Cyfoeth Naturiol Cymru
Natural Resources Wales

Menai Strait & Conwy Bay / Y Fenai a Bae Conwy Special Area of Conservation

Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017.

March 2018.

Contents

Summary

This document contains NRW's advice issued under Regulation 37 of the Conservation Regulations 2017, for the *Menai Strait and Conwy Bay Special Area of Conservation* namely conservation objectives and advice on operations. It also includes an explanation of the purpose and format of NRW's "Regulation 37 advice".

This latest version of the Regulation 37 package has been revised to improve accessibility of conservation objectives and to update the legislative context. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now more accessible but there has been no change in what is considered to represent Favourable Conservation Status.

***Table 1 lists the features for the site and provides a direct link to the Conservation Objectives but it is important that all sections are read in full*.**

This report is divided into a series of sections as follows:
Section 1 is a brief introduction to the legal context for Regulation 37 advice.

Section 2 explains in more detail the legal basis and practical requirements for setting conservation objectives for Natura 2000 sites, as understood by NRW. It also explains the legal and practical basis of the operations advice.

Section 3 contains a brief overall description of *Menai Strait & Conwy Bay Special Area of Conservation*, current operations taking place with the SAC and information on modifications as a result of human activity.

Section 4 describes habitats and species for which the *Menai Strait & Conwy Bay Special Area of Conservation* has been selected as a SAC as well as why they are considered important. The information is presented using the same headings as those used to describe the conservation objectives so that useful underpinning information in support of these objectives can easily be referenced.

Section 5 contains NRW's advice as to the conservation objectives (Regulation 37(3)(a)) for the features for which the site has been as a SAC. This includes a vision statement which is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

Section 6 contains NRW's advice as to the operations which may cause deterioration or disturbance of the habitats and species for which the site has been selected (Regulation 37(3)(b)). This is provided to assist the relevant authorities and others in understanding the implications of the designation of the site and the requirements of the Habitats Regulations and government policy towards it.

Table 1: Summary of site features and link to Conservation Objectives.

Site Name	Designated Features	Link to Conservation Objectives
Menai Strait & Conwy Bay SAC	**Habitats:** • Mudflats and sandflats not covered by seawater at low tide • Reefs • Sandbanks which are slightly covered by seawater all the time • Large shallow inlets and bays • Submerged or partially submerged sea caves	Conservation Objectives

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Reoliad 37 Rheoliadau Cadwraeth 2010 (fel y'u diwygiwyd), ar gyfer *Ardal Cadwraeth Arbennig Y Fenai a Bae Conwy*, sef amcanion cadwraethol a chyngor ynghylch gweithrediadau. Mae hefyd yn cynnwys esboniad o bwrpas a fformat "cyngor Rheoliad 37" CNC.

Mae fersiwn ddiweddaraf y pecyn Rheoliad 37 wedi'i ddiwygio er mwyn gwella'r modd y gellir asesu amcanion cadwraethol a diweddaru'r cyd-destun deddfwriaethol. Mae diben yr amcanion cadwraethol a'r cyngor ynghylch gweithrediadau a allai ddirywio neu amharu ar y nodweddion yr un fath ag yn y fersiynau blaenorol. Yn awr mae'r Amcanion Cadwraethol yn fwy hygyrch, ond ni chyflwynir unrhyw newid o ran yr hyn a ystyrir fel Statws Cadwraethol Ffafriol.

Mae Tabl 1 yn rhestru'r nodweddion ar gyfer y safle a hefyd cynhwysir dolen sy'n arwain yn syth at yr Amcanion Cadwraethol, ond mae'n bwysig i'r holl adrannau gael eu darllen yn llwyr.

Caiff yr adroddiad hwn ei rannu'n gyfres o adrannau, fel a ganlyn:
Yn **Adran 1** ceir cyflwyniad byr i gyd-destun cyfreithiol cyngor Rheoliad 37.

Mae **Adran 2** yn esbonio'n fwy manwl y sylfaen gyfreithiol a'r gofynion ymarferol wrth bennu amcanion cadwraethol ar gyfer safleoedd Natura 2000, fel y'u deellir gan CNC. Ymhellach, mae'n esbonio'r sylfaen gyfreithiol ac ymarferol parthed cyngor ynghylch gweithrediadau.

Mae **Adran 3** yn cynnwys disgrifiad cyffredinol byr o *Ardal Cadwraeth Arbennig (ACA) Y Fenai a Bae Conwy*, y gweithrediadau sydd ar waith ar hyn o bryd oddi mewn i'r ACA a gwybodaeth am addasiadau o ganlyniad i weithgareddau pobl. Yn yr adran hon hefyd ceir disgrifiad byr o'r tair Ardal Gwarchodaeth Arbennig sydd i'w cael naill ai'n gyfan gwbl neu'n rhannol oddi mewn i ffiniau'r ACA.

Yn **Adran 4** ceir disgrifiad o'r cynefinoedd a'r rhywogaethau sy'n sail i'r rheswm pam y dewiswyd *Ardal Cadwraeth Arbennig Y Fenai a Bae Conwy* fel ACA, yn ogystal â pham y cânt eu hystyried yn bwysig. Caiff yr wybodaeth ei chyflwyno trwy ddefnyddio'r un penawdau â'r rheini a ddefnyddir i ddisgrifio'r amcanion cadwraethol, fel y gellir cyfeirio'n rhwydd at wybodaeth ategol ddefnyddiol sy'n cefnogi'r amcanion hyn.

Mae **Adran 5** yn cynnwys cyngor CNC parthed amcanion cadwraethol (Rheoliad 37(3)(a)) y nodweddion sy'n sail i ddynodiad yr ACA. Mae hyn yn cynnwys datganiad gweledigaeth sy'n drosolwg disgrifiadol o'r hyn y mae angen ei gyflawni o safbwynt cadwraeth ar y safle. Mae'n dwyn ynghyd ac yn crynhoi'r Amcanion Cadwraethol mewn un datganiad integredig ynglŷn â'r safle.

Yn **Adran 6** ceir cyngor CNC o safbwynt y gweithrediadau a allai ddirywio neu amharu ar y cynefinoedd a'r rhywogaethau y cafodd y safle ei ddewis o'u herwydd (Rheoliad 37(3)(b)). Nodir y cyngor hwn er mwyn cynorthwyo'r awdurdodau perthnasol ac eraill i ddeall goblygiadau dynodiad y safle a gofynion y Rheoliadau Cynefinoedd a pholisïau'r llywodraeth.

Tabl 1: Crynodeb o nodweddion y safle a dolen yn arwain at yr Amcanion Cadwraethol.

Enw'r Safle	Nodweddion Dynodedig	Cysylltiad â'r Amcanion Cadwraethol
Y Fenai a Bae Conwy ACA	**Cynefinoedd:** • Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel • Riffiau • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Cilfachau a baeau mawr bas • Ogofâu môr sy'n danforol neu'n lleddanforol	Amcanion Cadwraethol

1. Introduction

The 1992 EC Habitats Directive[1] aims to help conserve the diversity of habitats and species across the European Union. The Habitats Directive requires member states to take a variety of measures aimed at the conservation of biodiversity. These measures include the designation of Special Areas of Conservation (SACs) on land and sea. Each SAC is to be designated for particular habitats and/or species, and they are to be managed in ways that help conserve those habitats and species.

The Habitats Directive is given effect in the UK largely through the Conservation of Habitats and Species Regulations 2017 ("the Habitats Regulations")[2]. These Regulations set out the powers and duties of UK statutory bodies towards compliance with the requirements of the Habitats Directive. Under these Regulations SACs, together with Special Protection Areas (SPAs) classified under the 1979 EC Birds Directive for the conservation of birds, are called "European sites" and those that include marine areas are called "European marine sites".

Regulation 37 of the Habitats Regulations requires Natural Resources Wales (NRW) to advise the relevant authorities[3] for each European marine site in, or partly in, Wales as to "(a) the conservation objectives for that site, and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated." This document contains NRW's advice under Regulation 37 in relation to the Menai Strait & Conwy Bay EMS.

None of the information contained in this document legally binds any organisation (including NRW) to any particular course of action. However, in exercising their functions in accordance with the requirements of the Habitats Directive, as required by the Habitats Regulations, and in accordance with government policy towards Ramsar sites, the relevant authorities should be guided by the advice contained in this document. This applies to, amongst other things, the establishment of a "management scheme"[4], if such a scheme is established.

Relevant authorities and others may have obligations towards the conservation of habitats and species that are not features for which the Menai Strait & Conwy Bay EMS has been designated, and such obligations are not affected by this document.

The information contained in this document is based on best available knowledge at time of writing and is subject to review at NRW's discretion. Further guidance relating to European marine sites is published by the National Assembly for Wales (*European marine sites in England and Wales*, June 1998, Department of the Environment and Welsh Office), CCW (*European marine sites: an introduction to management*, 1998, CCW Bangor) and European Commission (*Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the Habitats and Birds Directive May 2007)*.

[1] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (OJ No L 206)
[2] https://www.legislation.gov.uk/uksi/2017/1012/contents/made
[3] Defined in regulation 6 of the Habitats Regulations
[4] Regulation 38 of the Habitats Regulations.

2. Purpose and format of information provided under Regulation 37

The information provided under Regulation 37 is in two parts: the conservation objectives and the advice on operations. The legal context for each of these elements, the format of the advice and its underlying rationale are explained here. Sections 5 (conservation objectives) and 6 (operations advice) should be read in conjunction with these explanatory notes.

2.1 Conservation Objectives Background

2.1.1 Legal Background

The conservation objectives for a European marine site are intended to represent the aims of the Habitats and Birds Directives in relation to that site. The Habitats Directive requires that measures taken under it, including the designation and management of SACs, be designed to maintain or restore habitats and species of European Community importance at "favourable conservation status" (FCS), as defined in Article 1 of the Directive (see Box 1).

Box 1: Favourable conservation status as defined in Article 1 of the Habitats Directive

Conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.

The conservation [sic] status of a natural habitat will be taken as 'favourable' when:

- its natural range and the areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- conservation status of typical species is favourable as defined in [Article] 1(i).

Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term natural distribution and abundance of its populations within the territory referred to in Article 2;

The conservation status will be taken as 'favourable' when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a longterm basis as a viable component of its natural habitat(s), and
- the natural range of the species is neither being reduced, nor is likely to be reduced, for the foreseeable future and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis

Guidance from the European Commission[5] indicates that the Directive intends FCS to be applied at the level of an individual site, as well as to habitats and species across their European range. Therefore, in order to properly express the aims of the Habitats Directive

[5] European Commission (2000). Managing Natura 2000 sites

for an individual site, the conservation objectives for a site are essentially to maintain (or restore) the habitats and species of the site at (or to) FCS.

2.1.2 Practical Requirements

In practical terms, the conservation objectives for a site set the standards which must be met if the habitats and species (collectively referred to as "features") are to be at FCS. There are four elements to this. The conservation objectives must;

1) form the basis for proactively identifying what actions, if any, need to be taken by those bodies responsible for the management of operations in and around the site, in order to conserve the features.
2) inform the consideration of proposed developments, or "plans or projects"[6], which are likely to significantly affect the features of the site. In order for a plan or project to proceed, it must be ascertained that it will *not* adversely affect the "integrity of a site"[7]. This depends on whether or not the plan or project will adversely affect the conservation status of one or more of the features and therefore requires direct reference to the conservation objectives.
3) set the standard against which NRW reports to government on the conservation status of the features on the site. Government in turn will use this information, together with that from other SACs and on the status of habitats and species outside designated sites, to report to the EC on the implementation and effectiveness of the Habitats Directive.
4) set the standard against which the appropriateness of management can be judged. If the conservation objectives are not being met it may be due to inappropriate management of the site or to factors originating outside the site or outside the control of those responsible for management, or a combination.

To achieve this we provide conservation objectives covering all the elements of FCS as set out in the Directive, at the same time as being suitable for guiding the preparation of management plans and testing the acceptability or otherwise of the effects of plans and projects. Box 2 indicates the various aspects of conservation status described in this package to help explain the conservation objectives. NRW also uses a related set of "performance indicators" which supports monitoring[8] and allows judgements to be made

[6] Plans and projects are certain types of operation that the Habitats Directive and Regulations require be subject to specific procedures. Plans or projects considered likely to have a significant effect on a European (marine) site must be subject to appropriate assessment of their implications for the site in view of the site's conservation objectives. The carrying out of an appropriate assessment must include consultation with NRW, and such consultation is a separate process to the advice in this document. The information in this document is intended to assist in the identification of plans and projects which are likely to require appropriate assessments, and will form the basis for advice given by NRW in relation to individual plans and projects.

[7] "Integrity of the site" is not defined in the legislation, but has been defined by the UK government as "the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified [i.e. designated]". This definition is similar in intent to FCS.

[8] Monitoring is defined as "Surveillance undertaken to ensure that formulated standards are being maintained. The term is also applied to compliance monitoring against accepted standards to ensure that agreed or required measures are being followed." (*A statement on Common Standards Monitoring*, 1998, Joint Nature Conservation Committee, Peterborough, http://www.jncc.gov.uk/page-2198)

about site condition[9] and conservation status of features for purposes such as reporting and review of management.

The results of the monitoring of feature condition, combined with information on security and suitability of management and the results of surveillance support the making of judgements about whether or not the conservation objectives are being met. Knowledge of the dynamics of many marine species and communities and their sensitivity is limited. Accordingly, in many cases it is not yet possible to identify values above or below which conservation status would be considered unfavourable. When there is a dearth of information the precautionary principle is to be applied. Surveillance[10] is necessary to:

- gain a greater understanding of feature and factor variability,
- provide information which can assist in the interpretation of the results of monitoring of the performance indicators *e.g.* information on trends in other attributes and factors can assist the identification of the causes of changes observed in the performance indicators;
- improve the overall level of understanding of the site, its features and the factors affecting them.

Box 2: Elements of favourable conservation status described in this document to help explain the conservation objectives*

(i) For each HABITAT feature

- RANGE – including distribution and extent
- STRUCTURE & FUNCTION – including geology, sedimentology, geomorphology, hydrography & meteorology, water and sediment chemistry and biological interactions
- TYPICAL SPECIES – including species richness/eveness, population dynamics and range and as defined for species features (below)
- NATURAL PROCESSES

(ii) For each SPECIES feature

- POPULATION – including size, structure, production and physiological health
- RANGE – including areas of the site which the population/individuals use
- SUPPORTING HABITATS & SPECIES – including distribution and extent, structure, function and quality and prey availability & quality.

For both habitats and species information is provided on natural processes, current condition and modifications as a result of human activity.

*The information is limited by the availability of data and in many cases our understanding of these elements in particular locations is incomplete. All descriptions are therefore based on the best available information at the time of writing.

The performance indicators and surveillance requirements for the features of the site are not included in this document. Information about these will be provided by NRW in due course. Each of the habitat features of the SAC represents part of the range and variation of that feature within the UK and Europe. The SAC and all its features makes up part of a suite of sites across the UK that were selected to represent the range and variation of all relevant

[9] The status of the site at a particular moment in time.
[10] Surveillance is defined as “a continued programme of surveys systematically undertaken to provide a series of observations in time” (*A statement on Common Standards Monitoring*, 1998, Joint Nature Conservation Committee, Peterborough. http://www.jncc.gov.uk/page-2198)

features within the UK, and to become part of the pan-European network of conservation areas – Natura 2000. Additional information about the selection of SACs in the UK is provided on the website of the Joint Nature Conservation Committee[11].

2.2 Operations which may cause deterioration or disturbance

2.2.1 Legal context

NRW's specific duty in Regulation 37 to give advice on operations that are potentially damaging needs to be seen in the context of the Habitats Directive, which requires that for a SAC:

- the necessary conservation measures are established which correspond to the ecological requirements of the habitats and species on the site;
- appropriate steps are taken to avoid deterioration of habitats and significant disturbance of species.
- any plan or project which is likely to have a significant effect on a site is subject to an appropriate assessment in view of the site's conservation objectives.

The operations advice, in combination with the conservation objectives, is designed to assist relevant authorities and other decision-makers in complying with these provisions. The operations advice given in this document is without prejudice to other advice given, including the conservation objectives themselves and other advice which may be given by NRW from time to time in relation to particular operations.

The term "operations" is taken to cover all types of human activity, irrespective of whether they are under any form of regulation or management[12]. This is because the obligations in the Directive are defined by the conservation requirements of the habitats and species, not by existing regulatory or management regimes. Thus the advice contains reference to operations which may not be the responsibility of any of the relevant authorities.

2.2.2 Practical Requirements

Operations manifest themselves through one or more factors[13]. The conservation status of a given habitat or species could potentially be affected by many different types of factor, and hence many different types of operation[14]. The key practical purpose of the Regulation 37 operations advice is to assist in the identification of priorities for management, by identifying operations to which features are both 'sensitive' and 'vulnerable'. Sensitivity is defined as 'the intrinsic intolerance of a habitat, community or individual of a species to damage from an external factor.' Vulnerability is defined as 'the likelihood of exposure of a habitat, community or individual of a species to a factor to which it is sensitive'[15]. Thus the potential for an operation to deteriorate or disturb a feature depends both on the sensitivity of the feature to the operation – through its associated factors - and the location, intensity, duration and frequency of the operation and the factors that it affects or causes.

[11] http://jncc.defra.gov.uk/sacselection
[12] The term also includes what the Habitats Directive and Regulations call "plans and projects" (see footnote 6).
[13] A factor is defined as "A component of the physical, chemical, ecological or human environment that may be influenced by a natural event or a human activity" (*Sensitivity and mapping of inshore marine biotopes in the southern Irish Sea (Sensmap): Final report.* CCW, Bangor, December 2000.)
[14] The complexity of formulating operations advice is compounded by the "many-to-many" relationship that exists between operations and factors, where an operation may manifest itself through several factors, and a factor may be affected by several operations, in different ways and to different magnitudes.
[15] Adapted from Hiscock (1996).

Formulating the operations advice has three main elements:

1. Identifying factors to which the features are sensitive.
2. Identifying the types of operation that can cause or affect those factors.
3. Assessing the likelihood of those factors (and hence the features) being affected by those operations, in other words assessing the vulnerability of the features to those effects.

The first and second of these elements relies on current understanding of the inherent sensitivity of features to particular factors, and the effect of operations on factors. Although there will be site specific elements to this information, it may often rely on information from a variety of sources which are not specific to this site. The third stage is very site-specific, relying on information about the types, location, intensity, duration and so on, of operations occurring or likely to occur in or around the site.

Given that in many cases, information of the type indicated in the previous paragraph is rudimentary, or simply not available a precautionary approach is adopted for the identification of factors and operations. This means that where there is uncertainty about the relevance or otherwise of a factor or operation, NRW favours including it in Regulation 37 advice. The output from this process is a list of operations that NRW considers may cause deterioration or disturbance to the features of the site, with accompanying information on the factors through which the each operation affects the feature. The operations advice clearly has to be based on the best available knowledge at the time and is subject to continual review. It necessarily involves an element of risk assessment, both in terms of assessing the likelihood of an operation or factor occurring, and the likelihood of it having an adverse effect on a feature.

NRW's advice to the relevant authorities is that, as a minimum, the extent and management of the operations identified in Section 6 should be reviewed in the context of the conservation objectives. The list should also help identify the types of plans or projects that would be likely to have a significant effect and should be subject to appropriate assessment, noting that such judgements will need to be made on a case-specific basis.

The advice in Section 6 of this document is not a list of prohibited operations, or operations necessarily requiring consultation with NRW, or NRW's consent[16]. The input of the relevant authorities and others is a legal and practical necessity in determining the management needs of the site. Thus, the operations advice is provided specifically with the intention of initiating dialogue between NRW and the relevant authorities.

[16] However, in relation to land included within the SAC, which has been notified as a Site of Special Scientific Interest (SSSI), owners or occupiers require NRW's consent for any operations included in the SSSI notification, and statutory bodies intending to carry out or permit potentially damaging operations must notify NRW and comply with certain other provisions. (Wildlife and Countryside Act 1981, section 28, as amended by the Countryside and Rights of Way Act 2000, section 75). General guidance on the operation of SSSIs is given in the CCW leaflet *Sites of Special Scientific Interest: A guide for landowners and occupiers* (Countryside Council for Wales, Bangor, 2001).

3. Site Description

3.1 Introduction

The unique physiographic conditions experienced within the Menai Strait and Conwy Bay SAC make this an unusual site, which has long been recognised as important for marine wildlife. The variation in physical and environmental conditions throughout the site, including rock and sediment type, aspect, water clarity and exposure to tidal currents and wave action result in a wide range of habitats and associated marine communities. Many of these community types are unusual in Wales. Of particular interest is the continuum of environmental and physical conditions and associated marine communities from the tide-swept, wave-sheltered narrows of the Menai Strait to the more open, less tide-swept waters of Conwy Bay and the moderately wave-exposed Great and Little Ormes. The Menai Strait and Conwy Bay SAC is a multiple interest site that has been selected for the presence of 5 marine habitat types and associated wildlife (Habitats Directive Annex I habitat types).

For the qualifying habitats the SAC is considered to be one of the best areas in the UK for:

- Mudflats and sandflats not covered by seawater at low tide
- Reefs
- Sandbanks which are slightly covered by seawater all the time

and to support a significant presence of:

- Large shallow inlets and bays,
- Submerged or partially submerged sea caves,

The features are distributed throughout the SAC with no single feature occupying the entire SAC and with features overlapping in some locations. The SAC boundary and the general location of the Annex I habitat features are shown in the feature map[17]. The latter are indicative maps as the extent of most features is not known precisely and some, such as sandbanks, are dynamic and can be highly mobile. A number of habitats and species within the SAC are listed in the Section 7 list of habitats and species of principal importance in Wales and in the OSPAR list of threatened and declining species and habitats.

Two Special Protection Areas (SPAs) occur within the Menai Strait and Conwy Bay SAC: Traeth Lafan SPA & Ynys Seiriol / Puffin Island SPA. The conservation objectives and core management plans for these protected sites can be found on the NRW website. The overlaps with Liverpool Bay SPA, the conservation advice for this site can be found in a separate regulation 37 document on the NRW website.

3.1.1 Sources and limitation of site information

A considerable quantity of information is available on the marine environment and associated wildlife of the area with a great deal of scientific research and survey undertaken by staff within Bangor University at the School of Ocean Sciences in Menai Bridge, NRW

[17] All features are contained in one interactive PDF map available on the NRW website, details of data used in the maps can be found in Annex 1.

and its predecessors, Countryside Council Wales and the Nature Conservancy Council. Information on the marine environment and wildlife is summarised in two key documents from 1993 and 2006[18].

The majority of the subtidal data for the area of the SAC is point source, although since the mid 1990's seashore and subtidal mapping work has provided both a broader contextual background as well as baseline information that can be used for future monitoring. The intertidal data includes biotope maps from the CCW intertidal Phase 1 survey. Most of the Menai Strait and Conwy Bay SAC is subtidal which makes it difficult to map accurately. Habitats that are part of the SAC features may also occur in parts of the SAC that have yet to be surveyed.

Despite the quantity of information available about the SAC, it is not complete given the many difficulties associated with collecting and understanding marine data. Maps showing the distribution of the habitats may be indicative and the feature descriptions are provided on the basis of current knowledge and may be subject to change as knowledge improves.

3.2 Site Description

The Menai Strait and Conwy Bay SAC is mostly subtidal but also includes a few areas of foreshore. In places the landward boundary abuts the boundary of SACs encompassing terrestrial / coastal habitats and species and some intertidal areas that are part of the marine SAC have been notified as Sites of Special Scientific Interest (SSSI). The SAC also overlaps wholly or in part with a number of Special Protection Areas (SPAs) classified under the Birds Directive. The location of these, SPAs and SSSIs falling within the boundary of Menai Strait and Conwy Bay SAC are shown in the interactive feature map[17].

