Framework Directive (WFD) aims to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. To achieve this protection regions of the UK are divided into River Basin Districts (RBD), and these are further divided into specific water bodies. The META project is located within the Western Wales RBD. In context with the WFD, the RBDs contain a number of individual water bodies (NRW, 2018a). There is an overlap with the proposed works and the Milford Haven Outer (Dale Roads) and Milford Haven Inner (Warrior Way) waterbodies (Figure 4.1). Further details of the status of these waterbodies are provided in the Table 4.2.

Table 4.2: Current Status of transitional and coastal waterbodies scoped into assessment

Waterbody	Milford Haven Outer	Milford Haven Inner
ID	GB641008220000	GB531006114100
Type	Coastal	Transitional
Distance from project site (km)	0 (Dale Roads)	0 (Warrior Way)
Overall Status	Moderate	Moderate
Current Status (Ecological)	Moderate	Moderate
Current Status (Chemical)	Fail	Fail
Target Status (Date)	Good (2021)	Good (2027)
Is the Waterbody Heavily Modified (HMWB)?	No	No
Reason for HMWB	n/a	n/a
Hydromorphological Status	Not high	Not high
WFD Phytoplankton Status	High	High
History of Harmful Algae	No data available	No data available

Figure 4.1: Water Framework Directive Waterbodies screened into compliance assessment



5. Environmental Assessment

5.1. Methodology

The proposed variations to those parameters presented in the consented Marine Licence (ORML1957v1), and Planning Application (20/0756/PA), have the potential to result in environmental impacts on a number of receptors. These potential environmental impacts are assessed using the criteria set out in the original ES, Chapter 4: META Environmental Assessment Methodology (RPS, 2019) and summarised below in Table 5.1 and

Table 5.2.

Neither the definition of the magnitude of impact nor the sensitivity of the receptors has been revisited, and the assessment methodology reflects the approach adopted in original ES (RPS, 2019).

No additional surveys have been undertaken to inform the variation application, however the following survey requirements form part of the conditions of the Marine Licence (ORML1957v1) (NRW, 2021):

- Requirement for pre-deployment benthic survey to inform micro-siting; and
- Requirement for suspended sediment plume monitoring at Dale Roads site and at all sites where seabed levelling and/or clearance is required.

No variations to the pre-deployment surveys are proposed and the above requirements will be adhered to, prior to deployment where relevant.

Unless set out otherwise, topics follow the original ES methodology, summarised below in Table 5.1,

Table 5.2, and Table 5.3.

Table 5.1: Definition of magnitude of environmental impacts presented in this assessment (RPS, 2019)

Magnitude	Description
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (adverse). Large scale or major improvement or resource quality; extensive restoration or enhancement; major improvement of attribute quality (beneficial).
Moderate	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics, features or elements (adverse). Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (beneficial).
Minor	Some measurable change in attributes, quality or vulnerability, minor loss or, or alteration to, one (maybe more) key characteristics, features or elements (adverse). Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact

Magnitude	Description
	occurring (beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (adverse). Very minor benefit to, or positive addition of one or more characteristics, features or elements (beneficial).
No change	No loss or alteration or characteristics, features or elements; no observable impact in either direction.

Table 5.2: Definition of terms relating to the sensitivity of the receptor (RPS, 2019)

Value (Sensitivity of the receptor)	Description
Very high	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

The following is taken from the original ES, Chapter 4: Environmental Assessment Methodology (RPS, 2019):

"Unless separately defined, the assessment of significance takes into account relevant topic specific guidance, based on the following scale and guidance:

- *Substantial: adverse or beneficial. They represent key factors in the decision-making process with regard to consenting/licensing. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer the most damaging impact and loss of resource integrity;*
- *Major: These beneficial or adverse effects are considered to be very important considerations and re likely to be material considerations in the decision-making process;*
- *Moderate: These beneficial or adverse effects may be important but are not likely to be key decision-making factors. The cumulative impacts of such factors may influence decision making if they lead to an increase in the overall adverse effect on a particular resource or receptor;*

- *Minor: These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project; and*
- *Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error (ORML1957v1, Chapter 4: Environmental Assessment Methodology) (RPS, 2019).”*

Table 5.3: Assessment matrix

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

5.2. Scope for Potential Impacts

A scoping exercise has been undertaken to identify the receptors and impacts, assessed under the original META ES (RPS, 2019) and consented under Marine Licence (ORML1957v1) (NRW, 2021), and Planning Application (20/0756/PA) (PCC, 2021), that may be affected by the proposed variations to the consented PDE. The variations will only affect the operation and maintenance (O&M) phase as they relate to operational parameters and no variations are proposed that affect the installation or decommissioning of the test devices. Variations are also only proposed for Warrior Way (Site 6) and Dale Roads (Site 7); no variations are proposed in relation to the existing parameters on the Marine Licence for East Pickard Bay. The results of the scoping exercise are presented in Table 5.4 and the site specific assessments are presented in Section 0 onwards.

Table 5.4: Summary of key potential impacts scoped into the update assessment

Topic	Phase	Scope for Potential Impact
Coastal Processes	O&M	Increases in suspended sediment concentration and deposition of disturbed sediment to the seabed.
		Changes to the hydrodynamic regime due to the operation of tidal turbines.
Underwater Noise	O&M	Impacts to marine mammals and fish arising from operational noise of the test devices.
Benthic Subtidal and Intertidal Ecology	O&M	Temporary habitat disturbance.
		Temporary increases in suspended sediment concentrations and deposition.
		Alteration of benthic habitats resulting from changes to the hydrodynamic regime at Warrior Way.
Fish and Shellfish Ecology	O&M	Colonisation of hard structures.
		Medium term habitat loss.
		Tidal turbine collision risk at Warrior Way (Site 6).
		Physical barrier to movement of known migratory routes due to presence of tidal devices at Warrior Way (Site 6).
Marine Mammals, Basking Shark and Otter	O&M	Increased anthropogenic underwater noise – operation of tidal turbines.
		Collision risk – tidal turbines.
		Changes in hydrodynamic regime.
		Changes in fish and shellfish communities.
Ornithology	O&M	Collision with development.
Commercial Fisheries	O&M	Temporary loss of traditional fishing ground.
		Damage to fishing equipment.

Topic	Phase	Scope for Potential Impact
Shipping and Navigation	O&M	Physical presence of devices may deviate vessel routes leading to a loss of navigable space at Warrior Way (Site 6) and increased risk of grounding.
		Physical presence of devices may increase allision risk to vessels not under command (including unattended small craft, capsized craft) and in an emergency situation (e.g. machinery related problems and drifting).
		Physical presence of devices may increase risk of gear/anchor snagging.
		Physical presence of devices may lead to potential for interaction between leisure users and the device.
		Removal or disturbance of sediments - buried prehistoric deposits.
Marine Archaeology	O&M	Removal or disturbance of archaeological resource – shipwrecks.
		Impact on the designation of Milford Haven Waterway Registered Landscape of Outstanding Historic Interest in Wales.
SLVIA	O&M	Visual impact from viewpoints for receptors using the Pembrokeshire Coast Path along the Cleddau Bridge and across the Daugleddau from publicly accessible coastal viewpoints in Burton Ferry (VP1, VP2).
		Visual Impact from viewpoints for receptors using the Pembrokeshire Coast Path (VP3, VP4 and VP5).
		Visual impact for recreational receptors using the waterway for recreational boating.
		Operation and maintenance of the META project may displace recreational activities resulting in a loss of recreational resource.
Other users	O&M	Operation of META Project may Displace Recreational Activities, Resulting in a Loss of Recreational Resource

5.3. Coastal Processes

The proposed design changes to the project that affect marine and coastal processes are limited to the Warrior Way and Dale Roads sites and relate to the increase in mooring spread area (both Sites) and an increase in the rotor swept area (Warrior Way Site 6); details of which are provided in Table 3.2.

The text below outlines the environmental assessment for these parameters. All other parameters are unchanged, and the environmental assessment is presented in the original assessment (META ES Chapter 5: Coastal Processes; RPS, 2019).

5.3.1. Increases in Suspended Sediment Concentration and Deposition of Disturbed Sediment to the Seabed

In keeping with the original assessment, no assessment of sensitivity of receptor or significance of impact is provided for this impact pathway, as these are assessed by the associated receptor group assessments.

5.3.1.1. Warrior Way

As stated in the original assessment (META ES Chapter 5: Coastal Processes; RPS, 2019), the maximum design scenario 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 when the device is operational. The accelerated flow through the turbine may potentially mobilise sediment, however this is largely device dependent. The most likely design scenario for Warrior Way, is represented by a single floating device deployment at any one time, with the maximum (worst case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. The removal and replacement of each device inside the consent boundary of Warrior Way, is not expected to occur within the same footprint each time.

The proposed changes to the project design, which have the potential to directly affect coastal processes, include increasing the maximum rotor swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors) and increasing the mooring spread area from 150 m^2 to 22,500 m^2. Whilst, in relative terms, these represent large increases (a tripling of rotor swept area and a 150-fold increase in mooring spread area), in absolute terms this area is small and reflects the potential Marine Licence condition (ORML1957v1 Appendix 1.1, NRW, 2021; PCC, 2021) to only install up to 1 device at one time.

Increases in suspended sediment concentrations (SSC) may occur due to erosion via tidal flows funnelled and accelerated through the tidal devices. Described in Section **Error! Reference source not found.**, the coarse-grained and muddy nature of the seabed sediment (i.e. very coarse sand and gravel and muds) means that any sediment mobilised during device operation will either settle very rapidly or spend a more prolonged time in suspension. For example, using the principles of Stokes' Law (e.g. McCave and Syvitski, 1991) to calculate settling velocity, coarse sand (diameter = 1 mm) will settle at a rate of approximately 0.73 m/s. Thus, given the water depth on the site (19 m) and the peak tidal flow (1.2 m/s) particles of this size would be expected to travel no farther than 31 m.

If mobilised, coarser grained gravel would settle almost immediately, whilst mud sized particles (diameter ≤ 0.063 mm) may enter suspension, will remain in suspension longer (settling velocity of 0.003 m/s), and travel further. Given the potential for naturally high levels of suspended sediments at the site noted during the original assessment (META ES Chapter 5: Coastal Processes; RPS, 2019), the relatively small area subject to potential sediment erosion at this site is considered to have a low impact on the SSC and any increase is likely to be limited to within the site and not interact with any other META Project Site.

Outlined in Table 3.2, a further proposed change to the project envelope concerns the increase in mooring spread from 0.00015 km^2 to 0.02250 km^2. Anchor chains or cables may move due to the

action of tides, waves and other forces acting on the moored device. The mooring spread will be located completely within the site.

When moving over the seabed the mooring spread has the potential to disturb sediments and move these into suspension. As outlined above, coarse grained material (sands and gravel) will not enter suspension, however finer grained muds may; however, due to the mechanism of disturbance (abrasion rather than funnelled flow), it is considered that the magnitude of effect is likely to be minor. Whilst, in a worst-case such effects may occur over the 0.02250 km^2 area, in practice, movement is likely to be restricted to the seabed touchdown area.

The maximum design scenario indicates that the testing period will be limited to 6 months with the device in the water for 50 % of this time which would further limit the potential for increased suspended sediment.

5.3.1.2. Dale Roads

The most likely design scenario for Dale Roads is represented by a single floating device deployment at any one time, and up to 2 device deployments in a 12-month period over the 15-year project lifetime. The removal and replacement of each device inside the consent boundary of Dale Roads is not expected to occur within the same footprint each time.

The proposed change to the project design, which has the potential to directly affect coastal processes is an increase in the mooring spread area from 200 m^2 to 40,000 m^2. In relative terms this represents a large increase (a 200-fold increase), however, in absolute terms this area is small and constitutes 20% of the Dale Roads Site.

As summarised in Section **Error! Reference source not found.**, seabed substrates at the site are generally coarse-grained with rippled sand identified within the backscatter data (see META ES, Appendix 7.1: Benthic Ecology; RPS, 2019). Tidal current velocities on the site are low (<0.25 m/s during spring tide peak flow), however the site may experience more significant wave energy.

When moving over the seabed, the mooring spread has the potential to disturb sediments and move these into suspension. Outlined in Section **Error! Reference source not found.**, coarse grained material (sands and gravel) will not enter suspension, however finer grained muds may. In this site, due to the mechanism of disturbance (abrasion) and the generally sandy nature of the seabed substrate, it is considered that the magnitude of effect is likely to be minor. Whilst, in a worst-case such effects may occur over the entire 0.04 km^2 area, in practice movement is likely to be restricted to the seabed touchdown area.

5.3.2. Changes to the Hydrodynamic Regime due to the Operation of Tidal Turbines

5.3.2.1. Warrior Way

The original assessment (META ES, Chapter 5: Coastal Processes; RPS, 2019) assessed the impact of the proposed Warrior Way tidal devices on the hydrodynamic regime. In this assessment, a comparison was made with the Strangford Lough twin turbine (MCT, 2005), that employed 16 m diameter rotors (rotor swept area, therefore, 201 m^2). In the Strangford Lough case, the impact of

turbine operation of near field flows downstream was found to be negligible, and velocity differences away from the immediate turbine area were found to be <1% of typical tidal variation.

The proposed change to the project design, which has the potential to directly affect the hydrodynamic regime is the increase in rotor swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). In practice this allows for up to 1 device with 3 rotors, each rotor with a diameter of up to 5 m, to be deployed at one time.

Analysis of the hydrodynamic impact of the Warrior Way turbine was also undertaken as part of the original assessment and based on a 5 m diameter turbine (that still represents the worst-case scenario for maximum turbine diameter). The localised reduction in current speed in the immediate sweep area was 2%. In the Strangford Lough study (MCT, 2005) computational fluid dynamics (CFD) analysis indicated that downstream influence of the structure was unlikely to exceed an area greater than 1.5 times the diameter.

This is further supported by the assessment conducted for the Morlais Project (Royal HaskoningDHV, 2019), where in this much larger scale project, residual currents are still high velocity and scale of effect is low-medium in the near-field and negligible in the far-field.

On the basis of the existing studies, at Warrior Way, allowing for an increase to 3 rotors on 1 device, downstream influence is unlikely to exceed 7.5 m beyond the devices and will remain within the consent boundary. Far-field effects are negligible.

The assessment of sensitivity of receptor and magnitude of impact has not been changed from the original assessment. Therefore, the significance of effect remains **minor adverse**, which is not significant in EIA terms.

5.4. Underwater Noise

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The variation seeks to increase the moving part speed of the device from ≤5 m/s to ≤10.5 m/s, and to increase the number of rotors from 1 to 3, increasing the total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). No variations are proposed at Dale Roads that would result in changes to operational noise above those assessed in the original ES (META ES, Chapter 6: Underwater Noise; RPS, 2019).

As presented in the original ES Chapter 6: Underwater Noise (RPS, 2019), the specifications of the projects to be tested at the META Sites are not currently known. The original assessment therefore based the noise modelling on underwater noise measurements of an OpenHydro tidal turbine at the European Marine Energy Centre (EMEC) facility in Orkney (Parvin and Brooker, 2008) and the Pelamis P2 measured at Billia Croo (Lepper *et al.*, 2012). The OpenHydro turbine utilised a single rotor with a diameter of 6 m, producing a source sound pressure level of 162 dB re 1 µPa. In comparison, the Pelamis P2 turbine utilised a single rotor with a diameter of 4 m, and produced a source sound pressure level of 180 dB re 1 µPa. Whilst the variation seeks to make the changes described above (from 1 to 3 rotors), the maximum diameter of tidal turbines to be tested at Warrior Way remain 5 m, which is unchanged from the original ES (RPS, 2019).

The maximum number of rotors for the turbine to be installed at Warrior Way is increased in this variation from 1 to 3. Noise data relating to the use of multiple rotors on a single turbine device are limited within the public domain, due to the status of tidal energy as an emerging technology and the limited application of these devices, even in a test and demonstration capacity. Due to the absence of publicly available data (modelling and monitoring), a review of accessible information has been formed the basis of this assessment. A summary of parameters relating to underwater noise from all projects considered in this assessment is presented in Table 5.5

The DeltaStream tidal energy device was granted consent in March 2011, and later installed within Ramsey Sound by Tidal Energy Limited in December 2015 (Tidal Energy Limited, 2009). The device utilised 3 independent turbines with rotor diameters of a minimum of 11 m, mounted to a single triangular frame. This device is significantly larger than the maximum parameters of the device applied for within this variation (DeltaStream 3 rotors of 11 m; META consent 1 rotor of 5 m; META variation 3 rotors of 5 m). Modelling suggested a maximum sound source pressure level of 157.2 dB re 1 µPa, with behavioural responses of marine mammals not predicted to occur beyond 76 m, and injury only determined to occur within <10 m of the turbines.

The Roosevelt Island Tidal Energy Project is a United States based tidal energy project, installed in New York State in 2012 (Verdant Power LLC, 2010). The turbine comprises 3 independent rotors of 5 m diameter, mounted to a single triangular frame. Post-deployment sound source pressure levels were determined to be 144.7 dB re 1 µPa at the centre of the array. It is further noted within the noise assessment that issues with the turbine system during assessment may have resulted in a higher noise signature than would be expected during regular functioning. At the levels recorded it was determined that behavioural effects on fish species were unlikely to occur.

Table 5.5: Summary of parameters relating to underwater noise from comparative tidal projects

Device	Number of Rotors per Turbine	Rotor Diameter	Modelled/Measured dB re 1 µPa
OpenHydro	1	6 m	162 (measured)
Pelamis P2	1	4 m	180 (measured)
DeltaStream	3	11 m	157.2 (modelled)
Roosevelt Island Tidal Energy Project	3	5 m	144.7 (measured)

Modelling and recording of sound pressure levels from the DeltaStream tidal energy device and the Roosevelt Island Tidal Energy Project, respectively, indicate underwater noise levels lower than those considered likely within the original assessment. These projects closely match the parameter (3 independent rotors with a diameter ≥5 m on a single turbine system) applied for in this variation, with the rotor swept area of the DeltaStream device far exceeding that of the proposed project. On the basis the review of underwater noise modelling and monitoring for alternative turbine devices with configurations utilising 3 rotors, it is determined likely that the range of source noise levels

modelled for the original ES (162 to 180 dB re 1 µPa at 1 m) (RPS, 2019) remains a worst-case scenario for Warrior Way. Therefore updating the assessment is not considered necessary and the conclusions of the original META ES (Chapter 6: Underwater Noise; RPS, 2019) have been referred to in the impact assessments for fish and shellfish (Section 5.6) and marine mammals (Section 5.7) in this report.

5.5. Benthic Subtidal and Intertidal Ecology

The consent variation assessment, presented here for benthic ecology, has been undertaken in reference to the previous assessments presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019, and where relevant, META ES, Chapter 6: Coastal Processes; RPS, 2019.

5.5.1. Temporary Habitat Disturbance

5.5.1.1. Site 6 - Warrior Way

The most likely design scenario for Warrior Way, is represented by a single floating device deployment at any one time, with the maximum (worst-case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. The removal and replacement of each device, inside the consent boundary of Warrior Way, is not expected to occur within the same footprint each time.

Temporary habitat disturbance that may affect benthic ecology during the O&M phase, will arise from the mooring spread around the deployed device, with the precautionary approach for a worst-case scenario that the whole area within the mooring spread will be impacted. These areas have the potential to be subject to regular disturbance (e.g. sediment abrasion and disturbance) as anchor chains sweep across the seabed with changes in tides and currents, impacting epifaunal benthic species. The variation seeks to increase the maximum design scenario for mooring spread for a single device from 150 m^2 to 22,500 m^2.

In consideration of the proposed variation at Warrior Way, the baseline information summarised in Section 4.3, and the potential impact on the subtidal environment, the following subtidal Valued Ecological Receptors (VERs) (and their representative habitats/biotopes) are screened in for assessment under this consent variation:

- Annex I ‘Estuaries’; and
- Annex I ‘Large shallow inlets and bays’.

(Refer to Table 7.7 of META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019 for full list and details on VER groupings).

At present, additional subtidal VERs such as Annex I subtidal ‘Reef’ or ‘Seagrass beds’ have not been screened in for assessment as they have not been predicted to be present within the consent boundary of Warrior Way. To note, under the marine licence condition ORML1957v1 3.28 (NRW, 2021), targeted pre-deployment benthic surveys will seek to confirm the presence or absence of these features (and other features of conservation importance) to enable effective micro-siting of devices and their associated mooring systems.

The proposed increase in mooring spread for a single device to 22,500 m^2, alters the spatial spread at the Warrior Way Site from 0.00015 km^2 to 0.0225 km^2, which still results in only a small area of the consented boundary being impacted (24%, of the total area of 0.093 km^2). The increase in mooring spread would remain within the consented boundary, and only extend to a small area of the original META ES (RPS, 2019). The maximum potential area impacted at any one time whilst a device is being trialled remains limited in consideration of the wider consented area, and the VER habitat extents within the Milford Haven waterway and the wider Pembrokeshire Marine SAC. Furthermore, as devices are unlikely to be placed within the same footprint each time, this allows some period of recovery to occur during the O&M period.

Annex I 'Estuaries'

This VER is an extensive feature within the Pembrokeshire Marine SAC (60.19 km^2), and encompasses the entirety of the Milford Haven Waterway, from its mouth to its upper reaches. Its relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/ OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive, both within the consent boundary of Warrior Roads, and within Milford Haven itself (Lle Geo-Portal, 2022a;2022b). The impact of the proposed variation at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility. The magnitude is therefore considered to be minor.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Estuaries' VER is deemed to be of medium vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.29; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

Annex I 'Large shallow inlets and bays'

This VER is an extensive feature within the Pembrokeshire Marine SAC (203.85 km^2), and encompasses the entirety of the Milford Haven Waterway and St Brides Bay. Its relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/ OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive both within the consent boundary of Warrior Roads and within Milford Haven itself (Lle Geo-Portal, 2022a;2022b). The impact of the proposed variation at Warrior Way, for all the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility. The magnitude is therefore considered to be minor.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Large shallow inlets and bays' VER is deemed to be of medium vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.30; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.1.2. Site 7 – Dale Roads

The most likely design scenario for Dale Roads is represented by a single floating device deployment at any one time, and up to 2 device deployments in a 12-month period over the 15 year project lifetime. The removal and replacement of each device inside the consent boundary of Dales Roads is not expected to occur within the same footprint each time.

Temporary habitat disturbance that may affect benthic ecology during the O&M phase, will arise from the single mooring spread around the deployed device, with the precautionary approach for a worst-case scenario that the whole area within the mooring spread will be impacted. These areas have the potential to be subject to regular disturbance (e.g. sediment disturbance and scouring) as anchor chains sweep across the seabed with changes in tides and currents, which may impact epifaunal benthic species. The variation seeks to increase the maximum design scenario for mooring spread for a single device to 40,000 m^2.

In consideration of the proposed variation at Dale Roads, the baseline information summarised in Section 4.3, and the potential impact on the subtidal environment, only the following subtidal VERs (and their representative habitats/biotopes) are screened in for assessment of temporary habitat disturbance (O&M) under this consent variation:

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets and bays'.

(Refer to Table 7.7 of the original META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019 for full list and details on VER groupings).

At present, additional VERs such as Annex I 'Reef' or 'Seagrass beds' have not been screened in for assessment, as they have not been predicted to be present within the consent boundary of Dale Roads. To note, under the marine licence condition ORML1957v1, targeted pre-deployment benthic surveys will seek to confirm the presence or absence of this feature (and other features of conservation importance) to enable effective micro-siting of devices and their associated mooring systems.

The proposed increase in mooring spread for a single device to 40,000 m^2, alters the spatial spread at the Dale Roads Site from 0.0002 km^2 to 0.04 km^2, but still results in only a small area within the overall consented boundary (21%, of the total area of 0.196 km^2). The increase in mooring spread would remain within the consented boundary, and only extend to a small area of the test site at any one time. Whilst this area is greater than that originally applied for within the META ES (RPS, 2019), the maximum potential area impacted at any one time whilst a device is being trialled remains limited in consideration of the wider consented area, and the VER habitat extents within the Milford Haven waterway and the wider Pembrokeshire SAC. Furthermore, as devices are unlikely to be placed within the same footprint each time, this allows some period of recovery to occur during the O&M period.

