

Information to support Environmental Assessment of tidal lagoon developments in Wales

Guidance note

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What is this document about?

This guidance has been produced by Natural Resources Wales (NRW) to provide advice to developers about the information needed to inform environmental assessments of tidal lagoon developments in Welsh waters. The document provides an overview of the key environmental implications of tidal lagoon development in Wales.

The guidance is not exhaustive and does not replace the need for detailed project-level assessments, because these will be needed to take account of case specific information. It also does not take the place of the dialogue that will be needed with NRW marine licensing or advisory teams and is not a substitute for any formal consultation on the scope of assessments that may be required by legislation.

Some effects can only be addressed by considering project design and location at an early stage. It is recommended that developers engage with NRW at the start of project planning to ensure that significant environmental effects and consenting risks can be understood and minimised early in the project planning and design process.

NRW has published generic guidance on [Scoping and Preparing an Environmental Impact Assessment for Marine Development](#) and [detailed guidance](#) on more technical matters. Wherever possible this document avoids duplication of that guidance by focusing on additional information that is specifically relevant to the assessment of tidal lagoons. This guidance should therefore be read in conjunction with our generic and technical guidance that is signposted throughout this document.

The guidance is divided into three parts. Part A provides an overview of the general issues relevant to assessments of tidal lagoons. Part B provides information to assist with the assessment of the implications of a project for environmental receptors. Part C provides guidance on the implications of tidal lagoons for other functions and uses of the marine environment that NRW advises on. **The three parts of the guidance are complementary and should be read together to ensure a full understanding of assessment requirements.**

This guidance is provided by the advisory arm of NRW and is without prejudice to advice NRW may give in response to consultation on an individual development, or decisions NRW may take in the determination of Marine Licences.

Before contacting us, we advise that you review the information and guidance available on our website. You can contact the following teams for further advice:

- [Development Planning and Marine Service](#) for advice from NRW as a consultee.
- [Marine Licensing](#) for advice about applying for a marine licence.

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Part A: General information

A1. Introduction

The tidal resource necessary for tidal lagoon development in Wales is concentrated in the Bristol Channel and Severn Estuary, and around the coast and estuaries of North Wales.

Tidal lagoons, even relatively small lagoons, are large infrastructure developments with large spatial footprints. They are likely to have effects on numerous receptors both within the footprint and potentially over large distances from the development itself because of the resulting changes to physical processes and impacts to species that are highly mobile.

The consenting process will require assessment of the impact of tidal lagoons upon a wide range of receptors and uses of the marine environment and must be based on robust evidence. It will therefore be a complex and lengthy process.

A2. NRW's roles and responsibilities

NRW has a wide range of functions and a list of our roles and responsibilities can be found on our website: [Natural Resources Wales / Our roles and responsibilities](#)

We have two main functions in relation to the assessment of individual tidal lagoon proposals:

- The determination of Marine Licence applications in Welsh waters by our Permitting Service. In doing so NRW consults its own technical advisors and a range of other organisations for advice on the potential implications of the proposal. More information about the marine licensing process is available on the NRW website: [Natural Resources Wales / Marine licensing](#)
- As a consultee to licensing authorities such as NRW (Marine Licence), the Secretary of State (DCO), local planning authorities (Town & Country Planning), providing advice on a wide range of environmental matters that will be relevant to the assessment of development proposals.

In certain locations NRW has responsibilities for fisheries, aspects of flood risk management and is a Statutory Harbour Authority in the Dee estuary. This guidance provides advice about the implications of development for these activities. NRW is also the landowner of parts of the coast and may need to issue leases for some activities in certain locations.

A3. Purpose and scope

The purpose of this document is to provide guidance to inform environmental assessments that are required to accompany licence applications for tidal lagoons by:

- describing the most likely environmental effects and the receptors that might be impacted
- identifying the key consenting risks from an environmental perspective

This guidance does not cover:

- advice on NRW's marine licensing or species licensing procedures which are already available on NRW's website
- the environmental implications of any terrestrial aspects of development (such as transport or onshore grid infrastructure) or other non-marine effects (for example on local air quality or other implications such as effects upon green spaces)
- the environmental implications of sourcing construction materials or waste handling
- specific advice on in-combination and cumulative effects
- the implications for commercial fisheries, except salmonid, eel and cockle fisheries managed by NRW
- advice on matters outwith NRW's statutory responsibilities as a consultee such as land management
- advice that would be provided by other consultees such as on local nature reserves, tourism and recreation, Registered Historic Landscapes or effects upon other users of the marine environment (such as shipping, ports, energy generation etc)
- other tidal range developments (for example tidal barrages)

This guidance identifies the environmental receptors that NRW consider are most likely to be affected by tidal lagoon development:

- physical processes
- subtidal, intertidal and coastal habitats
- fish and shellfish
- marine and coastal birds
- marine mammals
- water
- landscape and seascape

This guidance also summarises NRW advice on other relevant uses and functions in the marine environment that fall within NRW's responsibilities:

- flood risk management
- freshwater and migratory fisheries regulated by NRW
- cockle fisheries managed by NRW under regulating orders (Burry Inlet, Dee Estuary)
- management of safe navigation in the Dee estuary (the Dee Conservancy)

The effects described in this guidance have been selected on the basis of the broad requirements of tidal lagoons (for instance in shallow coastal waters or estuaries) and expert judgement about the receptors most likely to be affected. Although all the categories of receptors that NRW would advise on have been included, the individual species, habitat or water quality element that might be affected may vary depending on the nature, location and timing of individual project activities.

The pressures and impacts described in Part B will apply to varying degrees during construction, operation, maintenance and decommissioning. For each receptor [Annex 10](#) describes how the pressures apply at each development stage.

This guidance does not address in-combination or cumulative effects because they can only be meaningfully considered when the locations and individual effects of projects are known. However, given the scale of lagoon developments and possibility that effects may

occur over large distances, in-combination and cumulative effects are likely to be a significant consideration.

You can find out more about the assessment of in-combination and cumulative effects on our website: [Natural Resources Wales / What to include in your marine development scoping report for EIA](#)

A4. Summary of key considerations

Main environmental implications

- Typically, the main potential effects of tidal lagoons are loss or alteration of marine or coastal habitats, impacts on migratory and mobile species, changes to the physical environment and the consequent implications for flood risk management and areas designated for their importance for biodiversity, water quality, and landscape. Effects may occur over very large distances, including across boundaries and jurisdictions, and may act in combination with the effects of other developments and activities.
- There is often interdependency between marine receptors. In particular, the potential to affect physical processes on a large scale increases the likelihood of indirect effects on other receptors. Similarly, the impacts on one biodiversity receptor, for example fish, may have consequences for other receptors such as birds or marine mammals.

Potential benefits

- Depending on how the scheme is delivered, tidal lagoons may have benefits beyond providing low carbon energy, for example as a flood defence or as an opportunity for landscape or green infrastructure enhancement.
- However, the positive and negative effects upon individual receptors may be finely balanced and subject to locally specific considerations. The positive effects should therefore be clearly described alongside the negative impacts to corresponding receptors.

Evidence

- Licensing decisions must be based on robust assessments which in turn require good evidence. There are often gaps in the evidence needed for assessments, especially of novel technologies. This can hamper decision making and their early identification is recommended so that they can be addressed.

Consenting and assessment process

- Systematic, comprehensive and rigorous scoping of project effects is essential at an early stage of project design. The potential for widespread effects means that establishing the size of the zone of influence exerted by a pressure is an important first step in the assessment process.
- Adaptive management is a way of dealing with residual and unforeseen uncertainty, but it also raises complex issues especially for permanent structures where options for subsequent intervention may be limited. Further information on using adaptive

management for marine developments can be found on NRW's website: [Natural Resources Wales / Using adaptive management for marine developments](#)

- It may not be possible to mitigate all the environmental impacts of a tidal lagoon and derogations under environmental legislation may be required if the application is to be approved. Such derogations may be very challenging to deliver.
- NRW considers that due to the very long operational life of lagoons, decommissioning options can only be considered in detail close to the time of decommissioning itself. It cannot be assumed the removal would return the site to original condition and all options (removal, partial removal or retention) should be retained up until the time close to decisions about decommissioning.

A5. Consenting and assessment legislation

Tidal lagoon projects wholly within or straddling Welsh waters require permission for development from the appropriate authority and a Marine Licence from NRW under the requirements of the [Marine and Coastal Access Act 2009](#). The exact requirements and the determining authority will vary depending on development size and location. An [overview of the primary consenting arrangements](#) is available on the Welsh Government website. NRW also issues licences for activities that have implications for species protected under the Conservation of Habitats & Species Regulations 2017 and the Wildlife & Countryside Act 1981 (as amended). [Information about NRW's marine licensing process](#) and [advice on applying for a protected species licence](#) are available on our website. The planning policy framework set out by the Welsh National Marine Plan and UK Government National Policy Statements is described below.

Some receptors (biodiversity, water etc) are subject to specific legal protections which are described in the relevant receptor sections of Part B.

Other permissions may be required for tidal lagoons. For example, cross-border development may also require a Marine Licence from the Marine Management Organisation. A lease from The Crown Estate or other bodies, including from NRW if it is the landowner may be required. Local authority permissions for land-based activities, or permissions from Welsh Government may be relevant and any harbour development may require approval by the Department for Transport. These are not covered in this guidance and the relevant organisation should be contacted for more information

Legislation requires applications to be accompanied by various environmental assessments to help the licensing authorities take account of the environmental effects of a project. These assessments are briefly described below.

Environmental Impact Assessment

The [Marine Works \(Environmental Impact Assessment\) Regulations \(2007\)](#) (as amended) requires assessment of projects described by either Schedule 1 or 2 of the Regulations. Tidal lagoons are typically classified as Schedule 2 developments. Environmental Impact Assessment (EIA) is a process for identifying the positive and negative environmental effects of a proposed development. It applies to projects which are likely to have a significant effect on the environment due to their nature, size or location.

The Applicant is responsible for carrying out the EIA and for presenting the findings of the EIA in an Environmental Statement to the licensing authority alongside their application.

Habitats Regulations Assessment

The [Conservation of Habitats and Species Regulations \(2017\)](#) (hereafter referred to as the "Habitats Regulations") transpose the European Habitats Directive into UK law.

Regulations 63 and 64 describe the process, known as Habitats Regulations Assessment (HRA), for assessing the implications of a plan or project for European sites and European Offshore marine sites. This is a multi-stage process (screening for likely significant effects, detailed appropriate assessment and, potentially, derogation after assessing possible alternatives, overriding public interest and identification of suitable compensation).

HRA is carried out by the licensing authority as a Competent Authority under the Habitats Regulations. However, it is the responsibility of the applicant to provide the information that will be needed by the licensing authority to conclude these assessments. The information should be provided as a chapter of the Environmental Statement or as an annex or as a separate report to inform appropriate assessment that must accompany the application.

WFD Compliance Assessment

The Water Framework Directive (WFD) (2000/60/EC) is transposed into Welsh law by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, as amended (hereafter referred to as 'WFD Regulations'). To comply with objectives of the Water Regulations, a WFD Compliance Assessment must be carried out if the development interacts with any element of any water body, including hydrologically connected water bodies with biotic/migratory routes from the water body in which the development is located. Article 4 of the WFD establishes the principle to prevent deterioration and achieve good status/potential. If assessment shows there is a risk of deterioration, and/or the achievement of good status/potential could be jeopardised, then a project can only proceed if it meets the requirements of Regulation 19 of the Water Regulations.

The WFD Compliance Assessment should be carried out in three stages (screening, scoping and detailed assessment) to assess the pressures and how they impact the status and objectives of the water bodies they interact with.

A WFD Compliance Assessment is carried out by the licensing authority as a Competent Authority under the Water Environment Regulations. However, it is the responsibility of the applicant to provide the information that will be needed by the licensing authority to conclude these assessments. This information is typically provided as a WFD Compliance Assessment and submitted as a chapter of the Environmental Statement or as an annex that must accompany the application.

More information about the requirements of EIA, HRA and WFD Compliance Assessments can be found on our website: [Natural Resources Wales / Marine licensing](#)

EU guidance on EIA, HRA and WFD Compliance, and UK guidance that refers to procedures and requirements of the related Directives up until January 31 2020 remains valid following the UK's departure from the European Union.

Derogations

Where certain effects cannot be mitigated, derogations under the Habitats and Water Regulations may allow projects to proceed subject to legal tests and criteria.

Consideration of a derogation under the Habitats Regulations may only occur once an HRA has concluded that it is not possible to rule out an adverse effect on a site(s). A derogation under the Habitats Regulations may be considered where there are no alternative solutions if there are reasons of overriding public interest and where suitable compensation can be secured.

A derogation under the provisions of Regulation 19 of the Water Regulations will be required if the WFD Compliance Assessment concludes there is a risk of deterioration, from one status class to a lower one, for any element in any water body, as a result of the project, or that the project may jeopardise the attainment of the WFD objectives for any water body. To determine if development can proceed a series of tests will need to be applied to understand if the conditions of Regulation 19 can be met. The tests cannot be applied until a full WFD Compliance Assessment has been carried out, all potential impacts have been quantified and the assessment concluded.