When the SAC boundary was drawn up, the biological survey and assessment of most of the foreshores within North Wales had not been completed and therefore many ecologically important intertidal areas are not included. Of particular note are the intertidal parts of the sea caves and reefs around the Great and Little Ormes, intertidal mudflats and sandflats, and much of the foreshore on the north and south side of the Menai Strait. These intertidal areas of conservation interest will gain a certain level of protection given that they are immediately adjacent to the SAC.

All references to depths should be taken as Below Chart Datum (BCD) unless stated otherwise.

a) Range

The Menai Strait and Conwy Bay SAC is situated in north-west Wales and includes the whole of the Menai Strait, from its south-western entrance at Abermenai Point through to Red Wharf Bay and Conwy Bay to the north. To the east the SAC extends to the Little Orme and to the north to Traeth Lligwy on the east coast of Anglesey[19]. The SAC covers an area of about 26,483 hectares.

[18] Young (1993), Morris & Goudge (2006).

[19] The seaward boundaries of the SAC are drawn as close as possible to include the five habitat features, but straight lines have been taken to ensure ease of marking, for example, along the northernmost boundary of the SAC. Where intertidal areas are included within the SAC, the landward boundary follows Mean High Water and where intertidal areas are not included, it follows Mean Low Water.

The five marine habitat features for which the site was selected are distributed throughout the SAC, with no single feature occupying the entire SAC and with some features overlapping in certain locations.

b) Structure

i. Geology

Geology within the site is complex and varied. There is hard green schist and gneiss in the central region of the Menai Strait, and exposures of softer carboniferous limestone around the north-east coast of Anglesey, the Great and Little Ormes, in the Menai Strait along the south shore of the Swellies and the north shore at Plas Newydd. There are likely to be additional exposures of carboniferous limestone within the central Menai Strait, but further survey work would be required to verify this. Many rocky areas within the site are composed of boulders, cobbles and pebbles rather than bedrock.

ii. Sedimentology

The sediment of the Menai Strait predominantly originates from the Quaternary period, together with sediment left by retreating glaciers and those washed off the land by rivers and streams. The seabed in the main channel at the northern end of the Menai Strait is largely composed of medium to coarse shell fragments and the intertidal areas are mostly sands with localised mixtures of gravel and mud. The sandflats, including those at Traeth Lafan, are medium and fine sands, although there is a greater proportion of mud towards the upper intertidal resulting from the reduced wave action and tidal streams. At Menai Bridge, strong currents mean the mid-strait region is composed of rocks and stones with very little sediment accumulation except in sheltered embayments. South of the Swellies the strait gradually widens towards the bank of predominantly fine sands called Traeth Gwyllt opposite Tal-y-Foel pier. Clay and silt is found in regions of low energy, such as Foel Jetty and the eddy created by Trefarthen Point, as well as around the area at Afon Seiont, Caernarfon. Medium sand occurs in regions of higher energy in the central channel. Further south at Traeth Melynog and also at Braich Abermenai, the sediment is characteristically uniform fine sand, except for the main channel where, in some places, the sediment is composed of gravel and pebbles. Foryd Bay, on the south side of the strait, has larger than expected sediment particle size due to the stable, sheltered nature of the beach, which consists of coarse gravels lying beneath a layer of muddy sand. Only the lower shore here is destabilised by the strong tidal currents of the Menai Strait.

In general the seabed in Conwy Bay is gently shelving, with depths of less than 30m (most are less than 20m). The sediments in Red Wharf Bay and Conwy Bay mostly range from gravels covered with sand veneers to areas of shell fragments. Sand-waves and sand ribbons, formed by wave and tidal action cover the seabed in some areas, with fully developed sand banks and organically enriched muddy patches in others. Overall in Conwy Bay there is a trend more muddy sediments close to land. Areas of mixed sediments occur around the Great Orme and south of Puffin Island. There is a general concentration of muddy sediments in the east of the Bay, and to the immediate west of the Great Orme an area of fine sediments, suggesting a sheltered area of deposition and low energy.

iii Geomorphology

The varied underlying geology, geological processes and variety of environmental and physical conditions experienced throughout the SAC have resulted in a complex coastal morphology. Physical processes such as wind and wave action have shaped, and continue

to shape, the areas of hard substrate, particularly the pebble, cobble and boulder areas within the SAC.

Glacial and post-glacial Irish Sea sediments throughout the SAC have undergone extensive reworking by the action of wind, waves and tidal currents, resulting in the formation of large tidal deltas at both ends of the strait. The two rocky headlands of Point Lynas and the Great Orme deflect the tidal current running to and from the inner parts of Liverpool Bay and the shelter provided to Conwy Bay results in muddy sediment deposits in this area.

At the north-eastern end of the Menai Strait by Gallows Point, south-west of Beaumaris, the depth of the seabed is particularly variable. During low spring tides a sand ridge can be exposed by up to 3m, whilst only 450m south of Gallows Point there is a hole with a depth of 22-26m below chart datum. This is commonly referred to as 'Gallows Deep' and comprises a cliff with clay outcrops and a cobble and shell fragmented bottom.

Water depths in the central Menai Strait channel vary from a few metres to nearly 22m, whilst the average depth of the strait itself is approximately 10m. Undersea cliffs on the southern shore of the strait extend under the Menai Suspension Bridge and into an area of shallow tidal rapids between the two bridges, known as the Swellies. South of this the strait channel reaches 27m at its deepest point, at Pwll Fanogl, which is believed by some to be a pothole in the underlying limestone.

Red Wharf Bay is a shallow bay comprised mostly of intertidal soft sediments. Depths range from 5 - 8m and there is only one navigable channel at Trwyn Dwlban, through the intertidal mud and sandflats. The channel gets deeper where a small river, Afon Nodwydd, joins two smaller tributaries on the western side of the bay. Further offshore is the Four Fathom Bank, which is generally shallower than 10m. From the east edge of Red Wharf Bay to Penmon Point runs the Table Road channel, an area close to the North Anglesey coast with a depth ranging from 10-16m.

Puffin Island Sound, between Red Wharf Bay and Conwy Bay includes a narrow submarine channel with a maximum depth of 16m. To the north of Puffin Island another interesting feature is Turbot Hole, a steep sided hole reaching a maximum depth of 24m.

Conwy Bay is gently sloping, mostly around 20m but with occasional areas up to 30m in depth. The outer edges of the Conwy estuary are muddy, with sandbank islands in the central channel exposed at low tide, and broken by smaller channels. At the north-east entrance to the Menai Strait there are extensive intertidal sandbanks and mudflats, most notably, Bangor Flats and Traeth Lafan. Further offshore the Dutchman's Bank is only partially exposed at extreme low tides. Within Conwy Bay itself, mega ripples (ripples with a wave length of between 5 and 15m) have been recorded at depths of 9m and 11m.

c) Function

i. Hydrography and meterology

Currents and tides are complicated in the Menai Strait, with opposing inflows at the south-western and north-eastern ends meeting between Bangor Pier and the Swellies. When this occurs there is no horizontal flow of water for about half an hour, although the water level continues to rise. Eventually all the water begins to flow to the south-west and then close to low water, the last of the tide in the north-east changes direction and flows back to the

north-east past Beaumaris.

The mean tidal range in the Menai Strait increases from approximately 4m at Fort Belan at the southwestern end to approximately 6 - 7m at Beaumaris in the north-east. This difference leads to a residual flow to the southwest through the strait. Water and suspended material entering the northeastern end of the strait may take two to three days or more than a week, to reach the south-western end with the prevailing south-westerly flowing tide. On a spring tide, water and suspended material can enter and pass through the entire length of the Menai Strait in one tidal cycle.

Tidal flows reach 3.5 to 4 m/sec in the Swellies and in the narrows near Caernarfon, and around 2.5 m/sec in Penmon Sound. Elsewhere in the strait they mostly do not exceed 1.5 or 2 m/sec and there are regions where the current is significantly less. There are many tidal eddies and gyres throughout the Menai Strait and, some at Gallows Point and Puffin Island.

The tidal regime in Conwy Bay is less well described than in the Menai Strait. The rocky headlands of Point Lynas and the Great Orme deflect the tidal current running to and from the inner parts of Liverpool Bay, so that tidal currents in the outer part of Conwy Bay are generally slight (0.3 – 0.45 m/sec). Elsewhere in Conwy Bay and around the Great and Little Ormes, tidal streams run at less than 1 m/sec. Residual currents near Great Orme's Head are to the north-east. In the Conwy Estuary, weak flood-directed currents occur on drying sandflats, but much stronger ebb-directed currents occur in the channels on either side.

The whole of the Menai Strait is wave-sheltered and Conwy Bay facing north-north-east is sheltered from the prevailing westerly to south-westerly winds and the longer open sea swells which can impinge on the western side of Anglesey.

The surface temperature of the Menai Strait generally varies seasonally between 4º-17ºC, although temperatures as low as -0.6ºC were recorded in January 1963, which resulted in considerable mortality of certain intertidal species. The warmest recorded temperature was 20.2ºC in August 1995. Surface temperature reaches a maximum between July and August and a minimum between January and March. In Conwy Bay measurements taken irregularly between January 2004 and December 2005 showed an average annual water temperature of 11.9ºC.

Forty years of measurements in the Menai Strait show a trend of increasing turbidity between the early 1960s and 1980s and then a return to almost the same levels as in the 1960s. Turbidity reaches a maximum in winter whilst within the tidal regime turbidity reaches its peak at high tide. Most of the suspended sediment in the Menai Strait is the result of mud being stirred up from the seabed so it is possible that these trends in turbidity are related to long-term wind trends since there is some evidence that wind strengths over Britain are now decreasing following higher levels in a period in the 1980s.

Suspended solid material in the Menai Strait is composed of two main fractions, mineral and organic material. Long-term datasets in the Menai Strait show increasing turbidity in the 1960s, 1970s and 1980s but a similar proportion of mineral to organic fractions, indicating that fluctuating trend was probably due to changes in wind activity over the period. In the mid-1990s, mineral suspended solid and total suspended solid concentrations in the strait

had almost returned to the values recorded in the 1960s. Elsewhere within the SAC, turbidity and suspended sediments have not been monitored as rigorously as in the Menai Strait. However, it has been noted that the water in Conwy Bay, is generally less turbid than in the Menai Strait and water in the Conwy Estuary becomes less turbid with increased distance from land.

ii. Water & sediment chemistry

The River Conwy is the largest of all the rivers that discharge into the SAC. Two major rivers also enter the SAC at the north-east and south-western ends of the Menai Strait (the Ogwen and the Seiont). The volume of water discharged is relatively small and the salinity of the Menai Strait is generally between 32‰ -34‰, only infrequently dropping below 30‰. Salinity in Conwy Bay is approximately 33‰ and is predominantly controlled by marine waters rather than riverine inputs except near to the mouth of the estuary.

Nutrient levels in the SAC are highest over the winter, due to land drainage and run-off at a time of low biological utilisation. Rapid biological utilisation during the summer leads to low nutrient concentrations during September and October.

Heavy metal concentrations are highest in Red Wharf Bay (probably as a result of its proximity to Parys Mountain and the Afon Goch) and in the estuarine environments of Foryd Bay and the Conwy Estuary. The concentrations of metals are however not high enough to be of concern in these areas and heavy metal concentrations have never been noted as a concern in the seawater of the Menai Strait. Further information on water quality can be found on the water watch Wales website[20].

iii Sediment processes

Most of the sediment transport in the Menai Strait is as suspended material in the water column. In the main channel of the Menai Strait and north-east of Puffin Island water movement may also transport larger or coarser particles along the seabed. The net direction of sediment transport through the Menai Strait is in the same direction as the prevailing water flow, towards the south-west. During a tidal cycle, an estimated 15 tonnes of sediment may be transported through the Menai Strait to the south-west.

Offshore sediments at the north-eastern end of the Menai Strait are thought to be transported shoreward and south-west by intermittent suspension caused by residual currents and by wave action. In the Conwy Estuary, currents across drying sandbanks are largest at the mouth of the estuary potentially moving the tips of the sandbanks upstream[21].

iv Biological interactions

The variety and magnitude of biological interactions within the SAC have a major influence on species variety and conservation status. However the range of interactions within and between species and between species and their habitats is immeasurable. Some examples are included in feature descriptions. Grazing and predation by vertebrate predators including seabirds, waders and wildfowl, marine mammals, fish, and invertebrates such as crustaceans both remove energy from the habitat features and contribute to nutrient enrichment which may be significant, e.g. in the case of wildfowl populations on sheltered mud-flats and seabird colonies on algal communities in adjacent sheltered shallow waters.

[20] http://waterwatchwales.naturalresourceswales.gov.uk/en/
[21] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)

d) Typical species

The variety of rock types and their complex formations present throughout the SAC provide many different types of substrate for colonisation by different species of marine plants and animals. This includes species which live on the surface of the rock such as seaweeds, barnacles, sponges and soft corals, and infaunal species that are able to bore into the surface of the rock, including piddocks, rockboring sponges and acorn worms. Cobble and boulder areas provide under-cover shelter, as well as space between the rocks for more delicate species that are not able to survive on open rock surfaces. Areas of rock with fissures, cracks and crevices provide habitat for shade-tolerant species. The waters of the whole SAC are relatively turbid which limits the water depth to which seaweeds within the SAC can survive.

Sediment type has a strong influence over the types of marine species which are associated with intertidal and subtidal sediment areas within the SAC. The surface of the sediment is often apparently devoid of vegetation, although mats and films of micro-algae are common. Muddy areas are highly productive, containing high levels of organic material and so are very important to the marine ecosystem, playing an important role in marine food chains. They generally support very large numbers of individuals of a few species. Few rare species occur in these areas. Diversity of various species, including marine worms tends to increase with increasing levels of sand and gravels, particularly where conditions result in sediments being muddier. However, in areas of coarse sand, where the sediment is of similar grain size, the sediment is easily moved by waves and tides and only a few specialist species are able to exist in these areas.

Tidal streams play a very important role in structuring the habitats features of the SAC and their associated species assemblages, particularly in the Menai Strait, which is one of the largest tidal rapid systems in the UK. Strong tidal streams result in characteristic communities, dominated by filter feeding animals fixed onto or into the seabed, typically including soft corals, hydroids (sea firs), bryozoans (sea mats), large sponges, sea anemones and mussels. The fast-flowing water brings a good supply of food and nutrients, supporting the growth of these animals and, in many areas of the strait, sponges are able to grow to unusually large sizes. In areas of extremely strong tidal currents, species are restricted to those that grow as thin encrusting layers across the seabed, since anything larger would quickly get swept away.

The lack of strong wave-action within much of the SAC results in the rocky shores being dominated by seaweeds like the serrated wrack *Fucus serratus* and kelps such as oar weed *Laminaria digitata*. Areas within the SAC which are exposed to moderate wave-action, such as the north Penmon coast are dominated by a mixture of seaweed, mussels and barnacles, which are resistant to dislodgement by waves. Waves can also influence the size and shape of animals and plants. For example, mussels found on rock habitats in sheltered areas within the strait are much larger than those on the north Penmon coast because they are able to open their shells and feed more frequently in the more sheltered conditions.

Increases in water temperature due to climate change may have a greater effect on the marine plants and animals within areas like North Wales than other parts of the UK, since many southern species reach their northern range and many northern species reach there southern range limit here. Consequently, increases in mean annual water temperature will result in changes (and have already in some cases) to the distribution of many plants and animals in this area.

The waters of the whole SAC are relatively turbid, containing a relatively high level of suspended material, which is reflected in the species and communities present. High levels of suspended material provide favourable conditions for animals which feed by filtering or capturing their food from the water column. Highly turbid water also reduces the levels of light that can penetrate the water column, which limits the water depth to which seaweeds within the SAC can survive, since photosynthesis is restricted.

3.3 Operations within the SAC

The area within and around the Menai Strait and Conwy Bay SAC is predominantly rural with little heavy industry, although heavily used for a range of commercial and recreational activities. Most of the major settlements in the area are concentrated around the coastal fringes (Bangor, Llandudno, Caernarfon, Menai Bridge, Beaumaris and Conwy), with resulting localised pressures on the marine environment. The landward boundary of the SAC is unmodified in many locations, though there are many sea defences in some areas, which include rock armour, gabions and sea walls as well as many areas of 'unofficial' sea defences, where private properties have been protected with gabions, rock armour, building rubble or garden waste. These sea defences are predominantly outside of the SAC, though they may have 'adjacent effects' on SAC features.

Recreational activities and tourism have equalled, and in some cases replaced, the traditional industries of mining, agriculture and fishing as the cornerstone of the local economy in North Wales. The SAC has a number of slipway, marina, port and harbour facilities and is extremely important for water-based recreation of all types. The sheltered nature of the Menai Strait increases its importance for a variety of recreational activities, since it remains accessible when poor conditions prevent activities in areas of open, more exposed areas of coast.

Recreational boating of a variety of types is popular throughout the SAC, including sailing, low and high-powered craft (including jet-skis) and kayaking. Other recreational activities include foraging, rock pooling, diving, snorkelling and kite surfing. Recreational sea angling is also extremely popular and takes place from the shore and from boats, this involves the collection for bait of a variety of marine worms, sandeels and soft shelled 'peeler' crabs. In the Menai straits a number of commercial charter boats operate, undertaking angling and sightseeing trips.

The area is very important for mariculture, with commercial mussel and oyster fisheries order sites in the eastern and western Menai Strait and in the Conwy Estuary. Capture fisheries take place for a variety of species including crabs, lobsters, bass and various flatfish. Intertidal hand gathering commercial fisheries take place throughout the SAC for shellfish including winkles and cockles.

3.4 Modifications as a result of human activity

Various anthropogenic activities currently taking place within the SAC have an influence on the site's five habitat features and Section 6 provides additional information on the ways in which such activities might affect the features. Some of the activities will have a direct effect whilst others will have an indirect effect, by altering or modifying the physical, chemical and environmental factors and processes (structural and functional characteristics) acting upon

the habitats and species. Whilst the structural and functional characteristics of the SAC and its five habitat features are inherently important attributes of the marine ecosystem, it is the effect that these characteristics have on the wildlife of the SAC that is of conservation importance.

Sedimentology and sediment processes within the SAC have been modified and altered by various anthropogenic activities in certain locations within the SAC directly, as well as indirectly through small-scale alterations to hydrodynamic and sediment processes. A detrimental impact on the species and communities associated with some sediment areas has been observed, as detailed in later sections of this document.

There is a trend of increasing sea surface water temperature around the UK which is universally thought to be influenced by anthropogenically induced climate change[22]. A rise of about 1°C in the annual mean sea surface temperature has been recorded in the Menai Strait, and possibly the rest of the SAC, since the 1960s, a similar rise to that of the rest of the UK. The effect that increasing sea surface water temperatures will have on the species and communities associated with the habitat features of the SAC remains to be ascertained and is the subject of various studies and investigations.

Short-term or small-scale changes in turbidity within the SAC may result, or have resulted, from various anthropogenic activities. These include husbandry operations within the mussel fisheries, agitation dredging and the building of the tunnel beneath the Conwy Estuary. However, there is no evidence to suggest that anthropogenic modifications to turbidity is having a significant impact on the species and communities associated with the habitat features of the SAC.

Water quality has generally been improving within the SAC since the 1980s, following tighter controls over land and sea-based discharges and an ongoing programme of upgrading and improving discharge quality within the area. Further information on water quality can be found on the water watch Wales website[23].

Many anthropogenic activities have the potential to affect the structural and functional characteristics of the SAC and these effects are considered to be significant where a subsequent detrimental impact on the species and communities associated with the habitat features of the SAC would result. An assessment of the conservation status of each of the habitat features, at a UK level, was first reported in 2001, again in 2007 and most recently in 2013[24].

[22] http://ukclimateprojections.metoffice.gov.uk/ & http://www.mccip.org.uk/uk-marine-projections/
[23] http://waterwatchwales.naturalresourceswales.gov.uk/en/. The relvant waterbodies for Menai Straits and Conwy Bay are: Menai Strait, Conwy Bay, Anglesey north and Caernarfon Bay north.
[24] Joint Nature Conservation Committee. 2013. General Implementation Report - 3rd UK Habitats Directive Reporting 2013. Available from: http://jncc.defra.gov.uk/page-6387

4. Feature Descriptions

4.1 Mudflats and sandflats not covered by seawater at low tide

Mudflats and sandflats not covered by seawater at low tide are defined in the EU Interpretation Manual[25] as:

“Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders”. Eelgrass communities are included in this habitat.”

In this document they are referred to as the ‘intertidal mudflats and sandflats’ feature.

There are three major categories of intertidal mudflats and sandflats although in practice they tend to be present as a continuous gradation between these categories depending on the prevailing conditions:

1. Clean sands - in areas exposed to wave action and strong tidal currents. May be found on open coast areas and estuary mouths.
2. Muddy sands – occur on more sheltered shores along the open coast and the lower reaches of estuaries.
3. Mudflats – only form in the most sheltered areas of the coast, usually where large quantities of silt derived from rivers are deposited.

Intertidal mudflats and sandflats form a major component of two other Annex I habitats (estuaries and large shallow inlets and bays) but also occur independently, sometimes covering extensive areas along the open coast.

There are several habitats of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats and species) that occur within this feature. These are:

- Intertidal mudflats
- Mussel beds
- Seagrass beds
- Sheltered muddy gravels
- Tide swept channels

4.1.1 Range

The intertidal mudflats and sandflats feature occurs throughout the SAC, with the most significant areas at Traeth Lafan and in Foryd Bay.

Mudflats occur throughout the site where conditions are relatively sheltered from wave-action and tidal currents. These include the western end of Traeth Lafan in the Bangor Flats area, sheltered areas of the shore at Menai Bridge, sections of the lower shore in the western Menai Strait and parts of Foryd Bay, and the Conwy Estuary. Muddy gravel habitats occur in patches on the foreshore between Penmon and Beaumaris on the north

[25] Interpretation Manual of European Union Habitats. EUR27, July 2007. European Commission. DG Environment.

shore of the Menai Strait and on the foreshore around Menai Bridge. There are also small areas of muddy gravels in the western Menai Strait and in Foryd Bay.

Areas of sandflat occur where exposure to tidal currents and wave-action is greater. These include the eastern end of Traeth Lafan and along the lower shores of Benllech, Red Wharf Bay and Conwy Bay and the Conwy Estuary. There are also large areas of tide-swept intertidal sand in the western Menai Strait and Foryd Bay.

4.1.2 Structure and Function

The intertidal mudflats and sandflats feature includes a variety of different sediment habitat types including sands, muds and muddy gravels. The size, shape, aspect, orientation, topography and sediment characteristics are all important structure and function characteristics of this habitat feature. In turn, these characteristics are determined by the physical nature of the available sediment and the degree of exposure to wave action and tidal currents, which together with the salinity regime, water quality (including turbidity) and sediment chemistry influence the assemblages of marine species associated with the different mudflat and sandflat habitats throughout the SAC. Biological processes and interactions, such as competition and predation also play an important structural and functional role in influencing the assemblages of marine species associated with the mudflat and sandflat feature throughout the SAC.

4.1.3 Typical Species

An important characteristic of the communities associated with the mudflats and sandflats feature is their ecological variation, reflecting the changing conditions experienced throughout the site. Tide swept, wave-sheltered communities associated with sandbars and muddy gravels in the Menai Strait, gradually change to the moderately wave-exposed, less tide-swept communities in the more open waters of Traeth Lafan, Red Wharf Bay and Conwy Bay. A variety of species assemblages are associated with these communities, including those living within the sediment, those living on the surface of the sediment, and mobile species. These communities include some unusual or nationally restricted examples, as well as highly representative examples of some of the nationally common types. Collectively they are of interest for their species richness and for being typical of the tide swept, predominantly wave-sheltered and turbid conditions that prevail throughout the SAC.

