MONA OFFSHORE WIND PROJECT

Appendix to ExQ1 Q1.10.6 Part A, Conservation objectives for SACs screened in for Likely Significant Effects

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Appendix

Glossary

Term	Meaning
Applicant	Mona Offshore Wind Limited.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Mona Offshore Wind Project	The Mona Offshore Wind Project is comprised of both the generation assets, offshore and onshore transmission assets, and associated activities.
The Planning Inspectorate	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects.

Acronyms

Acronym	Description
HRA	Habitats Regulations Assessment
LSE	Likely Significant Effect
SAC	Special Area of Conservation
SCI	Site of Community Importance (SCI)

1 Appendix to ExQ1 Q1.10.6 Part A Conservation objectives for SACs screened in for Likely Significant Effects

1.1 Introduction

1.1.1.1 This document has been prepared in response to Question 1.10.6 of the Examining Authority's first round of Written Questions addressed to the Applicant. The question is as follows:

Conservation Objectives

The ExA will be considering the potential for adverse effects on European sites in light of their conservation objectives. Can the Applicant provide conservation objectives for all European sites for which a Likely Significant Effect has been identified.

1.2 Response

1.2.1.1 This document includes the conservation objectives for the following Special Areas of Conservation (SACs) for which a Likely Significant Effect (LSE) was identified in the Habitats Regulations Assessment (HRA) Stage 1 Screening Report (REP2-012):

- Menai Strait and Conwy Bay/Y Fenai a Bae Conwy SAC (Appendix A)
- Dee Estuary/Aber Dyfrdwy SAC (Appendix B)
- River Dee and Bala Lake/Afon Dyfrdwy a Llyn Tegid SAC (Appendix C)
- River Ehen SAC (Appendix D)
- River Eden SAC (Appendix E)
- River Derwent and Bassenthwaite Lake SAC (Appendix F)
- Solway Firth SAC (Appendix G)
- River Kent SAC (Appendix H)
- River Bladnoch SAC (Appendix I)
- Afon Gwyrfai a Llyn Cwellyn SAC (Appendix J)
- North Anglesey Marine/Gogledd Môn Forol SAC (Appendix K)
- North Channel SAC (Appendix L)
- Lleyn Peninsula and the Sarnau/Pen Llyn a`r Sarnau SAC (Appendix M)
- West Wales Marine/Gorllewin Cymru Forol SAC (Appendix N)
- Cardigan Bay/Bae Ceredigion SAC (Appendix O)
- Pembrokeshire Marine/Sir Benfro Forol SAC (Appendix P)
- Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC (Appendix Q)
- Isles of Scilly Complex SAC (Appendix R)
- Lundy SAC (Appendix S)
- The Maidens SAC (Appendix T)
- Strangford Lough SAC (Appendix U)

- Murlough SAC (Appendix V)
- Rockabill to Dalkey Island SAC (Appendix W)
- Roaringwater Bay and Islands SAC (Appendix X)
- Blasket Islands SAC (Appendix Y)
- Saltee Islands SAC (Appendix Z)

1.2.1.2 The following French sites were also screened in for LSE in the HRA Stage 1 Screening Report (REP2-012):

- Mers Celtiques - Talus du golfe de Gascogne Site of Community Importance (SCI)
- Abers - Côte des legends SCI
- Ouessant-Molène SCI
- Côte de Granit rose-Sept-Iles SCI
- Anse de Goulven, dunes de Keremma SCI
- Tregor Goëlo SCI
- Côtes de Crozon SCI
- Chaussée de Sein SCI
- Cap Sizun SCI
- Récifs du talus du golfe de Gascogne SCI
- Anse de Vauville SCI
- Cap d'Erquy-Cap Fréhel SCI
- Baie de Saint-Brieuc – Est SC
- Banc et récifs de Surtainville SCI
- Baie de Lancieux, Baie de l'Arguenon, Archipel de Saint Malo et Dinard SCI
- Estuaire de la Rance SCI
- Baie du Mont Saint-Michel SCI

1.2.1.3 It should be noted that separate conservation objective documents are not available for these 17 French sites. The conservation objective for the harbour porpoise *Phocoena phocoena* feature of these French sites is therefore assumed to be as follows (taken from European Commission (2012)):

To maintain (or restore where appropriate) the qualifying interest to favourable conservation status.

1.2.1.4 The conservation objectives for the Special Protection Areas for which an LSE was identified in the HRA Stage 1 Screening Report (REP2-012) are provided separately in S_D3_25.6 Appendix to ExQ1 Q1.10.6 Part B, Conservation objectives for SPAs screened in for Likely Significant Effects at Deadline 3.

