Llywodraeth Cymru
Welsh Government

# Sector Locational Guidance: Enabling Evidence for Sustainable Development

## Wave Energy

December 2021

## Context for Sector Locational Guidance

The Welsh Government, as the marine planning authority, has produced this wave energy Sector Locational Guidance (SLG), implementing Welsh National Marine Plan (WNMP) sector supporting **policy ELC_02b (low carbon energy (supporting) wave)** which encourages a collaborative approach to understanding opportunities for the sustainable development of the sector.

This document represents an ongoing process. It builds on initial work undertaken by Atkins, Venn Associates and Pembrokeshire Coastal Forum, carried out in collaboration with industry representatives, regulators, and environmental specialists, through a series of stakeholder engagement events.

This version of the SLG describes the resources relevant to the sector's future prospects, how it may interact spatially with other sectors and also wider social and ecological considerations.

It is intended this SLG will support the sustainable development of the sector, informing identification of future opportunities. It will do this by helping guide the industry in their planning for future development (including through signposting to areas of potential consenting complexities), and through promoting engagement and dialogue within and between sectors.

Over time, SLG will feed back into marine planning, including the potential identification of Strategic Resource Areas to safeguard areas of wave resource. The Welsh Government is committed to engaging with stakeholders to further develop this SLG.

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Cover Image supplied by Visit Wales

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AIAA | Area of Intense Aerial Activity |
| CfD | Contract for Differences |
| CSAG | Consenting Strategic Advisory Group |
| EIA | Environmental Impact Assessment |
| ESA | Electricity System Operator |
| EU | European Union |
| GW | Gigawatt |
| HVAC | High Voltage Alternating Current |
| HVDC | High Voltage Direct Current |
| iMarDIS | Integrated Marine Data and Information System |
| iVMS | Inshore Vessel Monitoring System |
| LA | Local Authority |
| LSOA | Lower layer Super Output Area |
| MCA | Maritime and Coastguard Agency |
| MCZ | Marine Conservation Zone |
| MEECE | Marine Energy Engineering Centre of Excellence |
| META | Marine Energy Test Area |
| MEW | Marine Energy Wales |
| MoD | Ministry of Defence |
| MRESF | Marine Renewable Energy Strategic Framework |
| MW | Megawatt |
| NRW | Natural Resources Wales |
| ORJIP | Offshore Renewables Joint Industry Programme |
| OSPAR | Oslo/Paris Convention (for the Protection of the Marine Environment of the North-East Atlantic) |
| OWC | Oscillating Water Column |
| O&G | Oil and Gas |
| O&M | Operation and Maintenance |
| PDZ | Pembrokeshire Demonstration Zone |
| RA | Resource Area |
| RSA | Recreational Sea Angling |
| RSPB | Royal Society for the Protection of Birds |
| RYA | Royal Yachting Association |
| SAC | Special Area of Conservation |
| SEACAMS | Sustainable Expansion of the Applied Coastal and Marine Sectors |
| SLG | Sector Locational Guidance |
| SMMNR | Sustainable Management of Marine Natural Resources |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| TCE | The Crown Estate |
| UK | United Kingdom |
| WIMD | Welsh Index of Multiple Deprivation |
| WMPP | Welsh Marine Planning Portal |
| WNMP | Welsh National Marine Plan |
| WPD | Western Power Distribution |

# 1. Introduction

For the purpose of this SLG, the following definition of wave energy should be used:

**Definition**

Ocean wave energy technologies which rely on the up and down motion of waves to generate electricity. Energy output is determined by wave height, wave speed, wavelength and water density.

Section 4.1 outlines the types of wave energy technologies currently in development and operation around Wales.

## 1.1 Purpose of Sector Locational Guidance

The purpose of this document is to **support characterisation of areas in Wales where there is good potential for wave energy projects to prosper**. Bringing together technical and environmental knowledge with information on key social, cultural, and economic issues and using this to understand future potential opportunities can support and enable the sustainable development of the sector. This SLG provides a relevant evidence base for wave energy developers interested in operating in Welsh waters, highlighting key considerations and issues that may need to be addressed during project development and licensing processes. It will also inform the ongoing marine planning process. In order to support potential coexistence of multiple uses, the guidance also considers where opportunities may exist for the co-location of wave technologies with other marine activities where potentially beneficial and practical.

The evidence landscape around wave energy continues to develop and considerations identified in this SLG may change over time. Knowledge gained from the deployment and monitoring of wave energy technologies will also be key to further understanding. With time, this guidance may be developed to provide more specific signposting towards areas considered to be of higher potential for development.

This guidance has been developed in accordance with the Sustainable Development Principle and the five ways of working as set out within the Well-being of Future Generations Act. It is also informed by the Sustainable Management of Marine Natural Resources (SMMNR) principles of the Environment (Wales) Act and the direction provided by the United Kingdom (UK) Marine Policy Statement to provide a proactive and spatially planned approach to the management of the marine area.

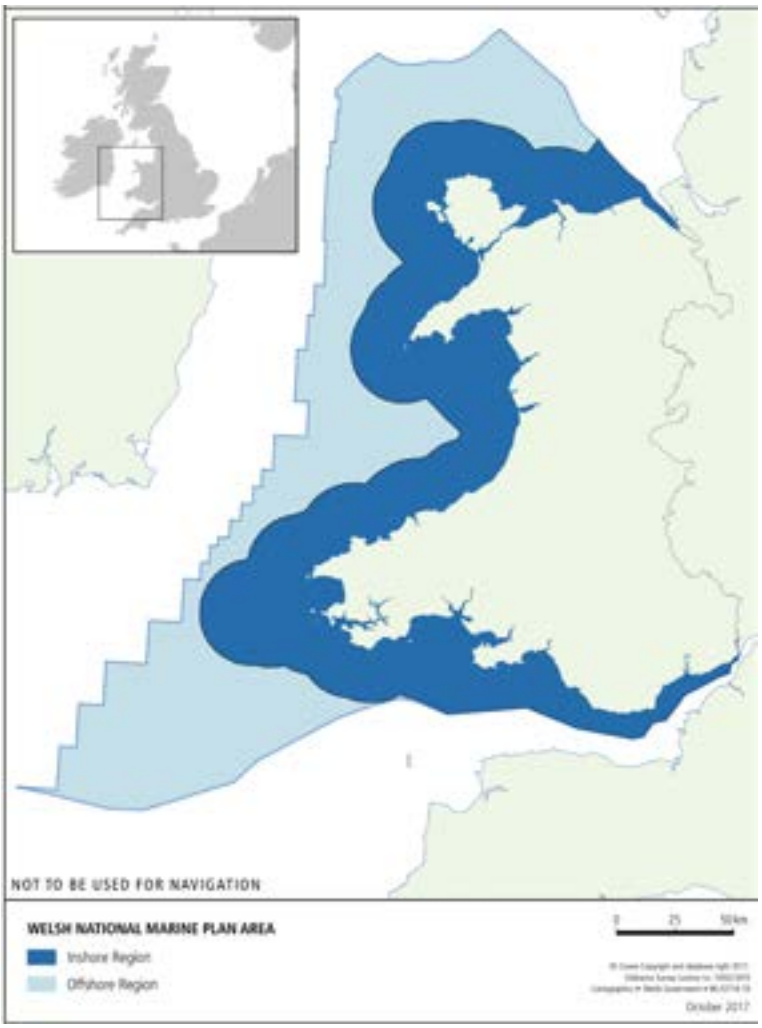
## 1.2 Marine planning policy context

In April 2019, Welsh Ministers declared a climate emergency. To address this, the Welsh Government has committed to achieving a carbon neutral public sector by 2030 and to make a decisive shift away from fossil fuels (Welsh Government, 2019). The Welsh Government has committed to reaching net zero by 2050 and set ambitious targets for the generation of renewable energy including for Wales to generate 70% of its electricity consumption from renewable energy sources by 2030[1]. Welsh Government has specific targets for local ownership of renewable energy developments which include[2]:

- 1 gigawatt (GW) of renewable electricity and heat capacity in Wales is to be locally owned by 2030; and
- all new renewable energy projects from 2020 onwards are to have at least an element of local ownership.

The Welsh Government published the first **Welsh National Marine Plan (WMNP)**[3] in November 2019 to support the sustainable development of Welsh seas (Figure 1.1). The plan sets out Welsh Government's vision for the Welsh inshore and offshore regions and incorporated the Welsh Government's aim of supporting the development of marine renewable energy in Welsh waters (Figure 1.2).

**Figure 1.1: WNMP area**




Source: WNMP, 2019

1 Oral Statement on "Energy" delivered by the Cabinet Secretary for Environment and Rural Affairs to the National Assembly for Wales on 26 September 2017.

2 Welsh Government Policy statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations (Welsh Government, 2020).

3 Refer to WNMP: Vision, Objectives and Policies for additional information. www.gov.wales/sites/default/files/publications/2019-12/welsh-national-marine-plan-vision-objectives-policies-quick-reference.pdf

**Figure 1.2: WNMP sector objective and supporting policies**

**WNMP Sector Objective: Energy – Low Carbon**

1. To contribute significantly to the decarbonisation of our economy and to our prosperity by increasing the amount of marine renewable energy generated; and

2. To develop Wales as an exemplar of marine renewable energy technology by developing the essential skill base, infrastructure and technical knowledge to support the development of the industry over the next 20 years.

**WNMP Sector Specific Supporting Policies**

- ELC_02 a: 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.
- ELC_02 b: 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.

## 1.3 Sector Locational Guidance context and use

This SLG brings together information and data from a variety of sources to provide a preliminary evidence base for those involved in sectoral planning and developing location options for wave energy projects. The SLG does not rule in or out specific areas for development; instead, it seeks to highlight environmental considerations, existing uses and associated infrastructure, sector interactions and social considerations. In doing so, the SLG provides a spatial understanding of potential sustainable development opportunities and challenges.

In considering this SLG, the following points should be noted:

- Understanding the range and interrelationships of a wide range of aspects important to the sector is a complex process. This guidance necessarily provides a high-level assessment of interactions using available evidence and incorporating stakeholder feedback.
- The presence of a large number of constraints does not prohibit development. Rather, mapping such information highlights an area already hosts multiple activities, contains important marine features or is subject to other constraints that might make development more challenging (e.g., take longer, reduce options, or increase costs). As set out in the WNMP, developers are advised to engage regulators and stakeholders early in project development to identify data needs, scope of assessments, ways of avoiding impacts that would need mitigating and whether mitigation measures may be viable.
- The guidance covers existing activities and looks forward. However, there may be activities that are not reasonably foreseeable at this time. Evolution in the use of marine resources and the speed at which technology changes will have a bearing on the options for sustainable use of Welsh waters.
- Maps have been created with accessible data and show the spatial distribution of activities at the time of publication. The absence of data may appear to indicate areas with few or no constraints which may be misleading. Such areas should always be investigated thoroughly as part of any optioneering process.
- Data used in this SLG is based on information available at the time of publication. As more data becomes available, this will need to be taken into consideration.
- The outputs of this SLG do not substitute the requirement for detailed project level assessment.
- This SLG is advisory and has no status in the decision-making process. It should be read alongside the WNMP and supporting Implementation Guidance.[4]

4 Welsh National Marine Plan: implementation guidance www.gov.wales/welsh-national-marine-plan-implementation-guidance

# 2. Approach

## 2.1 Review and integration of existing work

The existing evidence base for future potential wave energy resources has been reviewed and is reflected in this SLG. Sources used for the work are identified in Appendix A. Key sources include:

- SMMNR project reports (ABPmer, 2021 forthcoming). Elements of the SMMNR data have been incorporated into this SLG (see Sections 7 and 10 for further details)[5].
- Marine Renewable Energy Strategic Framework (MRESF) (Welsh Government, RPS 2007-2010).
- A review of the potential for co-existence of certain sectors in the WNMP Area (Cefas, 2020).

## 2.2 Stakeholder engagement

Effective and collaborative stakeholder engagement, creating cross-sector dialogue reflecting activities and interests across Wales, has been fundamental to the development of this SLG. This includes those operating within the wave energy sector but also connects with representatives of wider marine interests in Wales and other maritime activities.

## 2.3 Sectoral interactions assessment

Sectoral Interactions Matrices have been used elsewhere in the UK as a means of capturing stakeholders' views on the nature of interactions between marine-related activities and interests in the early stages of marine planning for specific areas. This has been adapted for the SLG process to demonstrate the perceptions of interactions between the focal sector (wave energy) and other marine sectors in Wales and provides a high-level assessment and a starting point for more detailed and in-depth studies in particular Resource Areas (RAs).

Sector interactions are used to inform the constraints analysis, and to better understand potential opportunities in the context of WNMP **policy ECON_02 (coexistence)** coupled with WNMP **sector supporting policies**.

Sectoral interactions assessment differs from the constraints analysis. Constraints analysis considers interactions in a way that may actively enable or preclude different activities from taking place as part of a decision-making process. Sectoral interactions assessment takes a more fundamental view of whether activities are perceived as being compatible with each other and helps contextualise spatial constraints analysis.

The following definitions are used for the sectoral interaction assessments:

- **Interactions:** where the proximity of two or more activities causes them to have an effect on each other. Interactions can be positive, neutral, or negative. They can also be likely, possible, or unlikely. The assessment of interactions involves an element of judgement: two, or more, assessments of the same interaction may not reach the same conclusion about its outcome.
- **Co-existence:** Where multiple developments, activities or uses can exist alongside or close to each other in the same place and/or at the same time.
- **Co-location:** A subset of coexistence where multiple developments (often structures), activities or uses are located in the same place by sharing the same footprint or area in the marine environment. 'Footprint' can include both the physical location of a development or activity e.g., a built structure, and a wider area associated with the development or activity e.g., a surrounding safety zone. It could involve designing projects to accommodate multiple uses of marine space.

5 Sustainable management of marine natural resources www.gov.wales/sustainable-management-marine-natural-resources

The approach to sectoral interactions used in the Cefas review of the potential for co-existence of different sectors in the WNMP area[6] has been adapted for this SLG. A range of marine activities have been assessed against the wave energy sector and it has been identified where interactions and the potential for co-existence and/or co-location might be likely, possible, or unlikely (see Section 9 for further details).

## 2.4 Constraints analysis

Constraints mapping has been undertaken to support the implementation of WNMP **general policies** (protecting socio-economic or environmental considerations) as well as safeguarding other sectors' interests (**policies SAF_01a and b**). Sector-sector interactions have been considered to inform the constraints analyses and to better understand potential opportunities as a contribution to **policy ECON_02 (coexistence)** coupled with the relevant **sector supporting policies**.

Constraints analysis mapping is a process of mapping and interpreting spatial evidence to understand, for a particular activity or development, the spatial considerations which may influence the prospects of a proposal in a particular area. As a first step to understanding these spatial considerations, a list of key potential constraints to wave energy development was identified drawing upon previous work undertaken for MRESF, alongside expert judgement. The distribution of these potential constraints was mapped to a 1 $km^2$ hexagonal grid, the same as that used for the SMMNR project, and the number of potential constraints was summed and is shown in Figure 10.5. The legend to Figure 10.5 lists the mapped potential spatial constraints.

Taken further, constraints analysis could develop a more refined understanding of spatial considerations to show differences in the relative constraints across areas. There is the potential to weight the relative importance of constraints in relation to the sector, and to combine multiple constraint layers to better understand their implications for development of the sector. Constraints mapping can be a useful tool to inform sectoral strategic planning but any such mapping exercise should clearly present the level of confidence and caution that should be applied in interpreting the resultant maps.

Developers will have different approaches, priorities, and risk appetites in relation to projects and will typically undertake their own constraints analysis in the project development process. The analysis presented here is intended to provide an accessible and focussed evidence base, and an early/high level indication of potential risks/issues to consider in the site selection process. It could also contribute to supporting the implementation of the WNMP's **general policies**, such as protecting socio-economic or environmental considerations (**ECON 01**), considering co-existence opportunities (**ECON_02**), and safeguarding other sector interests (**SAF 01a and b**).

Analysis of potential constraints to development has drawn on existing data, which has been supplemented with information gathered through stakeholder engagement and in discussion with Natural Resources Wales (NRW). The assessment of constraints relating to the different forms of wave energy considered in this SLG is based on information gathered during the MRESF project and highlights those aspects where interactions between the itemised elements may be considered as a significant constraint. Elements given a high score (a score of 4 or 5) would likely cause delay and could possibly stop a wave energy project from progressing.

6 Cefas, 2020. Mengo, E., Mynott, F. and Muench, A. A review of the potential for co-existence of different sectors in the Welsh Marine Plan Area . www.gov.wales/review-potential-co-existence-different-sectors-welsh-marine-plan-area

At the site selection stage, environmental designations are typically used by developers as an indication of the potential sensitivity and consenting risk associated with an area. Although site boundaries provide a limited indication of features and locations of mobile species, additional important considerations may lie beyond the boundaries but still need to be taken into account.

Environmental sensitivities are more nuanced than some of the physical characteristics or constraints associated with other marine users. The scoring approach used in SMMNR has attempted to reflect the spatial occurrence, conservation importance, and potential for impact pathways for different features. SMMNR outputs have been included in the constraints analysis. Further detail on the assessment of environmental sensitivities and the interpretation of the scoring outputs can be found in the SMMNR reports[7].

For the majority of constraints, both from other marine users, activities and ecological sensitivities, there are opportunities to either manage the interaction, microsite around key sensitivities, or apply appropriate mitigation. These options can only be properly explored at project level, so such areas should not be excluded prematurely at the site selection or marine planning stage but recognised as areas with particular characteristics which require consideration. Nevertheless, it is also recognised that there are some consenting risks that require better understanding before they can be resolved. If the risks are considered significant enough it may be appropriate, sensible, and more cost-effective to exclude the site at an early stage of any site selection process.

7 Sustainable management of marine natural resources www.gov.wales/sustainable-management-marine-natural-resources

# 3. Wave energy resource

## 3.1 Resource Area

Wave resource is the key driver for site selection. The available wave energy is based on wave height, wave speed, wavelength and water density (Figure 3.1). The wave RA[8] is defined in the WMNP (Figure 3.2), as informed by a study commissioned by Welsh Government in 2011 (MRSEF, 2011) and including resource further offshore. The RA was defined using the parameters set out in Table 3.1.

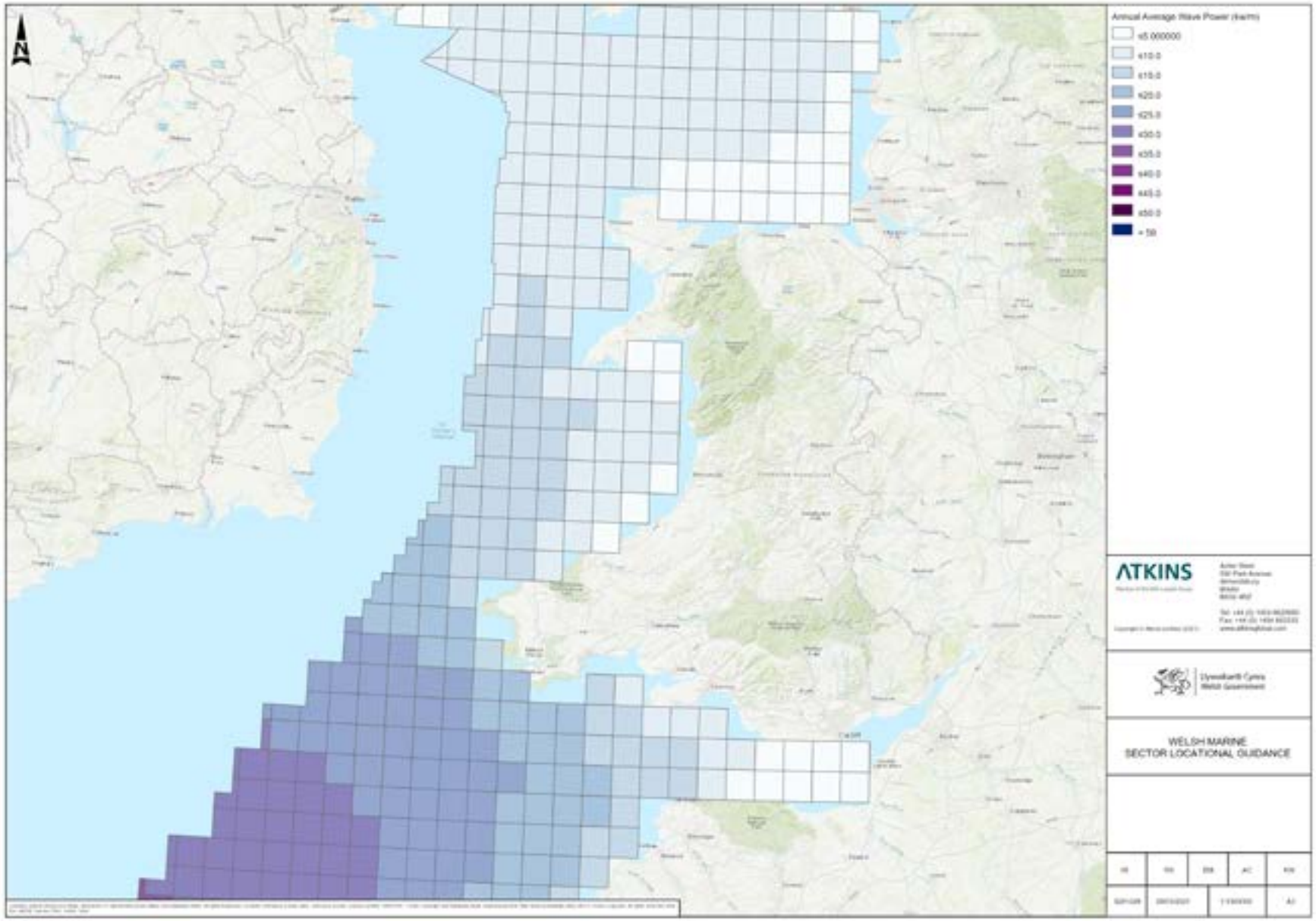
**Table 3.1: Wave parameters**

| Energy Type | Device Type Group | Device Type Sub-Group | Distance from shoreline | Water Depth | Energy Requirement |
|---|---|---|---|---|---|
| Wave | Shoreline | Oscillating Water Column (OWC) | 0 m – few 100 m if on breakwater | 5 – 8 m up to maximum 15 m, Economic preference around 10 m | Annual 15 – 30 kW/m, significant wave height 1 m |
| | | Hydraulic Pressure | 0 m | 4 m | - |
| | | Overtopping | 0 m | 6 – 15 m | 18 kW/m |
| | Nearshore | OWC | Less than 2 km | 10 – 50 m | 9 kW/m |
| | | Overtopping Collector | No constraints identified | 50 – 80 m | - |
| | | Single point/ Buoy | Between 500 – 800 m up to 8 km | 30 – 40 m ideal, up to 80 – 100 m | 20 kW/m significant wave height above 1 m, wave period 5 – 15 seconds |
| | | Oscillating wave surge converter | 10 m – 1 km | 10 – 50 m (very variable between devices) | 1 – 3 m swell or 40 kW/m2 |
| | Offshore | OWC | 10 – 16 km | 30 – 100 m | 60 kW/m |
| | | Single point/ buoy | 2 km quoted as economic presence in some cases, out to max + 10 km, with few to 20 km | 20 – 100 m, some needing > 50 m | 20 kW/m |
| | | Multi-Buoy | 3 – 20 km | 20 km | 2 m wave height or 4 kW/m |
| | | Attenuators | 5 – 50 km | 30 – 100 m | 25 – 55 kW/m |
| | | Overtopping Collector | 5 – 25 km | 20 – > 40 m | 24 kW/m |

*Source: MRESF, 2011*

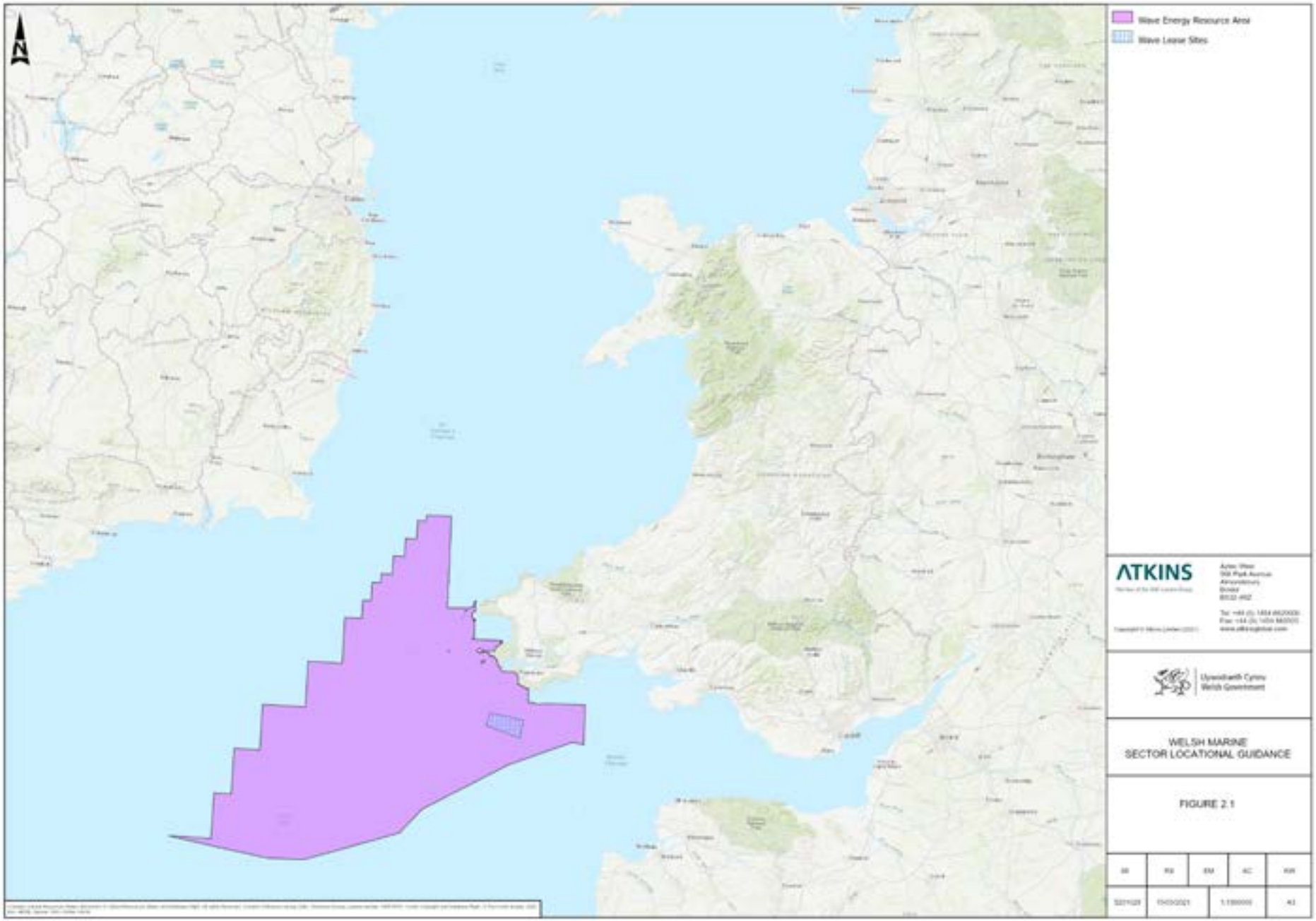
8 RAs are broad areas that describe the distribution of a resource that either has the potential to be used or is in use.

**Figure 3.1: Wave power potential in Wales**




*Source: Renewables Atlas, 2020*

**Figure 3.2: Wave energy RAs around Wales**




*Source: Source: Lle, 2021*

# 4. Current activity & future development

Wave renewable energy technologies are less well developed compared to tidal stream energy technologies and may take longer to be deployed commercially (i.e. smaller scale test devices offering proof of concept followed by larger-scale arrays). Nevertheless, an extensive wave resource exists in both Welsh inshore and offshore waters, particularly in the southwest of Wales which is exposed to waves generated in the Atlantic Ocean (see Figure 3.1 and Figure 3.2). The theoretically extractable annual mean UK wave power resource has been estimated as 43 ± 4 GW, with long-term annual mean wave power levels along the western UK coastline ranging from 25 to 75 kW/m (kilowatts of power potential per metre of wave crest). The UK Atlas of Marine Renewable Energy Resources estimates the theoretical annual mean wave power density to be 15 to 20 kW/m close to the Pembrokeshire coastline, with areas further offshore approaching 30 kW/m (Roche et al., 2016 and references therein).

Welsh Government prioritised €100 million of European Union (EU) structural funds (2014-2020) for marine energy in Wales (MEW, 2020a) with the strategic objective to increase the number of wave and tidal energy devices being tested in Welsh waters and off the Welsh coast, including multi-device array deployments, helping to establish Wales as a centre for marine energy innovation and production including wave technology.

## 4.1 Wave energy technology

Wave energy technologies rely on the up-and-down motion of waves to generate electricity (Figure 4.1). Energy output is determined by wave height, speed, wavelength, and water density. There are a number of different types of device at various stages of proof of concept and testing. The European Marine Energy Centre describes eight main types of waves devices[9]:

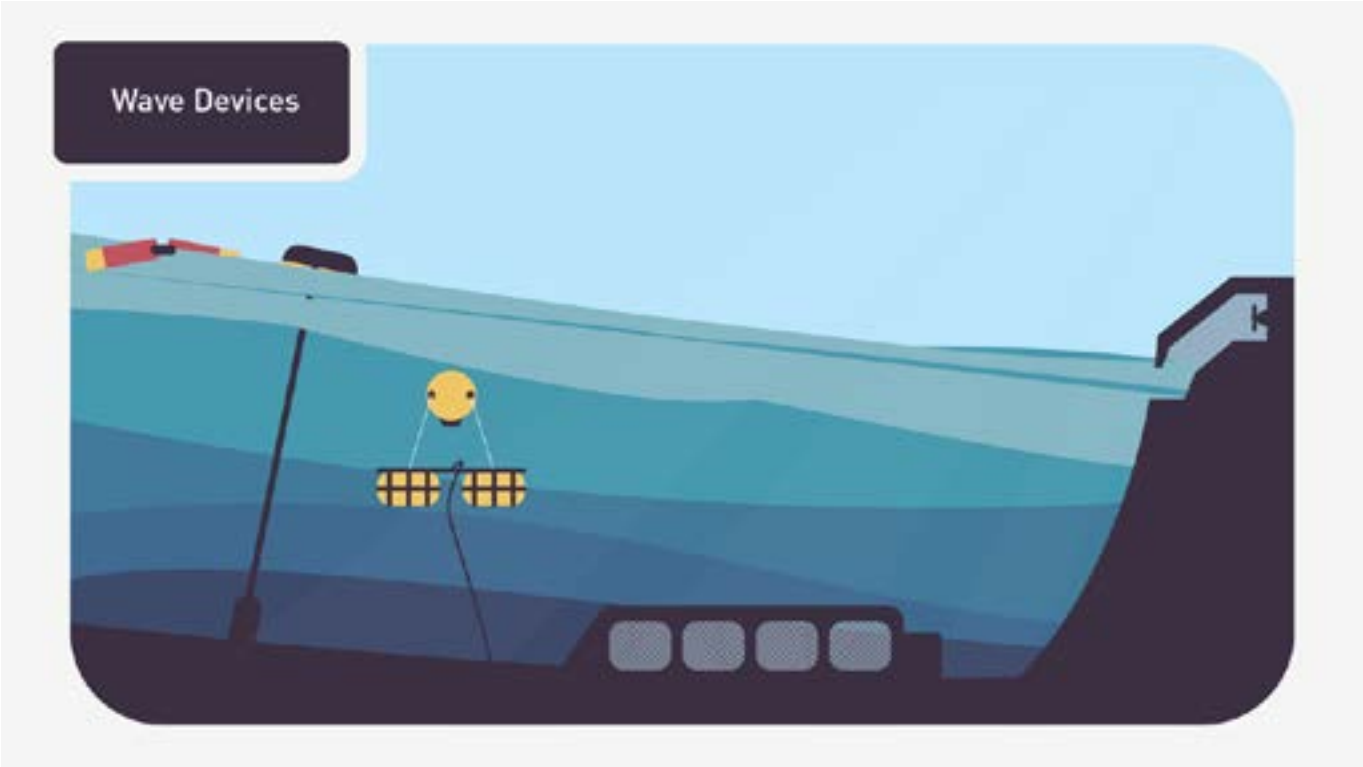
- attenuator
- point absorber
- oscillating wave surge converter
- oscillating water column
- overtopping/terminator device
- submerged pressure differential
- bulge wave; and
- rotating mass.

There are also unique designs whereby a flexible structure changes shape/volume as part of the power take-off system (e.g., Bombora's mWave device). Wave devices can either be located at the surface (e.g., Marine Power Systems WaveSub) or submerged (e.g., Bombora's mWave device).