Although the requirements of derogations under the Water and Habitats Regulations can only be established upon completion of impact assessments when the impacts of the project are confirmed, we strongly recommend discussion with licensing authorities and advisors about the potential requirement for a derogation early in the process. This will reduce the risk of the tests not being met through inadequate consideration of their requirements throughout the project, and insufficient information to apply them.

A6. Other relevant legislation and policy

This section describes additional legislation and policy that applicants will need to consider when preparing applications and assessments.

Welsh Government policy

In 2019, Welsh Government declared a climate change emergency. The Environment (Wales) Act 2016 requires Welsh Government to reduce greenhouse gas emissions in Wales by at least 80% by 2050. Welsh Government has established a target for 70% of electricity consumed in Wales to be met by renewable energy sources.

Welsh Government has also recognised the scale of loss of biodiversity and that there is a nature emergency. The [Nature Recovery Action Plan](#) emphasises the Sustainable Management of Natural Resources and the need to use good evidence to ensure that biodiversity loss is reversed whilst at the same time delivering renewable energy as a priority.

Wellbeing of Future Generations (Wales) Act (2015)

The [Well-being of Future Generations \(Wales\) Act 2015](#) defines sustainable development as the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the Sustainable Development Principle, to achieve the [wellbeing goals](#).

Environment (Wales) Act (2016)

The [Environment \(Wales\) Act 2016](#) is the framework for the Sustainable Management of Natural Resources (SMNR). It provides a statutory basis for implementing the ecosystem approach in Wales through the maintenance and enhancement of ecosystem resilience.

The primary legislative context for NRW's work is to deliver our purpose to pursue the Sustainable Management of Natural Resources. The objective of SMNR is to:

- 'maintain and enhance the resilience of ecosystems and the benefits they provide and, in so doing:
- (a) meet the needs of present generations of people without compromising the ability of future generations to meet their needs, and
 - (b) contribute to the achievement of the well-being goals in section 4 of the Well-being of Future Generations (Wales) Act 2015.'

The act also sets out duties and responsibilities for Welsh Ministers to meet targets for reducing emissions of greenhouse gases from Wales to mitigate the effect of climate change.

Welsh National Marine Plan

The Welsh National Marine Plan (WNMP), adopted in November 2019, provides an integrated set of objectives and policies for the sustainable development of Welsh seas. It provides the strategic policy framework to support integrated decision making that takes account of environmental, social and economic issues and therefore plays a key role in the delivery of the objectives of the Environment Act and Well-being of Future Generations Act in Welsh seas.

The WNMP contains general policies and sector-specific policies related to particular activities. Applicants are responsible for ensuring their proposals are in accordance with the WNMP although relevant authorities are responsible for assessing whether proposals are compliant with the WNMP.

Through [Policy ELC 04: Low carbon energy \(supporting\) tidal range](#), the WNMP recognises the significant tidal range resources around the Welsh coast and the need to consider all viable marine energy policy options to support decarbonisation. However, it also acknowledges the complex nature of tidal range developments and the uncertainty about environmental impacts and recognises the need for the development of strategic evidence to support understanding of environmental constraints and opportunities for sustainable use of the tidal range resource.

Restoration and enhancement

The Environment (Wales) Act 2016 and WNMP encourage restoration and enhancement of marine ecosystems. Inclusion of restoration and enhancement as part of marine developments is a relatively new consideration for developers, decision makers, and for NRW advice, and NRW has developed guidance focussed on a set of five core principles to provide a starting point for meaningful discussions with project developers. Early discussion with NRW is encouraged to evaluate potential proposals for restoration and enhancement. The NRW guidance is available on request and builds upon Welsh Government's WNMP [Implementation Guidance](#) which also covers the topic.

Future Wales: The National Plan 2040, Planning Policy Wales and Technical Advice Notes

[Future Wales](#) and the WNMP work together to provide a framework for the management of change around our coast. Co-ordination between marine and terrestrial planning is important to sustain and facilitate the development of port, harbour and marina businesses and associated enterprises; coastal communities; tourism opportunities; energy generation; and seascapes.

[Planning Policy Wales](#) is the land use planning policy document that establishes key planning principles for Wales.

Planning Policy Wales is supported by [Technical Advice Notes](#) that deal with policy issues that planning needs to address to shape development to deliver the best outcomes.

Although these policy documents primarily focus on land use planning matters which are outside the scope of this guidance, they may be relevant to terrestrial and coastal aspects of development. Technical Advice Notes covering policy matters that may be of particular relevance include Coastal Planning (TAN 14) and Development and Flood Risk (TAN 15).

National Policy Statements for energy

[National Policy Statements \(NPS\) for energy infrastructure](#) set out the UK Government objectives for the development of nationally significant (energy) infrastructure projects (NSIPs) via a Development Consent Order (DCO). DCO's are issued by the relevant UK Secretary of State under the Planning Act 2008 and the process is administered by the [National Infrastructure Planning](#) arm of the Planning Inspectorate. An overarching energy NPS is accompanied by a suite of NPSs covering individual energy sectors and although there is no statement that covers tidal range specifically, the overarching statement is applicable.

The Planning Inspectorate publish advice notes on a range of procedural matters relevant to applications for NSIP projects: [Advice notes | National Infrastructure Planning \(planninginspectorate.gov.uk\)](#)

Under the reserved powers model, only renewable energy projects that are above 350MW qualify as NSIPs in Wales.

A7. Evidence gaps

Development consent and Marine Licence determinations must be based on robust evidence and NRW can provide advice about any existing information and data that might be available (links to relevant information sources are provided in Part B).

However, there are often gaps in the evidence that is required to inform assessments. Information about the distribution, abundance, behaviour and impact sensitivity of many biodiversity receptors, physical processes (hydrodynamics, sediments and geology, and topography/morphology) and other physico-chemical parameters (such as, temperature, salinity, water quality etc) is often incomplete or unavailable. Similarly, information about effects on seascape character or uses of the marine environment may not be readily available. Existing information may also be out of date. Use of existing information is always the best first step but environmental data may need to be collected to characterise or monitor the baseline status of the receptors that may be affected.

Survey and assessment methodologies might also need to be developed and verified. The absence of empirical evidence about impacts of tidal lagoon development, and the specificity of local conditions mean that impacts of development infrastructure and activities on many receptors are often predicted using models that may need to be developed, verified or refined.

Similarly, some mitigation techniques may not be well-established and might need to be evaluated before they can be adopted.

A sector-wide analysis of the environmental evidence gaps that might hamper consenting has been published in the form of a [Forward Look](#) by the Offshore Renewables Joint Industry programme (Ocean Energy). A [State of the Science report](#) published by OES Environmental also provides useful information on environmental impact on various receptors from marine energy technologies although this is not specific to tidal lagoons.

Early discussion with NRW about the evidence requirements is encouraged to confirm and agree data gathering, modelling and assessment methodologies.

Evidence Plans are a formal mechanism for agreeing the information that applicants should provide in support of their applications. The approach was formally adopted in guidance that applies in England only, but they have been adopted for some projects in Wales and NRW encourages their use to assist with:

- adequately scoping out / down less significant issues to focus on the remaining critical issues as assessments and licensing procedures evolve
- ensuring discussions between parties are more structured and efficient
- allowing NRW (and other key stakeholders) to be able to engage early on to ensure that key issues are embedded into the assessments at the right time
- enabling NRW to forward plan the allocation of time and resources of staff and define the scope of Discretionary Advice Service (DAS) agreements.

A8. Information sources and guidance

Generic advice on the [scope of an EIA](#) for marine development is available on NRW's website. This includes explanation of related assessments, such as HRA and WFD Compliance Assessments.

NRW's website also hosts a sector [landing page for marine energy development](#) which signposts other guidance and information to support the preparation of assessments. These pages also provide contact details for NRW's advisory and permitting teams.

Interactive maps and spatial data about the environment of Wales are available on the Welsh Government data portal: [Home | DataMapWales \(gov.wales\)](#)

Practical advice about the ecological assessment of development is provided in [Guidelines for Ecological Impact Assessment](#) published by the Chartered Institute of Ecology and Environmental Management.

In siting and designing prospective sites, developers are also encouraged to consult other key data and information sources such as the [Marine Data Exchange](#).

The [Severn Tidal Power Feasibility Study](#) also remains a valuable source of information about the effects of tidal range developments.

Planning policy, advice and guidance for projects that qualify as Nationally Significant Infrastructure Projects is available on the [Planning Inspectorate website](#)

Topic-specific Information Notes published by Welsh Government the current state of science and evidence that underpins the assessment of selected matters relevant to marine renewable energy developments in Wales. Although mainly aimed at wave and tidal stream development, the notes will also be relevant to other technologies, including tidal lagoons. The information is generic and advice on these issues for individual projects may change depending on case specific circumstances and as the evidence base is continues to evolve. They include the views of NRW's advisory arm but do not prejudice NRW's future advice on specific project applications and should not replace any required, project-specific engagement between project developers, consultants, NRW and their statutory consultees. The notes will be available shortly on the Welsh Government website but are available upon request in the meantime.

Links to additional receptor or marine use-specific information sources are also provided in Parts B and C.

Part B. Implications for key receptors

General pressures and impacts

Tidal lagoons have the potential to exert a wide range of pressures upon the marine environment such as:

- habitat loss or change
- changes to physical processes
- changes to distribution and behaviour of species and populations
- changes to water quality
- changes to landscape and seascape

altering the effectiveness of natural and artificial flood and coastal defences.

As large and complex developments, the effects of lagoons may act:

- over large distances especially where there are effects upon physical processes or mobile species
- cumulatively and in-combination with the effects of other developments
- at different stages of development: construction, operation and decommissioning
- in the short or long term, depending on the pressure or the sensitivity of the receptor involved
- directly on a receptor and indirectly where an impact on one receptor has a resultant effect on another.

Lagoons can also have effects on other uses of the marine environment that NRW has responsibilities for including some fisheries, flood risk management and the Dee Conservancy.

The following sections provide advice on the individual receptors that may be affected. All the categories of receptors that NRW would advise on have been included and the most vulnerable species, habitat or water quality element that might be affected have been identified. However, the receptors that might be impacted by individual schemes may vary depending on the nature, location and timing of individual project activities. For some categories of receptor (for example fish), it is not possible to discount impacts on some species because there is insufficient data about their distribution. NRW encourages early discussion to determine exactly which receptors will be relevant to individual projects.

These sections identify the pressures that are likely to be relevant to tidal lagoon development. For biodiversity receptors these have largely been drawn from established pressure matrices available from [MarLIN - The Marine Life Information Network - MarESA pressures and benchmarks](#) supplemented by additional pressures based on NRW technical advice. For non-biodiversity receptors the pressures have been compiled based entirely on NRW technical advice. A more detailed breakdown of the pressures that apply to individual features are provided in Annexes 1-10.

B1. Physical processes

Receptor characterisation

Physical processes are a combination of hydrodynamics, sediments and geology, and topography/morphology of the seabed. Tidal lagoons can affect physical processes both directly and indirectly by changing the hydrodynamics (waves, currents and water levels), altering sediment transport and modifying the morphology of the seabed, intertidal and supra-littoral areas. These changes can often cause a rapid, 'shock like' rate of change rather than a gradual, progressive change in response to forcing factors.

Changes to physical processes have the potential to occur both within and outside of the development footprint and some may extend very significant distances from the development. An understanding of changes to physical processes is therefore a key determinant of the zone of influence and extent of the assessment envelope for a tidal range project.

Many receptors can be affected by changes to physical processes. Understanding changes to physical processes is therefore also key to the assessment of the vulnerability and sensitivity of other receptors, all of which are dependent on the physical environment.

Pressures and impacts

The list below set out what needs to be considered when assessing the effects on physical processes. They describe how proposals might affect hydrodynamics, sediment transport, sediment plumes and sediment budgets and the implications for seabed composition and morphology. Effects will include changes to:

- suspended sediment concentrations
- sediment distribution and topography
- sedimentation rates
- sediment regime/supply
- emergence regime changes, including tidal level
- wave climate
- water flow (hydrodynamics, tidal current etc), including sediment transport considerations
- wind-blown sand transport
- coastal squeeze

The above pressures will impact physical processes by altering the seabed, tidal range/water levels, wave and current regimes, and patterns of erosion and accretion. These impacts are likely to be complex and potentially long lasting. The relationship between pressures, impacts and the proximity to lagoon development is [described in Annex 1](#).

Interactions with other receptors

Changes to the physical environment can lead to impacts on other receptors within defined zones of influence, such as by:

- changing erosion and deposition patterns affecting habitat colonisation

- altering sediments and affecting biodiversity that is reliant on specific sediment composition for feeding, shelter and reproduction
- changing planktonic composition and patterns of larval supply
- reducing light availability for photosensitive species
- altering sediment supply to coastal areas changing flood risk profiles
- changing the character and appearance of the landscape/seascape
- sediment resuspension leading to turbidity and remobilisation of contaminants
- changing flow patterns, affecting species migration.

The potential effects of physical processes on other receptors are addressed in the subsequent receptor chapters.

Sources of data and information

We recommend consulting NRW's guidance on [Marine physical processes and Environmental Impact Assessment \(EIA\)](#)

This covers the need for baseline survey, monitoring and numerical modelling requirements for major development projects in marine, coastal and estuarine environments.

We also recommend consulting NRW's Guidance Note 062 on the Assessment of Coastal Squeeze, and NRW's position (PS 012) on the Sustainable Management of Marine and Coastal Sediment, both of which are available on request.