All of the intertidal mudflat and sandflat communities contribute to the overall representation, range and integrity of the feature within the site, however three notable mudflat and sandflat habitats and their associated assemblages of marine plants and animals are of particular conservation importance, namely:

- intertidal muddy gravels
- dwarf eelgrass *Zostera noltei* beds,
- intertidal sediments on Traeth Lafan.

Intertidal muddy gravels

Muddy gravel communities are characterised by a mixture of mud and sandy mud with gravel and pebbles in patches. They occur on the mid and lower shore between Menai Bridge and Penmon on the north shore of the Menai Strait. Smaller areas on the extreme lower shore between Menai Bridge and Beaumaris have a higher content of mud. There are also small patches of muddy gravel communities along the lower shores of the western

Menai Strait and in Foryd Bay. In many locations, the rich muddy gravel habitat is overlain by thick growths of serrated wrack *Fucus serratus*, attached to larger cobbles and pebbles.

The infaunal communities associated with muddy gravel habitats in the Menai Strait are very diverse and highly productive, with over 180 animals in 0.25m^3 occurring in some areas. Compared to similar habitat elsewhere in Wales there is also an unusually high diversity and abundance of marine worms. Deposit-feeding species such as the lugworm *Arenicola marina*, spaghetti worms (terebellids) and syllid worms are abundant in these muddy gravel habitats, as are detritus feeders such as the capitellid worm *Mediomastus fragilis*. Suspension feeders such as the sand mason worm *Lanice conchilega* and the peacock worm *Sabella pavonina* are also common, as are mobile carnivorous species, such as bootlace worms (nemerteans), the king ragworm *Neanthes virens* and the ragworm *Hediste diversicolor*. Other animals found in these species-rich habitats include amphipod shrimps, small shore crab *Carcinus maenas*, common shrimp *Crangon crangon*, brittlestars *Acrocnida brachiata*, sea mats (bryozoans) *Electra pilosa* and bivalves such as carpet shells *Venerupis corrugata*, cockles *Cerastoderma edule* and blue mussels *Mytilus edulis*.

The smaller patches of muddy gravels on the extreme lower shore between Menai Bridge and Gallows Point at Beaumaris tend to be muddier and support an infaunal community consisting of burrowing anemones, such as the fried egg anemone *Sagartia elegans*, the daisy anemone *Cereus pedunculatus* and the dahlia anemone *Urticina felina*, as well as various bristle worms (polychaetes and oligochaetes), bivalves and crustaceans.

Dwarf eelgrass *Zostera noltei* beds

Dwarf eelgrass *Zostera noltei* beds occur on the shore at Traeth Lafan between Glan y Mor Elias and Pwll Budr culvert. There are three areas in Foryd Bay, the largest of which is the north-western corner next to Fort Belan. Two smaller beds are found on the eastern shore, to the north and south of the mouth of the Afon Gwyrfai. Eelgrass beds die back during winter months and therefore may not be visible all year round. Recent surveys indicate that the dwarf eelgrass beds at Traeth Lafan may be increasing in area. In addition, areas of dwarf eelgrass are now present in the western Menai Strait.

The density of grass blades within the beds influences their stability and complexity and varies within the site from being localised dense patches to larger areas of sparse, but continuous plants. Monitoring work suggests that these may be colonising areas, where the eelgrass is spreading. Eelgrass plants can be prone to disease and do not appear able to survive in areas of poor water quality. Monitoring work undertaken by CCW and the University of Hull did not find any evidence of disease in the plants within the SAC[26].

Intertidal sediment communities at Traeth Lafan

Traeth Lafan is a good example of an almost fully marine mud and sandflat that experiences a broad range of wave exposure. There is vertical zonation of the marine communities from the top to the bottom of the shore, reflecting differing tolerances to uncovering by the tide and desiccation. There is also zonation from east to west across the shore, as wave exposure decreases and the mud content of the sediment increases. Some areas of Traeth Lafan also experience variable salinity due to the presence of the rivers Ogwen, Ddu and Aber.

[26] Boyes *et al*., (2009).

The lower shore sediment is mainly clean, mobile sands and gravels supporting bristle worms, shrimps and bivalves. The extreme lower shore can be very coarse sand and shell gravel with a sparse infauna of bristle worms including the catworm *Nephtys* sp. and amphipod shrimps, whilst the sand mason worm *Lanice conchilega* is found in more tide-swept areas. In areas along the lower shore where there is less shell gravel, abundant surf clam *Spisula solida* and other bivalves such as the clam, *Chamelea gallina* and the thin tellin *Angulus tenuis* may occur. Areas of mobile lower shore sand supports slabber shrimps *Parahaustorius holmesi* and sand digger shrimps *Bathyporeia* spp.

Dutchman's Bank, a sand bank off the north-eastern side of Traeth Lafan separated from the main shore by Penmaen Swatch, supports dense communities of the tube-dwelling trumpet worm *Lagis koreni*, particularly at the northern end of the bank. The majority of the bank supports sand digger shrimps *Bathyporeia* spp. and the lugworm *Arenicola marina*. Species such as the sea potato *Echinocardium cordatum*, the banded wedge shell *Donax vittatus*, the sand star *Astropecten irregularis* and the swimming crab *Liocarcinus holsatus* are also found here. The subtidal areas of this sand bank are part of the 'subtidal sandbanks' feature.

In mid-shore areas, where wave exposure is reduced, the sediment is mainly muddy-sand with cockle *Cerastoderma edule* beds and abundant lugworm *Arenicola marina*. Bivalves such as the gaper clam *Mya arenaria* and the Baltic tellin *Limecola balthica* are common in these more sheltered fine and muddy sands. The upper shore is characterised by muddy sediments with bivalves such as peppery furrow shell *Scrobicularia plana* and ragworm *Hediste diversicolor*. There are also areas of sandy mud, which support abundant mud shrimp *Corophium arenarium* and the mud snail *Peringia* spp. Dwarf eelgrass *Zostera noltei* beds which are typically found in sheltered mud and sand habitats occurs along the upper shore in muddy areas dominated by the ragworm *Hediste diversicolor*, the Baltic tellin *Limecola balthica* and the lugworm *Arenicola marina*. Saltmarsh creeks support soft mud with ragworm *Hediste diversicolor* and oligochaetes. Areas of shore not backed by saltmarsh are dominated by barren sand and barren shingle with a strandline community characterised by sandhoppers.

Much of Traeth Lafan consists of a dynamic mosaic of intertidal sand and mud which is in places overlain by a mosaic of natural and artificially created mussel beds. There is a large seabed lay mussel fishery operating within parts of the intertidal mudflats and sandflats feature on Traeth Lafan, whilst natural mussel beds occur towards the western end of Traeth Lafan, near the River Ogwen. The mudflats and sandflat areas at Traeth Lafan also support internationally important populations of various bird species, which are features of the Traeth Lafan Special Protection Area (SPA)

<u>Other areas</u>
Inshore areas of mudflat and sandflat within Red Wharf Bay and Conwy Bay, are thought to provide feeding / nursery / spawning grounds for a variety of fish species as described in the section on large shallow inlets and bays.

4.1.4 Natural Processes

Intertidal mudflats and sandflats are a very dynamic feature and many different processes and factors can have an effect on them, as described in Sections 3.2 and 4.1.2 (Structure and Function) above. Some of these factors, such as stochastic events vary in the short-

term and can have dramatic and immediate effects, whilst others such as natural cycles and climate influences vary over the longer term.

Intertidal mudflats and sandflats support a variety of different marine communities. These are predominantly infaunal communities of a variety of different animal species such as worms, molluscs and crustaceans living within the sediment habitat. The type of sediment, the forces acting on it (in particular the degree of exposure to wave action and tidal currents), its stability and the salinity of the water have a large influence on the marine species present.

4.1.5 Modifications as a result of human activity

Activities currently considered to be having an effect on the intertidal mudflats and sandflats feature include the use of vehicles on the foreshore, bait digging in some muddy gravel and sheltered mud habitats. A number of activities are considered to pose a potential threat to this feature, through the potential for accidental introductions of invasive non-native species.

Muddy gravel habitats on the extreme lower shore at Beaumaris are subject to compaction through the use of vehicles, to launch boats or access moorings. Quad bikes have also been used to access the commercial cockle fishery on Traeth Lafan. Certain parts of Traeth Lafan are particularly sensitive to compaction through the use of vehicles and sheltered muddy areas and dwarf eelgrass grass beds can take months to recover from this type of disturbance.

The muddy gravel habitats between Beaumaris and Penmon have been impacted by digging for bait, particularly for king ragworm *Alitta virens*, ragworm *Hediste diversicolor* and lugworm *Arenicola marina*. This activity can have a direct effect on populations of the target species, as well as indirect effects on other species associated with these habitats. Whilst the majority of local bait collectors undertake digging for bait responsibly, and adhere to voluntary codes of conduct for the activity, a small minority can undermine this, by failing to ‘backfill’ holes and trenches. This causes depressions and holes in the sediment, which collect water and form persistent pools, causing fine sediments to be washed away, whilst stones and shell buried in the sediment become exposed. This results in a detrimental effect on the associated species assemblages.

Other areas of intertidal sediment within the SAC have also been impacted by bait digging. Sheltered muddy shores, including the south shore of the western end of the Menai Strait beyond Caernarfon and Foryd Bay and within Foryd Bay itself can take a long time to recover from the effects of bait digging and holes and depressions can remain in the sediment for several months. Sandier shores, such as at Red Wharf Bay, Penmaenmawr, Llanfairfechan and West Shore, near the Great Orme recover more quickly from bait digging activity, since they are exposed to a higher degree of wave action. In addition, suction pumps which target Black lug (spp name) generally impact a much smaller area of sediment tend to be used in these sandier areas.

In 2006 the invasive non-native slipper limpet was inadvertently introduced into commercial mussel lays within the eastern Menai Strait with mussel seed from the English Channel. Eradication operations were undertaken to remove the species and prevent its spread. Surveys to date indicate that these operations were successful.

Other unregulated vectors exist for the accidental introduction of invasive marine non-native species into the SAC, for example, on the hulls of recreational craft entering the area from Ireland and elsewhere around the UK and through the use of live bait by recreational anglers. Invasive non-native species present a threat to the mudflats and sandflats feature since they often smother the seabed or out-compete native species, resulting in changes to community structure.

There is considered to be scope for restoration of some areas of intertidal mudflat and sandflat feature and measures to prevent damage to the feature in the future, through:

- the use of agreed routes by vehicles across the foreshore to avoid sensitive areas,
- co-operative working with the angling and bait collecting community,
- The introduction of 'Codes of Good Practice' and other measures to prevent against future introductions of non-native species.

Other future activities may have the potential to have an effect on the intertidal mudflat and sandflat feature.

4.2 Reefs

Reefs are widespread in northern and southern Europe and occur widely around the UK coast. They are defined in the EU Interpretation Manual as:

"either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions."

Rocky reefs are extremely variable, both in structure and in the communities they support. They range from vertical rock walls to horizontal ledges, sloping or flat bedrock, broken rock, boulder fields, and aggregations of cobbles. Reefs are characterised by communities of attached algae and invertebrates, usually with a range of associated mobile animals. Algae tend to dominate the more illuminated shallow water and intertidal areas and animals the darker deeper areas. The specific communities vary according to a variety of factors such as, rock type, wave exposure, slope, aspect, and tidal streams.
There is less variation in biogenic reefs, but the associated communities can vary according to local conditions of water movement, salinity, depth and turbidity. The main species which form biogenic reefs in the UK are blue mussels *Mytilus edulis*, horse mussels *Modiolus modiolus*, ross worms *Sabellaria* spp., the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*.

There are several habitats and species of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats and species) that occur within this habitat. These are:

- Estuarine rocky habitats
- Intertidal Underboulder Communities
- Mussel beds
- Peat and Clay exposures
- Subtidal mixed muddy sediments
- Tide swept channels

- *Edwardsia timida*
- *Ostrea edulis*
- *Pleuronectes platessa*

4.2.1 Range

The reef feature occurs throughout the entire SAC in intertidal and subtidal areas. The most significant areas of intertidal reef occur around Menai Bridge, between Beaumaris and Penmon, and between Penmon and Red Wharf Bay. Around the Great and Little Ormes the reef feature extends a short distance into the subtidal. At the eastern end of Conwy Bay, off the mouth of the Conwy Estuary, the reef feature occurs as cobble skears (areas of cobbles protruding just above sediment deposits). Mussel beds in the area known as 'Morfa Conwy' form small areas of biogenic reef. There is some evidence to suggest that beds of the horse mussel *Modiolus modiolus* occurred north-east of Puffin Island in the past, but these are no longer thought to be present, with only empty shells being found on recent surveys.

4.2.2 Structure and Function

The most important structure and function characteristics for this feature are the geology and geomorphology of the reefs, including topography (surface features), orientation, aspect and bathymetry, together with hydrodynamic processes (wave action and tidal currents) and water quality, clarity (turbidity) and temperature.

The reef feature includes areas of bedrock, boulders, cobbles, clay outcrops as well as 'biogenic' reefs formed by mussels. In the central region of the Menai Strait the hard substrata reef habitat is composed of green schist and gneiss. Around the north-east coast of Anglesey, the Great and Little Ormes, in the Menai Strait along the south shore of the Swellies and the north shore at Plas Newydd, there are exposures of carboniferous limestone. Other areas of reef in the strait are composed of cobbles and pebbles interspersed with gravelly sand. An unusual subtidal reef habitat of clay deposits occurs subtidally near Gallows Point just west of Beaumaris and between Beaumaris and Penmon.

Reef feature in the eastern side of Conwy Bay comprises areas of cobble skears. Throughout the site, geological features such as folding, fracturing, faulting and erosion have provided the basis for creating a varied rock topography which increases habitat diversity by forming crevices, gullies, fissures and overhangs in the rock. These physical characteristics, together with factors such as the salinity regime and water quality in turn influence the assemblages of marine species associated with the different reef habitats throughout the SAC.

Biological processes and interactions also play an important structural and functional role in influencing the assemblages of marine species associated with the reef feature throughout the SAC.

4.2.3 Typical species

An enormous variety of different marine animals and plants together make up communities associated with the reef feature. Intertidally, these communities show patterns of vertical zonation from the top to the bottom of the shore, reflecting differing tolerances to uncovering by the tide and desiccation. Subtidally, reef communities show zonation from shallow subtidal areas into deeper water. In shallow areas, rocky reefs generally support different types of seaweed community dominated by brown or red seaweeds. In deeper

water they are dominated by animal species such as sponges, sea anemones, sea squirts, hydroids, bryozoans and molluscs. Varied assemblages of mobile species such as fish, crabs and other species are also part of the reef communities.

An important characteristic of the communities associated with the reef feature is their ecological variation reflecting changing conditions throughout the site. Communities in the 'Swellies', in the central section of the Menai Strait reflect the extremely tide-swept conditions here. In the more open waters of Conwy Bay and around parts of the Great and Little Ormes, communities are more typical of those in more moderately wave-exposed conditions. These communities include some unusual or nationally restricted examples, as well as highly representative examples of some of the nationally common types. Collectively these are of local interest for their high species richness, extent, and for being typical of the tide-swept and turbid conditions that prevail throughout the SAC.

All of the reef communities within the site contribute to the overall representation, range and integrity of the feature within the site, however, four notable reef habitats and their associated assemblages of marine plants and animals are of particular conservation importance, namely;

i. Reef communities in high energy, tide-swept, wave-sheltered conditions.
ii. Under-boulder, overhang and crevice reef communities.
iii. Limestone reef communities.
iv. Clay outcrop reef communities.

Reef communities in high energy, tide-swept, wave-sheltered conditions
The Menai Strait contains some of the best examples of strongly tide-swept reef in the UK. Species associated with this tide-swept reef include the breadcrumb sponge *Halichondria* spp., shredded carrot sponge *Amphilectus furcorum*, hornwrack *Flustra foliacea*, encrusting and turf forming sea mats (bryozoans) composed of species such as *Scrupocellaria scruposa* and sea chervil *Alcyonidium diaphanum*, and sea squirts such as the star ascidian *Botryllus schlosseri* and the baked bean sea squirt *Dendrodoa grossularia*. A variety of mobile invertebrates, including crabs, starfish, brittlestars and various species of marine worm are also associated with these communities.

Strong tidal currents experienced in these reef areas prevent many grazing animals such as periwinkles and topshells from accessing open rocky surfaces. As a result, in the intertidal and shallow subtidal, where light levels are high enough, dense foliose red seaweeds flourish, including species such as dulse *Palmaria palmata*, false Irish moss *Mastocarpus stellatus*, *Hildenbrandia rubra* and species of encrusting coralline algae such as *Lithothamnion* sp.. In particularly highly tide-swept areas, where sand is suspended in the water, robust tough red seaweeds such *Polyides rotundus*, *Ahnfeltia plicata* and carrageen *Chondrus crispus* occur. In many locations in the strait, intertidal and shallow sublittoral tide-swept reefs are often overlain by very dense coverings of brown algae such as serrated wrack *Fucus serratus*, egg wrack *Ascophyllum nodosum* and oar weed *Laminaria digitata*. Red seaweeds such as *Phycodrys rubens*, *Plocamium cartilagineum* and sea beech *Delesseria sanguinea* grow as epiphytes on the kelp and wrack plants.

Subtidally, due to the turbid conditions in the site seaweed cover is restricted and filter-feeding animals dominate hard areas of the seabed. In areas of moderate tidal stream, communities are composed of unusually large and abundant sponges. Single colonies of

the breadcrumb sponges *Halichondria panicea* and *Halichondria bowerbanki* can cover areas of over 1m^2, whilst the finger sponge *Haliclona oculata* also grows to unusually large sizes. Recent monitoring surveys have suggested however, that the abundance of sponges in the Menai Strait may be decreasing[27]. These sponges themselves provide a habitat for colonisation by a wide variety of marine invertebrates, including the oaten pipes hydroid *Tubularia indivisa*, the sea fir *Sertularia argentea* and sea anemones including the fried egg anemone *Sagartia elegans*, the plumose anemone *Metridium dianthus* and the dahlia anemone *Urticina felina*. Many mobile species are associated with these subtidal reef areas, including the velvet swimming crab *Necora puber*, shore crab *Carcinus maenas*, edible crab *Cancer pagurus*, the long-clawed porcelain crab *Pisidia longicornis* and the butterfish *Pholis gunnellus*.

In extremely tide-swept locations such as the Swellies, the current is too strong for most erect species like sponges to survive and only acorn barnacles *Balanus crenatus* and thin encrusting sponges are able to maintain their position on intertidal and subtidal boulders and bedrock.

Under-boulder, overhang and crevice reef communities

The communities associated with intertidal under-boulder habitats in the Menai Strait are particularly diverse, as a result of the highly turbid, tide-swept conditions. The upper surfaces of boulders are dominated by either serrated wrack *Fucus serratus* on the mid to lower shore and oar weed *Laminaria digitata* on the extreme lower shore. The shaded sides of boulders are often colonised by various foliose and filamentous red seaweed species, such as false Irish moss *Mastocarpus stellatus*, *Lomentaria articulata*, pepper dulse *Osmundea pinnatifida*, dulse *Palmaria palmata* and carrageen *Chondrus crispus*.

The animal communities on the undersides of boulders may vary considerably depending on the type of underlying substrate. On muddy shores, the boulders sink into the surface of the mud, so that their undersides have a relatively sparse associated fauna. On firmer surfaces diverse and nationally uncommon communities can occur that are dominated by sponges including the shredded carrot sponge *Amphilectus fucorum*, *Leucosolenia* sp., *Hymeniacidon perleve* and the breadcrumb sponge *Halichondria panicea*. These sponge dominated communities also have a rich associated assemblage of animals which form turfs and colonies. This is particularly the case in tide-swept areas, where encrusting species such as sea mats (bryozoans) *Electra pilosa* and *Oshurkovia littoralis*, solitary and colonial sea squirts such as the baked bean sea squirt *Dendrodoa grossularia*, the star ascidian *Botryllus schlosseri*, and sea firs such as *Obelia* spp. occur. Other animals such as sea anemones *Sagartia troglodytes*, keel worms *Spirobranchus triqueter*, various spirorbid worms and saddle oysters *Anomia ephippium* also thrive in this habitat. Characteristic mobile species associated with these habitats include gastropods such as the flat periwinkles *Littorina obtusata* and *Littorina mariae*, the common periwinkle *Littorina littorea*, and the grey top shell *Gibbula cineraria*, as well as decapods such as the broad-clawed porcelain crab *Porcellana platycheles*, the long-clawed porcelain crab *Pisidia longicornis* and juvenile edible crabs *Cancer pagurus* and fish such as the butterfish *Pholis gunnellus* and the shanny *Lipophrys pholis*.

[27] Irving & Stanwell-Smith (2013)

Subtidally, where boulders and cobbles occur, animal communities of sea anemones, including the dahlia anemone *Urticina felina* and *Sagartia troglodytes*, as well as a variety of different sea mats and turf forming sea firs develop.

The Great and Little Ormes are more wave-exposed and less tide-swept than elsewhere in the SAC. Less extensive seaweed growth occurs here than in the more wave-sheltered Menai Strait. On the upper surfaces of boulders, beneath the wrack or kelp canopy, species such as the common limpet *Patella vulgata*, the dogwhelk *Nucella lapillus*, the beadlet anemone *Actinia equina* and the acorn barnacle *Semibalanus balanoides* occur.

The rock topography around the north-east coast of Anglesey and the Great and Little Ormes results in the formation of crevices, gullies, fissures and overhangs in the rock, which increases the diversity of habitat types. Crevice and overhang habitats are inhabited by shade-tolerant species of red seaweed such as *Lomentaria articulata*, *Plumaria plumosa* and *Membranoptera alata*. Shaded walls and overhangs are also covered by animal turfs and crusts, consisting of barnacles, sponges, sea mats, sea firs, sea squirts, calcareous tube-worms such as *Spirorbis* spp. and keel worms *Spirobranchus triqueter*. Anemones such as the beadlet anemone *Actinia equina* may often be found in particularly damp crevices and overhangs.

Limestone reef communities
Unique intertidal and subtidal reef communities are associated with the carboniferous limestone habitats around the northeast coast of Anglesey, including offshore islands and around the Great and Little Ormes. In addition to species generally associated with other rock types throughout the SAC, limestone areas also provide a habitat for species that are able to bore into the surface of the soft rock. Intertidally these include large numbers of the wrinkled rock borer, or piddock *Hiatella arctica*, whilst subtidally the rock-boring sponge *Cliona celata*, boring worms *Polydora* spp. and acorn worms *Phoronis hippocrepia* can be found.

Clay outcrop reef communities
An unusual subtidal reef community, composed of boring bivalves (piddocks) *Hiatella arctica* is associated with clay outcrops occurs in two known locations in the eastern Menai Strait, near Gallows Point just west of Beaumaris and between Beaumaris and Penmon. There is also an inter-tidal peat/clay exposure near the Telford Bridge (mainland side).

4.2.4 Natural Processes
Many different processes and factors can have an effect on reefs, as described in Sections 3.2 and 4.2.2 (Structure and Function) above. The distribution and extent of reefs are shaped predominantly by physical conditions, including geology, geomorphological processes, water movement (mainly wave action and tidal streams) and sediment transport processes and, as such is dynamic and fluctuates.

The diversity and type of wildlife communities found on reefs varies according to the nature and type of rock habitat present and is strongly influenced by a number of physical characteristics, in particular how exposed or sheltered a site is to wave action and tidal currents. Extremely exposed areas are dominated by a robust turf of animals such as sponges and anemones and, in shallower water, foliose red seaweed, while reefs in the

most sheltered locations such as sea lochs and rias support delicate or silt-tolerant seaweed, fan-worms, sea squirts and lamp shells, or brachiopods. Stronger tidal streams often increase species diversity, although some communities require very still conditions. Other physical, chemical and biological factors are also an important influence on reef communities, such as depth, clarity of the water, salinity, whether there is a lot of sediment nearby or held in suspension in the water and has a scouring effect and availability of food supply. Temperature also has an important influence and in the UK there is a marked biogeographical trend in species composition related to temperature, with warm, temperate species such as the pink sea-fan *Eunicella verrucosa* occurring in the south, and cold-water species, such as the deeplet sea anemone *Bolocera tuediae* in the north.