No single design has proven more effective/deployable to date and it is, therefore, not possible to determine which, if any, of the current designs might dominate a future wave energy market, or if a range of devices may be commercially viable. The MRESF report provides more information on the types of device and their water depth and wave energy requirements. This is general information and actual data will vary between individual devices/developers.

9 http://www.emec.org.uk/marine-energy/wave-devices/

**Figure 4.1: Wave energy devices**




*Source: TCE, 2021*

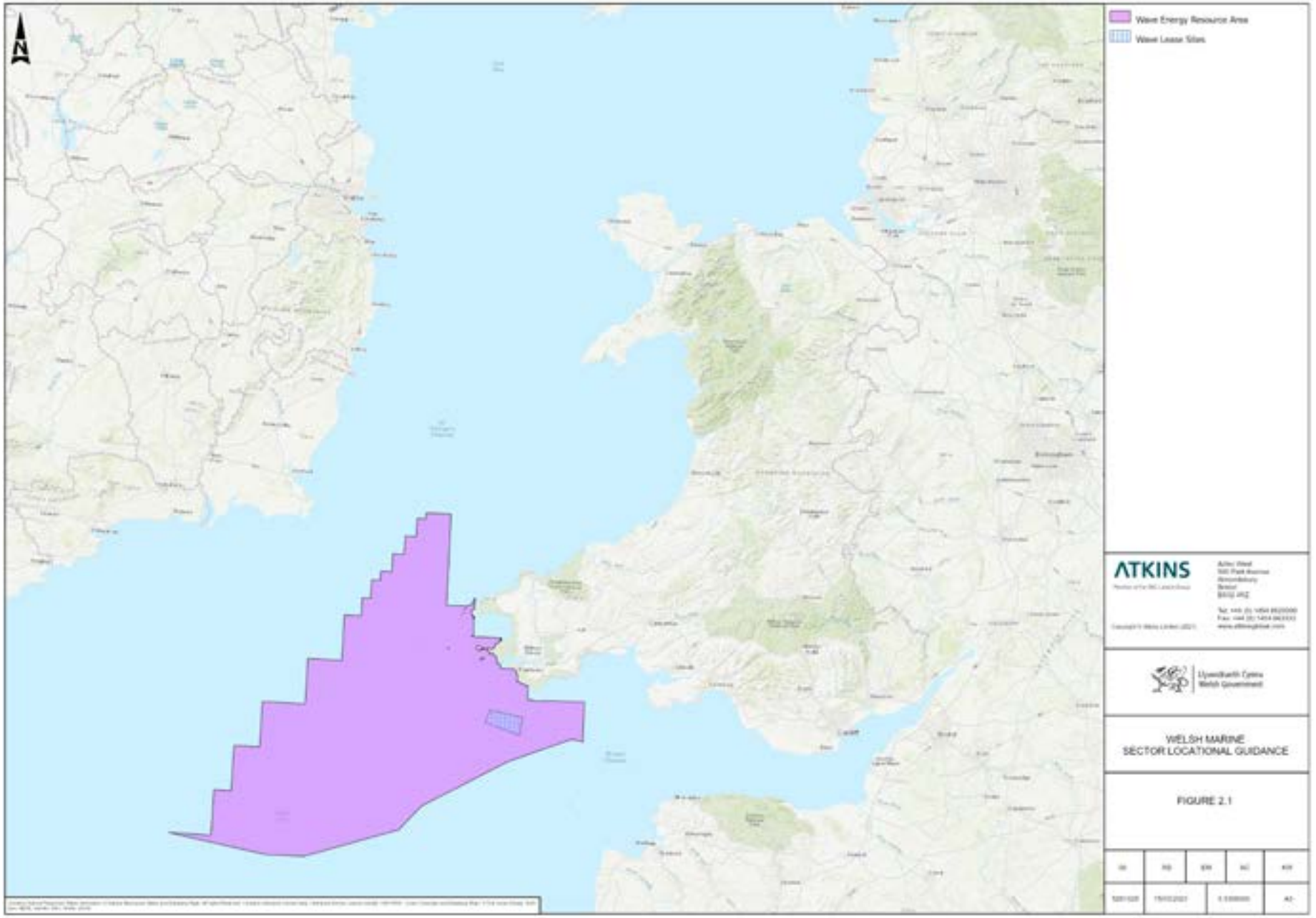
## 4.2 Projects in Welsh waters

There are currently no large-scale operational wave energy devices in Wales. Marine Energy Wales (MEW) is supporting the development of the marine renewables sector and there are test sites and demonstration zones around the Welsh coast, including the Marine Energy Test Area (META) and Pembrokeshire Demonstration Zone (PDZ).

The PDZ, which covers 90 km$^2$ area of seabed located between 15 and 21 km from shore with water depths of approximately 50 m, has been leased from The Crown Estate (TCE) by Wave Hub Ltd (who manage the site in collaboration with partners including MEW, Pembroke Port and Pembrokeshire County Council). Consent for this wave and floating wind demonstration zone could be achieved by 2022 with infrastructure built by 2024. There is the potential for coexistence with floating wind developments within the site.

In late 2019, the first marine licence in Wales for a wave energy device was granted for the deployment and testing of Bombora's mWave project (1.5 megawatt (MW) device) off the coast of Pembrokeshire. Figure 4.2 shows the existing wave energy lease areas in relation to the wave RA.

**Figure 4.2: Existing wave energy lease areas**




*Source: TCE, 2021*

## 4.3 Economic contribution

It is clear that coastal and peripheral regions of Wales are already experiencing benefits from emerging wave and tidal energy industries, with £96.2 million invested in Welsh wave and tidal energy developments to date. Developments in these areas have taken advantage of local skills, services, and infrastructure, providing additional indirect economic benefits (MEW, 2019)[10].

Combined with the figures for tidal range facilities (£8.6 million), wave energy (£29 million) and publicly funded Welsh research projects, the total investment to date in marine energy in Wales amounts to £123.7 million. Figures reported in previous research suggest that every £10 million of investment in marine energy resources could be associated with total Gross Value Added effects in Wales of around £2.5 million, including direct, supply chain and related household effects[11].

As an emerging industry, there is less social science research on which to draw in order to consider the social and cultural implications of developments and their associated local communities. Changes as a result of employment opportunities from wave energy developments would be expected to be reflected in nearby coastal communities. The industry can contribute to the stability and cohesion of those local communities by offering direct employment opportunities but also by providing a focus for investment in local infrastructure, providing wider social benefits e.g., upgrading roads. Making use of established marine-related skills found in the locale and extended supply chain e.g., boat building/ maintenance or boat handling, also contributes to stability and resilience of the local economy. As a result, development of this sector may reduce outward migration of the local population, maintaining traditions, language, and cultural heritage in support of WNMP **policies SOC_02 (well-being of coastal communities)** and **SOC_04 (Welsh language and culture)**. It may also attract inward migration and further investment into the community to support a growing industry, workforce, and their families (e.g., house building/sales, shops, and services) in support of **policy ECON_01 (sustainable economic growth)**.

Many companies with relevant experience and expertise have been able to diversify into supporting wave energy projects in Wales, with supply chain companies across Wales actively engaging in the wave sector (MEW, 2020). In addition, recent research has found that Wales is well placed to capitalise on this expanding market (and the wider marine renewables sector) with considerable pre-existing marine expertise (e.g., fabrication, Operation and Maintenance (O&M), anchors etc.), high-capacity electricity connection and embedded energy industry knowledge through oil and gas (O&G) developments (ORE Catapult, 2020). It is expected that the region can capture up to 52% of project development spend through local companies providing surveying, engineering design and other development services.

## 4.4 Business support

There is a range of specific support for the wave energy sector in Wales, as set out below.

### 4.4.1 Welsh Government

There is strong political support for development of marine energy in Wales and Welsh Government supports a number of sector specific initiatives including:

- Marine Energy Wales (MEW) – see below.
- A Consenting Strategic Advisory Group (CSAG) and Science & Evidence Group for wave and tidal stream energy.
- The Offshore Renewables Joint Industry Programme (ORJIP) for Ocean Energy.

10 Direct economic impacts are the result of money initially spent in the region by these industries, including money towards salaries, raw materials, supplies and operating expenses. Indirect economic impacts of these industries would include increased spending in the area, indirectly benefiting other local businesses, including hospitality and leisure businesses.

11 Fanning, T, Jones, C and Munday, M. Regeneris Consulting and the Welsh Economy Research Unit, 2014. Regional Employment Returns for Wave and Tidal Energy: A Welsh Analysis. Quoted in Marine Energy Wales (2020), State of the Sector 2020.

Welsh Government also provides business support available to companies operating in the marine energy sector or looking to diversify:

- **Welsh Government's Industrial Transformation Team** – provides support to companies looking to establish new operations in Wales by providing business advice and outlining potential financial assistance available.
- **Stakeholder groups** – Welsh Government supports MEW as well as coordinating a number of other stakeholder groups relevant to wave energy including the CSAG.
- **SMARTCymru** – supports businesses in Wales to develop, implement and commercialise new products, processes, and services.
- **Welsh Government Energy Service** – supports community organisations in Wales to develop renewable energy projects that will lower carbon emissions and provide cost savings, income generation and wider community benefits. Launched in October 2018, the service provides financial and technical support to help community groups develop their own renewable energy schemes.
- **Business Wales** – provides a range of general business advice and support, including focussed support through the Accelerated Growth Programme.
- **Development Bank of Wales** – set up by Welsh Government to support the economy of Wales by making it easier for businesses to get the finance needed to start up, strengthen and grow.

### 4.4.2 Marine Energy Wales

MEW[12] acts as a focal point for supporting the marine energy sector in Wales. It hosts a working group that brings together technology developers, the supply chain, academia, and the public sector to tackle issues collaboratively and help support the growth of the sector. MEW provides direct support to companies looking to develop projects in Welsh waters through highlighting sources of information and signposting to other support available.

### 4.4.3 Marine Energy Engineering Centre of Excellence

ORE Catapult's MEECE[13] delivers research, development, and demonstration activities to support innovation in the Welsh supply chain, accelerating the commercialisation of the wave, tidal and offshore wind sectors by reducing the cost of energy.

### 4.4.4 Marine Energy Test Centre

METC is a series of pre-consented test sites in the Milford Haven waterway that can be used by technology developers to test components, installation approaches, and full-scale devices ahead of deployment into array projects.

### 4.4.5 Sustainable Expansion of the Applied Coastal and Marine Sectors

SEACAMS2 is a research programme managed by Swansea and Bangor Universities that provides environmental focussed research and development support to companies developing marine energy projects in Wales.

12 Marine Energy Wales www.marineenergywales.co.uk

13 The Marine Energy Engineering Centre of Excellence www.meece.org.uk

## 4.5 Future development scenario

Over the next five years it is envisaged that the wave energy sector will be continuing to develop the technology with single device deployments to demonstrate the technical viability of the technology for a range of market options. Within that timeframe, demonstration deployments in Wales will likely be undertaken in the META in the Milford Haven waterway and PDZ. However, this momentum may stall unless a viable revenue support mechanism is put in place to support the next step. Consideration is being given to ring fencing part of the Contract for Differences (CfD) for wave energy, however this has not yet been confirmed (UK Energy Minister, 2020).

There are designs in development where wave technology can potentially be included as part of integrated floating offshore wind platforms. This potential development within an accelerating floating wind market could see industrial scale deployment of wave energy technologies from 2030 and beyond.

The key to unlocking future commercial growth is the presence of a clear and demonstrable route to market – that devices can make the 'jump' from testing to commercial deployment. This requires a funding mechanism, pipeline of work (for both financial backers and supply chain to have confidence to invest), and an evidence base to demonstrate that regulator and stakeholder concerns such as environmental considerations can be addressed. The latter can only realistically be achieved through the deployment and monitoring of devices in the water in real world situations. As evidence develops, issues can be better understood and retired to allow focus on any key remaining issues. WNMP **policy SCI_01 (risk-based decision making)** states that opportunities to apply adaptive management should be considered where appropriate. These can be used to manage uncertainty around impacts in conjunction with thresholds of acceptable adverse effects and associated monitoring programmes.

### 4.5.1 Co-location

Co-location is currently seen by technology developers as introducing unnecessary risk to demonstration projects. However, some project developers see co-location as an opportunity to increase the economic potential of projects by sharing infrastructure and operational resources, and to maximise the environmental benefits.

Co-location of different generation assets sharing electrical infrastructure could significantly improve the financial viability of projects. The first step towards co-location and greater cooperation between developers would be the sharing of some key infrastructure, such as grid connection points/ landfalls for cables (see Section 5.1). Such a move could also reduce environmental impacts and some stakeholder concerns. There has been industry interest in co-locating multiple low carbon energy devices within developments such as floating wind, tidal stream energy, and wave energy, as well as co-locating low carbon energy devices with other sector activities such as aquaculture. WNMP **policy ECON_02 (coexistence)** recognises the potential for optimum use of space and resources by promoting consideration of opportunities for coexistence between and within sectors.

### 4.5.2 Supply chain

It is expected that supply chain activity will be focused around the ports closest to the RA, in particular Pembroke Port. The recent Swansea Bay City Deal funding announcement, for the Pembroke Dock Marine project, once in a position to break ground, will kick-start significant infrastructure upgrades at Pembroke Port, and further establish the region as a hub for offshore renewables. Evidence of this project forming an anchor project for associated activity is already apparent with projects such as Selkie and Milford Haven: Energy Kingdom looking at sectoral opportunities and hydrogen respectively.

Floating wind development in the Celtic Sea is expected to grow significantly over the next 10 years with up to 120 GW of potential identified in recent reports (ORE Catapult, 2020). This will require significant growth in the supply chain in the region, as well as upgrades to grid and port infrastructure. The wave sector could benefit from synergies in supply chain and infrastructure developments, with floating wind accelerating the development of these areas in advance of wave energy deployment needs, thereby reducing potential cost and programme burdens for these projects.

As mentioned, Milford Haven; Energy Kingdom is a project looking at hydrogen potential (both blue and green), in coastal regions such as Pembrokeshire and Anglesey. Hydrogen offers a strategic opportunity for decarbonisation, particularly when looking to green renewable technologies to produce it. Given the pipeline, shipping, and gas infrastructure already in place in some regions, using wave power to produce hydrogen at times of surplus generation offers an opportunity for the decarbonisation of industry – clean steel from Port Talbot or Newport; hydrogen powered vessels and transportation from Anglesey or Pembroke Dock.

### 4.5.3 Employment

Employment associated with the wave energy sector will continue to be concentrated in distinct regions and will grow primarily from existing areas where there is strong absorptive capacity, especially the offshore wind, O&G, steel, and maritime sectors.

In the UK it is expected that wave energy jobs could grow to 8,100 by 2040, giving a total of almost 22,600 jobs supported by the sector by 2040 (ORE Catapult, 2018). A proportion of this new job creation can be in Wales, but it is unclear how much this will be at this point. There are some challenges in recruitment associated with the expansion of the wave energy sector including the availability of skilled workers in the locality of planned developments and uncertainty around future staff requirements for O&M activities. However, there are a number of opportunities for the wave energy sector to encourage positive social and economic outcomes for local coastal communities through training programmes, apprenticeships, and the attraction of skilled workers into the local area. As a result, there is potential for the expansion of the wave energy sector to support Welsh Government's objectives around creating employment, tackling poverty, and opportunities for coastal communities, under WNMP **policies ECON_01 (sustainable economic growth)**, and **SOC_02 (well-being of coastal communities)**.

### 4.5.4 Consenting

An important issue for the sector in the future will be around the consenting of array-scale projects. The move to commercial scale projects will require further collaborative work between government, the regulator, key stakeholders, and industry to address areas of uncertainty and increase confidence related to management of environmental impacts. As set out in Section 4.4, a framework for addressing these issues is already in place with the establishment of the CSAG that brings together key stakeholders in Wales, and links to ORJIP for Ocean Energy, ensuring positive and enabling steps are being taken at several levels.

The scale of a proposed wave energy development will influence the regulatory regime under which the permissions are required. It should also be recognised that in many cases there will be ancillary structures onshore, associated with offshore renewable energy generation, that will require planning permission.

Provisions under the Wales Act 2017 state that energy generation projects up to 350 MW (excluding wind energy) in Welsh waters are to be consented by Welsh Ministers, with those above 350 MW to be consented by the Secretary of State. Since 1 April 2019, Welsh Ministers are responsible for determining applications for a project of between 1 MW and 350 MW under Section 36 of the Electricity Act 1989.

Table 4.1 outlines the consents and licences which may be required for wave energy developments. In all cases a marine licence will be required. The Marine Licence Determination infographic in Figure 4.3 outlines the legislation which governs the marine licensing process in Wales. For more information on this process, see Welsh Government's marine renewable consenting infographic.[14]

**Table 4.1: Consents and Licences required for wave energy developments[15]**

| Regulator/Authority | Consent/Authorisation |
|---|---|
| NRW acting on behalf of Welsh Ministers | Marine Licence:<br>• For the deposit of substances or objects in the sea, or on or under the seabed. Other licensable activities include construction activities, dredging and removals. |
| Local Authority (LA) | Planning Permission where there is an intertidal aspect for any onshore facilities |
| Welsh Ministers | A Development of National Significance consent or Transport and Works Act Order (for harbour works). |
| Secretary of State (handled by the Planning Inspectorate) | A Development Consent Order for Nationally Significant Infrastructure Projects. |
| TCE (or other landowner) | Grants foreshore/seabed rights for a range of activities up to 12 nm.<br>Awards sovereign rights to generate electricity from wind, waves and tides (Energy Act 2004) for the continental shelf beyond 12 nm. |

*Source: Adapted and simplified from WG[16]*

Wave energy projects will largely follow the typical consenting process for any development in the marine environment in Welsh waters (see Figure 4.3). However, wider supporting elements may also be required including:

- Environmental Impact Assessment (EIA) – under the EIA Regulations (2020) and the Marine Works (EIA) (Amendment) Regulations 2017[17].
- Habitat Regulations Assessment – under the Conservation of Habitats and Species Amendment (EU Exit) Regulations (2019).
- Water Framework Directive Assessment – under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.
- Navigational Risk Assessment – compliant to the Maritime and Coastguard Agency's Marine Guidance Note 543.

14 www.gov.wales/sites/default/files/publications/2020-11/marine-renewable-consenting-infographic.pdf

15 Note this is not an exhaustive list. Each development should consult with regulatory sources to confirm which consents/licences are required for their specific project. www.naturalresources.wales/permits-and-permissions/marine-licensing/?lang=en

16 Welsh Government. (2021). Marine Renewable Consenting Process Flowchart www.gov.wales/sites/default/files/publications/2020-11/marine-renewable-consenting-infographic.pdf

17 Offshore renewable energy projects are likely to fall within Schedule A2 and require an EIA where any part of the development is likely to have significant effects on the environment.

If permission is granted, licence conditions may stipulate a range of post-consent management and monitoring to confirm the assumptions made in the EIA and to ensure no significant adverse impacts are occurring post-consent. Monitoring can help develop additional understanding of actual impacts which will in turn inform future consenting.

NRW has produced guidance notes of relevance to wave energy developments, including topics covering:

- marine vertebrate conservation legislation[18]
- marine ecology datasets[19]
- benthic habitat assessment[20]
- marine physical processes [21]
- marine mammal site characterisation requirements at wave and tidal stream energy sites in Wales[22].

NRW also provide guidance on:

- scoping an EIA[23]
- Water Framework Directive assessment[24]
- Habitats Regulation Assessment[25]
- the Marine Noise Registry[26]
- use of adaptive management approaches in consenting[27].

For more information on the consenting process for low carbon energy developments in Wales see NRW's marine renewables webpage[28] and flow chart[29] on the process for EIA applications. For additional information on preparing an application for development consent, see the relevant sections of the **WNMP Implementation Guidance**.[30] More information and evidence to support development preparation and consenting can be found on the Welsh Government's Marine Planning Portal.[31]

18 www.cdn.naturalresources.wales/media/691896/gn003-marine-vertebrate-conservation-legislation-in-wales.pdf

19 www.cdn.naturalresources.wales/guidance-and-advice/business-sectors/marine/marine-ecology-datasets-for-marine-developments/?lang=en

20 www.cdn.naturalresources.wales/media/691900/gn030-guidance-note-final-2-mar2019.pdf

21 www.cdn.cyfoethnaturiol.cymru/media/692263/marine-physical-processes-guidance-to-inform-environmental-impact-assessment-eia.pdf

22 www.cdn.naturalresources.wales/media/686187/eng-report-082-guidance-marine-mammal-site-characterisation-for-wave-and-tidal-energy-sites.pdf

23 www.cdn.naturalresources.wales/media/684594/gn13-scoping-an-environmental-impact-assessment-for-marine-developments.pdf

24 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-licensing-and-the-water-framework-directive/?lang=en

25 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-licence-habitats-regulations-assessment/?lang=en

26 www.naturalresources.wales/permits-and-permissions/marine-licensing/marine-noise-registry/?lang=en

27 www.naturalresources.wales/permits-and-permissions/marine-licensing/applying-for-a-marine-licence-for-projects-using-adaptive-management-or-project-phasing/?lang=en

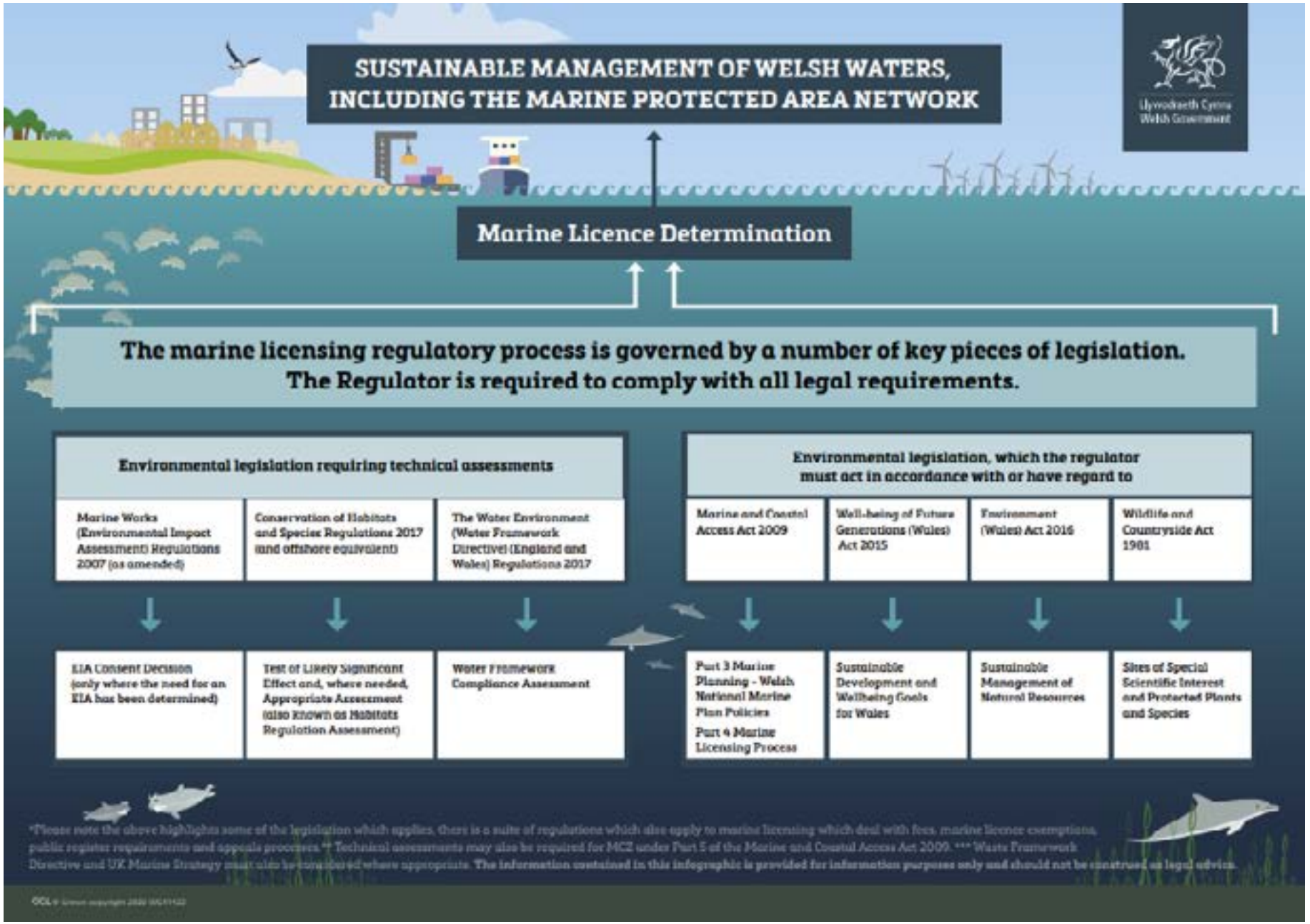
28 www.naturalresources.wales/guidance-and-advice/business-sectors/marine/marine-renewable-energy-developments/?lang=en

29 www.cdn.cyfoethnaturiol.cymru/media/688033/marine-licensing-band-3-application-process-flowchart.pdf

30 Welsh National Marine Plan: implementation guidance | GOV.WALES www.gov.wales/welsh-national-marine-plan-implementation-guidance

31 Marine Planning portal: www.lle.gov.wales/apps/marineportal/

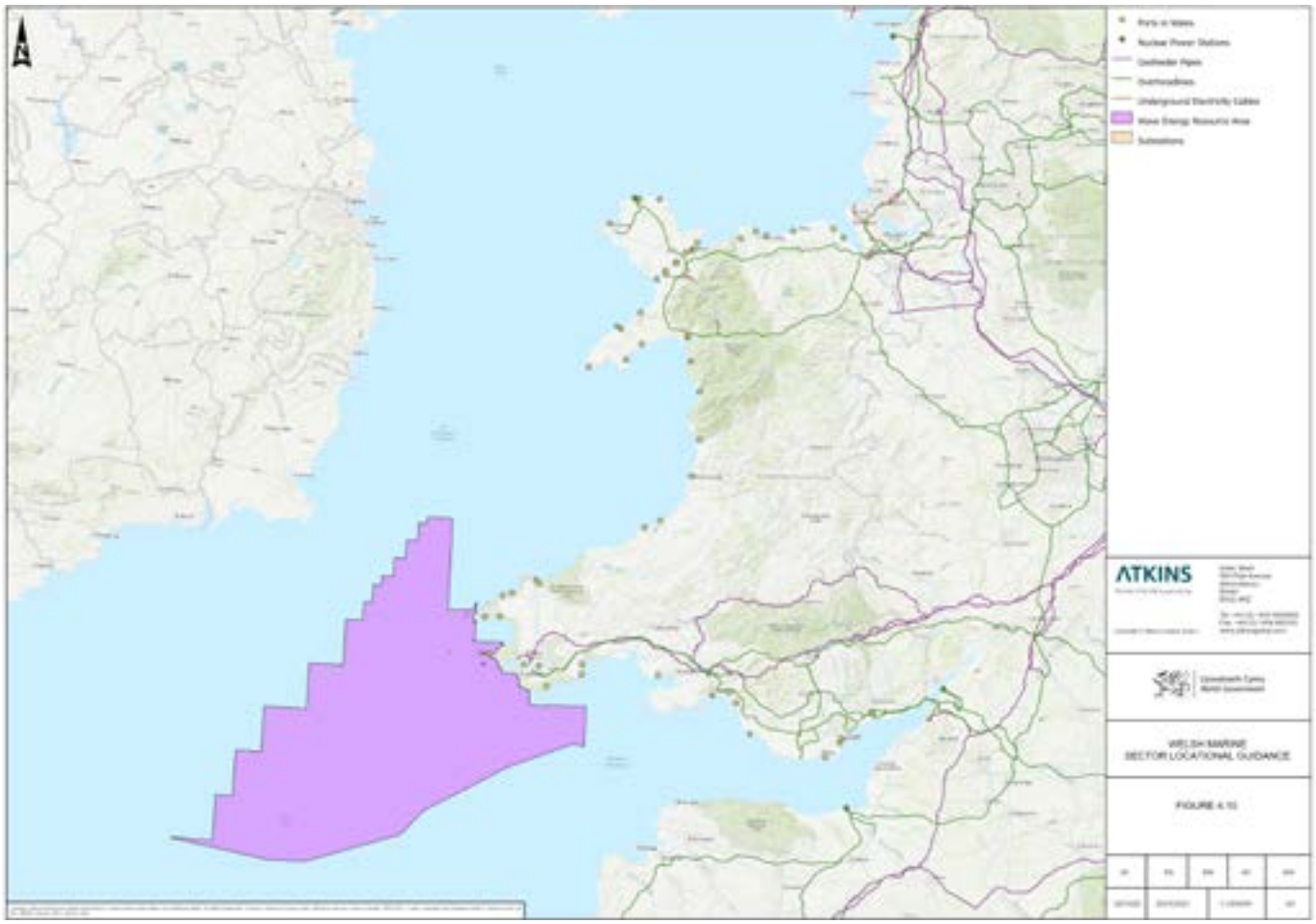
**Figure 4.3: Consenting process**




*Source: Welsh Government, 2020*

# 5. Infrastructure considerations

**Figure 5.1: Coastal and offshore infrastructure in relation to the wave RA**




*Source: National Grid, 2021 and Oceanwise, 2021*

## 5.1 Grid

Access to the grid is often raised as a constraint to wave energy development in Wales and more widely in the UK. Grid connection has been a deciding factor in some cases with regards to the location of developments. Figure 5.1 shows the existing coastal and offshore grid infrastructure in Wales.

An ORE Catapult study carried out for Welsh Government in 2020 assessed existing grid capacity in Wales, and upgrades required to accommodate future growth of offshore renewables over the next 20 years. The study primarily focussed on the growth of offshore wind (fixed and floating). The level of wave energy development is likely to be able to be accommodated within the scale of development expected in offshore wind.

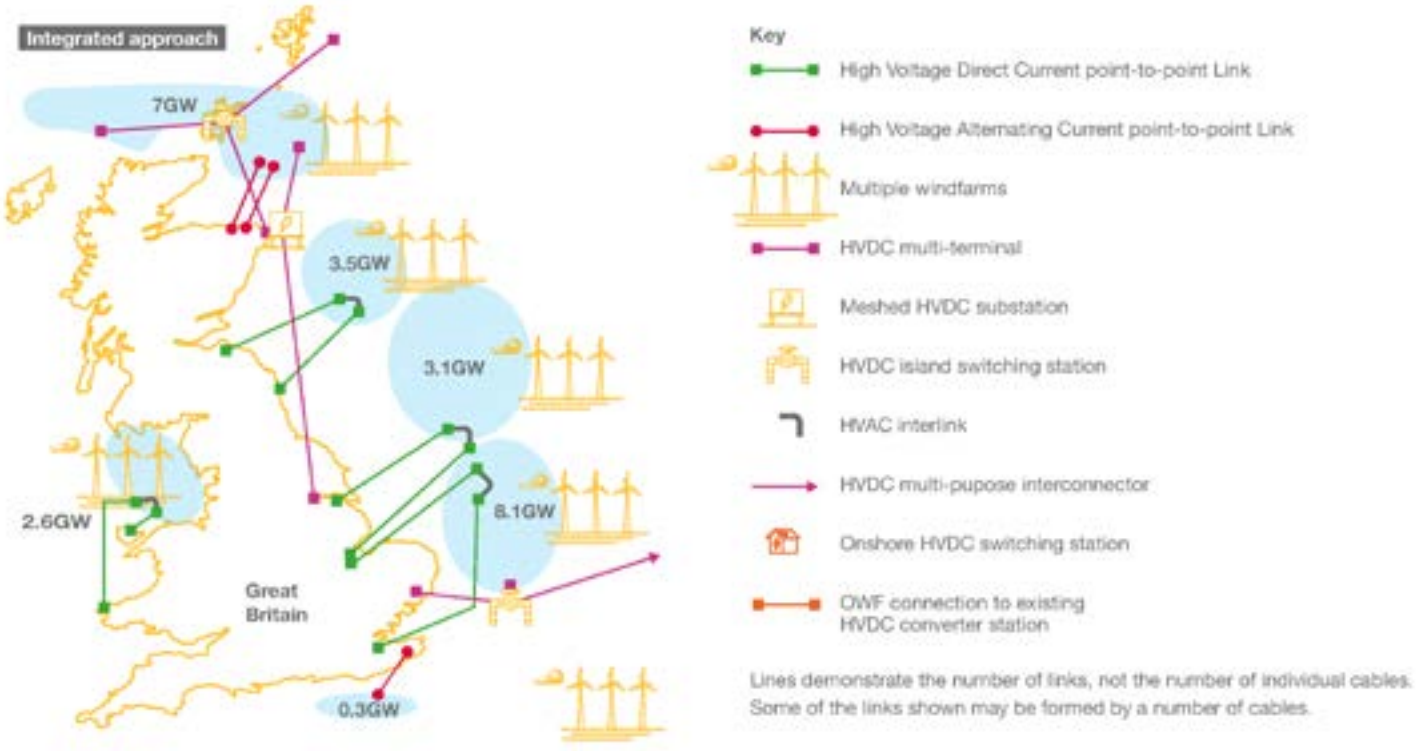
The ORE Catapult study assumed that landfall for projects would either be into Anglesey or Pembrokeshire and considered a number of scenarios based on the likelihood of projects going forward. Due to the scale of the projects being considered, the focus of the study was on the transmission system. Community scale wave projects would be anticipated to connect to the lower voltage distribution grid which would require project specific assessments (National Grid, 2020).