1.3 References

European Commission (2012) Commission Note on Setting Conservation Objectives for Natura 2000 Sites. Available at https://circabc.europa.eu/ui/group/3f466d71-92a7-

49eb-9c63-6cb0fadf29dc/library/3a8cbb6b-c03d-41af-ab2f-941fb2cbf41b?p=1&n=10&sort=modified_DESC. Accessed September 2024.

Appendix A Menai Strait and Conwy Bay/Y Fenai a Bae Conwy SAC

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.

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[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.

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[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].

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[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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
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**		
	<u>Physical disturbance</u>: displacement, crushing, abrasion, smothering visual, noise						contamination and availability. <u>Conservation status of typical species & species features</u>: likely decrease in species diversity and effects to population dynamics dependant on location and extent of proposed maintenance and materials used. *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	
Dredging: capital *	<u>Geophysical regime</u>: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters</u>: changes to available oxygen; turbidity; suspended sediments <u>Environmental quality</u>: increased suspended nutrients; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) <u>Physical disturbance</u>: displacement, abrasion, smothering, visual, noise <u>Other factors</u>: removal of biota	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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). *<u>Operation specific information required</u>: 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*	<u>Geophysical regime</u>: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters</u>: changes to available oxygen; turbidity; suspended sediments <u>Environmental quality</u>: increased suspended nutrients; toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, abrasion,	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
							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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
							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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
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*	<u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: suspended sediments, turbidity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential loss of / reduction in habitat extent. <u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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*	<u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: suspended sediments, turbidity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential loss of / reduction in habitat extent. <u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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*	<u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: suspended sediments, turbidity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential loss of / reduction in habitat extent. <u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
							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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
							Operation specific information required: 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.*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise. Potential electro-magnetic effects of electrical cables.	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. *Operation specific information required: 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.*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: 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 Physical disturbance: smothering	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: 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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
							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.	<u>parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓	✓		<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual,	✓			✓		<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
							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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	<u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species						<u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓	✓		✓		<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓			✓		<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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	<u>Geophysical regime</u>: modification of	✓	✓		✓		<u>Structure & function</u>: 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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	<u>Other factors</u>: removal of target species						potential depletion of predator prey species *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓	✓		✓	✓	<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Physical disturbance</u>: compactment and crushing	✓	✓		✓		<u>Structure & function</u>: 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.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing &	✓	✓		✓	✓	<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 <u>Other factors</u>: introduction of non-native species						oxygen demand); modification of biological interactions (*e.g.* predator-prey relationships) <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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.*	<u>Fundamental environmental parameters</u>: oxygen availability; turbidity <u>Environmental quality</u>: nutrient & organic enrichment; biocides, antibiotics	✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features</u>: local modification of species physiological health, variety, composition within zone of influence *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification of flow regime <u>Fundamental environmental parameters</u>: salinity	✓	✓		✓	✓	<u>Structure & function</u>: local modification of hydrography, temperature, water chemistry & salinity regime <u>Conservation status of typical species & species features</u>: modification of species variety and composition within zone of influence *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: removal and alteration of substrate; modification of sediment transport, wave and tidal stream regimes <u>Fundamental Environmental Parameters:</u> elevation of turbidity / suspended particulates <u>Physical disturbance</u>: displacement, smothering <u>Other factors</u>: removal of biota;	✓	✓	✓	✓		<u>Extent & distribution</u>: potential decrease in size of sandbanks and modification in extent of sediment features <u>Structure & function</u>: modification of habitat structure, sedimentology, morphology, sediment transport processes, hydrodynamics <u>Conservation status of typical species & species features</u>: modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. *<u>Operation specific information required</u>: 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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
							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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	<u>Environmental quality</u>: 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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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*#	<u>Geophysical regime</u>: modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance</u>: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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 *#	<u>Geophysical regime</u>: modification of wave and tidal regimes; modification to substrate <u>Environmental quality</u>: possible	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: 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 <u>Physical disturbance</u>: general physical effects; possible collision						sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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.*	<u>Environmental quality</u>: toxic contamination - petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: noise, visual	✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water chemistry (with purpose of ameliorating degree of modification) <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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.*	<u>Geophysical regime</u>: modification & removal of substrate <u>Fundamental environmental parameters</u>: salinity; temperature <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, noise, visual	✓	✓	✓	✓	✓	<u>Structure & function</u>: local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or sediment entrapment of hydrocarbon contaminants); <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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.*	<u>Environmental quality</u>: addition / increase petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: including displacement	✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources <u>Conservation status of typical species & species features</u>: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *<u>Operation specific information required</u>: 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 <u>Physical disturbance</u>: displacement, collision, noise, visual						species; local modification of species composition *<u>Operation specific information required</u>: 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.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: 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.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓		✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: 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.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓		✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: 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.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: 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: Mud & sandflats	Reefs	Sandbanks	Inlets & bays	Sea caves	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
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: Mud & sandflats	Features: Reefs	Features: Sandbanks	Features: Inlets & bays	Features: Sea caves	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
RAF Valley airbase on Anglesey. Occasional aircraft (tornados) transit over SAC.							species <u>*Operation specific information required*</u>*: 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.*	<u>Fundamental environmental parameters</u>: turbidity <u>Environmental quality</u>: metals <u>Physical disturbance</u>: displacement, abrasion, crushing, amputation, noise; visual	✓	✓	✓	✓	✓	<u>Structure & function</u>: potential local modification of sedimentology and sediment transport, geomorphology, water quality (mobilisation of contaminants) <u>Conservation status of typical species & species features</u>: local modification of species population structures <u>*Operation specific information required*</u>*: 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.*	<u>Physical disturbance</u>:: displacement, crushing, noise, visual <u>Other factors</u>: species removal	✓	✓		✓	✓	<u>Structure & function</u>: local modification of geomorphology, biological interactions <u>Conservation status of typical species & species features</u>: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species <u>*Operation specific information required*</u>*: 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.*	<u>Physical disturbance</u>:: displacement, crushing, noise, visual <u>Other factors</u>: species removal	✓	✓	✓	✓	✓	<u>Structure & function</u>: local modification of geomorphology, biological interactions <u>Conservation status of typical species & species features</u>: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species <u>*Operation specific information required*</u>*: 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.