Biogenic reefs are not as varied in comparison but do differ according to the local conditions of water movement, salinity, depth and turbidity. The main species which form biogenic reefs in the UK are blue mussels (*Mytilus edulis*), horse mussels *Modiolus modiolus*, ross worms *Sabellaria* spp., the serpulid worm *Serpula vermicularis*, and cold-water corals such as *Lophelia pertusa*. In addition to the reef-building animal, biogenic reefs can be very rich in species as the structure often provides more than one type of habitat. For example the sediment and spaces in and amongst mussels in a mussel bed are suitable for some species whilst others live attached to the surface of the mussel bed. Biogenic reefs are often highly productive and may be important ecologically as feeding, settlement and breeding areas for many other species.

4.2.5 Modifications as a result of human activities

A number of activities are considered to pose a possible threat to this feature, these include commercial and recreational collection of marine species. The collection of ‘Peeler’ crabs (those about to undergo ecdysis, or shell shedding) are popular for use as bait for sea angling in the UK. They are collected from beneath boulders on the lower shore of rocky areas throughout the SAC. From west to east, the main areas of collection are between Foryd Bay and Caernarfon, between the Sea Zoo and Plas Newydd in the western Menai Strait, between Beaumaris and Penmon and around the Great and Little Ormes. The main target species is shore crab *Carcinus maenas*, though the velvet swimming crab *Necora puber* and edible crab *Cancer pagurus* may also be collected from the lower shore at certain times of the year.

Boulder turning can drastically alter the habitat and affect species if boulders are not returned carefully to their original position. Animals on the undersides of boulders become exposed to predators, wave action and the possibility of drying out, while those species that were on the top of the boulder may be smothered and squashed, whilst seaweeds can no longer photosynthesize.

In addition to these effects, the removal of crabs in large quantities can impact intertidal communities as a whole, since they are key species in marine ecosystems and food chains. The vast majority of local bait collectors undertake peeler collection responsibly and turn back boulders to their original position, particularly since this increases the chances that on subsequent tides, additional peeler crabs will be found beneath the same boulder. However, a small minority of bait collectors can undermine this, by failing to adhere to voluntary Codes of Conduct and return boulders to their original position.

Survey work undertaken within boulder shore areas from 2008 - 2010 found that in some locations, up to 53% of boulders of a suitable size showed signs of having been turned, although this varied between years: 2008 (53%), 2009 (44%) and 2010 (13%) showing perhaps a decreasing trend in the areas surveyed [28].

Commercial collection of winkles occurs in most rocky intertidal areas throughout the SAC and where it takes place on boulder habitat, it can lead to similar damage to peeler crab collection.

Invasive non-native species are considered to pose a significant future threat to the reef feature since they may smother the seabed or out-compete native species, resulting in changes to community structure. There are various vectors, both within and adjacent to the SAC, for the accidental introduction of invasive marine non-native species into the SAC, many of which are unregulated or uncontrolled, as already discussed in relation to the intertidal mudflats and sandflats feature.

There is considered to be scope for restoration of some areas of reef feature and measures to prevent damage to the feature in the future, through:

- co-operative working with the angling and bait collecting community to minimise the impact of peeler crab collection on boulder habitats,
- working with the fishing industry and Welsh Government to ensure that winkle fisheries within the SAC take place in a way which does not damage boulder habitats,
- working with the fishing industry and Welsh Government to ensure that crab fisheries within the SAC are sustainable in the long-term,
- the production of a biosecurity plan for the site.

Other future activities may have the potential to have an effect on the reef feature.

4.3 Sandbanks slightly covered by sea water all the time

Sandbanks which are slightly covered by sea water all the time are defined in the EU Habitats Interpretation Manual as:

“elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water. They consist mainly of sandy sediments, but larger grain sizes, including boulders and cobbles, or smaller grain sizes including mud may also be present on a sandbank. Banks where sandy sediments occur in a layer over hard substrata are classed as sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata.”

In this document they are referred to as ‘subtidal sandbanks’.

Within the UK’s inshore waters subtidal sandbanks can be categorised into four main sub-types:

- gravelly and clean sands
- muddy sands;
- eelgrass *Zostera marina* beds;

[28] Moore & Brazier (2012).

- maerl beds (composed of free-living Corallinaceae).

A variety of different sandbank types and their associated communities exist in Wales. Of the few moderate sized sandbanks in Wales there are those that are exposed to prevailing winds and currents e.g. Devils Ridge, Bastram Shoal (Pen Llŷn) and Bais Bank (Pembrokeshire) and those that are less exposed to these conditions e.g. the Four Fathom Banks complex and Constable Bank (off Colwyn Bay). As well as these types that occur in fully marine environments there are also extensive mobile sandbanks that exist under reduced or variable salinity and turbid regimes in the Severn Estuary.

The sandbanks of the Menai Strait and Conwy Bay SAC are mainly of the 'gravelly and clean sand' type.

There are habitats and species of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats and species) that occur within this habitat. These are:

- Mussel beds
- Subtidal mixed muddy sediments
- *Arctica islandica*
- *Ostrea edulis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.3.1 Range

The general location of the known subtidal sandbanks feature within the SAC is indicated in the feature map[29].

The subtidal sandbanks feature occurs in three main areas within the SAC;

- Menai Strait sandbanks. These occur at the northern and southern entrances to the Menai Strait, adjacent to large areas of intertidal sandflat. To the north this includes Penmaen Swatch, and to the south the subtidal sediments between Felinheli and Abermenai Point.
- Conwy Bay Bank. This is located to the west of the Great Orme, extending southward into Conwy Bay (referred to as 'Four Fathom Bank' on Admiralty Charts). It runs roughly east/west for over 6km and varies in depth from 7-17m.
- Red Wharf Bay Bank. This occurs north of Red Wharf Bay and includes Ten Feet Bank near Puffin Island (also referred to as "Four Fathom Bank" on Admiralty Charts). Extends northwest/ south-east for around 12km from the western side of Puffin Island. The crest of the sandbank is generally at a depth of around 7m, although close to Puffin Island depths are shallower at around 2m. This sandbank extends into waters around 15m deep on the seaward side.

4.3.2 Structure and function

The sandbanks forming the subtidal sandbanks feature of the SAC are dynamic and their distribution and extent are determined by the patterns of water movement and sediment

[29] All features are contained in one interactive PDF map available on the NRW website, details of data used in the maps can be found in Annex 1.

transport processes. The size, shape, aspect, orientation, topography and sediment characteristics are all important structure and function characteristics of this habitat feature. In turn, these are determined by the physical nature of the available sediment and the degree of exposure to wave action and tidal currents, which together with the water quality (including turbidity) and sediment chemistry influence the assemblages of marine species associated with the different sandbank habitats throughout the SAC.

The Menai Strait Banks are highly mobile and so have variable topography over time. In areas of high energy, such as the central channel of the strait, sediments are composed of medium sands. In areas of lower energy, in Beaumaris Bay at the northern end of the strait and in the southern Menai Strait the subtidal sandbanks are composed of predominantly fine sand. The shallowest parts of the sandbanks in the southern end of the strait and around the area of Afon Seiont at Caernarfon are composed of very fine sediments, possibly due to silt and clay brought down by the river.

The subtidal sandbanks in Conwy Bay and Red Wharf Bay are subject to slower tidal streams than the Menai Strait Banks and, compared to other sandbanks in Wales, are relatively sheltered from wave action, due to the protection provided by the rocky headlands of Point Lynas and the Great Orme. They are not considered to be distinct from other seabed sediments in the area, but are extensions of the shallow coastal sediments adjacent to the coastline within the two bays. They are therefore considered to be part of the wider sediment system within the two bays.

The distribution and extent of Conwy Bay Bank are probably determined by the presence of the prominent headland of the Great Orme. The distribution and extent of Red Wharf Bay Bank are probably determined by the shelter from tidal streams (and subsequent gyre formation) caused by the rocky promontories of Point Lynas to the west and Puffin Island to the east.

Biological processes and interactions such as competition and predation also play an important structural and functional role in influencing the assemblages of marine species associated with the subtidal sandbanks feature throughout the SAC.

4.3.3 Typical species

A variety of species are associated with the subtidal sandbanks feature, both as part of the infaunal communities living within the sediment itself, those living on the surface of the sediment and those associated with the water column above the sandbank.

The Menai Strait Banks are subject to strong tidal currents and are therefore composed of very clean, mobile sand. As a result, the associated communities are characterised by a very sparse infauna consisting mainly of bristleworms, including the sand mason worm *Lanice conchilega* and the catworm *Nephtys* spp..

Given that the Red Wharf Bay and Conwy Bay Banks are not considered to be distinct from the surrounding seabed sediments within the wider embayment, further details of the communities associated with these sandbank areas are also provided in the section of this document detailing the ‘large shallow bay’ feature.

The Red Wharf and Conwy Bay Banks are thought to be feeding, nursery and spawning grounds for a variety of fish species and a number of species.

4.3.4 Natural processes

Subtidal sandbanks are a very dynamic feature and many different processes and factors can have an effect on them, as described in Sections 3.2 and 4.3.2 (Structure and Function) above. Some of these factors, such as stochastic events vary in the short-term and can have dramatic and immediate effects, whilst others such as natural cycles and climate influences vary over the longer-term. Their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics are largely determined by the sediment supply and the influence of the hydrodynamic processes affecting each bank. They change shape over time and while some are ephemeral, others may be relatively stable and long-established. Mobile sediments that form temporary sandbanks are considered to be associated sediments that should be retained in the system, although their location may change.

4.3.5 Modifications as a result of human activity

Various activities have the potential to have an effect on the subtidal sandbank feature, probably the most predominant of which are fisheries related activities, aggregate dredging and activities which affect coastal processes. However, at the present time, the feature is considered to be in favourable condition. This judgement may change in the future, as knowledge of the subtidal sandbanks and the activities affecting them improves.

4.4 Large shallow inlets and bays

Large shallow inlets and bays are defined in the EU Habitats Interpretation Manual as;

“Large indentations of the coast where, in contrast to estuaries, the influence of freshwater is generally limited. These shallow indentations are generally sheltered from wave action and contain a great diversity of sediments and substrates with a well-developed zonation of benthic communities. These communities have generally a high biodiversity.”

In the UK, there are several physiographic types of large shallow inlet and bay that meet the EC definition: embayments which are a type of marine inlet typically where the line of the coast follows a concave sweep between rocky headlands, sometimes with only a narrow entrance to the embayment; fjards which are series of shallow basins connected to the sea via shallow and often intertidal sills; rias which are drowned river valley in an area of high relief (known as voes in Scotland).

The feature in this SAC is an embayment and is referred to as a large shallow bay in this document.

There are several habitats and species of conservation importance (Environment (Wales) Act Section 7 and OSPAR threatened and declining habitats and species) that occur within this habitat. These are:

- Estuarine Rocky habitats
- Intertidal mudflats
- Intertidal Underboulder Communities
- Mussel beds
- Peat and clay exposures
- Seagrass beds
- Sheltered muddy gravels

- Subtidal mixed muddy sediments
- Tide swept channels
- *Arctica islandica*
- *Ostrea edulis*
- *Clupea harengus*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.4.1 Range

The large shallow inlet and bay feature of the SAC incorporates the area at the northern end of the Menai Strait extending to Bangor pier, Red Wharf Bay and Conwy Bay. It is approximately 13 nautical miles wide between the Great Orme and Moelfre and about 5 nautical miles across the greatest north-south dimension of the feature.

Within the large shallow bay there are a number of component habitats, which are indicated by the general distribution of different sediment types .There is also a significant presence of the four other Annex 1 habitats (intertidal mudflats and sandflats, reefs, subtidal sandbanks and sea caves) which are described separately.

4.4.2 Structure and function

The large shallow bay feature includes a variety of different habitat types including hard substrata, sands, muds and muddy gravels, many of which are part of the other four Annex 1 habitat features. Details on the important structure and function characteristics for each of these can be found in the separate feature sections in this document. Areas that do not form part of the other four features are dealt with here.

Much of the shoreline within the large shallow bay feature is rocky, including the north-east coast of Anglesey and around the Great Orme. These areas do not extend far into the subtidal zone, since throughout the large shallow bay, sediment cover extends close in to the land. Small areas of subtidal reef occur in the eastern Menai Strait consisting of clay outcrops bored by piddocks and there are also areas of partly sand-covered cobble skears on the eastern side of Conwy Bay.

About 98% of the seabed within the large shallow bay feature is covered by sediments. In general these sediments are gently shelving, although the seabed drops off more sharply at the seaward extent. Water depths are mostly less than 20m although down to 30m in places.

Subtidally, the sediments within the large shallow bay range from coarse ‘lag’ gravels covered with a relatively thin sand veneer, to areas of sand formed into small sand ribbons and larger sand waves, often with overlying shell fragments. In some areas these develop into sandbanks. There are also important areas of organically enriched muddy sand patches inshore of the sandbanks. These areas of subtidal sediment are likely to be relatively dynamic and their distribution and extent determined by the patterns of water movement and sediment transport processes. The protection afforded by the headlands of Point Lynas and the Great Orme results in marked depositional gradients where the tidal currents slacken in parts of Red Wharf Bay and Conwy Bay. Coupled with the relatively

high amounts of suspended organic matter in these coastal waters, the gradients foster the deposition of localised patches of somewhat enriched muddy sand.

Biological processes and interactions such as competition and predation also play an important structural and functional role in influencing the assemblages of marine species associated with the large shallow bay feature throughout the SAC.

4.4.3 Typical species

A variety of communities and species are associated with the large shallow bay feature, many of which are associated with the other four Annex I habitat features and thus covered elsewhere within this document. To avoid repetition, only the subtidal sediments of the large shallow bay feature are dealt with in detail here.

Long-term studies of the species and communities associated with subtidal sediments within the large shallow bay appear to show a tendency towards increasing stability in community structure. Over time, opportunistic species, which tend to be short-lived and have unstable populations seem to be becoming less dominant. One theory is that this may be part of the slow recovery process of the communities to the severe winter of 1962/1963, which caused mass mortality of many seabed species in the area.

All of the communities within the large shallow bay contribute to the overall representation, range and integrity of the feature within the site, however two notable habitats and their associated assemblages of marine plants and animals are of particular conservation importance, namely;

- areas of organically enriched muddy sand on the south-western side of Red Wharf Bay and the eastern side of Conwy Bay,
- subtidal and intertidal sediments believed to be of importance as a spawning, nursery and feeding ground for a variety of fish species.

It should also be noted that both of the above notable habitats also extend into the subtidal sandbanks feature.

The biomass of species and communities in areas of enriched muddy sand is higher than on the adjacent more tide-swept sands and gravelly sands. These areas are dominated by deposit-feeders such as the tube-dwelling trumpet worm *Lagis koreni*, the razor shell *Pharus legumen*, the blunt gaper *Mya truncata*, *Abra alba*, *Nucula nitidosa* and the basket shell *Corbula gibba*. Mobile species such as the common starfish *Asterias rubens*, the sandstar *Astropecten irregularis*, brittlestars *Ophiura ophiura*, *Amphiura filiformis*, sea potatoes *Echinocardium cordatum* and common whelk *Buccinum undatum* are also associated with these areas. Many of these species are opportunistic, with short life spans and high production rates, therefore, the fauna of the inshore muddy sands is liable to be quite variable from year to year.

Red Wharf and Conwy Bays are known to be nursery, feeding and possibly spawning areas for a variety of fish species, some of which are recruited into the Irish Sea fisheries. The suitability of areas as fish feeding, nursery and spawning grounds is determined by the presence of suitable food supply, protection from the open sea, a lack of predators, and suitable physical characteristics, such as salinity and temperature. The importance of the large shallow bay as a feeding, nursery and / or spawning area is at least in part due to the shelter provided by the headlands of Point Lynas and the Great Orme, its relatively shallow

depth (<20m, with much of the large shallow bay being <10m depth), while being in close proximity to deeper offshore waters, with faster tidal currents, combined with the type of seabed substrate. Warmer water temperatures as the rising tide moves across shallow subtidal and intertidal areas are also likely to be an important factor for feeding juvenile fish. A survey undertaken in 2001[30] caught 16 species of fish at Red Wharf Bay compared with an average of 9 species at the other sandbanks surveyed within Wales. The catch was dominated by dab *Limanda limanda*, sand goby *Pomatoschistus minutus*, solenette *Buglossidium luteum* and dragonet *Callionymus lyra*. It is likely that the fish assemblage associated with the Conwy Bay Bank is similar. In addition, a number of skate and ray species including the common skate *Dipturus batis*, the blonde ray *Raja brachyura* and the thornback ray or roker *Raja clavata* appear to be associated with sandbank areas within Red Wharf and Conwy Bays, as well as the wider sediment systems within the large shallow bay feature.

While all of the species associated with the large shallow bay feature contribute to the overall integrity of the SAC, a number of notable species, including 'Species of principal importance in Wales', 'Species of Conservation Concern' and 'Nationally rare species' are thought to be associated with the feature. These are the thumbnail crab *Thia scutellata*, the Icelandic cyprine *Arctica islandica*, the spiny cockle *Acanthocardia aculeata*, the common skate *Dipturus batis*, the blonde ray *Raja brachyura* and the thornback ray or roker *Raja clavata*.

4.4.4 Natural processes

The distribution, extent and shape of large shallow bays are largely a reflection of the underlying geology.

The types of sediment and hard substrata habitats within large shallow inlets and bays are largely determined by the underlying geology and sedimentology, along with orientation and aspect and the influence of the prevailing physical conditions such as the degree of exposure to wave action and tidal currents. These factors, combined with the influence of others, such as water quality (including turbidity) and sediment chemistry, influence the assemblages of marine species associated with the different habitats throughout large shallow inlets and bay.

Sediment granulometry and structure are primary factors in determining biological community structure. Sediment topography is the product of sediment structure and sediment transport determined by hydrodynamic process and these can vary with short and long-term natural cycles, climate influences and stochastic events.

The variety of species in inlets and bays is often high as a result of wide habitat variety, the wide range of wave exposure, current strength, depth, light and substrate type, and presence of habitats that support high diversity.

4.4.5 Modifications as a result of human activities

Various activities have the potential to have an effect on the large shallow bay feature of the SAC, including fisheries, coastal developments and recreational activities. At the present time, only those described within the sections of this document relating to the intertidal mudflats and sandflats and reef features are considered to contributing to the unfavourable

[30] Kaiser *et al.* (2004).

condition of the large shallow bay feature. This judgement may change in the future, particularly as knowledge of the subtidal sediments within the large shallow bay and the activities affecting them improves.

4.5 Submerged or partially submerged sea caves

Submerged or partially submerged sea caves (abbreviated to sea caves) are defined in the EU Habitats Interpretation Manual as “Caves situated under the sea or opened to it, at least at high tide, including partially submerged sea caves. Their bottom and sides harbour communities of marine invertebrates and algae.”

Caves can vary in size, from only a few metres to more extensive systems, which may extend hundreds of metres into the rock. There may be tunnels or caverns with one or more entrances, in which vertical and overhanging rock faces provide the principal marine habitat. The UK has the most varied and extensive sea-caves on the Atlantic coast of Europe. Sites encompass the range of structural and ecological variation of sea-caves and cover their geographic range in the UK. Selection was confined to well-developed cave systems, with extensive areas of vertical and overhanging rock, and those that extend deeply (ca. 4 m and more) into the rock, which are likely to support a wider range and higher diversity of plants and animals.

Some of the Welsh sea-caves are used as pupping sites by grey seals *Halichoerus grypus*. All the seacaves in Welsh SACs are considered to be of significant conservation value.

4.5.1 Range

Sea caves are present in areas of limestone throughout the SAC, with the main concentrations in the north-facing cliffs of the Great and Little Ormes and the north-east coast of Anglesey between and Penmon and Red Wharf Bay, including the offshore islands. The general location of the sea caves feature within the SAC is indicated in the feature map. The exact number and nature of caves within the SAC (particularly those with subtidal elements or in inaccessible parts of the coast, such as offshore islands) is unknown.

4.5.2 Structure and function

The most important structure and function characteristics for the sea caves feature are the geology and geomorphology, including topography (surface features), together with hydrodynamic processes (wave action and tidal currents) and water quality and clarity (turbidity). Sea caves in the Menai Strait and Conwy Bay SAC differ from those found elsewhere in Wales, predominantly due to differences in rock type, water quality (including turbidity) and exposure to wave action and tidal currents.

Within the SAC there are fully intertidal and fully subtidal sea caves, as well as some spanning both zones. Around the Great and Little Ormes, sea caves range from wave-cut indentations and clefts in the base of the cliffs, to fully formed caves and tunnels, some over 30m long, often with multiple entrances and complex architecture. The cave floors are generally composed of mobile boulders and cobbles with sand while the cave walls generally show some degree of scouring. Caves between Penmon and Red Wharf Bay, including the offshore islands occur as clefts and tunnels in the limestone bedrock. Subtidal caves may also occur here, but survey work is required to ascertain whether or not this is the case.

Biological processes and interactions such as competition and predation also play an important structural and functional role in influencing the assemblages of marine species associated with the sea caves throughout the SAC.

4.5.3 Typical species

A variety of species are associated with the sea cave feature, including the plants and animals that live attached to the rock surfaces within the caves and mobile species associated with the cave floors and the water column inside the caves. Many species can also be associated with the habitats created by the animals attached to the rock surfaces within the caves, whilst other species live in crevices, overhangs, cracks and fissures in the cave walls and floors.

Communities associated with the sea caves feature vary considerably depending on the structure and extent of the caves, the degree to which they are submerged during tidal cycles and their degree of exposure to scour and surge. They are typically colonised by encrusting animal species but may also support shade-tolerant algae near their entrances.

Sea caves in the SAC, though not particularly species-rich in comparison to other sea cave communities in Wales, support assemblages of species such as sponges, sea firs, sea squirts and sea anemones not often recorded in the rest of Wales and the UK. Because many of the sea caves occur in limestone, species able to bore into the soft rock occur here. These include the acorn worm Phoronis hippocrepia, the rock-boring sponges *Cliona celata* and *Microciona atrasanguinea* and the tube-dwelling worm *Polydora* spp.. Rock boring bivalves such as the wrinkled rock borer *Hiatella arctica* are particularly numerous in the lower shore and subtidal sections of the caves. Empty rock borer holes are home to many small invertebrates such as broad and long-clawed porcelain crabs *Porcellana platycheles* and *Pisidia longicornis*, juveniles of other crustacean species, brittlestars such as *Ophiothrix fragilis* and sea squirts.

Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders, which often scour the cave walls. Caves that occur in deeper water are subject to less water movement from the surrounding sea, and silt may accumulate on the cave floor. Intertidal sea cave communities are strongly influenced by humidity and air temperature, which in turn, is influenced by air movement. Although overall air movement is climatic, movement may be reduced in sea caves depending on their structure and exposure to wave action. Air temperatures may be buffered as a result of restricted airflow, seawater and / or underground rock temperatures, and incident sunlight, compared to the adjacent external environments. Humidity may also be elevated as a result of reduced airflow as well as use by grey seals. In combination, these conditions in intertidal sea caves tend to favour species sensitive to desiccation.