A significant amount of work is being undertaken by National Grid Electricity System Operator (ESO) to plan for the upgrades required to support the expected growth of offshore wind around the UK. In Wales, the future scenarios being considered are 3.7 GW of offshore generation by 2030 and 15.4 GW by 2050. (National Grid ESO, Future Energy Scenarios, July 2020). The scenarios have not specifically identified potential contributions from wave and tidal projects, likely due to the scale of offshore wind development envisaged.

Rather than a project-by-project approach that only considers point to point offshore network connections and individual project optimisation and transmission (HVAC or HVDC) decisions, the future upgrades are being looked at strategically considering a range of connection options including multi terminal/meshed HVDC and HVAC options, and considering whole system optimisation and transmission technology decisions.

A high-level representation of what the electricity system could look like in 2050 is shown in Figure 5.2.

**Figure 5.2: High-level representation of what the electricity system could look like in 2050**




*Source: National Grid, 2020*

Whilst the future scenarios do not currently include potential development of floating wind in the Celtic Sea, this will undoubtedly be factored into further strategic upgrades to the electricity system in south Wales. The scale of offshore wind in the Celtic Sea, and the associated upgrades to the electricity system, suggests that development of large-scale wave and tidal stream projects could also be relatively easily accommodated.

Welsh Government's MRESF study estimated 7 GW of potential wave capacity off the coast of Pembrokeshire. However, as the focus of the sector is still on proving the technology at commercial scale with individual device deployments, commercial arrays that would require significant capacity on the transmission system are not expected within the next 5 years.

Hydrogen use is being explored in Pembrokeshire through the Milford Haven: Energy Kingdom project and South Wales Industrial Cluster, which could present a potential alternative to grid connection for renewable energy projects, including wave, but the economic viability and uptake of this option would need to be further explored.

## 5.2. Ports

Whilst supporting the development of grid capacity is important to enable the delivery of wave energy projects, ports also need to consider how they can develop to maximise sectoral opportunities in the future. Accommodating large-scale technological components on laydown areas, either for construction before deployment or on their retrieval from operational areas for servicing or decommissioning, requires areas of hardstanding on land. Sufficient depth of water alongside quays or in approach channels may also be required to enable vessels to use ports in close proximity to RAs. The location of the main ports of significance to the wave sector in Wales are shown in Figure 8.9 showing harbour areas and shipping routes.

Given the lead-in time that can be required to secure planning permission for new quay areas or consents to undertake capital dredging, ports need to use the 2020s to plan ahead for wave energy business in the following decades. Projects like the PDZ enable costs of consenting and required infrastructure to be addressed upfront, providing the opportunities to share infrastructure with other projects and potentially reducing the costs faced by technology developers and their supply chain.

Pembroke Port is another example of a Welsh port with proven experience in supporting the marine renewables sector, having worked in partnership with Tidal Energy Ltd to accommodate the fabrication and deployment of the DeltaStream prototype onsite at the port. A planning application was submitted by the Port of Milford Haven in 2020 seeking approval to develop the port into a Marine Renewable Energy Hub. Floating devices or devices that can be towed to site may not require such significant water depths.

Welsh ports that benefit from investment and revenue from the offshore wind sector in the coming years, will potentially have the necessary infrastructure, workforce and supply chain to support the wave energy sector. However, if Welsh ports are not actively involved in offshore wind developments, the capacity and capital required to support future commercial wave energy will need to be driven by another source.

Welsh Government is working to develop a wider understanding of supply chains for marine renewable energy sectors and have commissioned a project looking at supply chain links for the offshore wind sector. The outputs from this work are due to be published in 2021.

# 6. Social considerations

The wave energy sector has the potential to positively contribute to the achievement of WNMP **social policies** and objectives, promoting resilient, prosperous, and equitable coastal communities. Sectoral developments can offer employment opportunities for coastal communities, helping to protect and create employment at all skill levels and tackle poverty through supporting deprived communities, in line with WNMP **policy ECON_01 (sustainable economic growth)**.

The sector can also contribute to the promotion and facilitation of the use of Welsh language and culture, in line with **policy SOC_04 (Welsh language and culture)**. This could be through simple actions such as providing Welsh language signage, information, and educational resources. The wave energy sector can also support the development of local industries and supply chain links within a development area, bringing job opportunities and supporting local economies and the well-being of coastal communities in support of **policy SOC_02 (well-being of coastal communities)**.

Whilst the location of new development will primarily be driven by the available wave resource and grid connectivity, social considerations are important for developers establishing themselves in a region, engaging with the local supply chain and local communities. Coastal communities living within 5 km of the coast account for an estimated 60% of the total population of Wales (NRW, 2020). Regional analysis shows that the characteristics of these coastal communities varies, but many parts of the Welsh coast have an ageing population, sometimes as a result of inward migration by retirees. Other areas have fragmented communities spread geographically along the coast and its hinterland. The more densely populated city regions such as Swansea and Cardiff have significant areas of deprivation but younger populations as a result of being hubs for academic institutions.

Social aspects considered for this guidance include the following elements:

- population density;
- demographics;
- area deprivation;
- Welsh speaking (%);
- local workforce/skill set;
- cultural identity; and
- business support.

A large proportion of social information is considered by LA area. Therefore, the information presented for the South West RA may vary slightly depending on the LA boundaries in relation to the RA.

The Welsh language, Welsh culture and heritage are integral elements of the social fabric of communities and are central to many people's sense of identity. The 2011 Census showed that across Wales approximately 20% of the population speak Welsh, whilst in some areas this is substantially higher, and Welsh is the first language. Figure 6.1 shows the distribution of Welsh speakers around Wales. The Welsh Language (Wales) Measure 2011 made Welsh an official language in Wales and, along with its associated Regulations introduced in 2014, created a new legislative framework for the Welsh language to ensure it must be treated no less favourably than English. For larger developments this includes assessment of the impact on the Welsh language as part of the planning process.

Government support has attracted a number of technology developers to base themselves in Wales. Wave resources in the southwest overlap with the spheres of influence of centres of socio-economic activity and supporting infrastructure, such as St. David's, Milford Haven and Cardiff, which have hinterlands that extend away from the coast. Such areas in turn may support supply chain interests and securing a workforce with the necessary skills. Figure 6.2 uses information on travel time to five key

identified centres of population across Wales as an indicator of the extent of their spheres of influence. Those in closest proximity to the RA may provide useful support but the likely impact of the sector will extend far beyond these localities.

The developing wave energy sector could result in potential new employment opportunities for local populations; however, feedback from stakeholder engagement suggests that the remote nature of the RA has meant that developers have sometimes found it a challenge to attract suitably qualified staff for some specialisms. Anecdotal evidence also suggests that the dispersed nature of rural communities has sometimes meant that younger recruits from outside those communities have struggled to settle if they have relocated for economic opportunities.

Feedback from stakeholders suggests that developers are aware of the 'push' and 'pull' factors relating to social policy, but they are not currently among the prime considerations for the siting of new developments. At the moment, the presence of the necessary viable resource understandably dictates the interest in an area for wave energy projects. However, it is acknowledged that access to a local supply chain, in which desired and required skill sets are present, plays an important role in decision-making. Travel time to/from these hinterland areas can also be an important factor in the development of business opportunities.

It is also acknowledged that investment and development in a peripheral coastal area may be a catalyst for stemming outward migration of the local population in search of work or study elsewhere. In turn, this bolsters and reinforces aspects of Welsh language and cultural identity.

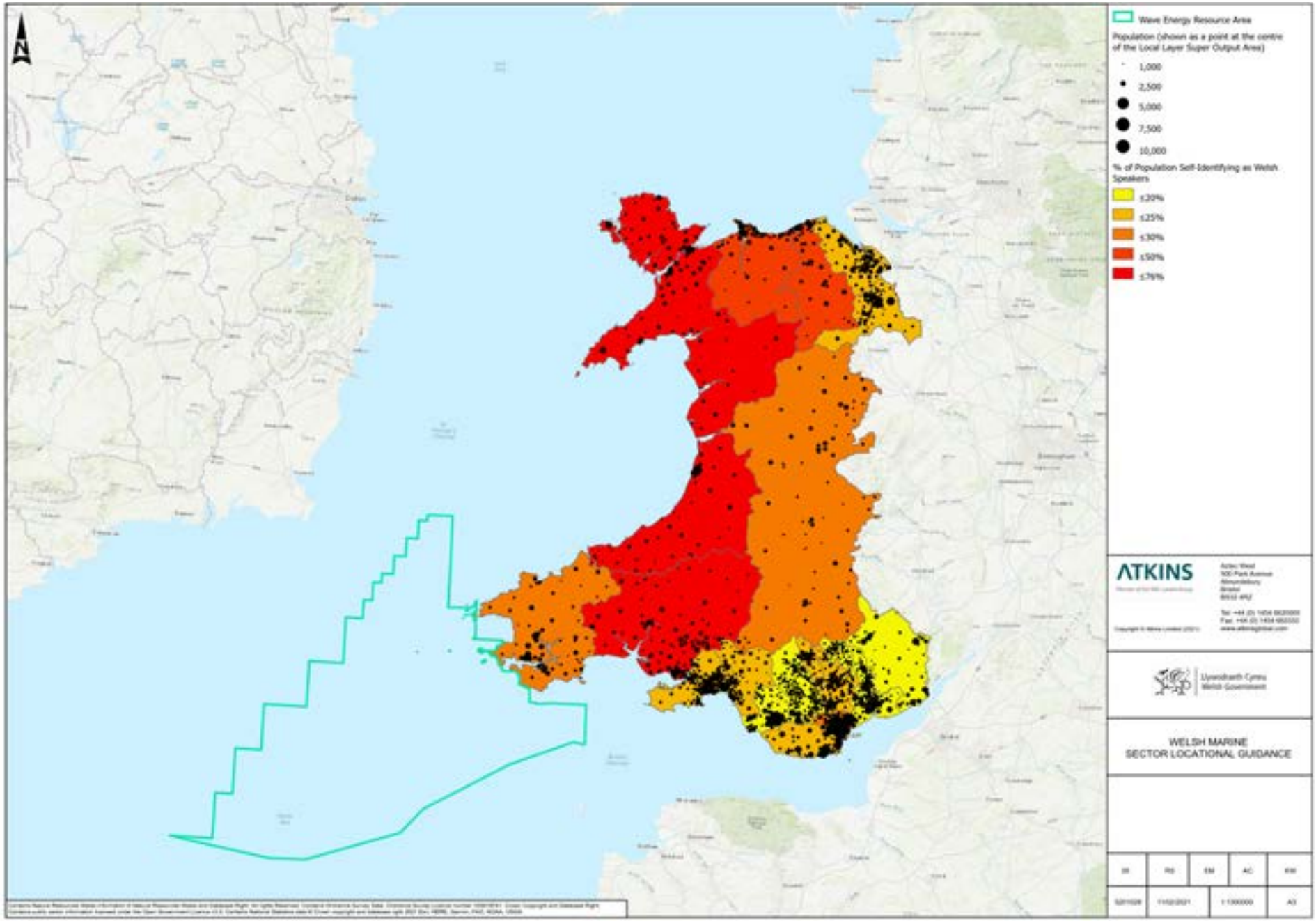
Support from the local community is an important factor in the success of a project. To date, there has been positive support for marine energy projects in Wales, with developers citing community support having a positive impact in helping them establish in the area. Welsh Government also has specific targets for local ownership of renewable energy developments, including:

- 1 GW of renewable electricity and heat capacity in Wales is to be locally owned by 2030; and
- all new renewable energy projects from 2020 onwards are to have at least an element of local ownership[32].

It is unlikely that social constraints will have a significant influence on determining the location of development. However, as can be seen from the tidal stream sector, Menter Môn's involvement in the Morlais tidal array initiative demonstrates that social enterprise may have a facilitating role to play in the development of offshore renewable energy. If successful, it could promote a model that other areas may subsequently adopt.

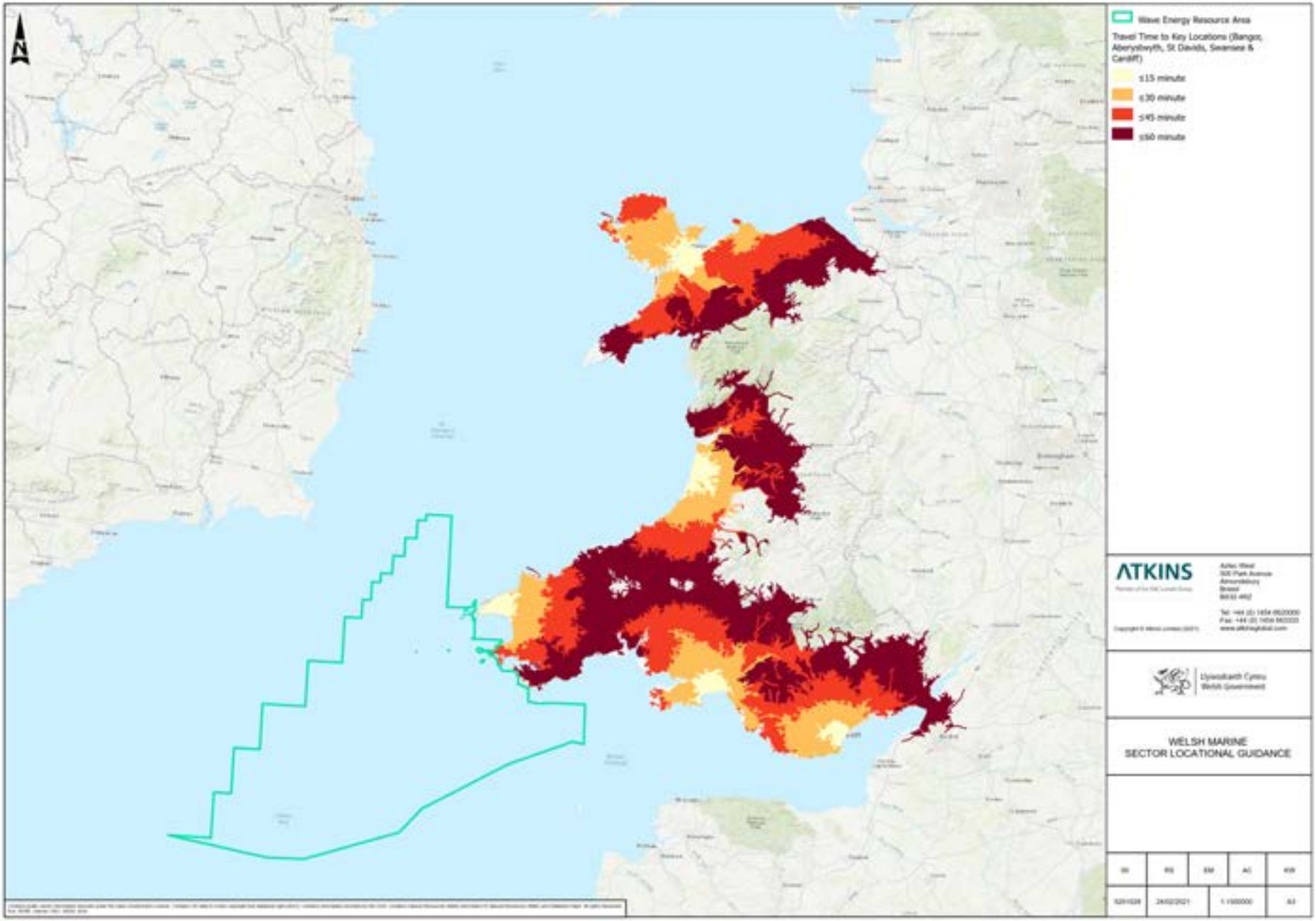
32 Welsh Government Policy statement: Local ownership of energy generation in Wales – benefitting Wales today and for future generations gov.wales/local-ownership-energy-generation-wales-policy-statement and Oral Statement on "Energy" delivered by the Cabinet Secretary for Environment and Rural Affairs to the National Assembly for Wales on 26 September 2017 www.assembly.wales/en/bus-home/pages/rop.aspx?meetingid=4644&assembly=5&c=Record%20of%20Proceedings#C494225

**Figure 6.1: Population size and % of people identifying as Welsh speaking**




*Source: WIMD, 2019 and Stats Wales, 2021*

**Figure 6.2: Travel time to key locations (Bangor, Aberystwyth, St. David's, Swansea and Cardiff)**




*Source: Atkins, 2021*

# 7. Environmental considerations

The wave energy sector has the potential to contribute to the Welsh Government's climate and renewable energy objectives in support of a clean, healthy, and resilient environment. Sectoral developments can align with WNMP **policy SOC_10 (minimising climate change)** through avoiding or minimising the emission of greenhouse gases and, in doing so, contribute to the decarbonisation of the energy system in Wales.

New renewable energy developments have the potential to change the dynamics of the use of an area through the establishment of safety or exclusion zones and/or the restriction of certain activities within the vicinity of the development site. Where this may be the case, there are good opportunities to gather evidence and information to understand how further development could deliver tangible environmental benefits. This is supported by WNMP **policy ELC_02b (low carbon energy (supporting) wave)** in relation to understanding future opportunities for the sector.

Wave energy developments also offer the potential to deliver additional environmental benefit through the incorporation of restoration or enhancement measures in line with WNMP **policy ENV_01 (resilient marine ecosystems)**. This could include even small details such as consideration of alternatives for substrates introduced into the marine environment to provide a more colonisable or valuable habitat to local species. As part of priorities identified through the Marine Area Statement, NRW are working to develop understanding of opportunities for restoration and enhancement of the marine and coastal environment around Wales. Current work is focussed on identifying spatial opportunities and associated benefits from restoring saltmarsh and intertidal mudflats, seagrass beds, native oyster (*Ostrea edulis*) habitat, horse mussel (*Modiolus modiolus*) beds and honeycomb worm (*Sabellaria alveolata*) reef. The outputs from this initial work including areas of potential opportunity are due to be published in 2021.

Wave energy devices, depending on the type and location, may have a range of adverse environmental impacts. These could include, for example, changes to seafloor habitat through the introduction of new structures and the introduction of underwater noise during construction activity. In the preparation of a development proposal, any identified impacts will need to be addressed in line with the relevant **environmental policies** of the WNMP.

Development can impact on marine biodiversity, some of which is given legal protection either because they are a feature of a site designated for their protection or because they are a species of conservation importance protected wherever they are located. Figure 7.1 shows the location of MPAs in Welsh waters and Figure 10.2 shows coastal and marine environmental designations in relation to the wave RA. Impacts on protected sites or species will be an important factor in project planning. Developments will need to demonstrate compliance with relevant national and international regulations and legislation with regard to protected sites and designated features as well as ensuring compatibility with established management measures. Mitigation measures may also need to be secured to ensure the integrity of protected species and sites are maintained.

The presence of a protected site or species does not preclude the possibility of development within an area; however, in such a situation, additional consideration of impacts and management measures would be required. Depending on the specific sensitivities of the protected feature and the type of activity proposed, there is potential for development activity to co-exist alongside ecological considerations. The WNMP supports a proportionate, sensitive, and evidence-based approach to the siting of new developments and the use of detailed management measures to ensure sustainable development of the marine area whilst not compromising the necessary and appropriate protection of marine species and habitats.

Adverse impacts can potentially be avoided through careful planning early in the project development process, and through timing of construction, as well as micro-siting within the project area to avoid specific features where necessary. Detailed assessment and extensive engagement with stakeholders would be required as part of the consenting process, and potential impacts need careful consideration within a designation. This is likely to lead to longer consenting times and increased consenting risk in designated areas with sensitive environmental features. It may also lead to the need for increased environmental monitoring and mitigation which would increase project costs.

Further information on development impacts and requirements relating to MPAs and protected species can be found on NRW's protected sites webpages[33], which provide information and advice about protected areas of land and sea; marine development guidance pages[34], where advice on assessment can be found; and marine licensing pages[35] which contain information and advice on the marine licensing process and formal requirements of assessment.

There is still some uncertainty around potential collision risk for birds with wave energy devices as well as potential impacts on marine mammals including collision risk and barrier effects. Work is being progressed to develop the evidence base through monitoring of demonstration scale projects. Such monitoring will allow further refinement of our understanding of relevant environmental constraints in an area. However, whilst there is still uncertainty it is likely projects will come under increased scrutiny in the consenting process in areas considered important for diving bird species and marine mammals. This will therefore likely extend consenting timescales and may require greater environmental monitoring and potentially mitigation during operation.

Through the European Maritime and Fisheries Fund SMMNR project,[36] Welsh Government has begun a process of mapping to understand the distribution of important environmental features which are likely to be a particular consideration for consenting. The project focussed on the aquaculture, tidal stream energy, and wave energy sectors and considered the relative consenting constraints associated with four ecological 'Broad Interest Features': marine mammals, fish, benthic habitats, and birds.

33 www.naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/protected-areas-of-land-and-seas/?lang=en

34 www.naturalresources.wales/guidance-and-advice/business-sectors/marine/?lang=en

35 www.naturalresources.wales/permits-and-permissions/marine-licensing/?lang=en

36 gov.wales/sustainable-management-marine-natural-resources

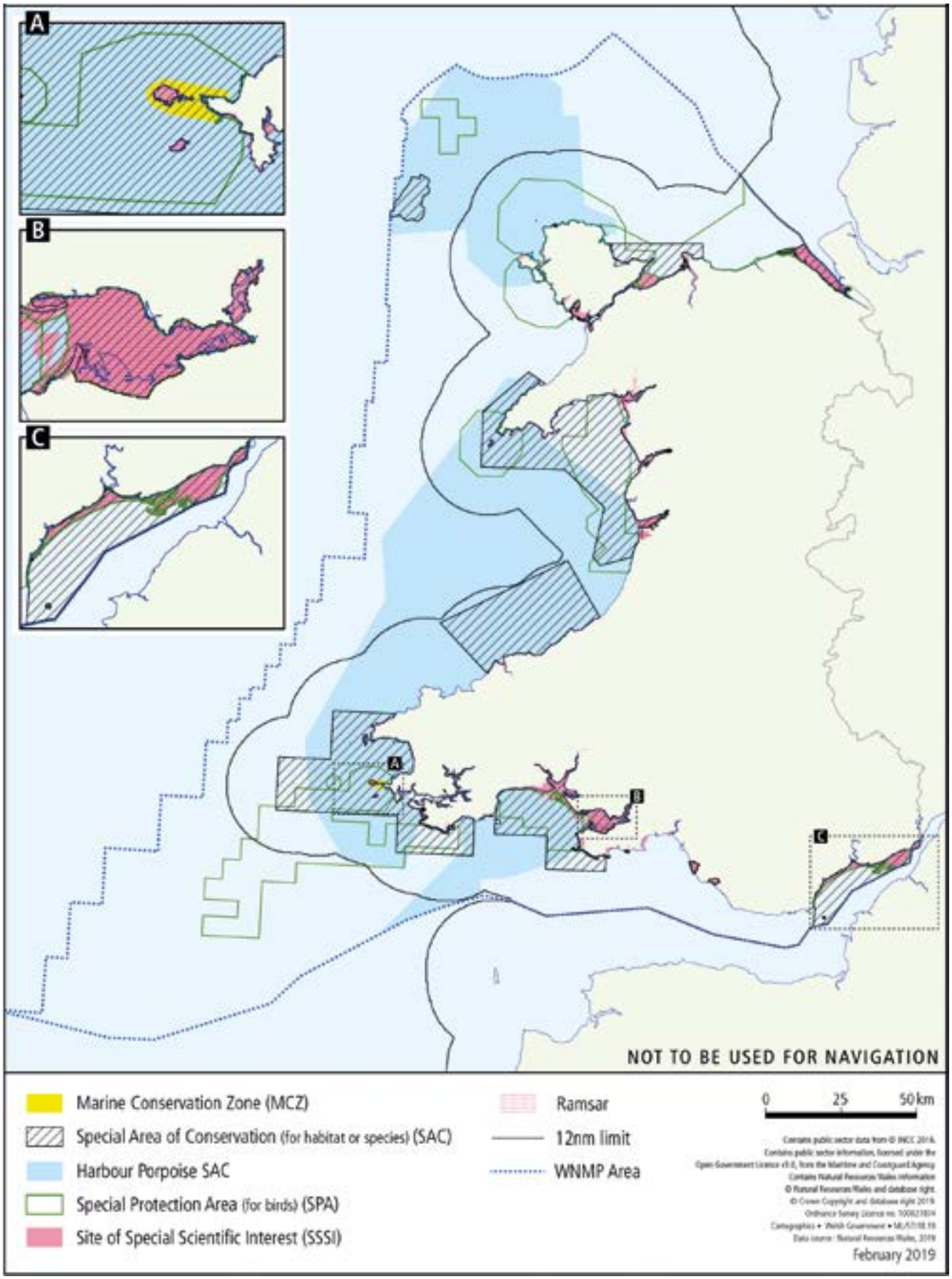
The SMMNR outputs represent the start of an iterative process of spatial analysis and mapping to support sustainable sectoral development and further marine planning. As such, they should be interpreted and applied carefully. The SMMNR outputs are reliant upon and reflect the available data at the time of production. It should be noted that there is limited availability of data in some areas, especially offshore, and confidence in some data may be lower. Figure 7.2 and Figure 7.3 are indicative of survey coverage for seabirds and habitats respectively, in relation to the wave RA. Future iterations of the SMMNR work can be updated both to develop the underlying models and to incorporate new evidence. Ongoing data collection and analysis is warranted, especially where evidence gaps have been identified.

Maps of the estimated relative constraints for the wave energy sector are shown below in relation to marine mammals (Figure 7.4), fish (Figure 7.5 and Figure 7.6), benthic habitats (Figure 7.7 and Figure 7.8) and birds (Figure 7.9 and Figure 7.10). For further details on methodology, assumptions and results, users should refer to the SMMNR project outputs, in particular the SMMNR Ecological Constraints and Opportunities report (ABPmer, 2020). In addition, Appendix A provides further information on data limitations.

The evidence presented within this SLG is to help users understand some of the ecological considerations relevant to wave energy development in Welsh seas. None of the material may be relied upon as being fully up to date or definitive in nature; it is a tool based upon a number of assumptions set out in the SMMNR work, which can be used at an early stage of sectoral planning. The resolution of the mapped constraints reflects that of the underlying data and the level of spatial resolution may be of limited relevance or value for small scale project planning purposes.

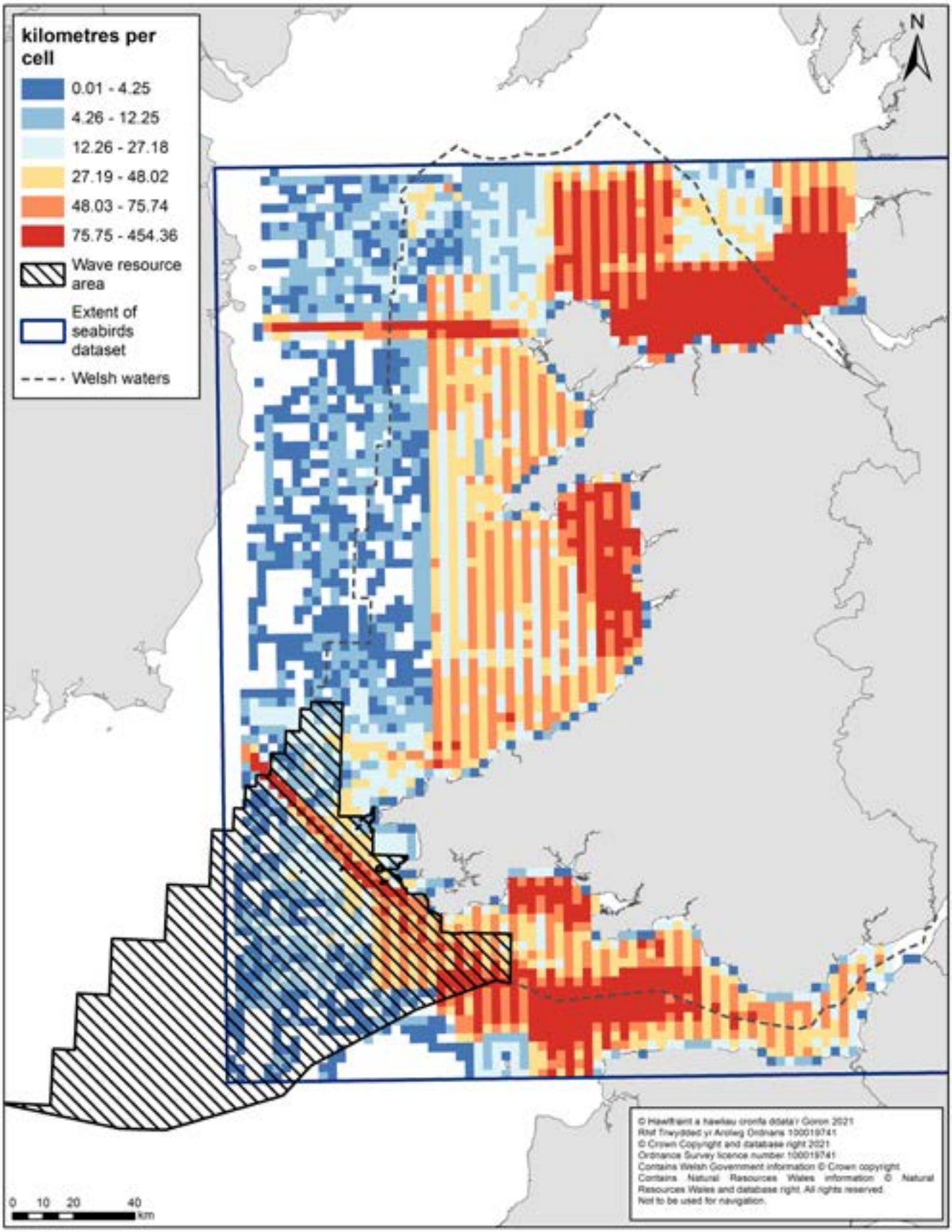
Further, careful consideration should be given to data limitations and gaps. High level ecological mapping such as this may imply there are no or few constraints in some areas. This should be interpreted as no known or few known relative constraints for a particular sector. Therefore, whilst the constraints maps provide a tool for users to explore and better understand potential ecological considerations, they do not obviate the need for users to consult the source datasets and other relevant evidence.