B2. Water

Management of the water environment is governed by legislation derived from European Directives.

[The Water Framework Directive \(WFD\) \(2000/60/EC\)](#) is transposed into Welsh law by the [Water Environment \(Water Framework Directive\) \(England and Wales\) Regulations 2017](#), as amended (hereafter referred to as 'WFD Regulations'). These regulations provide for the implementation of the WFD, from designation of all 'surface waters' (rivers, lakes, coastal and estuarine waters) and groundwater as water bodies, through to achieving good ecological status or potential. NRW is a Competent Authority for implementation of the WFD in Wales.

In addition, some surface waters require special protection under other European legislation and the WFD ensures compliance with a range of other European Directives. [The Bathing Waters Directive \(2006/7/EC\)](#) is designed to protect human health from bacterial pollution in bathing waters. [The Urban Wastewater Treatment Directive \(91/271/EEC\)](#) aims to protect the environment from sanitary discharges. The Nitrates Directive (91/676/EEC) aims to protect the water environment from the release of nitrates from diffuse sources. Shellfish waters provide protection from contamination by reducing bacterial loads and are managed by the WFD since the Shellfish Waters Directive (2006/113/EC) was repealed. These Directives establish protected areas to manage water, nutrients, chemicals, economically significant species and wildlife.

Since the Nitrate Pollution Prevention (Wales) Regulations (2013) were revoked and replaced by the [Water Resources \(Control of Agricultural Pollution\) \(Wales\) Regulations 2021](#), Nitrate Vulnerable Zones (NVZs) are no longer designated in Wales. The new

regulations were applied across Wales from 1 April 2021 but allow for transition periods for farms that were not previously in NVZ areas.

Water and sediment quality

Receptor characterisation

Water quality is based on parameters such as water clarity (turbidity), temperature, salinity, oxygen levels, nutrients, microbial pollution, acidity and contaminants such as metals and chemicals. Changes in water quality affect most other receptors (biological, hydromorphological) in the marine environment.

Water quality should be assessed at a water body scale within the WFD Compliance Assessment and can be assessed at a more local level for HRA subject to the size of the project's zone of influence. The Environmental Quality Standards Directive (EQSD)(2008/105/EC) allows for the provision of mixing zones where an EQS can be exceeded and any discharge where there will be a mixing zone should be assessed (including a thermal plume). Impacts to designated Bathing Waters, Shellfish Waters, UWWTD sensitive areas: eutrophic and NVZs will also need to be considered in assessments.

Contaminants can also be released from sediments when they are disturbed. Where sediment is to be disturbed it should be characterised in terms of grain size and contaminant content. Contaminant concentrations should be compared to CEFAS action levels. Impacts to the water body or site must be considered alongside impacts to hydrologically linked waterbodies or sites taking account of the extent of the zone of influence mediated by physical processes.

Pressures and impacts

The key pressures for marine water quality in relation to tidal lagoons include:

- water quality changes (incl. eutrophication)
- changes in suspended solids (water clarity)
- changes to the saline / thermal regime of the water column
- impoundment of discharges (continuous or intermittent)
- disturbance of seabed contaminants
- risk of spills
- runoff from terrestrial developments
- the development of muddy shorelines at Bathing Beaches

These pressures can result in poor water quality which can cause long-term alterations to ecosystem functioning.

We recommend the applicant discuss the potential for impoundment of discharges with the relevant discharge permit holder and NRW.

Lagoons will have effects on water quality within and outside the lagoon footprint ([see Annex 2](#)) which could impact human health and biota in Bathing and Shellfish waters.

Interactions with other receptors

Physical processes, water quality, and biodiversity receptors are affected by changes in:

- salinity / temperature/ turbidity changes (water clarity in WFD)
- changes to oxygen and nutrient levels leading to eutrophication and mortality
- metals and chemicals can cause mortality, hindered reproduction, imposex, and bioaccumulation in various species
- bacterial contamination can bind to sediment and be released into the environment on disturbance
- altered water column mixing and stratification
- river flow and flooding where a barrage cuts across an estuary to hold back the river and tide.

Shellfish are particularly vulnerable to changes in water quality.

Sources of data and information

Bathing Water classifications can be found on the Bathing Water Explorer website. Further general information can be found on our [website](#) and the data underpinning the classifications can be obtained from NRW.

[Shellfish Water classifications can be found on the CEFAS website](#) and the [data can also be obtained from CEFAS](#).

UWWTD sensitive area GIS shapefiles can be obtained from [Welsh Government data portal: Datamap Wales](#).

[Guidance on assessing surface water discharges](#) can be found on the gov.uk website. Note there are coastal and estuarine specific sections.

CEFAS action levels are used in a weight of evidence approach to determine whether sediment can be released to the marine environment. These action levels consist of a lower and upper tier for various metals and contaminants such as TBT and PAHs. NRW should be consulted on appropriate action levels prior to sampling.

WFD quality elements

Receptor characterisation

There are two separate classifications for surface water bodies (including rivers, coastal and estuarine waters): ecological and chemical. The ecological status of a surface water body is assessed according to the condition of biological elements. Chemical status of a waterbody is assessed by compliance with environmental standards for chemicals that are listed in the EQSD, as amended by Directive 2013/39/EU, a 'daughter' directive of the WFD. The two main aims of the WFD are to prevent deterioration of the status of all water bodies and to protect, enhance and restore water bodies to Good Status/Potential.

WFD water body types covered by the 2017 Regulations include:

- Surface waters
 - all inland surface freshwaters – including lakes, canals and rivers

- all transitional waters (estuaries) – up to the Highest Astronomical Tide limit, which could be well-inland of the coast
- all coastal waters to one nautical mile (nm) offshore for ecological status (although projects based >1 nm offshore may still impact on water bodies), and to the limit of territorial waters which may extend up to 12 nm for chemical status to the Highest Astronomical Tide limit
- Groundwaters
 - all groundwater bodies

The WFD describes the quality elements that make up ecological status classification for surface water bodies. These are: hydromorphology, biology and supporting physico-chemical elements. The UK Technical Advisory Group (UK TAG) provides further information about the biological elements that apply to water body types.

Pressures and impacts

The key pressures on WFD quality elements are:

- water flow (hydrodynamic, tidal current etc) changes, including sediment transport considerations
- changes to the sediment regime/supply
- physical changes to waterbody (morphology, habitats etc)
- barrier to species movement/ connectivity
- water quality changes (incl. nutrient enrichment)
- collision/passage through static or moving objects not naturally found in the marine environment
- introduction or spread of invasive non-native species (INNS)

The pressures listed above are likely to result in direct alteration to the water body(s) and, or indirect effects to the WFD elements, including disturbance and barrier effects.

Interactions with other receptors

The above pressures can impact habitats through erosion, sedimentation, and changes to water quality, with consequent effects for marine organisms rely upon them.

The WFD Compliance Assessment will draw upon information gathered as part of the wider EIA, but this information must be interpreted to explain the effects on WFD elements at the water body scale for relevant WFD water bodies. Some supplementary information may need to be gathered to inform the WFD Compliance Assessment. There may be interdependence between WFD elements and other receptors, for example hydromorphology will be dependent upon physical processes and vice versa.

Sources of data and information

The main source of data for WFD water bodies in Wales is [WaterWatchWales](#)

[Clearing the Waters for All](#) (Water Framework Directive assessment: estuarine and coastal waters) is the UK Government's guidance for completing a WFD Assessment.

[Welsh Government data portal: Datamap Wales](#) provides spatial data on WFD water bodies and River Basin Management Plans.

The [RBMP overview annex](#) provides an overview of WFD and why it is important, information on water body types and how the water environment is characterised for the purposes of implementing the WFD Regulations.

For further information on surface water classification, classification tools and reference conditions, visit the [WFD UK Technical Advisory Group \(TAG\) website](#). UKTAG also provides guidance on the [designation of heavily modified water bodies](#) which dictates how they should be assessed and on the classification of Good Ecological Potential for Heavily Modified and Artificial water bodies.

[CIS 20](#) provides information on exemptions to the objectives of the WFD.

B3. Biodiversity

Marine biodiversity is often protected by specific legislation. This is derived from European and, or national legislation and applies to species and habitats i) as named features within protected areas designated for their nature conservation importance or ii) habitats and species that are protected wherever they are located.

In terms of protected areas, this advice focuses mostly on marine and coastal sites such as European Sites (Special Areas of Conservation, SACs, Special Protection Areas, SPAs, and Ramsar Sites) and Sites of Special Scientific Interest (SSSIs). There is also a single Marine Conservation Zone in Wales.

Under the UK Marine and Coastal Access Act 2009, SSSIs now legally form part of the marine protected area (MPA) network where they are considered to protect marine features. There are also SSSIs in Wales with marine features of interest that are designated MPAs.

An overview of the range of environmental protections which may need to be considered when applying for a marine development, and the legislation that underpins can be found in our guidance on [What to include in your marine development scoping report for EIA](#). The protections vary by receptor type and so are also described in the Receptor Characterisation sections for each biodiversity receptor below.

In addition to protection as a feature of a designated site, some species are classified as a European Protected Species (EPS) or under Schedule 5 of the [Wildlife and Countryside Act 1981](#) (as amended) (WACA). Assessments will need to consider potential implications for these species. Where it is not possible to avoid effects upon these species a licence may be required to avoid committing an offence under this legislation. There is more information about species licensing on NRW's website: [Natural Resources Wales / List of protected species](#)

The habitats and species identified below are those we consider most at risk of being affected by a tidal lagoon development. For some receptor categories, it is possible to be confident that a particular species or habitat is very unlikely to be affected (for example benthic habitats such as sea caves or oceanic fish species, such as blue shark). For other receptor categories, these are less easily distinguished and where this is the case complete listings of those protected species are given.

Section 7 of the Environment (Wales) Act (2016) requires Welsh Ministers to publish lists of species and habitats that are of particular significance to sustaining and improving the

biodiversity in Wales and the implications for these species may need to be assessed. The list of 'Section 7' species and habitats can be found on the Wales Biodiversity Partnership website: [Wales Biodiversity Partnership - Environment \(Wales\) Act \(biodiversitywales.org.uk\)](http://biodiversitywales.org.uk)

Sources of data and information

Some information sources are specific to the receptor type, in which case they are described under *Sources of Data and Information* in the sections below. However, some sources provide information relevant to all biodiversity receptors and these are listed here to avoid unnecessary duplication.

Information about MPAs in Wales can be found on the [Protected areas of land and seas](#) page of our website. '[Regulation 37](#)' advice provides management plans, conservation objectives and other advice associated with MPAs. NRW has also published [assessments of the condition of the features of MPAs in Wales](#). The [JNCC website](#) provides information about MPAs across the UK, including MPAs that are located further offshore.

[A List of Threatened and/or Declining Species and Habitats](#) has been developed under the OSPAR Strategy for the Protection and Conservation of Ecosystems and Biological Diversity to ensure protection of biodiversity that is at risk. Some benthic habitats and species in Wales are listed as threatened or declining.

NRW has also published information about the marine ecological datasets that are most relevant to assessments of marine developments: [Natural Resources Wales / Marine ecology datasets for marine developments](#). This information should be consulted in the first instance to find out about the data that is already available and how to obtain it.

Many of the pressures identified for each of the biodiversity receptors have been derived from the [JNCC Pressures-Activities Database \(PAD\)](#) which should be consulted for a more detailed explanation of each receptor.

Intertidal and subtidal benthic habitats and species

Receptor characterisation

Benthic habitats typically comprise sessile or semi-sessile seabed species or physical features that support biodiversity. There are seven fully marine SACs in Wales that have been designated for habitat features including two cross border sites in the Dee and Severn Estuaries. There are four coastal SACs which have qualifying marine features, and two SACs and five SPAs in Wales where benthic habitats are supporting elements of the features of sites designated for mammal and birds.

Section 7 benthic habitats and species include marine habitat features; some are included within Annex I of the Habitats Directive and are therefore features of SACs, but others exist outside of the designated sites network.

Whilst our advice specifically relates to habitats that are present as designated features of SACs, the overarching aim of the Habitats Directive is to achieve favourable conservation status of Annex I habitats and its typical species, and this aim relates to the entire occurrence of a habitat type within its natural range rather than applying only to the occurrences within the SAC network. NRW therefore advises that assessments should

also consider impacts on Annex I habitats outside of protected sites, to ensure compliance with the requirements of the Directive, and any effects mitigated as far as possible.

Pressures and impacts

Tidal lagoon development can exert the following pressures on benthic habitat:

- abrasion/disturbance/compaction of the surface substrate (seabed/Intertidal)
- barrier to species movement/connectivity
- changes in suspended solids (water clarity)
- deoxygenation
- emergence regime changes, including tidal level
- habitat structure changes - removal of substratum (extraction)
- contamination by Hydrocarbons, PAH's metals and other synthetic compounds and substances (solid, liquid or gas)
- introduction or spread of invasive non-native species
- litter
- water quality changes (incl. nutrient enrichment)
- penetration, disturbance and abrasion of the substrate below the seabed surface
- physical change (to another seabed, substrate or sediment type)
- physical loss of habitat
- salinity increase or decrease/change to stratification
- smothering and siltation rate changes (heavy and light)
- temperature change (increase or decrease)
- water flow (tidal current) changes, including sediment transport considerations
- changes to wave climate

These pressures can result in habitat loss or alteration and changes to community distribution, structure and function.