Annex I 'Estuaries'

This VER is an extensive feature within the Pembrokeshire Marine SAC (60.19 km^2), and encompasses the entirety of the Milford Haven Waterway, from its mouth to its upper reaches. Its

relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/ OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive both within the consent boundary of Dale Roads and within Milford Haven itself (Lle Geo-Portal, 2022a;2022b). The impact of the proposed variation at Dale Roads, for all the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility. The magnitude is therefore considered to be minor.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Estuaries' VER is deemed to be of medium vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.29; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

Annex I 'Large shallow inlets and bays'

This VER is an extensive feature within the Pembrokeshire Marine SAC (203.85 km^2), and encompasses the entirety of the Milford Haven Waterway and St Brides Bay. Its relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/ OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive both within the consent boundary of Dale Roads and within Milford Haven itself (Lle Geo-Portal, 2022a; 2022b). The impact of the proposed variation at Dale Roads, for all the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility. The magnitude is therefore considered to be minor.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Large shallow inlets and bays' VER is deemed to be of medium vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.30; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.1.3. All META Test Sites

The most likely design scenario for all 3 META Test Sites, is represented by a single floating device deployment at any one time at Warrior Way and Dale Roads, and 2 device deployments at East Pickard Bay, with the maximum (worst case) being that there will be up to 150 device deployments (installation events) occurring intermittently across all 3 META test sites over the 15 year project lifetime.

The proposed variation in mooring spread for the O&M phase at Warrior Way (Site 6) and Dale Roads (Site 7) should also be taken into consideration in combination, and alongside the mooring spread at East Pickard Bay (Site 8) (as currently licensed under ORML1957v1). The proposed increase in maximum design scenario in mooring spread at Warrior Way (to 22,500 m^2) and Dale Roads (to 40,000 m^2), combined with the currently consented mooring spread at East Pickard Bay (500,000 m^2), is 562,500 m^2 (0.56 km^2); a small increase from the originally consented 0.50 km^2.

This total value of 0.56 km^2 remains assessed as occurring across a small scale in relation to the available habitat and extent of VER features. The increase in mooring spread at Warrior Way and Dale Roads will not impact the VER 'circalittoral coarse sediment' that is only present and assessed for East Pickard Bay, where the majority of the total combined temporary disturbance is predicted to occur, and has already been assessed under META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (RPS, 2019). Furthermore, this total maximum (worst-case) design scenario of 0.56 km^2 of habitat disturbance is assumed to occur only if there is disturbance occurring across the whole area under the footprint of the mooring spread, which is a precautionary value over the most likely design scenario.

The impact of the combined effects of the proposed variation for mooring spread at Warrior Way and Dale Roads, with the consented values for East Pickard Way, for temporary habitat disturbance is predicted to be of local spatial extent, long-term duration, intermittent with high reversibility. The magnitude is therefore considered to be minor.

As assessed in Section 5.5.1.1 and Section 5.5.1.2 above, the VERs Annex I 'Estuaries' and Annex I 'Large shallow inlets and bays' that both overlap Warrior Way and Dale Roads, are of very high value. The VER 'Circalittoral coarse sediment' at East Pickard Bay is of medium value. As a precautionary assessment., the combined subtidal benthic VER receptors are deemed to be of medium vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.28 – 7.11.2.31; RPS 2019). The sensitivity of these VERs combined are therefore, considered to be low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.2. Temporary Increases in Suspended Sediment Concentrations and Deposition

As presented above for both Warrior Way (Section 5.5.1.1) and Dale Roads (Section 5.5.1.2), the proposed variation in increase in mooring spread at the 2 sites was assessed for temporary habitat disturbance during the O&M phase of the project. In the original META ES (Chapter 7: Subtidal and Intertidal Ecology; RPS, 2019), temporary increases in SSC and associated sediment deposition had been assessed following sediment disturbance arising from the installation and decommissioning phases (e.g. gravity base installations and drilling pin piles at Dale Roads). It is deemed precautionary to also consider potential increases in suspended sediment concentrations and deposition during the O&M phase that could occur from the movement of catenary chains across the sediment surface, that may re-suspended fines into the water. An increase in SSC in the water column and associated sediment deposition can impact benthic ecology by increasing water turbidity and smothering sessile species, potentially affecting functioning such as feeding capabilities of filter and suspension feeders.

5.5.2.1. Site 6 – Warrior Way

See Section 5.5.1 above for a description of the most likely design scenario and the proposed variation increase in mooring spread at Warrior Way.

As assessed for Warrior Way in the original META ES Chapter 7: Subtidal and Intertidal Ecology (Paragraph 7.11.1.27) (RPS, 2019), during the installation phase, all but the finest materials (silts and clays etc.) are expected to settle relatively quickly following disturbance, with the plume itself having

SSC of <40 mg/l, travel up to 100 m from the site, and settle within 2 hours. These levels are within the range of reported levels for Milford Haven Waterway. The magnitude of the indirect impact of temporary increases in SSC and associated sediment deposition on benthic ecology was predicted to be of local spatial extent, short-term duration, intermittent and reversible and therefore considered to be negligible (see META ES, Chapter 7: Subtidal and Intertidal Ecology, paragraph 7.11.1.31; RPS, 2019).

This assessment had been based on the disturbance of the sediments during installation activities. The disturbance of the seabed during O&M, under the footprint of the mooring chains making contact with the seabed surface, is expected to be of less severity than that which would occur during the installation phase, but be of a longer duration (e.g. the Project lifetime). As such, the magnitude for potential increases in SSC and associated sediment deposition arising during the O&M phase from the mooring spread is still predicted to occur across a localised spatial extent, but be of long-term duration, and be intermittent and reversible and, therefore, is considered to be minor.

In consideration of the proposed variation at Warrior Way, the baseline information summarised in Section 4.3, and the potential impact on the subtidal environment, the following subtidal VERs (and their representative habitats/biotopes) are screened in for assessment under this consent variation.

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets and bays';
- Annex I (subtidal) 'Reefs'.

(Refer to Table 7.7 of META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019 for full list and details on VER groupings).

These 3 VERs are either predicted to directly overlap the Warrior Way consent boundary, or potentially overlap the maximum extent of the plume that can occur outside of the boundary (600 m, as based on worst-case assessment during the installation phase at Dale Roads, see Section 5.5.2.2 below).

All 3 VERs are of high value as they are Annex I protected habitats and qualifying features of the Pembrokeshire Marine SAC, where they are all extensive in their range. In accordance with the assessment undertaken in the original META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (Paragraphs 7.11.1.34-7.11.1.40) (RPS, 2019) for Annex I 'Estuaries' and Annex I 'Large shallow inlets and bays', they are both assessed to be of medium vulnerability, high recoverability and very high value, and as such their sensitivities are, therefore, considered to be low.

In respect to Annex I 'Reefs', as assessed in Paragraphs 7.11.1.40-7.11.1.43 (RPS, 2019), they are assessed to be of medium to high vulnerability, medium to high recoverability and very high value, and thus the sensitivity of this VER is considered to be low. This assessment had been undertaken in the META ES for East Pickard Bay (Site 8), but is deemed appropriate and valid for the sensitivity assessment for shallow subtidal 'Reef' habitat identified in the vicinity of the consent boundary at Warrior Way. EMODnet had indicated that the communities associated with these areas of rocky reef are representative of the biotope 'cushion sponges, hydroids and ascidians on turbid tide-swept sheltered circalittoral rock' (CR.MCR.CfaVS.CuSpH). The Marine Evidence Based Sensitivity assessment (MarESA) available for its parent biotope CR.MCR.CfaVS ('Circalittoral faunal

communities in variable salinity') reports these communities are comprised of a diverse range of sponges, hydroids and ascidians that are often silt-tolerant. They are assessed to not be sensitive to any change in suspended solids (water clarity), where they have a high resistance and resilience to this pressure. If any associated increases in deposition of sediment arise during the O&M phase, it is predicted to be light, and this biotope has a low sensitivity to this pressure where it has medium resistance and high resilience to any change in smothering and siltation rate (Readman, 2016).

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.2.2. Site 7 – Dale Roads

See Section 5.5.1 above for a description of the most likely design scenario, and the proposed variation increase in mooring spread at Dale Roads.

As assessed for Dale Roads in META ES, Chapter 7: Subtidal and Intertidal Ecology (Paragraph 7.11.1.28) (RPS, 2019), during the installation phase the finest materials (silts and clays etc.) are expected to travel <600 m from the source, with increases in SSC of <50 mg/l which is within range of that experienced under storm conditions. The magnitude of the indirect impact of temporary increases in SSC and associated sediment deposition on benthic ecology was predicted to be of local spatial extent, short-term duration, intermittent and reversible and therefore considered to be negligible (see paragraph 7.11.1.31; RPS, 2019).

This assessment had been based on the disturbance of the sediments during installation activities. The disturbance of the seabed during O&M under the footprint of the mooring chains making contact with the seabed surface, is expected to be of less severity than that which would occur during the installation phase, but be of a longer duration (e.g. the Project lifetime). As such, the magnitude for potential increases in SSC and associated sediment deposition arising during the O&M phase from the mooring spread is predicted to occur across a localised spatial extent, but be of a long-term duration, and be intermittent and reversible and, therefore, is considered to remain as minor.

In consideration of the proposed variation at Dale Roads, the baseline information summarised in Section 4.3, and the potential impact on the subtidal environment, the following subtidal VERs (and their representative habitats/biotopes) are screened in for assessment under this consent variation.

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets and bays';
- Annex I (subtidal) 'Reefs'.

(Refer to Table 7.7 of META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (RPS, 2019) for full list and details on VER groupings).

These 3 VERs are either predicted to directly overlap the Dale Roads consent boundary, or potentially overlap the maximum extent of the plume that can occur outside of the boundary (600 m, as based on worst-case assessment during the installation phase for Dale Roads). There is poor confidence in the predicated occurrence of Annex I subtidal 'Reef' within the consent boundary of Dale Roads itself (see Section 4.3**Error! Reference source not found.** above), and the pre-deployment benthic surveys will seek to confirm the presence or absence of this feature. However,

there are records of Annex I 'Reef' representative biotopes in the vicinity of Dale Roads (Lle Geo-Portal, 2022a) and, as such, on a precautionary basis, the potential impacts from increases in SSC and associated sedimentation will be assessed here for Annex I subtidal 'Reefs'.

All 3 VERs are of high value as they are Annex I protected habitats and qualifying features of the Pembrokeshire Marine SAC, where they are all extensive in their range. In accordance with the assessment undertaken in the META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (Paragraphs 7.11.1.34-7.11.1.40) (RPS, 2019) for Annex I 'Estuaries' and 'Annex I Large shallow inlets and bays', they are both assessed to be of medium vulnerability, high recoverability and very high value and, as such, their sensitivities are, therefore, considered to be low.

In respect to Annex I subtidal 'Reefs', as assessed in Paragraphs 7.11.1.40-7.11.1.43 (RPS, 2019), they are assessed to be of medium to high vulnerability, medium to high recoverability and very high value, and thus the sensitivity of this VER is considered to be low. This assessment had been undertaken in the ES for East Pickard Bay (Site 8), but is deemed appropriate and valid for the sensitivity assessment for shallow subtidal 'Reef' habitat that potentially is present in the vicinity of the consent boundary at Dale Roads. Lle Geo-Portal (2022a) reports records of the biotope CR.MCR.CFaVs.CuSpH.As ('Cushion sponges, hydroids and ascidians on turbid tide-swept sheltered circalittoral rock') present in the western vicinity of Dale Roads. The MarESA assessment for its parent biotope (Readman, 2016) assesses its sensitivity to increases in turbidity and light smothering and siltation to be low, overall (see Section 5.5.2.1 above for Warrior Way). Therefore, it is assessed that the sensitivity of the VER Receptor to any increases in SSC and sediment deposition, arising from disturbance of the seabed from moorings during O&M for Annex I subtidal 'Reefs' is low.

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.2.3. All META Test Sites

As described above, and subsequently assessed in Section 5.5.1.3, the proposed variation in mooring spread for the O&M phase at Warrior Way (Site 6) and Dale Roads (Site 7) should also be taken into consideration, in combination, and alongside the mooring spread at East Pickard Bay (Site 8) (as currently licensed under ORML1957v1). The proposed increase in maximum design scenario in mooring spread at Warrior Way and Dale Roads, combined with the currently consented mooring spread at East Pickard Bay, is 0.56 km^2, and is only a small increase from the originally consented 0.50 km^2.

While at East Pickard Bay, outside of the Milford Haven Waterway, there is less potential for suspended sediment to reach long distances (predicted to be 50 m), due to its lower fines content compared to Warrior Way and Dale Roads, it is at this site where the greatest area of sediment disturbance during O&M may occur under the swept areas of the moorings (89% of the total area may be impacted under a maximum (worst-case) design scenario). The magnitude of impact combined from any localised increases in SSC and associated sediment deposition, occurring simultaneously across all 3 META sites through the lifetime of the Project, and any potential increases arising through this proposed consent variation at Warrior Way and Dale Roads, is also assessed as negligible (as assessed for the construction phase, in the original META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (Paragraphs 7.11.1.31) (RPS, 2019). Furthermore, this total maximum (worst-case) design scenario of 0.56 km^2 of habitat disturbance is assumed to occur only if

there is disturbance occurring across the whole area under the footprint of the mooring spread, which is a precautionary value over the most likely design scenario.

The sensitivity of the 4 VERs likely to overlap, or be in the vicinity of the 3 site consent boundaries (Annex I 'Estuaries' and Annex I 'Large tidal inlets and bays (Warrior Way and Dale Roads); 'Circalittoral coarse sediment' (East Pickard Bay); and Annex I 'Reefs' (all 3 META Sites) are collectively assessed negligible-minor (see META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology (Paragraphs 7.11.1.38-7.11.40 and 7.11.1.44); RPS, 2019).

The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.5.3. Alteration of Benthic Habitats Resulting from Changes to the Hydrodynamic Regime

5.5.3.1. Site 6 – Warrior Way

The most likely design scenario for Warrior Way is represented by a single floating device deployment at any one time, with the maximum (worst case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. The removal and replacement of each device inside the consent boundary of Warrior Way, is not expected to occur within the same footprint each time.

During the O&M phase, the operation of tidal current devices which use impellor or turbine technology to extract kinetic energy from the tidal flow, may result in changes in hydrodynamic regime, that in turn may affect benthic ecology. Changes in hydrodynamic regime can include alteration to flow conditions, waves regime and sediment transport pathways, which may lead to changes in sediment type and structure, and thus the supported benthic assemblages of these altered habitats. Warrior Way is the only META Site where scaled and micro-scaled tidal devices may be deployed on a short-term basis for this Project. The variation seeks to increase the maximum design scenario for the speed of moving parts of these devices from ≤5 m/s to ≤10 m/s, and increase the rotor swept area to allow for up to 3 rotors; resulting in an increase in total rotor swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors).

In consideration of the proposed variation at Warrior Way, the baseline information summarised in Section 4.3, and the potential impact on the subtidal environment, the following subtidal VERs (and their representative habitats/biotopes) are screened in for assessment under this consent variation:

- Annex I 'Estuaries';
- Annex I 'Large shallow inlets and bays'.

(Refer to Table 7.7 of META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019 for full list and details on VER groupings).

At present, additional subtidal VERs such as Annex I subtidal 'Reef' or 'Seagrass beds' have not been screened in for assessment as they have not been predicted to be present within the consent boundary of Warrior Way. To note, under the marine licence, reference ORML1957v1; condition 3.28 (NRW, 2021), targeted pre-deployment benthic surveys will seek to confirm the presence or

absence of these features (and other features of conservation importance) to enable effective micro-siting of these devices.

The proposed increase in the speed of moving parts to ≤10.5 m/s, and an increase in rotor swept area to 58.89 m^2 (for 3 rotors) for a single device deployment at Warrior Way (at any one time), is unlikely to be a significant change which will result in an alteration of the local hydrodynamic regime, and thus any potential impacts on benthic habitats and their supported communities. As discussed in the original META ES Chapter 5: Coastal Processes (RPS, 2019), even a limited number of full scale tidal current devices will have a marginal influence on tidal flows. This proposed design variation (speed of moving parts and rotor swept area) is still within the limits of the design capabilities for these scaled and micro-scaled devices, and thus the original assessment of magnitude of impact will remain the same as assessed overall for coastal processes (minor), and for each VER for benthic ecology (negligible) (see paragraph 5.9.2.29 - 5.9.2.32 in META ES, Chapter 5: Coastal Processes, and paragraph 7.11.2.53 – 7.11.2.55 in ORML1957v1, Chapter 7: Benthic Subtidal and Intertidal Ecology; RPS, 2019).

Annex I 'Estuaries'

This VER is an extensive feature within the Pembrokeshire Marine SAC (60.19 km^2), and encompasses the entirety of the Milford Haven Waterway, from its mouth to its upper reaches. Its relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive both within the consent boundary of Warrior Roads and within Milford Haven itself (Lle Geo-Portal, 2022a;2022b). The impact of the proposed variation in tidal device rotor design at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent (a single scaled/micro-scaled device at any one time), short-term duration, continuous (when device is in operation), but reversible. The magnitude is, therefore, considered to be negligible.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Estuaries' VER is deemed to be of low vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.58; RPS, 2019). The sensitivity of the receptor is, therefore, considered to be low.

The effect will, therefore, be of **negligible significance**, which is not significant in EIA terms.

Annex I 'Large shallow inlets and bays'

This VER is an extensive feature within the Pembrokeshire Marine SAC (203.85 km^2), and encompasses the entirety of the Milford Haven Waterway and St Brides Bay. Its relevant representative subtidal habitats (Annex I 'Tide Swept Channels'; and Section 7/OSPAR 'Estuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive both within the consent boundary of Warrior Roads and within Milford Haven itself (Lle Geo-Portal, 2022a;2022b). The impact of the proposed variation in tidal device rotor design at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent (a single scaled/micro-scaled device at any one time), short-term duration, continuous (when device is in operation), but reversible. The magnitude is therefore, considered to be negligible.

The value of this VER is determined to be very high as it is an Annex I protected habitat and a qualifying feature of the Pembrokeshire Marine SAC. The 'Large shallow inlets and bays' VER is deemed to be of low vulnerability, high recoverability and very high value (as presented in META ES, Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.11.2.30; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low.

The effect will, therefore, be of **negligible significance**, which is not significant in EIA terms.

5.5.3.2. Site 7 – Dale Roads

There are no proposed design variations in the speed of moving parts, or rotor swept area for devices installed at Dale Roads, that would result in alterations to the parameters that the original META ES (RPS, 2019) was based upon. As such, no further assessment for Dale Roads is required under this potential impact.

5.5.3.3. All META Test Sites

The variation in change in design (rotor number and speed) has only been proposed for Warrior Way, and it is only at this site where scaled and micro-scaled tidal devices may be deployed. As such, there is no requirement to assess any combined impacts from all 3 META Test Sites under this consent variation, for any alteration of benthic habitats from changes in hydrodynamic regimes.

5.6. Fish and Shellfish Ecology

5.6.1. Colonisation of Hard Structures

Proposed variations to the PDE likely to alter the conclusions of the original META ES (RPS, 2019) in relation to the colonisation of hard structures, are only relevant to Warrior Way. The relevant variation relates to an increase in the number of rotors from 1 to 3, with an associated increase in the total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors).

As stated in the original META ES, Chapter 8: Fish and Shellfish (RPS, 2019), the marine renewable device is likely to have an EU compliant marine biofoulant applied to prevent the colonisation of the structure. However, supporting and ancillary structures including chains, anchors and gravity bases will not be coated in biofoulant. These structures may have the potential to increase fish and shellfish recruitment through the provision of a substrate suitable for egg laying, or direct colonisation.

This variation is seeking no change to the proposed size of the gravity base, and the increase from 1 to 3 rotors will not support the colonisation of fish and shellfish receptors due to the use of biofoulant. Whilst there is the potential for an increase in the length of anchor chain as a result of the increase in mooring spread at both sites, this additional length will lie primarily on the seabed. The abrasive action of the chain on the seabed through tidal and current driven movement is unlikely to allow colonisation by fish and shellfish receptors in the form of eggs and larvae. Therefore, the potential impact of colonisation of hard structures from operation and maintenance activities remains the same as assessed within the original META ES, Chapter 8: Fish and Shellfish (RPS, 2019). Impacts are predicted to be of local spatial extent, short term duration, and to be both

intermittent and reversible. The magnitude of impact is therefore considered to be negligible (adverse/beneficial). The significance of effect is presented under specific receptor groups.

5.6.1.1. Estuarine Fish Assemblage

The sensitivity of the receptor is considered to be medium (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse/beneficial). The effect will therefore be of **negligible significance,** which is not significant in EIA terms.

5.6.1.2. Migratory Fish Species

The sensitivity of the receptor is considered to be medium (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse/beneficial). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.1.3. Spawning or Nursery Grounds

Spawning or nursery grounds are determined to be of low vulnerability, high recoverability and of low-high value. The sensitivity of the receptor is therefore considered to be negligible (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse/beneficial). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.1.4. Estuarine Shellfish Assemblage

Estuarine shellfish assemblages are determined to be of low vulnerability, high recoverability and of low-high value. Therefore, the sensitivity of the receptor is considered to be negligible (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse/beneficial). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.1.5. Designated Shellfish Waters

Designated shellfish waters are determined to be of low vulnerability, high recoverability and of high value. Therefore, the sensitivity of the receptor is considered to be negligible (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse/beneficial). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.1.6. Shellfish Spawning or Nursery Grounds

Shellfish spawning or nursey grounds are determined to be of low vulnerability, high recoverability and of low value. Therefore, the sensitivity of the receptor is considered to be of medium to negligible sensitivity (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019). The effect will, therefore, be of **negligible significance**, which is not significant in EIA terms.

5.6.2. Medium-term Habitat Loss

Proposed variations to the PDE likely to alter the conclusions of the original META ES (RPS, 2019) in relation to medium term habitat loss are proposed for both the Warrior Way and Dale Roads site. The variations relevant to potential medium term habitat loss are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads. These areas have the potential to undergo regular disturbance as anchor chains move across the seabed with changes in tides and currents.

The original META ES (Chapter 8: Fish and Shellfish; RPS, 2019) did not assess the impact of mooring spread on medium term habitat loss for fish and shellfish receptors; however, given the increase in area, this has been scoped in and assessed below. The area of seabed occupied by the footprint of the device (200 m^2 at Warrior Way, and 600 m^2 at Dale Roads) remains unchanged from the original ES (META ES, Chapter 8: Fish and Shellfish; RPS, 2019).

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, this area is small when considering the wider available habitat and constitutes no more than a quarter of each site's consented boundary. Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. The maximum testing scenario at Warrior Way is up to one testing activity occurring at any time within the test area. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst-case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime. The maximum testing scenario at Dale Roads is up to one testing activity occurring at any time within the test area.

The potential impact of medium-term habitat loss from operation and maintenance activities is therefore predicted to be of local spatial extent, long-term duration but intermittent and reversible at both Warrior Way and Dale Roads. The magnitude of impact is therefore considered to be minor (adverse). The significance of effect is presented under specific receptor groups.

5.6.2.1. Estuarine Fish Assemblage

Estuarine fish assemblages are determined to be of low vulnerability, high recoverability and of medium value. Therefore, the sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be minor (adverse). The effect will therefore be of **minor (adverse) significance**, which is not significant in EIA terms.

5.6.2.2. Migratory Fish Species

Migratory fish species are determined to be of low vulnerability, high recoverability and of high-very high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be

minor (adverse). The effect will therefore be of **minor (adverse) significance**, which is not significant in EIA terms.

5.6.2.3. Spawning or Nursery Grounds

Spawning or nursery grounds are determined to be of medium vulnerability, high recoverability and of low-high value. Therefore, the sensitivity of the receptor is considered to be low to medium (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be minor (adverse). The effect will therefore be of **minor (adverse) significance**, which is not significant in EIA terms.

5.6.2.4. Estuarine Shellfish Assemblage

Estuarine shellfish assemblages are determined to be of low vulnerability, high recoverability and of low-high value. Therefore, the sensitivity of the receptor is considered to be medium (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be minor (adverse). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.2.5. Designated Shellfish Waters

Designated shellfish waters are determined to be of low vulnerability, high recoverability and of high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be minor (adverse). The effect will therefore be of **negligible significance**, which is not significant in EIA terms.

5.6.2.6. Shellfish Spawning or Nursery Grounds

Shellfish spawning or nursery grounds are determined to be of low vulnerability, high recoverability and of low value. Therefore, the sensitivity of the receptor is considered to be negligible (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be minor (adverse). The effect will therefore be of **minor (adverse) significance**, which is not significant in EIA terms.

5.6.3. Tidal Turbine Collision Risk at Warrior Way

Design changes with the potential to alter results of the original assessment, in relation to the risk of collision with tidal turbines are proposed for the Warrior Way site only. The assessment of this impact on fish and shellfish for the Dale Roads site therefore remains the same as in the original assessment (as presented within META ES, Chapter 8: Fish and Shellfish; RPS, 2019).