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Appendix B Dee Estuary/Aber Dyfrdwy SAC

NATURAL ENGLAND

Noddir gan
Lywodraeth Cynulliad Cymru
Sponsored by
Welsh Assembly Government

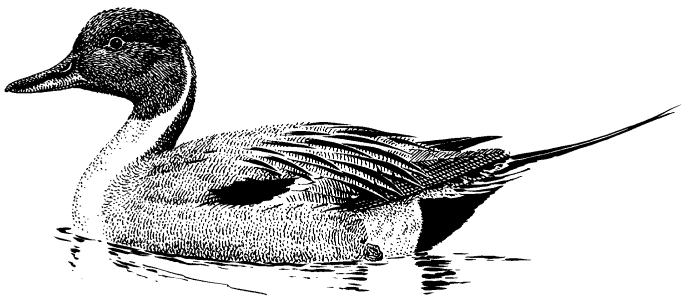
Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

The Dee Estuary
European Marine Site

comprising:

Dee Estuary / Aber Dyfrdwy Special Area of Conservation
The Dee Estuary Special Protection Area
The Dee Estuary Ramsar Site

Natural England & the Countryside Council for Wales' advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994



January 2010

This document supersedes the May 2004 advice. A Welsh version of all or part of this document can be made available on request

This is Volume 1 of 2

Natural England and the Countryside Council of Wales' advice for the Dee Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Preface

This document contains the joint advice of Natural England[1] and the Countryside Council for Wales (CCW) to the other relevant authorities for the Dee Estuary European marine site, as to:

(a) the conservation objectives for the 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 advice is provided in fulfilment of our obligations under Regulation 33(2) of the Habitats Regulations.[2]

An earlier version of this document was published in 2004 by English Nature and CCW. This document replaces that earlier version.

The Dee Estuary European marine site comprises the marine areas of The Dee Estuary Special Protection Area (SPA) and Dee Estuary / Aber Dyfrdwy Special Area of Conservation (SAC). The extent of the Dee Estuary European marine site is defined in Section 1. European marine sites are defined in the Habitats Regulations as any part of a European site covered (continuously or intermittently) by tidal waters or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters. European sites include SACs designated under the 1992 Habitats Directive[3], which support natural habitats and species of European importance, and SPAs classified under the 1979 Birds Directive[4], which support internationally important wild bird populations. The Dee Estuary is also designated as a 'Ramsar site' under the Convention on Wetlands of International Importance especially as Waterbird Habitat, because it supports internationally important wetlands and wetland species. According to UK and Welsh Assembly Government policy, Ramsar sites should receive the same level of protection as European sites.[5] The interrelationship of the various legislation and designations is shown diagrammatically in Figure A.