A description of the pressures that can affect individual benthic habitat types [is provided in Annex 3](#)

NRW recommend that any sensitivity assessment should use information provided by the [MarLIN MarESA data extract](#) as a starting point for identifying the sensitivity of individual biodiversity receptors to each pressure.

Interactions with other receptors

The close functional relationship with the physical environment means that any alteration of physical processes is likely to affect benthic habitats particularly:

- wave climate
- water flows and exchange
- energy in the water column and sediment transport regimes

Any impact assessment for benthic habitat receptors should therefore be closely linked with physical processes modelling to define the zone of influence and magnitude of impacts. Similarly, water and sediment quality are integral to healthy benthic habitat function and any changes to these can have implications for benthic habitats.

Benthic habitats are important for other receptors especially mobile species such as birds, mammals and fish that rely on habitat for:

- food and foraging
- spawning/mating
- juvenile life stages
- protection from predators.

Sources of data and information

Spatial datasets and maps showing the known distributions of benthic habitat receptors are provided in NRW's [Guidance on Marine Ecological Datasets](#). Links to original data sources are referenced where possible (including those available on the Welsh Government data portal: [Home | DataMapWales \(gov.wales\)](#))

NRW holds data layers describing the location of INNS that already occur in Wales. These can be obtained from NRW by completing an [online data request](#).

The above sources describe the known and indicative locations of benthic habitat features in Wales. However, the distribution of marine features is often unknown and existing data may need to be supplemented by additional surveying to understand the potential for impacts to occur.

NRW provides guidance on [Benthic habitat assessments for marine developments](#) which gives details of the types of information and surveys required for impact assessments.

There is uncertainty about the sensitivity of some habitats to some pressures. Links to evidence used for biotope pressure/sensitivity assessments are provided by MarLIN as part of the [MarESA programme](#). Not all pressures have been assessed for all features and component biotopes and these evidence gaps are highlighted on the MarESA website. The assessments also use pressure benchmarks that may not be appropriate for the scale, duration and nature of a proposed activity, and should be evaluated accordingly.

Coastal habitats

Receptor characterisation

Coastal habitats are subject to dynamic and often extreme conditions, such as exposure and high salinity. This gives rise to specialised and varied ecosystems, and the extent of maritime influence (tidal inundation or inputs of salt spray for example) is often reflected in distinct zones of vegetation. The geology of the coastline is a major influence on coastal habitats. Sand dune, saltmarsh and soft cliff habitat form on the mobile sediments of 'soft' coasts. More resistant hard coastlines support a range of maritime communities including crevice and ledge communities, maritime grassland and maritime heath.

There are of four main types of coastal habitat feature in Wales:

- saltmarsh
- sand dune
- sea cliff including cliff top habitats coastal grassland and heathland
- shingle and strandline

Coastal habitats support 14 Annex I habitats and there are 15 SACs in Wales where coastal habitats or species are A or B grade features. They also provide supporting habitat for SPA bird features and are included within 4 RAMSAR sites.

All the main coastal habitats in Wales are included on the list of Section 7 habitats. Only saltmarsh qualifies as an OSPAR habitat.

Pressures and impacts

The most significant pressures on coastal habitats include:

- salinity increase or decrease/change to stratification
- changes to sediment regime/supply
- emergence regime changes, including tidal level
- abrasion/disturbance/compaction of the surface substrate (seabed/Intertidal)
- water flow (tidal current) changes, including sediment transport considerations
- introduction or spread of invasive non-native species
- barrier to species movement/connectivity
- physical change (to another seabed, substrate or sediment type)
- direct/indirect loss of species

These pressures can lead to habitat loss or alteration and changes to community distribution, structure and function and may also contribute to coastal erosion. Habitat loss and change could also impact the coastal species reliant on the affected habitat. A description of the pressures that are relevant to individual coastal habitat features is [provided in Annex 4](#)

The [MarESA programme](#) provides an assessment of sensitivity but for saltmarsh only, and it is worth noting that some of the information is old and may need to be reviewed before including it in an assessment.

Interactions with other receptors

Alterations to coastal physical processes are likely to impact the ecological conditions to which coastal habitats are adapted leading to habitat loss or change. For example, declines in sediment supply could cause loss of pioneer communities or erosion of dunes and changes to wave climate has the potential to impact the distribution of some coastal vegetation communities.

Coastal habitats are important for many species groups including lower plants, vascular plants, reptiles, amphibians, birds, invertebrates and mammals by provision of foraging and breeding habitat and resting places. The species which rely on coastal habitats can include scarce and declining species which may be impacted by coastal habitat loss or change.

Alterations to coastal habitats can also change the character and appearance of the landscape or seascape, for example by changing sand dunes to coastal grassland or salt marsh to mudflats.

Sources of data and information

Further information on the marine ecological data that NRW holds including links to relevant Annex I habitat maps, Section 7 and OSPAR habitat and species maps and MPA boundaries are available in the NRW's [Guidance on Marine Ecological Datasets for Marine Developments](#). Note however that this only covers saltmarsh but not the other coastal habitats.

Interactive map layers of Section 7 and OSPAR habitats and species are available to view on the [Welsh Government data portal: Datamap Wales](#) (individual habitat maps can also be downloaded). OSPAR habitat maps for the whole of Europe are available from the [European Marine Observation and Data Network \(EMODnet\)](#) using the seabed habitat and biology data portals.

Fish

This section describes the fish species of nature conservation importance in Welsh waters which may be affected by tidal lagoons. Shellfish may be protected as benthic features of protected sites and may be important prey species for other biodiversity receptors (for example mammals, birds etc) and are therefore considered primarily in the Benthic Habitats section. Advice about impacts of tidal lagoons on commercial or recreational marine fisheries are outside the scope of NRW's responsibilities, however, NRW manage cockle fisheries and fisheries for Atlantic salmon, sea trout and European eel around the Welsh coast. The impacts of tidal lagoons on these fisheries are described in Part C.

Receptor characterisation

Numerous fish species in Welsh waters are of nature conservation importance because they are rare, threatened or important as food sources for other protected species. These include diadromous fish species, which migrate between freshwater and marine environment to complete their life cycle, and marine fish species which complete their life cycle in marine and estuarine waters.

There are five estuarine/marine SACs and eight riverine SACs with diadromous fish species as qualifying features and sub-features (Severn Estuary SAC). The Severn Estuary Ramsar site is also designated for its fish assemblage, which includes both diadromous and marine fish species. Both marine, estuarine and riverine sites should be considered, as the protected diadromous fish species make long distance migrations and may interact with developments even at some distance from the sites where they are designated.

Some diadromous and marine fish species are classified as EPS or under Schedule 5 of the Wildlife & Countryside Act 1981 (as amended) and some are also listed as Threatened or Declining by OSPAR or are listed under Section 7 of Environment Act (Wales) 2016.

Pressures and impacts

Pressures and impacts need to be considered both temporally and spatially to account for patterns in life cycle and behaviour and should consider immediate and long-term population level impacts.

The pressures from tidal lagoons that are likely to be most relevant to fish include:

- artificial light generation
- electromagnetic field generation
- barrier to species movement/connectivity
- direct/indirect loss of species
- habitat structure changes - removal of substratum (extraction)
- water flow (tidal current) changes, including sediment transport considerations
- collision/passage through static or moving objects not naturally found in the marine environment
- underwater noise and, or vibration
- water quality changes (incl. nutrient enrichment)

The above pressures could impact on the abundance, distribution and age-structure of fish species by causing mortality, injury, reduced migration or spawning success, reduced feeding or prey availability, reduced spawning or nursery ground habitat availability, or increased predation risk.

A description of the pressures that are relevant to individual fish species is [provided in Annex 5](#).

Interactions with other receptors

Changes to physical processes, water quality and benthic ecology receptors are likely to impact fish species. Changes to marine and diadromous fish species populations are likely to impact upon marine mammal and bird species, as well as recreational and commercial fisheries.

Sources of data and information

Further information on available data for fish is available on our website: [Natural Resources Wales / Marine ecology datasets for marine developments](#)

In addition, our website has a list of [UK fish protected by law](#)

David Clarke, Claudia Allen, Céline Artero, Lorna Wilkie, Ken Whelan, Dylan Roberts (2021). Acoustic tracking in Wales – designing a programme to evaluate Marine Renewable Energy impacts on Diadromous fish. NRW Report No: 553. [Acoustic tracking in Wales – designing a programme to evaluate Marine Renewable Energy impacts on Diadromous fish](#)

David Clarke, Claudia Allen, Céline Artero, Lorna Wilkie, Ken Whelan, Dylan Roberts (2021). Feasibility Study of Methods to Collect Data on the Spatial and Temporal Distribution of Diadromous Fish in Welsh Waters. [NRW Report No: 552. Feasibility Study of Methods to Collect Data on the Spatial and Temporal Distribution of Diadromous Fish in Welsh Waters](#)

Marine birds

Receptor characterisation

A wide range of bird species and assemblages are protected as features of SPAs and SSSI's. Impacts to bird populations that are not features of these sites may also need to be considered especially those listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). All wild birds, their nests and their eggs are protected under Section 1 of the Wildlife and Countryside Act 1981 (as amended).

A number of marine and coastal birds are listed under Section 7 of the Environment Act (Wales) 2016.

Pressures and impacts

Pressures and impacts need to be considered both temporally and spatially to account for patterns in life cycle and behaviour and should consider immediate and long-term population level impacts. SPA's and SSSI's most likely to be affected are those in close proximity to development, but high mobility of many species and the reliance on habitat outside the site means that effects at considerable distance from the site boundary may need to be considered.

Assessments will also need to consider those species that are part of a community assemblage where this is a designated feature of a site. EIAs for example will need to assess potential effects on regional and national populations.

The key pressures include:

- abrasion/disturbance/compaction of the surface substrate (seabed/Intertidal)
- barrier to species movement/connectivity
- changes in suspended solids (water clarity)
- collision/passage through static or moving objects not naturally found in the marine environment
- direct/indirect loss of species
- emergence regime changes (extraction of substratum)
- physical change (to another seabed, substrate or sediment type)
- physical loss of habitat
- smothering and siltation rate changes (heavy and light)
- water flow (tidal current) changes, including sediment transport considerations

The above pressures can lead to a wide range of impacts including mortality, sub-optimal foraging, changes to habitat and prey availability (fish and shellfish).

A description of the pressures that are relevant to individual bird species that are most likely to be affected is [provided in Annex 6](#).

Interactions with other receptors

There is particular sensitivity to changes to other receptors that are dietary components (e.g. fish and shellfish) and changes to supporting habitat caused by physical loss or changes in physical processes.

Sources of data and information

Further information on bird protections and species licensing can be found on the bird licensing pages of the NRW website: [Natural Resources Wales / Bird licences](#)

Identification of species vulnerability is best achieved by reference to Woodward *et al.* (2019), colony tracking studies in the scientific literature and the modelling results from the RSPB, FAME and STAR projects available at [RSPB Open Data](#).

MMO (2018). Displacement and habituation of seabirds in response to marine activities. A report produced for the Marine Management Organisation. MMO Project No: 1139, May 2018, 69pp

Waggitt, J.J., Evans, P.G.H., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., *et al.* (2019). [Distribution maps of cetacean and seabird populations in the North-East Atlantic](#). *Journal of Applied Ecology*, 57(2): 253-269.

Woodward I, Thaxter CB, Owen E, and Cook ASCP, 2019. Desk-based revision of seabird foraging ranges used for HRA screening. Report of work carried out by the British Trust for Ornithology on behalf of NIRAS and The Crown Estate BTO Research Report No. 724.

Marine mammals

Receptor characterisation

There are several marine mammal species regularly present in Welsh waters. The most common species are harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, minke whale and grey seal. European otter are also commonly present along many parts of the Welsh coast

There are two cetacean species (harbour porpoise and bottlenose dolphin) and one seal species (grey seal) common in Wales that are listed on Annex II of the Habitats Directive. These species are features of six SACs in Welsh waters. Numerous SSSI's in Wales are designated for marine mammal features for Bottlenose dolphin (2 SSSI's), Grey seal (11 SSSI's) and European Otter (10 SSSI's).

All cetaceans and European otter are listed on Annex IV of the Habitats Directive as EPS for which there is strict protection throughout their natural range in European territorial waters.

Seals are also protected under the Conservation of Seals Act 1970. A full description of the [conservation legislation for marine vertebrates in Wales](#) is available on the NRW website. European otter and several cetacean species are also on the Section 7 list. Harbour porpoise is on the OSPAR list of threatened and/or declining Species & Habitats.

Pressures and impacts

Pressures and impacts need to be considered both temporally and spatially to account for patterns in life cycle and behaviour and should consider immediate and long-term population level impacts.

The key pressures include

- abrasion/disturbance/compaction of the surface substrate (seabed/Intertidal)
- barrier to species movement/connectivity
- changes in suspended solids (water clarity)
- collision/passage through static or moving objects not naturally found in the marine environment
- contamination by Hydrocarbons, PAH's metals and other synthetic compounds and substances (solid, liquid or gas)
- deoxygenation
- disturbance from airborne noise
- habitat structure changes - removal of substratum (extraction)
- physical change (to another seabed, substrate or sediment type)
- physical loss of habitat
- salinity increase or decrease/change to stratification
- smothering and siltation rate changes (heavy and light)
- underwater noise and, or vibration
- underwater noise and, or vibration
- water flow (tidal current) changes, including sediment transport considerations

These pressures can lead to a wide range of impacts including injury and mortality, disturbance/displacement, loss or alteration of supporting habitat of the species, and impacts to prey and prey habitat.