**Figure 7.1: MPAs**



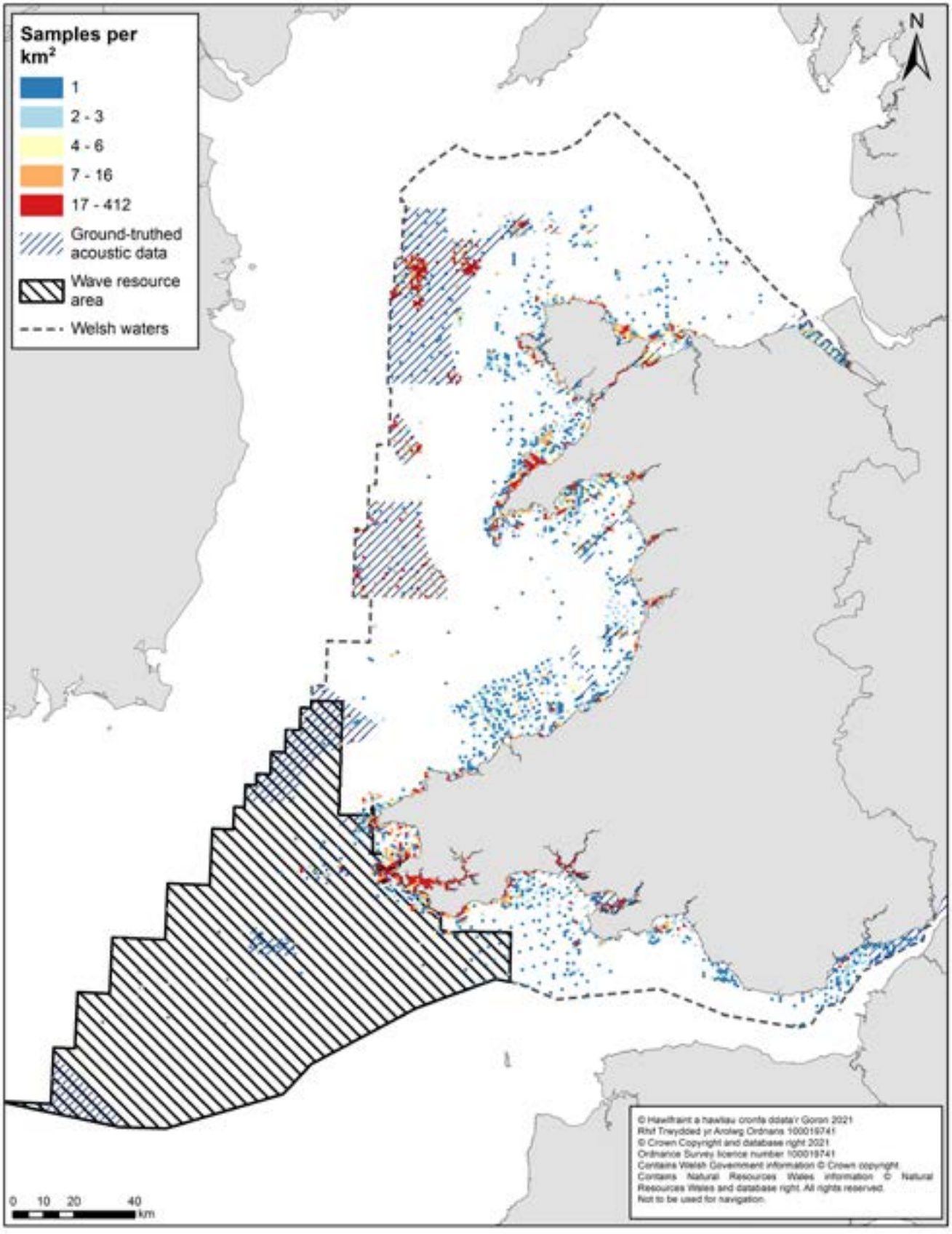

*Source: WNMP, 2019*

**Figure 7.2: Survey coverage from seabirds at sea data**



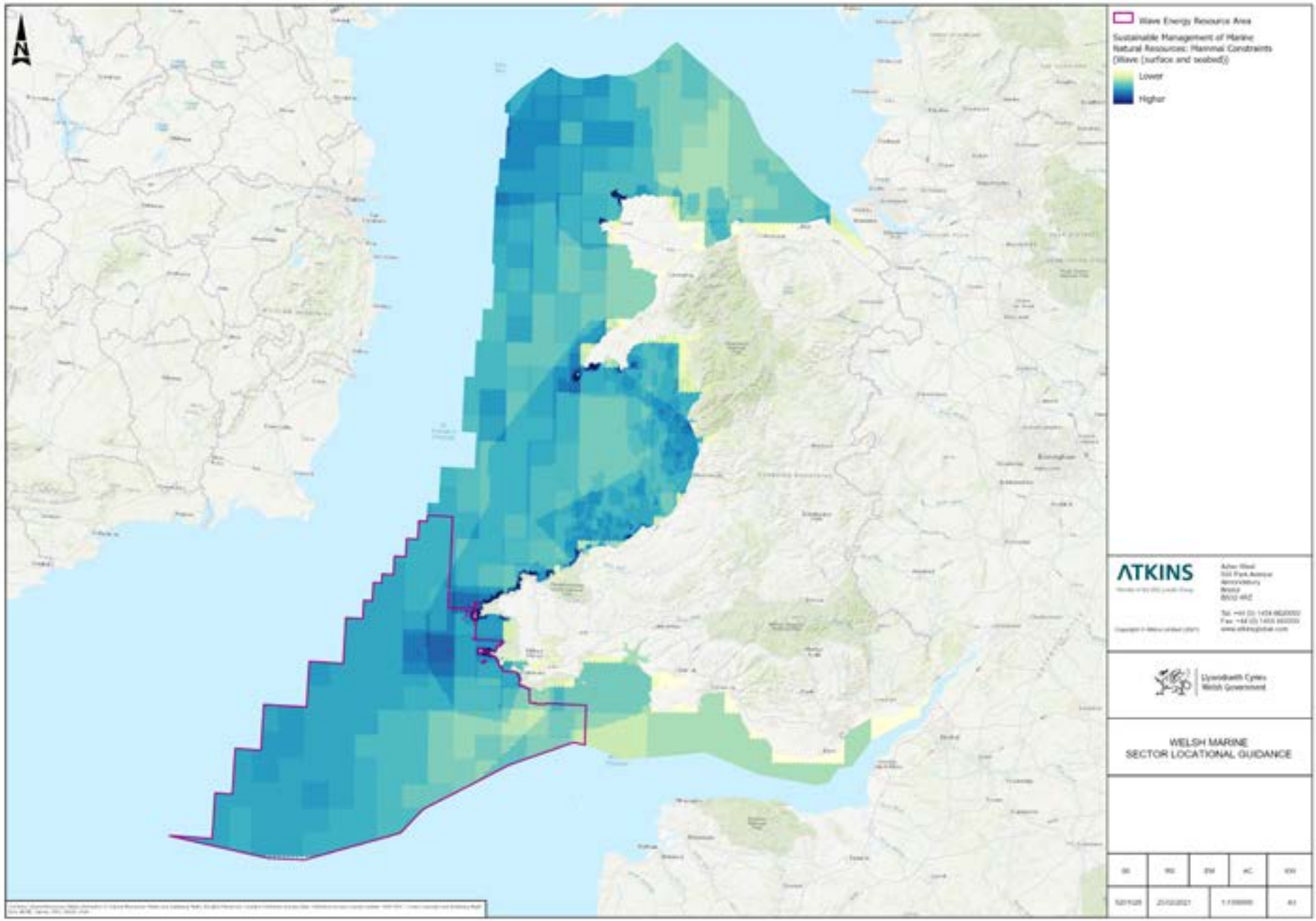

*Source: SMMNR, 2021*

**Figure 7.3: Survey coverage from Marine Recorder data and ground-truthed acoustic data from the JNCC combined map**



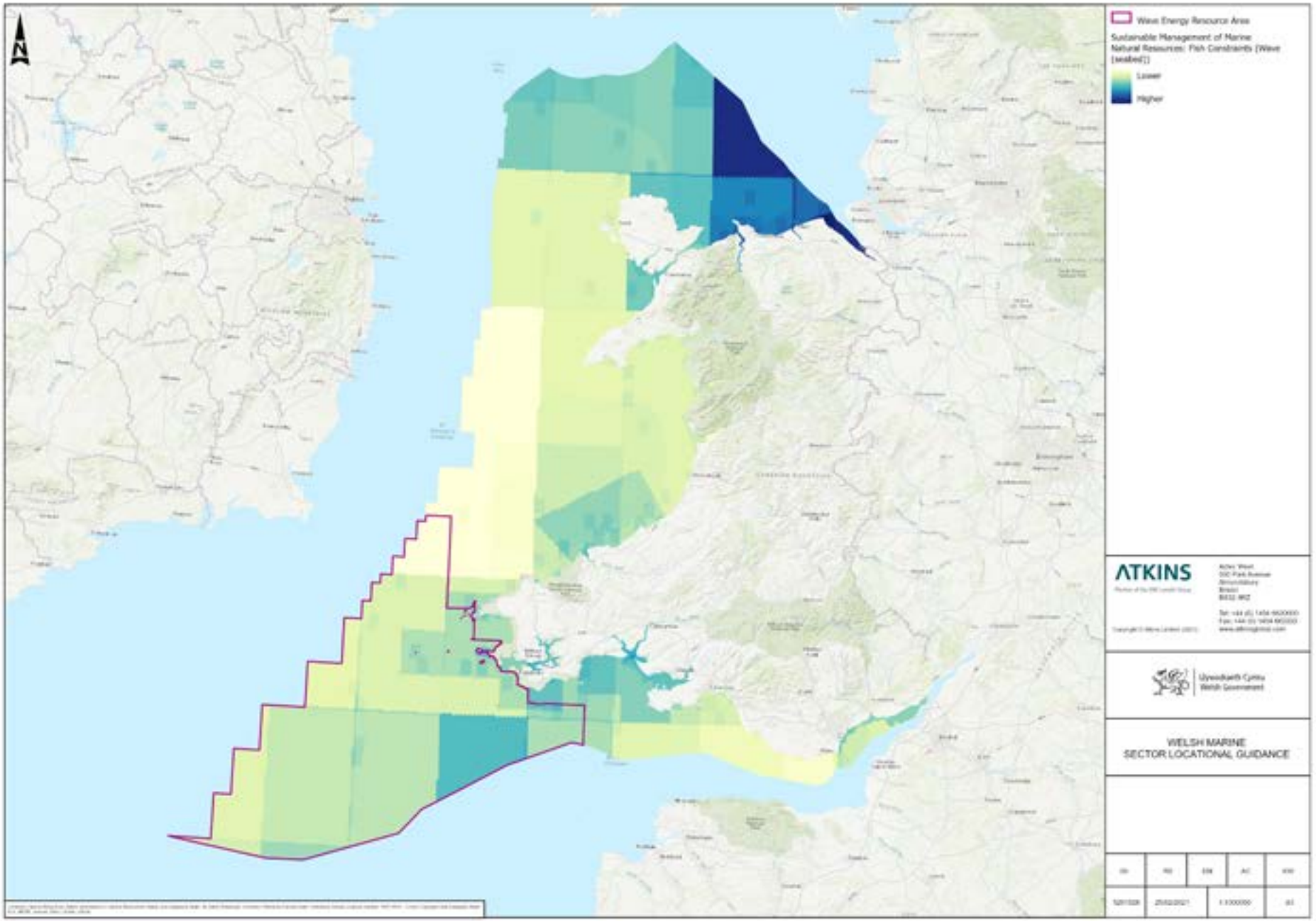

*Source: SMMNR, 2021*

**Figure 7.4: Relative potential marine mammal constraints for surface and seabed wave energy**



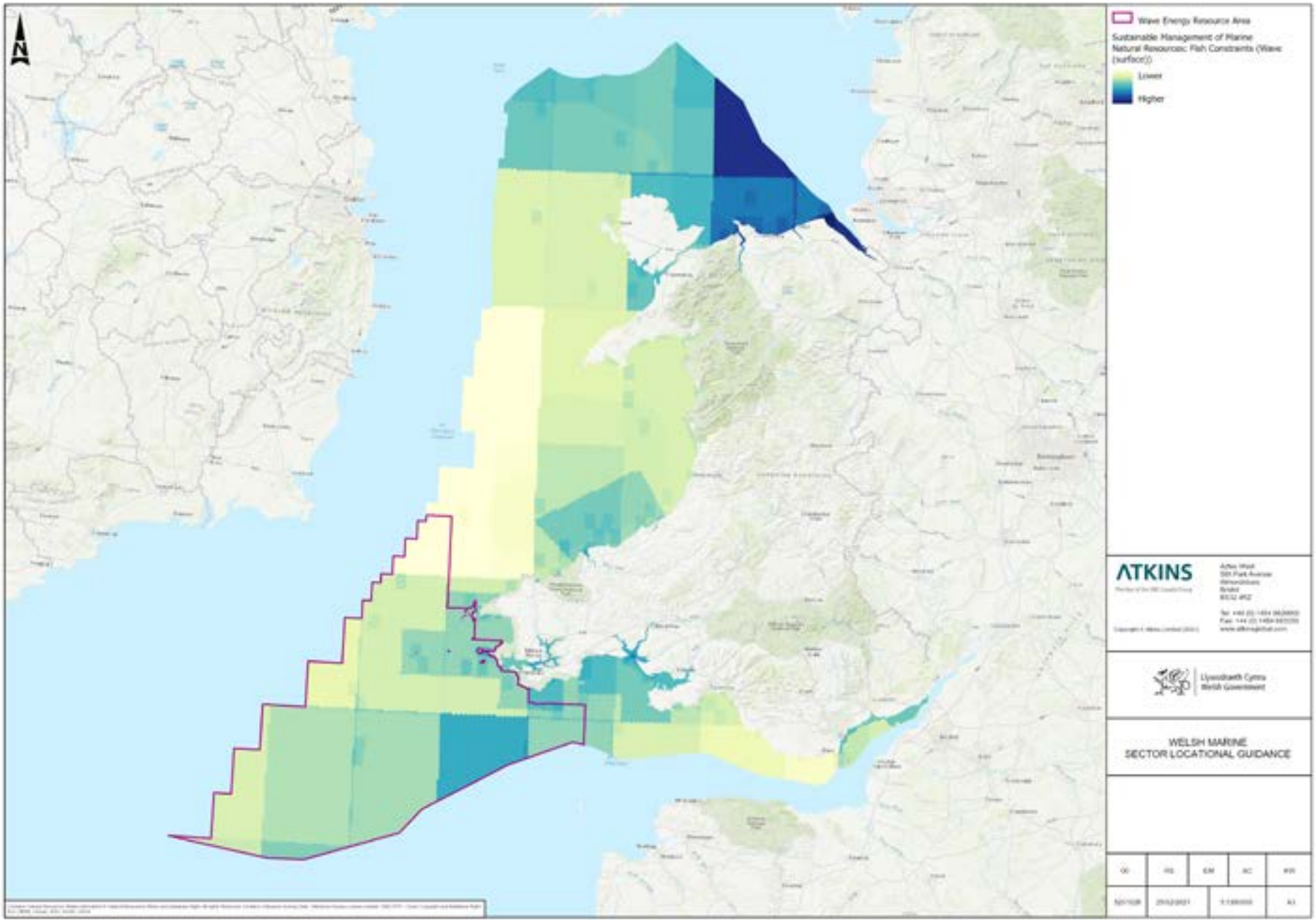

*Source: SMMNR, 2021*

**Figure 7.5: Relative potential fish constraints for seabed wave energy devices**



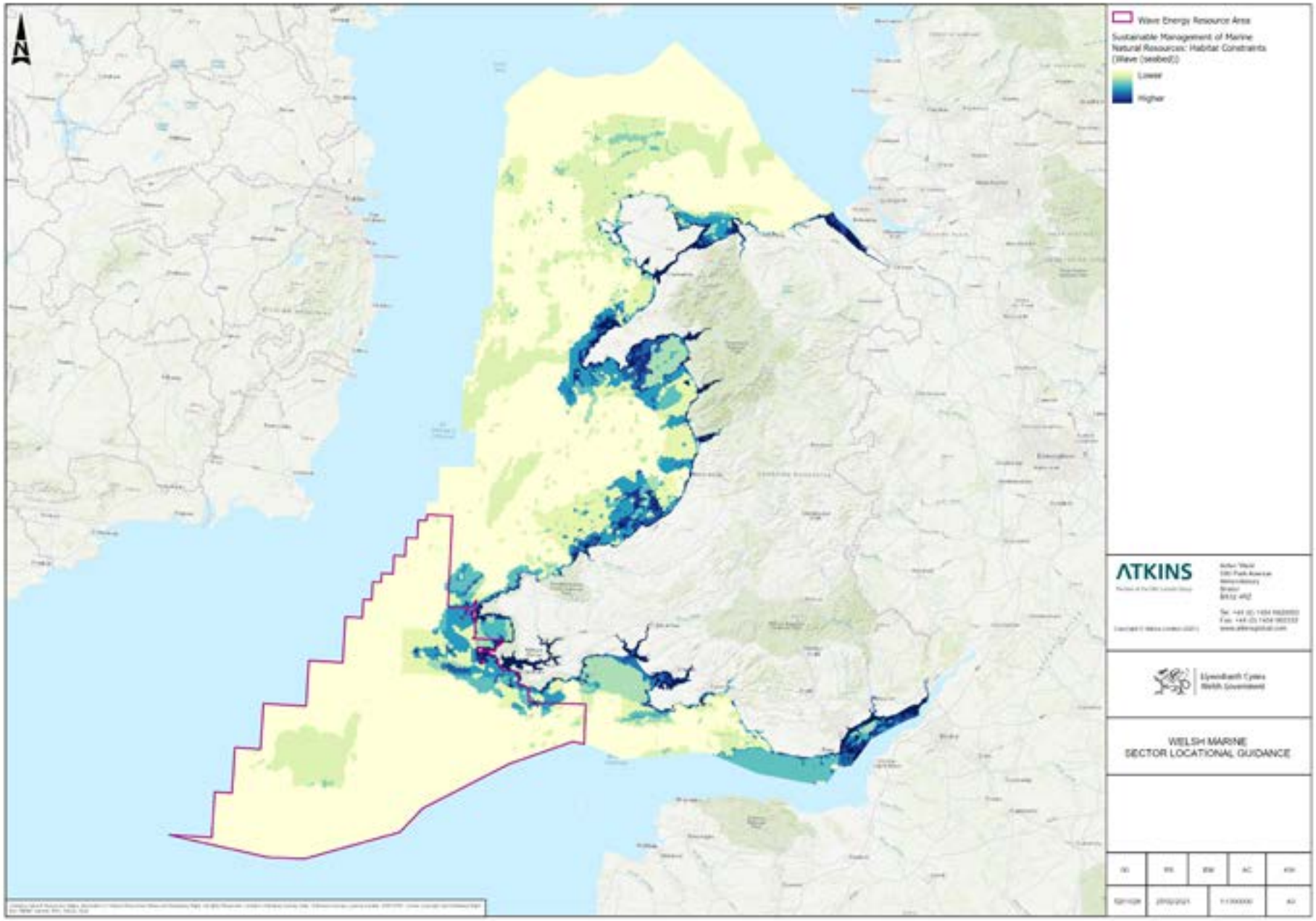

*Source: SMMNR, 2021*

**Figure 7.6: Relative potential fish constraints for surface wave energy devices**



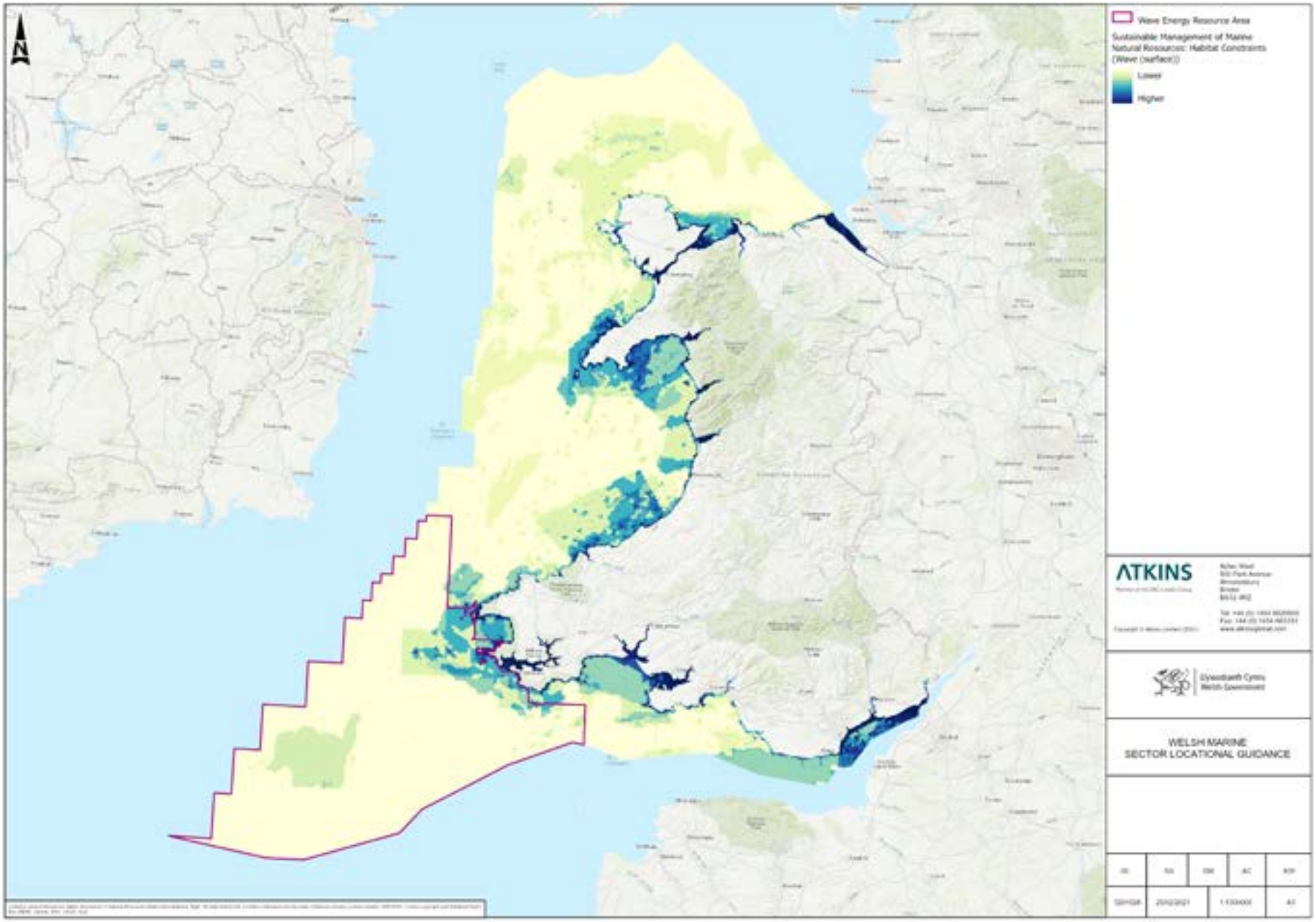

*Source: SMMNR, 2021*

**Figure 7.7: Relative potential benthic habitat constraints for seabed wave energy devices**



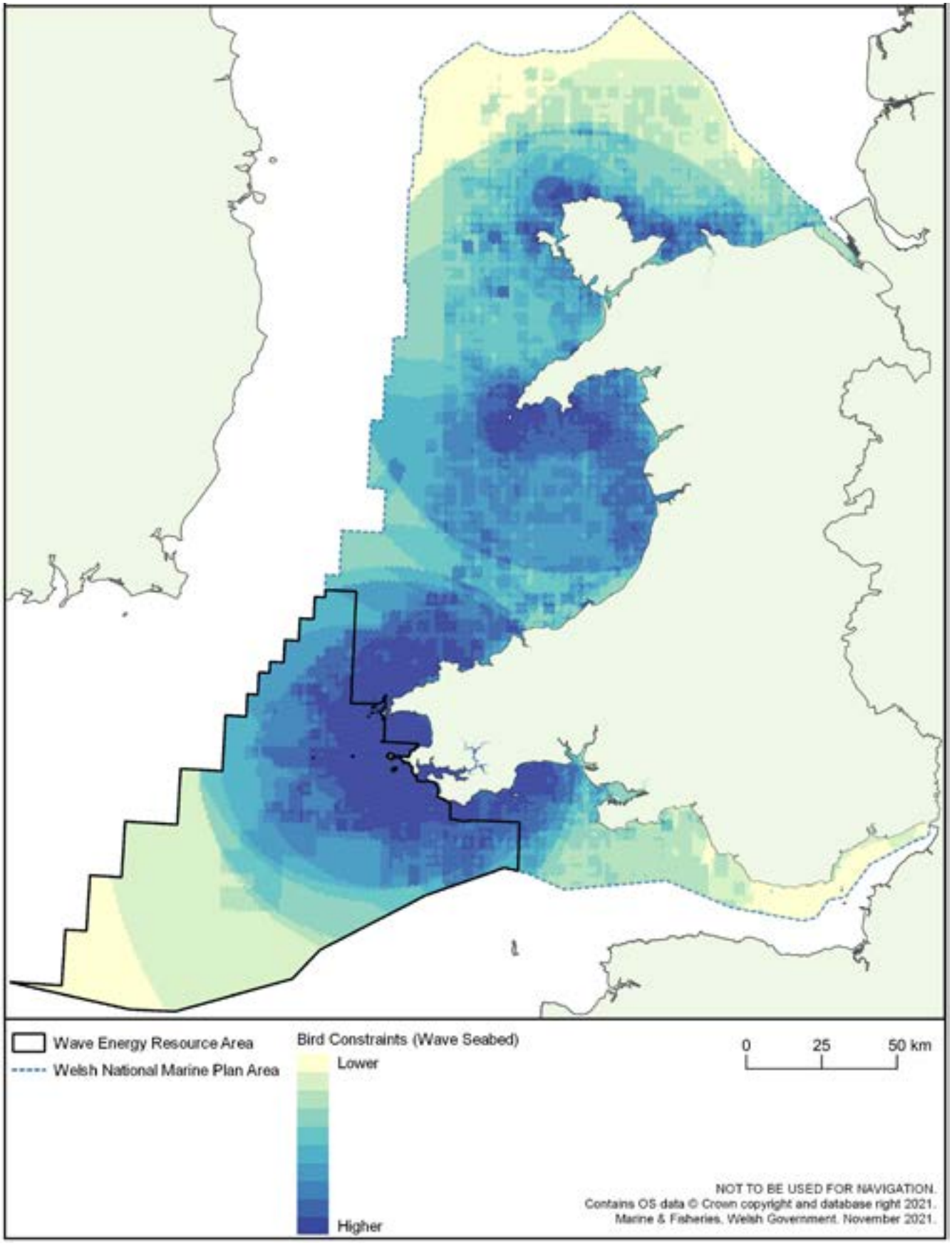

*Source: SMMNR, 2021*

**Figure 7.8: Relative potential benthic habitat constraints for surface wave energy devices**



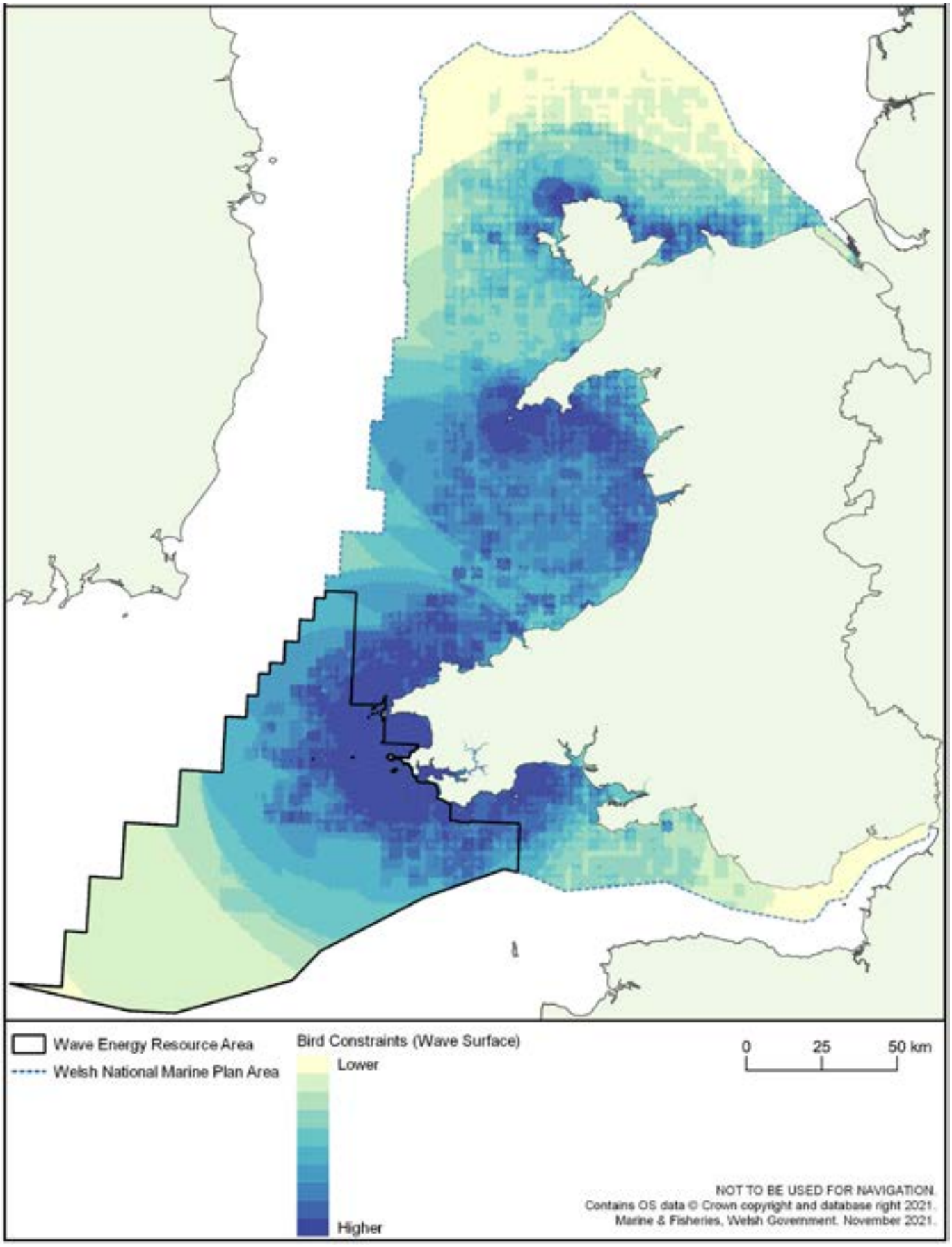

*Source: SMMNR, 2021*

**Figure 7.9: Relative potential bird constraints for seabed wave energy devices**




*Source: SMMNR, 2021*

**Figure 7.10: Relative potential bird constraints for surface wave energy devices**




*Source: SMMNR, 2021*

# 8. Other marine users

This section provides an overview at the national level on where wave resources may be found and where they interact with other marine users' areas of interest. The maps provided are high-level and indicative only. For further, more detailed information on combinations of activities in particular areas within Welsh waters, please use the Marine Planning Portal[37]. SLG users should also refer to Sections 2 and 9 for cross sector interactions and Section 10 for further regional considerations. As there is only one RA for wave energy, please see Section 10.1.5 for greater detail in relation to other marine users.

Although wave energy is considered to be an industry with scope to develop, potentially at scale, it will have to establish itself alongside those developments and activities already taking place around Wales. Wave sector developments have the potential to impact on other marine or coastal activities, either existing or planned, future activities, as well as the RAs of other sectors. In line with WNMP **policy SAF_01 (safeguarding existing activity)**, any proposals for new development are required to assess their likely impact on established activities and demonstrate how they will address any compatibility issues. WNMP **policy SAF_02 (safeguarding strategic resources)**, requires similar consideration of any impacts on the Strategic Resource Area of another sector, where such an area exists.

Not all activities are able to coexist or share the same space due to conflicting resource or technological requirements. Where a wave energy development is not compatible with an existing activity, this will act as a hard constraint. Where coexistence is a possibility, these may represent soft constraints that may need consideration including issues around timing, safety, and consenting. WNMP **policy ECON_02 (coexistence)** requires proposals to consider appropriate opportunities for coexistence with other marine users in order to deliver multiple benefits and optimise the value and use of the marine area.

For coastal communities across Wales, tourism is often the prime economic driver. The total contribution of tourism to Wales, including impacts through the supply chain and capital investment, was £6.2 billion in 2016, accounting for 13.3% of the total economy, with a direct contribution of £2.7 billion (8%). The sector is of significant local importance in the South West RA with the Pembrokeshire Coast National Park, where over 40% of the population may be involved. The industry provides considerable numbers of jobs for the 16-24 age bracket and employs a disproportionate number of women, often when other opportunities may be lacking.

The arrival of wave energy developments may cause mixed reactions in communities. Some may welcome the additional opportunities brought, both for employment and for renewable energy generation. Others may be concerned about potential adverse impacts on existing uses, for example, recreational waterborne activities or perceived loss of visual amenity.

Wave energy sector developments have the potential to impact on other marine or coastal seascapes, including terrestrial areas with views of the coast or seas. Seascapes tend to have a distinct and well-conserved character; they range from the spectacular and remote Pembrokeshire Coast National Park and Gower, to built heritage that uses the natural setting, such as Llandudno which is flanked by craggy limestone headlands (NRW, 2015). Their high quality and great diversity provide the sought-after settings for many cultural and economic activities. Seascapes around Wales are important for activities including health and wellbeing, tourism, quality of life and economics (NRW, 2015).