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation relevant to tidal turbine collision risk are limited to an increase in the number of rotors from 1 rotor to 3 rotors; an increase in total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2(for 3 rotors); and an increase in the speed of moving parts from ≤ 5 m/s to ≤ 10.5 m/s. As benthic species, shellfish were not considered within the original assessment due to the rotors being located within the water column. They are therefore considered to be unaffected by the changes applied for in this variation.

The width of the Cleddau river at the location of Warrior Way is 330 m from MLWS to MLWS. The diameter of a single rotor is 5 m (as consented under ORML1957v1; NRW, 2021; PCC, 2021) and this variation seeks to increase the number of rotors to 3, where the total cross-sectional width of 3 turbines side by side equals 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. The maximum duration of scaled tidal device testing at Warrior Way is a single device for a maximum period of up to 6 months. Any collision risk is therefore restricted to a small area of the total available river width, and for a short, intermittent, period of time, although noting that testing is consented for up to 15 years.

For the purpose of the assessment conducted in the original META ES (RPS, 2019), it was assumed that fish were evenly distributed across the width of the river. With a tip speed of 10 m/s (0.5 m/s slower than that proposed within this variation) the survival rate of fish within the presence of the turbine has been recorded at 100% for a range of species, with no recorded injuries or deaths (Zhang *et al*., 2016). The magnitude of this impact is therefore considered to be of local spatial extent, short/medium term duration, and to be intermittent and reversible. The magnitude is therefore considered to be negligible. The significance of effect is presented under specific receptor groups.

5.6.3.1. Estuarine Fish Assemblage

Estuarine fish assemblages are determined to be of low vulnerability, high recoverability and of medium value. Therefore, the sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.6.3.2. Migratory Fish Assemblage

Migratory fish assemblages are determined to be of low vulnerability, high recoverability and of high-very high value. Therefore, the sensitivity of the receptor is considered to be medium (as assessed within META ES, Chapter 8: Fish and Shellfish (RPS, 2019) and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.6.3.3. Spawning or Nursery Grounds

Spawning or nursery grounds are determined to be of low vulnerability, high recoverability and of high-very high value The sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.6.4. Physical Barrier to Known Migratory Routes due to Presence of Tidal Devices at Warrior Way

Design changes with the potential to alter results of the original assessment in relation to the potential physical barrier effects on migratory fish species are proposed for the Warrior Way site only. The assessment of this impact on fish and shellfish for the Dale Roads site therefore remains

the same as in the original assessment (as presented within META ES, Chapter 8: Fish and Shellfish; RPS, 2019).

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation, relevant to the physical barrier of known migratory routes, are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s, and an increase in the total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). The presence of the turbine has the potential to cause a barrier to the movement of migratory fish and prevent them from reaching breeding/feeding grounds. As benthic species, shellfish are not considered within this assessment due to the rotors being located within the water column. They are therefore considered to be unaffected by the changes applied for in this variation.

The width of the Cleddau river at the location of Warrior Way is 330 m from MLWS to MLWS. The diameter of a single rotor is 5 m (as consented under ORML1957v1; NRW, 2021; PCC, 2021) and this variation seeks to increase the number of rotors to 3, where the total cross-sectional width of 3 turbines side by side equals 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. With a tip speed of 10 m/s (0.5 m/s slower than that proposed within this variation) the survival rate of fish within the presence of the turbine has been recorded at 100% for a range of species, with no recorded injuries or deaths (Zhang *et al*., 2016). The maximum duration of scaled tidal device testing at Warrior Way is a single device for a maximum period of up to 6 months. Any barrier effects are therefore likely to be restricted to a small area of the total available migratory route, and for a short period of time, although noting that testing is consented for up to 15 years.

The magnitude of this impact is therefore considered to be of local spatial extent, short/medium term duration, and to be intermittent and reversible. The magnitude is therefore considered to be negligible. The significance of effect is presented under specific receptor groups.

5.6.4.1. Estuarine Fish Assemblage

Estuarine fish assemblages are determined to be of low vulnerability, high recoverability and of high-very high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.6.4.2. Migratory Fish Assemblage

Migratory fish assemblages are determined to be of low vulnerability, high recoverability and of high-very high value. Therefore, the sensitivity of the receptor is considered to be medium (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.6.4.3. Spawning or Nursery Grounds

The sensitivity of the receptor is considered to be negligible (as assessed within META ES, Chapter 8: Fish and Shellfish; RPS, 2019), and the magnitude of the impact is deemed to be negligible (adverse). The effect will therefore be of **negligible (adverse) significance**, which is not significant in EIA terms.

5.6.5. Increased Anthropogenic Underwater Noise – Operation of Tidal Turbines

Underwater noise was scoped out of the original META ES, Chapter 8: Fish and Shellfish; RPS, 2019. Following a reassessment of underwater noise in Section 5.4: Underwater Noise, it is determined that the changes proposed within this variation are not likely to result in an increase in levels of underwater noise. The impacts of underwater noise are therefore determined not to result in significant injury or disturbance effects on fish and shellfish receptors and the conclusions presented in the original META ES (RPS, 2019) have not been revisited.

5.7. Marine Mammals, Basking Shark and Otter

5.7.1. Increased Anthropogenic Underwater Noise – Operation of Tidal Turbines

Following a reassessment of underwater noise in Section 5.4: Underwater Noise, it is determined that the changes proposed within this variation are not likely to result in an increase in levels of underwater noise. The impact assessments of increased anthropogenic underwater noise on marine mammals, basking shark and otter have, therefore, not changed from those presented in the original META ES (Chapter 9: Marine Mammals, Basking Shark and Otter; RPS, 2019) and are not considered further.

5.7.2. Collision Risk – Tidal Turbines

Design changes that have the potential to alter the results of the original assessment in relation to collision risk with tidal turbines of marine mammals, basking shark, and otter are proposed only for the Warrior Way site. As such, the assessment of this impact at the Dale Roads site remains unchanged from the original assessment (as presented in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019).

The changes proposed in this variation relevant to collision risk with tidal turbines are an increase from the number of rotors from 1 rotor to 3 rotors and an increase in the speed of moving parts from ≤5 m/s to ≤10 m/s.

At the Warrior Way site, the width of the Cleddau river is 330 m from MLWS to MLWS. The rotor diameter for each rotor is 5 m, equating to 15 m across the 3 rotors. The total swept area will increase from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). This equates to 4.55% of the tidal stream cross-sectional area at this location. The maximum duration of scaled tidal device testing at Warrior Way is 6 months.

As stated within the original ES (RPS, 2019), it is highly likely that animals within the waterway are adjusted to high traffic levels and are practised at avoiding these obstacles. Furthermore, it is predicted few cetaceans and basking shark passage down the Waterway as far as Warrior Way, and grey seal are only found in proximity to the site in low abundances (based on sightings data). Whilst

otters are found throughout the Waterway it is highly likely they would exhibit avoidance behaviours and prefer shallower depths (Kruuk and Moorhouse, 1991). The magnitude of this impact is considered to be of local spatial extent, long-term duration, intermittent and reversible (irreversible in the case of otters). The magnitude is, therefore, considered to be minor (adverse). The significance of effect is presented under specific receptor groups.

5.7.2.1. Cetaceans

The receptor is deemed not vulnerable to impacts regardless of value/importance, excluding harbour porpoise *Phocoena phocoena*, which is deemed to be of medium vulnerability, low recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be negligible to medium (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **negligible to minor (adverse) significance**, which is not significant in EIA terms.

5.7.2.2. Grey Seal

The receptor is of medium vulnerability, low recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be medium (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.2.3. Basking Shark

The receptor is deemed not vulnerable to impacts regardless of value/importance. Therefore, the sensitivity of the receptor is considered to be negligible (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **negligible significance**, which is not significant in EIA terms.

5.7.2.4. Otter

The receptor is deemed to be of medium vulnerability, low recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be medium (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.3. Changes in Hydrodynamic Regime

Design changes that have the potential to alter the results of the original assessment in relation to changes in hydrodynamic regime are only proposed for the Warrior Way site. As such, the assessment of this impact at the Dale Roads site remains unchanged from the original assessment (as presented in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The changes proposed in this variation relevant to changes in hydrodynamic regime are an increase in the number of rotors from 1 rotor to 3 rotors and an increase in the speed of moving parts from ≤5 m/s to ≤10 m/s.

At the Warrior Way site, the width of the Cleddau river is 330 m from MLWS to MLWS. The rotor diameter for each rotor is 5 m, equating to 15 m across the 3 rotors increasing the total swept area

from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). This equates to 4.55% of the tidal stream cross-sectional area at this location. Following principles described within Shannon (2011), the proposed device can be shown to result in the potential reduction in energy across the channel of <2.02%. The original assessment determined that in the immediate area of the turbines, current speed was reduced by 2%, which is equivalent to 0.035 m/s at peak current speeds. Combined with the results of the Strangford Lough study (Marine Current Turbines, 2005, Chapter 5: Coastal Processes) which suggest that the wake is unlikely to cover an area greater than 1.5 times the diameter of the turbines, data suggest there would be minimal flow disruption within the Warrior Way site.

There is a potential absence of receptor-impact pathway as harbour porpoise are unlikely to passage into the Waterway as far as the Warrior Way site, suggested by sightings data (META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). Otters are also unlikely to be found in locality of the turbines as they prefer shallow water depths of 0-3 m for foraging (Kruuk and Moorhouse, 1991). Additionally, as stated within the original assessment, it is highly likely that animals in the area are adjusted to high traffic levels and are practised at avoiding obstacles within the Waterway. As such, animals are not expected to be found within such a distance of the turbines that they would be impacted by any changes to hydrodynamic regime.

The magnitude of this impact is considered to be of local spatial extent, long-term duration, intermittent and reversible (irreversible in the case of otters). The magnitude is therefore considered to be minor (adverse). The significance of effect is presented under specific receptor groups.

5.7.3.1. Cetaceans

The receptor is deemed to be of low vulnerability, high recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.3.2. Grey Seal

The receptor is deemed to be of low vulnerability, high recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.3.3. Otter

The receptor is deemed to be of low vulnerability, high recoverability and very high value. Therefore, the sensitivity of the receptor is considered to be low (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.4. Changes in Fish and Shellfish Communities

Design changes that have the potential to alter the results of the original assessment in relation to changes in fish and shellfish communities as prey of marine mammals, basking shark, and otter are

proposed for the Warrior Way site and the Dale Roads site. The potential impacts to the fish and shellfish community during the operation and maintenance phase of the project are assessed in META ES, Chapter 5: Fish and Shellfish Ecology (RPS, 2019), with changes in this variation being considered in Section 5.6. The impacts assessed include colonisation of hard structures, medium term habitat loss, tidal turbine collision risk, and a physical barrier effect to migratory routes.

As no significant adverse effects are predicted to occur to fish and shellfish for the impacts assessed for this variation, it can be concluded that magnitude of the impact on marine mammals is minor (adverse). The significance of effect is presented under specific receptor groups.

5.7.4.1. Cetaceans

The receptor is deemed to be of low vulnerability, high recoverability and high value (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). Therefore, the sensitivity of the receptor is considered to be low. The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.4.2. Grey Seal

The receptor is deemed to be of low vulnerability, high recoverability and high value (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). Therefore, the sensitivity of the receptor is considered to be low. The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.4.3. Basking Shark

The receptor is deemed to be of low vulnerability, high recoverability and high value (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). Therefore, the sensitivity of the receptor is considered to be low. The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.7.4.4. Otter

The receptor is deemed to be of low vulnerability, high recoverability and high value (as assessed in META ES, Chapter 9: Marine Mammals, Basking Shark, and Otter; RPS, 2019). Therefore, the sensitivity of the receptor is considered to be low. The effect will be of **minor (adverse) significance**, which is not significant in EIA terms.

5.8. Ornithology

5.8.1. Collision with Development

Design changes that have the potential to alter the results of the original assessment in relation to collision risk are proposed for the Warrior Way site only. As such, the assessment of this impact at the Dale Roads site remains unchanged from the original assessment (as presented in META ES, Chapter 10: Marine Ornithology; RPS, 2019).

The variations relevant to collision risk are an increase from the number of rotors from 1 rotor to 3 rotors and an increase in the speed of moving parts from ≤5 m/s to ≤10 m/s. At the Warrior Way

site, the width of the Cleddau river is 330 m from MLWS to MLWS. The rotor diameter for each rotor is 5 m, equating to 15 m across the 3 rotors. The total swept area will increase from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). This equates to 4.55% of the tidal stream cross-sectional area at this location. The maximum duration of scaled tidal device testing at Warrior Way is 6 months.

Previous correspondence with the Royal Society for the Protection of Birds (RSPB) and NRW highlighted a potential impact pathway on little grebe. The mitigation measure agreed to, of a minimum blade clearance of >2 m below the water surface at Warrior Way, is maintained and this variation does not seek to alter or amend this value. Thus, little grebe will not be assessed any further as there is no residual impact pathway. All species assessed as negligible (adverse) in the original assessment have been scoped out of further assessment.

Due to the project's small, localised scale, and proximity to suitable alternative habitat, the risk of bird collision with the development is unlikely. Many species are either pelagic surface feeders, or use short/shallow dives to catch their prey, reducing their risk of collision. Additionally, in proximity of the development, most species are present in very low numbers (between 0.08-6 animals per 3 km^2). Waders are present in nationally important numbers; however alternative suitable habitat is available to the east of the Warrior Way site, at Cosheston Pill, a site known to support significant numbers of waders. The potential impact for the proposed variation at Warrior Way is considered to be of long-term duration, intermittent and irreversible. The magnitude is therefore considered to be negligible (adverse). The significance of effect is presented under specific receptor groups.

5.8.1.1. Puffin

The receptor is considered high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance** which is not significant in EIA terms.

5.8.1.2. Guillemot

The receptor is considered high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.8.1.3. Razorbill

The receptor is considered very high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.8.1.4. Gannet

The receptor is considered high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.8.1.5. Kittiwake

The receptor is considered very high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.8.1.6. Waders

The receptor is considered high sensitivity (as assessed in META ES, Chapter 10: Marine Ornithology; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.9. Commercial Fisheries

The proposed design changes to the project that affect commercial fisheries occur at both the Warrior Way and Dale Roads sites and relate to the increase in mooring spread area (both sites) and an increase in the rotor swept area (Warrior Way site); details of which are provided in Table 3.2.

The text below outlines the environmental assessment for these parameters. All other parameters are unchanged, and the assessment is presented in the original META ES (Chapter 11: Commercial Fisheries; RPS, 2019).

5.9.1. Temporary Loss of Traditional Fishing Ground

Design changes with the potential to alter results of the original ES (RPS, 2019), in relation to the temporary loss of traditional fishing ground, are proposed for both the Warrior Way and Dale Roads sites.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021) however, in absolute terms, these areas are small when considering the available commercial fisheries resources in the upper Waterway, and constitute no more than a quarter of each site's consented boundary.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst-case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst-case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime.

This would have a minimal impact on commercial fisheries traditional fishing grounds, specifically noting that there is very limited fishing activity within both Warrior Way and Dale Roads, as outlined in Section **Error! Reference source not found.**. The impact of the proposed variation at both sites, is predicted to be of local spatial extent, long-term duration, intermittent with high reversibility. The magnitude is therefore considered to be negligible. The commercial fisheries receptors are deemed to be of low vulnerability, high recoverability, and high levels of alternative fishing grounds are

available. The sensitivity of the receptors is therefore, considered to be low. The effect will, therefore, be of **negligible** or **minor (adverse) significance**, which is not significant in EIA terms.

5.9.2. Damage to Fishing Equipment

Design changes with the potential to alter results of the original assessment, in relation to the damage to fishing equipment, are proposed for both the Warrior Way and Dale Roads sites. The changes proposed in this variation, relevant to potential damage to fishing equipment, are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads.

As conditioned in the Marine Licence (ORML1957v1; NRW, 2021), the test deployments will be demarked by up to four navigational marker buoys, and it is assumed that no fishing will be undertaken within these buoys. Therefore, the proposed variations for Warrior Way, to increase the number of rotors and the speed of the moving parts, will not be considered for this impact, as they would be located within the area demarked by the navigational marker buoys. The increased risk of gear/anchor snagging has been also assessed in Section 5.10.3, as part of the Shipping and Navigation assessment.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms these areas are small when considering the available commercial fisheries resources in the upper Waterway, and constitute no more than a quarter of each site's consented boundary.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime.

As described in the original META ES (Chapter 11: Commercial Fisheries; RPS, 2019), the receptor groups will be able to avoid any marine devices left for testing, due to the measures adopted as part of the project. As conditioned in the Marine Licence (ORML1957v1; NRW, 2021), the test deployments will be demarked by up to four navigational marker buoys and a Notice to Mariners will outline the location of any devices prior to deployment; this will enable fishing vessels to clearly identify where the devices are and avoid the risk of snagging.

The impact of the proposed variation at both sites, is predicted to be of local spatial extent, long-term duration, intermittent with high reversibility. The magnitude is therefore considered to be negligible. The commercial fisheries receptors are deemed to be of low vulnerability, high recoverability, and high levels of alternative fishing grounds are available. The sensitivity of the receptors is therefore, considered to be low. The effect will, therefore, be of **negligible** or **minor (adverse) significance**, which is not significant in EIA terms.

5.10. Shipping and Navigation

The proposed design changes to the project that affect shipping and navigation are limited to the Warrior Way and Dale Roads sites and relate to the increase in mooring spread area (both sites) and an increase in the rotor swept area (Warrior Way site); details of which are provided in Table 3.2.

The text below outlines the environmental assessment for these parameters. All other parameters are unchanged, and the assessment is presented in the original META ES (Chapter 12: Shipping and Navigation; RPS, 2019).

5.10.1. Physical Presence of Devices may Deviate Vessel Routes, Leading to a Loss of Navigable Space and Increased Risk of Grounding

The presence of tidal devices at the Warrior Way Site may cause vessel routes to deviate, leading to a loss of navigable space. The Dale Roads site is not located within any regularly used routes for any class of vessel considered, and the deployment of devices is therefore not expected to have any impact on vessel routing within the Waterway or approaches (META ES, Chapter 12: Shipping and Navigation; Appendix 12.1: Navigational Risk Assessment; RPS, 2019).

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, increased from 150 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, this area is small when considering the available navigable area in the Waterway, and constitutes no more than a quarter of the site's consented boundary.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime.

The device will be demarked by up to four navigational marker buoys and any temporary advisory clearance distances around maintenance vessels and activities may extend beyond the device footprints of the respective areas. The presence of a device, and any associated maintenance activities, would be communicated in advance via Notices to Mariners as part of the 'designed-in measures', ensuring that vessels can plan their routes accordingly. The Warrior Way site is located within the Statutory Harbour Authority (SHA) area and is, therefore, subject to existing traffic management measures (where relevant) (RPS, 2019).

Vessels transiting in the vicinity of Warrior Way, in the upper Waterway, are most likely to be recreational vessels, high speed craft and tugs/other service vessels. The Warrior Way site is located in a relatively narrow section of the Waterway, and during consultation, stakeholders expressed concern that vessels may be deviated to shallower water to the north (RPS, 2019). However, although the proposed variation has an increase in the mooring spread, considering that only a small part of the test area would be used at any one time, this will have minimal impact on vessel routing.

This potential impact is considered within the Navigational Risk Assessment (NRA) for Warrior Way under the hazard "*grounding*" which considers the potential for vessels (including passenger, recreational and commercial vessels and tugs/service craft) to ground due to a range of possible causes including unplanned course alteration due to traffic density or position of devices (RPS,

2019). Considering a combination of consequence and frequency, the overall risk rating was considered to be low (Acceptable) (META ES, Chapter 12: Shipping and Navigation; Appendix 12.1: Navigational Risk Assessment; RPS, 2019), and this would not change under the proposed variation. As agreed in the Marine Licence (ORML1957v1; NRW, 2021), a device-specific NRA will be undertaken prior to device deployment.

The impact at Warrior Way for the maximum design scenario is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be minor. The shipping and navigation receptor is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore considered to be medium. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.10.2. Physical Presence of Devices may Increase Allision Risk to Vessels Not Under Command (Including Unattended Small Craft, and Capsized Craft) and in an Emergency Situation (e.g. Machinery Related Problems and Drifting)

Design changes with the potential to alter results of the original assessment, in relation to the increased allision risk to vessels not under command and in an emergency situation, are proposed for both the Warrior Way and Dale Roads sites. The changes proposed in this variation for both sites, relevant to potential increased allision risk to vessels under command and in an emergency situation, are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads.

At both sites, there is a proposed variation to increase the height of the structures above the sea surface but not the overall sea surface area. This will not affect allision risk and is therefore not considered for this impact. At Warrior Way, the variation is also seeking to increase the speed of moving parts and increase the rotor swept area; however, these variations are only relevant for the structures 2 m below the sea surface which would be located within the mooring spread, so will not increase the allision risk and are therefore not considered for this impact.

Vessels transiting in the vicinity of Warrior Way and Dale Roads are most likely to be recreational vessels, high speed craft, tugs/other service vessels and seasonal sight-seeing passenger vessels. It is noted that commercial vessels are active to the south of the Dale Roads site. There were no recorded incidents in the immediate vicinity of either site over a period of 20 years, although incidents involving leisure craft are unlikely to be represented in Marine Accident Investigation Board (MAIB) statistics (META ES, Chapter 12: Shipping and Navigation; RPS, 2019).

This potential impact is considered within the NRA for Warrior Way and Dale Roads under the hazards "*contact with fixed structure*" and "*contact with floating object*". The hazard "*contact with fixed structure*" considers the potential for vessels (including passenger, recreational and commercial vessels and tugs/service craft) to contact a fixed structure (e.g. fixed foundation) due to a range of possible causes including machinery or equipment failure. The hazard "*contact with floating object*" considers the potential for vessels (including passenger, recreational and commercial vessels and tugs/service craft) to make contact with a floating object (e.g. navigation aid or test device) due to a range of possible causes including machinery or equipment failure. Considering a combination of consequence and frequency, the overall risk rating for both Warrior

Way and Dale Roads was considered to be low for each hazard assessed (Acceptable) (META ES, Chapter 12: Shipping and Navigation; Appendix 12.1: Navigational Risk Assessment; RPS, 2019).

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, these areas are small when considering the available navigable area in the upper Waterway, and constitute no more than a quarter of each site's consented boundary. A large part of the mooring spread will be under 2 m water depth, so would not pose a direct risk of allision, therefore the increase in the mooring spread area is not likely to affect the magnitude of the impact.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst-case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst-case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime.

The impact at Warrior Way and Dale Roads for the maximum design scenario is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be minor. The shipping and navigation receptor is deemed to be of medium vulnerability, medium recoverability and medium value; as outlined in (META ES, Chapter 12: Shipping and Navigation; RPS, 2019), and there are a number of existing risk control measures within the Statutory Harbour Authority area which will continue to remain in place during the operation and maintenance of the test areas. The sensitivity of the receptor is therefore considered to be medium. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.10.3. Physical Presence of Devices may Increase Risk of Gear/Anchor Snagging

Design changes with the potential to alter results of the original assessment, in relation to an increased risk of gear/anchor snagging, are proposed for both the Warrior Way and Dale Roads sites. The changes proposed in this variation, relevant to potential damage to fishing equipment, are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads. As conditioned in the Marine Licence (ORML1957v1; NRW, 2019), the test deployments will be demarked by up to four navigational marker buoys. Therefore, the proposed variations for Warrior Way, to increase the number of rotors and the speed of the moving parts, will not be considered for this impact, as they would be located within the area demarked by the navigational marker buoys.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, these areas are small when considering the

available navigable area in the upper Waterway, and constitute no more than a quarter of each site's consented boundary. A large part of the mooring spread will be under 2 m water depth, so would not pose a direct risk of allision, therefore the increase in the mooring spread area is not likely to affect the magnitude of the impact.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst-case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst-case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime.

As conditioned in the Marine Licence (ORML1957v1; NRW, 2019), the test deployments will be demarked by up to four navigational marker buoys and any temporary advisory clearance distances around maintenance vessels and activities may extend beyond the device footprints of the respective areas. The presence of a device and any associated maintenance activities would be communicated in advance via Notices to Mariners as part of the 'designed-in measures', ensuring that vessels can plan their routes accordingly to reduce the risk of gear/anchor snagging. The Warrior Way and Dale Roads sites are located within the SHA area and are therefore subject to existing traffic management measures (where relevant) (RPS, 2019).