A description of the pressures that are relevant to individual marine mammal species is [provided in Annex 7](#)

Marine mammals associated with SACs are thought to be part of much larger populations that occupy wider spatial areas known as Marine Mammal Management Units (MMMUs) that comprise functionally linked areas upon which the mammals depend. Impacts upon these populations are also assumed to potentially affect the SACs within these wider areas or MMMUs ([Management Units for cetaceans in UK waters \(January 2015\)](#)).

NRW consider MMMUs to be the most appropriate spatial scale for starting to assess marine mammal populations in HRA, although other approaches are also possible where adequately justified (NRW 2020b).

The following position statements are relevant for assessing marine mammal features in HRA. Applicants should use these to formulate assessments:

- [NRWs position on determining Adverse Effect on Site Integrity \(AEoSI\) for marine mammal site features in Wales](#) in relation to potential anthropogenic removals (mortality) from marine developments (NRW 2020a).
 - Describes the supporting evidence and rationale used to develop levels of permissible marine mammal mortality where only a small number of annual marine mammal removals are permissible in a MMMU before being unable to rule out an AEoSI.
- [NRWs position on the use of Marine Mammal Management Units for screening and assessment in Habitats Regulations Assessments for Special Areas of Conservation with marine mammal features](#) (NRW 2020b).
 - Describes the evidence supporting the use of MMMUs as the relevant spatial scale for HRA. Acknowledging that for some species these large areas can result in many SACs being screened into an assessment, NRW have developed a set of species-specific assessment principles that can be used to streamline the assessment process.

Although movements are confined to rivers, coast and very close inshore, European Otter can range over significant distances (typically up to 50km for males and 24km for females, Chanin, 2003) which should be taken into account when considering whether otters may be affected by a development.

Interactions with other receptors

All mammal species are reliant upon prey species and habitat of prey species (mostly fish prey: see fish section).

Grey seals depend on intertidal habitats (beaches, rocky shores, sea caves) as pupping, moulting and haul-out sites.

Sources of data and information

Additional guidance on [Marine Vertebrate Conservation Legislation in Wales](#) is available from the NRW website.

Detailed species accounts for Annex II marine mammal species of SACs in Wales can be found in the appendices of NRW (2020a).

Baines ME, Evans PGH (2012). Atlas of the Marine Mammals of Wales. 2nd Edition. Marine Monitoring Report No. 68. Countryside Council for Wales, Bangor.

Baines ME, Earl SJ, Pierpoint CJL, Poole J (1995) The west Wales grey seal census. CCW Contract Science Report No. 131. Countryside Council for Wales, Bangor

Carter MID, Russell DJF (2018) Seal habitat preference and distribution on the west and north UK coasts; interim report. Sea Mammal Research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-16-78.

Ecology of the European Otter, Conserving Natura 200 Rivers, Ecology Series 10, Chanin, P. (2003).

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Keily O, Lidgard D, McKibben M, Connolly N, Baines ME (2000) Grey seals: Status and monitoring in the Irish and Celtic Seas. Maritime Ireland/Wales INTERREG Report No. 3

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Lohrengel, K., Evans, P.G.H., Lindenbaum, C.P., Morris, C.W., Stringell, T.B. (2018). Bottlenose Dolphin Monitoring in Cardigan Bay 2014 - 2016, NRW Evidence Report No: 191, 162pp, Natural Resources Wales, Bangor. Available at:

<https://naturalresources.wales/evidence-and-data/research-and-reports/marine-reports/marine-and-coastal-evidence-reports/?lang=en>

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B4. Landscape and seascape

Receptor characterisation

NRW's advisory responsibilities are focussed on development proposals that affect National Parks and Area of Outstanding Natural Beauty (AONB), collectively referred to as designated landscapes. The scenic quality of coastal landscapes and sea views can be a key reason for the designation, where the seascape will form the setting for the area. The coast and seascape may also form a component of the setting of inland areas.

Landscape and seascape assessments should be included within the EIA and will need to consider the implications of any development, whether the development is located within or out with the designated landscape boundary. Assessments will need to evaluate the implications for seascape character and visual amenity of people experiencing the area. National Parks and AONBs have management plans that set out the purposes and special qualities of the area and which provide further information on the landscape and seascape characteristics and qualities to be conserved and enhanced.

The importance of all landscapes and seascapes is set out in the European Landscape Convention, of which the UK is a signatory. Definitions of terms and high-level working principles for landscapes are set out in the [European Landscape Convention](#).

The policy context for nationally designated landscapes is described in the Wales National Marine Plan (See Part A of this document) but also [Planning Policy Wales](#).

NRW recommends early discussion to resolve potential issues at an early stage of project design. This is especially important for addressing impacts to seascape and designated landscapes before development designs and layouts have become fixed.

Pressures and impacts

The main pressures exerted by tidal lagoons include:

- direct physical impacts
- noise, traffic and related human activity
- alteration of views

The above pressures could impact on the character, special qualities and use experience of a designated landscape.

The assessment of impacts on designated landscapes should refer to Marine Character Areas that highlight the key natural, cultural and perceptual influences that make the character of each seascape distinct and unique. More detailed locally based seascape character assessments will also be relevant

A detailed description of the pressures that may affect landscapes and seascapes is [provided in Annex 8](#).

Interactions with other receptors

Physical processes can change the character and experience of the landscape and seascape.

Changes to coastal habitats can alter character and experience. Mitigation, such as through habitat enhancement, can adversely affect landscape character although can also provide landscape enhancement.

Sources of data and information

[Marine Character Areas](#) (including published local seascape character assessments in Wales)

Most Local Planning Authorities and National Park Authorities have local landscape character assessments which have been informed by [LANDMAP](#) which comprises spatial landscape datasets to support decision-making.

Each National Park Authority and Area of Outstanding Natural Beauty publishes its own Management Plan, detailing the special qualities being conserved.

[Offshore Renewables - guidance on assessing the impact on coastal landscape and seascape \(pnnl.gov\)](#) (these cover wind, wave and tidal stream energy technologies but the principles are applicable to tidal lagoons)

[MMO1204 An Approach to seascape sensitivity assessment technical report for publication.pdf \(publishing.service.gov.uk\)](#)

[Guidelines for Landscape and Visual Impact Assessment \(GLVIA3\) | Landscape Institute](#)

[Landscape and seascape character assessments - GOV.UK \(www.gov.uk\)](#)

[Registered historic landscapes | Cadw \(gov.wales\)](#)

[Natural Resources Wales / LANDMAP - the Welsh landscape baseline](#)

Part C. Advice relating to other NRW functions

NRW has responsibilities for flood risk management, fisheries and navigation within the Dee Conservancy which may have implications for tidal range developments and that should be addressed within assessments.

As for the other environmental receptors, NRW's [Development Planning and Marine Service](#) should be contacted to discuss the implications of your development for the Conservancy.

C1. Flood risk

Characterisation

Tidal lagoon developments are likely to have implications for flood risk management. Assessments will need to consider the implications of lagoon development on coastal and estuarine flood risk, including the effects on coastal communities and on flood infrastructure.

Evaluations of the implications for Shoreline Management Planning under SMP2, alignment with TAN15 and flood risk defence schemes will also be necessary.

TAN15

New developments must fulfil the requirements of TAN15 to ensure that they do not exacerbate flood risk elsewhere. A [revised version of TAN15](#) is currently available to view via the Welsh Government website. This is due to come into effect as revised planning policy in June 2023. The revised TAN15 is supported by the [Flood Map for Planning](#), which will replace the current Development Advice Map in June 2023. This shows the projected risk of flooding taking account of climate change over the next 100 years.

Planning policy and the [National FCERM Strategy](#) are clear that defences are to protect existing communities/properties. It is important that the construction of any flood alleviation scheme, whether associated with a lagoon or not, should be to reduce the frequency of flooding to existing development and not to facilitate new development. Flood risk can be reduced but not eliminated. New development in coastal flood risk areas will be particularly vulnerable to future sea level rise and increased storminess. The building of a lagoon will not remove land from being at risk of flooding and therefore should not be seen as a way to build in flood risk areas.

Although there may be some increased flood risk benefits resulting from tidal lagoon development, this in itself is not sufficient justification to consider it a formal flood defence asset. It is unlikely a lagoon development would create a new TAN15 Defended Zone in the Flood Map for Planning unless this is formally agreed with the Welsh Government and meets their specified criteria.

Shoreline Management Plans (SMP2)

Lagoon developments may have different implications for shoreline management plans depending on the policy for an area. For example, a lagoon may be considered consistent with a 'hold the line' policy but not with a policy of 'managed realignment'. An assessment

based on detailed predictive modelling would need to be made using information about local and project parameters and compared with the policy requirements for relevant coastal cells (such as the need to maintain dune systems as coastal defences).

Should approval of any tidal lagoon project require significant areas of compensatory habitat to be secured under the requirements of the Habitats Regulations there is a risk that these requirements would be in conflict with other plans or projects that also need to secure compensatory habitat around the Welsh coast. This could have implications for Welsh Government's National Habitat Creation Programme, the mechanism for securing compensatory habitat required for delivery of Shoreline Management Plans and local Flood Risk Management Strategies, and also potentially for a number of other schemes that are required to deliver compensatory measures. There may be opportunities to work collaboratively to jointly deliver the compensatory requirements of multiple projects. However, this will require careful analysis of the residual effects of each project as they emerge.

Pressures and impacts

Any part of a lagoon project could have impacts on flood risk and coastal erosion dependent on location, construction methods and phasing but the main effects are likely to be during operation when walls are complete and water levels within the lagoon are raised. There may be significant implications for natural defences such as sand dunes.

Potential flood defence / coastal erosion impacts may include:

- changes to coastal processes/flow patterns (particular risk for dune systems and their effectiveness as flood defences)
- restricting the conveyance area for tidal flows within an estuary
- changes to sediment regime/supply
- fluvial / pluvial discharge into the lagoon
- the need for additional flood defence in the vicinity of lagoons caused by changes in water levels.

The above pressures will have impacts on coastal erosion, physical processes, sediment supply and other flood defences in the vicinity of the lagoon and further along adjacent coasts, potentially leading to increased flood risk elsewhere.

Impact predictions would need to be considered in detail as part of a Flood Consequences Assessment and based on predictive modelling of coastal processes, sediment transport, waves and hydraulics. Location specific assessment would need to take account of the full range of conditions, including an allowance for climate change over the lifetime of the development and the potential sources of flood risk.

The geographical extent of effects may be considerable, as demonstrated by some of the wave climate modelling undertaken as part of the Severn Tidal Power Feasibility Study.

The cumulative effects of multiple lagoon developments would need to be considered, especially if they are to be developed in adjacent locations or within a restrictive geographical feature such as an estuary where tidal flows share characteristics with fluvial flows. Modelling would need to consider effects throughout the estuary and potentially beyond, perhaps over very large distances, to reflect the extent of effects. NRW should be consulted on potential cumulative effects and flood modelling parameters when the location of the development is known as both aspects are location specific.

Design standards

If a lagoon is to be considered as a form of flood defence, the standard of design would need to be considered based on the use and responsibility for long term ownership, maintenance and management. Whether or not these benefits would outweigh any adverse impact on erosion rates or flood risk impacts elsewhere requires consideration of detailed project information and assessment. Typically, NRW would not advise on the design parameters for private defences.

Generally, new coastal flood defences will be built to a 1 in 200yr standard (0.5% probability), plus an allowance for sea level rise due to climate change. Even where a lagoon development is constructed to this standard, it is unlikely to be considered a formal flood defence on the flood map for planning unless it is formally agreed with the Welsh Government.

Flood risk benefits

Lagoons offer the potential to mitigate against coastal and fluvial flooding assuming water levels within the lagoon are kept at a sufficiently low level prior to predicted coastal surges and high fluvial flows (requires interventions by operators and close collaboration with flood forecasters such as NRW). The main benefits would be achieved through:

- reduced coastal / storm surge risks for land within the lagoon walls or immediate vicinity*
- reductions in wave height/energy due to the much reduced 'fetch' leading to reduced risk of over topping and therefore flood defence breach/failure (assuming lagoon walls have a sufficiently elevated crest to minimise overtopping during coastal/storm surges).

Interactions with other receptors

Changes to flood risk management infrastructure can impact on other receptors and users, in particular:

- Water Quality
- Physical Processes
- Landscape/Seascape
- Benthic habitats
- Shoreline Management Planning
- People, property and other infrastructure

Sources of data and information

Welsh Government guidance on [Climate change allowances and flood consequence assessments | GOV.WALES](#)

[Flood and coastal erosion risk management: adapting to climate change | GOV.WALES](#)

C2. Fisheries managed by NRW

Freshwater fisheries

Characterisation

NRW have statutory duties for managing freshwater and migratory fisheries principally under the Salmon and Freshwater Fisheries Act (1975), Water Resources Act (1995), the Environment (Wales) Act (2016) and the Eels Regulations (England and Wales) 2009.