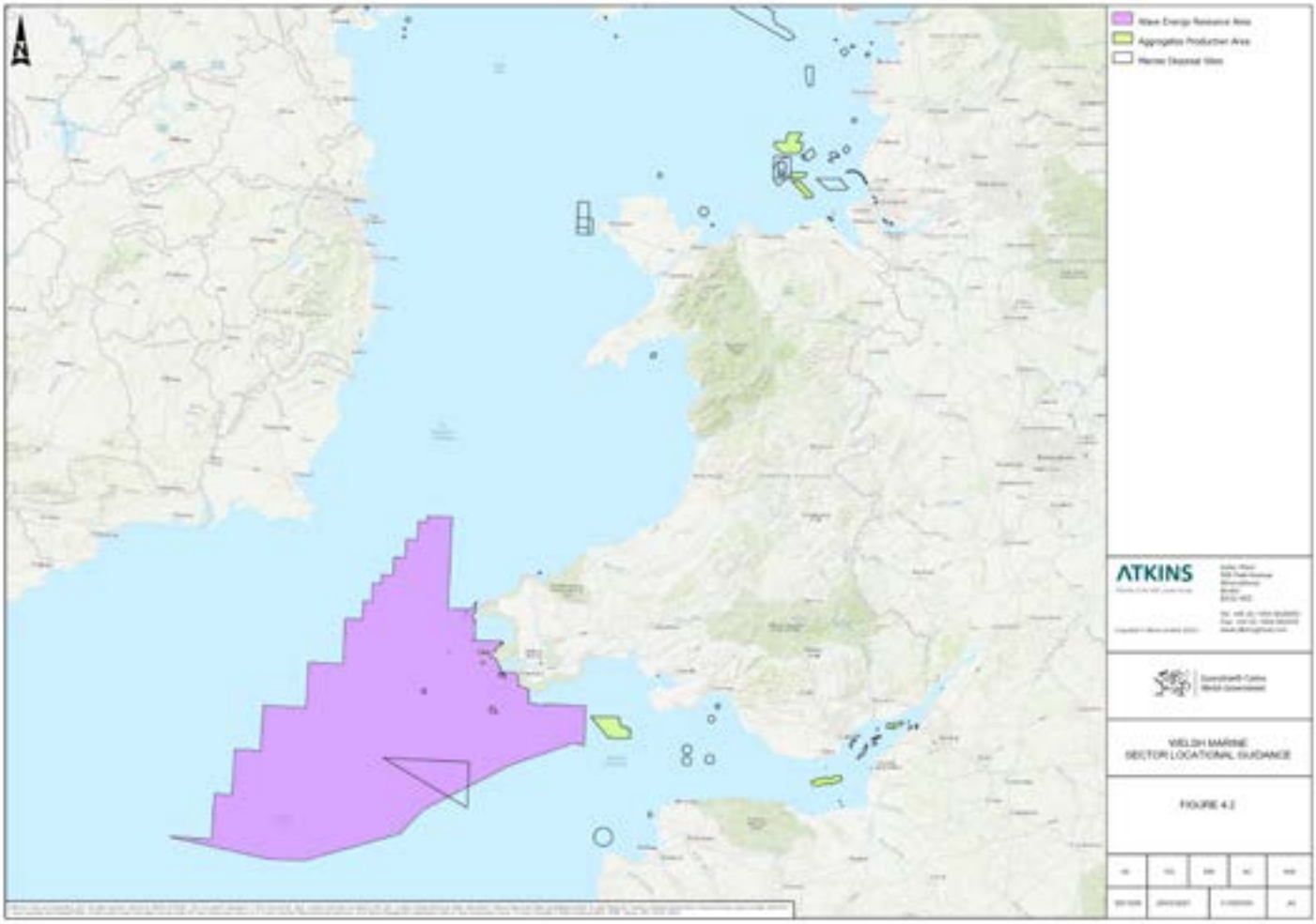
37 www.lle.gov.wales/apps/marineportal/

A study looking at the natural heritage evidence to support strategic planning for renewable energy was conducted in 2011, which provides additional details of seascape/landscape character, views and visual amenity, and landscape values (CCW, 2011). In addition, a National Seascape Assessment for Wales was conducted in 2015 which provides further details on seascape and marine character areas for Wales (NRW, 2015).

Potential constraints relating to seascape will depend on both the technology type and setting. In line with **policy SOC_07 (seascapes)**, any proposals for new development are required to assess any potential seascape impacts and demonstrate how they will address these. It is in the early stages of project planning that addressing adverse seascape impact is most effective. Appropriate siting and early consideration of alternatives can help to identify and avoid potential impacts.

Maps of the locations of existing activities and other marine users where these overlap with the wave energy RAs are shown below in relation to marine aggregates and disposal sites (Figure 8.1), aquaculture (Figure 8.2), Military Practice Areas (Figure 8.3), other energy sectors (Figure 8.4, Figure 8.5 and Figure 8.6), fishing (Figure 8.7 and Figure 8.8), shipping (Figure 8-9 and Figure 8.10), subsea cables (Figure 8.11), and maritime heritage (Figure 8.12). The overlap of existing activities will be a consideration for development proposals in line with **policy SAF_01 (safeguarding existing activity)**.

**Figure 8.1: Marine aggregates and marine disposal sites with wave energy RAs**

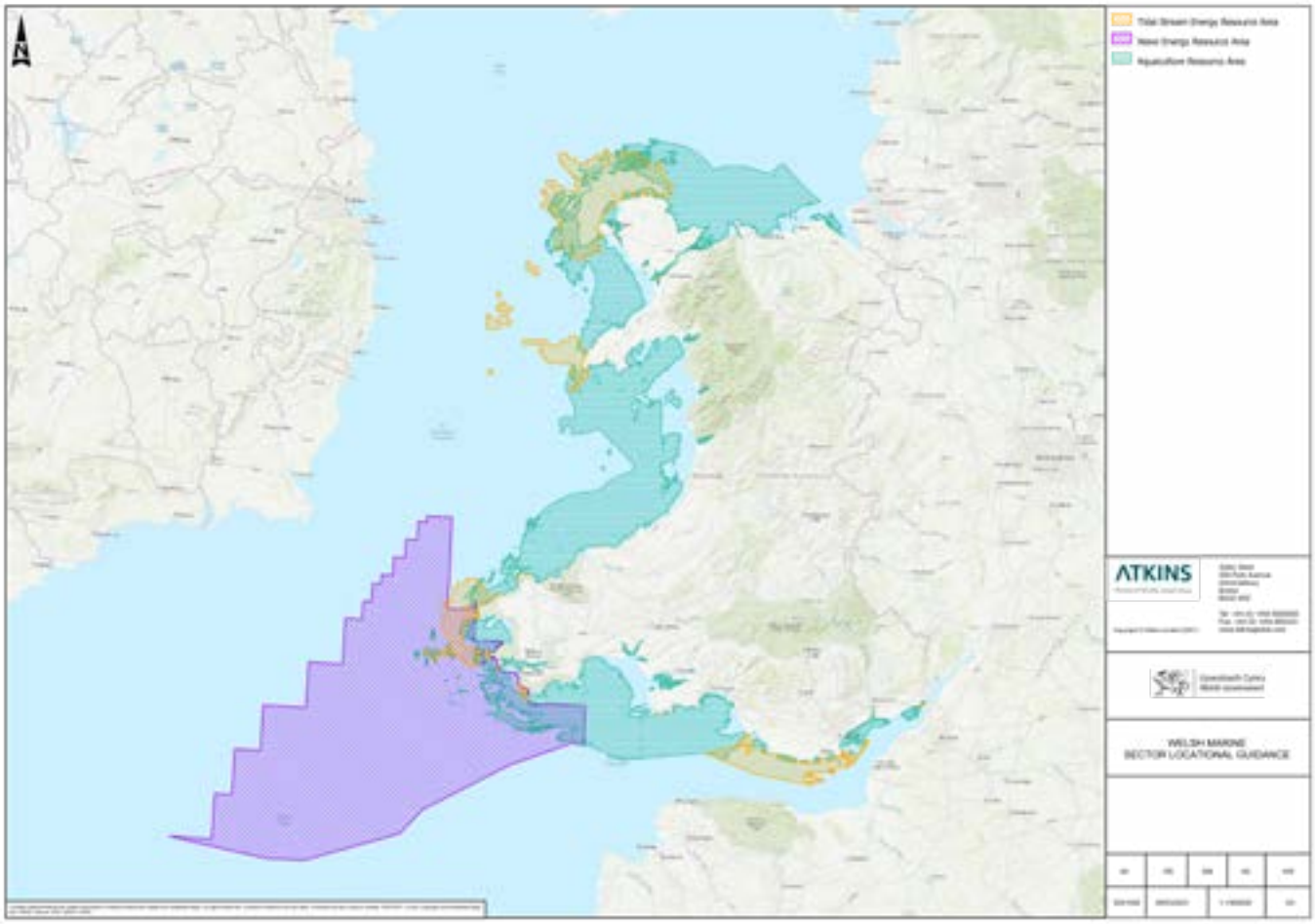



*Source: TCE, 2021 and Cefas, 2020*

There are areas where wave resources coincide with aggregate resources off Pembrokeshire.

For consenting, safety, and operational reasons, licensed aggregate extraction is likely to be spatially separate from wave energy developments.

**Figure 8.2: Wave RA and Tidal stream RA overlapping with Aquaculture RAs**




*Source: Ile, 2020*

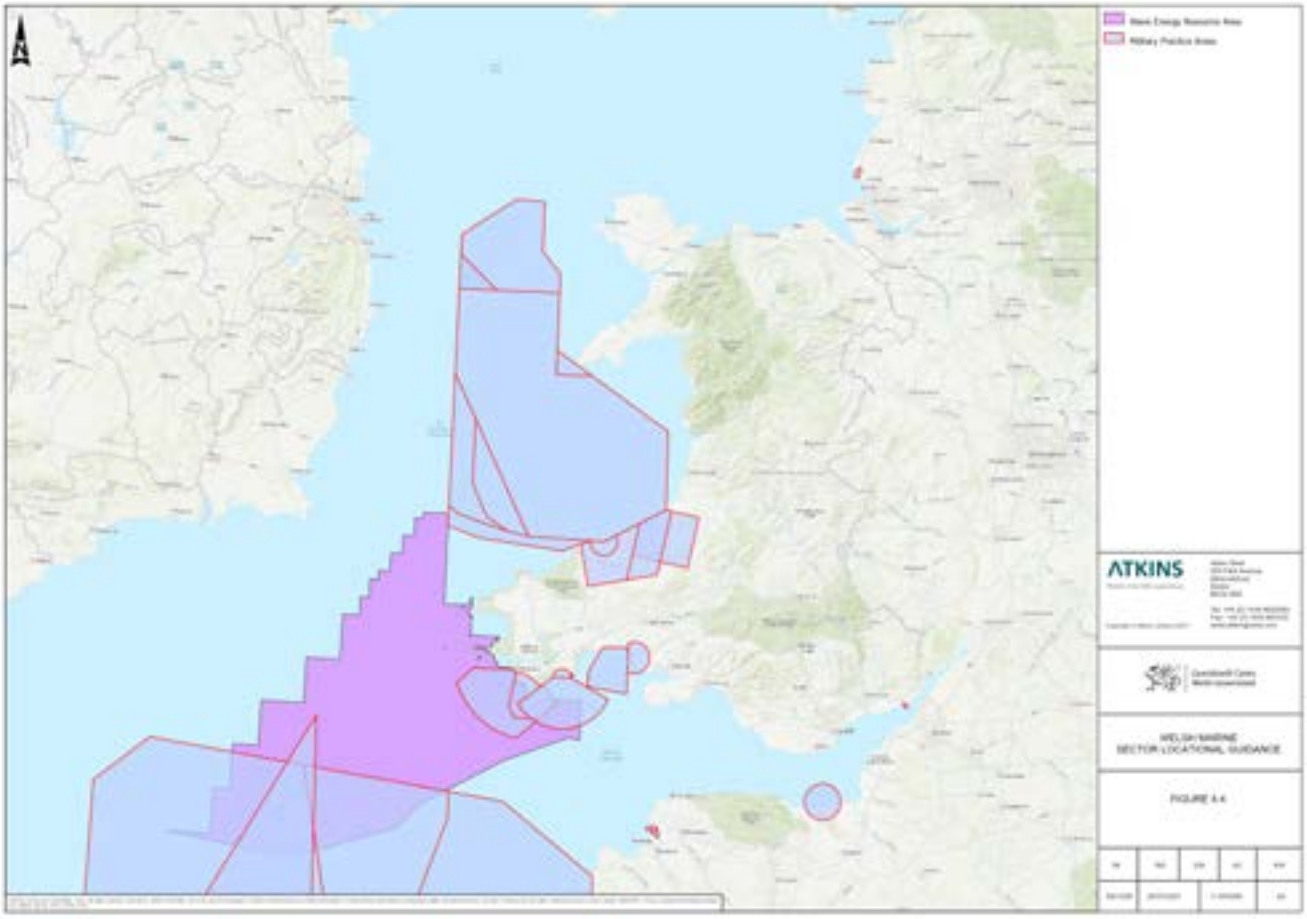
There is no overlap or interaction between the wave RA and several and regulating orders for aquaculture.

Wave resources overlap with resources for potential aquaculture (bottom cultivation), rope culture of shellfish, and some limited areas identified as suitable for rope culture of seaweed in locations off Pembrokeshire. Areas of resource potential are not subject to WNMP **safeguarding policies**; however, an overlap in RAs could indicate potential future competition for space between the two sectors.

Wave energy and cage culture RAs overlap in some locations off Pembrokeshire but areas with significant wave climate are not considered optimal for caged fish farm operations with current technology and approaches (SARF, 2014). This is supported by recent stakeholder engagement which suggested that water depth and wave climate around Welsh inshore waters was not suitable for cage culture.

Operational wave devices are unlikely to interact with intertidal trestle cultivation.

**Figure 8.3: Military Practice Areas with the wave energy RA**

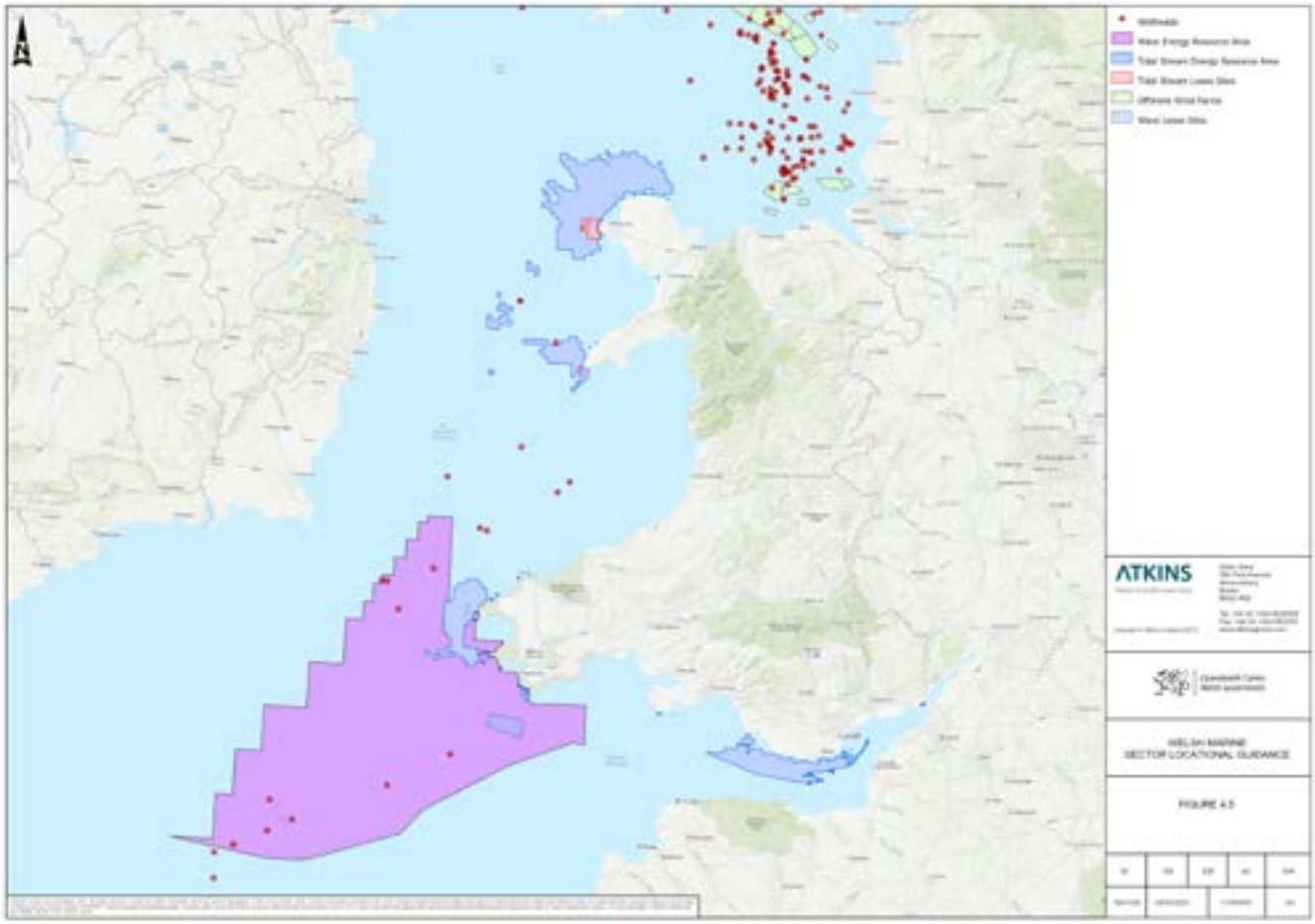



*Source: Oceanwise, 2020*

There is an overlap of wave resources with two Military Practice Areas off Pembrokeshire that cover large areas. WNMP **policy DEF_01 (safeguarding)** concerns proposals with the potential to affect Ministry of Defence (MoD) areas or strategic defence interests. Planning permission, a marine licence or other relevant consent/permit will only be granted with the agreement of the MoD and where the MoD is satisfied that the proposal will not cause unacceptable risk to defence and national security.

Achieving consent in MoD areas may be difficult or inappropriate but may be possible through detailed consultation with the MoD.

**Figure 8.4: Energy (including low carbon and O&G) with the wave energy RAs**



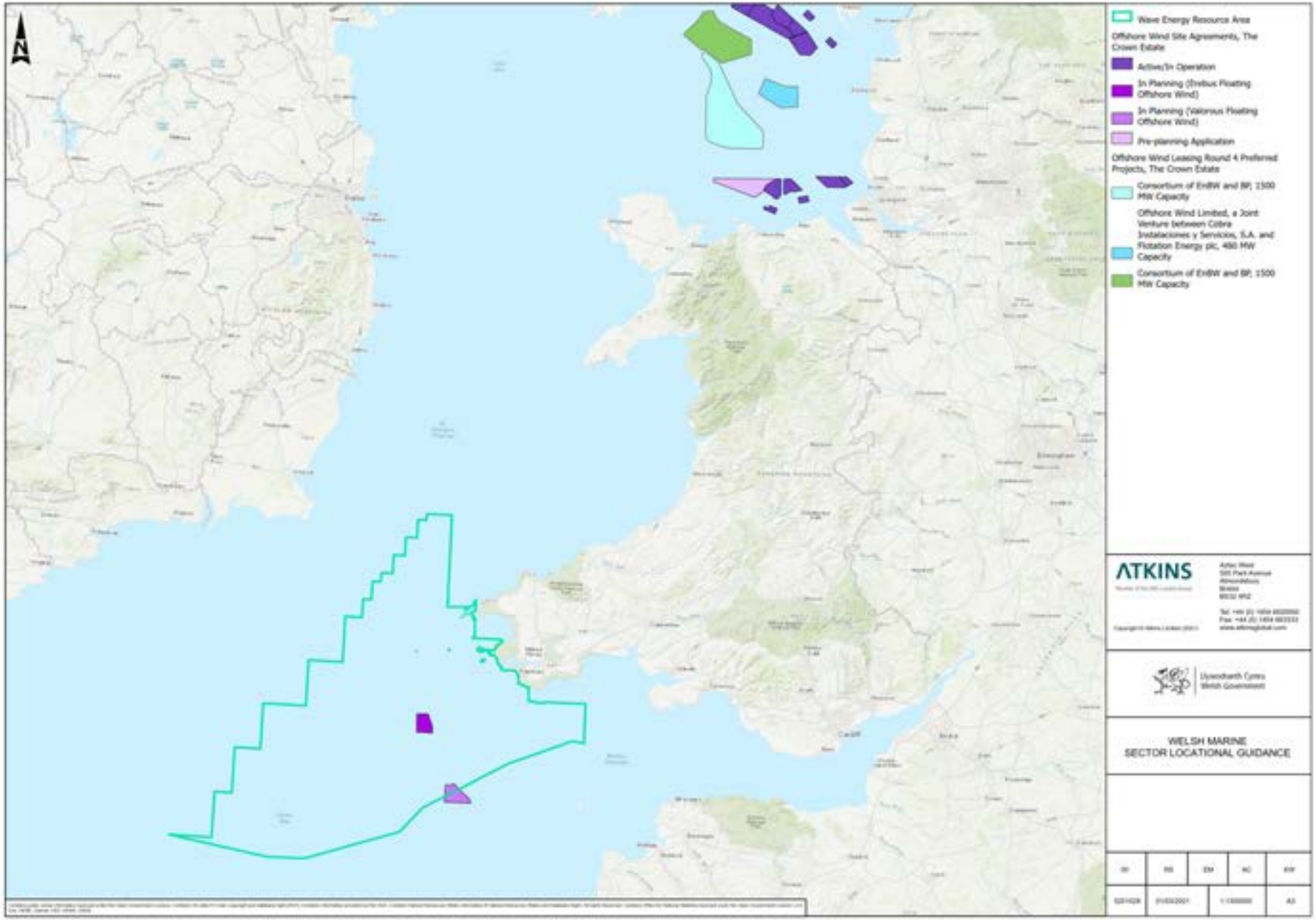

*Source: TCE, 2021*

Wave resources coincide with tidal stream resources off the Pembrokeshire coast.

Wave resources overlap with wind energy resources off Pembrokeshire. Current floating wind development is further offshore in the Celtic Sea, but wave climate would be similar to that in the RA.

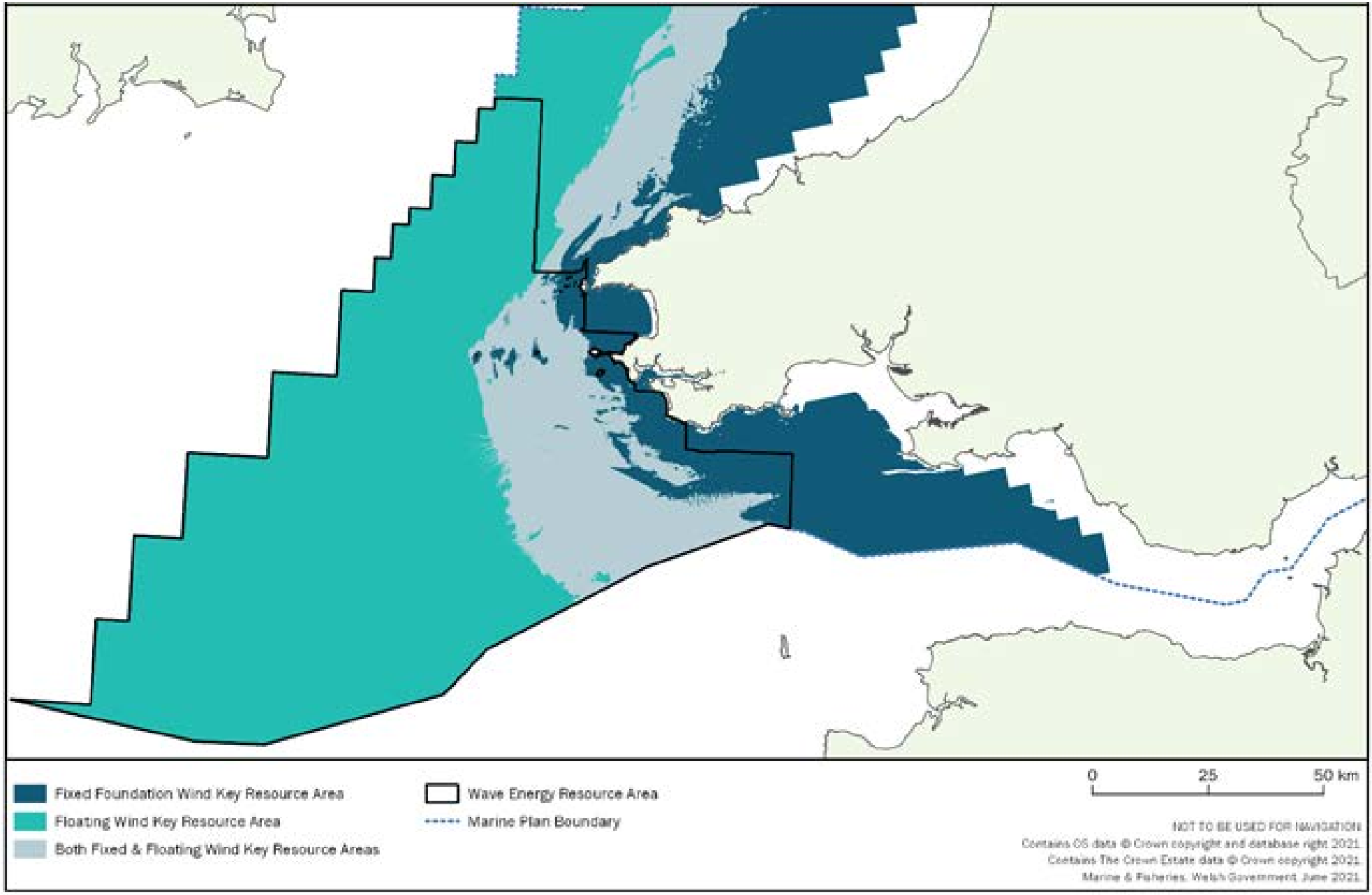
There is an overlap of wave RA and some existing O&G wells but these are all abandoned.

**Figure 8.5: Energy (offshore wind site agreements) with wave energy RA**



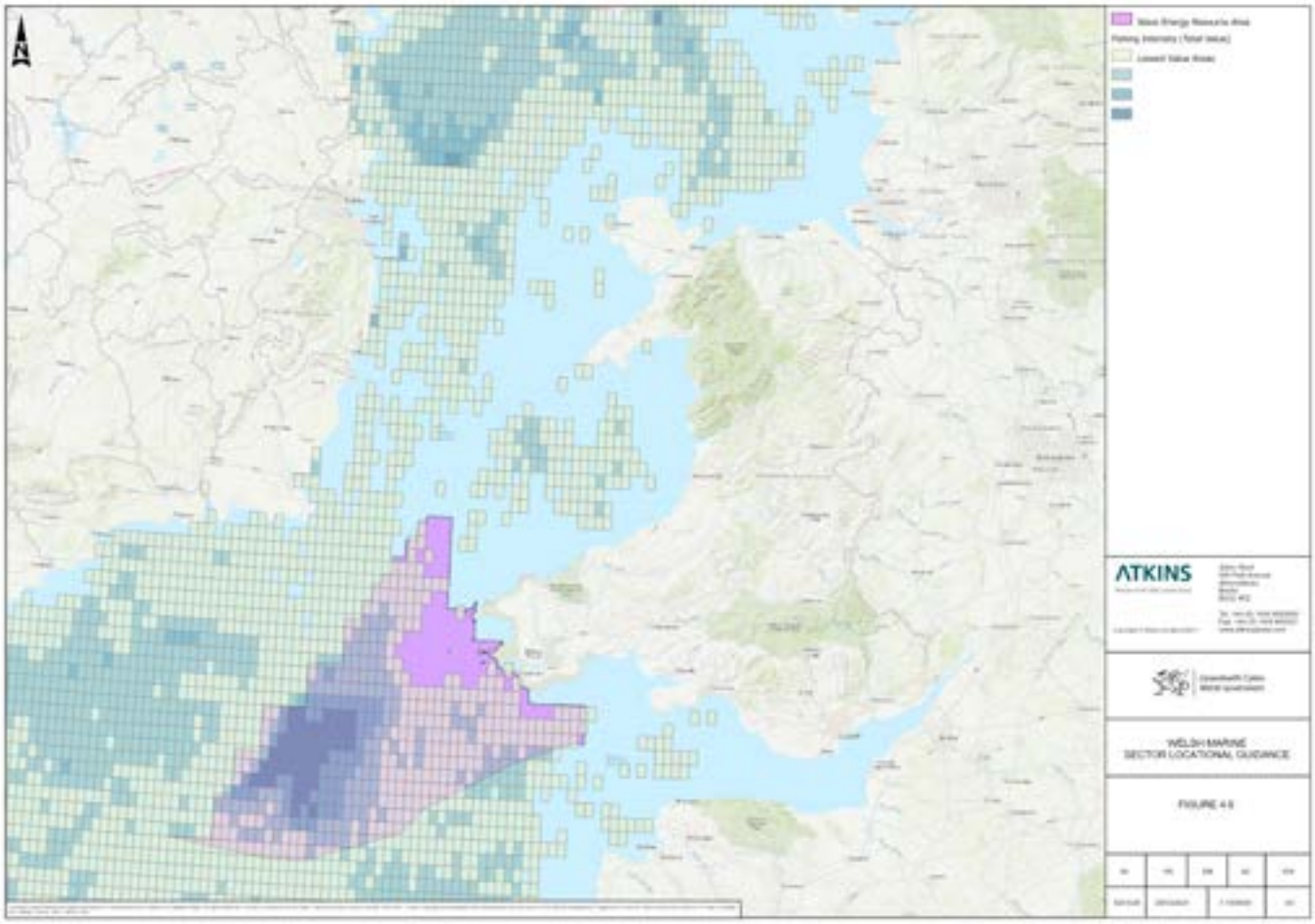

*Source: TCE, 2021*

**Figure 8.6: Key RAs for offshore wind in relation to the Wave – South West RA**




*Source: Welsh Government, 2021*

**Figure 8.7: Fishing Intensity in relation to the wave energy RA**



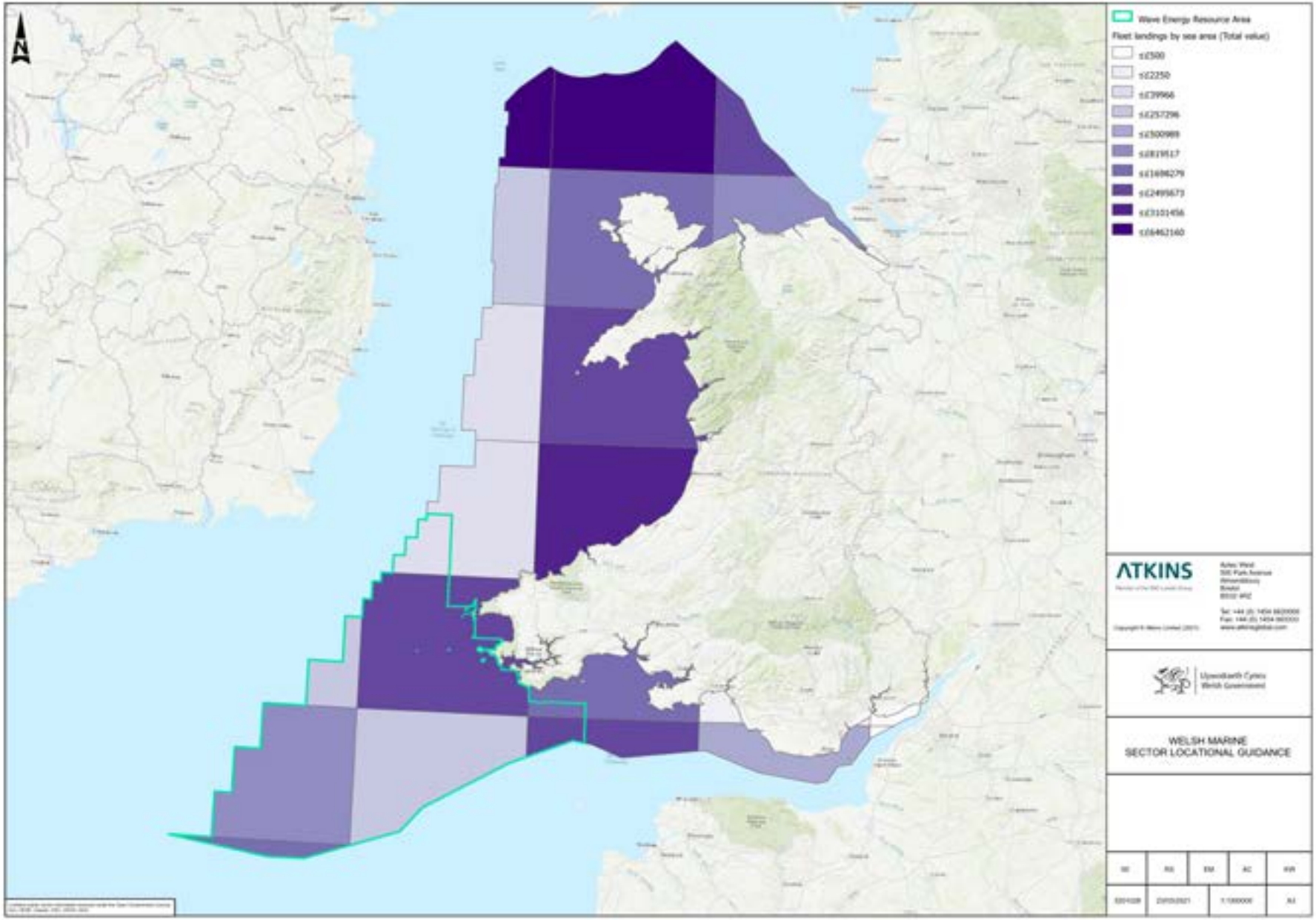

*Source: ICES, 2021 and MMO, 2017*

Commercial fishing is an important sector of the Welsh economy and, as such, impacts on fishing activity should be fully considered at site selection stage. Fisheries activities include inshore (coast to 12 nm) and offshore (beyond 12 nm) commercial fishing. The fishing fleet provides direct income and employment, fresh and local seafood to the retail and hospitality trade which helps to support a vibrant coastal tourism industry. In addition, the fishing fleet contributes indirectly to local businesses through operational costs such as fuel, ice, gear, etc. Vessels involved in the commercial fishing sector are found all around the Welsh coast and include larger, offshore vessels (> 10 m) and smaller inshore vessels (< 10 m).