In the larger caves there is zonation vertically (from intertidal through to subtidal areas) and horizontally (from the sunlit entrances through to the shaded and permanently dark rears). Intertidal areas of the floors of the larger caves are typically scoured smooth and barren, whilst the upper parts of the walls at the cave rears are covered in a thin biotic film with small blue mussels (*Mytilus edulis*) and barnacles such as *Semibalanus balanoides* and *Austrominius modestus* occurring in cracks. Algal crusts and films occur on the main parts of the cave walls, with dense zones of barnacles, tubeworm *Spirorbis* spp., blue mussels *Mytilus edulis* and short turfs of sea firs such as the bushy wine-glass hydroid *Obelia*

dichotoma. Lower wall areas are scoured, with occasional barnacles, tubeworms and keel worms *Spirobranchus* spp.. Overhang areas within these caves are dominated by mussels, barnacles and plumose anemones *Metridium dianthus*. Toward the cave entrances the walls (in most cases) descend into the shallow subtidal and the rock beneath overhangs is typically covered by the silty tubes of the worm *Polydora* spp., dense turfs of sea anemones including the fried egg anemone *Sagartia elegans* and plumose anemones *Metridium dianthus* as well as sea squirts including *Polycarpa scuba* and the baked bean sea squirt *Dendrodoa grossularia* overlaying a crust of barnacles and tubeworms. Submerged floors and ledges in many of the sea caves appear to support particularly high densities of velvet swimming crab *Necora puber* and the common prawn *Palaemon serratus*.

Smaller caves support interesting communities of encrusting sponges, sea mats, mussels, barnacles and sea firs. In addition, a variety of anemones and sea squirts can be found in damper caves and crevices. In more wave-sheltered locations, many of the intertidal caves are characterised by turfs of red seaweeds such as *Rhodochorton purpureum* and *Hildenbrandia rubra*, with filamentous green seaweeds such as *Cladophora* spp.

Intertidal ‘beaches’ at the backs of some of the sea caves may be suitable as seal haul-out areas for the North Wales population of grey seals. Further information on the North Wales population of grey seals is provided in the Regulation 37 package for the Pen Llyn a’r Sarnau SAC, for which grey seals are an Annex II species feature.

4.5.4 Natural processes

Cave morphology and topography is strongly determined by the underlying geology and erosion processes and has an important influence on qualities as a substratum for plants and animals. The microtopography, derived as a result of rock type and exposure to physical, chemical and biological processes also strongly influences niche diversity within caves. Localised protection from scour provided by microtopographical features, for example often strongly influences the distribution of sessile organisms within caves.

Physical conditions, such as inclination, wave surge, scour and shade, change rapidly from cave entrance to the inner parts of a cave and this often leads to a marked zonation in the communities present. The combined effects of scour from suspended particulates and sediment and food particle supply is particularly important to the development, survival and diversity of cave species populations, especially in caves adjacent to sediment or with sediment floors.

Caves on the shore and in the shallow sublittoral zone are frequently subject to conditions of strong wave surge and tend to have floors of coarse sediment, cobbles and boulders. These materials are often highly mobile and scour the cave walls. Caves that occur in deeper water are subject to less water movement from the surrounding sea, and silt may accumulate on the cave floor. Intertidal sea cave communities and species ecology and function are strongly influenced by humidity and air temperature, mediated by air movement. Although overall air movement is climatic, movement may be reduced in sea caves depending on their structure and exposure to wave action. Air temperatures may be buffered as a result of restricted airflow, seawater and / or underground rock temperatures, and incident sunlight, compared to the adjacent external environments. Humidity may also be elevated as a result of reduced airflow as well as use by grey seals. In combination, these conditions in intertidal sea caves tend to favour species sensitive to desiccation.

4.5.5 Modifications as a result of human activity

Various activities have the potential to have an effect on the sea caves feature. However, at the present time, the feature is considered to be in favourable condition. This judgement may change in the future, as knowledge of the sea caves and the activities affecting them improves.

5 Conservation Objectives

This latest version of the Regulation 37 package has been revised to improve accessibility of conservation objectives and to update the legislative context. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now shorter and more generic but there has been no change in what is considered to represent Favourable Conservation Status.

In order to meet the aims of the Habitats Directive, the conservation objectives seek to maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site.

The Vision Statement is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

5.1 Vision statement for Menai Strait and Conwy Bay

The intertidal mudflats and sandflats feature should continue to comprise an array of sediment habitats and their associated biological communities, ranging from wave-exposed sands, through to sheltered muds and tide-swept muddy gravels. In many areas, such as at Traeth Lafan and around the mouth of the Conwy Estuary, the feature will comprise a dynamic mosaic of sediment types, with associated communities, whilst other intertidal sediments, such as sheltered areas in the Menai Strait are expected to have more temporal and spatial stability. On the extreme lower shore in the western Menai Strait and Conwy Bay, dynamism is expected between the intertidal mudflat and sandflat and the subtidal sandbank features, depending on the prevailing physical conditions. For further information on Traeth Lafan, refer also to the ‘Vision Statement’ for the Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI).

Intertidal mud and sandflat habitats and communities which are currently impacted by activities such as bait digging and the use of vehicles on the shore, would be expected to improve in quality and become more diverse under appropriate management. As water quality in the area continues to improve, dwarf eelgrass *Zostera noltei* beds are expected to expand their range and distribution within the site. Other habitats and communities associated with this feature are expected to either maintain their condition or improve. While the commercial mussel fisheries continue to operate at the eastern and western ends of the Menai Strait, as well as in the Conwy Estuary, intertidal mud and sandflat feature in these areas will continue to be present in a modified state. There is currently no requirement for restoration of these areas of intertidal mudflat and sandflat.

The reef feature should continue to comprise a variety of habitats and their associated biological communities, occurring on hard substrate of different types throughout the site. Substrate types range from limestone and clay habitats, through to areas of tide-swept sublittoral hard substrata, including boulders and bedrock. Some areas of reef feature, such as intertidal boulder habitats are expected to improve in quality and become more diverse under appropriate management. Other areas will be expected to either maintain their condition or improve.

The subtidal sandbanks feature should continue to comprise mobile or highly mobile sediment habitats and their associated communities. On the extreme lower shore in the western Menai Strait and Conwy Bay, dynamism is expected between the subtidal sandbank and the intertidal mudflat and sandflat features, depending on the prevailing physical conditions. In addition, sandbanks in Conwy Bay and Red Wharf Bay are expected to continue to be part of the dynamic mosaic of shallow sublittoral coastal sediments within the two bays and may also fluctuate according to prevailing physical conditions.

The large shallow bay feature should continue to comprise a variety of sediment and hard substrate habitats and their associated biological communities, subject to a wide range of physical conditions, from the wave-sheltered, tide-swept conditions at the eastern end of the Menai Strait through to the more open coast, wave-exposed conditions in Conwy Bay. The subtidal sediments within the embayment should comprise a dynamic mosaic of sediment types, with associated communities which may display considerable temporal and spatial variation, influenced by prevailing physical conditions. Areas of enriched muddy sand in Red Wharf Bay and Conwy Bay are expected to persist, whilst the large shallow bay is expected to continue to be an important feeding and breeding area for a variety of fish species. Certain habitats and communities within the large shallow bay (many of which are part of other habitat features) are expected to improve in quality and become more diverse under appropriate management. Other areas will be expected to either maintain their condition or improve.

The sea caves feature should continue to comprise intertidal and subtidal caves, clefts, crevices and tunnels in the limestone substrate around the Great and Little Ormes and the north-east coast of Anglesey.

The health and quality of the five SAC habitat features are inter-related and may also depend on the state of other non-feature marine habitats within the site, as well as structural and functional components of the marine ecosystem.

The Menai Strait and Conwy Bay supports a vibrant coastal economy, with a variety of commercial and recreational activities dependent on the area, many of which in turn rely on the long-term health and quality of the marine environment. NRW’s vision for the SAC and its features cannot be achieved without the help and co-operation of those who use the maritime area in and around the site. NRW and other stakeholders are currently exploring approaches to achieve this vision, including taking an integrated approach to management of activities in the maritime area.

5.2 Conservation objectives for the Menai Strait & Conwy Bay SAC

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

5.2.1 Habitat Features

- Mudflats and sandflats not covered by seawater at low tide
- Reefs
- Sandbanks which are slightly covered by seawater all the time
- Large shallow inlets and bays
- Submerged or partially submerged sea caves

5.2.2 Range

The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.

For the intertidal mudflats and sandflats feature these include;

- Muddy gravel communities
- Dwarf eelgrass, *Zostera noltei* beds
- Sediment communities at Traeth Lafan

For the **reef** feature these include;

- Reef communities in high energy wave-sheltered, tide-swept conditions
- Under-boulder, overhang and crevice communities
- Limestone reef communities
- Clay outcrop reef communities

For the **large shallow bay** feature these include;

- Organically enriched muddy sediment areas

5.2.3 Structure and function

The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include;

- geology,
- sedimentology,
- geomorphology,
- hydrography and meteorology,
- water and sediment chemistry,
- biological interactions.

This includes a need for nutrient levels in the water column and sediments to be:

- at or below existing statutory guideline concentrations
- within ranges that are not potentially detrimental to the long term maintenance of the features species populations, their abundance and range.

Contaminant levels in the water column and sediments derived from human activity to be:

- at or below existing statutory guideline concentrations
- below levels that would potentially result in increase in contaminant concentrations within sediments or biota
- below levels potentially detrimental to the long-term maintenance of the feature species populations, their abundance or range taking into account bioaccumulation and biomagnification.

Restoration and recovery

This includes the need for restoration of some **reef** features such as underboulder, overhang and crevice communities, and of some **mudflat and sandflat** features such as the muddy gravel habitats and sheltered muddy habitats. All of these habitats are also part of the **large inlets and bays** feature

5.2.4 Typical Species

The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include:

- species richness
- population structure and dynamics,
- physiological heath,
- reproductive capacity
- recruitment,
- mobility
- range

As part of this objective it should be noted that:

- populations of typical species subject to existing commercial fisheries need to be at an abundance equal to or greater than that required to achieve maximum sustainable yield and secure in the long term
- the management and control of activities or operations likely to adversely affect the habitat feature is appropriate for maintaining it in favourable condition and is secure in the long term

5.3 Understanding the Conservation Objectives

5.3.1 A dynamic marine environment

The conservation objectives recognise and acknowledge that the features are part of a complex, dynamic, multi-dimensional environment. The structures, functions (environmental processes) and species populations of habitat features are inextricably linked. Marine habitats are complex ecological webs of species, habitat structure and environmental functions that vary dynamically in time and space. Variety and change in habitat structure is primarily driven by environmental and physicochemical factors, including water movement, water quality, sediment supply and prevailing weather conditions.

The species populations associated with these habitats also vary in time and space and this is, in part, a direct reflection of the variable habitat structure and dynamic environment. It is also the product of stochastic events and the great variation in survival and recruitment of species, particularly those with dispersive reproductive strategies.

Within the dynamism of habitats and species, there is also an element of stability and persistence, where species' and communities' populations as well as physical habitat structure show little overall long-term variation.

5.3.2 Human activities

These conservation objectives recognise and acknowledge that human activity has already modified and continues to modify habitats and species populations in various ways, to varying degrees and at varying spatial and temporal scales, either acutely or chronically. The conservation objectives do not aim to prevent all change to the habitat and species features, or to achieve an indefinable, abstract natural or pristine state, since these would be unrealistic and unattainable aspirations. Rather, they seek to prevent further negative modification of the extent, structure and function of natural habitats and species' populations by human activity and to ensure that degradation and damage to the features that is attributable to human activities or actions is prevented. Consequently, in order to meet the requirements of the Directive and ensure the site makes its appropriate contribution to conservation of biodiversity, the conservation objectives seek to:

- Encompass inherent dynamism rather than to work against it;
- Safeguard features and natural processes from those impacts of human activity that cause damage to the features through the degradation of their range, extent, structure, function or typical species;
- Facilitate, where necessary, restoration of features or components of features that are currently damaged or degraded and in unfavourable condition.

The term *degradation* is used to encompass damage or deterioration resulting only from such human activities or actions as have a detrimental effect on the feature. The magnitude of any degradation is dependent on the longevity and scale of the impact and the conservation importance of the species or habitats on which the impact occurs. This is influenced by:

- the type of human action, its nature, location, timing, frequency, duration and intensity;
- the species or habitats, and their intolerance and recoverability.

Outcomes arising from human action that are likely to be considered detrimental include such effects such as:

- permanent and long-term change of distribution or reduction in extent of a feature or feature component, or temporary modification or reduction sufficiently significant to negatively impact on biota or ecological processes;
- reduction in ecological function caused by loss, reduction or modification of habitat structural integrity;
- interference in or restriction of the range, variety or dynamism of structural, functional or ecological processes, *e.g.*: alteration of habitat structure, obstruction of tidal streams, chronic or acute thermal, salinity or suspended sediment elevations or reductions;
- hypertrophication or eutrophication;
- contamination by biologically deleterious substances;
- reduction in structure, function and abundance of species populations;
- change in reproductive capacity, success or recruitment of species populations;
- reduction in feeding opportunities of species populations

- reduction of health to a sub-optimal level, or injury, rendering the population less fit for, *inter alia,* breeding, foraging, social behaviour, or more susceptible to disease;
- increase in abundance and range of opportunist species through the unnatural generation of preferential conditions (*e.g.* organic enrichment), at the expense of existing species and communities.
- increase in abundance and range of non-native species.

Table 2 provides illustrative examples of specific changes and whether they would constitute degradation of the feature.

It is important to note that many human activities can either be beneficial (reduce or reverse detrimental human influence (*e.g.* improve water quality)), trivial (*e.g.* no significant and/or substantive long-term effect) or benign (no outcome) in terms of their impact on marine habitats and species.

Advice on potentially detrimental human activities is provided in Section 6 (activities or operations which may cause damage or disturbance to features).

Table 2: Examples of change and whether they would constitute degradation of the feature.

Degradation	Not Degradation
Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by high tissue burdens of anthropogenically derived contaminants.	Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by density dependent incidence of endemic disease.
Modification of a seabed community by organically rich effluent from a new sewage outfall.	Modification of a seabed community as a result of a reduction in organic material entering the sea from a sewage outfall.
Change in seabed community composition as a result of coastal engineering that has altered local wave exposure.	Change in seabed community composition as a result of a cliff fall, the debris from which has altered local wave exposure.
Change to the species composition of a seabed community as a result of an increase in scallop dredging intensity.	Change to the composition of a seabed community as a result of a reduction in scallop dredging intensity.
Permanent reduction of extent of sand and mud-flat as a result of new coastal development.	Permanent reduction of extent of sand and mud-flat as a result of long-term natural changes in sediment transport.
Changes in sediment granulometry as a result of beach recharge operations	Changes in sediment granulometry as a result of natural cliff fall and erosion

5.3.3 Use of the conservation objectives – Site management

The components of favourable conservation status detailed in the conservation objectives have different sensitivities and vulnerabilities to degradation by human activities. Conservation and protection of site features is provided by management, which should be based on levels of risk. The form of management and degree of protection necessary will vary spatially, temporally and from one feature component to another due to their differences in conservation importance and their sensitivity and susceptibility to change as a result of human action. Therefore it needs to be understood that these conservation objectives require a risk-based approach to the identification, prioritisation and implementation of management action.

Security of management is provided in part 6, sections 59 to 66, of the Conservation of Habitats and Species Regulations 2017, which require the assessment of plans and projects likely to have a significant effect on the site.

Where there is a potential for a plan or project to undermine the achievement of the conservation objectives, NRW will consider the plan/project to be likely to have a significant effect and require appropriate assessment. Unless it is ascertained, following an appropriate assessment, that a plan or project will not undermine the achievement of the conservation objectives, the plan/project should be considered as having an adverse effect on the integrity of the site[31].

Appropriate and secure management of activities may also be provided through a site management plan.

[31] Uncertainity should not result in a conclusion of no adverse effect on site integrity.

6 Advice as to operation which may cause deterioration or disturbance to the features

The range of different habitat types within each of the SAC's features is extremely wide and marine habitats and species populations are inherently dynamic. The range and scale of both natural and anthropogenic stressors on the marine habitats and species within the SAC are also very large. Human activities have the potential to impose stresses on each habitat's structure and function in many ways that result in acute, chronic or permanent impacts at different spatial scales. Species populations may also be affected at many levels e.g. physiological, genetic, single organism, population and groups of species.

Table 3 identifies where there is a potential for operations or activities to have an adverse effect on a feature or component of a feature exists. This does not imply a significant actual or existing causal impact. The potential for, and magnitude of, any effect will be dependent on many variables, such as the location, extent, scale, timing and duration of operations or activities, as well as proximity to features that are sensitive to one or more factors induced or altered by the operation. Due to the complexity of the possible inter-relationships between operations or activities and the features, the factors and effects listed in this table are the predicted most likely effects and are not exhaustive.

- The 'activity' column lists potentially damaging operations and gives an indication of their current known status within the SAC. Operations or activities marked with an asterisk (*) may have associated consents, licences, authorisations or permissions which are (or may be) plans or projects, within the meaning of Article 6 of the Habitats Directive. (The potential effects of the construction phase of operations marked with a hash (#) are included in the general operation 'construction').
- The 'relevant factors' column (physical, chemical and biological factors) give an indication of the key mechanisms by which the operation or activity may cause an effect on each habitat feature.
- The 'most likely relevant component and effects' column indicates the most likely components of Favourable Conservation Status that might be affected by each operation or activity.
- The 'features' columns indicate which Annex I habitats and Annex II species could potentially be affected by the operation or activity.
- The 'advice as to likely required action' column provides an indication of the actions required (from NRW and others) to undertake specific risk assessments of relationships between the operation or activity and relevant features, including any further information that would be necessary to further refine / tailor advice.