Freshwater fisheries regulated by NRW include:

- recreational rod and line fisheries for Atlantic salmon, sea trout and European eel.
- commercial and heritage net fisheries for salmon, sea trout, and eel.

Pressures and impacts

The main pressures exerted by tidal lagoons include:

- direct loss of target species, no longer available to fishery
- economic impact from loss of associated income from angling tourism
- direct/indirect loss of species
- loss of revenue for commercial nets
- loss of revenue to rod fisheries
- loss of value of fishing rights

The above pressures can impact the productivity and viability of freshwater and migratory fisheries.

Annex 9 summarises how the Salmon, Sea trout and Eel fisheries might be affected by the above pressures.

Interactions with other receptors

These fisheries are sensitive to the loss of other species and habitats that target prey that act as food or supporting habitat. Altered coastal processes affect intertidal estuary access and restrict fishing locations

Changes to these fisheries have the potential to interact with the following:

- other fish and shellfish
- tourism
- heritage.

Sources of data and information

Stock assessments for Wales:

- [Natural Resources Wales / Salmon and sea trout stocks in Wales](#)
- [Assessment of Salmon Stocks and Fisheries in England and Wales in 2020](#)

- [Assessment of Salmon Stocks and Fisheries in England and Wales: Background Report 2020](#)

These are updated annually.

Rod and Net Catch Data

- [Salmonid and fisheries statistics for England and Wales](#)
- [Environment Agency Science Report: Method for Assessing the Heritage Value of Net Fisheries](#)
- [A Review of the Economic Value of Angling in Welsh Rivers \(2018\)](#)
- [An Economic Evaluation of Inland Fisheries. Science project SC050026/SR2](#)

Cockle fisheries

Receptor characterisation

The regulated cockle fisheries in the Burry Inlet and Dee estuaries, managed by NRW through the Burry Inlet Cockle Fishery Order 1965 and the Dee Estuary Cockle Fishery Order 2008.

Pressures and Impacts

The main pressures exerted by tidal lagoons include:

- changes in salinity impacting stocks or Shellfish hygiene classification
- changes in water quality impacting stocks or Shellfish hygiene classification
- direct and indirect loss of access to fishing grounds
- direct loss of target species, no longer available to fishery.
- direct loss of cockle contributing to population supporting the fishery
- direct loss of intertidal and subtidal habitat for cockle
- loss of Income (cockle industry)
- indirect loss due to changes in physical processes
- loss of Licences
- loss of revenue (cockles).

A description of the pressures that are relevant to individual features of the cockle fishery is [provided in Annex 9](#)

Interactions with other receptors

- altered coastal processes affect intertidal estuary access and restrict fishing locations
- benthic habitat and species
- water quality including shellfish water standards
- birds

Sources of data and information

- [Burry Inlet management plan: Cockle Fishery Order 1965](#)

- [Dee Estuary Cockle Fishery Order \(2008\) management plan](#)
- [COCKLES PROJECT | \(cockles-project.eu\)](#)

C3. Dee Conservancy

NRW is the conservancy, harbour and local lighthouse authority for the much of the Dee estuary. NRW promotes safe navigation and good management of the Dee Conservancy by:

- Undertaking and regulating marine operations in a way that safeguards the Conservancy, its users, the public, and the environment to meet the requirements of the Port Marine Safety Code.
- Promoting its use and ensuring that its economic development considers and balances the views and needs of all stakeholders with the use of natural resources and conservation of the environment.

Receptor characterisation

The area includes the River Dee and its estuary, extending from Wilcox Point downstream of the weir at Chester, seawards to an imaginary line linking the Point of Ayr on the Welsh coast to Hilbre Point on the Wirral peninsula.

Pressures and impacts

Key pressures include:

- changes to physical processes that alter hydrological regimes of the estuary
- water flow (hydrodynamics, tidal current etc) changes, including sediment transport considerations
- creation of hazards and obstacles
- interactions with shipping and other vessel movements

The above pressures can result in impacts to safe and effective navigation, biodiversity supported by the estuary, other uses of the estuary such as recreation and the cockle fishery supported by the estuary.

Sources of data and information

NRW has published [Marine Safety in the Dee Conservancy](#) which describes the Conservancy functions, the role of NRW and the features and uses of the Conservancy that might be affected by lagoon development.

Additional background information about the Conservancy is available on NRW's website: [Natural Resources Wales / Information for mariners using the Dee Conservancy](#)

Glossary

Adverse Effect on Site Integrity (AEoSI) – Referred to in Article 6(3) of the Habitats Directive to describe a negative effect upon site integrity. The integrity of a site is defined in Managing Natura 2000 guidance as: “the coherence of the site’s ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified”.

Annex I Habitats – Habitats identified in Annex I of the Habitats Directive as in need of conservation and listed in Annex I of the Directive.

Annex II Species – Species identified in Annex II of the Habitats Directive as in need of conservation and listed in Annex II of the Directive.

Annex IV Species – European Protected Species (EPS) identified in Annex IV of the Habitats Directive as subject to strict protection across their entire natural range.

Appropriate Assessment – An assessment required by the Habitats Directive where a plan or project would be likely to have a significant effect on a European site, either alone or in combination with other plans or projects.

Cumulative and In-combination Effect – the effects of an activity that are amplified by other effects or that combine with the effects of other developments or activities.

Ecosystem Resilience – The capacity of ecosystems to deal with disturbances, either by resisting them, recovering from them, or adapting to them, whilst retaining their ability to deliver services and benefits now and in the future.

Environmental Impact Assessment (EIA) – An assessment of a project’s likely significant environmental effects required for certain projects by the EIA Directive. This helps to ensure that the predicted effects, and the scope for reducing them, are understood by the public and the relevant authority before it makes its decision.

Habitat – An ecological or environmental space/area that is inhabited by a particular organism or ecological community. It is characterised primarily by its physical features and secondarily by the species of plants and animals that live there.

Habitats Regulations Assessment – the process of considering the effects of developments or other activities upon European sites (SACs and SPAs, but also including Ramsar Sites) in accordance with Article 6(3) and Article 6(4) of the Habitats Directive.

Invasive Non-Native Species (INNS) – Plants, animals, fungi and microorganisms whose introduction and/or spread outside their natural past or present ranges pose a risk to biodiversity or have other unforeseen negative consequences.

Marine Conservation Zone (MCZ) – MCZs are designated under the Marine and Coastal Access Act 2009 to protect any marine species, habitats, or geological feature of interest.

Marine Protected Area (MPA) – Defined geographical areas of the sea identified for the protection of marine habitats and species. They cover a wide range of marine wildlife, including rare and sensitive habitats and species that have been designated under EU and/or UK legislation for specific biological or geological features. SACs, SPAs, SSSIs, MCZs and Ramsar Sites that have marine features are all categorized as MPAs.

OSPAR – The OSPAR Convention (1992) concerns itself primarily with strategies to control pollution in order to protect marine ecosystems and biodiversity. Decisions adopted

by OSPAR are legally binding for the contracted parties. OSPAR has produced a List of Threatened and/or Declining Species and Habitats. Wales lies in OSPAR region III.

Pressure – Activities that have the potential to have adverse effects on the environment.

Ramsar – A wetland area designated for its conservation value under the 1971 Convention on Wetlands of International Importance, especially as Waterfowl Habitat. The Ramsar Convention promotes the conservation of listed wetlands and their wise use.

Section 7 Habitat/Species – the living organisms of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales and are identified in lists of priority habitats and species in Wales as required by Section 7 of the Environment (Wales) Act (2016).

Sensitivity – a measure of the ability of a species or habitat to withstand or recover from change resulting from a pressure.

Site of Special Scientific Interest (SSSI) – SSSIs are notified under the Wildlife and Countryside Act for certain species and habitats and are legally protected from damage through development, unsuitable management or other activities. SSSIs now legally form part of the marine protected area network where they are considered to protect marine features.

Special Area of Conservation (SAC) – Areas designated under the Habitats Directive for habitats and species listed in Annex I and II of the Directive.

Special Protection Area (SPA) – areas designated under the Birds Directive for birds listed in Annex I of the Directive also providing special conservation measures to protect habitats for vulnerable species and to regularly occurring migratory species.

Sustainable Management of Natural Resources – Using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide, in doing so, meet the needs of current generations without compromising the ability of future generations to meet their needs, and contribute to the achievement of the well-being goals set out in the Well-being of Future Generations Act. Also referred to as sustainable management.

Water Framework Directive Compliance Assessment – An assessment carried out on any new project or activity to determine whether it will prevent achievement of the management objectives of waterbodies.

Welsh Waters – Welsh inshore waters and estuaries (landward boundary at Mean High Water Spring tide out to 12 nautical miles) and Welsh offshore waters (12-200 nm, or to the median line between countries).

Zone of Influence – the area of the seabed or foreshore that could be affected by the proposed development or activity, during both construction and/or operation.

Annex 1: Physical processes

Table 1: Pressures and impacts relevant to physical processes in the lagoon, outside the lagoon/in the estuary, and outside the lagoon/open coast.

Pressure	Impact	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Water flow (tidal current) changes – local (including sediment transport considerations)	Magnitude, timing and pattern of flood and/or ebb current speeds and directions to change	YES	YES	YES
Water flow (tidal current) changes – local (including sediment transport considerations)	Effects on phasing and timing of tidal cycle	YES	YES	NO
Water flow (tidal current) changes – local (including sediment transport considerations)	Alteration of the tidal prism	NO	YES	NO
Water flow (tidal current) changes – local (including sediment transport considerations)	Tidal lagoon provides a new hard edge leading to channel width restriction and increased current velocities	NO	YES	NO
Water flow (tidal current) changes – local (including sediment transport considerations)	The lagoon may act like a new static headland, realigning current flow patterns and sediment transport processes around the structure, changing coastline morphodynamics as the coast realigns itself	NO	NO	YES
Water flow (tidal current) changes – local (including sediment transport considerations)	Tidal currents will increase along lagoon wall boundaries increasing scour and potentially undermining the lagoon wall	NO	YES	YES

Pressure	Impact	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Water flow (tidal current) changes – local (including sediment transport considerations)	Higher flows through the lagoon opening (turbines/sluices) causing eddies and scour and the need for scour protection	YES	YES	YES
Water flow (tidal current) changes – local (including sediment transport considerations)	Reduction in tidal currents will draw sediment into lagoon resulting in settlement potentially requiring maintenance dredging and disposal	YES	NO	NO
Water flow (tidal current) changes – local (including sediment transport considerations)	Modification of waves, tides and currents leading to interruption or change to natural sediment supply to nearshore areas	YES	YES	YES
Water flow (tidal current) changes – local (including sediment transport considerations)	High magnitude water jet conditions may induce counter-rotating eddies close to the turbines similar to rip currents and may interfere with other socio-economic activities within the lagoon such as sailing and swimming.	YES	YES	NO
Water flow (tidal current) changes – local (including sediment transport considerations)	Modified flows changing the movement of sands and muds and the potential for large scale morphological change which may affect associated ecology	YES	YES	YES
Water flow (tidal current) changes – local (including sediment transport considerations)	Changes in flows and the implications for changes in siltation and consequences for port dredging and commercial aggregate extraction.	NO	YES	NO

Pressure	Impact	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Water flow (tidal current) changes – local (including sediment transport considerations)	A two-way generating lagoon will generally lead to lower peak water elevations and therefore reduced flood risk for the impounded coastline. Flood risk may increase outside the lagoon.	YES	YES	YES
Emergence regime changes – local (includes tidal level change considerations)	Changes to water levels near field and far-field depending on lagoon size	YES	YES	YES
Emergence regime changes – local (includes tidal level change considerations)	Increased low tide water levels restricting drainage from outfalls, rivers, surface water and land drains	YES	NO	NO
Emergence regime changes – local (includes tidal level change considerations)	Changes in water levels may affect navigation, lead to a change in intertidal habitats, alter flood risk and modify the propagation of the tide upriver.	YES	YES	YES
Wave exposure changes - local	Lagoon structure will cause wave reflection effects and alteration to wave transformation processes and wave focussing on adjoining/nearby coastline	NO	YES	YES
Wave exposure changes - local	Longshore sediment transport interruption leading to upstream sediment build up and potential starvation downstream	NO	YES	YES
Wave exposure changes - local	Reduced fetch length restricting wind wave growth. Wave heights reduced, refocussing wave impacts to the coastline. Potential for coastal stabilisation.	YES	NO	NO

Pressure	Impact	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Wave exposure changes - local	The lagoon wall provides flood protection for the impounded area as it reduces the wave and wind action (or energy) impacting on the impounded coastline	YES	NO	NO
Permanent Physical change (to another substratum type)	Potential change from coarser to finer sediment due to settling	YES	YES	NO
Permanent Physical change (to another substratum type)	Potential change in sediment type and distribution due to hydrodynamic change.	YES	YES	YES
Habitat structure changes - removal of substratum (extraction)	Sediment supply to nearby receptors (including the coast and any nearshore banks) as well as the overall sediment budget may be altered through removal of material from the sedimentary system i.e. sediment is drawn into the lagoon and deposited through settling	YES	YES	YES
Abrasion/disturbance at the surface of the substratum	Capital and/or maintenance dredging requirements may lead to abrasion/disturbance affecting ecology/benthic habitats	YES	NO	NO
Penetration and/or disturbance of the substratum below the surface	Geotechnical investigations and construction activities may lead to penetration/disturbance below the surface affecting ecology/benthic habitats	YES	YES	YES
Changes in suspended solids (water clarity)	High concentration sediment plumes during capital or maintenance dredging or from construction activities	YES	YES	YES

Pressure	Impact	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Smothering and siltation rate changes (depth of vertical sediment overburden)	Deposition from sediment plumes during capital or maintenance dredging or from construction activities	YES	YES	YES
Other Pressures	The presence of the lagoon may affect windblown sand and therefore the behaviour of coastal sand dunes.	YES	YES	YES
Other Pressures	The potential for coastal squeeze resulting from the interaction between the lagoon wall and any existing coastal structures within the lagoon and rising sea-levels	YES	YES	YES

Annex 2. Water and sediment quality

Table 2: Pressures and impacts relevant to water and sediment quality.