Figure 8.7 and Figure 8.8 illustrate commercial fishing activity in Welsh waters in relation to wave energy RAs.

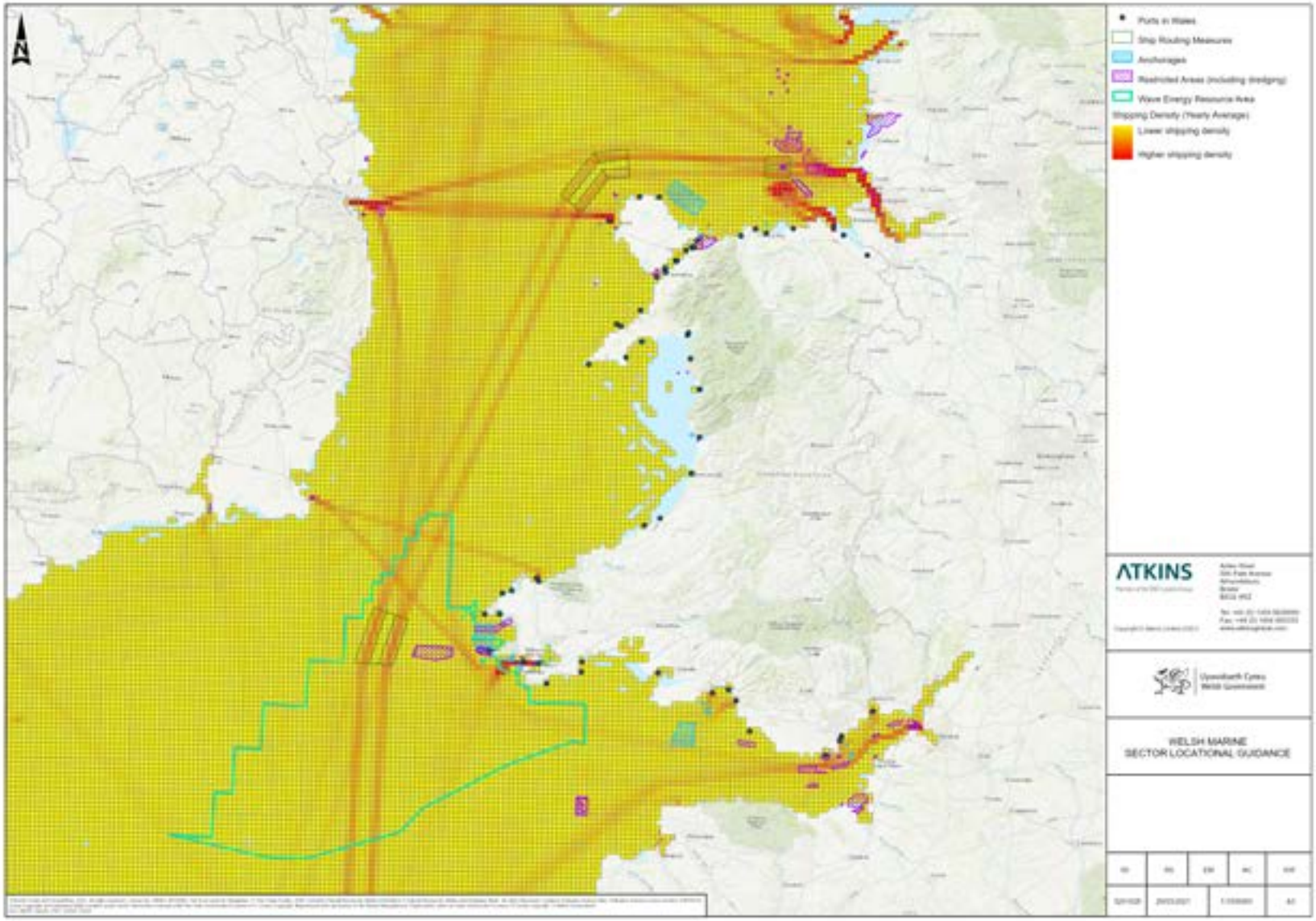
Data on fishing activity in Wales is limited and this SLG has focussed on ICES data. However, it is acknowledged that this data does not provide an accurate reflection of fishing activity, particularly static gear fishing, which is not captured in the data available but is a significant component of the Welsh fisheries sector and which operates in inshore waters. As such there may be significant interactions and a need for careful consideration when planning projects. Developers should, therefore, undertake early engagement with fisheries representatives such as the Welsh Fisherman's Association or the National Federation of Fishermen's Organisations, to inform site selection.

**Figure 8.8: Fleet landings by Sea Area in relation to the wave energy RA**




*Source: MMO, 2017 and Oceanwise, 2021*

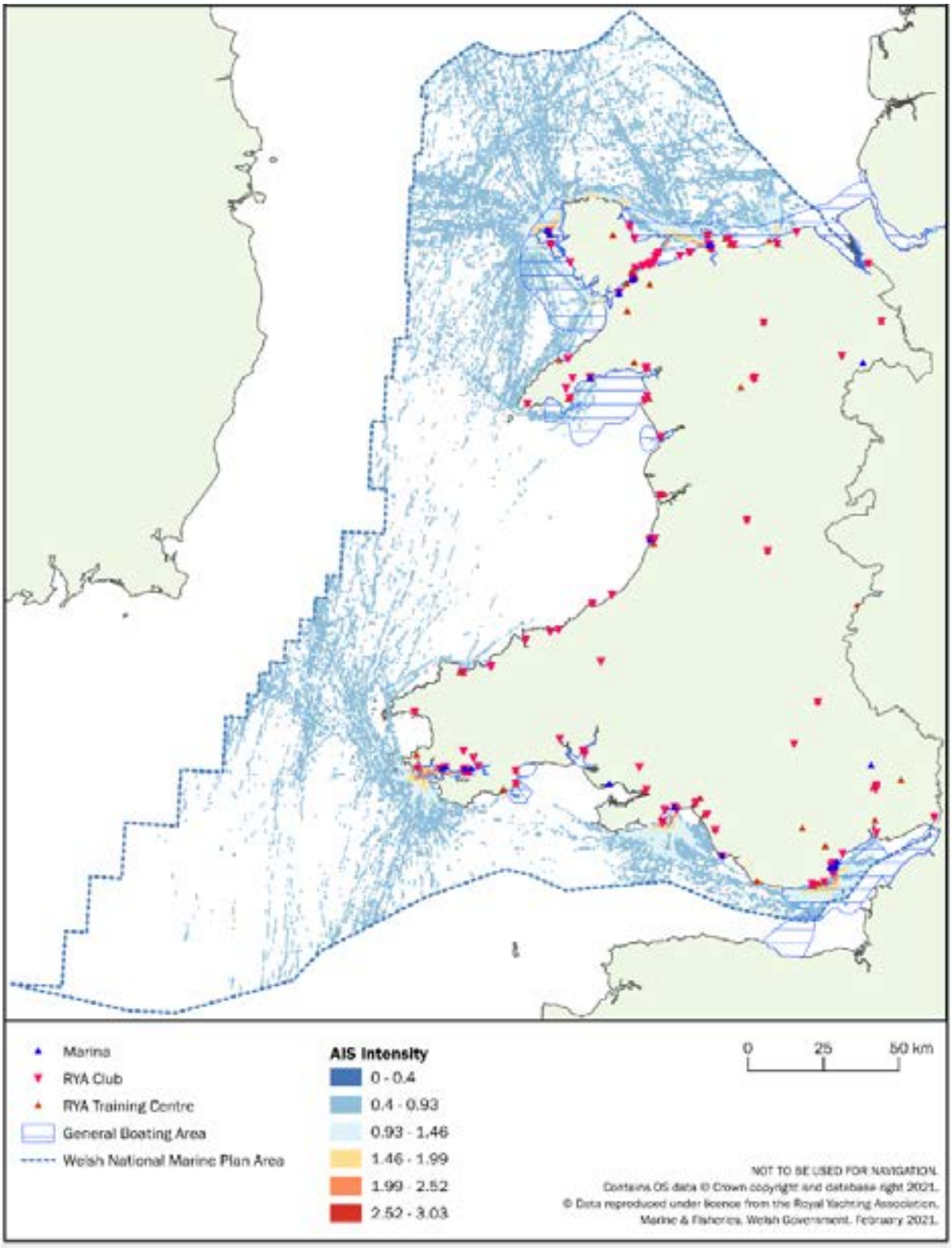
**Figure 8.9: Shipping density, ports, anchorage and restricted sites with the wave energy RA**




*Source: MMO, 2017*

The wave RA coincides with vessel traffic routes including to/from Pembroke/Milford Haven. Through consultation with shipping agents and the Maritime and Coastguard Agency (MCA), shipping routes may be able to be diverted if determined to be necessary.

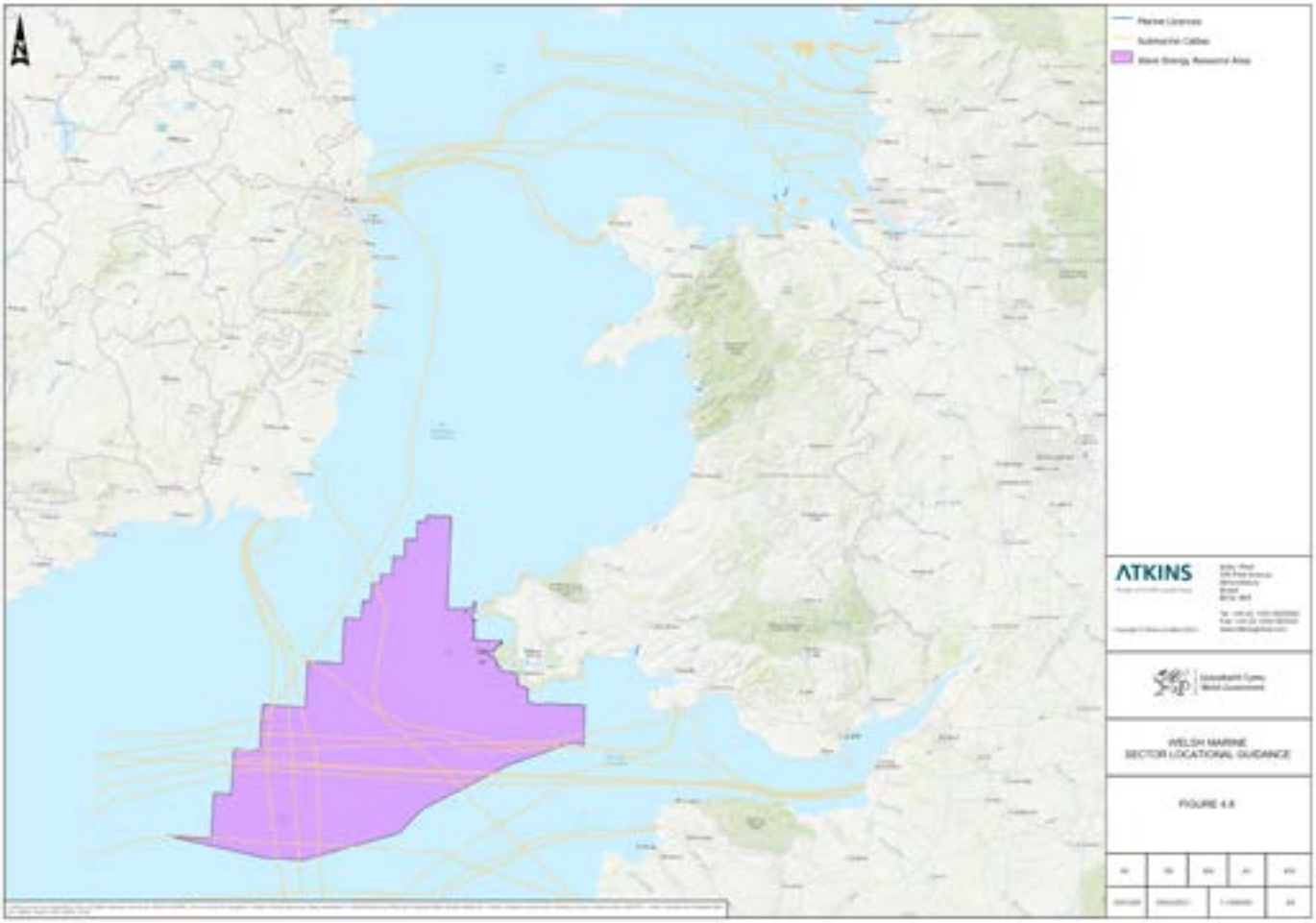
**Figure 8.10: Royal Yachting Association (RYA) clubs, marinas, training centres and general boating areas**




*Source: Welsh Government using RYA information*

Sailing routes overlap with the wave RA off Pembrokeshire. It is unlikely that wave energy developments will overlap with coastal based marinas.

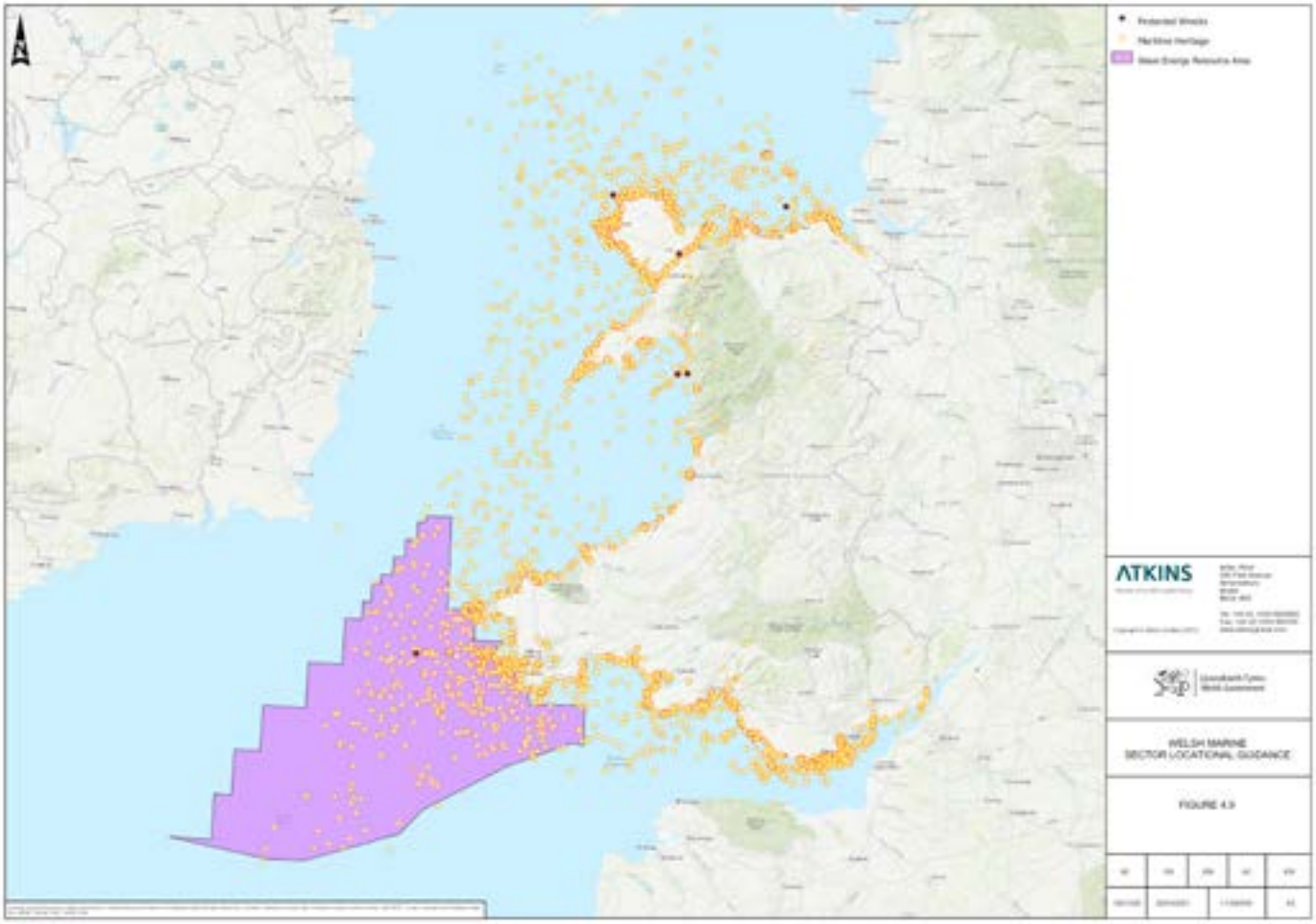
**Figure 8.11: Subsea cables with the wave RA**




*Source: Oceanwise, 2020*

Many subsea cables cross the wave RA off Pembrokeshire. This includes telephone cables operated by TATA Communications, BT, ESAT, Apollo and Global Crossing. A separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure.

**Figure 8.12: Protected wrecks and maritime heritage in relation to wave RA**




*Source: Lle, 2020*

There are a number of maritime heritage assets within the wave RA; however, only one of these is identified as a protected wreck. Stakeholder engagement raised the issue of protected wrecks, specifically war graves, as being a definite constraint and not an issue that could be mitigated or worked around.

In line with WNMP **policy SOC_05 (historic assets)**, development proposals need to consider any impacts on historic assets and their settings and, where necessary, address those impacts. The **WNMP Implementation Guidance** also notes that the absence of designated historic assets should not be taken to imply that non-designated historic assets are necessarily of lesser significance. Given the logistical difficulties and resource-intensive nature of working underwater, the significance of many marine historic assets is yet to be established. As a result, all such assets, and their settings, should be considered in the preparation of a development proposal.

# 9. Cross sector interactions & opportunities

The potential or perceived impact of one marine-related activity making use of marine resources on another activity, or the cumulative interactions between multiple activities, need to be considered as part of the marine planning and consenting process. Where interactions between activities are considered to be likely (or possible), there is the opportunity to consider the prospects for co-location and/or co-existence of such activities in the same spatial area.

Co-location of activities perceived to be in conflict with each other is unlikely to be welcomed by the sectors involved or by the affected communities of interest. However, there are differing degrees of compatibility, and perceived 'conflict' may relate to competition for space that could be alleviated through spatial or temporal management measures. An assessment of interactions that concluded activities were incompatible with each other, on the grounds of health and safety or direct contradiction in uses, e.g., an extractive industry such as aggregate dredging in an area of offshore cultural heritage, may conclude that co-existence could be possible. In the example of aggregates and cultural heritage, advice has been produced to assist the industry and regulators in identifying and understanding issues of archaeological importance when developing dredging areas.

This SLG supports WNMP policies such as **ECON_02 (coexistence)** and **SAF_01 (safeguarding existing activity)** by providing information that may be useful for developers in considering, and demonstrating how they have considered, coexistence opportunities with other compatible activities. The outputs of the sectoral interactions assessment undertaken as part of this SLG are included below. Table 9.1 provides the scoring criteria used for the assessment of interactions, co-existence and co-location with the detailed assessment for relevant sectors provided in Table 9.2. More information on the methodology for this assessment is provided in Section 2.3.

Where co-location is considered possible, it will ultimately depend on the specifics of the technologies/activities being co-located. Therefore, developers should fully investigate the requirements of deployment, O&M and decommissioning for the life cycles of co-located activities. Early engagement between sea users will be important in the achievement of successful coexistence or co-location opportunities.

Sector interactions have focussed on potential future developments, but co-location could still be explored within existing lease or licence areas. In relation to constraints mapping, existing leases or licences have been scored highly as they represent a significant issue/constraint. However, development may be possible in these areas with appropriate management measures if agreement can be reached with existing lease/licence holders, and amendments to existing consents secured.

**Table 9.1: Assessment of interactions, co-existence and co-location**

| | Interaction | Co-existence | Co-location |
|---|---|---|---|
| **Yes/Likely** | Interactions between activities are believed to be likely, for example, due to overlap in resource and/or proximity between resource and existing development. | Where two or more developments, activities or uses **can** exist alongside or close to each other in the same place and/or at the same time. | Potential for co-location exists and involved sectors are [actively] exploring the opportunities and benefits that co-location of activities would bring. |
| **Possible** | Interactions between activities are believed to be possible. | Where two or more developments, activities or uses **could** exist alongside or close to each other in the same place and/or at the same time | If access to the same resources or areas can be managed by spatial, temporal, or other management measures, co-location may be possible |
| **No/Unlikely** | Interactions between activities are believed to be unlikely. | Where multiple developments, activities or uses **cannot** exist alongside or close to each other in the same place and/or at the same time because of incompatibility on grounds of safety, adverse environmental impact or other factors. | Opportunities for co-location cannot be resolved through management measures. |

**Table 9.2: Wave energy possibilities for co-existence**

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Marine minerals | Marine aggregates | **Possible** – there are areas where wave resources coincide with aggregate resources off Pembrokeshire. | **Unlikely** – for consenting, safety, and operational reasons, licensed aggregate extraction likely to be spatially separate from wave development. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| Energy | Tidal energy | **Possible** – wave resources coincide with tidal stream resources off the Pembrokeshire coast. | **Possible** – currently for consenting, safety and operational reasons, spatial separation is required. However, future projects could be designed so that issues are appropriately managed, and devices could be co-located with one on the seabed and one in midwater or on the surface or integrated together as technology progresses. | **Yes** – there is interest in both co-location and integration of wave technology into floating wind platforms in the future. Opportunity to share costs associated with electrical infrastructure and O&M and maximise economic potential of area. |
| | Offshore wind | **Possible** –wave resources overlap with wind energy resources off Pembrokeshire. Current floating wind development is further offshore in the Celtic Sea, but wave climate would be similar to that in the RA. | **Possible** – currently for consenting, safety and operational reasons, spatial separation is likely to be required. However, in future, projects could be designed so that operational issues are managed | **Yes** – opportunity to share costs associated with electrical infrastructure, grid connection and O&M, and maximise economic potential of an area. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Energy (Cont'd) | O&G | **Unlikely** – overlap of wave RA and some existing wells but they are all abandoned. Petroleum licensing area off Pembrokeshire but further O&G development in Wales is considered **Unlikely** due to focus on decarbonisation. | **Unlikely** – limited potential for interaction. | **No** – limited potential for interaction. |
| | Hydrogen | **Possible** – interest in offshore production of hydrogen using offshore renewables. Hydrogen production requires electrolysis so is not spatially limited. | **Possible** – potential for hydrogen production to co-exist with wave projects. | **Yes** – opportunity to transport hydrogen either by pipeline or boat which could reduce costs associated with electrical infrastructure in areas where significant grid upgrades would be required. |
| Aquaculture | Bottom culture | **Possible** – wave resources overlap with resources for aquaculture (bottom cultivation), in locations off Pembrokeshire. | **Possible** – currently wave devices (especially on the seabed) are likely to be spatially separate from shellfish cultivated on the seabed for safety and operation reasons. However, in future when wave technology is more established, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated. | **Yes** – in future, when wave technology is more mature, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated. Opportunity to share costs associated with O&M and maximise economic potential of area. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Aquaculture (Cont'd) | Cage culture (finfish) | **Possible** – currently No cage culture in Wales. Wave and cage culture RAs overlap in some locations of Pembrokeshire but areas with significant wave climate are not considered optimal for caged fish farm operations with current technology and approaches (SARF, 2014). This is supported by stakeholder engagement carried out which suggested that water depth and wave climate around Welsh inshore waters was not suitable for cage culture. However, there is potential interest in co-locating floating wind with both wave and cage culture further offshore. | **Possible** – currently cage culture is not undertaken in sites with significant wave environment. However, in future when wave technology is more mature, and cage culture technology is more developed for offshore environments, projects could co-exist. | **Yes** – in future, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated can be realised. Opportunity to share costs associated with O&M and maximise economic potential of area. |
| | Rope culture (shellfish) | **Possible** – wave resources overlap with resources for rope culture of shellfish off Pembrokeshire. | **Possible** – currently wave devices (especially on the seabed) are likely to be spatially separate for safety and operational reasons. However, in future, when wave technology is more established, projects could be designed so that issues are appropriately managed, and potential for infrastructure to be integrated e.g. ropes off floating platforms. | **Yes** – potential for infrastructure to be integrated. Opportunity to share costs associated with O&M and maximise economic potential of area. |
| | Rope culture (seaweed) | **Possible** – wave resources overlap with some limited areas identified as suitable for rope culture of seaweed off Pembrokeshire. | | |
| | Trestle culture | **Unlikely** – operational wave devices devices at sea unlikely to interact with intertidal trestle cultivation. | **Unlikely** – limited potential for interaction. | **No** – limited potential for interaction. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Fisheries | Mobile gear | **Possible** – wave RAs coincide with locations where fishing with mobile gears has been known to occur (ICES). | **Unlikely** – for safety and operational reasons, wave devices on the seabed and midwater/floating with associated anchors/lines, are likely to be kept spatially separate from grounds fished by mobile fishing gears. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Static gear (pots, lines, nets etc) | **Possible** – given the widespread and changeable nature of fisheries activity, wave resources could coincide with locations targeted by fishers with static gear, particularly in the inshore area. | **Possible** – wave developments likely to be kept spatially separate from grounds fished by static fishing gear for safety and operational reasons. However, potential benefits from hard substrata of seabed mounted wave devices as artificial reef for fauna to be considered, and potential for integrating infrastructure into device structures once technology is more mature. Potential for static gear to be deployed within wave farms if agreed with lease holder and appropriate management measures put in place. | **Yes** – potential opportunity to integrate static gear into project infrastructure design. |
| | Hydraulic dredging | **Unlikely** – wave RAs do not coincide with locations where hydraulic dredging has been known to occur (ICES). | **Unlikely** – for safety and operational reasons, wave devices likely to be kept spatially separate from hydraulic dredging operations. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Fisheries (Cont'd) | Rod and line | **Possible** – wave RAs could be used for commercial fishing with rods and lines. | **Unlikely** – for safety and operational reasons, wave devices and associated anchors/lines, likely to be spatially separate from rod and lining. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Hand gathering | **Possible** – hand gathering is primarily intertidal. However, device foundations have been seen to act as artificial reef for fauna, and some wave developments could be inshore or integrated into flood defences or port infrastructure. | **Possible** – marine energy devices have been seen to act as artificial reef so could be used by divers for hand gathering if properly managed. | **Yes** – potential opportunity for hand gathering from infrastructure if properly managed. |
| Ports & shipping | Shipping – navigation routes | **Likely** – wave RAs coincide with vessel traffic routes including to/from Pembroke/Milford Haven. | **Possible** – Possible for vessels to safely pass over the top of wave devices on seabed if there is sufficient clearance. Mid-water and surface devices Unlikely to be able to co-exist. Vessels involved with construction and O&M of the devices may utilise existing navigational routes and statutory navigational measures. Potential for co-existence with appropriate measures in place. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Anchorage areas | **Possible** – some limited overlap with anchorage site off Pembrokeshire. | **Unlikely** – safety and operational issues around Possible interaction with midwater and floating devices. Danger of anchor snagging with devices on seabed. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Subsea cables | Cables and telecommunications | **Likely** – many subsea cables cross wave RA off Pembrokeshire. | **Unlikely** – a separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure. Mid-water and floating devices could potentially be in the same space as cables, but placement of moorings would need to be considered. Agreement from operator would be required which is **Unlikely** due to risk to assets. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| Surface water and wastewater treatment and disposal | Intakes and outfalls, including licensed discharges | **Possible** – No submarine pipelines identified within wave RA, but potential for inshore wave development to interact. | **Possible** – potential for intakes/ outfalls to interact with inshore wave development or be built into flood defences. | **No** – Unlikely to actively choose to co-locate for operational reasons. |
| Dredging and Disposal | Designated disposal sites (Active) | **Likely** – wave resources off Pembrokeshire coincide with two open disposal areas. | **Unlikely** – for safety and operational reasons wave developments likely to be kept spatially separate from designated disposal sites. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Defences | Military exercise areas/ammunition disposal sites | **Likely** – overlap of wave resources with two Military Practice Areas off Pembrokeshire that cover large areas. | **Unlikely** – for safety and operational reasons, defence areas are usually kept separate from wave developments. There are some instances where agreement has been reached with MoD where activities can be managed in tandem. However, in general, MoD areas are seen as a hard constraint by developers. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| Tourism and Recreation | Recreational Sea Angling (RSA) | **Possible** – RSA undertaken from chartered vessels around seabed features/wrecks, and islands, could overlap with wave resources. Possibility of structures acting as fish aggregating devices which may draw RSA to fish in the area. | **Unlikely** – for safety and operational reasons, wave devices and associated anchors/lines, likely to be kept spatially separate from RSA. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Royal Yachting Association (RYA) marinas and sailing routes | **Likely** – sailing routes overlap with wave RAs off Pembrokeshire. Unlikely overlap with coastal based marinas. | **Possible** – wave developments and recreational sailing routes could co-exist, subject to safety measures e.g. device lighting and marking, safe clearance above seabed mounted devices for recreational craft. Also recognising the mobile nature of the recreational activity relative to the requirements for siting wave developments. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |

| Marine plan sector | Activity | Interaction | Potential to co-exist | Opportunity for co-location |
|---|---|---|---|---|
| Tourism and Recreation (Cont'd) | Water sports (e.g. surfing, kite surfing, diving, rafting) | **Possible** – Possible use of the sea surface or water column for water sports, in proximity to wave resources. | **Possible** – For safety and operational reasons, water sports are likely to be restricted in the footprint of developments that include midwater and floating devices but may be Possible over seabed mounted developments where there is sufficient clearance. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Shore based activity (e.g. coasteering, hiking, dog walking, kites) | **Possible** – Unlikely to interact with offshore activities but potential to interact with inshore developments and those integrated into onshore infrastructure. | **Possible** – potential for activities to be undertaken on/around wave developments integrated into onshore infrastructure but would need to be properly managed from a safety perspective. | **No** – Unlikely to actively choose to co-locate for safety and operational reasons. |
| | Wildlife watching – shore based | | | |
| | Wildlife watching – boat based | **Possible** – wave resources and boat-based tourism could overlap. Potential for boat-based tourism in proximity to the wave developments, due to the project being of interest, attracting wildlife or through proximity to islands that are wildlife hotspots. | **Possible** – wave developments could co-exist with boat-based wildlife tourism. Though this is likely to be subject to safety measures e.g. device lighting and marking, safe clearance above devices for vessels. Boat-based tourism may also be flexible in locations and visited areas to accommodate wave developments. | **Yes** – significant interest in offshore renewables, and in how the technology interacts with the environment, so could accommodate both subject to appropriate management of activities. |

# 10. Regional characterisation

## 10.1 Wave – South West

The Wave – South West RA is extensive whilst limited to the most southwestern waters around Wales. Much of the resource is offshore, beyond the 12 nm territorial limit and thus in the Welsh offshore marine planning region, with the comparatively minimal inshore areas limited to the western and southwestern Pembrokeshire coastline. Pembrokeshire has the highest concentration of wave resource in Wales, equating to an indicative capacity of up to 5.6 GW combined with water depth and seabed topography among the best in the EU (MEW, 2020).

### 10.1.1 Resource considerations

Table 10.1 outlines the key physical considerations for wave energy developments in the Wave – South West RA. See Section 3 for further details on wave resource.

**Table 10.1: Wave – South West physical considerations**

| Topic | Description |
|---|---|
| Wave resource | The wave energy RA was derived from the Atlas of UK Marine Energy Resources (ABPmer, 2008) and from areas defined in the MRESF (RPS, 2011).<br>TCE defines an area suitable for wave power generation as having a minimum annual mean wave power of 20 kW/m, minimum water depth of 20 m and a maximum water depth of 200 m (TCE, 2013). In line with these physical characteristics, the Wave – South West RA was identified as being suitable for a range of wave energy device requirements, with the exception of attenuators. No RAs for attenuators were identified in Welsh waters. |
| Wave resource data | Swansea University has developed a detailed wave model through SEACAMS, some of the outputs are available on the Marine Planning Portal. |
| Physical survey data | Multibeam surveys by SEACAMS for parts of the area – data is available through the Integrated Marine Data and Information System (iMarDIS).<br>Conductivity, Temperature, and Depth profile data undertaken by SEACAMS for parts of the area – data is available through iMarDIS.<br>UK Hydrographic Office also holds bathymetry data. |
| Wave RA area ($km^2$) | 9,731.1 $km^2$ |
| Average water depth in the RA | -85.62 m below the surface. |
| Maximum water depth in the RA | -144.76 m below the surface. |

### 10.1.2 Infrastructure & supply chain

Table 10.2 describes the existing infrastructure and supply chain in the Wave – South West RA.