Consultation has advised that there is very little/no commercial fishing vessel activity within both Warrior Way and Dale Roads (RPS, 2019), and gear snagging for this receptor has been considered in Section 5.9.2. In terms of the potential for anchor snagging, there are no restrictions on anchoring in any of the sites, however leisure vessels may choose to anchor in the shallower waters of Warrior Way and Dale Roads.

The impact at Warrior Way and Dale Roads for the maximum design scenario is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be minor. The shipping and navigation receptor is deemed to be of low vulnerability, medium recoverability and medium value; as outlined in the original META ES (Chapter 12: Shipping and Navigation; RPS, 2019), and there are a number of existing risk control measures within the Statutory Harbour Authority area which will continue to remain in place during the operation and maintenance of the test areas. The sensitivity of the receptor is therefore considered to be medium. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.10.4. Physical presence of Devices may Lead to Potential for Interaction Between Leisure Users and the Device

Design changes with the potential to alter results of the original assessment, in relation to the potential for interaction between leisure users and the device, are proposed for both the Warrior Way and Dale Roads sites. The changes proposed in this variation for both sites, relevant to this impact, are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads.

At both sites, there is a proposed variation to increase the height of the structures above the sea surface but not the overall sea surface area. This will not lead to an increased potential for

interaction between leisure users and the device and is, therefore, not considered for this impact. At Warrior Way, the variation is also seeking to increase the speed of moving parts and increase the rotor swept area; however, these variations are only relevant for the structures 2 m below the sea surface which would be located within the mooring spread, so will not increase the potential for interaction between leisure users and the device and are, therefore, not considered for this impact.

The Warrior Way site is intensively used for recreational purposes, including youth sail training and other activities, and there are likely to be inexperienced leisure users in this area (META ES, Chapter 12: Shipping and Navigation; RPS, 2019). There is potential for local leisure users to interact with the devices, however training activities would be subject to supervision and, therefore, this is considered to reduce the extent of this impact. The Dale Roads site is a popular leisure area for cruising/passage, with occasional yacht anchoring and power boat training exercises, although the area is less intensively used by leisure vessels than Warrior Way (META ES, Chapter 12: Shipping and Navigation; RPS, 2019). There is considered to be low potential for local leisure users to interact with the devices at this site.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, these areas are small when considering the available resources to leisure users in the Waterway, and constitute no more than a quarter of each site's consented boundary.

Devices, and associated moorings are to be *in situ* for no more than 6 months at Warrior Way, with the maximum (worst-case) being that there will be up to 4 device deployments within a 12-month period, over the 15 year project lifetime. Deployments at Dale Roads will not extend beyond 12 months with the maximum (worst-case) being that there will be up to 2 device deployments within a 12-month period, over the 15 year project lifetime.

As conditioned in the Marine Licence (ORML1957v1; NRW, 2021), the test deployments will be demarked by up to four navigational marker buoys and a Notice to Mariners will outline the location of any devices prior to deployment; this will ensure that leisure activities can be planned accordingly and avoid any interactions with the device. It was also conditioned within the Marine Licence, that a strategy for raising awareness of the risks concerning power generating structure will be implemented; this will include safety information/warnings provided at recreational access points, which could be incorporated into existing navigation safety advice provided by the port. Temporary advisory clearance distances will be designed to provide additional separation distance between any maintenance activities and leisure users. MEW will implement an Operational Management Plan (including Emergency Response) which will include a requirement for device-specific risk assessments to be prepared in advance of each specific device deployment to ensure that any risks to leisure users are minimised to 'As Low as Reasonably Possible' or lower. Other designed-in measures include use of safety vessels/guard boats during short term deployments subject to the results of the device-specific risk assessment.

This potential impact is considered within the NRA for Warrior Way and Dale Roads under the hazards "*contact with fixed structure*" and "*contact with floating object*". Considering a combination

of consequence and frequency, the overall risk rating was considered to be low for each hazard assessed (Acceptable) (META ES, Chapter 12: Shipping and Navigation; Appendix 12.1: Navigational Risk Assessment; RPS, 2019).

The impact at Warrior Way and Dale Roads for the maximum design scenario is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be minor. As outlined in the original META ES, Chapter 12: Shipping and Navigation (RPS, 2019), the Warrior Way and Dale Roads sites are located within the SHA area and are, therefore, subject to existing management measures (where relevant). It was also noted during consultation that there is good management and relationships between recreational users and the MHPA, which is considered to reduce the vulnerability of the receptor to this impact (RPS, 2019).

The leisure user receptor for Warrior Way is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be medium. The leisure user receptor for Dale Roads is deemed to be of low vulnerability, high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be low. The effect for both sites will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.11. Marine Archaeology

Of the variations proposed only the increase in mooring spread is likely to affect identified marine archaeology receptors and receptor groups. This only applies to the O&M phase once the device is installed therefore the installation and decommissioning phases have not been revisited.

5.11.1. Removal or Disturbance of Sediments - Buried Prehistoric Deposits

5.11.1.1. Warrior Way

The variation seeks to increase the mooring spread at Warrior Way from 150 m^2 to 22,400 m^2, which may affect a variety of heritage assets through the disturbance of sediments. The movement of the mooring lines as a result of tides and currents may disturb seabed sediments and this may result in changes to archaeological materials such that the asset is altered or modified. However, the consent limits the installation of 1 test device at a time at Warrior Way, for a maximum period of 6 months. The intermittent and temporary nature of the operation of this site mitigates any potential significant or likely comprehensive changes.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24% of the 0.093 km^2 consent boundary. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, this area is small when considering the area of likely prehistoric deposits within the Milford Haven Waterway.

Even factoring in the increase in area to an approximate 150 m by 150 m spread, the impact is still predicted to be of local spatial extent, short duration, intermittent and not reversible. It is predicted that the impact would affect the receptor directly. The magnitude is therefore, considered to be minor.

The potential Prehistoric deposits on the site are deemed to be of medium vulnerability, and medium value. The sensitivity of the receptor is therefore, considered to be medium (META ES, Chapter 13: Marine Archaeology; RPS, 2019). Overall, the sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.11.1.2. Dale Roads

The variation seeks to increase the mooring spread at Dale Roads from 200 m^2 to 22,500 m^2, which may affect a variety of heritage assets through the disturbance of sediments. The movement of the mooring lines as a result of tides and currents may disturb seabed sediments and this may result in changes to archaeological materials such that the asset is altered or modified. However, the consent limits the installation of 2 test device at a time at Dale Roads for a maximum period of 12 months. The intermittent and temporary nature of the operation of this site mitigates any potential significant or likely comprehensive changes.

The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021) however, in absolute terms, this area is small when considering the area of likely prehistoric deposits within the Milford Haven Waterway.

Even factoring in the increase in area to an approximate 200 m by 200 m spread the impact is still predicted to be of local spatial extent, short duration, intermittent and not reversible. It is predicted that the impact would affect the receptor directly. The magnitude is therefore, considered to be minor. The potential Prehistoric deposits on the site are deemed to be of medium vulnerability, and medium value. The sensitivity of the receptor is therefore, considered to be medium (META ES, Chapter 13: Marine Archaeology; RPS, 2019). Overall, the sensitivity of the receptor is considered to be medium and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.11.2. Removal or Disturbance of Archaeological Resource – Shipwrecks

5.11.2.1. Warrior Way

The variation seeks to increase the mooring spread at Warrior Way from 150 m^2 to 22,500 m^2, which may remove or disturb archaeological resources, specifically shipwrecks. The movement of the mooring lines as a result of tides and currents may disturb seabed sediments and this may result in changes to archaeological materials such that the resource is altered or modified. However the consent limits the installation of 1 test device at a time at Warrior Way for a maximum period of 6 months. The intermittent and temporary nature of the operation of this site mitigates any potential significant or likely comprehensive changes.

The maximum area of mooring spread at Warrior Way proposed within the variation is 22,500 m^2, which comprises 24 % of the 0.093 km^2 consent boundary. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021; PCC, 2021) however, in absolute terms, this area is small when considering the area of likely prehistoric deposits within the Milford Haven Waterway.

Even factoring in the increase in area to an approximate 150 m by 150 m spread the impact is still predicted to be of local spatial extent, short duration, intermittent and not reversible. It is predicted that the impact would affect the receptor directly. The magnitude is, therefore, considered to be minor. The potential wrecks on the site are deemed to be of low vulnerability, low recoverability and low value (META ES, Chapter 13: Marine Archaeology; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low. Overall, the sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.11.2.2. Dale Roads

The variation seeks to increase the mooring spread at Dale Roads from 200 m^2 to 40,000 m^2, which may remove or disturb archaeological resources, specifically shipwrecks. The movement of the mooring lines as a result of tides and currents may disturb seabed sediments and this may result in changes to archaeological materials such that the asset is altered or modified. However, the consent limits the installation of 1 test device at a time at Dale Roads for a maximum period of 12 months. The intermittent and temporary nature of the operation of this site mitigates any potential significant or likely comprehensive changes.

The maximum area of mooring spread at Dale Roads proposed within the variation is 40,000 m^2, which comprises 21% of the 0.196 km^2 site. In relative terms this represents a large increase from the areas originally consented (ORML1957v1; NRW, 2021) however, in absolute terms, this area is small when considering the area of likely prehistoric deposits within the Milford Haven Waterway.

Even factoring in the increase in area to an approximate 200 m by 200 m spread the impact is still predicted to be of local spatial extent, short duration, intermittent and not reversible. It is predicted that the impact would affect the receptor directly. The magnitude is, therefore, considered to be minor. The potential wrecks on the site are deemed to be of low vulnerability, low recoverability and low value (META ES, Chapter 13: Marine Archaeology; RPS, 2019). The sensitivity of the receptor is therefore, considered to be low. Overall, the sensitivity of the receptor is considered to be low and the magnitude of the impact is deemed to be minor. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.12. Seascape

5.12.1. Overview

The Marine Licence (ORML1957v1), consented by NRW in August 2021, allows the following maximum project envelope at Warrior Way and Dale Roads. Planning Permission (20/0756/PA) consented by PCC in August 2021 relates to Warrior Way only:

- Test device height about surface <2 m; and
- Sea-surface area per device/component ≤200 m^2.

The variation originally proposed increasing the height of the device above the water at Warrior Way and Dale Roads from 2 m to 5 m across the total sea surface area (≤200 m^2). This was shared with the NRW Marine Licence Team (MLT) and NRW Advisory and initial feedback identified this may adversely impact sensitive receptors, noting objections received during the original consent

application and the request by PCC for supplementary seascape and visual assessment. On the basis of this feedback, the proposed design envelope variation was reviewed and refined to reduce the magnitude of impact and effect on sensitive receptors.

The alternative variation proposed within this report is for a discrete height increase from 2 m to 5 m within a sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under Marine Licence, ORML1957v1, and Planning Permission, 20/0756/PA, at a height of 2 m over the remaining 100 m^2.

This variation is proposed to address the novel marine energy technologies, including those designed to generate electricity, that META provides test facilities for. The sites are not connected to the national or local electricity grid and do not have any consented or pre-existing cables installed. Therefore, on occasion surface equipment is required to "off take" the electricity generated by the devices. This equipment is often known as 'grid emulation', a 'micro grid' or a 'grid dump'. The most practical place for this surface equipment is to be mounted onto a buoy, barge or similar floatation device. The equipment must be sufficiently protected from the sea (waves) and weather. It must be appropriately marked for other sea users and in some cases provide communication to the shore. This equipment is described in the original META ES, Chapter 2: Project Description (RPS, 2019) and consented under Marine Licence (ORML1957v1), specifically "test device height about surface - <2 m" and "sea-surface area per device/component - ≤200 m^2" (NRW, 2021).

The proposed variation to increase the height above the sea surface from 2 m to 5 m at Warrior Way and Dale Roads is to accommodate the equipment discussed above and reflects feedback from marine renewable energy technology developers. The variation also reflects current market solutions for surface power "off take" equipment, which incorporate adequate floatation support, waterproofing, aids to navigation and antennae. Some illustrative and examples of working "off take" surface equipment are presented in Figure 5.1 and Figure 5.2 below.

The majority of the sea surface equipment will be lower than the proposed variation of 5 m, with only the antenna and aids to navigation being up to 5 m above sea surface. The equipment is anticipated to fit inside weatherproof containers approximately 2.59 m high, which with flotation (approximately 1 m above sea surface) will comprise a total height above sea surface of 3.59 m, however a maximum envelope of 5 m is proposed to allow contingency for antenna and aids to navigation, as discussed above. The installation of the "off take" equipment will not result in an increase in the number of vessels present from that already consented under Marine Licence ORML1957v1. It should also be noted that not all potential developers will require this "off take" equipment and a conservative estimate would suggest it would be required for < 50% of deployments.

Figure 5.1 shows an illustrative example of sea surface support equipment based on the MPS Buoy. An image of the MPS Buoy is shown in the left hand image in Figure 5.2. This depicts the type of structure that this variation is seeking consent for, i.e. a structure up to 5 m high, including antenna and aids to navigation. The MPS Buoy was included in the supplementary Seascape, Landscape and Visual Impact Assessment (SLVIA) information and photomontages submitted with the original META ES (RPS, 2019) in respect of Warrior Way. This image is reproduced below, see Figure 5.3, with the MPS Buoy and installation gantry barge annotated for comparison. The Photomontages are provided again in full in Appendix A: Photomontages.

Figure 5.1: Illustrative examples of sea surface support equipment

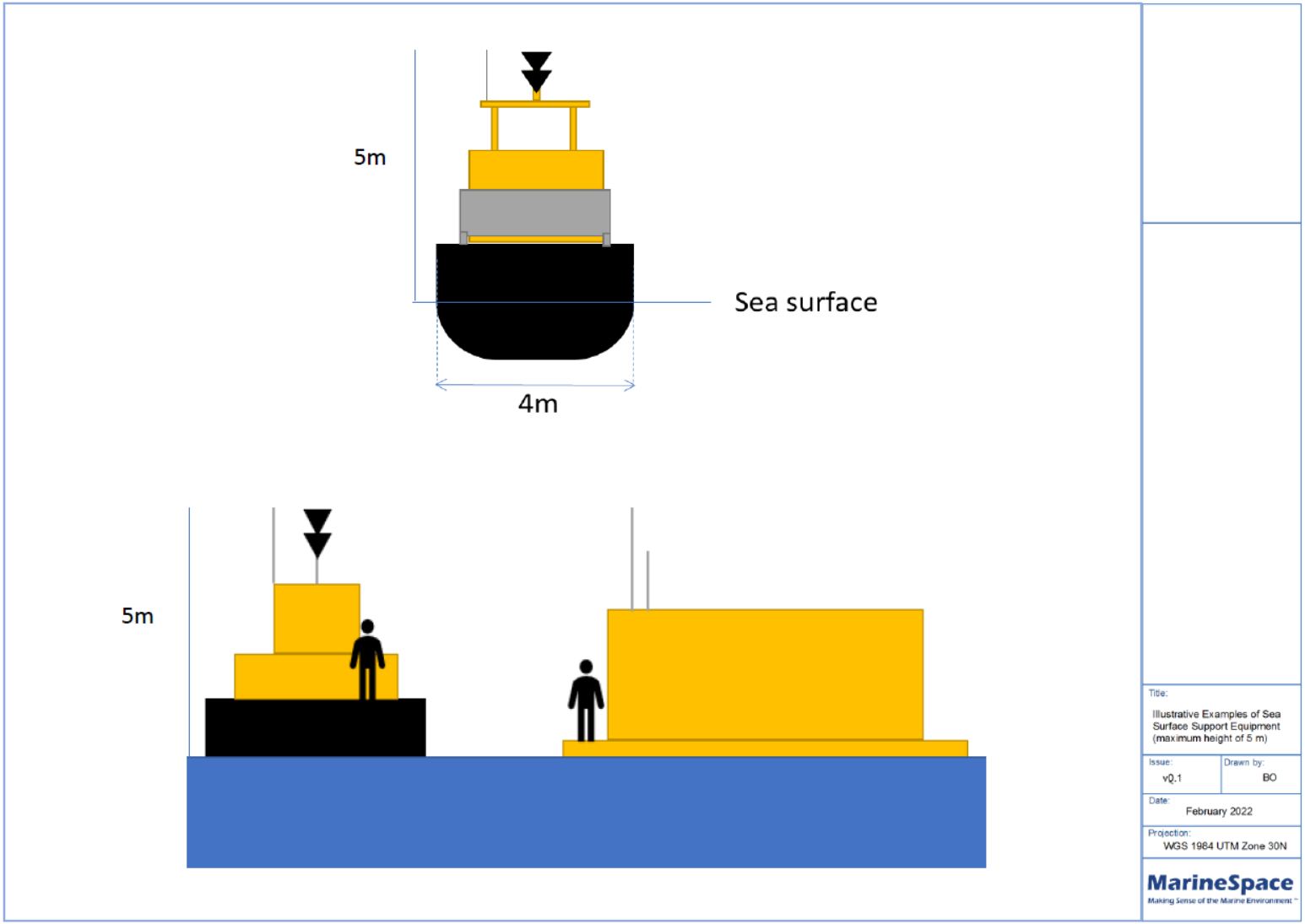
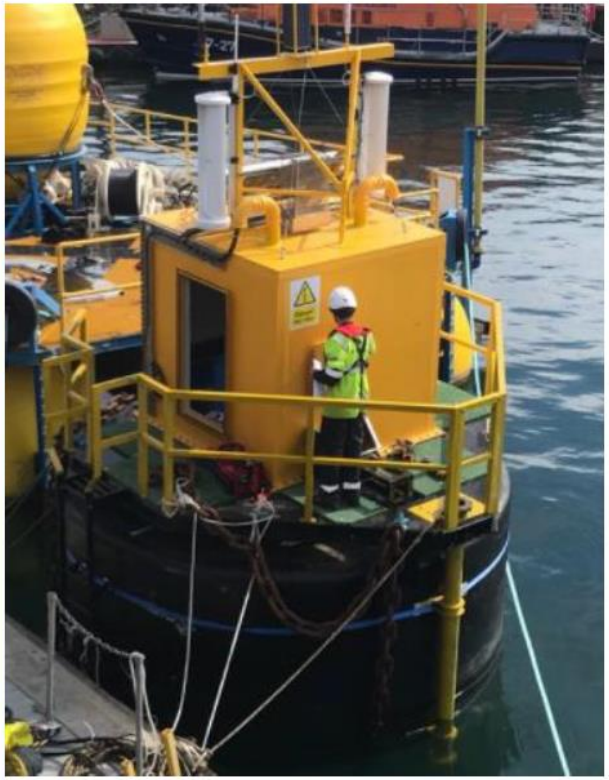


Figure 5.2: Market ready examples of sea surface support equipment (maximum height of 5 m)



Title:
Working Examples of Sea Surface Support Equipment (maximum height of 5 m)

Issue: v0.1
Drawn by: BO
Date: February 2022
Projection: WGS 1984 UTM Zone 30N

MarineSpace
Making Sense of the Marine Environment

Figure 5.3: Warrior Way Photomontage depicting MPS Buoy and Installation Gantry Barge

Figure 5.3 above provides an example of the scale of the proposed variation. The gantry barge is up to 16 m above sea surface, would only be used to deploy the test devices and is included in the original consents (ORML0957v1 and 20/0756/PA). The MPS Buoy is operational "off take" sea surface equipment with a maximum height of 5 m and illustrates the maximum height increase this variation is seeking consent for during the O&M phase.

5.12.2. Assumptions

The variation proposed, for a discrete height increase from 2 m to 5 m within a sea surface area of 10 m x 10 m (100 m^2) is the only variation proposed that may affect identified seascape and landscape visual receptors and receptor groups. This only applies to the O&M phase, once the device is installed, therefore the installation and decommissioning phases have not been revisited.

The assessment does not revisit the baseline, the sensitivity of the receptor or the visual impact assessment established in the META ES Chapter 14: Seascape (RPS, 2019). The assessment does reflect the understanding that due to the temporary and intermittent nature of the test devices, any impact will be short term and reversible. On the basis that device installations are for a maximum period of no more than 6 months (Warrior Way) and 12 months (Dales Roads) the impacts are limited by the project parameters consented under the Marine Licence, reference ORML0957v1 (NRW, 2021) and Planning Permission, 20/0756/PA (PCC, 2021).

This assessment is informed by META ES Chapter 14: Seascape (RPS, 2019), conclusions of supplementary Seascape, Landscape and Visual Impact Assessment (SLVIA) information and photomontages submitted to supplement the original META ES (RPS, 2019) in respect of Warrior Way.

The additional SLVIA information addressed concerns raised by NRW with respect to the potential effect of META on the character and views of, and from, Pembrokeshire Coast National Park, as well as the LANDMAP Visual and Sensory Aspect layers for the seascape and landscape areas. NRW highlighted character areas that were assessed as Outstanding and High and drew attention to specific areas within some of them, including:

- PCNP SCA32;
- PCNP SCA33;
- LCA28 Daugleddau within the NP;
- PMBRKVS050 within the NP;
- PMBRKVS051 at Cosheston Pill; and
- PMBRKVS114 around Burton Ferry.

These specific character areas were visited and reviewed in the context of the level of sensitivity of the character and the receptors within those views from the most sensitive landscapes. Based on the supplementary assessment it was concluded that "*during the operation and maintenance phase, no significant effects will be experienced by seascape, landscape and visual resources and receptors*" (META ES, Landscape, Seascape and Visual Impact Assessment; RPS, 2019). This reflected the temporary, intermittent and fully reversible nature of the effect at Warrior Way.

This assessment should also be read in conjunction with photomontages produced and submitted with the original META ES (RPS, 2019) and reproduced in Appendix A: Photomontages, which present an operational scenario inclusive of a MPS Buoy, as shown in Figure 5.3.

5.12.3. Impact on the Designation of Milford Haven Waterway Registered Landscape of Outstanding Historic Interest in Wales

The Milford Haven Waterway Registered Landscape of Outstanding Historic Interest in Wales in defined in the ES as follows:

"*Pembroke Dock historic landscape character area comprises the 19th century naval dockyards and the 19th century grid-pattern planned town. Included in this area are many 19th century worker and town houses, with 20th century housing, light industrial development on its outskirts. The large scale LNG refinery and gas/oil storage tanks, the power station and other energy related development including the wind turbines form elevated and visually prominent permanent elements in the local landscape beyond the port towards the open sea. This busy waterway and port is littered with evidence of commercial shipping and recreational boating including markers buoys, slipways and moorings and a variety of floating vessels ranging from small craft, yachts, tug boats, ferry ships and oil tankers*" (META ES, Chapter 14: Seascape; RPS, 2019).

5.12.3.1. Warrior Way

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) and 20/0756/PA (PCC, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence and Planning Permission at a height of 2 m over the remaining 100 m^2.

The original META ES (RPS, 2019) recognised that due to the intermittent and reversible nature of the project, and within the context of the industrial background of the Milford Haven Waterway, the impact of the visible components of the temporary test devices would result in a change over a limited area but that the landscape would appear largely unchanged.

In assessing the variation, it is recognised the increase in height from 2 m to 5 m over 50% of the sea surface area will result in a greater change in the landscape from the consented parameters, however this will only occur over a limited spatial area and the change is temporary, long term but intermittent, and fully reversible. The magnitude is therefore, considered to be minor. The receptor is deemed to be of low vulnerability with full recoverability (see META ES, Chapter 14: Seascape, section 14.11.2.7; RPS, 2019). The sensitivity of the receptor is therefore considered to be of medium value. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.12.3.2. Dale Roads

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence, a height of 2 m over the remaining 100 m^2.

The introduction of the sea-surface component of the temporary test devices will result in a visible change but within a limited area and for short, intermittent periods.

The impact of the variation will be direct, long-term but intermittent and fully reversible however it will result in a visible change and therefore the magnitude is considered to be moderate. The receptor is deemed to be of medium vulnerability as the change in the baseline view will be moderate. The sensitivity of the receptor is therefore considered to be medium value. The effect will, therefore, be of **moderate significance**, which is significant in EIA terms, however, remains the same significance of effect as concluded in the original META ES (RPS, 2019).

5.12.4. Visual Impact from Viewpoints for Receptors Using the Pembrokeshire Coast Path along the Cleddau Bridge and across the Daugleddau from Publicly Accessible Coastal Viewpoints in Burton Ferry (VP1, VP2)

5.12.4.1. Warrior Way

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) and 20/0756/PA (PCC, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence and Planning Permission at a height of 2 m over the remaining 100 m^2.

The site is located within the context of the industrial background of the Milford Haven Waterway and the impact of the visible components of the temporary test devices would result in a change over a limited area but the landscape will appear largely unchanged.