This 'Regulation 33 advice':

- is designed to help relevant and competent authorities responsible for complying with the requirements of the Birds and Habitats Directives to understand the international importance of the Dee Estuary European marine site, and the underlying

[1] The roles of English Nature, the Landscape Access and Recreation division of the Countryside Agency and the environmental activities of the Rural Development Service were brought together to form a new independent body – Natural England.
[2] Conservation (Natural Habitats, &c.) Regulations 1994 (SI 1994 No 2716), as amended.
[3] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
[4] Council Directive 79/409/EEC on the conservation of wild birds.
[5] Office of the Deputy Prime Minister (2005) *Planning Policy Statement 9: Biological and Geological Conservation,* Welsh Assembly Government (2006*) Draft Revised Technical Advice Note 5 Nature Conservation and planning,* DEFRA (2006) *Ramsar sites in England*, National Assembly for Wales (2001) *Ramsar sites in Wales*.

physical and ecological processes supporting the habitats and species for which the European marine site is designated;

- is intended to assist the relevant authorities to develop, if considered appropriate, a management scheme under Regulation 34 of the Habitats Regulations, under which they shall exercise their functions in accordance with the requirements of the Directives;

- contains Natural England and CCW's advice to competent authorities as to the conservation objectives for the European marine site for the purpose of considering plans and projects in accordance with Article 6 of the Habitats Directive and Parts IV and IVa of the Habitats Regulations. Natural England and CCW will provide more detailed advice to competent authorities to assess the implications of particular plans or projects, where appropriate, at the time those plans or projects are being considered. An example of the processes involved in the consideration of development proposals affecting Internationally Designated Nature Conservation Sites is shown in Figure B;

- sets out the standards against which the condition of the features of the site can be monitored, enabling judgements to be made about whether that condition is favourable.

The advice in this document is subject to review by Natural England and CCW, including to take account of new information about the European site or its features, or changes to the SAC, SPA or Ramsar site designations. For example this document has been updated to reflect the formal designation of the Dee Estuary / Aber Dyfrdwy SAC in December 2009. In relation to the Dee Estuary SPA and Ramsar site, this document is based on the list of qualifying features that formed part of the consultation over modifications to the SPA/Ramsar site in 2001. These changes to the designations have now been formally approved by the Welsh Assembly and UK government in December 2009 and are reflected in this document. However in July 2007 the Dee Estuary Ramsar site was classified additionally under criterion 1, which indicates that 'A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region'. As this is a feature of the European marine site it has been included within this revised document in Appendix XI.

David Parker

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Area Manager
Natural England
January 2010

Dr David Parker
Director Science
Countryside Council for Wales
January 2010

Figure A. Chart showing the inter-relationship between the legislation and different designations that make up the Dee Estuary European marine site