Table 3: Operations which may cause deterioration or disturbance to the features

Activity	Relevant factors	Features					Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
DOCKS, MARINAS & SHIPPING								
Dock, harbour & marinas structures: Construction* *Small to medium-scale dock / marina facilities at Conwy, Deganwy, Felinheli, Bangor (Port Penrhyn), Caernarfon.*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport, and turbidity regimes, water and sediment chemistry; mobilisation / addition of contaminants; introduction of anthropogenic material; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile benthic species and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: likely decrease in species/community diversity, effects to population dynamics, and restrictions to range of mobile species (especially migratory fish) dependant on location and extent of proposed construction. *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Dock, harbour & marinas structures: Maintenance* *As above*	Environmental quality: addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates)	✓	✓	✓	✓	✓	Structure & function: noise/visual disturbance effecting mobile species particularly mammals; localised elevated suspended material and contaminants limiting growth of benthic flora, smothering sessile benthic fauna and increasing likelihood of toxic bioaccumulation; modification to biological processes including food	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	Physical disturbance: displacement, crushing, abrasion, smothering visual, noise						contamination and availability. Conservation status of typical species & species features: likely decrease in species diversity and effects to population dynamics dependant on location and extent of proposed maintenance and materials used. *Operation specific information required: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	
Dredging: capital *	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: increased suspended nutrients; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) Physical disturbance: displacement, abrasion, smothering, visual, noise Other factors: removal of biota	✓	✓	✓	✓	✓	Structure & function: habitat loss and change; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile benthic fauna and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to loss and modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in species/community diversity and extent. Also an alteration/reduction in quality of communities/populations containing species sensitive to changes in turbidity, light, oxygen, smothering and toxic contaminants (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, sponge communities). *Operation specific information required: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Dredging: Maintenance*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate Fundamental environmental parameters: changes to available oxygen; turbidity; suspended sediments Environmental quality: increased suspended nutrients; toxic & non-toxic contaminants Physical disturbance: displacement, abrasion,	✓	✓	✓	✓	✓	Structure & function: habitat modification; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments limiting growth of benthic flora, and smothering sessile benthic fauna; modification to sediment transport leading to changes in local habitat structure; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) modification to biological processes including food contamination and availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in species/community diversity and extent. Also an alteration/reduction in quality of communities/populations	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	smothering, visual, noise Other factors: removal of biota						containing species sensitive to changes in turbidity, light, oxygen, smothering and toxic contaminants (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, sessile faunal turf communities). *Operation specific information required: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	
Shipping: vessel traffic *No data available. Most shipping in transit in Irish Sea unlikely to pass through SAC, except to use 'safe haven' within Red Wharf Bay.*	Geophysical regime: vessel wash - substrate erosion, local modification of wave exposure regime Fundamental environmental parameters: turbidity Physical disturbance: collision, noise, visual	✓	✓	✓	✓	✓	Structure & function: local effects to sediment habitat structure; noise/visual disturbance effecting mobile species particularly mammals; potential for collision with seals; local modification of physical processes with elevated levels of suspended sediments effecting benthic flora, and smothering sessile benthic fauna; modification to biological processes including food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: particularly effecting the diversity, health and extent of wave sheltered communities and the distribution of communities along physical gradients. Also an alteration/reduction in quality of communities/populations containing species sensitive to changes in turbidity, light, oxygen and smothering (particularly shallow subtidal algal and eelgrass communities, species-rich sediment infaunal communities, and sessile faunal turf communities). *Operation specific information required: location, frequency and duration of operation; scale of effect of wash and water movement from vessel movement dependent on vessel size, activity, speed and proximity to sensitive (sheltered, intertidal and /or shallow subtidal) habitats/communities and species; relevant location-specific biotic and abiotic information; baseline data (occurrence and status) on non-native species present within the site.*	Review, revise or establish management practices and spatial, temporal and technical operational limits suitable to secure features at FCS. Seek advice from NRW.
Shipping: Mooring*	Geophysical regime: local alteration / loss of substrate; local modification of sediment transport Physical disturbance:, displacement, crushing, & abrasion	✓	✓	✓	✓		Structure & function: habitat modification and loss through introduction of anthropogenic material; physical disturbance to adjacent habitats/communities; local modification of physical processes; modification to biological processes including competition for space and food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in quality of sediment communities/populations containing species sensitive to continuous substrate disturbance (particularly algal and eelgrass communities, and species-rich sediment infaunal communities). *Operation specific information required: location, extent,*	Treat new mooring developments as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							frequency, timing and duration; size and construction of mooring(s), frequency of use and proximity to sensitive habitats/communities; maintenance requirements & frequency; relevant location-specific biotic and abiotic information	
Shipping: anchoring *Red Wharf Bay is occasionally used for anchorage by shipping during bad weather, or while awaiting dock in Liverpool.*	Geophysical regime: local modification of substrate structure & sediment transport Physical disturbance: crushing, abrasion & displacement.	✓	✓	✓	✓	✓	Structure & function: habitat modification; physical disturbance; local modification of physical processes with raised suspended particulate concentrations; modification to biological processes including food availability, and changes to biological interactions due to modification of habitat and physical factors. Conservation status of typical species & species features: alteration/reduction in quality of sediment communities/populations containing species sensitive to substrate disturbance (particularly algal, maerl and eelgrass communities, and species-rich sediment infaunal communities) and alteration/reduction in quality of rocky communities/populations containing species sensitive to physical impact (particularly physically fragile and long-lived species of corals, sponges and bryozoans). *Operation specific information required: location, extent, frequency, timing and duration; size/types of anchor(s); proximity to sensitive habitats/communities*	Treat new mooring developments as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Shipping: Vessel maintenance (incl. antifouling) *Not known in SAC, unlikely.*	Environmental quality: addition of toxic & non-toxic contaminants - (organo-metals, biocides, oxidising and reducing agents, petrochemicals); organic enrichment	✓	✓	✓	✓	✓	Structure & function: habitat modification through introduction of anthropogenic material; elevated suspended particulates limiting growth of benthic flora and smothering sessile benthic fauna; chemical contamination increasing likelihood of toxic bioaccumulation; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: effects to population dynamics and likely decrease of diversity and health in species/communities sensitive to organometal compounds, biocides, bleaches etc. (particularly chronic effects on sediment, molluscan, algal and macrophyte species). *Operation specific information required: location, extent, scale, frequency, timing and duration; types of antifouling compounds and other materials employed, disposal methods used; proximity to sensitive habitats/communities/populations.*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: Ballast water discharge *Ballast water convention now in force.*	Environmental quality: organo-metals (antifoulants) Other factors: introduction of non-native species	✓	✓	✓	✓	✓	Structure & function: chemical contamination increasing likelihood of toxic bioaccumulation; modification to biological processes including food contamination and availability, and changes to biological interactions due to the introduction of new species. Conservation status of typical species & species features: effects on population dynamics and likely decrease of diversity and health	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							in species/communities sensitive to antifouling contaminants. Alteration of ecological processes and community structures by introduced species which may compete with and/or predate on native species (including pests on commercial species) and spread disease. Possible increase in bloom forming algae. *Operation specific information required: location, extent, scale, frequency, timing and duration; origin of ships and likelihood of ballast water discharge within the site; baseline data (occurrence and status) on non-indigenous species present within the site.*	
Shipping: Refuse & sewage disposal *Potential exists for effects from shipping transiting in Irish Sea.*	Environmental quality: addition of toxic (metals, synthetic organic compounds, microbial pathogens) & non-toxic (nutrients, inert particulates and materials) contaminants. Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	Structure & function: water and sediment quality; habitat modification through introduction of anthropogenic material; physical disturbance; local modification of sediment processes with raised suspended particulate concentrations; elevated suspended particulates modifying turbidity & ambient light (limiting growth of benthic flora) and smothering sessile benthic fauna; chemical contamination leading to toxic effects; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors. Conservation status of typical species & species features: effects on species variety, population dynamics, physiological health in species sensitive to organo-metal compounds, biocides, bleaches etc. (particularly chronic effects on sediment, molluscan, algal and macrophyte species); entanglement (grey seal, erect benthic invertebrates including a low growing, long lived species e.g. sponges, corals); local smothering. *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of waste; relevant location-specific biotic and abiotic information*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: operational discharges *Potential exists for effects from shipping transiting in Irish Sea.*	Environmental quality: addition of toxic & non-toxic contaminants particularly hydrocarbons; organic enrichment Physical disturbance: smothering	✓	✓	✓	✓	✓	Structure & function: elevation of water (and sediment) contaminant and / or nutrient burden. Conservation status of typical species & species features: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Shipping: accidents - fuel oil & / or petrochemical discharges *Potential exists for a damaged or struggling vessel to be brought in to the "safe haven" in Red Wharf Bay.*	Environmental quality: addition of toxic & non-toxic contaminants particularly petrochemicals Physical disturbance: smothering	✓	✓	✓	✓	✓	Structure & function: elevation of water and sediment hydrocarbon contaminant burden; decrease in habitat quality; modification of biological interactions following decline in populations of ecologically structuring species (*e.g.* grazing molluscs) Conservation status of typical species & species features: lethal and sub lethal physiological effects on species sensitive to hydrocarbons; effects on population variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: accidents-non-petrochemical cargo losses / discharges *Potential exists for a damaged or struggling vessel to be brought in to the "safe haven" in Red Wharf Bay.*	Geophysical regime: local modification of or addition to substrate Environmental quality: addition of toxic & non-toxic contaminants - potentially wide range of organic & inorganic materials & particulates. Physical disturbance: displacement, amputation, abrasion, smothering	✓	✓	✓	✓	✓	Structure & function: elevation of water and sediment contaminant burdens; decrease in habitat quality. Conservation status of typical species & species features: lethal and sub lethal physiological effects on species sensitive to discharge; effects on population variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharge; relevant location-specific biotic and abiotic information*.	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).
Shipping: accidents - salvage operations	Geophysical regime: local modification of or addition to substrate Environmental quality: addition of toxic & non-toxic contaminants - petrochemicals, synthetics & metals debris Physical disturbance: displacement, amputation, crushing, abrasion, noise; visual	✓	✓	✓	✓	✓	Structure and function: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) contaminant burdens. Conservation status of typical species & species features: local effects on populations of species sensitive to physical impacts &/or potential contaminants; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, frequency and duration of operation; scale of effect of wash and water movement from vessel movement dependent on vessel size, activity, speed and proximity to sensitive (sheltered, intertidal and /or shallow subtidal) habitats/communities and species; relevant location-specific biotic and abiotic information; baseline data (occurrence and status) on non-native species present within the site.*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS. Seek advice from relevant agency (e.g. NRW).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
CIVIL ENGINEERING								
Construction*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: potentially acute effects on any component factors, potentially chronic effects particularly on suspended particulates / turbidity Environmental quality: addition of toxic & non-toxic contaminants - particulates, synthetics & metals debris, petrochemicals Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise; visual	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport, water and sediment chemistry and turbidity regimes; mobilisation / addition of contaminants; introduction of anthropogenic material; noise/visual disturbance effecting mobile species particularly mammals; modification to local hydrodynamic regime effecting exposure sensitive communities/species; elevated suspended sediments and contaminants limiting growth of benthic flora, smothering sessile benthic species and increasing likelihood of toxic bioaccumulation; modification to sediment transport leading to changes in local habitat structure; modification to biological processes including food contamination and availability, and changes to biological interactions due to modification to habitat and physical factors Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; indirect modification of population structure, physiological health, reproductive capacity. *Operation specific information required: location, extent, scale and nature of construction; timing and duration of operation; relevant location-specific biotic and abiotic information; transport leading to changes in local habitat structure; modification of biological processes.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Land claim *# *See relevant shoreline management plan*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: turbidity Environmental quality: toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution. Structure & function: modification of physical structure and morphology; modification of hydrodynamic, sediment transport and turbidity regimes, and water and sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species population structure, physiological health, reproductive capacity. *Operation specific information required: location, extent and scale of reclamation; timing and duration of operation; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Coast protection: hard defence (sea walls / breakwaters)*# *See relevant shoreline management plan*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Coast protection: hard defence (railways)*# *See relevant shoreline management plan*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Coast protection: soft defence*# *See relevant shoreline management plan*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements &*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	modified hydrodynamic regime						*frequency; relevant location-specific biotic and abiotic information*	
Coast protection: groynes*#	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Coast protection: beach replenishment*# *See relevant shoreline management plan.*	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Coast protection: storm surge / tidal barrage *#	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: potential loss of / reduction in habitat extent. Structure & function: modification of physical structure (particularly sedimentology) and morphology; change of habitat type; modification of hydrodynamic, sediment transport and turbidity regimes, sediment chemistry; addition of contaminants Conservation status of typical species & species features: direct loss or modification of species variety, extent, distribution, population sizes; consequential near and far-field modification of species variety, extent, distribution, particularly sediment living species adjacent to wave exposed coastlines. *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Barrage: amenity*#	Geophysical regime: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance Environmental quality: toxic & non-toxic contaminant build-up; modification of suspended particulates; organic enrichment Physical disturbance: displacement	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution, *e.g.* estuary and encompassed (particularly intertidal and rocky) habitats; chronic loss of reef through siltation in enclosed waterways Structure & function: upstream of barrage: change of habitat type(s); modification or loss of characterising geomorphology of features (ria, estuaries, tidal narrows); loss or change of habitat structure, sedimentology & bathymetry; disruption of hydrodynamic regime (including tidal regime) & sediment transport processes; modification of suspended particulates, turbidity, light; modification of water and sediment chemistry (salinity regime, deoxygenation, eutrophication, contaminant & nutrient accumulation); increased homogeneity of habitats within impounded areas Downstream from barrage: modification of habitat structure, sedimentology; hydrodynamic regime; sediment transport processes; suspended particulates, turbidity, water (and sediment) chemistry, particularly salinity regime and nutrient / contaminant fluxes. Conservation status of typical species & species features: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species. Consequential near and far-field modification of species population structure, physiological health, reproductive capacity. Reduction in species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *Operation specific information required: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements &*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							frequency; relevant location-specific biotic and abiotic information.	
Foreshore deposit of rock, rubble etc.	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments, turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution, *e.g.* estuary and encompassed (particularly intertidal and rocky) habitats; chronic loss of reef through siltation in enclosed waterways Structure & function: upstream of barrage: change of habitat type(s); modification or loss of characterising geomorphology of features (ria, estuaries, tidal narrows); loss or change of habitat structure, sedimentology & bathymetry; disruption of hydrodynamic regime (including tidal regime) & sediment transport processes; modification of suspended particulates, turbidity, light; modification of water and sediment chemistry (salinity regime, deoxygenation, eutrophication, contaminant & nutrient accumulation); increased homogeneity of habitats within impounded areas Downstream from barrage: modification of habitat structure, sedimentology; hydrodynamic regime; sediment transport processes; suspended particulates, turbidity, water (and sediment) chemistry, particularly salinity regime and nutrient / contaminant fluxes. Conservation status of typical species & species features: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species. Consequential near and far-field modification of species population structure, physiological health, reproductive capacity. Reduction in species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *Operation specific information required: location, extent, scale, timing and duration; construction; maintenance requirements and frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Artificial reef	Geophysical regime: modification of tidal, streams, wave exposure, substrate, sediment transport Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance Environmental quality: modification of suspended particulates Physical disturbance: displacement, smothering,	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent Structure & function: change of habitat type(s); modification or loss of structure, characterising geomorphology, sedimentology & bathymetry; disruption of hydrodynamic regime & sediment transport processes; modification of suspended particulates, turbidity, light; modification of biological interactions (change in habitat type and altered balance of predator and grazer species) Conservation status of typical species & species features: modification in species variety, distribution, composition, ranges *Operation specific information required: location, extent, scale of structure; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Hard-engineered freshwater watercourses *#	Geophysical regime: substrate, sediment transport Fundamental environmental parameters: modification of salinity, suspended sediments, turbidity Physical disturbance: displacement	✓	✓		✓	✓	Structure & function: localised, and potential far-field, modification of salinity regime and water circulation. Conservation status of typical species & species features: localised modification of species distribution, composition and variety. *Operation specific information required: location, extent, and scale of modification to discharge; timing and duration of construction; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Power station *#	Fundamental environmental parameters: thermal discharge; local modification of salinity Environmental quality: addition of toxic contaminants - biocides; atmospheric discharge; deposition of toxic & non-toxic contaminants	✓	✓	✓	✓	✓	Structure & function: localised, and potential far-field, modification of thermal regime; salinity and water circulation; possible increase in contaminants. Conservation status of typical species & species features: localised modification of species distribution, composition, variety; modification of physiological health, reproduction, survival and competitive ability. Facilitation of survival and reproduction of non-native species. *Operation specific information required: location, extent, scale, frequency, timing, duration and nature of operations affecting features; location, scale, frequency, timing, duration and content of discharges, relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Pipelines *# *Gas pipeline beneath Traeth Lafan.*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise.	✓	✓	✓	✓	✓	Structure & function: dependent on depth of pipeline burial in seabed –modification of sediment transport processes and local hydrodynamic regime. Conservation status of typical species & species features: dependent on depth of pipeline burial in seabed – localised modification of species composition, variety.	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							<u>*Operation specific information required*</u>*: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	
Power / communication cables *# *Cables run across the central section of Menai Strait.*	<u>Geophysical regime</u>: addition of artificial substrate; local modification of water movement <u>Physical disturbance</u>: displacement, visual, noise. Potential electro-magnetic effects of electrical cables.	✓	✓	✓	✓	✓	<u>Structure & function</u>: dependent on depth of cable burial in seabed –modification of sediment transport processes and local hydrodynamic regime. Scour effect on benthic habitats from cables due to wave action. <u>Conservation status of typical species & species features</u>: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. <u>*Operation specific information required*</u>*: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
WASTE DISPOSAL								
Effluent disposal; domestic & industrial (sewage & chemical) *NRW and DCWW datasets available on locations and inputs.*	<u>Geophysical regime</u>: modification of & addition to substrate <u>Fundamental environmental parameters</u>: elevation of suspended particulates; oxygen depletion <u>Environmental quality</u>: addition of toxic and non-toxic contaminants - nutrients, microbial pathogens, surfactants, hormone mimics, petrochemicals, PAHs, PCBs, metals & organometals, organohalides, biocides and other organic & inorganic compounds; organic enrichment <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	<u>Structure & function</u>: direct modification of water quality through elevation of toxic and non-toxic contaminants, nutrients and suspended particulates; indirect modification of sediment quality, salinity, oxygen levels. <u>Conservation status of typical species & species features</u>: water quality directly or indirectly affects habitats feature species and species features. The range of composition of industrial and domestic effluents is extremely wide and the potential impacts arising from the various chemical constituents span the full breadth of biological components of the features. Primary effects on the physiological health of species leading to declines in species population and variety and shifts to opportunistic pollution tolerant species; *inter alia:* - effects of eutrophication and deoxygenation on sediment-living species, caused by organic enrichment & increase in nutrients: disruption to competitive balance in favour of opportunist species and decrease in species richness, consequent decrease in community diversity; increase in opportunistic algal growth - smothering low shore and shallow water algal and macrophyte species - decrease in species variety and physiological health; - direct / indirect, sub lethal / lethal, chronic / acute toxic impacts on algae and invertebrates - *e.g.* chronic species depletion of sediment communities - increased turbidity / suspended particulates - interference with	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							feeding mechanisms and processes in reef dwelling species - decrease in health of species and community diversity - effects of endocrine (hormone) disruptors, persistent bioaccumulated organic toxins (*e.g.* PCBs) on health and reproduction of vertebrates, including grey seal feature - disruption of characteristic ecological structure of features through indirect impacts on predator, scavenger, ecologically structuring species. *Operation specific information required: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	
Effluent disposal: thermal*	Fundamental environmental parameters: thermal regime; possibly also salinity, suspended particulates; oxygen depletion	✓	✓	✓	✓	✓	Structure & function: local modification of thermal regime; possible modification of salinity regimes and water quality depending on content of discharge Conservation status of typical species & species features: effects on species survival, competitive and reproductive capabilities; consequential changes in population sizes and species variety. Potential facilitation of survival and reproduction of non-native species. *Operation specific information required: location, frequency, timing and duration, volume, flow and degree of difference from ambient temperature of discharge; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Sludge dumping*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: addition of nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment Physical disturbance: smothering	✓	✓	✓	✓	✓	Structure & function: direct modification of water and sediment quality through elevation of, nutrients, suspended particulates, toxic and non-toxic contaminants and inert materials; local eutrophication and modification of dissolved oxygen; local (and far field) modification of sedimentology. Conservation status of typical species & species features: effects on the physiological health of species leading to declines in species population and variety, and shifts to opportunistic pollution tolerant species; largely through effects of nutrient enrichment and eutrophication. Magnitude of effects proportional to distance from disposal location. *Operation specific information required: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary).
Miscellaneous wastes & debris (including refuse & litter)	Geophysical regime: addition of persistent artificial substrates Environmental quality: Addition of	✓	✓	✓	✓	✓	Structure & function: local modification of structure, morphology, topography; local modification sediment transport processes, hydrodynamic regime; degradation of inherent quality of habitats; entanglement and/or obstruction of mobile species	Enforce relevant legislation. Education & awareness raising.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	toxic & non-toxic contaminants Physical disturbance: entanglement, smothering						Conservation status of typical species & species features: modification of species composition; population sizes; range and mobility. *Operation specific information required: location, extent, scale, frequency, timing, duration, nature and composition of disposal; relevant location-specific biotic and abiotic.*	
Dredge spoil disposal * *None at present. Nearest dredge material disposal sites are in Liverpool Bay. Historic dredge disposal site off Puffin Island, but has not been used for many years.*	Geophysical regime: modification of sediment transport processes; alteration to substrate Fundamental environmental parameters: changes to suspended sediments, turbidity; dissolved oxygen Environmental quality: increased nutrients; remobilisation of toxic & non-toxic contaminants Physical disturbance: smothering	✓	✓	✓	✓	✓	Structure & function: local modification of sedimentology, topography, sediment transport processes, suspended particulates/turbidity, water and sediment chemistry – remobilisation and redeposition of contaminants; far-field effects (*e.g.* elevated suspended sediments) depending on scale of operation and hydrodynamic regime at disposal point. Conservation status of typical species & species features: modification of species composition – shift toward more disturbance tolerant species; effects on population sizes, physiological health, reproduction, biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, nature and composition of spoil and nature and composition of contamination of spoil; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary). Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off* *Probably widespread and common around coastal populations and industry.*	Fundamental environmental parameters: suspended particulates – increased turbidity; oxygen depletion Environmental quality: addition of toxic & non-toxic contaminants - petrochemicals, PAHs, PCBs, metals & organo-metals, organohalides, biocides, surfactants, hormone mimics, oxidising and reducing agents, and other organic & inorganic compounds.	✓	✓	✓	✓	✓	Structure & function: modification of water & sediment chemistry – nutrient enrichment; contaminant increases; potential local modification of suspended particulates. Conservation status of typical species & species features: modification of physiological health and consequential effect on species reproduction, composition and variety; potential increases in opportunist algal species (including plankton blooms and consequential effects) from nutrient enrichment, modification of species composition and biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, composition of run-off; improved information on type, scale and synergistic effects of toxic contaminants; relevant location-specific biotic and abiotic information*	Continued surveillance and monitoring of inputs and water quality by NRW. Continued development and promotion of good practice. Maintain review of consents to take account of new scientific information. Include in assessment of plans and projects as appropriate
Agricultural run-off *Probably widespread, particularly around coast of Anglesey within SAC, where agricultural use is higher than on the*	Geophysical regime: addition to substrate, modification to hydrodynamic regime & sediment transport Fundamental environmental parameters: elevation of suspended sediments; oxygen	✓	✓	✓	✓	✓	Structure & function: modification of water & sediment chemistry – nutrient enrichment; contaminant increases; increase in suspended particulates/turbidity; decrease in light penetration through water column, increased oxygen demand. Conservation status of typical species & species features: modification of physiological health and consequential effect on species reproduction, composition and variety; contrary effects on	Continued surveillance and monitoring of inputs and water quality by NRW. Continued development and promotion of good practice. Maintain review of consents to take account of new scientific information. Include in assessment of plans and projects as

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
mainland. Concentrated around estuaries.	depletion Environmental quality: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.						plant species from nutrient enrichment and decreased light; potential increases in opportunist algal species (including plankton blooms and consequential effects), modification of species composition and biomass. *Operation specific information required: location, extent, scale, frequency, timing, duration, composition of run-off; relevant location-specific biotic and abiotic information*	appropriate
EXPLOITATION OF LIVING RESOURCES								
Trawling: beam *Byelaws limit larger vessels fishing within SAC.* *Some beam trawling occurs in SAC for research.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species		✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Trawling: otter *Light otter trawling from vessels under 12m occurs in the SAC. Byelaws limit larger vessels from fishing within SAC.* *Some otter trawling occurs in SAC for research.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species		✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size;*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information	
Dredging: toothed *Does not occur.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species		✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This activity has been assessed and is not permitted within the site.
Dredging: bladed - mussel *Occurs within the Fishery Orders within the SAC.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species	✓	✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This is a permitted fishery and undergoes Habitat Regulation Assessments.
Dredging: bladed – mussel seed	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental	✓	✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species,	This is a permitted fishery and undergoes Habitat Regulation Assessments.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Occurs intermittently at a few localised areas in the site.	parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species						removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Dredging: bladed - oyster *Not known to occur.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise Other factors: removal of target species	✓	✓	✓	✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Dredging : mechanical – cockle *Not an approved Welsh Government fishing method.*	Geophysical regime: modification of substrate; addition of persistent inert debris Fundamental environmental parameters: elevation of turbidity & suspended particulates. Physical disturbance: displacement, crushing, amputation, abrasion, entanglement, collision, visual,	✓			✓		Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage to rocky habitat structure; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features). Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	noise Other factors: removal of target species						sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Dredging: deep hydraulic (e.g. WJID)	Geophysical regime: modification of substrate Fundamental environmental parameters: elevation of turbidity & suspended particulates Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, crushing, amputation, smothering Other factors: removal of target species		✓	✓	✓		Structure & function: modification of seabed structure, sedimentology, sediment transport processes; damage to rocky habitat structure; modification of biological reef structures (*e.g.* mussel); modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch, modification of prey and food availability for predator and scavenger species (including species features) Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects. *Operation specific information required: gear type and size; target species; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Dredging: shallow hydraulic (e.g. suction) *Not an approved Welsh Government fishing method.*	Geophysical regime: modification of substrate Fundamental environmental parameters: elevation of turbidity & suspended particulates Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, crushing, amputation, smothering Other factors: removal of target species	✓	✓		✓		Structure & function: modification of seabed structure, sedimentology, suspended particulates & sediment transport processes; modification of biological interactions (ecosystem effects) through depletion of target species, removal of ecologically structuring species as by-catch; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; indirect effect on reef species from elevated suspended particulates / turbidity - sub lethal impacts on invertebrate species (smothering, impedance of feeding mechanisms) *Operation specific information required: gear type; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Netting: (bottom set gill) *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓	✓	✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Netting: bottom-set tangle / trammel *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓	✓	✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Netting: surface-set gill *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species				✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Netting: beach seine *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓		✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Netting: demersal seine *Not currently known to occur within the SAC.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓		✓	✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Netting: beach-set gill *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓		✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Netting: other (e.g. fyke) *Research netting can occur*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: entanglement, displacement (target & non-target species), amputation, abrasion Other factors: removal of target species	✓	✓		✓		Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), removal of ecologically structuring species (predators & scavengers) as by-catch, modification of prey availability for predators (including species features). Lost net will degrade habitat quality and create chronic entanglement risk. Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, e.g. damage / displacement of fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *Operation specific information required: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Permitted activity
Potting: lobster / crab *Occurs throughout site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: displacement, crushing & abrasion Other factors: removal of target species	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, *e.g.* bycatch, damage / displacement of fragile, erect benthic reef species, entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost pots. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							abiotic information	
Potting: prawn *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: displacement, crushing & abrasion Other factors: removal of target species	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, *e.g.* bycatch, damage / displacement of fragile, erect benthic reef species, entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost pots. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Potting: whelk *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate -addition of persistent inert debris Physical disturbance: displacement, crushing & abrasion Other factors: removal of target species	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target species populations. Incidental modification of non-target species populations, population structures, *e.g.* bycatch, damage / displacement of fragile, erect benthic reef species, entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost pots. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Line: long-line *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement Other factors: removal of target species	✓	✓	✓	✓		Structure & function: potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target & non-target species populations and modification of population structures. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Line: handline *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement Other factors: removal of target species		✓	✓	✓		Structure & function: potential reduction of prey availability for predators (including species features) Conservation status of typical species & species features: depletion of target & non-target species populations and modification of population structures. *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Electro-fishing: molluscs *Not approved Welsh Government fishing method.*	Other factors: removal of target species, possible impact to non-target species.	✓		✓	✓		Conservation status of typical species & species features: modification of target & non-target species composition, population sizes, structures and ranges – particularly long-lived species; reduction in species variety, extent, distribution and biomass in sediment habitats; shift in species composition toward opportunist species; potential incidental physical damage to reef-living species on rocky substrates; potential disruption of species feature behaviours and consequential effects.	This would be a permitted fishery and would have to undergo a Habitats Regulation Assessment.
Hand gathering: cockles (excluding access issues) *Significant commercial fishery on Traeth Lafan, Traeth Melynog and Red Wharf Bay occurs annually, when stocks sufficient.* *Also casual private collection.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓			✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	Commercial: This is a permitted fishery and has to undergo a Habitats Regulation Assessment. Casual: To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand gathering: mussels (excluding access issues)	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging)	✓	✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species	Commercial: This is a permitted fishery and has to undergo a Habitats Regulation Assessment. Casual: To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species						Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	
Hand gathering: mussel seed (excluding access issues) *Probably very low levels in SAC.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓	✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	This is a permitted fishery and has to undergo a Habitats Regulation Assessment.
Hand gathering: razor clam (including salting) *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓			✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand gathering: other bivalves	Geophysical regime: modification of	✓	✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of	To secure features at FCS, assess the impacts from