Furthermore, as noted in the original META ES, Chapter 14: Seascape "*This busy waterway and port is littered with evidence of commercial shipping and recreational boating including markers buoys, slipways and moorings and a variety of floating vessels ranging from small craft, yachts, tug boats, ferry ships and oil tankers. The oil refinery structures and vertical elements of the power stations and wind turbines elevated on the cliffs above the waterway edges are visible in the view back towards the inner waterway*" (RPS, 2019).

The impact of the variation will be indirect, long-term but intermittent and fully reversible and therefore the magnitude is considered to be minor. The receptor is deemed to be of low vulnerability as the change in the baseline view will be minor. The sensitivity of the receptor is therefore considered to be medium value. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.12.5. Visual Impact from Viewpoints for Receptors Using the Pembrokeshire Coast Path (VP3, VP4 and VP5)

5.12.5.1. Dale Roads

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m

(100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence at a height of 2 m over the remaining 100 m^2.

The introduction of the sea-surface component of the temporary test devices will result in a visible change but over a limited area and for short, intermittent periods.

The impact of the variation will be direct, long-term but intermittent and fully reversible however it will result in a visible change and therefore the magnitude is considered to be moderate. The receptor is deemed to be of medium vulnerability as the change in the baseline view will be moderate. The sensitivity of the receptor is therefore considered to be medium value. The effect will, therefore, be of **moderate significance**, which is significant in EIA terms, however, remains the same significance of effect as concluded in the original META ES (RPS, 2019).

5.12.6. Visual Impact for Recreational Receptors Using the Waterway for Recreational Boating

5.12.6.1. Warrior Way

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) and 20/0756/PA (PCC, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence and Planning Permission at a height of 2 m over the remaining 100 m^2.

The site is located within the context of the industrial background of the Milford Haven Waterway and the impact of the visible components of the temporary test devices would result in a change over a limited area, but the landscape will appear largely unchanged.

Furthermore, as noted in the original META ES, Chapter 14: Seascape "*This busy waterway and port is littered with evidence of commercial shipping and recreational boating including markers buoys, slipways and moorings and a variety of floating vessels ranging from small craft, yachts, tug boats, ferry ships and oil tankers. The oil refinery structures and vertical elements of the power stations and wind turbines elevated on the cliffs above the waterway edges are visible in the view back towards the inner waterway*" (RPS, 2019).

The impact of the variation will be indirect, long-term but intermittent and fully reversible and therefore the magnitude is considered to be minor. The receptor is deemed to be of low vulnerability as the change in the baseline view will be minor. The sensitivity of the receptor is therefore considered to be medium value. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.12.6.2. Dale Roads

The variation seeks to increase the height parameters of the test device from those consented via ORML1957v1 (NRW, 2021) from 2 m to 5 m within a discrete sea surface area of 10 m x 10 m (100 m^2). The height above sea surface outside this footprint would remain as consented under the Marine Licence at a height of 2 m over the remaining 100 m^2.

The introduction of the sea-surface component of the temporary test devices will result in a visible change but over a limited area and for short, intermittent periods.

The impact of the variation will be direct, long-term but intermittent and fully reversible however it will result in a visible change and therefore the magnitude is considered to be moderate. The receptor is deemed to be of medium vulnerability as the change in the baseline view will be moderate. The sensitivity of the receptor is therefore considered to be medium value. The effect will, therefore, be of **moderate significance**, which is significant in EIA terms, however remains the same significance of effect as concluded in the original META ES (RPS, 2019).

5.13. Other Users

5.13.1. Operation of META Project may Displace Recreational Activities, Resulting in a Loss of Recreational Resource

5.13.1.1. Warrior Way

The presence of tidal devices at Warrior Way may displace recreational activities from the footprint of the development resulting in a loss of recreational resource.

The consented maximum project envelope for Warrior Way is for "*1 device/test at any one time (i.e. no other testing/deployment /retrieval or other operation for another device/test may be undertaken during this period)*" (NRW, 2021). The variation seeks to increase the mooring spread for a single device to 22,500 m^2, altering the spatial spread at the Warrior Way from 0.00015 km^2 to 0.0225 km^2, which is a small area of the overall consented boundary (total area of 0.093 km^2), and small in the context of the available recreational resources in the upper Waterway.

The increase in mooring spread would remain within the consented boundary and only extend to a small part of the test area at one time (approximately 24%). This would have a minimal impact on recreational vessel routing, specifically noting that AIS tracks for recreational vessels were predominately recorded transiting to the north of the test site boundary (see META ES, Chapter 12: Shipping and Navigation, Appendix 12.1: Navigational Risk Assessment; RPS, 2019). It is recognised that the Warrior Way site is intensively used for recreational purposes, including youth sail training and other activities, and there are likely to be inexperienced leisure users in this area (META ES, Chapter 12: Shipping and Navigation; RPS, 2019). However, although there is potential for local leisure users to interact with the devices, training activities would be subject to supervision and, therefore, this is considered to reduce the extent of this impact.

The impact of the proposed variation at Warrior Way, during the O&M phase, is predicted to be of local spatial extent, long-term duration, intermittent with high reversibility. The magnitude is therefore considered to be minor. The recreational receptor is deemed to be of low vulnerability, high recoverability and moderate value (as presented in META ES, Chapter 16: Other Users, Section 16.11.1.16; RPS, 2019). The sensitivity of the receptor is, therefore, considered to be medium. The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.13.1.2. Dale Roads

The presence of wave energy devices at Dale Roads may displace recreational activities from the footprint of the development resulting in a loss of recreational resource.

The consented maximum project envelope for Dale Roads is represented by 1 testing activity (NRW, 2021). The variation seeks to increase the mooring spread for a single device to 40,000 m^2, altering the spatial spread at the Dale Roads from 0.0002 km^2 to 0.04 km^2, which equates to approximately 21% of the overall consent boundary.

The Dale Roads site is located in an area which is not regularly transited by recreational vessels (as recorded by AIS) and stakeholder consultation also confirmed that the density of recreational vessel traffic was much lower than at Warrior Way, although it is noted the area is occasionally used for power boat training (META ES Chapter 16: Other Users; RPS, 2019).

The impact of the proposed variation at Dale Roads during the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, intermittent with high reversibility. The magnitude is therefore considered to be minor. The recreational receptor is deemed to be of low vulnerability, high recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be medium (as presented in META ES, Chapter 16: Other Users, Section 16.11.1.19; RPS, 2019). The effect will, therefore, be of **minor (adverse) significance**, which is not significant in EIA terms.

5.14. Water Framework Directive

A full Water Framework Directive (WFD) compliance assessment is provided in the original META ES (RPS, 2019) and this section should be read in conjunction with the ES. The WFD assessment presented herein is limited to consideration to WFD receptors that may be affected by the project aspects which are proposed for variation. These have been identified as:

- Changes in hydromorphology;
- Changes to level of impact on benthic receptors;
- Potential increases in barrier effect/collision risk to migratory fish;
- Risk to priority habitats/species; and
- Potential increase in scale of effect on designated shellfish areas.

5.14.1. Hydromorphology

Detailed assessment of predicted impacts on coastal processes receptors in accordance with the EIA Regulations is provided in Section 5.3.2. The proposed changes to the project design at Warrior Way, which have the potential to directly affect the hydromorphology of the Milford Haven Inner WFD waterbody, are an increase in the maximum rotor swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors) and an increase in the mooring spread area from 150 m^2 to 22,500 m^2. The change proposed to design at Dale Roads (within the Milford Haven Outer WFD waterbody) is an increase in the mooring spread area from 200 m^2 to 40,000 m^2.

Increased tidal flow from water funnelled through tidal devices at Warrior Way may cause elevated SSC due to erosion of seabed sediments. As described in Section 4.2.3, the coarse-grained and

muddy nature of the seabed sediment (i.e. very coarse sand and gravel and muds) means that any sediment mobilised during device operation will either settle very rapidly or spend a more prolonged time in suspension. For example, using the principles of Stokes' Law (e.g. McCave and Syvitski, 1991) to calculate settling velocity, coarse sand (Diameter = 1 mm) will settle at a rate of approximately 0.73 m/s. Thus, given the water depth on the site (19 m) and the peak tidal flow (1.2 m/s), particles of this size would be expected to travel no farther than 31 m. If mobilised, coarser grained gravel would settle almost immediately, whilst mud sized particles (Diameter ≤ 0.063 mm) will remain in suspension longer (settling velocity of 0.003 m/s), travel farther, and the finer grained element may enter suspension.

In terms of effect on hydrodynamic regime, the increase from 1 to a maximum of 3 rotors is expected to result in a maximum downstream influence of ≤7.5 m (see Section 5.3.2.1). Effects beyond this range are predicted to be negligible.

As outlined above, a further proposed change to the project envelope concerns the increase in mooring spread from 0.00015 km² to 0.02250 km² at Warrior Way, and from 0.0002 km² to 0.04 km² at Dale Roads. Anchor chains or cables may move due to the action of tides, waves and other forces acting on the moored device. The mooring spread will be located completely within the site. As detailed above, seabed substrates at Warrior Way comprise both coarse-grained and muddy fractions (see Section 4.2.3.1). Substrates at the Dale Roads Site are generally coarse-grained with rippled sand (see Section 4.2.3.2).

When moving over the seabed the mooring spread has the potential to disturb sediments and move these into suspension. Outlined above, coarse grained material (sands and gravel) will not enter suspension, however finer grained muds may. Whilst, in a worst-case such effects may occur over an area of 0.02250 km² and 0.04 km² at Warrior Way and Dale Roads respectively, in practice movement is likely to be restricted to the seabed touchdown area.

The proposed variation is likely to result in highly localised and small magnitude changes to hydrology and benthic morphology. Given the scale of predicted change, these are expected to make a negligible difference to hydromorphological quality elements at the waterbody level. Accordingly, these activities are not expected to jeopardise attainment of the WFD objectives of the Milford Haven Inner or Milford Haven Outer waterbodies.

Given that impacts on hydrology and sediment transport are not predicted to affect the hydromorphology status of Milford Haven Inner and Milford Haven Outer waterbodies, an assessment of the impact that changes to sediment transport may have on biological receptors has not been included in Sections 6.1-6.4.

5.14.2. Biology: Benthic Habitats

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

Temporary habitat disturbance that may affect benthic ecology during the O&M phase, will arise from the single mooring spread around the deployed device, with the precautionary approach for a worst-case scenario that the whole area within the mooring spread will be impacted. These areas have the potential to be subject to regular disturbance (e.g. sediment abrasion and disturbance), as anchor chains sweep across the seabed with changes in tides and currents, impacting epifaunal

benthic species. The variation seeks to increase the maximum design scenario for mooring spread for a single device from 150 m² to 22,500 m² at Warrior Way and from 200 m² to 40,000 m² at Dale Roads. These revised maximum extents correspond with 0.1% and 0.1% of the Milford Haven Inner (total area 21.02 km²) and Milford Haven Outer (total area 35.39 km²) waterbodies, respectively.

Detailed assessment of potential impacts on benthic receptors is provided in Section 5.5.1. At both Warrior Way and Dale Roads it is considered there is potential for impacts on Annex I 'Estuaries' and Annex I 'Large Shallow Inlets and Bay' habitats. There is extensive 'estuary' habitat within the Pembrokeshire Marine SAC (60.19 km²). Similarly, Annex I 'Large shallow inlets and bays' are also extensive within the Pembrokeshire Marine SAC (203.85 km²). The impact of the proposed variation at Warrior Way on both of these habitats, for the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility. Accordingly, these activities are not expected to result in the WFD objectives of the Milford Haven Inner or Milford Haven Outer waterbodies not being achieved.

5.14.3. Biology: Fish

Design changes with the potential to alter results of the original assessment in relation to the risk to migratory fish species are proposed for the Warrior Way site only. The assessment of this impact on fish and shellfish for the Dale Roads site therefore remains the same as in the original assessment (as presented in META ES, Chapter 8: Fish and Shellfish; RPS, 2019). The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation, relevant to effects on migratory fish species (tidal turbine collision risk and risk of barrier effects), are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in total swept area from 19.63 m² (for 1 rotor) to 58.89 m² (for 3 rotors), and an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s.

The width of the Cleddau river at the location of Warrior Way is 330 m between MLWS at opposite banks. The diameter of each of the 3 rotors equals 5 m, for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. With a tip speed of 10 m/s (0.5 m/s slower than that proposed within this variation), the survival rate of fish within the presence of a turbine has been recorded at 100% for a range of species, with no recorded injuries or deaths (Zhang *et al.*, 2016). In view of this, it is considered there is negligible risk that the presence of this device will adversely impact the migratory fish features of the Milford Haven Inner transitional waterbody.

The changes proposed in this variation relevant to the colonisation of hard surfaces are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). The presence of the turbine has the potential to cause a barrier to the movement of migratory fish and prevent them from reaching breeding/feeding grounds. However, the diameter of each of the 3 rotors equals 5 m for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. Any barrier effects are therefore likely to be restricted to a small area of the total available migratory route. Given the small proportion of the water column that will be affected, the increase in number of rotors covered by the present variation is not expected to result in an adverse impact on the migratory fish features of the Milford Haven Inner transitional waterbody, and will not prevent the objectives of this waterbody from being achieved.

5.14.4. Priority Species and Habitats

Priority species and habitats identified within each waterbody have been assessed in Sections 5.5 to 5.6. Those not discussed in the previous sections (i.e. benthic habitats and fish) are assessed herein.

The following priority species are considered most likely to be encountered in the study area (as defined in META ES, Chapter 10: Marine Mammals, Basking Shark and Otter; RPS, 2019) (excluding those discussed above):

- 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*.

Design changes that have the potential to alter the results of the original assessment in relation to the increased anthropogenic noise of tidal turbines on marine mammals, basking shark, and otter are proposed only for the Warrior Way site (Milford Haven Inner waterbody). As such, the assessment of this impact at the Dale Roads site (Milford Haven Outer waterbody) remains unchanged from the original assessment.

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation relevant to effects on priority species (tidal turbine collision risk and risk of barrier effects) are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in total swept area from 19.63 m² (for 1 rotor) to 58.89 m² (for 3 rotors), and an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s.

The width of the Cleddau river at the location of Warrior Way is 330 m between MLWS at opposite banks. The diameter of each of the 3 rotors equals 5 m for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location.

Whilst the variation seeks to make the discussed changes, the maximum diameter of tidal rotors at Warrior Way remains the same as in the original assessment at 5 m. Following a reassessment of underwater noise in Section 5.4: Underwater Noise, it is determined that the changes proposed within this variation are not likely to result in an increase in levels of underwater noise. Accordingly, the proposed variation will not result in any change in subsea noise, and this pressure is screened out of any further assessment.

In terms of collision risk, it is highly likely that animals within the waterway are adjusted to high traffic levels and are practised at avoiding these obstacles. Furthermore, it is predicted few cetaceans and basking shark passage down the Waterway as far as Warrior Way, and grey seal are only found in proximity to the site in low abundances (based on sightings data) (META ES, Chapter 10: Marine Mammals, Basking Shark and Otter; RPS, 2019). Whilst otters are found throughout the Waterway it is highly likely they would exhibit avoidance behaviours and prefer shallower depths (Kruuk and Moorhouse, 1991). In view of these factors, it is considered there is no potential for the

proposed licence variation to prevent the objectives for the Milford Haven Inner or Milford Haven Outer waterbodies from being achieved.

5.14.5. WFD Protected Areas

Section 6 provides an assessment of the expected effects of the proposed licence variation on UK National network, Natura 2000 or Ramsar sites. This assessment carried out in accordance with the requirements of the EU Habitats Directive (transposed into UK law by The Conservation of Habitats and Species Regulations 2017[1] (as amended) and The Conservation of Offshore Marine Habitats and Species Regulations 2017[2] (as amended)) concluded that there is no risk that the proposed variation will adversely affect the integrity of any UK National network, Natura 2000 or Ramsar site.

5.14.5.1. Upper Cleddau Shellfish Waters

The Warrior Way site is located within the boundary of the Upper Cleddau Shellfish Waters within the Milford Haven Inner waterbody. The Dale Roads site is not located within 2 km of this site. Within the protected area, shellfish populations include native oysters *Ostrea edulis,* stocks of mussels *Mytilus* spp., cockle beds *Cerastoderma edule*, carpet shell clams *Venerupis pullastra*, razor clam *Ensis* spp., and Pacific oysters *Crassostrea gigas* (Cefas, 2012). However, of these species, only native oysters are found at the Warrior Way site. Native oysters are widespread throughout the area with stocks present from Milford Haven town up to Picton Point.

Habitat disturbance in this area may affect native oysters within the direct project footprint. However, the Warrior Way site occupies a small portion of the area within which this species is found, and this site is not considered to be of special importance within the classification zone. Device presence will not alter the habitat suitability and therefore it is expected that any changes in species abundance would be reversible, and populations would recolonise the area following device removal.

The proposed increase in mooring spread may result in associated increase in spatial extent and concentration of suspended sediment mobilised by works activity. Temporary increases in SSC and associated sediment deposition may occur from the movement of catenary chains across the sediment surface that may re-suspended fines into the water column. Temporary increases in suspended sediments may affect sessile organisms such as mussels or oysters within the secondary effect (plume) extent, and potentially damage filter-feeding or breathing organs.

As assessed in the original META ES, Chapter 7: Subtidal and Intertidal Ecology (RPS, 2019), where sediment is disturbed at the Warrior Way Site all but the finest materials (silts and clays etc.) are expected to settle relatively quickly following disturbance. The plume itself is predicted to have SSC

[1] https://www.legislation.gov.uk/uksi/2017/1012/contents/made

[2] https://www.legislation.gov.uk/uksi/2017/1013/contents/made

of <40 mg/l up to 100 m from the site, and will settle within 2 hours. These levels are within range of background levels reported for Milford Haven waterway.

Any potential increases in SSC and associated sediment deposition arising during the O&M phase from the mooring spread will occur across a localised spatial extent, but be of long-term duration (albeit intermittent). Species identified as present in this area are considered able to recover rapidly following disturbance and as such no significant impact is predicted to the Upper Cleddau Shellfish Waters.

5.14.6. Summary

Based on the above, no non-temporary deterioration of WFD status is likely to occur and the Western Wales RBD, Milford Haven Inner transitional and Milford Haven Outer coastal waterbody, will not be prevented from achieving their WFD objectives. The assessment presented herein determined that the proposed marine licence variation may result in effects of small magnitude and spatial extent and these do not pose a risk of jeopardising achievement of Good status within the Milford Haven Outer or Milford Haven Inner waterbodies. The potential for significant cumulative or in-combination effects has been examined and none is anticipated. Based on these findings, the proposed licence variation is considered to be compliant with WFD requirements.

5.15. Cumulative Impact Assessment

The Infrastructure Planning (EIA) Regulations 2017 requires that the likely cumulative impacts of proposed development(s) be assessed as part of an Environmental Impact Assessment (EIA). In their Guidelines for IEMA (2016), IEMA define cumulative impacts as:

"*…the impacts on the environment which result from incremental impacts of the action when added to other past, present and reasonably foreseeable future actions …*"

Cumulative impacts can be additive or interactive. Typically, additive impacts occur when different project activities have an impact upon the same environmental receptor at the same time. Interactive impacts are assessed in relation to a specific receptor but are caused by the interaction of different types of impacts from project activities, even if these are not significant individually.

To be considered within the cumulative impact assessment (CIA), other plans and projects should meet the following criteria. They should:

- Generate their own residual impacts of at least minor significance;
- Be likely to be constructed or operate over similar time periods to the proposed development (or their environmental consequences have the potential to be realised over the same time period);
- Be spatially linked to the predicted zone of influence of the proposed development; and
- Be either consented or the subject of consent applications with the statutory authorities in the study area or part of another statutory procedure.

Projects which are built and operational are considered to be part of the baseline. However, where it is identified that there are ongoing impacts from built and operational projects, these have been considered within the CIA. For those projects that were only partially constructed, or have only

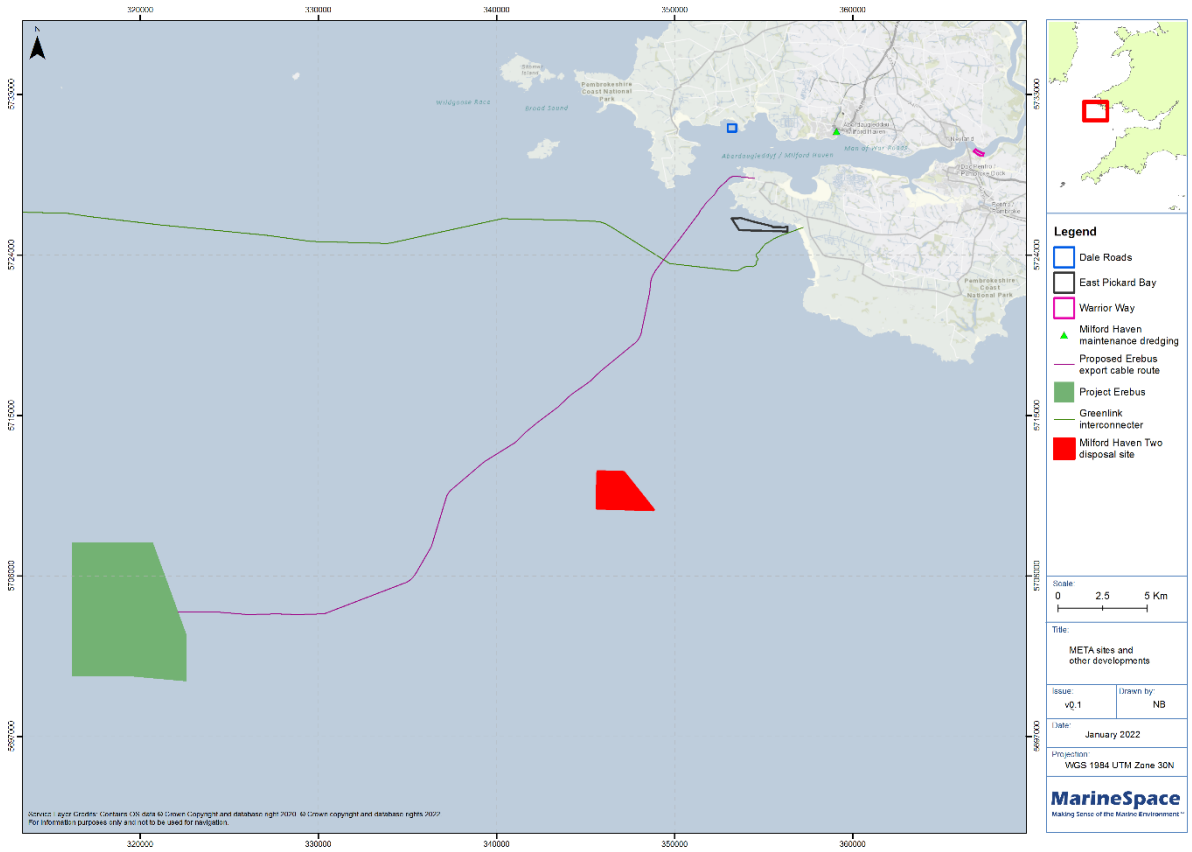
recently been completed, the full extent of the impacts arising from the development(s) may not be known and have therefore been included within assessment.

Based on these criteria, the CIA will consider the developments listed in Table 5.6 (see Figure 5.4).

Table 5.6: Short-list of projects included in cumulate impact assessment (CIA)

Project	Construction Timings
META – East Pickard Bay (Bombora)	Summer 2022 for a maximum duration of 18 months including removal.
Greenlink Interconnector	2023-2024
Milford Haven Maintenance Dredging	Ongoing
Maintenance Dredge Disposal: Milford Haven Two Disposal Site	Ongoing
Project Erebus	2026

Figure 5.4: Location of projects included in cumulate impact assessment (CIA).



It is considered that several of the impacts assessed in Section 5.3-5.14 can be screened out of the cumulative assessment on the basis that any effects are likely to be highly localised or associated with a residual impact of negligible significance. These potential impacts, together with a justification, are presented in Table 5.7.