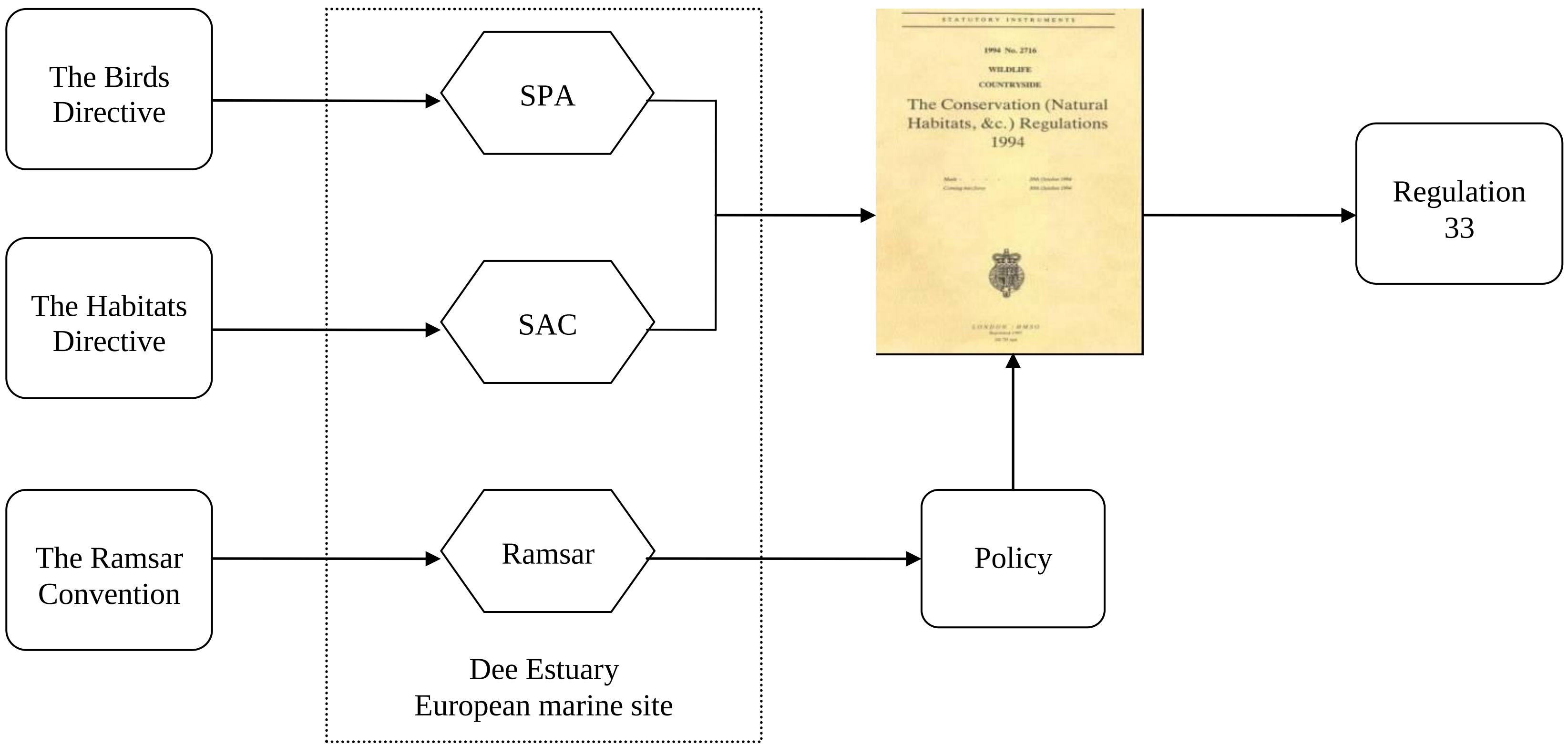
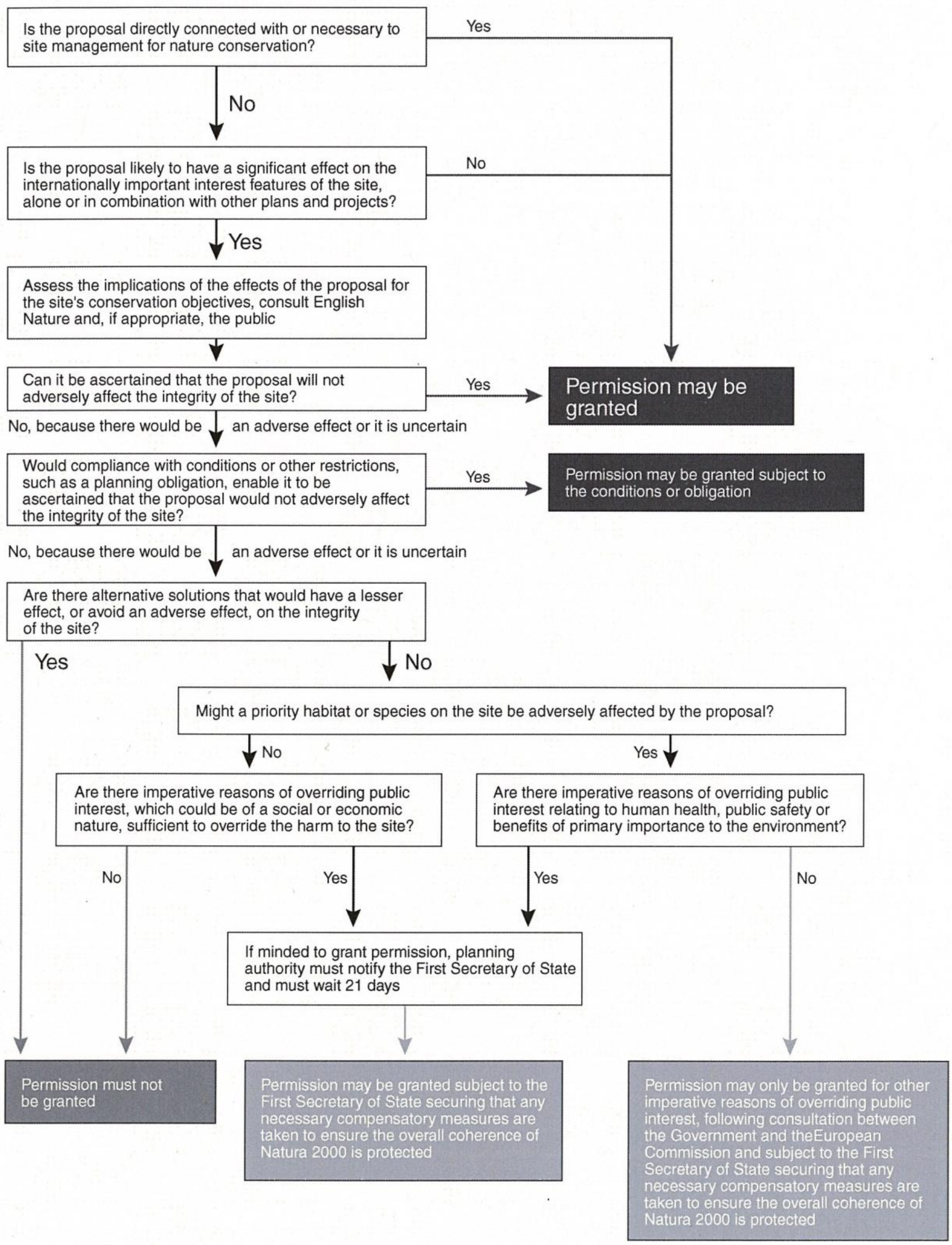