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Occurs within the site but location and effort information is unknown.	substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species						sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	the activity on the features of the site.
Hand gathering: winkles *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓	✓		✓	✓	Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand gathering: crustacean / shellfish *Peeler crab (shore and edible) collection occurs, particularly from boulder shores around the SAC and on sediment shores, where tyres are used to 'attract' crabs.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual	✓	✓		✓	✓	Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats;	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	Other factors: removal of target species						potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	
Hand gathering: algae & plants for human consumption (e.g. *Porphyra, Salicornia*) *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species	✓	✓		✓	✓	Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand gathering: access and vehicle use	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Physical disturbance: compactment and crushing	✓	✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants).	This is a permitted activity and has to undergo a Habitats Regulation Assessment.
Hand / mechanical gathering: algae for chemical extraction / biomass *Occurs within the site but location and effort information is unknown but probably low.*	Geophysical regime: modification of substrate, physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing &	✓	✓		✓	✓	Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (e.g. sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species; modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of species composition and	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	amputation, visual Other factors: removal of target species						variety (e.g. increase in predatory species) in sediment habitats; potential depletion of predator prey species *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	
Bait collection: digging *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate physical structure (direct and indirect through addition of artificial habitat to attract bait species, e.g. 'crab tiles') Fundamental environmental parameters: elevation of turbidity; reduced oxygen, local salinity modification ('salting') Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement; possible crushing, amputation & smothering Other factors: removal of target species		✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (*e.g.* sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory species) in sediment habitats; potential depletion of vertebrate predator prey species *Operation specific information required: target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site. Education & awareness raising
Bait collection: pump *Occurs within the site but location and effort information is unknown.* *Main target species is black lug Arenicola defodiens.*	Geophysical regime: modification of substrate physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen, local salinity modification ('salting') Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement; possible crushing, amputation & smothering Other factors: removal of target species	✓			✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (*e.g.* sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory species) in sediment habitats; potential depletion of vertebrate predator prey species *Operation specific information required: target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site. Education & awareness raising

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Bait collection: boulder turning *Widespread and locally intense. Target species are peeler crab (various species).*	Geophysical regime: modification of substrate physical structure Fundamental environmental parameters: elevation of turbidity; reduced oxygen, local salinity modification ('salting') Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement; possible crushing, amputation & smothering Other factors: removal of target species		✓		✓		Structure & function: modification of habitat structure, sedimentology, topography and microtopography; modification of sediment processes, sediment chemistry (*e.g.* sediment oxygenation, mobilisation of contaminants); modification of biological interactions (ecosystem effects) through depletion of target species (including ecologically structuring species); modification of prey and food availability for predator and scavenger species Conservation status of typical species & species features: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory species) in sediment habitats; potential depletion of vertebrate predator prey species *Operation specific information required: target species and shore type; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site. Education & awareness raising
Collection, for aquarium / curio trade *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement, amputation, visual Other factors: removal of target species	✓	✓	✓	✓	✓	Structure & function: modification of biological interactions (ecosystem effects) through depletion of target species, including ecologically structuring species Conservation status of typical species & species features: depletion of target species populations and modification of target & non-target species population structures. *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site. Education & awareness raising
CULTIVATION OF LIVING RESOURCES								
Aquaculture: algae	Geophysical regime: modification of substrate structure, sedimentology, sediment transport Fundamental environmental parameters: oxygen depletion Environmental quality: organic enrichment Physical disturbance: displacement, smothering Other factors: introduction of non-native species	✓	✓	✓	✓	✓	Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (nutrients, contaminants, sediment oxygen depletion); modification of biological interactions (*e.g.* predator-prey relationships) Conservation status of typical species: decrease in species variety (except possibly in low variety habitats), modification of species composition, population sizes, structures, dynamics and ranges; increase in population size and range of (invertebrate) predatory species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Aquaculture: finfish - sea cages or impoundments * *Not known to occur in SAC.*	Fundamental environmental parameters: oxygen depletion Environmental quality: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓	Extent & distribution: potential decrease in (intertidal) habitat extent Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: crustaceans - sea cages or impoundments* *Not known to occur in SAC.*	Fundamental environmental parameters: oxygen depletion Environmental quality: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓	Extent & distribution: potential decrease in (intertidal) habitat extent Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: molluscan 'ranching'* *Fishery Orders occur within the site.*	Fundamental environmental parameters: oxygen depletion Environmental quality: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓	Extent & distribution: potential decrease in (intertidal) habitat extent Structure & function: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *Operation specific information required: location, extent and scale; species and aquaculture practices; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	This is a permitted activity and has undergone a Habitats Regulation Assessment.
Aquaculture: molluscan 'farming' * (molluscan culture using trestles, ropes,	Fundamental environmental parameters: oxygen depletion Environmental quality: nutrient & organic enrichment; possible	✓	✓	✓	✓	✓	Structure & function: modification of habitat structure, sedimentology, sediment processes; reduction in habitat quality (introduction of artificial substrate); modification of water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants,	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
cages or other structures) *Trestles with oysters on shore in western Menai Strait.*	addition of pesticides & antifoulants Other factors: introduction of non-native species						oxygen demand); modification of biological interactions (*e.g.* predator-prey relationships) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence; increase in population size and range of (invertebrate) predatory species; modification of behaviour and range of predatory vertebrate species (including species features) *Operation specific information required: species and aquaculture structures; location, extent, scale and duration; relevant location-specific biotic and abiotic information*	
Aquaculture: land based semi-enclosed / recirculation * *Large recirculation system facility at Penmon.*	Fundamental environmental parameters: oxygen availability; turbidity Environmental quality: nutrient & organic enrichment; biocides, antibiotics	✓	✓	✓	✓	✓	Structure & function: modification of water chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) Conservation status of typical species & species features: local modification of species physiological health, variety, composition within zone of influence *Operation specific information required: location, extent, scale; content, volume frequency and duration of discharges; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
EXPLOITATION OF NON-LIVING RESOURCES								
Water abstraction* *Abstraction occurs at various locations throughout SAC.*	Geophysical regime: modification of flow regime Fundamental environmental parameters: salinity	✓	✓		✓	✓	Structure & function: local modification of hydrography, temperature, water chemistry & salinity regime Conservation status of typical species & species features: modification of species variety and composition within zone of influence *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.
Aggregate extraction * (mineral & biogenic sands & gravels) *None known at present.*	Geophysical regime: removal and alteration of substrate; modification of sediment transport, wave and tidal stream regimes Fundamental Environmental Parameters: elevation of turbidity / suspended particulates Physical disturbance: displacement, smothering Other factors: removal of biota;	✓	✓	✓	✓		Extent & distribution: potential decrease in size of sandbanks and modification in extent of sediment features Structure & function: modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics Conservation status of typical species & species features: modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. *Operation specific information required: target aggregate & method of extraction; location, extent, volume, frequency, timing and*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
							duration; relevant location-specific biotic and abiotic information	
Oil & gas exploration: seismic survey* *None known at present.*	Physical disturbance: noise (dependant on proximity to site)		✓	✓	✓		Extent & distribution: potential decrease in size of sandbanks and modification in extent of sediment features Structure & function: modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics Conservation status of typical species & species features: modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. *Operation specific information required: target aggregate & method of extraction; location, extent, volume, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.
Oil & gas exploration & production: drilling operations* *None known at present.*	Geophysical regime: substrate modification Environmental quality: hydrocarbon contamination Physical disturbance: displacement, crushing, smothering in immediate vicinity; noise		✓	✓	✓		Conservation status of typical species & species features: sub-lethal physiological effects & modification of behaviour of vertebrate species (including species features) *Operation specific information required: location, extent, scale, frequency, timing duration and nature; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.
Oil & gas exploration & production: operational* & accidental discharges *None known at present.*	Geophysical regime: modification of substrate Environmental quality: petrochemicals, toxic contamination Physical disturbance: general physical effects	✓	✓	✓	✓	✓	Structure & function: water & sediment chemistry: elevation of contaminants (particularly hydrocarbons) and nutrient concentrations. Conservation status of typical species & species features: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment. *Operation specific information required: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.
Renewal energy generation: tidal barrage and impoundments*#	Geophysical regime: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure Fundamental environmental parameters: salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light	✓	✓	✓	✓	✓	Extent & distribution: loss of / reduction in habitat extent; reduction in habitat distribution, *e.g.* estuary and encompassed (particularly intertidal and rocky) habitats; chronic loss of reef through siltation in enclosed waterways Structure & function: upstream of barrage: change of habitat type(s); modification or loss of characterising geomorphology of features (ria, estuaries, tidal narrows); loss or change of habitat structure, sedimentology & bathymetry; disruption of hydrodynamic	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	Environmental quality: toxic & non-toxic contaminant accumulation; organic enrichment						regime (including tidal regime) & sediment transport processes; modification of suspended particulates, turbidity, light; modification of water and sediment chemistry (salinity regime, deoxygenation, eutrophication, contaminant & nutrient accumulation); sediment transport processes; increased turbidity; increased homogeneity of habitats within impounded areas. Downstream from barrage: modification of habitat structure, sedimentology; hydrodynamic regime; sediment transport processes; suspended particulates, turbidity, water (and sediment) chemistry, particularly salinity regime and nutrient / contaminant fluxes. Conservation status of typical species & species features: decrease in species variety, modification of distribution; change in species composition from fully saline and mixed salinity to low salinity species; consequential near and far-field modification of species population structure, physiological health, reproductive capacity. Reduction in species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *Operation specific information required: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance*	
Alternative energy production: tidal and wave energy*#	Geophysical regime: modification of wave and tidal regimes; removal & alteration of substrate Environmental quality: possible toxic & non-toxic contaminants; modification of suspended particulates Physical disturbance: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓	✓	✓	Extent & distribution: potential habitat loss within footprint of generating structures Structure & function: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime Conservation status of typical species & species features: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *Operation specific information required: type, construction & size; location & extent; timing and duration of installation; permanence; anchoring structures; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.
Alternative energy generation: offshore wind *#	Geophysical regime: modification of wave and tidal regimes; modification to substrate Environmental quality: possible	✓	✓	✓	✓	✓	Extent & distribution: potential habitat loss within footprint of generating structures Structure & function: potentially highly variable dependent on nature, construction and scale of structures. Modification of	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
	toxic & non-toxic contaminants Physical disturbance: general physical effects; possible collision						sedimentology & sediment processes, hydrodynamic regime Conservation status of typical species & species features: modification of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) *Operation specific information required: type, construction & size; location & extent; timing and duration of installation; permanence; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	
POLLUTION RESPONSE								
Oil spill response: at sea *Reactive only. No recent activity.*	Environmental quality: toxic contamination - petrochemicals, surfactants, demulsifiers Physical disturbance: noise, visual	✓	✓	✓	✓	✓	Structure & function: modification of water chemistry (with purpose of ameliorating degree of modification) Conservation status of typical species & species features: acute modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics (primarily shallow sediment & reef species, fish and mammals, including species features) *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
Oil spill response: shore cleaning – washing *Reactive only.*	Geophysical regime: modification & removal of substrate Fundamental environmental parameters: salinity; temperature Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, noise, visual	✓	✓	✓	✓	✓	Structure & function: local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or sediment entrapment of hydrocarbon contaminants); Conservation status of typical species & species features: acute local depletion of population sizes, effects on physiological health and potential consequential population dynamics and distribution effects. Disturbance of vertebrate species, including species features *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
Oil spill response: shore cleaning - chemical *Reactive only.*	Environmental quality: addition / increase petrochemicals, surfactants, demulsifiers Physical disturbance: including displacement	✓	✓	✓	✓	✓	Structure & function: modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources Conservation status of typical species & species features: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *Operation specific information required: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Oil spill response: shore cleaning - physical *Reactive only.*	Geophysical regime: modification & removal of substrate Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, trampling, noise, visual	✓	✓	✓	✓	✓	Structure & function: modification of habitat structure, sedimentology, water & sediment chemistry through remobilisation and transfer of hydrocarbon contamination Conservation status of typical species & species features: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Develop and maintain appropriate pollution response contingency plans; inclusion and maintenance of information on site features and sensitivity to at-sea response activities in appropriate pollution response advice contingency plan
RECREATION								
Angling *Occurs within the site but location and effort information is unknown.*	Environmental quality: metals, persistent inert debris Physical disturbance: displacement, entanglement Other factors: removal of target species	✓	✓	✓	✓	✓	Structure & function: local modification of habitat quality through depletion of vertebrate species food resources; disturbance; discarded & lost debris and equipment; modification of local biological interactions (predator-prey relationships) Conservation status of typical species & species features: local depletion of fish species populations; local modification to sensitive species populations through entanglement, displacement (intertidal and vertebrate species including species features); potential by-catch of fish species features *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising To secure features at FCS, assess the impacts from the activity on the features of the site.
Recreational boating: high speed power craft (incl. PWC) *Occurs within the site but location and effort information is unknown.*	Geophysical regime: modification of substrate physical structure; wave exposure regime Fundamental environmental parameters: turbidity Environmental quality: hydrocarbon contaminants; organic enrichment Physical disturbance: displacement, collision, noise, visual	✓	✓	✓	✓	✓	Structure & function: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Recreational boating: low speed power craft *Occurs within the site but location and effort*	Geophysical regime: modification of substrate physical structure; wave exposure regime Fundamental environmental parameters: turbidity Environmental quality: hydrocarbon	✓	✓	✓	✓	✓	Structure & function: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
information is unknown.	contaminants; organic enrichment Physical disturbance: displacement, collision, noise, visual						species; local modification of species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Recreational boating: sail *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement, collision, noise & visual	✓	✓	✓	✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Recreational boating: canoeing *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement, collision, noise & visual	✓	✓		✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Recreational boating: other non-mechanically powered craft (e.g. kite-surfing, board-sailing etc.) *Occurs within the site but location and effort information is unknown.*	Physical disturbance: displacement, collision, noise & visual	✓	✓		✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Recreational boating: moorings *Moorings at various locations around the SAC, particular concentrations around centres of leisure boating activity.*	Physical disturbance: displacement, collision, noise & visual	✓	✓	✓	✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat as plans or projects as appropriate (including assessment of cumulative effects in association with others plans and projects, where necessary); review existing consents, where appropriate.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Recreational boating: anchoring *Occurs within the site but location information is unknown.*	Physical disturbance: displacement, collision, noise & visual	✓	✓	✓	✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS.
Scuba diving, snorkelling *Occurs within the site but location and intensity information is unknown.*	Physical disturbance: displacement noise & visual Other factors: removal of target species		✓	✓	✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Spearfishing *Occurs within the site but location and intensity information is unknown.*	Physical disturbance: displacement noise & visual Other factors: removal of target species		✓	✓	✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Enforcement of relevant legislation. Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Coastal access for recreation (bathing, dog walking, coasteering etc.) *Occurs within the site but location and intensity information is unknown*	Environmental quality: organic enrichment, microbial pathogens, persistent inert materials Physical disturbance: general physical effects; trampling; noise; visual	✓	✓		✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Vehicles on foreshore *Occasional on areas of foreshore within SAC in relation to launching of boats.*	Geophysical regime: substrate Physical disturbance: crushing collision, noise; visual	✓	✓		✓	✓	Structure & function: modification of habitat sedimentology, geomorphology, sediment processes Conservation status of typical species & species features: local modification of benthic species composition and population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working. Appropriate implementation of SSSI procedures & access byelaws
Light aircraft	Physical disturbance: noise & visual	✓	✓		✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate	Activity surveillance

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
Small airfield at Caernarfon, light aircraft fly over SAC.							species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Wildfowling	Environmental quality: metals, persistent inert materials Physical disturbance: crushing; noise; visual	✓	✓		✓		Structure & function: modification of sediment chemistry (heavy metal contamination); habitat modification (manipulation to encourage target species) Conservation status of typical species & species features: local modification of sediment benthic species population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Permitted activity.
Marine wildlife watching / eco-tourism	Physical disturbance: noise & visual	✓	✓		✓	✓	Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance
MILITARY ACTIVITIES								
Military activity: ordnance ranges* *No ranges within or near to SAC.*	Environmental quality: metals, persistent inert materials Physical disturbance: noise; visual	✓	✓		✓		Structure & function: modification of water quality Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; potential effects of contaminants on physiological health *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance, as appropriate.
Military activity: marine exercises *None known within SAC.*	Environmental quality: metals, persistent inert materials Physical disturbance: noise; visual	✓	✓	✓	✓	✓	Structure & function: modification of water quality Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance, as appropriate.
Military activity: aircraft	Physical disturbance: noise & visual	✓	✓		✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate	Activity surveillance, as appropriate.

Activity	Relevant factors	Features					Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
		Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves		
RAF Valley airbase on Anglesey. Occasional aircraft (tornados) transit over SAC.							species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
MISCELLANEOUS OPERATIONS AND USES								
Marine archaeology & salvage *Several fish weirs and traps in the Menai Strait ('Goradau'). Many protected by CADW. HMS CONWAY wrecked in Swellies. Other, smaller shipwrecks in SAC.*	Fundamental environmental parameters: turbidity Environmental quality: metals Physical disturbance: displacement, abrasion, crushing, amputation, noise; visual	✓	✓	✓	✓	✓	Structure & function: potential local modification of sedimentology and sediment transport, geomorphology, water quality (mobilisation of contaminants) Conservation status of typical species & species features: local modification of species population structures *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working.
Education *Occurs within the site but location and intensity information is unknown.*	Physical disturbance:: displacement, crushing, noise, visual Other factors: species removal	✓	✓		✓	✓	Structure & function: local modification of geomorphology, biological interactions Conservation status of typical species & species features: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working. Appropriate implementation of SSSI procedures & access byelaws
Science research *Occurs within the site but location and intensity information is unknown.*	Physical disturbance:: displacement, crushing, noise, visual Other factors: species removal	✓	✓	✓	✓	✓	Structure & function: local modification of geomorphology, biological interactions Conservation status of typical species & species features: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, revise or establish management of practices to secure features at FCS, through education, awareness raising and cooperative partnership working. Appropriate implementation of SSSI procedures & access byelaws

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Also

- Geological Conservation Review Reports.
- North Wales and North Western Sea Fisheries Committee Reports
- CCW Marine Monitoring Reports

Annexes

Annex 1 Menai Strait and Conwy Bay SAC feature map: interpretation guide

The data found within the Menai Strait and Conwy Bay SAC feature map represents the indicative location of the Annex 1 marine features for which the site has been designated, namely:

- **Mudflats and sandflats** not covered by seawater at low tide
- **Sandbanks** which are slightly covered by seawater all the time
- **Reefs**
- **Large Shallow Inlets and Bays**
- Submerged or partially submerged **sea caves**

All feature definitions are taken from the "Interpretation Manual of European Union Habitats[32]"

The following text provides some background information on how each of these feature map layers was compiled including relevant data sources, and any changes that have been made compared with the original indicative feature distributions that were mapped at the time of site designation.

Note:

i. The maps only represent indicative locations of each feature type. They do not show habitat absence. There are areas of seabed within Welsh SACs that have not been mapped or surveyed and therefore the possibility exists for features to be present in other locations i.e. the white areas of the maps. Similarly, the exact boundaries of each feature extent may not be accurate due either to a lack of recent survey data or the mobile nature of some features.

ii. Features such as reefs and sandbanks may occasionally overlap. This is due to the mobile nature of the seabed meaning that sediment may move from time to time (e.g. seasonally or after storm events) to either cover or expose rocky areas beneath.

iii. When MHW or MLW lines are referred to, these relate to Ordnance Survey Mastermap GIS layers.

iv. Features do not appear to sit exactly on top of the coastline in some areas (e.g. intertidal reef polygons or sea cave lines) due to differences in the map datum / projection of the source data and the OS background map.

Mudflats and Sandflats:
The feature extent outline for the mudflats and sandflats features is based on the following information sources:

- CCW Phase 1 Intertidal Habitat Map
- Admiralty Charts
- Expert knowledge

[32] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

No changes in total feature extent have been made except where data errors (e.g. unaligned polygon feature edges) existed in the original map.

Sandbanks
The feature extent outline for the sandbank features found within Menai Strait and Conwy Bay SAC is based on the following data sources:

- UKHO Admiralty Charts and bathymetry data
- Expert knowledge

The indicative sandbank feature polygons within the SAC reflect the mobile nature of the banks by including seabed areas for both the known presence of the elevated bank structure, and areas of associated sediment that the banks could occupy in any given year due to natural movement of sediment over time.

No changes in feature extent have been mapped compared extent mapped at the time of site designation.

Reefs
The indicative reef polygon feature map for Menai Strait and Conwy Bay SAC is predominantly composed of intertidal habitat areas, with only small areas of subtidal reef. Data sources for the indicative feature extent map are:

- CCW Phase 1 Intertidal Habitat Map (intertidal reef areas)
- Admiralty charts
- Expert knowledge

Only one small change has been made to the feature map since site designation. This was to add a small area of subtidal reef identified during an internal data review by Natural Resources Wales.

A reef point location map has also been provided to show where biological records exist for reef habitats from subtidal survey work.

Large Shallow Inlets and Bays
Only one Large Shallow Inlet and Bay is present in Menai Strait and Conwy Bay SAC, namely Conwy Bay. No changes have been made to the extent of this feature since site designation. The Bay uses the landward boundary of the SAC on the coast and a line between the bounding headlands for closure on the seaward side.

Sea caves
The sea caves feature is represented as both points (known cave locations) and lines (sections of the coast where caves are known to occur) derived from survey work. The lines follow the Mean Low Water boundary and represent indicative rather than actual cave locations.

A small number of additional sea cave locations have been added to the feature map from recent survey records.