Table 5.7: Potential impacts screened out of cumulative impact assessment (CIA)

Receptor	Potential Impact	Justification
Coastal Processes	Increases in SSC and deposition of disturbed sediment to the seabed.	The spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in Table 5.6
Coastal Processes	Changes to the hydrodynamic regime due to the operation of tidal turbines.	The spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in Table 5.6
Benthic, Subtidal and Intertidal Ecology	Alteration of benthic habitats resulting from changes to the hydrodynamic regime at Warrior Way.	Section 5.5.3 determined that residual effect will be negligible. As such, this impact pathway is screened out of CIA.
Benthic, Subtidal and Intertidal Ecology	Temporary increases in suspended sediment concentrations and deposition.	The spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in Table 5.6
Fish and Shellfish Ecology	Colonisation of hard structures.	Section 5.6.1 determined that residual effect will be negligible. As such, this impact pathway is screened out of CIA.
Fish and Shellfish Ecology	Tidal turbine collision risk at Warrior Way.	None of the other projects listed in Table 5.6 is considered to present subsea-structure collision risk. As such there is no pathway for cumulative effect.
Fish and Shellfish Ecology	Physical barrier to known migratory routes due to presence of tidal devices at Warrior Way.	None of the other projects listed in Table 5.6 is considered to present risk of barrier effects due to presence of installed structures. As such there is no pathway for cumulative effect.
Marine Archaeology	Removal or disturbance of sediments - buried prehistoric deposits.	Effects of the proposed variation on archaeological receptors are expected to be highly localised. Similarly. the developments listed in Table 5.6 would not be expected to affect known archaeological sites at Warrior Way or Dale Roads. As such, there is no potential for spatial overlap of effects from these projects, and this impact pathway is screened out of CIA.

Receptor	Potential Impact	Justification
Marine Mammals, Basking Shark and Otter	Impacts to otter arising from operational noise of the test devices.	Section 5.4 determined that residual effect on otter will be negligible. As such, this impact pathway is screened out of CIA.
Marine Mammals, Basking Shark and Otter	Collision risk – tidal turbines.	None of the other projects listed in Table 5.6 is considered to present subsea-structure collision risk. As such there is no pathway for cumulative effect.
Ornithology	Subsea collision with development.	None of the other projects listed in Table 5.6 considered to present subsea-structure collision risk. As such there is no pathway for cumulative effect.
Marine Archaeology	Removal or disturbance of archaeological resource – shipwrecks.	Effects of the proposed variation on archaeological receptors are expected to be highly localised. Similarly. the developments listed in Table 5.6 would not be expected to affect known archaeological sites at Warrior Way or Dale Roads. As such, there is no potential for spatial overlap of effects from these projects, and this impact pathway is screened out of CIA.
Other Users	O&M of the META project may displace recreational activities resulting in a loss of recreational resource.	Of the projects listed in Table 5.6, only the META East Pickard Bay introduces potential for cumulative impact in terms of displacement of recreational activities resulting in a loss of recreational resource. The changes proposed within the present variation are not likely to expected to result in any increase in risk of displacement of recreational activities. As such, it is considered there is no pathway for cumulative impact to exceed that assessed within the original META ES (RPS, 2019) and this impact pathway is screened out of cumulative assessment.
Water Framework Directive (WFD)	Hydromorphology.	The spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in Table 5.6.In addition, the magnitude of effect predicted is so low that this would not be expected to result in measurable changes at a waterbody level.

Receptor	Potential Impact	Justification
Water Framework Directive (WFD)	Biology: fish.	None of the other projects listed in Table 5.6 is considered to present risk of barrier effects due to presence of installed structures or subsea-structure collision risk. As such there is no pathway for cumulative effect.

An assessment of the potential cumulative impacts is presented in Table 5.8**Error! Reference source not found.**.

Table 5.8: Assessment of potential impacts screened into cumulative impact assessment (CIA).

Receptor	Potential Impact	Justification
Benthic, Subtidal and Intertidal Ecology	Temporary habitat disturbance.	Habitat loss may be additive across the proposed variation and other projects listed in Table 5.6. However, it is unlikely that other activities, will have a temporal overlap with these works. The total loss over the lifetime of the project is small, and due to the discrete, localised nature of this impact, and the fact that other activities, are sufficiently distant from this project, it is determined that there is **negligible potential for cumulative adverse impact from this pathway**.
Fish and Shellfish Ecology	Medium term habitat loss.	Habitat loss may be additive across the proposed variation and other projects listed in **Error! Reference source not found.**. However, it is unlikely that other activities will have a temporal overlap with these works. The total loss over the lifetime of the project is small, and due to the discrete, localised nature of this impact, and the fact that other activities are sufficiently distant from this project, it is determined that there is **negligible potential for cumulative adverse impact from this pathway**.
Marine Mammals, Basking Shark and Otter	Impacts to marine mammals (other than otter) and fish arising from operational noise of the test devices.	Many of the offshore projects screened into CIA are expected to be associated with a negligible risk of adverse effect on marine mammals or basking shark. The greatest risk will be associated with piling activities (if employed) and UXO clearance for Project Erebus. It should be noted that the ES for this development determined that the risk of acoustic impacts on marine mammal receptors was negligible to minor adverse, and the Project is proposing requesting consent for a single UXO event. Given the low probability of temporal overlap, and small magnitude of effect associated with acoustic disturbance for all projects screened into CIA, **risk for this impact pathway is determined to be Minor**

Receptor	Potential Impact	Justification
		adverse
Marine Mammals, Basking Shark and Otter	Changes in hydrodynamic regime.	Although the spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in **Error! Reference source not found.**, marine mammals and basking shark are highly mobile receptors and may therefore travel between more distant sites. The spatial extent of any effect is considered to be of small magnitude and highly localised. Given the spatial separation of the projects screened into assessment it is expected that any effect on hydrodynamic regime will constitute a negligible proportion of the foraging range for these highly mobile animals. Accordingly, it is determined that there is **negligible potential for cumulative adverse impact from this pathway**. .
Marine Mammals, Basking Shark and Otter	Changes in fish and shellfish communities.	The proposed variation is expected to result in minor adverse effects on local fish and shellfish communities. Similar effect magnitudes may result from the other projects screened into assessment. However, given the localised spatial extent of such effects, and the extensive foraging range of marine mammals and basking shark, **this impact pathway is expected to result in a negligible cumulative effect.**
Seascape	Impact on the designation of Milford Haven Waterway Registered Landscape of Outstanding Historic Interest in Wales.	It is considered that only those projects within Milford Haven Waterway introduce risk of affecting the status of this area as a Registered Landscape of Outstanding Historic Interest in Wales. The projects located in coastal waters are considered sufficiently distant to preclude applicability of this impact pathway. The remaining projects listed in **Error! Reference source not found.** are Milford Haven maintenance dredging and the East Pickard Bay META site. Effects from the East Pickard Bay META site will be limited in terms of spatial extent and the landscape will appear largely unchanged. The seascape within Milford Haven characterised by the presence of recreational boating and shipping activity. As such, it is also considered that Milford Haven dredging activity will have negligible impacts in terms of visible disturbance. Given the small magnitude of change relative to background activity, it is considered that **this impact pathway will result in a negligible cumulative effect.**

Receptor	Potential Impact	Justification
Seascape	Visual impact from viewpoints for receptors using the Pembrokeshire Coast Path along the Cleddau Bridge and across the Daugleddau from publicly accessible coastal viewpoints in Burton Ferry (VP1, VP2).	Given the small area occupied by devices proposed for installation at the META sites, the predominant pathway for cumulative visual impacts on receptors using the Pembrokeshire Coastal Path will be associated with increased vessel traffic. As noted in the noted in the original META ES, Chapter 14: Seascape: "*This busy waterway and port is littered with evidence of commercial shipping and recreational boating including markers buoys, slipways and moorings and a variety of floating vessels ranging from small craft, yachts, tug boats, ferry ships and oil tankers. The oil refinery structures and vertical elements of the power stations and wind turbines elevated on the cliffs above the waterway edges are visible in the view back towards the inner waterway*" (RPS, 2019). Given this background level of vessel traffic, it is considered that the small increase that would be associated with those projects listed in **Error! Reference source not found.** would represent a negligible increase. Given the small magnitude of change relative to background activity, it is considered that **this impact pathway will result in a negligible cumulative effect.**
Seascape	Visual Impact from viewpoints for receptors using the Pembrokeshire Coast Path (VP3, VP4 and VP5).	
Water Framework Directive (WFD)	Biology: benthic habitats.	Habitat loss may be additive across the proposed variation and other projects listed in **Error! Reference source not found.**. However, it is unlikely that other activities, will have a temporal overlap with these works. The total loss over the lifetime of the project is small, and due to the discrete, localised nature of this impact, and the fact that other activities, are sufficiently distant from this project, it is determined that there is **negligible potential for cumulative adverse impact at a waterbody level from this pathway**.
Water Framework Directive (WFD)	Priority species and habitats.	Assessment of cumulative effects on priority species and habitats is limited to those not considered within other WFD receptor classifications (i.e. benthic habitats and fish). The remaining receptors include marine mammals, basking sharks and otters. As determined above, all impact pathways associated with these receptors are associated with **negligible risk of cumulative impact**.
Water Framework Directive (WFD)	Protected areas.	In-combination assessment provided for the HRA (see Section 6.5) concluded that the proposed variation would not result in adverse effects on the integrity of any European Site.

Based on the small spatial scale and low predicted magnitude of effects from the proposed Marine Licence variation, and considering the information available and assessed for all reasonably foreseeable plans and projects**, no significant cumulative impacts are determined**.

6. Information to Inform Habitats Regulations Assessment and Marine Conservation Zone Assessment

An HRA Screening Report (RPS, 2019) and Report to Inform Appropriate Assessment (RPS, 2019) were submitted as part of the original Marine Licence application for the submitted for the META projects. It is not considered that any aspect of the proposed Marine Licence variation will impact the outcomes of the original HRA Screening Report. As such, the following assessment will be limited to consideration of features of UK National network, Natura 2000 or Ramsar sites (hereafter collectively referred to as European Sites) that were identified therein. The aspects of the Project which are proposed for variation and therefore may identify these European sites are identified as:

- Annex I habitat features of the Pembrokeshire Marine/Sir Benfro Forol SAC;
- Migratory fish features of the Pembrokeshire Marine/Sir Benfro Forol SAC and the Afonydd Cleddau/Cleddau Rivers SAC;
- Harbour porpoise features of the West Wales Marine/Gorllewin Cymru Forol SAC and the Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC;
- Grey seal features of the Cardigan Bay/Bae Ceredigion SAC; and
- Classified seabird populations of the Skomer, Skokholm and the Seas off Pembrokeshire/Sgomer, Sgogwm a Moroedd Penfro SPA.

6.1. Annex I Benthic Habitat Assessment

The Pembrokeshire Marine/Sir Benfro Forol SAC (hereto referred as the Pembrokeshire Marine SAC) was designated in December 2004 by the National Assembly for Wales. The 1,380.4 km^2 site is located on, and off from, the southwest Pembrokeshire coastline, spanning from Abereiddy, on the north Pembrokeshire coast, to Manorbier on the south coast. The site includes the coasts of several islands offshore west of Pembrokeshire. The site is designated for the protection of 8 Annex I marine habitats and 7 Annex II species.

It is considered there is possibility that the following Annex I benthic habitat features of the SAC may be affected by the proposed Marine Licence variation (features in **bold** have been identified as a primary reason for site selection):

- **Estuaries (H1130)**;
- **Large shallow inlets and bays (H1160)**;
- **Reefs (H1170)**.

Other Annex I habitats designated within the Pembrokeshire Marine SAC, but not listed above, have been screened out of assessment as they are not known to be present within the footprint, or secondary effects range, of the Warrior Way or Dale Roads sites. It should be noted that conditions of the present marine licence ORML1957v1 (NRW, 2021) stipulate that targeted pre-deployment benthic surveys must be completed to confirm the presence or absence of this feature (and other features of conservation importance). This allows effective micro-siting of devices and their associated mooring systems to avoid sensitive benthic habitats.

6.1.1. Estuaries

6.1.1.1. Temporary Habitat Disturbance

Temporary habitat disturbance that may affect benthic ecology during the O&M phase, will arise from the single mooring spread around the deployed device, with the precautionary approach for a worst-case scenario that the whole area within the mooring spread will be affected. These areas have the potential to be subject to regular disturbance (e.g. sediment disturbance and scouring) as anchor chains sweep across the seabed with changes in tides and currents, which may impact epifaunal benthic species.

The proposed increase in mooring spread for a single device to 22,500 m², alters the spatial spread at the Warrior Way Site from 0.00015 km² to 0.0225 km². The proposed increase in spatial spread at Dale Roads increases the maximum value at this site to 40,000 m², an increase from 0.0002 km² to 0.04 km². These proposed maximum values still correspond with small proportions of the total extent of Annex I Estuaries habitat within the SAC (60.19 km²). Furthermore, as devices are unlikely to be placed within the same footprint each time, this allows some period of recovery to occur during the O&M period.

The entirety of the Milford Haven Waterway, from its mouth to its upper reaches is classified as estuary habitat. Its relevant representative subtidal habitats (Annex I 'Tide swept channels'; and Section 7/OSPAR 'eEstuarine rock' and 'Subtidal mixed muddy sediments') are similarly extensive within the Pembrokeshire Marine SAC (Lle Geo-Portal, 2022a; 2022b). The impact of the proposed variation at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent, long-term duration, but intermittent with high reversibility.

6.1.1.2. Elevated Levels of Suspended Sediment Concentration

The proposed increase in mooring spread may result in associated increase in spatial extent and concentration of suspended sediment mobilised by works activity. Temporary increases in SSC and associated sediment deposition may occur from the movement of catenary chains across the sediment surface that may re-suspended fines into the water column. Any increase in SSC in the water column and associated sediment deposition can impact benthic ecology by increasing water turbidity and smothering sessile species, potentially affecting functioning such as feeding capabilities of filter and suspension feeders.

As assessed in the original META ES, Chapter 7: Subtidal and Intertidal Ecology (META ES, RPS 2019), where sediment is disturbed at the Warrior Way site all but the finest materials (silts and clays etc.) are expected to settle relatively quickly following disturbance. The plume itself is predicted to have SSC of <40 mg/l up to 100 m from the site, and will settle within 2 hours. These levels are within the range of background levels reported for Milford Haven waterway. At Dale Roads, the finest materials (silts and clays etc.) are expected to travel <600 m from the source, and will be associated with SSC increases of <50 mg/l, which is within range of that experienced under storm conditions.

This assessment had been based on the disturbance of the sediments during installation activities, and plume created during O&M through contact between the mooring chains and the seabed surface would be associated with less severe effects, but over a longer duration (e.g. the Project lifetime). As such, the magnitude of potential increases in SSC and associated sediment deposition

arising during the O&M phase from the mooring spread will occur across a localised spatial extent but be of long-term duration (albeit intermittent). Annex I 'Estuaries' are assessed to be of medium vulnerability, high recoverability and very high value and, as such, its sensitivity to elevated SSC is considered to be low.

6.1.1.3. Alteration of Benthic Habitats Resulting from Changes to the Hydrodynamic Regime at Warrior Way

During the O&M phase, the installation of tidal current devices which use impellor or turbine technology to extract kinetic energy from the tidal flow, may result in changes in hydrodynamic regime that, in turn, may affect benthic ecology. Changes in hydrodynamic regime can include alteration to flow conditions, wave regime and sediment transport pathways, which may lead to changes in sediment type and structure, and thus the supported benthic assemblages of these altered habitats). Warrior Way is the only META Site where scaled and micro-scaled tidal devices may be deployed.

The variation seeks to increase the maximum design scenario for the speed of moving parts of these devices from ≤5 m/s to ≤10 m/s, and increase the rotor swept area to allow for up to 3 rotors; resulting in an increase in total rotor swept area from 19.63 m² (0.00002 km²) to 58.89 m² (0.00006 km²). It is considered unlikely that this will cause any significant alteration of the local hydrodynamic regime, and thus any potential impacts on benthic habitats and their supported communities.

The impact of the proposed variation in tidal device rotor design at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent (a single scaled/micro-scaled device at any one time), short-term duration, continuous (when device is in operation), but reversible. Estuaries are considered to have low sensitivity to changes in hydrodynamic regime and high recoverability.

With respect to the conservation objectives for the SAC, there is no indication that any of the pressures discussed will lead to a reduction in environmental quality, nor will they inhibit natural environmental processes. It is predicted that there will be a small loss of habitat extent, however, this will be temporary, and recovery is expected to occur rapidly following cession of disturbance. Therefore, it is determined that there is **no potential for an adverse effect on integrity, having regard to the conservation objectives of subtidal Estuary features of the Pembrokeshire Marine SAC from any pressures assessed.**

6.1.2. Large Shallow Inlets and Bays

6.1.2.1. Temporary Habitat Disturbance

Annex I 'Large Shallow Inlets and Bays' is an extensive feature within the Pembrokeshire Marine SAC (203.85 km^2) and encompasses the entirety of the Milford Haven Waterway and St Brides Bay. Its relevant representative subtidal habitat (Annex I 'Tide Swept Channels') is similarly extensive within the SAC (Lle Geo-Portal, 2022a; 2022b).

As detailed in 6.1.1, the proposed increase in maximum mooring spread value represents a small area, and benthic habitat disturbance from anchor chain sweep will be limited to this spatial extent. Any adverse effects at the Warrior Way and Dale Roads sites are predicted to be of local spatial

extent, long-term duration, but intermittent with high reversibility. Given that devices are unlikely to be placed within the same footprint each time, this allows some period of recovery to occur during the O&M period.

6.1.2.2. Elevated Levels of Suspended Sediment Concentration

Annex I 'Large Shallow Inlets and Bays' are assessed to be of medium vulnerability, high recoverability and very high value and, as such, their sensitivities to elevated SSC are considered to be low. Based on the small magnitude of SSC increase expected for the proposed variation, and the low receptor sensitivity to this pressure, it is concluded that any effects on this habitat will be short-term and habitat quality will not be degraded in the long-term.

6.1.2.3. Alteration of Benthic Habitats Resulting from Changes to the Hydrodynamic Regime at Warrior Way

The impact of the proposed variation in tidal device rotor design at Warrior Way, for the O&M phase of the project, is predicted to be of local spatial extent (a single scaled/micro-scaled device at any one time), short-term duration, continuous (when device is in operation), but reversible. Annex I 'Large Shallow Inlets and Bays' are considered to be of low sensitivity to changes in hydrodynamic regime and to have high recoverability. Given the localised nature of any change in hydrodynamic regime and low receptor sensitivity, it is considered the proposed variation will not result in adverse effect on this Annex I habitat.

With respect to conservation objectives, above and beyond the general overarching site conservation objectives outlined for all features within the Pembrokeshire Marine SAC, NRW emphasises the requirement for restoration of several typical species within Annex I 'Large Shallow Inlets and Bays'. Given the rapid recovery of typical species and the dynamic nature of this environment, there is no indication that the highly localised and temporary habitat disturbance will negatively affect typical species, or the structure and functioning within this habitat. As such, it is determined that there is **no potential for an adverse effect on integrity, having regard to the conservation objectives of large shallow inlets and bays features of the Pembrokeshire Marine SAC from any pressures assessed**.

6.1.3. Reefs

There are no Annex I 'Reef' habitats within the direct footprint of either the Dale Roads or Warrior Way sites. As such, there is no pressure-pathway for effects from temporary habitat disturbance. In addition, any effects from changes to hydrodynamic regime will be highly localised; as such, it is considered there is also no pathway for this pressure to affect Annex I 'Reef'.

6.1.3.1. Elevated Levels of Suspended Sediment Concentration

EMODnet had indicated that the communities associated with areas of Annex I subtidal (rocky) 'Reef' within the vicinity of the Warrior Way are representative of the biotope 'cushion sponges, hydroids and ascidians on turbid tide-swept sheltered circalittoral rock' (CR.MCR.CfaVS.CuSpH). Lle Geo-Portal (2022a) reports records of the biotope CR.MCR.CFaVs.CuSpH.As ('Cushion sponges, hydroids and ascidians on turbid tide-swept sheltered circalittoral rock') present in the western vicinity of Dale Roads. The Marine Evidence Based Sensitivity assessment (MarESA) available for its

parent biotope CR.MCR.CfaVS ('Circalittoral faunal communities in variable salinity') reports these communities are comprised of a diverse range of sponges, hydroids and ascidians that are often silt-tolerant. They are assessed to not be sensitive to any change in suspended solids (water clarity), where they have a high resistance and resilience to this pressure. If any associated increases in deposition of sediment arise during the O&M phase, it is predicted to be light, and this biotope has a low sensitivity to this pressure where it has medium resistance and high resilience to any change in smothering and siltation rate (Readman, 2016).

Activities associated with the proposed licence variation will not affect distribution or extent of Annex I reef within the Pembrokeshire Marine SAC. Although increased sediment disturbance may lead to increased silt deposition, any change will be small. Given the low sensitivity of Annex I reef, there is no indication that the expected small increase in SSC will negatively affect structure and functioning within this habitat. Accordingly, it is determined that there is **no potential for an adverse effect on site integrity, having regard to the conservation objectives of intertidal reef features of the Pembrokeshire Marine SAC from any pressures assessed**.

6.2. Annex II Migratory Fish Species

Design changes that have the potential to alter the results of the original assessment in relation to the increased collision risk or barrier effect migratory fish species (at the Warrior Way site only), or through indirect effects on foraging habitats (at both Warrior Way and Dale Road sites).

The following Annex II migratory fish species are listed as designated features of the Pembrokeshire Marine/Sir Benfro Forol SAC and screened into assessment:

- River lamprey *Lampetra fluviatilis;*
- Sea lamprey *Petromyzon marinus;*
- Twaite shad *Alosa fallax*;
- Allis shad *Alosa alosa.*

The following Annex II migratory fish species are listed as designated features of the Afonydd Cleddau/Cleddau Rivers SAC and screened into assessment:

- River lamprey*;*
- Sea lamprey.

6.2.1. Tidal Turbine Collision Risk at Warrior Way

Design changes with the potential to alter results of the original assessment in relation to the risk to migratory fish species are proposed for the Warrior Way site only. The assessment of this impact on fish and shellfish for the Dale Roads site therefore remains the same as in the original assessment (as presented in META ES, Chapter 8: Fish and Shellfish; RPS, 2019). The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation relevant to effects on migratory fish species (tidal turbine collision risk and risk of barrier effects) are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors), and an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s.

The width of the Cleddau river at the location of Warrior Way is 330 m between MLWS at opposite banks. The diameter of each of the 3 rotors equals 5 m for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. With a tip speed of 10 m/s (0.5 m/s slower than that proposed within this variation) the survival rate of fish within the presence of a turbine has been recorded at 100% for a range of species, with no recorded injuries or deaths (Zhang *et al.*, 2016). In view of this, it is considered there is negligible risk that the presence of this device will adversely impact the migratory fish features of the Afonydd Cleddau/Cleddau Rivers SAC or those of the Pembrokeshire Marine/Sir Benfro Forol SAC travelling to or from clean river gravels in upstream freshwater.

6.2.2. Physical Barrier to Movement of Known Migratory Routes due to Presence of Tidal Devices at Warrior Way

The changes proposed in this variation relevant to the barrier effects are limited to an increase in the number of rotors from 1 rotor to 3 rotors, and an increase in total swept area from 19.63 m^2 (for 1 rotor) to 58.89 m^2 (for 3 rotors). The presence of the turbine has the potential to cause a barrier to the movement of migratory fish and prevent them from reaching breeding/feeding grounds. However, the diameter of each of the 3 rotors equals 5 m for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. Any barrier effects are therefore likely to be restricted to a small area of the total available migratory route. Given the small proportion of the water column that will be affected, the increase in number of rotors covered by the present variation is not expected to result in an adverse impact on the migratory fish features of the Afonydd Cleddau/Cleddau Rivers SAC or those of the Pembrokeshire Marine/Sir Benfro Forol SAC travelling to or from clean river gravels in upstream freshwater.

6.2.3. Habitat Loss

The changes proposed in this variation relevant to potential medium term habitat loss are limited to an increase in the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way, and from 200 m^2 to 40,000 m^2 at Dale Roads. These areas have the potential to undergo regular disturbance as anchor chains move across the seabed with changes in tides and currents.

River and sea lamprey larvae remain in areas of clean river gravels before migrating to estuaries and inshore waters from feeding grounds as juveniles. Similarly, allis and twaite shad (not listed as designated species for the Afonydd Cleddau/Cleddau Rivers SAC) use the Pembrokeshire Marine SAC area as an access corridor between their freshwater spawning grounds in rivers and the open sea. As such, only juvenile fish migrating to open waters from estuarine feeding grounds, and adults in coastal waters or during migration back to their freshwater spawning grounds, may be affected by direct habitat loss/disturbance/alteration. Accordingly, only juvenile fish migrating to open waters from estuarine feeding grounds, and adults during migration back to their freshwater spawning grounds, may be affected by direct habitat loss/disturbance/alteration. Therefore, assessment of this pressure for these species will be limited to juvenile and adult phases (i.e. excludes larval phase).