Sensitivity	Pressure	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Eutrophication	Altered mixing and flushing potentially impacting on Dissolved Inorganic Nitrogen (DIN).	YES	YES	NO
Eutrophication	Altered mixing and flushing reducing dissolved oxygen (DO) in the water column.	YES	YES	NO
Eutrophication	Excessive growth of algae and decomposition causing reduced oxygen in sediment and water column.	YES	YES	NO
Eutrophication	Altered long-term turbidity impacting on DO in water column	YES	YES	NO
Eutrophication	Altered long-term turbidity light penetration and photosynthesis.	YES	YES	NO
Eutrophication	Changes to the salinity and temperature regime of a waterbody, altering flushing and mixing properties and potentially leading to stagnation.	YES	YES	NO
Eutrophication	harmful algal blooms	NO	NO	NO
Saline / thermal regime	Altering the physical geography of an area, including bathymetry, currents, coastline, can alter the saline / thermal regime, including vertical structure and flushing rates.	NO	NO	NO
Discharges	Impounding discharges (continuous or intermittent such as storm overflows) can result in altered mixing properties and potentially reduced flushing of contaminants. Contaminants, including nutrients, could build up in the lagoon and lagoon sediments.	YES	NO	NO

Sensitivity	Pressure	Inside Lagoon	Outside lagoon: Estuary	Outside lagoon: open coast
Discharges	An impoundment may cause far reaching changes to currents and mixing properties, changing how discharges disperse.	NO	YES	YES
Contaminants	Contaminants released from discharges, disturbed sediment (during construction and maintenance) and via spills.	YES	YES	YES

Annex 3. Benthic habitats

Pressures and impacts relevant to benthic habitats. Given the likely widescale impacts of tidal lagoon developments, all pressures have been applied to Annex I features, although case specific consideration will be necessary. It should also be noted that all features will be sensitive to the pressures of “Physical loss” and “Physical change”.

Table 3: Pressures and impacts relevant to benthic habitats.

Feature Category	Feature Name	Relevant Pressures
Annex I	Large Shallow Inlets and Bays (LSIBs)	All pressures may be relevant. Can cover large areas within SACs and comprise different habitats with varying sensitivity to pressures. LSIBs contain interdependent mosaics of subtidal, intertidal habitats, many associated with coastal and terrestrial habitats. Some LSIB habitats, such as reefs, sandbanks, mudflats and sandflats, sea caves and saltmarsh are also Annex I features in their own right. Other habitats such as seagrass beds, subtidal muds and maerl beds are feature components; highly sensitive to damage and disturbance with limited ability to recover.
Annex I	Estuaries	All pressures may be relevant. Estuaries are often large features comprising an interdependent mosaic of subtidal and intertidal habitats, many are associated with coastal and terrestrial habitats. Some estuary habitats, such as reefs, mudflats and sandflats and saltmarsh, are also Annex I features in their own right. Other habitats such as seagrass beds, subtidal muds and maerl beds are sub-types with their own conservation objectives.
Annex I	Sandbanks	All pressures may be relevant. Sandbank features support a wide range of species upon which the conservation objectives of an SAC can be based. The biotopes and species linked to sandbanks may be sensitive to pressures associated with tidal lagoon development, especially changes to water flows and sediment processes.
Annex I	Mudflats and Sandflats	All pressures may be relevant. This intertidal feature is widespread and comprises biotopes with varying sensitivity to tidal lagoon development pressures.
Annex I	Reefs	All pressures may be relevant. Includes intertidal and sub-tidal biogenic, bedrock and stony sub-types. This feature is comprised of different biotopes with varying sensitivity to tidal lagoon development pressures.

Feature Category	Feature Name	Relevant Pressures
Annex I	Sea caves	All pressures may be relevant. Sea-caves are generally nested within the reef features of SACs. Often contain specialised communities that are highly sensitive to tidal lagoon development pressures.
Annex I	Coastal Lagoons	All pressures may be relevant. A scarce feature in Wales that depends on specific physico-chemical conditions. Physico-chemical change, including water exchange, will have a significant impact.
Section 7 / OSPAR	Blue mussel beds	Habitat structure changes - substrate removal (extraction); Physical change (to another seabed or sediment type); Physical loss; Smothering / siltation (heavy). Changes in emergence regime; wave exposure, water flows, suspended solids (water clarity), abrasion/disturbance, penetration; smothering / siltation (light) and temperature.
Section 7 / OSPAR	Carbonate reefs	Habitat structure changes - substrate removal (extraction); Physical change (to another seabed or sediment type); Physical loss; Abrasion/disturbance; Penetration.
Section 7	Estuarine Rock	Habitat structure changes - substrate removal (extraction); Physical change (to another seabed or sediment type); abrasion/disturbance; Physical loss; Changes in emergence regime. Changes in salinity, nutrient enrichment, temperature change, wave exposure, water flows; Penetration; Smothering / siltation (light and heavy) and Organic enrichment.
Section 7 / OSPAR	Fragile sponge and anthozoans	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Deoxygenation; Salinity change; Smothering / siltation (heavy); Abrasion / disturbance. Salinity change; Temperature change; Deoxygenation; Changes in suspended solids (water clarity).
Section 7 / OSPAR	Horse Mussel (Modiolus) beds	Removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Abrasion / disturbance, Penetration; Smothering / siltation (heavy); Salinity change. Barriers to species movement.

Feature Category	Feature Name	Relevant Pressures
Section 7	Intertidal boulder communities	Physical change (to another seabed or sediment type); Abrasion/disturbance; Physical loss. Changes in emergence regime; Habitat structure changes - removal of substratum (extraction); Penetration; Abrasion / disturbance; Salinity change; Smothering / siltation (heavy).
Section 7 / OSPAR	Intertidal mudflats	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss. Changes in emergence regime; Penetration; Abrasion / disturbance; Salinity change, Changes to water flows; Smothering / siltation (heavy); Temperature change.
Section 7 / OSPAR	Maerl beds	The only currently known locations of maerl beds in Wales are within the Milford Haven waterway. Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Smothering / siltation (heavy and light); Abrasion / disturbance; Penetration; Deoxygenation; Changes in water flows; Organic enrichment. Changes in suspended solids (water clarity); Temperature change; Salinity change.
Section 7	Mud habitats in deep water	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Smothering / siltation (heavy and light); Abrasion / disturbance; Penetration; Changes in water flows; Deoxygenation; Salinity Change. Organic enrichment; Changes in suspended solids (water clarity); Temperature change; Smothering / siltation (light).
Section 7	Musculus discors beds	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss. Smothering / siltation (heavy); Abrasion / disturbance; Salinity change.
OSPAR	Oyster (<i>Ostrea edulis</i>) beds	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Abrasion/disturbance; Penetration. Temperature change; Salinity change.

Feature Category	Feature Name	Relevant Pressures
Section 7 / OSPAR	Peat and clay exposures	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Penetration. Changes in emergence regime; Abrasion / disturbance; Smothering / siltation (heavy and light).
Section 7 / OSPAR	Sabellaria reefs	Physical change (to another seabed or sediment type); Physical loss. Abrasion / disturbance; Smothering / siltation (heavy); Salinity change; Changes in suspended solids (water clarity); Penetration; Habitat structure changes - removal of substratum (extraction); Temperature change; Changes in emergence regime.
Section 7 / OSPAR	Saline lagoons	Physical change (to another seabed or sediment type); Physical loss; Salinity change; Smothering / siltation (heavy); Abrasion / disturbance. Habitat structure changes - removal of substratum (extraction); Changes to water flows; Penetration; Changes in emergence regime; Changes to wave exposure; Temperature change; Organic enrichment; Deoxygenation; Smothering / siltation (heavy and light)
Section 7 / OSPAR	Seagrass beds	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Changes in suspended solids (water clarity); Smothering / siltation (heavy). Changes in emergence regime; Changes to wave exposure; Smothering / siltation (light); Abrasion / disturbance; Changes to water flows; Salinity Change; Organic enrichment; Nutrient enrichment; Temperature change.
OSPAR	Seapens and burrowing megafauna communities	Habitat structure changes - removal of substratum (extraction); Physical change (to another seabed or sediment type); Physical loss; Smothering / siltation (heavy and light); Abrasion / disturbance; Penetration; Changes to water flows; Salinity Change. Organic enrichment; Nutrient enrichment; Deoxygenation; Temperature change.
Section 7 / OSPAR	Sheltered muddy gravels	Physical change (to another seabed or sediment type); Abrasion/disturbance; Physical loss; Habitat structure changes - removal of substratum (extraction); Smothering / siltation (light and heavy). Changes in emergence regime; Salinity change; Penetration; Temperature change; Changes in emergence regime; Organic enrichment.

Feature Category	Feature Name	Relevant Pressures
Section 7 / OSPAR	Subtidal mixed muddy sediments	Physical change (to another seabed or sediment type); Physical loss. Habitat structure changes - removal of substratum (extraction); Abrasion/disturbance; Penetration; Temperature change; Smothering / siltation (light and heavy); Salinity change;
Section 7 / OSPAR	Tide swept channels	Physical change (to another seabed or sediment type); Physical loss; Habitat structure changes - removal of substratum (extraction); Smothering / siltation (heavy); Abrasion/disturbance; Changes in emergence regime. Salinity change; Changes in suspended solids (water clarity); Temperature change; Penetration; Deoxygenation; Organic enrichment; Changes to wave exposure.

Annex 4. Coastal habitats

Pressures and impacts relevant to coastal habitats.

Coastal Habitat: Saltmarsh

Annex 1 Features:

- H1330 Atlantic salt meadow (*Glauco-Puccinellietalia maritimae*)
- H1310 *Salicornia* and other annuals colonising mud and sand
- H1420 Mediterranean and thermo-Atlantic halophilous scrubs

Section 7 Priority Habitat:

- Coastal saltmarsh

Relevant Pressures

- Changes to the emergence regime-, sedimentary regime; Hydrodynamic changes, Physical loss and direct alteration to coastal habitats
- Compaction of substrates,
- Isolation and loss of connectivity
- Introduction of INNS

Coastal Habitat: sand dunes

Annex 1 Features:

- H2110 Embryonic shifting dunes
- H2120 Shifting dunes along the shoreline with *Ammophila arenaria* (“white dunes”)
- H2130 Fixed dunes with herbaceous vegetation (“grey dunes”)
- H2190 Humid dune slacks
- H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)
- H2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)

Section 7 Priority Habitat:

- Coastal sand dunes

Relevant Pressures

- Hydrodynamic change: dunes would be sensitive to increased erosion rates causing habitat loss.
- Changes to the sediment regime; dunes sensitive to decreases sediment input affecting extent and active succession.

- Physical loss and direct alteration to habitats
- Changes to water table/ dune aquifers leading impacts to habitat extent, condition and distribution

Coastal Habitat: Sea Cliffs

Annex 1 Features:

- H1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

Section 7 Priority Habitat:

- Maritime cliff and slope

Relevant Pressures

- Hydrodynamic changes: changes to erosion reduced erosion affecting open habitat of soft cliffs, increased erosion also potentially damaging. Changing salt spray levels impact crevice and ledge communities and the extent of maritime cliff top habitats.
- Physical changes and direct alteration
- Coastal habitat loss
- Isolation and loss of connectivity
- Compaction of substrates
- Habitat loss
- Introduction of INNS.

Coastal Habitat: Shingle and strandline

Annex 1 Features:

- H1210 Annual vegetation of drift lines
- H1220 Perennial vegetation of stony banks

Section 7 Priority Habitat:

- Coastal vegetated shingle

Relevant Pressures

- Hydrodynamic changes; increased, decreased, or changed erosion, changes in salt spray and disturbance could all impact shingle and strandline vegetation. Increased erosion could lead to habitat loss, but these habitats also require inputs of salt spray and some disturbance to be maintained.

Coastal Habitat:

- Features where coastal habitats can be a component

Annex 1 Features:

- H1130 Estuaries
- H1160 Large shallow inlets and bays

Relevant Pressures

- All pressures referred to above depending on range of component habitats.

Annex 5. Fish

Pressures and impacts relevant to fish. Other fish species may require consideration depending on the specific functioning of the local ecosystem in the location of the tidal lagoon. The following pressures are likely to apply to the fish species in the table below although to a varying extent depending on the species, location and scale of development:

- turbine passage
- entrapment and barrier effects
- habitat structure changes (including substrate removal or disturbance, and other physical changes to the seabed)
- hydrodynamic changes
- water quality changes
- underwater noise and vibration
- artificial light generation
- electromagnetic field generation

Table 4: Pressures and impacts relevant to fish.