Figure B. An example of the Consideration of development proposals affecting Internationally Designated Nature Conservation Sites (Taken from Government Circular: Biodiversity and Geological Conservation – statutory obligations and their impact within the planning system. Office of the Deputy Prime Minister Circular 06/2005)



Acknowledgements

Natural England and the Countryside Council for Wales would like to acknowledge the contributions from individuals and organisations who have provided assistance at various times during the preparation of this Regulation 33 advice.

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Please note - Appendices I to XI are found in Volume 2 of the printed version of this document

Introductory sections

Natural England and the Countryside Council of Wales' advice for the Dee Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

1. Introduction

1.1 Natura 2000

The European Union Habitats[6] and Birds Directives[7] are international agreements that set out a number of actions to be taken for nature conservation. The Habitats Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, and sets out measures to maintain or restore, natural habitats and species of European Union interest at favourable conservation status[8]. The Birds Directive protects all wild birds and their habitats within the European Union, and there are special measures for migratory birds and those species that are considered rare or vulnerable.

The Habitats and Birds Directives include requirements for the designation of conservation areas. In the case of the Habitats Directive these are Special Areas of Conservation (SACs) which support certain natural habitats or species, and in the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. In 1999, lists of candidate Special Areas of Conservation were submitted to the European Commission for a process known as moderation. Shortfalls across the whole Atlantic Biogeographic Region were identified and in the UK these have been addressed by adding further interest features to existing sites or by extending site boundaries to include more of particular habitats and species. However, 81 new sites were also identified and these included the Dee Estuary/Aber Dyfrdwy possible SAC (pSAC).

SACs and SPAs are known as European Sites and will form a network of conservation areas to be known as '*Natura 2000*'. Where SACs or SPAs are designated in areas continuously or intermittently covered by tidal waters or any part of the sea in or adjacent to Great Britain up to the limit of territorial waters, they are referred to as European marine sites.

The Convention on Wetlands of International Importance especially as Waterbirds Habitats (Ramsar Convention) was signed in Ramsar, Iran in 1971. The broad objectives are to stem the loss and progressive encroachment on wetlands now and in the future, through the designation of Ramsar sites. A habitat can qualify as a Ramsar site for its representation of a wetland, the plant or animal species it supports and for its role in supporting internationally important populations of waterbirds. In accordance with Office of the Deputy Prime Minister (ODPM)'s *Planning Policy Statement 9* (PPS9) , Welsh Office Planning Guidance *Technical Advice Note No. 5* (TAN5), the Department for Environment, Food and Rural Affairs (DEFRA) and National Assembly for Wales (NAW) statements *Ramsar Sites in England* (November 2006) and *Ramsar Sites in Wales* (February 2001); Ramsar sites classified under

[6] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
[7] Council Directive 79/409/EEC on the conservation of wild birds
[8] A habitat or species is defined as being at favourable conservation status 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.

the Convention on Wetlands of International Importance must be given the same consideration as European sites when considering plans and projects that may affect them.

Further guidance on European marine sites can be found within the documents:

1. European marine sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the Preparation and Application of Management Schemes (DETR & The Welsh Office, 1998);
2. Planning Policy Statement 9: Biodiversity and Geological Conservation, August 2005;
3. Planning Policy Wales March 2002 (Welsh Assembly Government);
4. Welsh Assembly Government (WAG) (2006*)* Draft Revised Technical Advice Note 5 Nature Conservation and Planning.