**Table 10.2: Population and demographics for area adjacent to Wave – South West RA**

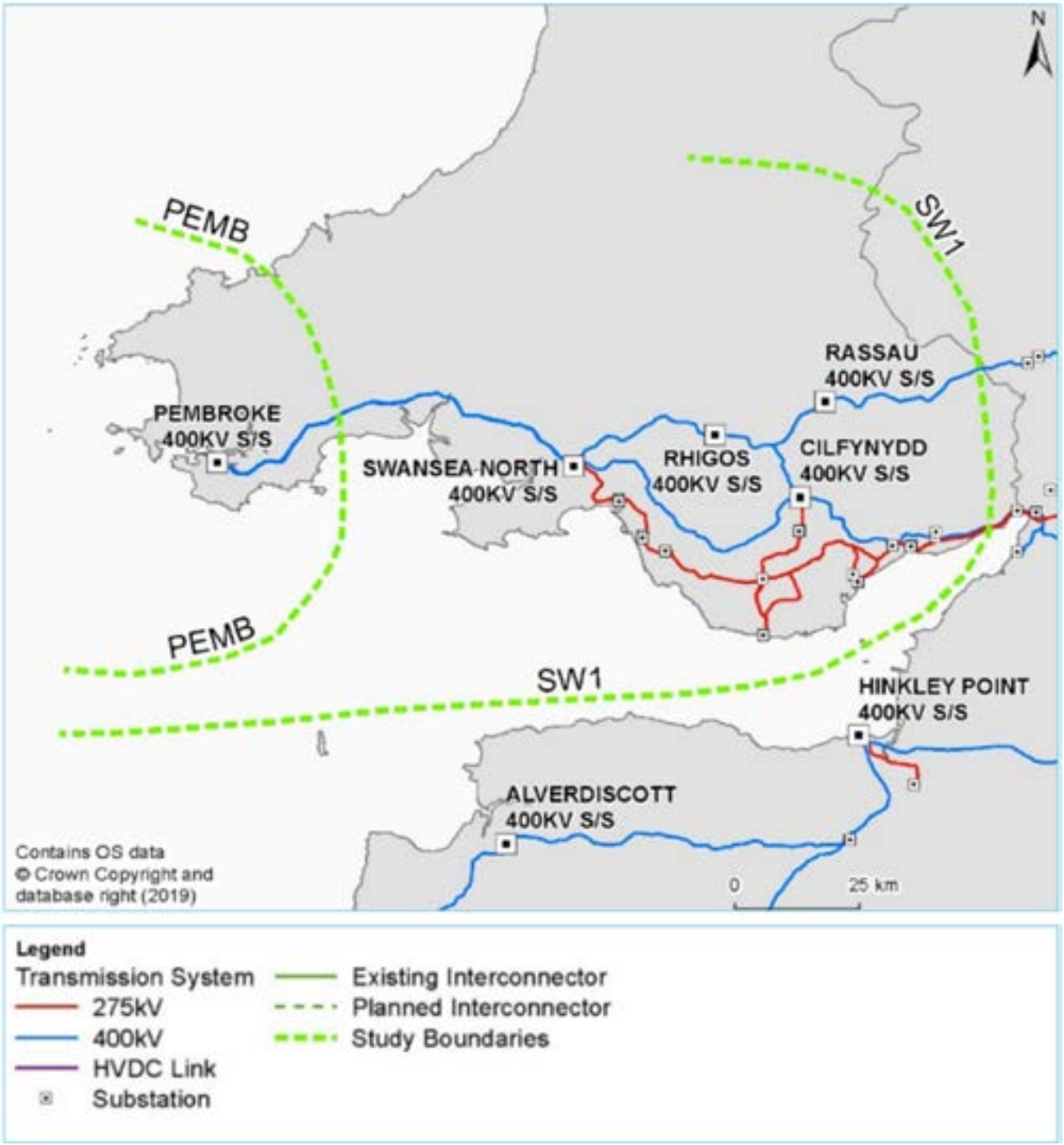
| Topic | Description |
|---|---|
| Grid | The grid in South Wales consists of a 400 kV ring from Pembroke to Walham, and from there to Melksham. There is a meshed 275 kV network that connects to this ring at Swansea North, Cilfynydd and Melksham. The meshed 275 kV network connects numerous current and contracted generators of various technology types including tidal, coal, gas and solar.<br><br>The distribution network in this region is owned and operated by Western Power Distribution (WPD) South Wales and feeds large demand centres of Swansea and Cardiff along with the surrounding industry. There are also substantial volumes of generation connected or contracted to connect to WPD South Wales.<br><br>Pembroke substation currently connects the Pembroke Power station to the grid and is due to connect to the Greenlink interconnector, tying the Great Britain transmission system to Ireland. |
| Ports | Port of Milford Haven<br><br>Pembroke Dock |
| Supply chain | Project developers often prefer in-house resources, especially in project management, but outsourcing is typically used wherever specialist advice is needed. There are a number of consultancies in the region with expertise in EIAs for marine energy projects. There are also many smaller local engineering consultancies with skills across design areas, particularly in mooring and anchor design.<br><br>Secondary steel stands out as an area of manufacturing that can readily be met within the region. 24 companies, largely clustered in South Wales and several in Cornwall, were identified by the Ocean Renewable Energy Coalition as having potential expertise in serial manufacturing parts such as boat landings, external access ladders, external and internal work platforms, and corrosion protection systems. Tata steel produce two million tonnes of steel coils a year in their steel production plant in Port Talbot. This can be used by fabricators for secondary steelwork for structures.<br><br>Pembroke Dock has a history of ship repair. Mainstay Marine has been based in Pembroke Dock for over thirty years and have fabricated a number of wave and tidal devices as well as designed and built wind farm support vessels, workboats, and passenger vessels.<br><br>Leask Marine, with a base in Pembroke Dock, have been contracted on many of Europe's offshore wind farms for anchor handling, towing, diving support and wider uses.<br><br>Other suppliers outside of the immediate RA may also form part of the supply chain and companies located near to other renewable energy hubs, ports and manufacturing bases would form part of the wave energy supply chain. In North Wales Faun Trackway are manufacturing gravity anchors for the Orbital 02 floating tidal device, while a further three companies specialise in installation of drilled and grouted, or driven seabed anchor piles. |

| Topic | Description |
|---|---|
| Supply chain (cont'd) | Prysmian Group, an established cable supplier with bases in Wrexham and Aberdare, stands out as having the ability and experience to supply cables to projects, both within the region and exporting more widely. The Wrexham facility, which manufactures submarine cable cores, currently employs 309 people across 3 shifts. Prysmian Powerlink Services is the subsidiary of the parent company that specialises in offshore wind, which is managed globally. Prysmian Group has upgraded its Wrexham facility to become the first UK facility to manufacture submarine array cable cores. Depending on cable design (insulation type, resistance required), Wrexham may be able to produce cables end to end. |
| Research | Both Swansea and Bangor University have extensive experience around Pembrokeshire through work undertaken on the SEACAMS programme that has been extended to 2021, which carries out environmental research focussed on the marine energy sector in Wales.<br><br>MEECE, led by ORE Catapult, and based in Pembroke Dock supports marine energy related research across Wales. |

Figure 10.1 shows the existing South Wales energy transmission system. The ORE Catapult study identified approximately 5.6 GW of generation connected within the South Wales region, and an additional 2.7 GW of generation and a 526 MW interconnector contracted to connect. There appears to be up to 3 GW capacity across the system so any additional connection would likely require reinforcements.

Pembroke substation is ideally located close to the wave RA and offers a distinct opportunity for future floating offshore wind and/or wave energy connections to South Wales. The 400 kV line from Pembroke Power Station could present opportunity for connection for larger projects. Milford Haven: Energy Kingdom project is exploring how hydrogen could be used in a local energy system, and the potential for the production of green hydrogen from renewable resources in the locality. An offshore hub is also being considered for PDZ that could provide opportunities for connection of wave farms.

**Figure 10.1: South Wales transmission system**




*Source: TCE, 2019*

The Port of Milford Haven is the UK's largest energy port. It is actively diversifying its interest and has a keen focus on marine energy. Milford Haven Port Authority has worked with different marine energy technology developers to ensure the port is suitable for deploying large arrays.

The Pembroke Dock Marine area is currently seeking £21 million investment from the Swansea Bay City Deal and £7 million from the Welsh European Funding Office alongside private investment to redevelop Quay Four at Pembroke Dock. This will create 20,000 $m^2$ of open plan fabrication and laydown areas and widen the slipway to up to 65 m. Berthing for workboats

will be extended to 100 m. Quay One has a crane strip 15 m back from the water, capable of lifting 300 tonnes, more than the mass of any turbine components that would be lifted during O&M or assembly.

The port could act as a one-stop-shop for fabrication, assembly, and O&M, bringing in nearby facilities and third-party engineering services to support large commercial-scale projects when required. Traditionally O&G companies such as Ledwood, Altrad, and Birwelco USA who have diversified marine renewables into their portfolio, are based near the port. If the project pipeline opportunity increases sufficiently to warrant further investment, the port could develop an additional laydown area, possibly repurposing the offshore jetty at Hobbs Point. Pembroke Port also sees a large opportunity in O&M to support project offices and ongoing engineering activity over the lifetime of projects.

### 10.1.3 Social considerations

The Wave – South West RA is adjacent to Pembrokeshire County Council. Information produced by and relating to this LA area has been used to inform this section.

#### 10.1.3.1 Population and demographics

Information on population density demographics, area deprivation and percentage of Welsh speaking individuals are highlighted in Table 10.3. This can provide useful information to developers when looking at establishing teams in the locality, for community engagement, and also to marine planners/regulators during planning and policy decision-making.

**Table 10.3: Population and demographics for area adjacent to Wave – South West RA**

| | |
|---|---|
| **Population density** | In 2019, Wales had an average population density of 15[2] persons per km[2] (ONS, 2020). Approximately 20% of the population of Wales live in areas that are classified as broadly rural[38]. In Pembrokeshire, there is an average population density of 77.7 persons per km[2]. |
| **Demographics** | Wales has an aging population. Between 1998 and 2018 the proportion of the population aged 65 and over increased from 17.4% to 20.8% (Welsh Government, 2020). In Pembrokeshire, the highest percentage of the population is in the following age groups:<br>• 0 to 14 (16.0%)<br>• 45 to 64 (27.9%) |
| **Area deprivation** | Area deprivation from the WIMD shows that Pembrokeshire contains 71 Lower layer Super Output Areas (LSOAs), 3.7% of the 1,909 total in Wales. Of the 0-10% most deprived LSOAs (overall) in Wales, four are in Pembrokeshire, which accounts for 5.6% of those in the county and 0.2% of those in Wales (WIMD, 2019). |
| **Welsh speaking** | According to census data (ONS, 2020), there were 866, 600 Welsh speakers aged three and over in Wales. In the Pembrokeshire LA approximately 28% (34,200) of residents speak Welsh (ONS, 2020). |

38 There is no standard definition of what is considered to be rural, however for Welsh analyses it is suggested that the usual starting point would be to have urban defined as the small and large towns in the less sparse context; the other categories being rural. i.e. · Urban: Less Sparse Large and Less Sparse Small Towns · Rural: All classifications excluding Less Sparse Large and Small Towns. Under this definition, towns such as Holyhead, Newtown, Aberystwyth and Carmarthen are considered rural. Usk, Denbigh, Beaumaris and Monmouth are considered urban.

### 10.1.3.2 Cultural identity

Pembrokeshire is described as having one of the most significant cultural landscapes in Wales. St David's Peninsula, Ramsey Island and Skomer Island are designated as Landscapes of Outstanding Historic Interest. Along the north-facing coast, within the southern extent of West Pembrokeshire, Strumble Head and Garn Fawr form part of a Landscape of Special Historic Interest for their medieval settlements, Neolithic chamber tombs and early Christian sites.

There is a significant historic military presence in West Pembrokeshire. There are historic military airfields associated with the Battle of the Atlantic, with a memorial in place on Whitesands Bay In remembrance of a plane crash during WWII. The remains of WWII cliff defences and 'Highwinds' (a submarine listening post) are present on the slopes of Carn Llidi.

The coastline is characterised by the remnants of historic coastal quarrying, particularly associated with Porthgain and Abereiddi during the late 19th and 20th centuries. At Abereiddi, the 'blue lagoon' is a product of quarrying and acts as an important tourism destination for the area. Porthgain harbour was important for the export of slate, granite and brick – with large, nationally designated brick hoppers which dominate the harbour used to store crushed dolerite before shipment.

Tourism is the main economic driver in West Pembrokeshire, attributed to the Pembrokeshire Coast National Park. Many walkers visit the area to hike the Pembrokeshire Coast Path. Pembrokeshire has numerous sandy beaches, large and small, that attract visitors, with Barafundle Bay consistently being voted one of the best beaches in the UK and making it into the top 25 in the world[39]. There are 11 Blue Flag beaches in Pembrokeshire: the most in any Welsh county.

Sea cliffs along the coastline attract climbers to the area, as well as wildlife tourism to view bird colonies, dolphins and seals. The Grade II listed Strumble Head lighthouse is also a tourist attraction in the area. The rugged coastline of Pembrokeshire also made it a haven for pirates and smugglers in the 15th, 16th, and 17th centuries.

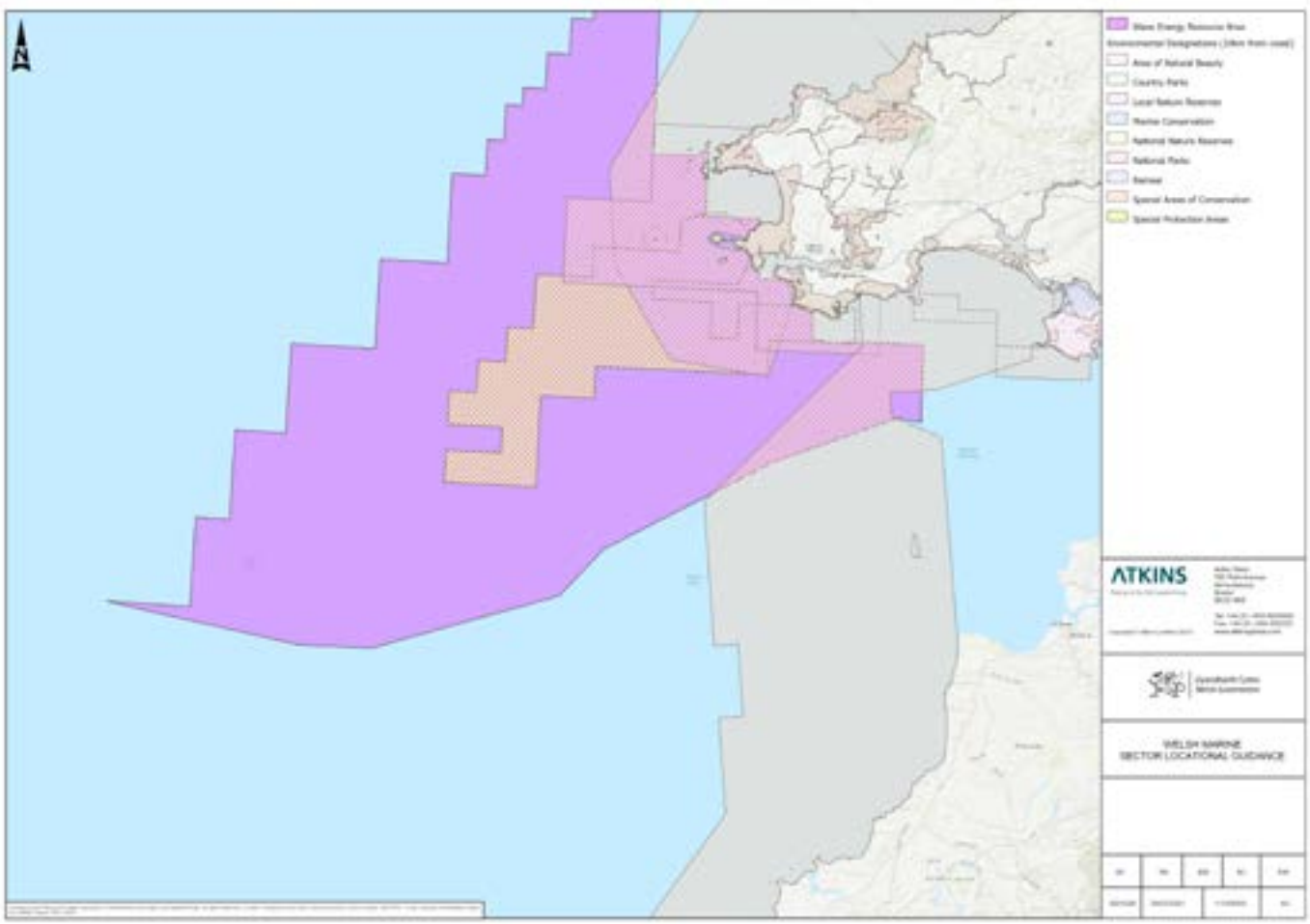
The importance of the shipping lanes, particularly in St George's Channel, made them prime targets for enemy submarines during both the first and second world wars. Patrol aircraft and airships are among some of the wrecks present in the area. Many of the drowned planes are designated as Protected Places under the Military Remains Act 1989.

39 A Welsh beach has been named as one of the best in the world – Wales Online www.walesonline.co.uk/whats-on/whats-on-news/welsh-beach-been-named-one-12430466

### 10.1.4 Environmental considerations

Figure 10.2 illustrates the environmental designations within the Wave – South West RA. Table 10.4 gives further details on these designations.

**Figure 10.2: Environmental designations within the Wave – South West RA**




*Source: Lle, 2020*

**Table 10.4: Wave – South West environmental considerations**

| Topic | Description |
|---|---|
| Designations | Beyond the 12 nm limit there are no designated sites that overlap with the wave energy RA.<br><br>Within the 12 nm boundary the RA overlaps with the West Wales Marine Special Area of Conservation (SAC) (designated for harbour porpoise), the Pembrokeshire Marine SAC (designated for Annex I habitats, including reefs, fish and marine mammals), the Bristol Channel Approaches SAC (designated for Harbour Porpoise) and the Skomer Marine Conservation Zone (MCZ).<br><br>The RA also overlaps with several Special Protection Areas (SPAs): the Skomer, Skokholm and the Seas off Pembrokeshire SPA (designated for Puffin, Storm Petrel, Lesser Black-backed Gull and Manx Shearwater), and Grassholm SPA (designated for Northern Gannet). |

| Topic | Description |
|---|---|
| Designations (Continued) | There are also a number of coastal designated sites which are adjacent to the wave energy RA. These include St David's / Ty Ddewi SAC, Castlemartin Coast SPA, Ramsey and St David's Peninsula Coast SPA and numerous Sites of Special Scientific Interest (SSSIs) such as Dale and South Marloes Coast, St. David's Peninsula Coast, Skokholm, Skomer Island and Middleholm; Grassholm / Ynys Gwales, Ramsey / Ynys Dewi, The Offshore Islets of Pembrokeshire / Ynysoedd Glannau Penfro, Castlemartin Range Cliffs and Dunes and Milford Haven Waterway.<br><br>The whole coastline and most of the islands are also encompassed by the Pembrokeshire Coast National Park. |
| Seabirds | A number of important bird colonies are located within the RA such as Ramsey Island, Bishops and Clerks, Skomer, Grassholm, and Skokholm. Seabirds from these colonies, and those further afield such as at New Quay Head, utilise the waters within the RA, and there are important foraging grounds for species such as Gannet, Puffin, Fulmar, Guillemot and Razorbill around the islands and Pembrokeshire coastline.<br><br>The colony at Ramsey Island is home to populations of Puffins, Fulmars, Great Black-backed Gulls, Herring Gulls, Kittiwakes, Lesser Black-backed Gulls, Razorbills, Shags and Storm Petrels. The Offshore Islets of Pembrokeshire / Ynysoedd Glannau Penfro SSSI overlaps with the Bishops and Clerks seabird colony, and is home to Great Black-backed Gulls, Herring Gulls, Lesser Black-backed Gulls, Puffins and Storm Petrels.<br><br>To the south, Skomer Island has important populations of Manx Shearwater, Fulmar, Puffin, Razorbill, Kittiwake and Lesser Black-backed Gull. High concentrations of birds are also found at Grassholm (Gannet and Guillemot) and Castlemartin (Guillemot and Razorbill).<br><br>The extensive foraging ranges of many seabirds mean that foraging areas of some bird species may extend 50 km or more into the RA.<br><br>Although the Milford Haven Waterway is beyond the boundary of the RA, it provides important foraging areas for a number of bird species that colonise sites located within or adjacent to the RA. |
| Marine mammals | There are multiple designated sites, with marine mammals as qualifying features, which overlap with the RA including the West Wales Marine SAC, the Pembrokeshire Marine SAC, the Bristol Channel Approaches SAC and the Skomer MCZ.<br><br>Many grey seal haul-out and pupping areas off the west coast of Pembrokeshire are encompassed or adjacent to the RA. As a consequence, density of grey seal is comparatively high in the waters around Ramsey, Skomer and Grassholm.<br><br>Bottlenose and Risso's dolphin are fairly common within the 12 nm limit; however, these species, in addition to minke whale and short beaked common dolphin, are commonly recorded in waters beyond the 12 nm limit which overlap with the RA.<br><br>Off the southwest coast of Pembrokeshire, near Tenby and Saundersfoot, Harbour Porpoise are commonly recorded and are likely to occur within the part of the RA which overlaps with the Bristol Channel Approaches SAC. |

| Topic | Description |
|---|---|
| Fish | Just off the west coast of Pembrokeshire, the RA overlaps with high intensity spawning grounds for sandeel and low intensity spawning grounds for mackerel and whiting.<br><br>More than 20 km to the south of Milford Haven; the RA overlaps with important spawning grounds for multiple fish species (e.g., cod, sandeel, plaice and sole). While in offshore waters to the southwest, the RA overlaps with spawning and nursery grounds for important commercial species such as mackerel, sole and cod.<br><br>The Milford Haven Waterway is an important corridor for migratory fish species such as lamprey, Atlantic salmon, sea trout, European eel, and shad. As such, these fish species will be present in the waters around the Haven. The estuary generally is an important spawning, breeding and nursery area for many marine fish species, forming important habitat supporting young fish before moving out to deeper waters. |
| Habitats | The RA overlaps with or is adjacent to many designated sites which have habitats as qualifying features.<br><br>Article 17 'subtidal reefs' and 'large shallow inlets and bays' are primary reasons for designation of the Pembrokeshire Marine SAC which overlaps with a large part of the wave RA off the coast of Pembrokeshire. Subtidal reefs are particularly extensive throughout this region, extending offshore and encompassed by the RA. Adjacent to the RA, much of the coastline along the west and south of Pembrokeshire consists of intertidal reef features with many sea caves dotted along the coast.<br><br>The RA extends into St Bride's Bay. Reefs exist around the edges of the bay which is completely encompassed by the Article 17 'large shallow inlet and bay' feature. Mudflats and sandflats are also present within more sheltered parts of the bay.<br><br>Tide swept channels which exist between the islands of Ramsey and Skomer and the mainland, are a Section 7 feature in themselves. The waters around the islands, overlapping and adjacent to the RA, contain many designated habitats and communities. Around Ramsey Island are Article 17 intertidal and subtidal reefs, sea caves, in addition to Section 7 fragile sponge and anthozoan communities, subtidal mixed muddy habitats, intertidal under-boulder communities and tide-swept channels. To the northwest of Ramsey Sound, off St David's Head, the inshore environment is still subject to strong tidal streams, and the RA overlaps with Article 17 and Section 7 habitats including intertidal reef (e.g., Bishops and Clerks Islands), subtidal reef and biogenic blue mussel beds. |
| Habitats (cont'd) | Similarly, within and around the Skomer MCZ are many Article 17 habitats, including intertidal and subtidal reefs, sea caves and sandbanks. Section 7 features are also numerous, including widespread mixed muddy habitat, many examples of fragile sponge and anthozoan communities, and swathes of seagrass. Records also exist for several Section 7 benthic species around Skomer, including stalked jellyfish (*Haliclystus auricula and Lucernariopsis campanulata*), ocean quahog (*Arctica islandica*) and pink sea fan (*Eunicella verrucosa*).<br><br>Further offshore, to the southwest, are extensive areas of the Section 7 feature 'mixed muddy sediments'. There are also many records of the Oslo/Paris Convention (for the Protection of the Marine Environment of the North-East Atlantic) (OSPAR) feature 'seapens and burrowing megafauna' communities, a biotope indicative of soft mud habitats in deep water. |

In relation to seabirds, the outputs of the SMMNR project suggest that constraints in the wave – South West RA are noticeably higher in locations closer to shore and reduce with distance offshore. Gaps in survey coverage were identified; however, in general, the numbers of birds recorded in far offshore areas was minimal relative to inshore. The main contributor to potential constraints offshore was identified as foraging birds with extensive ranges rather than the presence of nearby seabird colonies. Moving offshore, away from the colonies, there is a clear reduction in relative constraints occurring from approximately 25 km offshore. The constraints steadily reduce to the west, southwest and east.

In relation to marine mammals, the outputs of the SMMNR project also indicate a higher level of potential constraint in the inshore area, along the coastline in particular. This is due to the presence of seal haul-out and pupping sites in this area. Constraints are notably lower in offshore waters to the south and southeast as a result of the lower cetacean densities in these areas and lower usage by grey seal. However, the mobile nature of these species means that interactions cannot be ruled out, even in areas of lower constraints.

In addition to designated sites and species, WNMP **policy ENV_07 (fish species and habitats)** includes consideration of impacts on important feeding, breeding (including spawning and nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance. The relative constraints in the wave – South West RA identified in the SMMNR project are a result of overlaps with spawning and nursery grounds. Spawning and nursery grounds for multiple fish species are found offshore to the south of Pembrokeshire. Adverse impacts on these important breeding areas can potentially be avoided through careful timing of any impacting activities outside of the breeding seasons for the relevant fish species.

In relation to habitats, the outputs of the SMMNR project highlight that inshore along the Welsh coastline, the relative constraints are notably higher than offshore environments and more than 10-20 km offshore are extensive areas of good wave resource occurring in areas of relatively low known constraints. Further offshore, the pattern of higher constraints reflects the coincidence with the Pembrokeshire Marine SAC which extends some way offshore and is designated for Annex I reef. Beyond the extent of the SAC, most of the area is indicated as having ecological constraints comparatively lower than elsewhere in Welsh waters.

### 10.1.5 Other marine users

Table 10.5 outlines the other marine users and activities present in the Wave – South West RA. See Section 8 for more information on other marine users in wider Welsh waters.

**Table 10.5: Other marine users Wave – South West RA**

| Sector | Description |
|---|---|
| Aggregates | No interaction with any aggregate production areas but there is overlap with aggregate RAs, meaning these two sectors could be considering the same areas for potential development. |
| Aquaculture | No existing aquaculture projects within RA. Some overlap with aquaculture RAs. |
| Defence | Overlap with a number of Military Practice Areas. The inshore areas are Castlemartin and Manorbier firing ranges.<br>An Area of Intense Aerial Activity (AIAA) overlaps with the southwestern end of the RA.<br>A Fleet Exercise Area also overlaps with the southwestern end of the RA. |

| Sector | Description |
|---|---|
| Dredging & disposal | There are several disposal areas within the RA:<br>• Milford Haven – closed<br>• Milford Haven 2 – open<br>• Milford Haven 3 – open |
| Energy (low carbon) | The PDZ is in the southeast of the RA. The lease is currently held by WaveHub Ltd as the third-party manager for the demonstration zone, and they are going through the process of amending the lease to allow floating wind as well as wave energy to be developed in the area.<br>There is some overlap with the tidal stream RA in inshore areas off St David's, and there is an existing tidal project lease in Ramsey Sound, just on the edge of the RA.<br>There is increasing and significant interest in floating wind development in the Celtic Sea with potential areas identified off Pembrokeshire. A floating wind project is also under development in the RA – Erebus, led by Simply Blue and Total, which secured an Agreement for Lease in 2020. |
| Energy (O&G) | There are a number of abandoned well heads in the RA but there are no operating platforms or pipelines. |
| Fishing | The RA is used extensively for fishing activity, with beam trawl, otter trawl and demersal seine activity all being recorded. Shellfish fishing in the inshore area of the RA is valued at over £2 million. |
| Shipping | • Traffic Separation Scheme west of Pembrokeshire Off Smalls, and ship routing measures between the Smalls Lighthouse and Grassholm Island.<br>• Ferry route between Pembroke and Rosslare passes through RA.<br>• Anchorage and associated dredging area in St Brides Bay.<br>• Harbour area and pilot boarding area outside Milford Haven waterway. |
| Subsea cabling | Multiple subsea cables cross the RA. Marine licence areas also show the location of the Greenlink interconnector currently being developed which passes through the RA, the Erebus floating wind project and the associated export cable route. |
| Wrecks | There are many wrecks within the RA, but just one that is designated as a protected wreck, located at the Smalls. |

Wave development is not considered compatible with aggregate production areas as the establishment of fixed structures will affect aggregate potential of an area where resource exists. There are no areas with activity currently within the Wave – South West RA; however, the RAs for wave energy and aggregates overlap, potentially leading to competition for space or constraints in the future for any new aggregate production areas established within the Wave – South West RA.

There has been some interest in the potential for coexistence of aquaculture projects with wave energy projects. Floating wave structures could potentially provide shelter to aquaculture in their 'shadow'. However, in the main, prospective areas of tidal stream and wave energy are not a suitable physical environment for aquaculture. The offshore areas of the Wave – South West RA may also be unattractive locations for future stand-alone aquaculture activity due to the distance from shore and high levels of exposure. Co-location with floating energy devices may be a possibility in the offshore area; however, this is likely to be more of an option in the inshore area of the RA.

Based on the engagement with the MoD in the development of the PDZ, Military Practice Areas should be treated as 'hard' constraints, with any development in these areas very unlikely to be acceptable. Interaction between AIAA and wave developments is expected to be minimal so may not need to be treated as a 'hard' constraint; however, engagement with the MoD would be required if interaction with these areas was anticipated. For Fleet Exercise Areas, consultation with MoD would be required to establish the usage of the area and potential for interaction, but at this stage it is assumed that this should be treated as a 'hard' constraint for floating devices, with any development in these areas very unlikely to be acceptable.

There is potential for co-location between wave and floating wind, with wave technology being incorporated into floating wind platforms, as being explored by a number of developers including Marine Power Systems, Floating Power Plant and Bombora. These areas should, therefore, not be treated as a hard constraint at this stage and further research to investigate co-location potential is warranted.

The presence of abandoned O&G sector well heads could act as a constraint to the siting of wave devices. Extant infrastructure of this type is covered under the WNMP **safeguarding policy** for O&G, including any statutory exclusion zones. It is anticipated, however, that any conflicts of this type could be resolved through early planning and micro-siting of devices.

Fisheries activity, depending on the type, may interact or conflict with wave energy activities. Due to the widespread and changeable nature of fisheries activity, it is difficult to anticipate the potential for interaction within the Wave – South West RA. In line with the WNMP **safeguarding policy** for fisheries, any new developments must consider the risk of displacement of vessels from fishing grounds. The existence of established fisheries within the Wave – South West RA may not represent a hard constraint; however, consideration of fisheries impacts will be required in the preparation of any new development proposals.

The shipping overlaps identified in Table 10.5 would need to be treated as 'hard' constraints due to the risks posed to navigational safety from the introduction of fixed structures. There is the potential for shipping routes to be diverted, if necessary, through consultation with shipping agents and the MCA; however, this is unlikely to be a viable option for most developments. Management measures can be put in place to address interactions with shipping areas, for example, marker buoys/lighting, and marking on maps/charts, but development near or within busy shipping routes would require extensive engagement with MCA, Trinity House and other navigation stakeholders. This could lead to extended delays and/or objections from these stakeholders could preclude development in these areas altogether.

Cable routes would need to be avoided by moorings for floating devices and existing cables are protected by the WNMP **safeguarding policy** for the subsea cabling sector. However, the fact that they are in deeper water suggests these are unlikely to interact with areas of interest for bottom mounted devices. Micro-siting of structures within an area is also an option for avoiding cable interactions.

Wrecks, along with any designated and non-designated maritime heritage assets, will represent a hard constraint for wave energy activities and these will need to be avoided. It is anticipated, however, that this can be achieved during site selection and through micro-siting within the wider development site.

As a result of the emerging nature of the wave energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA. In line with WNMP **policy ELC_02b (low carbon energy (supporting) wave),** the sector is encouraged to collaborate with regulators, other developers, other sectors, and interested parties to understand opportunities for future wave energy activity.

## 10.2 Summary of key opportunities and constraints

Several key constraints have been identified that would either potentially cause lengthy decision making for consent or could preclude development altogether. Several opportunities have also been identified which could support or guide future development of the sector.