Species Category	Species
Annex II, Section 7, OSPAR, WACA Sch 5	Allis shad
Annex II, Section 7, WACA Sch 5	Twaite shad
Section 7, OSPAR	European eel
Annex II, Section 7	River lamprey
Annex II, Section 7, OSPAR	Sea lamprey
Annex II, Section 7, OSPAR	Atlantic salmon
Section 7	Sea trout
Section 7	Smelt/European sparring
Section 7	Sand eel
Schedule 5, Section 7, OSPAR	Basking shark
Section 7	Herring
Section 7, OSPAR	Common skate
Section 7, OSPAR	Cod
Section 7	Tope shark

Species Category	Species
Schedule 5, Section 7, OSPAR	Long snouted seahorse
Schedule 5, OSPAR	Short snouted seahorse
Section 7, OSPAR	Porbeagle shark
Section 7	Monkfish/Anglerfish
Section 7	Whiting
Section 7	Hake
Section 7	Ling
Section 7	Plaice
Section 7	Blue shark
Section 7	Blonde ray
Section 7, OSPAR	Thornback ray
Section 7	Undulate ray
Section 7, OSPAR	White or bottlenosed skate
Section 7	Mackerel
Section 7	Sole
Section 7, OSPAR	Spiny dogfish/spurdog
Section 7, OSPAR, WACA Sch 5	Angel shark
Section 7	Horse mackerel
OSPAR	Leafscale gulper shark
OSPAR	Portuguese Dogfish
OSPAR	Spotted ray

Annex 6. Birds

Pressures and impacts relevant to birds. Given the likely widescale impacts of tidal lagoon developments, any seabird could be affected. The most relevant pressures related to tidal lagoon developments are listed below:

- barrier to species movement
- changes in suspended solids (water clarity)
- collision below water with static or moving objects not naturally found in the marine environment
- physical loss (to land or freshwater habitat)
- abrasion/disturbance of the substrate on the surface of the seabed
- emergence regime changes, including tidal level change considerations
- habitat structure changes - removal of substratum (extraction)
- physical change (to another seabed or sediment type)
- smothering and siltation rate changes (Heavy and Light)
- water flow (tidal current) changes, including sediment transport considerations

Table 5: Pressures and impacts relevant to birds.

Feature Category	Species	Relevant Pressures
Annex I	Little terns	Displacement and disturbance especially while nesting; loss of habitat and prey; Barrier to species movement
Annex	Sandwich tern, Arctic tern, Roseate tern	Displacement and disturbance especially while nesting; loss of habitat and prey; Barrier to species movement
Annex I	Common tern	Displacement and disturbance especially while nesting; loss of habitat and prey; Barrier to species movement
Regularly occurring migratory species	Auks (Razorbill, Puffins, Guillemots, Black Guillemots)	Loss of prey, changes in turbidity; collision, entrapment
Regularly occurring migratory species	Great Cormorant, Shag	Loss of prey, collision
OSPAR/regularly occurring migratory species	Black-legged kittiwake	Loss of prey

Feature Category	Species	Relevant Pressures
Annex I / regularly occurring migratory species	Overwintering wildfowl and waders	Habitat and prey loss; disturbance; displacement
Annex I / regularly occurring migratory species	Divers and sea ducks (Common scoter, red throated diver, little gull, little tern, common tern)	Displacement and disturbance especially while loafing; collision, entrapment; loss of habitat; loss of prey

Annex 7. Marine mammals

Pressures and impacts relevant to marine mammals. All the following pressures would potentially be relevant for all mammal features.

- changes in suspended solids (water clarity)
- collision below water with static or moving objects not naturally found in the marine environment
- physical loss (to land or freshwater habitat)
- abrasion/disturbance of the substrate on the surface of the seabed
- habitat structure changes - removal of substratum (extraction)
- physical change (to another seabed and sediment type)
- smothering and siltation rate changes (Heavy and Light)
- water flow (tidal current) changes, including sediment transport considerations
- deoxygenation
- contamination by Hydrocarbons, PAH's metals and other synthetic compounds and substances (solid, liquid or gas)
- salinity increase or decrease
- underwater noise changes
- vibration
- disturbance from airborne noise
- barriers to movement

Table 6: Pressures and impacts relevant to marine mammals.

Feature Classification	Feature Name
Annex II/ Annex IV/WACA Sch 5/Section 7/OSPAR	Harbour Porpoise
Annex II/ Annex IV/WACA Sch 5/Section 7	Bottlenose Dolphin
Annex II	Grey Seal
Annex II/ Annex IV/WACA Sch 5/Section 7	European Otter
Annex IV (EPS)/Section 7/OSPAR	All other Cetaceans

Annex 8. Landscape and seascape

Table 7: Pressures and impacts relevant to landscape and seascape.

Feature Category	Feature Name	Relevant Pressures
Natural landscape feature	for example: Cliff formation, Beach, Sand dune, Mud flat, Salt marsh, Coastal scrub	Physical impact of construction of built feature. Changing character from natural feature to built area. Changing character for example of sandy beach to mud flat due to change in coastal processes
Cultural landscape feature	for example historic building/structure, archaeological feature, historic park/designed landscape, boundary feature – walls/hedges	Physical impact. Changes to features setting. Changing character of historic seafront.Changes to boundary patterns/types
Landscape character	for example Natural character, Historic built character, Tranquillity	Erosion of natural character and increase in built/man-made. Erosion of historic character for example modern structures out of keeping with historic landscape. Erosion of tranquillity by introduction of built structures/movement
Seascape character	for example wild, open, natural seascape, tranquil, calm bay	Changes to seascape character of impounded lagoon. Erosion of tranquillity by introduction of built structures and increase in vessels and movement changes character

Feature Category	Feature Name	Relevant Pressures
Visual amenity	Visitors to designated landscape, Recreational users of landscape/seascape, Residents and workers within the area	Changes to views along coast/to sea for example from scenic viewpoint, visitor centre, historic monument. Changes to experience and enjoyment for example along Wales Coast Path, a coastal rowing/kayaking route. Changes to views towards coast for example from properties; ferry approaches

Annex 9. NRW managed fisheries

Table 8: Pressures and impacts relevant to NRW managed fisheries.

Fishery	Fishery Method	Relevant Pressures
Salmon and sea trout nets, Eel/elver fisheries	Conwy Seine, Cleddau Compass, Dyfi Seine, Dysynni Seine, Mawddach Seine, Nevern Seine, Taf Coracle and Wade, Teifi Coracle and Seine, Tywi Coracle and Seine Wye Lave	Direct and indirect loss of fish. Direct loss of income. Impact to heritage and cultural value.
Rod and line	23 Principle Salmon Rivers, 33 Main sea trout rivers	Loss of amenity value. Direct loss of value of fishing rights. Indirect loss of reduced income to fisheries and angling tourism
Regulated cockle fisheries	Burry Inlet, Dee Estuary	Direct and indirect loss of cockle available to the fishery

Annex 10. Pressures relevant to construction, operation and maintenance, and decommissioning

Pressures exerted at each development stage for the receptors identified in Parts A, B and C.

Key.

C	Commissioning
O/M	Operation / Maintenance
D	Decommissioning
N/A	Not applicable

Table 4: Pressures exerted at each development stage for the receptors identified in Parts A, B and C.

Pressure	Birds	Coastal habitats	Cockle fisheries	Dee Conservancy	Fish	Flood risk	Freshwater fisheries	Intertidal and subtidal benthic habitats and species	Mammals	Physical processes	Landscape and seascape	Water and sediment quality	WFD
Abrasion/disturbance/compaction of the surface substrate (seabed/Intertidal)	C, O/M, D	C, O/M, D	N/A	N/A	N/A	N/A	N/A	C, O/M, D	C, O/M, D	N/A	N/A	N/A	N/A
Alteration of views	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, O/M, D	N/A	N/A
Artificial light generation	N/A	N/A	N/A	N/A	C, O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Barrier to species movement/connectivity	C, O/M, D	C, O/M, D	N/A	N/A	O/M	N/A	N/A	O/M	C, O/M, D	N/A	N/A	N/A	O/M
Changes in salinity impacting stocks or Shellfish hygiene classification	N/A	N/A	C, O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Changes in suspended solids (water clarity)	C, O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	C,O/M, D	N/A	N/A	C, O/M, D	N/A
Changes in water quality impacting stocks or Shellfish hygiene classification	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Changes to coastal processes/flow patterns	N/A	N/A	N/A	N/A	N/A	C, O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Changes to coastal squeeze	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M, D	N/A	N/A	N/A
Changes to physical processes that alter hydrological regimes of the estuary	N/A	N/A	N/A	C, O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Changes to sediment distribution and topography	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, O/M, D	N/A	N/A	N/A
Changes to sediment regime/supply	N/A	C,O/M, D	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	C,O/M, D	N/A	N/A	C,O/M, D
Changes to sedimentation rates	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A
Changes to suspended sediment concentrations	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A

Pressure	Birds	Coastal habitats	Cockle fisheries	Dee Conservancy	Fish	Flood risk	Freshwater fisheries	Intertidal and subtidal benthic habitats and species	Mammals	Physical processes	Landscape and seascape	Water and sediment quality	WFD
Changes to the saline/thermal regime of the water column	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A
Changes to the thermal regime of the water column	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A
Changes to wave climate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A	C,O/M, D	N/A	N/A	N/A
Changes to wind-blown sand transport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M, D	N/A	N/A	N/A
Collision/passage through static or moving objects not naturally found in the marine environment	O/M	N/A	N/A	N/A	O/M	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	O/M
Contamination by Hydrocarbons, PAH's metals and other synthetic compounds and substances (solid, liquid or gas)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	C, D	N/A	N/A	C,O/M, D	N/A
Creation of hazards and obstacles	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Deoxygenation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	C,O/M, D	N/A	N/A	N/A	N/A
Direct and indirect loss of access to fishing grounds	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Direct loss of cockle contributing to population supporting the fishery	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Direct loss of intertidal and subtidal habitat for cockle	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Direct loss of target species, no longer available to fishery.	N/A	N/A	C, D	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Direct physical impacts	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, D	N/A	N/A
Disturbance from airborne noise	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, D	N/A	N/A	N/A	N/A
Disturbance of seabed contaminants	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, D	N/A
Economic impact from loss of associated income from angling tourism	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Electromagnetic field generation	N/A	N/A	N/A	N/A	O/M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergence regime changes (extraction of substratum)	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergence regime changes, including tidal level	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	O/M	N/A	O/M, D	N/A	N/A	N/A
Fluvial / pluvial discharge into the lagoon	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Habitat structure changes - removal of substratum (extraction)	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	C,O/M, D	C, D	N/A	N/A	N/A	N/A
Impoundment of discharges	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A

Pressure	Birds	Coastal habitats	Cockle fisheries	Dee Conservancy	Fish	Flood risk	Freshwater fisheries	Intertidal and subtidal benthic habitats and species	Mammals	Physical processes	Landscape and seascape	Water and sediment quality	WFD
Indirect loss due to changes in physical processes	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interactions with shipping and other vessel movements	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Introduction or spread of invasive non-native species	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	C,O/M, D
Litter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A
Loss of Income (cockle industry)	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loss of Licences	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loss of revenue (cockles)	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loss of revenue for commercial nets	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Loss of revenue to rod fisheries	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Loss of value of fishing rights	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Muddying of shorelines at Bathing Beaches	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A
Noise, traffic and related human activity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A
Penetration, disturbance and abrasion of the substrate below the seabed surface	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A
Physical change (to another seabed, substrate or sediment type)	C,O/M, D	C,O/M, D	N/A	N/A	N/A	N/A	N/A	C, O/M	C,O/M, D	N/A	N/A	N/A	N/A
Physical changes to water body (morphology, habitats etc)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D
Physical loss of habitat	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	C, O/M	C	N/A	N/A	N/A	N/A
Restricting the conveyance area for tidal flows within an estuary	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Runoff from terrestrial developments	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	C, D	N/A
Salinity increase or decrease/change to stratification	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	O/M	C,O/M, D	N/A	N/A	N/A	N/A
Smothering and siltation rate changes (Heavy and Light)	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	C,O/M, D	C,O/M, D	N/A	N/A	N/A	N/A
Direct/indirect loss of species	N/A	C,O/M, D	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A
Temperature change (increase or decrease)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O/M	N/A	N/A	N/A	N/A	N/A
Underwater noise and, or vibration	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A

Pressure	Birds	Coastal habitats	Cockle fisheries	Dee Conservancy	Fish	Flood risk	Freshwater fisheries	Intertidal and subtidal benthic habitats and species	Mammals	Physical processes	Landscape and seascape	Water and sediment quality	WFD
Water flow (hydrodynamics, tidal current etc) changes, including sediment transport considerations	C,O/M, D	C,O/M, D	N/A	C,O/M, D	C,O/M, D	N/A	N/A	O/M	C,O/M, D	C,O/M, D	N/A	N/A	C,O/M, D
Water level change and need for additional flood defence	N/A	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Water quality changes (including nutrient enrichment)	N/A	N/A	N/A	N/A	C,O/M, D	N/A	N/A	O/M	N/A	N/A	N/A	O/M	C,O/M, D