1.2 The role of Natural England and the Countryside Council for Wales

The Conservation (Natural Habitats, &c.) Regulations 1994 transpose the Habitats Directive into law in Great Britain. It gives Natural England and the Countryside Council for Wales a statutory responsibility to advise relevant authorities on the conservation objectives for European marine sites in England and Wales and to advise these authorities regarding any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the sites have been designated. This information will be a key component of any management scheme, which may be developed for this site. It will also aid competent authorities in defining the scope and nature of 'appropriate assessment' which the Habitats Directive requires to be undertaken for plans and projects having a significant effect on the European site (Regulations 20, 48 & 50). Note that Natural England and the Countryside Council for Wales will also advise competent authorities on individual plans and projects as they arise. Natural England and the Countryside Council for Wales are themselves also competent and relevant authorities.

1.3 The precautionary principle

The advice on operations contained within this package has been made based on the precautionary principle and the interpretation of any monitoring programmes undertaken by Natural England and the Countryside Council for Wales will also be made on this basis. All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences. Moreover, it is important, when considering whether the information available is sufficient, to take account of the associated balance of likely costs, including environmental costs, and benefits (DETR & the Welsh Office, 1998).

1.4 The role of competent and relevant authorities

The Conservation (Natural Habitats, &c.) Regulations 1994 require competent authorities to exercise their functions so as to secure compliance with the requirements of Habitats Directive. The term 'competent authority' includes all public bodies and statutory undertakers. The Regulations identify a number of competent authorities as 'relevant authorities', with particular functions in relation to European marine sites. In addition to their duties as competent authorities, under Regulation 34, the relevant authorities may establish a management scheme for a European marine site under which they shall exercise their relevant functions. If such a management scheme is established, it should be guided by the information contained in this document. Relevant authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site. This may include consideration of issues outside the boundary of the European marine site.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, Natural England and the Countryside Council for Wales are empowered to use their bylaw-making powers for Marine Nature Reserves (MNR) and National Nature Reserves (NNR) for use in European marine sites.

1.5 Factors outside the control of relevant authorities

Nothing within this Regulation 33 advice will require relevant and competent authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that the changes result wholly from natural causes[9] or human events outside their statutory functions. Natural England and the Countryside Council for Wales will work with relevant authorities and others to develop a protocol for evaluating all observed changes and to develop our understanding of natural change.

1.6 Responsibilities under other conservation designations

In addition to its status under the Habitats and Birds Directives and Ramsar Convention Dee Estuary European marine site is also notified as various Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act, 1981(as amended). The obligations of relevant authorities and other organisations under the SSSI designations are not affected by the advice contained in this document. There are Local Nature Reserves (LNRs) at Hilbre Island and Gronant Dunes designated under Section 21 of the National Parks and Access to the Countryside Act, 1949.

1.7 Role of conservation objectives

The role of the conservation objectives for a European marine site is to define the nature conservation aspirations for the features of interest, thus representing the aims and requirements of the Habitats and Birds Directives in relation to the site.

The Habitats Directive requires that:

- measures taken under it are designed to maintain or restore habitats and species of European importance at “favourable conservation status” (FCS). According to the Directive, a habitat will be at FCS when its range and area in Europe are stable or increasing, the specific structure and functions necessary for its long term maintenance exist and are likely to continue to exist, and the conservation status of its typical species is favourable;
- appropriate steps be taken in SPAs and SACs to avoid the deterioration of habitats and significant disturbance[10] of species;

[9] Determination of what constitutes natural change will be based on the best available information and scientific opinion at the time
[10] Significant disturbance is defined in the ‘European Commission (2000). Managing Natura 2000 sites: The provisions of Article 6 of the “Habitats” Directive 92/43/EEC. DGXI, Brussels’ as ‘Any event which contributes

- any plan or project not directly connected with or necessary to the management of an SAC or SPA (for nature conservation) but likely to have a significant effect on it, be subject to appropriate assessment in view of the site's conservation objectives.

In addition, the Birds Directive requires that, in relation to certain species of birds listed in Annex I of the Directive and regularly occurring migratory species, special measures be taken in order to ensure their survival and reproduction in their area of distribution.

Therefore, the conservation objectives for the Dee Estuary SAC, SPA and Ramsar site represent Natural England and the Countryside Council for Wales' judgement of the appropriate contribution of the site to ensuring the survival and reproduction of the species concerned in their area of distribution. They are intended to guide relevant and other competent authorities in the exercise of their functions to comply with the requirements of the Directives outlined above.

In relation to the Dee Estuary European marine site, Natural England and the Countryside Council for Wales use the term "favourable condition" for the condition represented by the achievement of the conservation objectives, in other words the desired condition for a habitat or a species on an individual site. Reports with condition of features are available on the Joint Nature Conservation Committee (JNCC) website.

1.8 Role of advice on operations

The advice on operations set out in Sections 8, 12, and 16 provides the basis for consideration of the nature and extent of the operations taking place within or close to the site and which may have an impact on its interest features.