Annex 2 Glossary of Terms

Meaning of the following terms as employed in this conservation advice:

Term	Meaning as employed in this conservation advice
baroclinic	Seawater circulation pattern arising when density and pressure gradients are perpendicular to each other
benthos; benthic	The forms of marine life that live on, or in, the sea or ocean bottom. Pertaining to the sea or ocean bottom.
bioaccumulation	The uptake and retention of a 'bioavailable' chemical form from any one of, or all possible external sources (*cf* biomagnification *qv*).
biodiversity	Biodiversity has been widely defined and is understood in various ways. It is widely used to capture the concept of the 'variety of life' and includes genetic, species and community diversity.
biogenic	Produced directly by the physiological activities of organisms, either plant or animal (Baretta-Bekker *et al* 1998). Biogenic reefs – long-lived, hard, biological structures comprised of large numbers individual organisms such as mussel or sand-tube building worms *Sabellaria*.
biomagnification	The process whereby a chemical, as it is passed through a food chain or food web, builds to increasingly higher concentrations in the tissues of animals at each higher trophic level (*cf* bioaccumulation *qv*).
biotic and abiotic *factors* (*qv*)	Biotic: "Pertaining to life … influences caused by living organisms", *cf* abiotic: "characteristics and elements of the environment (which) influence survival or reproduction of organisms, that are not alive themselves" (Baretta-Bekker *et al ibid*) Influences and elements of both a biological and non-biological nature that: • contribute to the composition of a habitat, its structure, function or biology (*i.e.* the factors that the comprise habitat, as defined in Habitats Directive, Article 1f: "*habitat of a species* means an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle"); • contribute to a result or to bringing about a result; • affect the course of events. Many factors are *processes* (*qv*) Biotic factors include competitive interaction (e.g. for space and food, predation, scavenging and grazing).
bioturbation	Biological perturbation, or reworking, of sediment by organisms, affecting the exchange of organic matter, oxygen, nutrients etc between buried sediment and the sediment surface and overlying waters.
by-catch	"The catch of non-target species and undersized fish of target species." (CCW 200125). "The part of the catch that does not belong to the retained part of the target species of a fishery. … unmarketable component of target species, marketable species which were not aimed for, … accidental catches. The term is often used rather loosely" (Baretta-Bekker *et al ibid*)
contaminant	Anthropogenically synthesised chemicals (e.g. PCBs, biocides etc.) and anthropogenically elevated naturally occurring chemical components (e.g. heavy metals) that are toxic or otherwise detrimental to the physiological health or well-being of typical species.
degrade	(*degrade*: to lower in rank or grade, to lower in character, value or position or in complexity; *degraded*: declined in quality or standard. *Chambers Dictionary 1998*). In this document, the meaning of degrade is applied to damage or impairment resulting from such human action as has a detrimental outcome for features.
demersal	Living on or near the seabed.
detrimental	Causing damage or harm; damaging, disadvantageous
dioecious	Sexes separate, *i.e.* not hermaphrodite
epifauna (-flora, -biota)	Animals (fauna), plants (flora), organisms (biota) that live on top of seabed or other organisms, either attached to them or freely moving over then; *cf* infauna (*qv*)
eutrophic	Waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the reduction or extinction of other organisms.
evolve	To alter with time, either remaining stable (qv) or changing

Term	Meaning as employed in this conservation advice
extent	The area a feature, or one of its components, covers within its natural range (qv) within the site.
factor	A circumstance, fact, influence or element that: • contributes to composition of a habitat, its structure, function or biology; • contributes to a result or to bringing about a result; • affects the course of events. *Many factors are processes (qv)*
functions	Functions are processes that may, directly or indirectly, influence: • the state of a physical habitat; • the marine life associated with that habitat.
habitat components	Contributing to the composition of a habitat. This includes physical and biological sub-habitats e.g. different types of reef, as well as different elements such as particular communities that make up reef habitats
halocline	The boundary zones between layers of seawater at different salinities (see also thermocline and oxyclines). Together with thermoclines, halocline have a strong influence on seawater density, circulation and species distribution
hydrodynamics	The mechanical effects of moving fluids; i.e. the motions of the sea. (Baretta-Bekker *et al ibid*)
hydrography	The description of the seas: 1) “marine cartography” (coastlines, bathymetry); 2) “descriptive oceanography” (the “description of water properties, their distribution and variation”; encompasses hydrodynamics qv) (Baretta-Bekker *et al ibid*)
hypertrophic	Waters in which mineral and organic nutrients are elevated above natural levels (cf eutrophic qv).
inherent	Existing in and inseparable from something else; innate; natural; the relation between a quality or attribute and its subject (Oxford English and Chambers Dictionaries)
inhibit	To hold in or back; to keep back; to restrain or check; to restrict or prevent
maerl	A calcareous red alga (seaweed) that is an important habitat-structuring component. Maerl is very slow growing and maerl beds tend to support particularly rich and biodiverse marine communities.
maximum sustainable yield (MSY)	Maximum use that a renewable resource can sustain without impairing its renewability through natural growth or replenishment. Fishing at MSY levels means catching the maximum proportion of a fish stock that can safely be removed from the stock while, at the same time, maintaining its capacity to produce maximum sustainable returns, in the long term. Considered as an international minimum standard for stock rebuilding strategies (i.e. stocks should be rebuilt to a level of biomass which could produce at least MSY).
mega, macro, and meio- (biota / flora / fauna)	The sizes of plants and animals. Mega-: no internationally agreed definition, but commonly defined as large enough to be seen discriminated in photographs, 2 cm or larger. Macro - large enough to be seen by the naked eye, greater than 0.5 mm, to up to 2cm. Meio-: organisms that cannot be observed without a microscope; organisms between 0.03 or 0.06 mm and 0.5 mm (cf micro-: organisms invisible to the naked eye, smaller than meiofauna; defined as <32µm) (*Multiple references*)
natural	In this document, the meaning of natural is taken to be as defined in standard English dictionaries: inherent, innate, self-sown and uncultivated, not the work of or the direct product of interference by human action; in accordance with nature; relating to or concerning nature; existing in or produced by nature; in conformity with nature; not artificial. It does not mean or imply pristine (i.e. an original, unmodified, state).
oxycline	The boundary zones between layers of seawater with different dissolved oxygen concentrations (see also halocline and thermocline). Strong influence on species distribution.
process	A series of actions, events or changes that vary in space and over time. In this context processes include physical, chemical and biological environmental changes which are inherently natural but which may be modified by human activity (e.g. wave action, nutrient fluxes).

Term	Meaning as employed in this conservation advice
	All processes are factors.
quality (of habitat)	The relative absence of anthropogenic modification of naturalness of habitat extent, structure, function and typical species as a result of, inter alia: • change in distribution, extent, geology, sedimentology, geomorphology, hydrography, meteorology, water and sediment chemistry and biological interactions; • change in species richness, population structure and dynamics, physiological health, reproductive capacity, recruitment, mobility and range or of anthropogenic modification of suitability of habitat as a result of, inter alia; • level of disturbance • alternation of prey/food supply • contamination of food supply
range	The natural spatial distribution of a feature, habitat, habitat component or species. Depending on the context, this term either describes the global distribution of the feature or, in the context of the site, the distribution of the feature within the site
safe biological limits	ICES definition of fisheries sustainability. “Within SBL” defined as stock at full reproductive capacity and harvested sustainably. ICES Advice Autumn 2004 & summarised at www.defra.gov.uk/environment/statistics/coastwaters/cwfishstock.htm
salinity	Seawater salinity is measured in parts of salt in one thousand parts water (‰).
salt wedge	When freshwater and seawater meet in an estuary or sheltered marine inlet, the two water masses or different density often do not mix completely. A distinguishable inflowing tongue of dense seawater beneath a less dense layer of freshwater is referred to as a salt wedge. The shape of the salt wedge in Milford Haven is measurably deflected to the south side of the Haven by the earth’s rotation.
sessile	Benthic (qv) organisms living attached to the seabed substrate.
species richness	Variety of species. The total number of species: • among a fixed number of individuals; • per unit of surface area (of habitat).
spraint	Descriptive term for otter faeces. Spraint has a distinctive smell and appearance; it contains indigestible food remains from which prey species may be identified.
stable	Tendency towards an equilibrium state in spite of varying external conditions.
structure	The composition and arrangement of those: • parts of the feature, • parts of the natural environment, • circumstances, that constitute the feature or are required by the feature for its maintenance in both the long term and foreseeable future.
stochastic	Random, chaotic, possible but unpredictable.
thermocline	A boundary zone between layers of seawater at different temperatures (see also halocline and oxycline). Together with haloclines, thermoclines have strong influences on seawater density, circulation and species distribution.
supporting sediments	Sediments with strong geomorphological / sediment-transport links to the feature. Particularly relevant to areas of sediment exchange and supply.
thermohaline circulation	Seawater circulation driven by density differences caused by seawater temperature and salinity differences.
typical species	Species that are, from time to time, associated with a specified habitat within the site; i.e. all species that contribute to the biodiversity of the specified habitat within the site.

Annex 3 List of SSSIs and SPAs partly or wholly with the SAC

Sites of Special Scientific Interest that are partly or wholly within the SAC:

- Arfordir Gogleddol Penmon – North Penmon Coast
- Glannau Penmon – Biwmares – Penmon to Beaumaris shore
- Glannau Porthaethwy – Menai Bridge Shore
- Y Foryd – Foryd Bay
- Traeth Lafan – Lavan Sands
- Aber Afon Conwy – Conwy Estuary
- Pen Y Gogarth – Great Ormes Head
- Criegiau Rhiwledyn – Little Ormes Head

SPAs that are partly or wholly within the SAC:

- Ynys Seiriol – Puffin Island
- Traeth Lafan – Lavan Sands

Locations are shown on the associated feature map[33].

[33] Available from the NRW web site

Annex 4 Elements of favourable conservation status

Elements that may be considered when assessing or considering favourable conservation status of a habitat or feature.

Table 4.1: Habitats – elements of favourable conservation status and its rationale

Element	Description and rationale
RANGE	
Distribution	Distribution of habitat features within the site, and also within a national and European context, has a key role in determining the distribution and abundance of typical species. Also important is the distribution within a habitat feature of components of habitat structure (e.g. Sediment granulometry) and of habitat function (e.g. Wave exposure).
Extent	Overall extent, large examples or extensive areas are inherently highly rated and contribute to conservation of structure and function The extents of habitat components, both structural functional are important determining factors of habitat and species diversity.
Structure	Physical structures of habitat features and their variation are the foundation of habitat diversity and, accordingly, species diversity. Along with environmental processes (function), habitat structure strongly influences where things live.
Geology	Geology at all spatial scales underpins the structure of the habitats, from overall coastal structure, which determine exposure to major environmental processes, to local habitat structure. The range of rock types and the distribution of rock folding, faulting and fracturing determine the overall complexity of shape of the seabed and coast and the diversity of habitats.
Sedimentology	Sedimentology is the result of complex processes significantly influenced by water movement. Sediment granulometry, structure and degree of sorting (from well sorted fine – medium sands and muddy sands to poorly sorted, mixed substrata containing mud, gravel, shell and stones) creates an extremely wide range of sediment habitats.
GEOMORPHOLOGY	
morphology (shape)	The gross shape of features and of individual sections of features is an essential component of habitat structure and contributes to habitat diversity.
topography (surface structure)	Surface relief of all substrates is a fundamentally important component of habitat structure, underpinning biological diversity through the provision of different habitats and microhabitats and a range of depths below sea level or intertidal drying heights. Topography, together with morphology, has a critical influence on hydrodynamic processes. Rock topography is fundamentally determined by geology. The range of rock topography is a particularly important contributor to reef biodiversity. Sediment topography is important in sediment habitats. For example granulometry and slope together determine sediment flats' ability to retain water during low tide (the amount of interstitial water retained is important in determining community composition); the breadth of the shore (related to slope) in combination with shore aspect, is important in determining the degree of wave energy expended on any part of the shore, therefore influencing community composition.
microtopography	Rock microtopography is determined by geology, with surface pits, cracks, fissures, bore-holes etc. providing additional niches for marine wildlife. The microtopography of sediment flats is important in determining water runoff (including the formation of rips) and retention and, in turn, influence the distribution of surface biota and granulometry.
orientation and aspect	Orientation and aspect are products of morphology and topography that, in combination with functional processes such as wave or light exposure, extend the variety of niches provided by habitat features. Range and variation in orientation and aspect enhance habitat and species diversity.
bathymetry	Bathymetry is determined by other structural components and by hydrodynamic and sediment processes. Depth of seabed is in turn a critical influence on hydrodynamic processes, such as wave exposure and tidal streams. In combination with water

Element	Description and rationale
	clarity, depth determines light attenuation through the water column thereby contributing directly to community structure. Bathymetric variation within and between individual parts of features enhances habitat and species diversity
FUNCTION	Distribution, extent, abundance and variety of species populations is shaped by spatial and temporal variation of a wide range of physico-chemical and biological processes (functions).
Hydrography & meteorology	Hydrographic & meteorological processes are fundamental to the structure and function of habitats and their species populations. The magnitude of hydrographic factors varies along gradients determined by the underlying geomorphology of the site and complex interactions with other functional processes.
hydrodynamics (water movement)	Water movement is a fundamentally important environmental process that determines the species composition present at any particular location, both directly and indirectly through its effect on other important processes such as nutrient, sediment and dissolved gas transport. The range of relative contributions of tidal streams, wave action and residual currents to water movement is particularly important in determining biological composition.
	Tidal range and rise - fall is of critical importance to structure, function and species population of habitats both directly – determining extent of intertidal areas and the emergence regime; and indirectly through the action of tidal streams.
	Tidal streams (currents): the strength, patterns, relative constancy, lack of attenuation with depth, general bidirectionality and spatial and temporal variations in tidal streams are important in structuring the distribution of species populations; food, sediment and chemical transport processes; water mixing.
	Wave exposure. Wave action is one of the most physically powerful, chaotic and relatively unpredictable processes. Exposure to wave action is determined by habitat morphology, topography, aspect, attenuation with depth and meteorological processes and has a major influence on distribution of species populations; water clarity and water mixing. The range of wave exposure within the site is extreme.
	Residual current flows modify local hydrodynamic and meteorological processes for example through inputs of water masses with elevated suspended sediment loads, temperature and / or nutrients and contaminants.
temperature (water)	Water temperature strongly influences water chemistry and biological processes, such as reproduction and metabolism. The biogeographical location of the sites and the degree of buffering of winter minima and summer coastal warming by oceanic waters (North Atlantic Drift) strongly influences and limits the sea temperature range. Temperature range is important in mediating reproduction and survival of species, shielding submerged species from the more extreme temperatures experienced by intertidal species and reducing the ability of some non-native species to become established. Global processes (global warming, shifts in ocean currents), influenced by climate change, also influence local seawater temperature regime temporarily, seasonally or chronically.
light intensity (ambient seabed and water column)	Seabed light intensity has an important influence on community structure, particularly through algal species distribution, mediated by bathymetry, water transparency and localised shading (e.g. from overhangs, caves or aspect). Spatial and temporal variation in light intensity has considerable broad and local scale impacts on species population distributions and community variation. Water column light intensity in combination with shelter from extreme water movement and elevated nutrients is important in the occurrence and distribution of seasonal plankton blooms.
Seston Concentrations and water transparency (clarity/ turbidity)	Seston (suspended particulate matter) concentrations are critically importance as a food-energy resource, is a factor in sediment processes and deposition including smothering and scouring of biota, and through absorption of light modifying light availability at seabed and in water column. Seston composition and water column loads are determined by the origins of the particulate matter – biological productivity and / or riverine, coastal or oceanic water inputs.

Element	Description and rationale
METEOROLOGY	
temperature (air)	Air temperature is an important factor in several aspects of intertidal habitat function (heat / cold tolerance, control of reproduction, desiccation, dissolved oxygen, salinity). Although overall air temperature is climate controlled, it is subject to local modifications by habitat structure and species populations.
light (solar irradiance)	Solar irradiance is a fundamental requirement for plant primary production. It is determined by meteorological conditions, and seabed and water column irradiance is mediated as described above. It also has direct effects on temperature, desiccation, UV exposure, dissolved oxygen and salinity in intertidal habitats, where it is mediated by localised shading (e.g. from overhangs, caves or aspect).
humidity	In association with temperature and air movement, humidity is an important factor controlling evaporation, and consequently salinity and the desiccation of intertidal species. Although overall humidity is climate controlled, it is subject to local modifications by habitat structure and species populations.
air movement (wind)	Wind strength, direction and fetch are the fundamental influences on wave action. The effect of air temperature and humidity on intertidal species and communities is strongly influenced by air movement. Although overall air movement is climate controlled, it is subject to local modification by habitat structure and local topography.
precipitation	Rainfall locally modifies salinity in intertidal areas, modifies temperature and humidity and increases transport of terrestrial sediments and other materials (e.g. nutrients, contaminants) into the marine environment. Land use and surface water management influences the effect of heavy rainfall in creating spate events that increase short term flow rates, soil erosion and particulate suspension.
WATER & SEDIMENT CHEMISTRY	
salinity	Salinity is of fundamental physiological and ecological significance. Horizontal and vertical salinity gradients from average fully saline open coast seawater through brackish to freshwater and temporal variation in the gradients are of primary importance in species distribution.
nutrients	Dissolved organic nutrients and trace elements are essential to biochemical processes. Major nutrients in unmodified conditions vary seasonally within ranges characteristic of individual water bodies with the uptake by and decomposition of biota. Acute or chronic anthropogenic elevation causes ecologically important eutrophication or toxic effects.
contaminants	Levels of acutely or chronically toxic anthropogenically synthesised chemicals (e.g. PCBs, biocides etc.) and anthropogenic elevation of naturally occurring chemical components (e.g. some hydrocarbons, heavy metals) are critical influences for example on species survival, physiological health, and reproductive capacity.
dissolved oxygen	Oxygen availability is of fundamental physiological and ecological significance. Availability is influenced by water movement and surface disturbance, water temperature, sediment granulometry and disturbance, organic content and biological oxygen demand. Reduced oxygen flow and / or increased oxygen demand (through decomposition of trapped organic matter) within sediments tends to result in significantly reduced levels; anaerobic conditions in sediments may result in the formation of toxic substances (e.g. hydrogen sulphide).
sediment processes	Sediment erosion, transport and deposition are critical in determining extent, morphology and functional processes of sediment based habitats and have important functional influences on rock-based habitats. Sediment processes in the site are a reflection of many complex causal processes and are themselves complex, contributing to high habitat and community diversity.
TYPICAL SPECIES	As the rationale for selection of components of species conservation status is similar for both species features and typical species of habitat features the rationale for both has been combined and is given the species table below.

Table 4.2: Typical species & species features – elements of favourable conservation status and its rationale.

Element	Description and rationale
SPECIES RICHNESS (Variety of species)	Species richness is most likely to be applicable as a component of FCS for typical species of Habitat features. However, the variety of available prey is likely to be important to predatory species features such as dolphins, seals, otter, lamprey and shad, and, as such, it forms an important measure of a species features habitat quality. Biological variety is a key contributor to biodiversity and applies at both taxonomic and genetic levels. Species variety "typical" of different habitats is dependent on the ecological opportunities available (niche diversity), particularly the degree of stress from natural processes. Habitats and communities subject to moderate levels of disturbance tend toward high species diversity. A high proportion of the species in such highly diverse communities are usually present at low frequencies and, individually, may make a small contribution to the overall functioning of the community. Nevertheless, such "species redundancy" is a vital contribution to biodiversity in many marine habitats and communities, and is consequently extremely important in terms of the conservation of the habitat features.
POPULATION DYNAMICS	Species population dynamics are inherently important in maintaining viability of species populations and species variety.
POPULATION SIZE	
Population size (species abundance)	Sizes of species populations vary widely depending on their biology and ecology (e.g. Reproductive, competitive, survival and life history strategies; recruitment, habitat requirements; adaptation to natural processes and factors) and stochastic events. For a species feature, population size is a key measure of the species ecological success or failure. Along with a typical species' distribution, its population size determines its contribution to biodiversity and to habitat structure and function. Population sizes of small, short-lived, rapidly reproducing species are orders of magnitude greater than large, long-lived, slowly reproducing and infrequently recruiting species. Populations of many species fluctuate widely in response to natural and artificial perturbations and opportunities; many others remain stable for long periods and many of these are particular sensitive to anthropogenic disturbance or habitat degradation.
Contribution to the integrity of wider population	The full range of some species features are only partly encompassed by the site. The long-term viability of the species population may therefore be in part or mainly determined by stock outside the site, and vice versa (e.g. through immigration and emigration, genetic variation etc.). The contribution a species population occurring within a site makes to the wider population status is important to the long-term viability of the species as a whole, including that occurring within the site.
Biomass	Biomass is the potential energy of species populations, and thus fundamental to species physiological health, reproductive capacity and energy reserves, and is an energy resource for other species. Sediments with high organic input typically support a species biomass and rate of turnover (productivity) sufficiently high to contribute significantly to the maintenance of predatory typical species such as fish and waders and wildfowl. However, high biomass and low species variety may also be indicative of environmental stress or perturbation. Biomass of different reef habitats is extremely variable, varying with species composition and recruitment, age structure, health and environmental stress and consequently frequently varies widely within a small area of apparently similar habitat for a variety of reasons.
Reproductive success	The ability to successfully reproduce is critical to a species population's long-term viability. Reproductive success is a function of reproductive capability and the survival of young. Reproductive capability is a function of many factors including physiological health, temperature regime and population density. Reduced physiological health and other

Element	Description and rationale
	stressors can reduce reproductive capability as, under these circumstances, most species concentrate internal resources on survival instead of reproduction. For many species (not mammals and birds) gonadal somatic index (ratio between body mass and gonad mass) is a good measure of reproductive capability. High reproductive capability does not necessarily translate to high reproductive success. Survival of young to age of recruitment to the population is a function of reproductive strategy and varies by orders of magnitude depending on the strategy, ecological hazards and stochastic events. Dispersive invertebrate larval stages vary extremely in the numbers surviving from place to place and time to time with weather, currents, availability of food, period spent in the plankton, predation and intrinsic variability in processes killing and removing species e.g. competition for food and space, predation. At the other extreme, survival of young marine mammals is very high because of the heavy parental investment in low numbers of offspring. However, the relative survival rates of all strategies are vulnerable to modification by stochastic events.
Recruitment	Recruitment of young is critical to the maintenance of species population's long-term viability. Natural variation in successful recruitment is a critical factor contributing to species variety. Many invertebrate and algal species are at least partly dependant on recruitment from outside the feature.
POPULATION STRUCTURE	
Age frequency	Age frequency is important in determining the degree of success of population reproduction and resilience to perturbation for many species. Variation in population structure contributes to the complexity of community mosaics and to biodiversity. Age or size frequency is an important indicator of a species population's long-term viability.
Sex ratio	Sex ratio is important in determining the degree of reproductive success and therefore the long-term viability of dioecious species populations.
Physiological health	Physiological health is a critical component of a species population's long-term viability. It encompasses both genetic and physiological fitness. Knowledge of the physiology of most marine species is inadequate to directly express health in positive terms. Indicators of healthiness include reproductive capacity (e.g. gonadal somatic index) and immunity to disease; and of potential poor health: contaminant burden, immunosuppression, epibiota burden, nutritional state and physical damage.
Immunity to endemic disease	Reduced physiological health, e.g. through raised stress or chemical contamination, typically increases susceptibility to endemic diseases.
Exposure to anthropogenic disease	Certain species may contract diseases of humans and domesticated animals. Certain anthropogenic activity can increase the risk of this. Whilst diseases that can cross such species barriers are few, if it were to occur there is the potential for very significant impact on the wild species population.
RANGE	
Distribution throughout site	Species populations are distributed within their habitats according to their ecological requirements (particularly sessile species). The distribution of most species across and along environmental gradients results in extremely complex mosaic of communities (aggregations of species) that vary over time. The distribution and extent of species are, within constraints of species' adaptation to physical factors and biological interaction, variable in time and space. Modification of structural and functional factors by human action will likely result in alterations to species distribution, extent and abundance.
Distribution of specific behaviours throughout the site	Some mobile species (e.g. dolphins, seals, spider crabs & bass) use different parts of their habitat for different behavioural purposes (e.g. feeding, moulting, breeding). The locations used are usually important for the particular behaviour displayed. Displacement of this behaviour to other less favourable locations can be detrimental to the species.
Mobility (ability to move about the site, within and between features,	For most non-sessile species the ability to move around unimpeded is a prerequisite to maintenance of viable populations through, inter alia, successful feeding, predation-avoidance and reproduction. This includes both territorial species with localised mobility requirement and highly mobile and / or migratory species which are dependent on features for a part of

Element	Description and rationale
unimpeded)	their ecological requirements (inter alia otter, seals, sea and river lamprey, shad, herring). Unimpeded mobility of reproductive products, larvae and juveniles of species is critical to the maintenance of viable species populations.
SUPPORTING HABITAT & SPECIES	Any components of habitat conservation status (Table 4.1 above) may apply to typical species of habitat features, and may apply to a species feature where the component is relevant to the conservation of that species feature. The most likely components of habitat conservation status that are relevant to the conservation of species features are given below.
DISTRIBUTION AND EXTENT	
Preferred habitat	The habitat used by the species within the site. For wide ranging species this will likely be the whole area of the site.
Habitats utilised for specific behaviours	The distribution and extent of habitat necessary for specific behaviours, such as feeding, breeding, resting and social behaviour.
STRUCTURE & FUNCTION	
Structural and functional integrity of preferred and specific habitats	The structure and functions that maintain the habitat in a form suitable for the long-term maintenance of the species population. This is linked to habitat quality.
Quality of habitat	The natural quality of habitat features may be reduced by modification of structural components identified above and, including by: • the presence and persistence of artificial inert or toxic materials (e.g. synthetic plastics and fibres, hydrocarbons) • causing entanglement, smothering or ill-health; • decrease in seclusion because of noise and visual disturbance. Human activity with the potential to cause disturbance, • affecting behaviour or survival potential includes waterborne leisure and commercial activities, wildlife watching; • competition for space, causing displacement, collision, noise and visual disturbance, increased density dependent • pressure on preferred sites, exposure to disease (see above); • Contamination of prey (see below);
Prey availability	The presence and abundance of prey within the site may contribute to the species presence and its long term viability.
Prey contamination	Contamination of species feature prey can reduce the long-term viability of the species population. Contaminants that bioaccumulate and biomagnify and which affect the species physiological health would be of particular concern.

Published by:
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