This SLG aims to highlight features within this region which may influence site selection and/or could present a potential challenge to development in this area. It may be that some features can be easily avoided through micro-siting or applying appropriate buffers at the project design stage, whereas some features may require more detailed assessment and consultation at project level. Developers should consider the cost and programme implications of progressing developments that impact on key features.

This SLG provides an overview of potential spatial constraints which may be important considerations for new wave energy projects. The number of constraints is generally higher inshore; however, it is important to note that not all constraints will have an equal effect on wave energy developments. Key features that were assigned a high score in the MRESF constraints analysis are illustrated in Figure 10.3 and Figure 10.4. Figure 10.5 and Figure 10.6 show the number of constraints potentially effecting wave energy developments within the Wave - South West RA and at a national scale (respectively), presented in a 1 $km^2$ hexagonal grid.

**Key constraints:**

- **Shipping** – Projects could present a risk to safe navigation and any proposed alteration to shipping routes could lead to extended delays.
- **Defence** – Developments within or overlapping with MoD areas could present a risk to both the MoD's activities and to the project infrastructure itself so would require extensive engagement. Whilst it is possible that development could go ahead in these areas depending on how the areas are used by the MoD, the engagement could lead to extended delays.
- **Existing energy leases** – Whilst the floating wind areas could present an opportunity for co-location, this would require extensive engagement with the lease holders and potentially more complicated consenting.
- **Disposal areas** – Development is unlikely to be possible within active disposal areas due to operational activity, and risks to project infrastructure.
- **Subsea cables** – Owners/operators of active cables are unlikely to allow development within the vicinity of their assets due to the risk of damage. A buffer is likely to be required either side of a cable and development would need to be outside of this.

**Key constraints:**

- **Environmental designations** – Development within designations is possible but is dependent on the potential impact on the species related to the designation and the potential impact pathways.
- **Marine mammals** – There is still some uncertainty around potential impacts of wave energy devices on marine mammals including collision risk and barrier effects.
- **Birds** – There is still some uncertainty around potential collision risk for birds.
- **Wrecks** – Whilst not all wrecks are protected, it is likely that a buffer would be required and development would need to be outside of this.

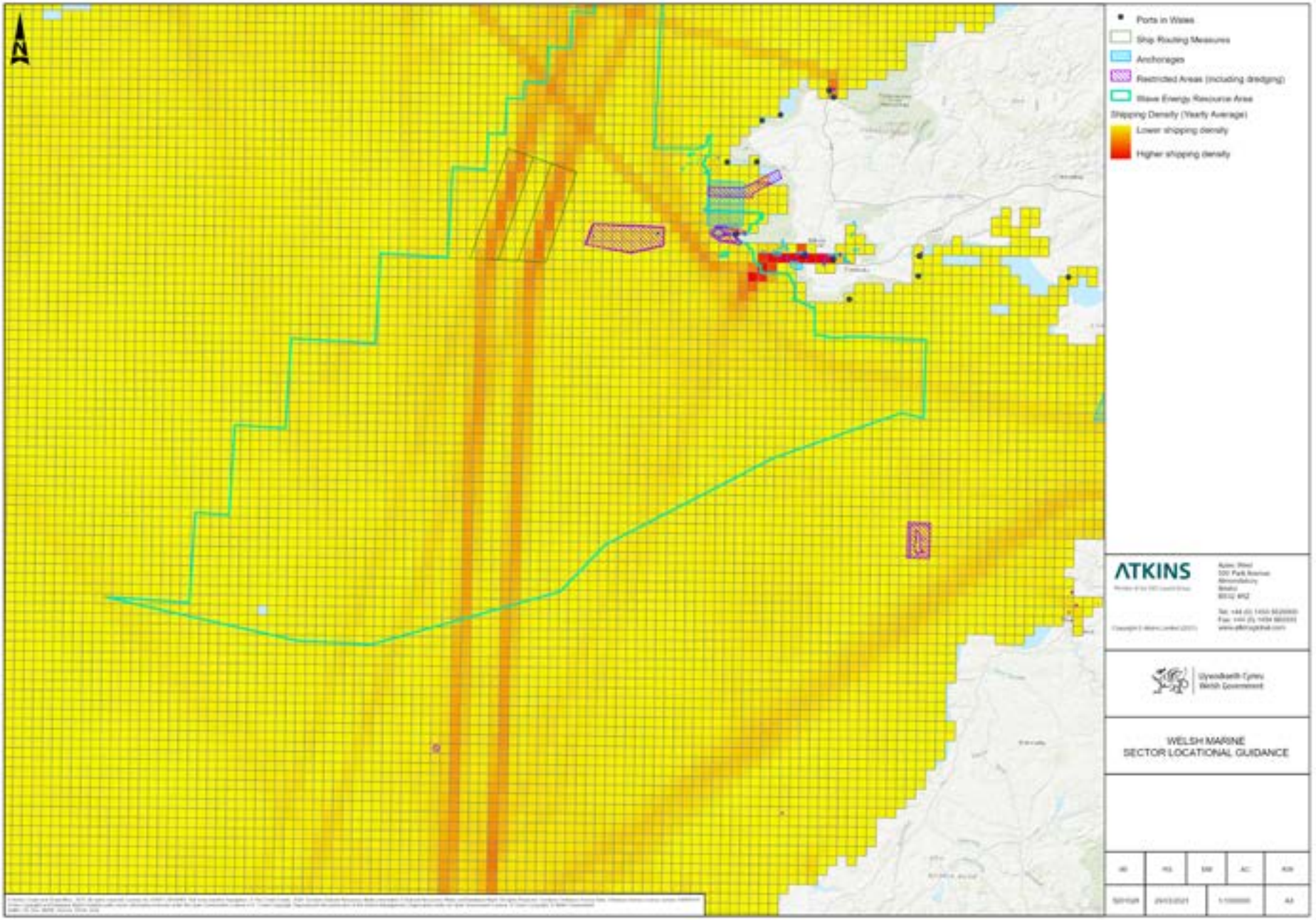
Considering the available wave energy resource, the identified constraints (both hard and soft constraints), and the socio-economic context identified, several key opportunities have also been identified. These opportunities could support, promote, or facilitate the development of the wave energy sector in the future, as well as the achievement of Welsh Government targets and objectives linked to employment opportunities in Welsh coastal communities, emissions reduction, and climate change adaptation.

The maps in Figure 10.3, Figure 10.4, Figure 10.5 and Figure 10.6, whilst showing the location of known constraints within the RA, also provide information on areas of lower relative constraint. These maps can be used to guide discussions within project planning processes on areas for further consideration, where constraints may be 'softer' and development could proceed in a quicker and more straightforward manner.

**Key opportunities:**

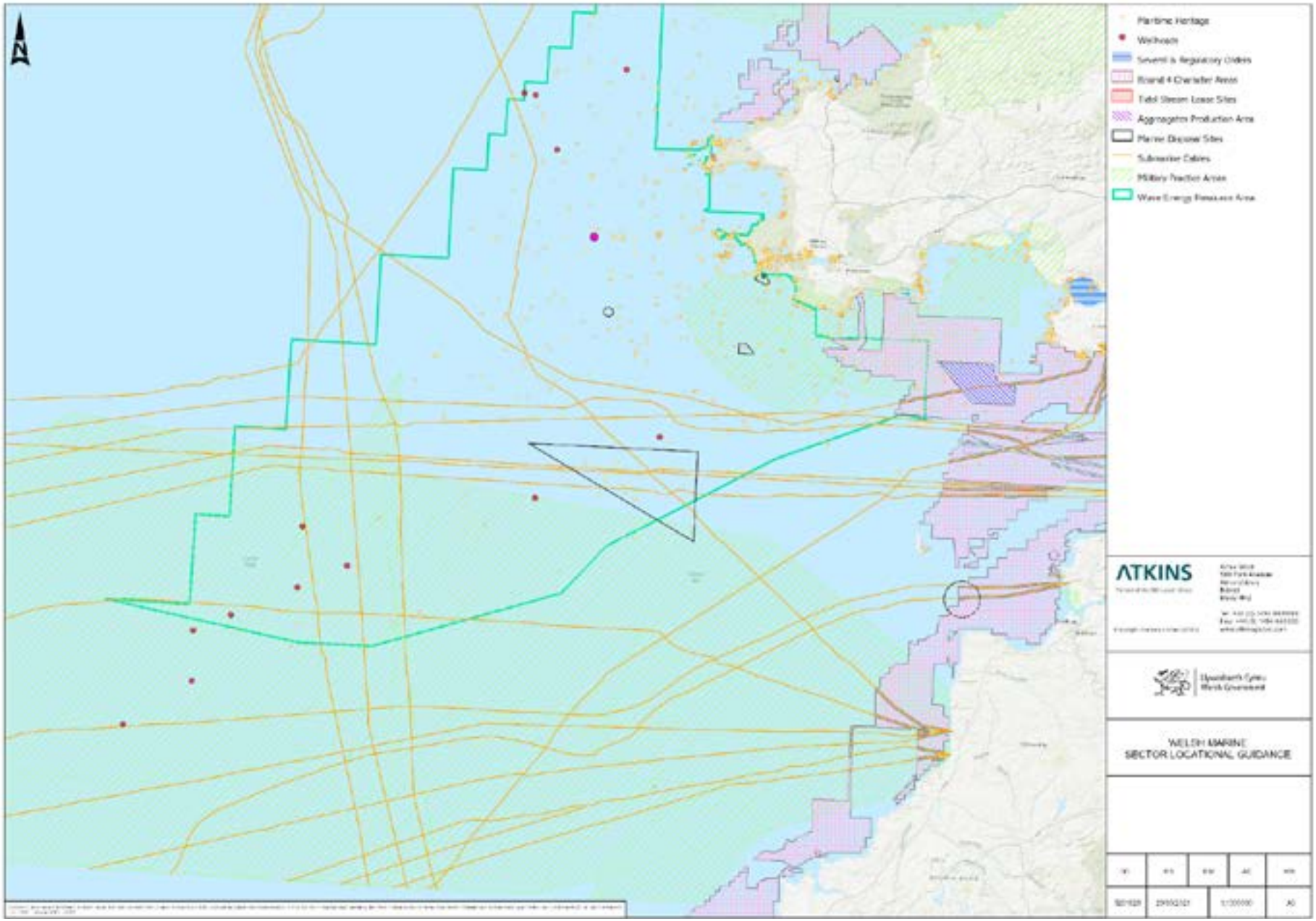
- **Wave resource** – An extensive and potentially significant wave RA exists within Wales with the necessary physical and environmental conditions to support the production of wave energy at a commercial scale. The large extent of the resource, and the reduction in constraints further offshore, provides greater opportunity to locate a suitable area for development.
- **National grid** – A programme of expansion of the grid network is already underway in Wales with upgrades planned to accommodate a large expansion of offshore renewable energy.
- **Supply chain** – Due to the expansion of the offshore wind sector over the last decade, there are many companies already in Wales with the relevant experience and expertise to support wave energy projects. Developments can also make use of established marine-related skills in local communities and the extended supply chain. Within the South West RA region, several installation and maintenance ports are already in operation.
- **Co-location** – There is significant potential for wave energy to co-exist or co-locate with a number of other marine users such as other energy technologies, aquaculture, some fisheries, tourism and recreation. Co-location and/or sharing of devices, structures or infrastructure can offer benefits such as cost-saving as well as increasing the use of marine space.
- **Refining of RA** – As a result of the emerging nature of the wave energy sector, there are a large number of opportunities to strengthen the evidence base and further refine the RA and develop an understanding of opportunities for future wave energy activity.

**Figure 10.3: Location of shipping constraints in relation to the Wave – South West RA**



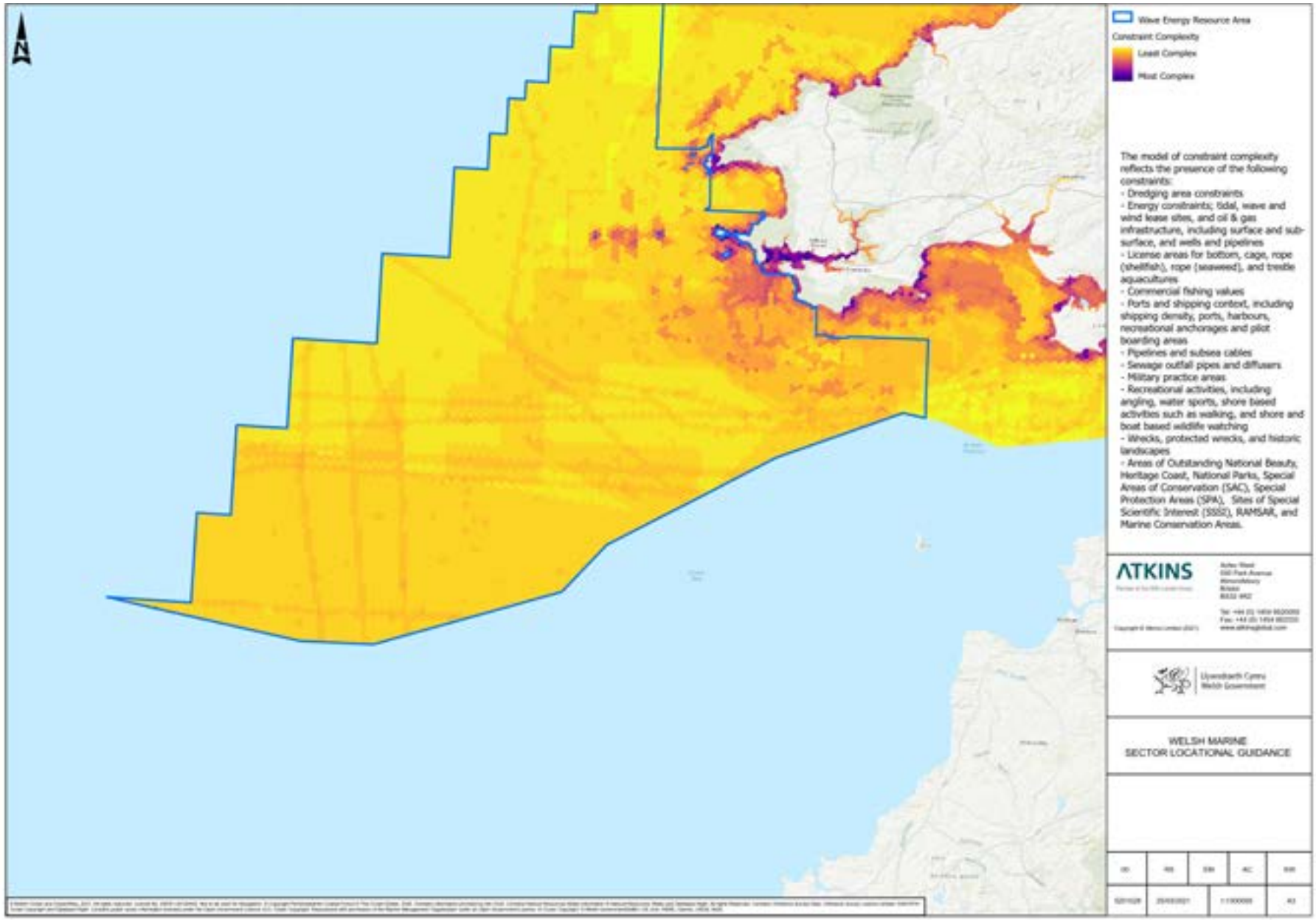

*Source: MMO, 2017*

**Figure 10.4: Location of significant issues/constraints in relation to the Wave – South West RA**



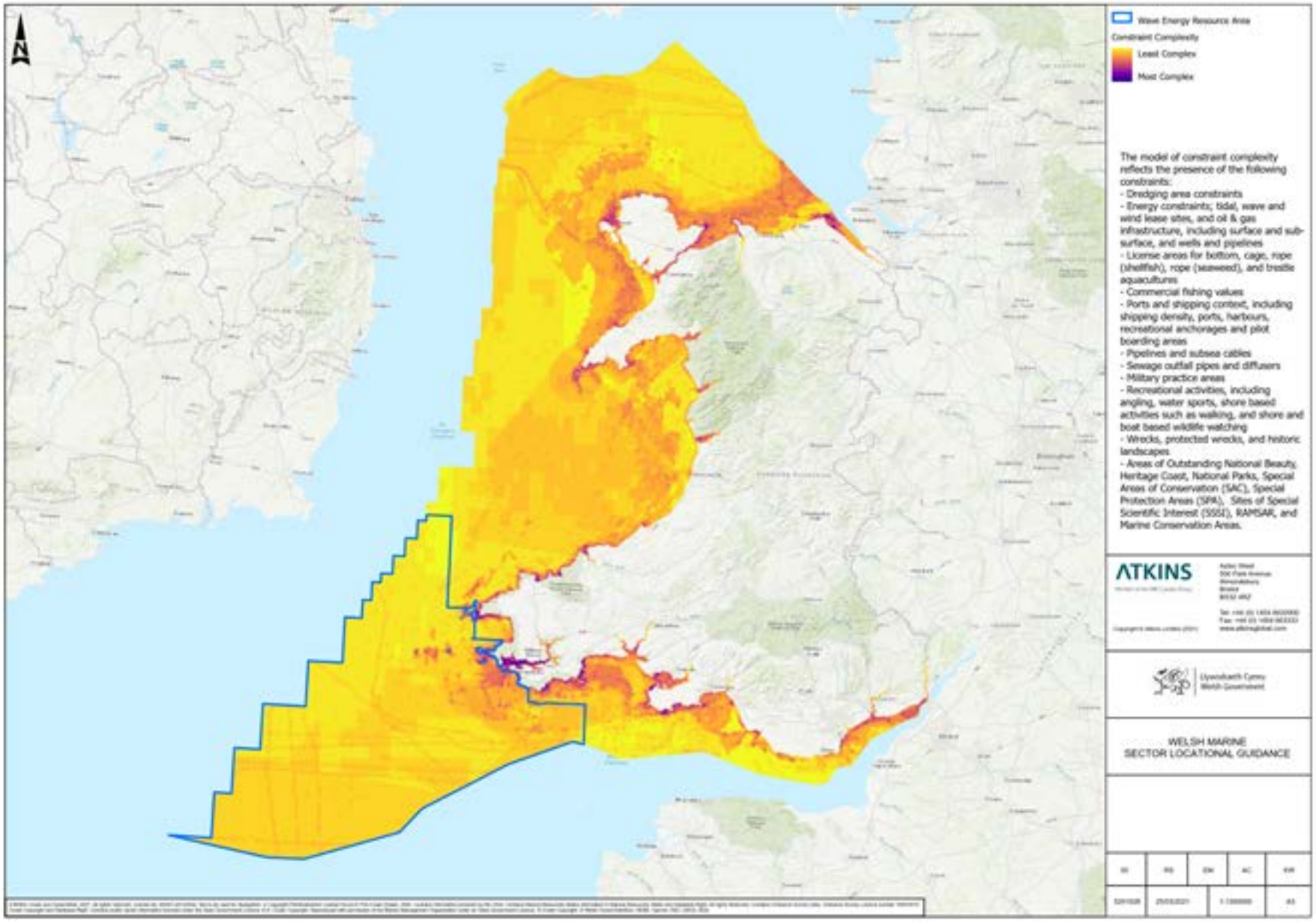

*Source: see Table A 1*

**Figure 10.5: Number of constraints to wave energy development in the Wave – South West RA**




*Source: see Table A 1*

## Figure 10.6: Number of constraints to wave energy development in Welsh waters




*Source: see Table A 1*

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# Appendix A: Data

## A.1. Data sources

Data sources used to inform the guidance are outlined in Table A.1 below[40].

**Table A.1: Data sources used for Wave SLG**

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| **Resource Area** | | | | |
| Wave Energy RA | Wave Energy RA<br>Accessed Online (2021):<br>www.lle.gov.wales/catalogue/item/WaveEnergyResourceArea/?lang=en | High | All, except Figure 1.1, Figure 1.2, Figure 3.1, Figure 4.1, Figure 4.3, Figure 5.1, Figure 5.2, Figure 8.10, Figure 10.1, | |
| Wave potential | Renewable Atlas<br>www.renewables-atlas.info/downloads/ | Medium | Figure 3.1 | |
| Existing Wave lease | The Crown Estate<br>www.opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-wave-site-agreements-england-wales-ni-the-crown-estate | High | Figure 4.2 | |
| WNMP Area | Welsh Marine Plan Area<br>www.lle.gov.wales/catalogue/item/WelshNationalMarinePlanArea/?lang=en | High | Figure 1.1 | |
| **Conservation Sites** | | | | |
| Designated sites (Ramsar, SACs, SPAs, MCZs, SSSIs) | Designated conservation site boundaries (various): Ramsar, SAC, SPA, MCZ, SSSI.<br>On Lle geoportal and Welsh Marine Planning Portal (WMPP)<br>www.lle.gov.wales/apps/marineportal/#lat=52.5129&lon=-3.9111&z=8&layers=231,390<br>www.lle.gov.wales/catalogue/item/ProtectedSitesRamsarWetlandsOfInternationalImportance/?lang=en<br>www.lle.gov.wales/catalogue/item/ProtectedSitesSpecialAreasOfConservation/?lang=en<br>www.lle.gov.wales/catalogue/item/ProtectedSitesSpecialProtectionAreas/?lang=en | High | Figure 10.2, Figure 10.5 | ✓ |

40 Note that all data links were available at the links in Table A-1 at the time of writing.

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| **Biodiversity** | | | | |
| Seabird foraging | Bird colony locations and counts – Seabird Monitoring Programme (varied years).<br>www.app.bto.org/seabirds/public/data.jsp<br>Rationalised list of colonies produced following NRW input<br>Mean foraging range – Woodward et al., 2019 | High | Used to inform SMMNR data | |
| Seabird loafing | Bird colony locations – Seabird Monitoring Programme. Rationalised list of colonies produced following NRW input<br>www.app.bto.org/seabirds/public/data.jsp<br>Joint Nature Conservation Committee maintenance extensions<br>www.data.jncc.gov.uk/data/4bf39157-852c-4a27-87eb-fb44e6f55b32/sas-generic-maintenance-extensions-seabird-colonies.pdf | High | Used to inform SMMNR data | |
| RSPB seabird utilisation distributions | RSPB metadata showing utilisation of Kittiwake, Guillemot, Razorbill, Shag – Cleasby et al., 2018<br>www.opendata-rspb.opendata.arcgis.com/search?sort=name&tags=Tracking%20Data&type=Feature%20Layer | High | Used to inform SMMNR data | |
| Seabirds at Sea | Seabird distribution – Seabirds at Sea.<br>Rationalised seabird list produced following NRW input<br>www.lle.gov.wales/catalogue/item/SeabirdsAtSea/?lang=en | Medium | Used to inform SMMNR data | |
| Grey Seal at Sea | Seal at Sea – Russell et al, 2017<br>www.data.marine.gov.scot/dataset/estimated-sea-distribution-grey-and-harbour-seals-updated-maps-2017 | High | Used to inform SMMNR data | |
| Atlas of Marine Mammals of Wales | Atlas of the marine mammals of Wales – Baines and Evans, 2012 | High | Used to inform SMMNR data | |
| Cetacean distribution | Waggitt et al., 2019<br>www.datadryad.org/stash/dataset/doi:10.5061/dryad.mw6m905sz | High | Used to inform SMMNR data | |
| Seal pupping and haul out sites | Baines et al., 1995; Westcott and Stringell, 2004; Strong et al., 2006 and Clarke et al., 2020 (in prep) | Medium | Used to inform SMMNR data | |
| Nursery areas | Spawning and nursery grounds of selected fish species in UK waters (Ellis et al., 2012)<br>www.data.cefas.co.uk/#/View/153 | Medium | Used to inform SMMNR data | |

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| Spawning grounds | Spawning and nursery grounds of selected fish species in UK waters – Ellis et al., 2012<br>Fisheries sensitivity maps in British waters – Coull et al., 1998;<br>www.data.cefas.co.uk/#/View/153 | Medium | Used to inform SMMNR data | |
| Basking Shark distribution | The Marine Conservation Society Basking Shark Watch 20-year report (1987-2006) – Bloomfield and Solandt, 2010 | Medium | Used to inform SMMNR data | |
| Migratory fish transitional waters | Article 17 Estuaries<br>On WMPP and Lle geoportal | High | Used to inform SMMNR data | |
| Article 17 (Annex I) | Article 17 (Annex I habitats)<br>On WMPP and Lle geoportal | High | Used to inform SMMNR data | |
| Section 7 and OSPAR habitats | Section 7 and OSPAR habitats<br>On WMPP and Lle geoportal | High | Used to inform SMMNR data | |
| Section 7 and OSPAR species | Section 7 and OSPAR species<br>On WMPP and Lle geoportal | High | Used to inform SMMNR data | |
| SMMNR Constraints | SMMNR – Fish, bird, marine mammal and habitat constraints<br>www.lle.gov.wales/catalogue/item/SMMNRConstraintMapping?lang=en | High | Figure 7.4, Figure 7.5, Figure 7.6, Figure 7.7, Figure 7.8, Figure 7.9, Figure 7.10 | |
| **Social** | | | | |
| Administrative boundaries | UK constraints<br>www.geoportal.statistics.gov.uk/datasets/counties-december-2017-full-clipped-boundaries-in-england | Medium | All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 10.1 | |
| LSOA<br>MSOA | www.ordnancesurvey.co.uk/opendatadownload/products.html<br>www.geoportal.statistics.gov.uk/datasets/middle-layer-super-output-areas-december-2011-generalised-clipped-boundaries-in-england-and-wales | High | Figure 6.1 | |

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| Boroughs | www.api.os.uk/downloads/v1/products/BoundaryLine/downloads?area=GB&format=ESRI%C2%AE+Shapefile&redirect | Medium | All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 10.1 | |
| Parishes | www.osdatahub.os.uk/downloads/open/BoundaryLine | Medium | All, except Figure 1.2, Figure 4.1, Figure 4.3, Figure 5.2, Figure 10.1 | |
| Population density, demographics, area deprivation, Welsh speaking % | WIMD interactive Map www.wimd.gov.wales/<br>Stats Wales www.statswales.gov.wales/Catalogue | High | Figure 6.1 | |
| Travel time | Travel time layer generated by Atkins | High | Figure 6.2 | |
| Recreation | Recreation data provided by the Pembrokeshire Coastal Forum, covering recreational angling, water sports, shore based activity and wildlife watching | Low | Figure 10.5 | |
| **Infrastructure & Supply Chain** | | | | |
| Submarine Cables | Oceanwise<br>www.oceanwise.eu/data/marine-themes/ | High | Figure 8.11, Figure 10.4, Figure 10.5 | ✓ |
| O&G lease areas & infrastructure & pipelines | Sourced from the O&G Authority online portal<br>www.data-ogauthority.opendata.arcgis.com/ | High | Figure 10.5 | ✓ |
| National grid overhead powerlines / substations | National Grid www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps | | Figure 5.1 | |
| Nuclear power stations | National Grid www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps | High | Figure 5.1 | |
| Gas pipelines | National Grid www.nationalgrid.com/uk/electricity-transmission/network-and-infrastructure/network-route-maps | High | Figure 5.1 | |

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| Ports/Harbour Areas/Pilot Boarding Areas & Recreational Anchorages | Ports in Wales – Oceanwise data: Ports and Harbours of the UK<br>Supplied by Welsh Government | Medium | Figure 8.10, Figure 5.1, Figure 10.3 | ✓ |
| Wastewater | Intake and outfalls, including licensed discharges, provided by Welsh Government by email, 15th January 2021. | High | Figure 10.5 | ✓ |
| **Other Marine Users** | | | | |
| Aggregate production | The Crown Estate<br>www.opendata-thecrownestate.opendata.arcgis.com/datasets/thecrownestate::offshore-minerals-aggregates-site-agreements-england-wales-ni-the-crown-estate | High | Figure 8.1, Figure 10.4, Figure 10.5 | ✓ |
| Marine disposal sites (licensed) | Cefas<br>www.data.cefas.co.uk/#/View/407 | High | Figure 8.1, Figure 10.4, Figure 10.5 | ✓ |
| Marine spoil grounds | Cefas<br>www.data.cefas.co.uk/#/View/407 | High | Figure 8.1, Figure 10.4 | ✓ |
| Military practice areas | Oceanwise<br>www.oceanwise.eu/data/marine-themes/ | High | Figure 8.2, Figure 10.4, Figure 10.5 | ✓ |
| Offshore Wind | Offshore Wind Leasing – Round 4<br>www.opendata-thecrownestate.opendata.arcgis.com/datasets/54dce8a263324a85b36523e31fff20cc_0 | High | Figure 8.4, Figure 10.4 | |
| Tidal | Tidal RA<br>www.lle.gov.wales/catalogue/item/TidalStreamEnergyResourceArea/?lang=en<br>Tidal stream leasing areas<br>www.opendata-thecrownestate.opendata.arcgis.com/ | High | Figure 8.3, Figure 10.4, Figure 10.5 | ✓ |
| Wave | Wave RA<br>www.lle.gov.wales/catalogue/item/WaveEnergyResourceArea/?lang=en | High | Figure 8.2, Figure 10.5 | ✓ |
| Aquaculture | Several Regulating Orders<br>www.lle.gov.wales/catalogue/item/SeveralAndRegulatingOrders/?lang=en<br>Aquaculture RA<br>www.lle.gov.wales/catalogue/item/AquacultureResourceArea?lang=en | High | Figure 8.2, Figure 10.5 | ✓ |

| Topic | Core Datasets | Confidence assessment | Figure reference | Model inclusion |
|---|---|---|---|---|
| Fishing | MMO Fish landings provided by WG<br>These layers are based on MMO Sea Fisheries Statistics. WG have aggregated the datasets by species group and added spatial information.<br>Fishing Intensity<br>www.ices.dk/sites/pub/Publication%20Reports/Forms/DispForm.aspx?ID=35169 | Medium/High | Figure 8.7, Figure 8.8, Figure 10.5 | ✓ |
| Shipping | Ship routing measures, anchorage: Supplied by WG<br>Vessel density<br>www.data.gov.uk/dataset/vessel-density-grid-2015<br>RYA data: supplied by Welsh Government but is available from the RYA directly for a fee. | High | Figure 8.9, Figure 10.3, Figure 10.5 | ✓ |
| Heritage | World Heritage Sites<br>www.lle.gov.wales/catalogue/item/WorldHeritageSites/?lang=en<br>Protected Wrecks<br>www.lle.gov.wales/catalogue/item/CADWProtectedWrecks/?lang=en<br>Maritime Heritage Assets<br>www.lle.gov.wales/catalogue/item/NationalMonumentsRecordOfWalesMaritimeHeritageAssets/?lang=en | High | Figure 8.12, Figure 10.4, Figure 10.5 | ✓ |
| Seascape | Heritage Coasts<br>Lle – Heritage Coasts<br>www.lle.gov.wales/catalogue/item/ProtectedSitesHeritageCoast/?lang=en<br>National Parks<br>www.lle.gov.wales/catalogue/item/NationalParks/?lang=en<br>National Trails<br>www.lle.gov.wales/catalogue/item/NationalTrails/?lang=en<br>Country Parks<br>www.lle.gov.wales/catalogue/item/ProtectedSitesCountryParks/?lang=en | High | Figure 10.5 | ✓ |

## A.2. Data limitations/gaps

Data was reproduced from the SMMNR study,[41] detailing fish, bird, mammal and habitat constraints.

Stakeholder engagement has identified that war graves are a definite constraint to development. However, data on war graves are currently amalgamated with protected wrecks. Data identifying war graves specifically may help with micro-siting and consultation with those with heritage interests.

Data on fishing activity in Wales is limited and this SLG has focussed on ICES data. However, it is acknowledged that this data does not provide an accurate reflection of fishing activity, particularly static gear fishing which is not captured in the data available. More detailed and up to date data would help inform on this important sector and help developers engage with fishers from an early stage using more accurate data.

iVMS data is used for most of marine planning and project level assessment but it is only for vessels > 12 m. 90% of welsh fleet is < 12 m therefore there is currently a significant data gap for this sector. iVMS is being implemented on all commercial vessels < 12 m in 2021 so it is hoped this will help inform marine planning and development of projects. Until this data is available developers should consult fisheries representatives at as early a stage as possible, ideally at the site selection phase, so that important fishing areas can be identified.

Spoil Ground data was sourced from Cefas, in projection system WGS84. The authors caveat use of the data, requesting WGS84 to be retained as other projection systems can cause distortion. As the geospatial model is in British National Grid projection, spoil grounds were intersected without prior conversion from WGS84.

Raw RYA data was not available to this study; however, the data has been reproduced by Welsh Government directly.

## A.3. Data review

It is the intention of Welsh Government that the analysis and more specifically, the datasets that are used to derive the outputs, are reviewed at regular intervals to allow an opportunity to consider their ongoing suitability. Should more suitable data, or additional data to supplement and amalgamate with selected datasets become available, then these will be incorporated within the analysis accordingly.

41 gov.wales/sustainable-management-marine-natural-resources