The habitats at Warrior Way and Dale Roads do not constitute a unique habitat for the Annex II species considered in this assessment. In their juvenile/adult stages all of the migratory fish species designated under the Afonydd Cleddau/Cleddau Rivers SAC and/or the Pembrokeshire Marine/Sir

Benfro Forol SAC are widely distributed, providing capacity to adaptively exploit alternative areas if faced with localised and temporary habitat loss/disturbance/alteration.

With respect to conservation objectives for designated Annex II migratory fish populations of the Afonydd Cleddau/Cleddau Rivers SAC and the Pembrokeshire Marine/Sir Benfro Forol SAC, there is no evidence to suggest that the proposed project activities will negatively affect long-term population viability. Although activities may lead to temporary loss/disturbance of supporting habitats, these do not constitute key habitats and are not expected to adversely affect distribution within the natural range of designated populations. Barrier effects and collision risk are expected to pose a negligible risk at a population level. It is therefore determined that there is **no potential for an adverse effect on integrity, having regard to the conservation objectives of migratory fish features of the Afonydd Cleddau/ Cleddau Rivers SAC or those of the Pembrokeshire Marine/Sir Benfro Forol SAC from any pressures assessed**.

6.3. Annex II Marine Mammal Species

Design changes that have the potential to alter the results of the original assessment in relation to the increased anthropogenic noise of tidal turbines on marine mammals are proposed only for the Warrior Way ite. As such, the assessment of this impact at the Dale Roads site remains unchanged from the original assessment.

The following Annex II marine mammal species are screened into assessment:

- Harbour porpoise features of West Wales Marine/Gorllewin Cymru Forol SAC;
- Harbour porpoise features of Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC;
- Grey seal features of the Cardigan Bay/Bae Ceredigion SAC.

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation relevant to effects on marine mammal receptors (tidal turbine collision risk, acoustic disturbance and risk of barrier effects) are limited to an increase in the number of rotors from 1 rotor to 3 rotors (for an increase in total swept area from 19.63 m² to 58.89 m²), and an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s.

6.3.1. Potential Barrier Effects

The width of the Cleddau river at the location of Warrior Way is 330 m between MLWS at opposite banks. The diameter of each of the 3 rotors equals 5 m for a total of 15 m. This equates to 4.55% (maximum scenario) of the tidal stream cross-sectional area at this location. Any barrier effects are therefore likely to be restricted to a small area of the total available water column available to these animals. It is expected that this can be easily avoided by these highly mobile animals.

6.3.2. Subsea Acoustic Disturbance

Following a reassessment of underwater noise in Section 5.4: Underwater Noise, it is determined that the changes proposed within this variation are not likely to result in an increase in levels of underwater noise. Accordingly, the proposed variation will not result in any change in subsea noise, and this pressure is screened out of any further assessment.

6.3.3. Collision Risk

In terms of collision risk, it is highly likely that animals within the Waterway are adjusted to high traffic levels and are practised at avoiding these obstacles. Furthermore, it is predicted few cetaceans and basking shark passage down the Waterway as far as Warrior Way, and grey seal are only found in proximity to the site in low abundances (based on sightings data).

With respect to the conservation objectives of the West Wales Marine/Gorllewin Cymru Forol SAC, the Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC for harbour porpoise, and the Cardigan Bay/Bae Ceredigion SAC for grey seal, considering the very low percentage of the Management Unit (MU) reference populations that may potentially interact with the project sites, and in view of the low magnitude of risk, there is no indication that project effects will impact the population viability. There is also no evidence to suggest that this pressure would adversely impact any other factor required to maintain the favourable conservation status. It can therefore be concluded that there is **no potential for an adverse effect on integrity, having regard to the conservation objectives of the harbour porpoise feature of the West Wales Marine/Gorllewin Cymru Forol SAC, the Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC, or the grey seal feature of the Cardigan Bay/Bae Ceredigion SAC from any pressures assessed**.

6.4. Classified Seabird Populations

Design changes that have the potential to alter the results of the original assessment in relation to the increased number of rotors on tidal turbines are proposed only for the Warrior Way site. As such, the assessment of this impact at the Dale Roads site remains unchanged from the original assessment.

The following classified seabird species are listed for the Skomer, Skokholm and the Seas off Pembrokeshire/Sgomer, Sgogwm a Moroedd Penfro SPA and screened into assessment:

- Atlantic puffin *Fratercula arctica*;
- European storm petrel *Hydrobates pelagicus*;
- Lesser black-backed gull *Larus fuscus*;
- Manx shearwater *Puffinus puffinus*;
- Razorbill *Alca torda*;
- Common guillemot *Uria aalge*;
- Black-legged kittiwake *Rissa tridactyla.*

6.4.1. Subsea Collision Risk

The proposed design changes may result in increased subsea collision risk to marine ornithological receptors at the Warrior Way site. Conclusions presented in the original Project HRA screening Report (RPS, 2019a) and Report to Inform Appropriate Assessment (META ES; RPS, 2019) are considered to remain valid for all other pressure pathways.

The most likely design scenario for Warrior Way is represented by a single floating device deployment. The changes proposed in this variation relevant to subsea collision risk are limited to an increase in the number of rotors from 1 rotor to 3 rotors, an increase in total swept area from

19.63 m² (for 1 rotor) to 58.89 m² (for 3 rotors), and an increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s. This equates to 4.55% of the tidal stream cross-sectional area at this location.

Seabird collision with the development is unlikely. This is due to the project's small, localised scale, and proximity to suitable alternative habitat. Classified bird species of the Skomer, Skokholm and the Seas off Pembrokeshire SPA are either pelagic surface feeders, or use short/shallow dives to catch their prey, reducing their risk of collision. Additionally, in proximity of the development, most species are present in very low numbers (between 0.08-6 animals per 3 km²). The site is not considered to represent a unique foraging habitat and extensive alternative areas of similar habitat are available in the surrounding waters. The potential impact for the proposed variation at Warrior Way is considered to be of long-term duration, intermittent and irreversible.

There is no evidence to suggest that subsea collision risk will adversely affect the long-term viability of seabird populations. Therefore, it is assessed that **no potential for an adverse effect on integrity, having regard to the conservation objectives of all classified populations of the Skomer, Skokholm and the Seas off Pembrokeshire SPA from subsea collision risk.**

6.5. In-combination Assessment

Environmental impacts arising from the proposed Marine Licence variation have the potential to combine with impacts resulting from other seabed user activities. A short list of other projects for consideration within the in-combination assessment has been drawn up in accordance with the criteria detailed in Section **Error! Reference source not found.** (Cumulative Impact Assessment).

Based on these criteria, the in-combination assessment will consider the developments listed in Table 6.1 (locations illustrated in Figure 5.4).

Table 6.1: Short-list of projects included in cumulate impact assessment (CIA)

Project	Construction Timings
META – East Pickard Bay (Bombora)	Summer 2022 for a maximum duration of 18 months including removal.
Greenlink Interconnector	2023-2024
Milford Haven Maintenance Dredging	Ongoing
Maintenance Dredge Disposal: Milford Haven Two Disposal Site	Ongoing
Project Erebus	2026

It is considered that several of the impacts assessed in Section 6.1-6.4 can be screened out of the cumulative assessment on the basis that any effects are likely to be highly localised or associated with negligible risk of adverse effect on European Sites. These potential impacts, together with a justification, are presented in Table 6.2.

Table 6.2: Pressures screened out of in-combination assessment

Receptor	Pressure Pathway	Justification
Annex I Benthic Habitats	Elevated levels of suspended sediment.	The spatial extent of associated effects is not expected to be sufficient to interact with effects envelope of the other projects listed in Table 6.1. In addition, the spatial extent of any sediment plumes is considered too small to result in any meaningful contribution to in-combination effects on the extensive Annex I habitats screened into assessments.
Annex I Benthic Habitats	Alteration of benthic habitats resulting from changes to the hydrodynamic regime at Warrior Way.	The spatial scale of this effect is considered to be negligible. As such, it is considered there is no potential for this pathway to contribute to in-combination effects on Annex I habitats within the SAC.
Annex II Migratory Fish Species	Tidal turbine collision risk at Warrior Way.	None of the other projects listed in Table 6.1 is considered to present subsea-structure collision risk. As such there is no pathway for in-combination effect.
Annex II Migratory Fish Species	Physical barrier to known migratory routes due to presence of tidal devices at Warrior Way.	None of the other projects listed in Table 6.1 is considered to present risk of barrier effects due to presence of installed structures. As such there is no pathway for in-combination effect.
Annex II Migratory Fish Species	Habitat loss.	The spatial extent of potential habitat loss is considered to be negligible relative to amount of similar habitat available elsewhere. Fish species are also expected to be transient, passing through the area to or from breeding grounds. This is expected to minimise the temporal window for effects. Given the small scale of effect and temporally limited receptor pressure interaction, it is considered that there is no risk of adverse in-combination effect from habitat loss on Annex II migratory fish species.

Receptor	Pressure Pathway	Justification
Annex II Marine Mammals	Potential barrier effects.	None of the other projects listed in Table 6.1 is expected to create a barrier to marine mammal movement. As such there is no pathway for in-combination effect.
Annex II Marine Mammals	Subsea acoustic disturbance.	Considered within in-combination assessment below.
Annex II Marine Mammals	Collision risk.	None of the other projects listed in Table 6.1 is considered to present subsea-structure collision risk. As such there is no pathway for in-combination effect.
Classified Seabird Populations	Subsea collision with development.	None of the other projects listed in Table 6.1 is considered to present subsea-structure collision risk. As such there is no pathway for in-combination effect.

The remaining pressures screened into appropriate assessment that should be assessed for potential in-combination effects are:

- Temporary habitat disturbance to Annex I benthic habitats;
- Subsea acoustic disturbance to Annex II marine mammal species.

An assessment of the potential in-combination effects from these pressures is presented below.

6.5.1. Temporary Habitat Loss/Disturbance to Annex I Benthic Habitats

The temporary habitat loss/disturbance due to the proposed variation may affect benthic ecology during the O&M phase, will arise from the single mooring spread around the deployed device, with the precautionary approach for a worst-case scenario that the whole area within the mooring spread will be affected. These areas have the potential to be subject to regular disturbance (e.g. sediment disturbance and scouring) as anchor chains sweep across the seabed with changes in tides and currents, which may impact epifaunal benthic species. The proposed increase in mooring spread for a single device to 22,500 m², alters the spatial spread at the Warrior Way site from 0.00015 km² to 0.0225 km². The proposed increase in spatial spread at Dale Roads increases the maximum value at this site to 40,000 m², an increase from 0.0002 km² to 0.04 km².

Habitat loss/disturbance from the proposed works may interact with Annex I 'Estuaries' and Annex I 'Large shallow inlets and bays'. Of the other projects screened into in-combination assessment, only maintenance dredging at Milford Haven, and only a small portion of cable installation and O&M activities (those at landfall) for the GreenLink Interconnector and Erebus floating offshore wind development, may interact with these Annex I habitats. Both Annex I 'Estuaries' and Annex I 'Large

shallow inlets and bays' are extensive habitats within the Pembrokeshire Marine SAC and the spatial extent of affected habitat will constitute a small proportion of total available similar habitat. Any benthic disturbance will be temporary and would be expected to recover quickly following cessation of disturbance.

With respect to the conservation objectives for the SAC, there is no indication that in-combination temporary habitat loss/disturbance will lead to a reduction in overall environmental quality, nor will it inhibit natural environmental processes. It is predicted that this small extent of habitat loss/disturbance will be a temporary effect, and recovery is expected to occur rapidly following cession of disturbance. Therefore, it is determined that there is **no potential for an in-combination adverse effect on integrity, having regard to the conservation objectives features of the Pembrokeshire Marine SAC from temporary habitat loss/disturbance.**

6.5.2. Subsea Acoustic Disturbance to Annex II Marine Mammal Species

Turbine noise from the proposed deployment at Warrior Way is expected to be low and not strongly discernible above baseline noise levels at Warrior Way. Cetaceans and grey seals are known to exhibit avoidance behaviours in response to tidal turbine noises (Heinanen and Skov, 2015; Hastie *et al*, 2017). In addition, cetacean and seal abundances at Warrior Way are relatively low, and so it is expected that there will be relatively few instances where these animals interact with project effects.

Of the other projects screened into in-combination assessment, potential for acoustic disturbance on marine mammal receptors may be presented by UXO clearance during construction of the Greenlink Interconnector and UXO clearance or pile driving during construction of the Erebus floating offshore wind development. Both of these developments have committed to employing marine mammal impact mitigation measures to reduce the risk of auditory disturbance to negligible levels. Given the low level of acoustic disturbance predicted for turbine operation at Warrior Way (relative to background noise levels), the spatial separation between Warrior Way and the other projects screened into in-combination assessment, and the mitigation measures that will be employed at Greenklink and Erebus, it is determined there is no risk of adverse effects on the integrity of designated harbour porpoise populations of the West Wales Marine/Gorllewin Cymru Forol SAC and Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC, or grey seal designated for the Cardigan Bay/ Bae Ceredigion SAC.

With respect to the conservation objectives of the West Wales Marine SAC and Bristol Channel Approaches SAC for harbour porpoise, and the conservation objectives of the Cardigan Bay SAC for grey seal, considering the very low percentage of the MU reference populations that may potentially interact with the project sites, and in view of the low magnitude of risk, there is no indication that subsea acoustic disturbance effects will impact the population viability. There is also no evidence to suggest that this pressure would adversely impact any other factor required to maintain the favourable conservation status. It can therefore be concluded that there is **no potential for an in-combination adverse effect on integrity, having regard to the conservation objectives of the harbour porpoise feature of the West Wales Marine SAC or Bristol Channel Approaches SAC, or the grey seal feature of the Cardigan Bay SAC from subsea acoustic disturbance**.

6.6. Marine Conservation Zone (MCZ) Assessment

The only Marine Conservation Zone (MCZ) within 40 km from the META Sites is the Skomer MCZ (located 20.3 km from Warrior Way and 6.6 km from Dale Roads). This MCZ was designated for protection of the following features:

- Grey seal *Halichoerus grypus*;
- Pink seafan *Eunicella verrucose*;
- Sponge communities;
- Eelgrass *Zostera marina*;
- Algal communities.

There is no impact pathway between the proposed works and the benthic community features of this site, due the high spatial separation relative to the expected maximum secondary impact (plume) extent. It is therefore concluded that there is **No Likely Significant Risk to pink seafan, sponge community, eelgrass or algal community features of the Skomer MCZ**.

Grey seal are highly mobile animals and therefore may interact with the effects associated with the META Sites. However, grey seal have been screened into the Habitat Regulation Assessment (HRA) for the Cardigan Bay/Bae Ceredigion (SAC) and therefore this protected feature is assessed as part of the HRA. Seals are managed in seal management units (SMUs), which consider distinct populations. The designated grey seal populations listed for the SAC sites considered within the RIAA are part of the same population (the wider OSPAR region III SMU). This assessment is presented in Section 6.3, and concludes that there is no potential for an adverse effect on integrity of the grey seal feature of the Cardigan Bay SAC from any pressures assessed. It is therefore determined that there is also **No Likely Significant Risk to grey seal of the Skomer MCZ**.

7. Conclusions

This report presents details of the impact assessment for the proposed variations to META, Warrior Way and Dale Roads Sites, from the PDE consented under Marine Licence ORML1957v1 (NRW, 2021) and Planning Permission, reference 20/0756/PA, approved by PCC in August 2021. An updated WFD assessment; HRA Screening and Test for Likely Significant Effect have also been undertaken.

The variations include:

- An increase in the speed of moving parts from ≤5 m/s to ≤10.5 m/s at Warrior Way;
- An increase in the number of rotors on a single device at Warrior Way from 1 rotor to 3 rotors. The currently consented maximum diameter per rotor (≤5m) will remain the same, however the total swept area will increase from 19.63 m^2 (for one rotor) to 58.89 m^2 (for three rotors);
- An increase in the height of structures above the water surface from <2 m to <5 m within a discrete footprint of 10 m x 10 m at both Warrior Way and Dale Roads;
- An increase in the area of the mooring spread from 150 m^2 to 22,500 m^2 at Warrior Way; and
- An increase in the area of the mooring spread from 200 m^2 to 40,000 m^2 at Dale Roads.

Following screening of the original ES topics and impacts (RPS, 2019) a shortlist of impacts was identified where the variations proposed may affect the outcomes of the original META ES (RPS, 2019), specifically the magnitude of impact and consequently the significance of effect.

In summary, the following key conclusions can be reached with respect to the potential environmental impacts of the proposed variations:

- Due to the limited magnitude and temporal extent of the planned variations the assessment for coastal process has not changed from the original assessment and a minor adverse significance is predicted;
- The original underwater noise assessment modelled source noise levels that were sufficiently conservative to capture any potential increases in noise arising from the proposed variation to rotors and therefore assessments relating to fish and marine mammals, basking shark and otters have not required reassessment;
- A minor(adverse) significance has been identified for benthic habitat receptors for all impacts due to the limited impact of disturbance, increases in SSC and changes in the hydrodynamic regime;
- Negligible to minor (adverse) significance is predicted on fish and shellfish from colonisation, habitat loss, collision risk and physical barriers due to the localised scale, medium term and reversibility of the proposed variations;
- Collision risk and changes in the hydrodynamic regime associated with the variations will not result in any significant increase in spatial extent or reduction in energy affecting marine mammals, basking shark or otters, and no more than minor (adverse) significance has been predicted;
- Due to the localised scale and intermittent nature no greater than minor (adverse) significance has been predicted for marine ornithology;

- Negligible to minor (adverse) significance has been identified for commercial fisheries in respect of the potential loss of fishing grounds and damage to fishing equipment. This is further mitigated by conditions stipulated in ORML1957v1 (NRW, 2021);
- The limited spatial extent of the impacts associated with the variations, limits the significance to marine archaeology to minor (adverse);
- The impact assessment on seascape reflects the significance identified in the original META ES (RPS, 2019) of moderate and significant adverse effect but does not exceed that concluded for East Pickard Bay, which was substantial (RPS, 2019);
- Minor (adverse) significance is predicted on other users due to the localised and intermittent nature of the proposed variations;
- No non-temporary deterioration of WFD status is likely to occur and the Western Wales RBD, Milford Haven Inner transitional and Milford Haven Outer coastal waterbody, will not be prevented from achieving their WFD objectives;
- Based on the small spatial scale and low predicted magnitude of effects and considering the information available and assessed for all reasonably foreseeable plans and projects, no significant cumulative impacts are determined;
- There is no potential for an adverse effect on integrity, having regard to the conservation objectives of features of the Pembrokeshire Marine SAC; West Wales Marine SAC; Bristol Channel Approaches SAC; Skomer, Skokholm and the Seas off Pembrokeshire SPA; and Cleddau Rivers SAC from any pressures assessed;
- There is no potential for an in-combination adverse effect on integrity, having regard to the conservation objectives features of the Pembrokeshire Marine SAC; West Wales Marine SAC; Bristol Channel Approaches SAC; and Cardigan Bay SAC from any pressures assessed; and
- There is No Likely Significant Risk to pink seafan, sponge community, eelgrass, algal community or grey seal features of the Skomer MCZ.

With the exception of seascape, none of the above is significant in EIA terms or results in an adverse effect on integrity. The effects on seascape are considered to be mitigated by the intermittent and temporary nature of the proposed test devices.

8. References

Baines ME, and Evans PG, 2009. *Atlas of the marine mammals of Wales*. Countryside Council for Wales.

Baines ME, and Evans PGH, 2012. Atlas of the Marine Mammals of Wales. CCW Monitoring Report No. 68. 2nd Edition. 139pp

Bohn K, 2014. The distribution and potential northwards spread of the invasive slipper limpet *Crepidula fornicata* in Wales, UK. NRW Evidence Report No: 40, 43pp, Natural Resources Wales, Bangor.

Brooker A, Barham R, and Mason T, 2012. Underwater noise modelling technical report. Subacoustech Ltd. E287R0919.

BTO WeBS, 2013-2016. Wetland Bird Survey Data, Available online at: Wetland Bird Survey Data | BTO - British Trust for Ornithology [Accessed: January 2022]

Carey DA, Hayn M, Germano JD, Little DI, and Bullimore B, 2015. Marine habitat mapping of the Milford Haven Waterway, Wales, UK: Comparison of facies mapping and EUNIS classification for monitoring sediment habitats in an industrialized estuary. Journal of Sea Research Volume 100, June 2015, Pages 99-119.

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

Cefas, 2016. Suspended Sediment Climatologies around the UK

Ellis JR, Miligan SP, Readdy L, Taylor N, and Brown MJ, 2012. Spawning and nursery grounds of selected fish species in UK waters. Science Series Technical Report No. 147.

EMODnet, 2016. EMODnet Seabed habitats. Available online at: https://www.emodnet-seabedhabitats.eu/ [Accessed January 2022].

Evans PGH, Anderwald P, and Baines ME, 2003. UK Cetacean Status Review. Report to English Nature and Countryside Council for Wales, Oxford.

Germano and Associates, 2013. Sediment-Profile Imaging Survey of Milford Haven Waterway, Wales, UK - May 2012. Report to the Milford Haven Waterway Environmental Surveillance Group from Germano & Associates, Inc., Seattle, Washington, USA. vii&34pp + tables, figures and appendices.

Ghoul A, and Reichmuth C, 2012. Sound Production and reception in southern sea otters (*Enhydra lutris nereis*). In: Popper AN, Hawkins A (eds). The Effects of Noise on Aquatic Life. Advances in Experimental Medicine and Biology, 730.

Hammond PS, 1995. Estimating the abundance of marine mammals: a North Atlantic perspective. In Developments in Marine Biology, Elsevier Science, 4, pp. 3-12.

Hastie GD, Russell DJF, Lepper P, Elliot J, Wilson B, Benjamins S, and Thompson D, 2017. Harbour seals avoid turbine noise: Implications for collision risk, Journal of Applied Ecology, 55 (2) 684-693.

Heinänen S, and Skov H, 2015. The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area, JNCC Report No.544 JNCC, Peterborough.

IEMA, 2016. Environmental Impact assessment: A guide to delivering quality development.

JNCC, 2007. Second UK Report on the implementation of the Habitats Directive from January 2001 - December 2006. Peterborough: JNCC. Available from: [ARCHIVED CONTENT] Article 17 Habitats Directive report (nationalarchives.gov.uk) [Accessed: January 2022]

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

Lepper PA, and Robinson SP, 2016. Measurement of underwater operational noise emitted by wave and tidal stream energy devices. The Effects of Noise on Aquatic Life II.

Lle Geo-Portal, 2022a. Lle. A Geo-Portal For Wales. Marine Article 17 Habitats Features. Available online at: https://lle.gov.wales/catalogue/item/MarineArt17Features/?lang=en. [Accessed: January 2022].

Lle Geo-Portal, 2022b. Lle. A Geo-Portal for Wales. Environment (Wales) Act Section 7 and OSPAR: Marine Habitats. Available online at: https://lle.gov.wales/catalogue/item/MarineBAPOSPARHabitats/?lang=en. [Accessed January 2022].

Lle Geo-Portal, 2022c. Lle. A Geo-Portal for Wales. European Seabirds at Sea (ESAS) Data Set, Provided by NRW, Available online at: Lle - Seabirds at Sea (gov.wales) [Accessed: January 2022]

Marine Current Turbines (MCT), 2005. Strangford Lough Marine Current Turbine Environmental Statement

McCave IN, and Syvitski JPM, 1991. Principles and methods of geological particle size analysis, in, Syvitski JPM (Ed.) Principles, methods, and Application of Particle Size Analysis: Cambridge, pp. 3-22.

Miller PI, Scales KL, Ingram SN, Southall EJ, and Sims DW, 2015. Basking sharks and oceanographic fronts: quantifying associations in the north-east Atlantic. Functional Ecology, 29(8), pp.1099-1109.

NBN, 2022a. *Crepidula fornicata* (Linneaus, 1758) American slipper limpet. Available online at: https://species.nbnatlas.org/species/NBNSYS0000174750 [Accessed January 2022].

NBN, 2022b. *Magallana gigas* (Thunberg, 1793) Pacific Oyster. Available from: https://species.nbnatlas.org/species/NHMSYS0021185273. [Accessed January 2022].

NRW (Natural Resources Wales), 2018a. Guidance for assessing activities and projects for compliance with the Water Framework Directive. OGN 72.

NRW, 2018b. Pembrokeshire Marine/Sir Benfro Forol Special Area of Conservation. Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017. Available from: https://cdn.cyfoethnaturiol.cymru/media/687999/eng-pembrokeshire-marine-reg-37-report-2018.pdf [Accessed January 2022]

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

NRW, 2021a. Marine Energy Test Areas (META) Phase 2 Sites: Warrior Way, Dale Roads and East Pickard Bay, within and in proximity to the Milford Haven waterway, Pembrokeshire; Licence Number: ORML1957v1.

NRW, 2020. Marine Licence Consultation: Pre-deployment Benthic Survey Plan: Warrior Way & Dales Roads. Memo (15 July 2021).

Parvin SJ, and Brooker AG, 2008. Measurement and Assessment of Underwater Noise from Crest Energy/OpenHydro Tidal Turbine at the EMEC Facility, Orkney. 812R0101. Subacoustech Ltd.

Pawson MG, Pickett GD, and Walker P, 2002. The coastal fisheries of England and Wales, Part IV: A review of their status 1999-2001. Science Series Technical Report – Centre of Environment Fisheries and Aquaculture Science.

Pembrokeshire County Council, 2021. Planning Permission, Town and Country Planning Act 1990, Application Number 20/0756/PA.

Readman JAJ, 2016. Circalittoral faunal communities in variable salinity. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Available online at: https://www.marlin.ac.uk/habitats/detail/1013/circalittoral_faunal_communities_in_variable_salinity [Accessed January 2022].

Reid JB, Evans PGH, and Northridge SP, 2003. Atlas of Cetacean Distribution in North-west European Waters, JNCC, Peterborough.

Royal HaskoningDHV, 2019. Morlais Project Environmental Statement, Chapter 7: Metocean Conditions and Coastal Processes. Ref. PB5034-ES-007.

RPS (RPS Energy Ltd.), 2019. META Environmental Statement (including chapters and technical appendices). Available at: https://www.meta.wales/rm_login/?redirect_to=%2Fmembers-area%2Fdocument-library%2F [Accessed January 2022]

RPS (RPS Energy Ltd.), 2019. Habitats Regulations Assessment (HRA): Stage 1 Screening Report. Available at: https://www.meta.wales/wp-content/uploads/2020/02/Habitat-Regulation-Assessment-RIAA-Appendices.pdf [Accessed January 2022]

SCOS, 2017. Scientific Advice on Matters Related to the Management of Seal Populations

Sims DW, Southall EJ, Tarling GA, and Metcalfe JD, 2005. Habitat-specific normal and reverse diel vertical migration in the plankton-feeding basking shark, Journal of Animal Ecology, 74(4), pp.755-761.

Tidal Energy Limited, 2009. DeltaStream Demonstrator Project Ramsey Sound, Pembrokeshire Non-Technical Summary.

Verdant Power LLC, 2010. Roosevelt Island Tidal Energy Project Volume 2 of 4. FERC No. 12611.

Welsh Government, 2019. Welsh National Marine Plan. Available at: https://gov.wales/welsh-national-marine-plan-document [Accessed January 2022]

Witt MJ, Hardy T, Johnson L, McClellan CM, Pikesley SK, Ranger S, Richardson PB, Solandt JL, Speedie C, Williams R, and Godley BJ, 2012. Basking sharks in the northeast Atlantic: spatio-temporal trends from sightings in UK waters. *Marine Ecology Progress Series*, *459*, pp.121-134.

WWBIC, 2019. Marine mammal, European otter and basking shark sightings data, West Wales Biodiversity Information Centre. Data provided by Seatrust targeted small vessel surveys 2005 – 2015 and incidental sightings 1979 – 2018. Accessed 8 February 2019.

Zhang J, Kitazawa D, Taya S, and Mizukami Y, 2017. Impact assessment of marine turbines on fish behaviour using an experimental approach based on the similarity law. Journal of Marine Science and Technology.

Appendix A. Photomontages

NPA Visuals

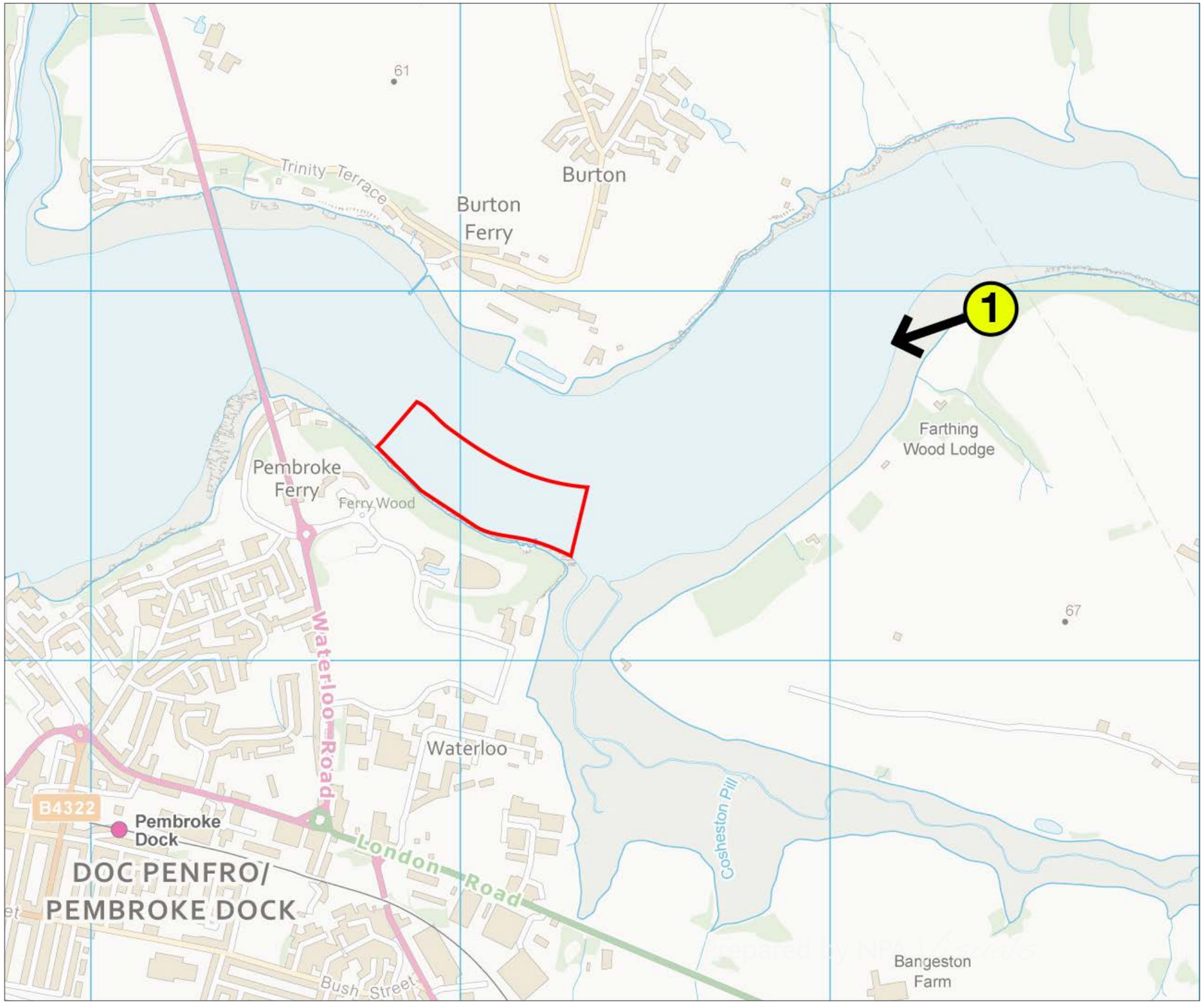
Nicholas Pearson Associates

Pembroke META, Pembroke

Visually Verified Montages

October 2020 | NPA 11171 RPS |

Viewpoint Location Plan



Viewpoint Information

View 1 - PROW by Mill Bay overlooking site OS: 199410 , 204926

Date of Photo:	18/08/2020 11:56
Weather:	Sunny
Visualisation Type:	Type 3
AVR Level:	3
Bearing of View:	251°
Camera:	Canon EOS 5D MK III
Frame Type:	Composite
Projection:	Planar
Lens Focal Length:	Sigma 50mm
Horizontal FOV:	53.5°
Distance to site :	1145m

NPA Visuals
NICHOLAS PEARSON ASSOCIATES

Project No:	11171	**Date:**	Oct - 2020
Client:	RPS	**Project:**	Pembroke Dock META
Status:	Planning	**Figure:**	Fig. 01: Viewpoint Location Plan

NPA Visuals

Nicholas Pearson Associates

0cm (Original image width 820mm) 10cm

Please note: To view this image digitally, calibrate this scale bar, on screen, for a correct scale representation and view the image at a comfortable arm's length

Project No:	11171	**Date:**	Oct-20
Client:	RPS	**Project:**	Pembroke Dock META
Status:	Planning	**Figure:**	Fig. 02: View 1 - PROW by Mill Bay overlooking site - Existing

NPA Visuals

Nicholas Pearson Associates

0cm (Original image width 820mm) 10cm

Please note: To view this image digitally, calibrate this scale bar, on screen, for a correct scale representation and view the image at a comfortable arm's length

Visualisation Type:	Type 3
Image Enlargement:	150% (Binocular)
Page Size:	A1 width

Project No:	11171	**Date:**	Oct-20
Client:	RPS	**Project:**	Pembroke Dock META
Status:	Planning	**Figure:**	Fig. 03: View 1 - PROW by Mill Bay overlooking site - Proposed 'Most Likely scenario'

NPA Visuals

Nicholas Pearson Associates

0cm (Original image width 820mm) 10cm

Please note: To view this image digitally, calibrate this scale bar, on screen, for a correct scale representation and view the image at a comfortable arm's length

Visualisation Type:	Type 3
Image Enlargement:	150% (Binocular)
Page Size:	A1 width

Project No:	11171	**Date:**	Oct-20
Client:	RPS	**Project:**	Pembroke Dock META
Status:	Planning	**Figure:**	Fig. 04: View 1 - PROW by Mill Bay overlooking site - Proposed 'Worst case scenario'

NPA Visuals

Nicholas Pearson Associates

0cm (Original image width 820mm) 10cm

Please note: To view this image digitally, calibrate this scale bar, on screen, for a correct scale representation and view the image at a comfortable arm's length

Visualisation Type:	Type 3
Image Enlargement:	150% (Binocular)
Page Size:	A1 width

Project No:	11171	**Date:**	Oct-20
Client:	RPS	**Project:**	Pembroke Dock META
Status:	Planning	**Figure:**	Fig. 05: View 1 - PROW by Mill Bay overlooking site - Proposed 'Operational' scenario

Visually Verifiable Montage Methodology

Introduction

A Type 3 Photomontage is an image that combines a photographic view with an accurate 3d CAD representation of a proposed development, displayed to an agreed level of detail. Using a baseline of visual data and information, its purpose is to impartially and if required, realistically represent the proposal.

“Photographs can have an important role to play in communicating information about the landscape and the visual effects of a proposed development, although they cannot convey exactly the way that the effects would appear on site.” (GLVIA, Third Edition)

We have an established reputation for the production of Verified Views for both urban and rural developments and have successfully presented these for planning applications and as expert witnesses at public inquiry.

The methodology used by us accords with the following guidance documents where appropriate:

The Third Edition of the good practice ‘Guidelines for Landscape and Visual Impact Assessment’ 2013; produced by the Landscape Institute and Institute of Environmental Management & Assessment.

Visual Representation of Development Proposals, September 2019. Landscape Institute Technical Guidance Note 06/19

London View Management Framework Supplementary Planning Guidance: Appendix C: Accurate Visual Representations. March 2012.

Visual Representation of Wind Farms Version 2.2, February 2017, Scottish Natural Heritage

Assessing the impact of small-scale wind energy proposals on the natural heritage, March 2016 Version 3, Scottish Natural Heritage

‘Visualisation Standards for Wind Energy Developments’ (July 2016), The Highland Council

When producing Type 3 Photomontages, a series of options are available to aid design and planning decisions according to the level of detail required. To assist agreement between all parties prior to preparation, the following classification types are presented to broadly define the purpose of the photomontage in terms of the visual properties it represents.

This classification is a cumulative scale in which each level incorporates all the properties of the previous level.

AVR Level 0 Location and size of proposal

AVR Level 1 As level 0 + degree of visibility of proposal

AVR Level 2 As level 1 + visual architectural form and details

AVR Level 3 As level 2 + use of realistic materials and lighting

Visualisation ‘Types’ according to the Landscape Institute guidance note 06/19 refer to the following

Type 4: visualisations where the highest level of locational accuracy. Image scaleing may be required.

Type 3: Visulialisations where a verifiable process and printed scale representation is not required

Preparation

Each view of the proposal is represented so that an informed decision can be made by balancing the needs of the assessor or viewer on site. Wherever possible, consultation with the relevant planning professional takes place on the matter and our final methodology is based on the most appropriate agreed set of professional Guidance.

Initially all baseline and proposal data is compiled so we can plan and agree the viewpoint locations with the client and relevant authorities. If the information is available we will also “pre-visualise” the viewpoints showing both the existing and proposed. This can also be used as an accurate guide on site and discuss all options with the client to ensure that our site photography covers all the potential locations and captures the full extent of the proposed scene correctly.

Prior to the site visit we prepare a “site pack” containing all the drawings and information we require on site. Pre-planning also includes a review of transport options so that public transport is utilised wherever possible. Route planning and time estimates are considered and a site risk assessment is completed for record.

Photography

Equipment available:

Canon 5D MkIII full frame digital SLR camera (Full frame sensor)

Canon EF 50mm f/1.4 STM lens

Sigma 50mm f/1.4 EX DG HSM

Canon EF 28mm f/1.8 USM Lens

Canon TS-E 24mm f/3.5 L II

Manfrotto Tripod 190

Nodal Ninja Ultimate M2 Panorama Head with Advanced Rotator RD16-II

NN4-D16-Nodal Ninja NN4 Panorama head with RD-16 rotator base

Arca-Swiss Style Standard Camera Plate

NN-EZ-Nodal Ninja EZ Leveler MKII (Tribrach)

Hand held spirit level

Canon RS-80N3 Remote Switch

UV, Polarising, Graduation & neutral density filters

Batteries & chargers

SD cards

Plumb bob, tape measure, spray paint & Hilti nails

Compass

Suitable weather conditions are sought so that the proposals may be clearly visible in the context of the view. We endeavor to take the photographs at an appropriate time of day to reduce the chance of the site being in shadow or back-lit. Therefore, when planning a site visit, detailed consideration is given to weather forecasts and sunrise/set times, particularly during the winter when the low angle of the sun can be problematic. The photograph(s) correctly portray the view which is obtained at each representative viewpoint whilst avoiding obvious obstructions.

At each viewpoint the camera is mounted on a tripod at a height of between 1.5 and 1.65m above existing ground level, which best represents the average human eye level. The height of the lens “nodal point” is checked by using a tape measure.

Photographs are taken in a RAW format using manual settings to enable the best quality results. If necessary, the original RAW file can be submitted as part of the verification process

The photographer takes note of the weather conditions and direction of view. All other details relating to the photograph are stored in the image EXIF data.

Lenses

No ‘one size fits all’, and we will use the most appropriate set of lenses / formats to convey the view. Only prime lenses are used; in the following order of preference: 50mm, 28mm, 24mm, 24mm/Shift. Both landscape and portrait orientations are considered when planning the photography. The 50mm lens has always been regarded as the “standard” lens on a full frame 35mm camera and closest to the human eye when image printed at A3 and viewed at arm’s length. 50mm lenses are not always appropriate for all situations and so when viewing photomontages based on other lenses, the observer must be aware of the limitations of the printed format. Alternative lenses are only selected when the viewpoint is close to the site. This means that even at a reduced printed scale, the observer is still able to identify all the features visible by the naked eye. (Ref: LI TGN 06/19 Appendix 1.1 & 13.1)

Full Frame Sensor lenses are quoted as having the following Horizontal Fields of View. Canon EF 50mm: 39.6 Degrees / Canon EF 28mm: 65.5 Degrees / Canon TS-E 24mm: 74 Degrees. However, the exact field of view cannot be assumed, and the actual field of view may vary +/- 2 or 3 degrees depending on the lens.

Visually Verifiable Montage Methodology

The Effective Focal Lengths (EFL) shown below represent the calculated field of view for our lenses based on known measurements.

Canon EF 50mm f/1.4 STM lens – EFL51.4mm (38.6° HFoV / 26.3° VFoV)

Sigma 50mm f/1.4 EX DG HSM – EFL 47.8mm (41.2° HFoV / 28.2° VFoV)

Canon EF 28mm f/1.8 USM Lens – EFL 28.2mm (65.1° HFoV / 46.1° VFoV)

Canon TS-E 24mm f/3.5 L II - EFL 24.7mm (73.7° HFoV / 51.8° VFoV)

Image composition and Presentation

Each viewpoint is intended to capture the view as perceived and experienced by the observer.

A practical and aesthetic approach is applied to our viewpoint photography where good composition is important. No one format or lens is suitable for all situations; as a rule of thumb, rural and coastal sites tend to require a 50mm based "panoramic" format (in line with SNH & LI TGN 06/19 guidelines), whilst urban sites can require a more considered approach where alternative lenses and formats may be required.

Viewpoint photographs are taken so that the camera is level to the horizon, so that converging verticals and perspective distortion is avoided. Proposals are in the central portion of the view.

The final baseline viewpoint photographs are single frame planar or composite panoramic images.

Planar or Cylindrical? Most technical guidance advises that the final verified views should be presented in Planar format. Therefore, cylindrical "panoramic" views will be re-projected back to planar (53.5° or 60° HFoV) for presentation. Occasionally linear sites or panoramic urban views (such as city scapes, power lines, roads and solar farms for example), may be best presented cylindrically.

When a proposed development is at distance, whilst the observer is aware of the wider area within their peripheral vision they tend to focus on the area in question. To ensure that the viewer is provided with a representation of the wider context, a "representative" view with a wider horizontal field of view may be presented alongside. This may be a single frame photograph or panorama of either 60° or 90° HFoV and "provides landscape and visual context only"

Most imagery is viewed electronically on screen or printed at A3 with the occasional use of A1 wide by A4 high (840 x 297mm) for panoramic views. Therefore, a sensible balance must be struck to place the proposal within meaningful context whilst providing clarity for the viewer.

Baseline Imagery Processing

Following review in Adobe Bridge, the original Canon RAW files are selected and processed in Adobe Photoshop to adjust white balance, colour accuracy and sharpness. The images undergo further correction procedures to ensure the horizon is precisely horizontal and any lens/barrel distortion is compensated for. The images are then saved as uncompressed Photoshop files for future compositing. Separate .jpg images are saved for use in the camera matching process.

Camera locations and accuracy

The method used to establish the camera location can either be handheld GPS/GNSS, GNSS/RTK, survey point, visual reference and the level of accuracy depends upon the best survey information available.

3d Modeling

The proposals supplied by the architects and landscape architects are combined with the site survey and mapping data so that they correspond with each other. A geo-referencing system is used when doing this so that information regarding viewpoints can be accurately located. The model(s) supplied or constructed by us are cross-checked with the site plan and elevations to ensure they accurately match the design drawings, including floor levels, roof heights and footprint.

Camera Matching & Verification:

Irrespective of whether the final photomontage is output as a single or composite panoramic image, each view is based upon a single rendered image.

Viewpoint markers are used to tie the photograph to the CAD Camera view. These are surveyed features and points such as lamp posts, walls, boundaries and buildings; anything that has a known location. These markers are required to be as accurate as possible and should ideally be positioned within the central portion of the image. They should be at both varying heights, distances and breadth within the view. The background plate photograph is imported into 3ds Max to verify the accuracy of the match.

The location accuracy and angle of view can also be checked by triangulating the position and preparing view line sections. This is a reliable method successfully used for location finding in the field.

There are two ways of camera matching.

For planar baseline photography:

This can be achieved within the 3D modeling program by aligning a virtual camera with the reference survey points to obtain an accurate match. The survey is rendered out and, if necessary, this can be adjusted to align correctly to detailed or distant elements that may have been difficult to get pixel perfect precision in 3ds max. The rendered Survey points can then be replaced by the final render to ensure accuracy.

For cylindrical baseline photography:

This can be achieved within the 3D modeling program by aligning virtual planar camera and survey points with a version of the cylindrical image re-projected to a planar perspective. The reference points are then rendered out cylindrically to the required horizontal and vertical FoV, and this is aligned in Photoshop to the cylindrical baseline image. The survey image is then replaced with the rendered model output, based upon the same camera and render settings.

Texturing, Rendering & Post Production

3ds Max is used for applying photo-realistic surfaces and materials to the 3D model. Material references and planting sizes are based upon information provided by the Architects / Landscape Architect

The exact resolution of the photograph is noted and used as the size for the final rendered output of the 3D Model view so that the two overlay each other precisely.

Adobe Photoshop is used to blend the render(s) of the model(s) with the existing baseline / base plate photograph. Where elements are removed from the baseline photograph, reference photography and/or models of the existing site are used to accurately place elements that were not seen in the original photography

Viewing Procedures

The purpose is to reproduce the photomontage so that it correctly reconstructs the perspective seen from the location from which the photograph was taken.

We aim to reproduce all wire frames and photomontages so that they can be viewed at a comfortable arm's length. When comparing the view in the field, the viewer must keep their head motionless and fix their eyes on the centre of the view. This ensures that the represented view falls within the human field of view.

Cylindrical views are only intended for viewing as a printed image or in an appropriate electronic viewing application. The printed image should be viewed on an arc that matches the images field of view, at a comfortable arms-length.

Additional Comments

While all effort has been made to achieve reasonable levels of viewpoint accuracy, all photomontages should be regarded as such and not as verified views.

Visually Verifiable Montage Methodology

Appendix A

Project Title	Pembroke META
Site Location	Pembroke
Status	Planning
Architect	NA
Landscape Architect	NA
Planning Consultant	NA
Heritage Consultant	NA

Coordinate System	OSGB36 (EPSG 277000)
Accuracy of Viewpoint Location	±1.5m
Method used to locate camera horizontally	Aerial Photography / DSM & DTM
Method used to locate camera vertically	Aerial Photography / DSM & DTM
Camera Matching Technique	Planar (Model Camera Aligned)
Details used for camera matching - Horizontally	DSM & DTM
Details used for camera matching - Vertically	DSM & DTM
Modeling Software	3ds Max
Compositing Software	Photoshop / PT GUI
Other applications	InDesign
Height and Age of Proposed Planting	NA
Season(s)	Summer
LI Visualisation Type	View 1: Type 3
AVR Level	View 1: AVR 3
Design Data Provided	2d CAD Plans
Photography Equipment Used	Canon 5D full frame digital SLR camera (Full frame sensor) Sigma 50mm f/1.4 EX DG HSM Manfrotto Tripod 190 NNodal Ninja Ultimate M2 Panorama Head with Advanced Rotator RD16-II NN-EZ-Nodal Ninja EZ Leveler MKII

Lens and format

50mm / 150% / 53.5° @ A1 Wide

The baseline photograph for Viewpoint 1 was a composite image taken using the Sigma 50mm f/1.4 lens at intervals of 20 degrees (Landscape Orientation), these images were then stitched together to form a standard 53.5-degree field of view planar image and reproduced suitable to be viewed at comfortable arm's length (150% @ A1wide). This format is selected as suitable for assessing sites which sit within a panoramic landscape setting and a method derived from the SNH Visual representation of wind farms and the landscape institute.

Exceptions to regular Methodology / Additional Comments

NA

Each viewpoint within the document may be supplied with all or some of the following information:

Figure Number
Viewpoint Number
Viewpoint Details
OS Coordinates (12 digit)
Eye level (A.O.D)
Direction of View (Bearing)
Camera Height (AGL)
Date & Time
Viewing distance (Advisory)
Single Frame or Composite
Horizontal Field of View
Vertical Field of View
Weather / Lighting Conditions
Camera Type
Lens / Focal Length

Model and camera location accuracy

The Verified views in this document may also contain other information such as:

Illustrative bar indicating compass bearing

Extent of central 50mm frame used to construct panorama
Extent of which Proposed development occupy – (Degrees noted)
Number of buildings visible
Distance to site
Note on A3 versions: "This image provides landscape and visual context only."
Annotation of key features
Note: "View flat at a comfortable arm's length"
Building ID numbers

Viewpoint Pack: Note: This image is intended only for use at the viewpoint.

Wirelines views are colour coded as follows:

DTM – Grey/Black
Waterbodies – Light Blue
Proposed structures – Brown
Existing structures - Blue
Proposed Vegetation - Light Green
Existing Vegetation - Dark Green