The advice should also be used to help identify the extent to which existing use and management of the site are, or can be made, consistent with the achievement of the conservation objectives and thereby focus the attention of relevant authorities on factors affecting or likely to affect the interest features of the site.

1.9 European sites

A European site is any one of the following, as defined in The Conservation (Natural Habitats, &c.) Regulations 1994, as amended (and a European marine site is any of the following in so far as it consists of marine – including intertidal - areas).

- A special area of conservation (SAC) designated by the UK Government or devolved administrations under the Habitats Directive.
- A site of community importance (SCI). An SCI is a candidate SAC which the government and European Commission have agreed will be designated as an SAC but which has not yet been so designated.

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to the long term decline of the population of the species or, any event contributing to the reduction or to the risk of reduction of the range of species within the site or, any event which contributes to the reduction of the size of the habitat of the species within the site'.

- A site hosting a priority natural habitat type or priority species which is not on the list of candidate SACs submitted by the UK but which the European Commission thinks should be on that list (not relevant in the case of the Dee Estuary).
- A Special Protection Area (SPA) classified under the Birds Directive.
- In England only, a candidate SAC, that is a site submitted by the UK to the EC under the Habitats Directive, but not yet agreed as an SCI (see above). In Wales, a candidate SAC is not in law a European site. The Dee Estuary lies partly in England and partly in Wales, so strictly speaking it would become subject to two different legal regimes once submitted as a candidate SAC. However, it is Welsh Assembly Government policy that candidate SACs be treated as if they were European sites.

Also, in accordance with ODPM's Planning Policy Statement 9 (PPS9), WAG (2006*) Draft Revised Technical Advice Note 5 Nature Conservation and Planning*, and the DEFRA and NAW statements *Ramsar Sites in England* (November 2006) and *Ramsar Sites in Wales* (February 2001)*;* Ramsar sites must be given the same consideration as European sites when considering plans and projects that may affect them.

Where a European site lies below highest astronomical tide, i.e. land covered (continuously or intermittently) by tidal waters, or any part of the sea, in or adjacent to Great Britain, up to the seaward limit of territorial waters, it is described as a European marine site.

At the time of compiling the draft advice in 2004, the Dee Estuary European marine site comprised the Dee Estuary / Aber Dyfrdwy possible Special Area of Conservation (pSAC), The Dee Special Protection Area (SPA), Phase 1 and Phase 2 and The Dee Estuary Ramsar site, Phase 1 and Phase 2. Phase 1 of these sites was classified in July 1985 whilst Phase 2 is a revision of these sites proposed in February 2001. This advice has now been updated to reflect the formal classification of these sites in December 2009.

The marine components of all of these sites qualify as European marine sites, but for simplicity and for the purposes of this advice, the Dee Estuary SAC, The Dee Estuary SPA and The Dee Estuary Ramsar site, Phases 1 and 2 are referred to as the Dee Estuary European marine site and are covered within this single Regulation 33 advice.

The areas of the three designations do not overlap in all areas. In particular it should be noted that the area of North Wirral Foreshore SSSI forms part of the Dee Estuary SAC but it is not included within The Dee Estuary SPA or Ramsar site. Maps showing the boundaries of the different designation are provided in Appendices I-III. North Wirral Foreshore SSSI does form part of the Mersey Narrows and North Wirral Foreshore potential SPA (pSPA) and proposed Ramsar (pRamsar) site. Regulation 33 advice relating to Mersey Narrows and North Wirral Foreshore pSPA and pRamsar site is therefore not included within this document and will be provided subsequently.

1.10 Description of the site

The Dee Estuary is one of the largest estuaries in the UK, with an area of over 14,000 ha, (38,765 acres). It is the largest macro-tidal coastal plain estuary along a long stretch of coast between the larger Severn estuary and the Solway Firth. The River Dee drains an area of 2088 km^2 and flows from the mountains of Snowdonia to the Cheshire Plain (Environment

Agency, 1998). The Dee Estuary is hyper-tidal with a mean spring tidal range of 7.7 m at the mouth.

The estuary is considered to have been formed as an 'ice-way' cut by a glacier which occupied the Irish Sea during the Pleistocene period (Gresswell, 1964 in NCC, 1978). Following the retreat of the glaciers, alluvial deposits of sand, silt and mud were laid down on the valley floor as it gradually silted up, now reaching a depth of approximately 40 m covering the bedrock (NCC, 1978).

The estuary historically stretched as far inland as Chester and its form has been modified considerably over the past 300 years as a direct result of human intervention. The canalisation of the upper Dee in 1737 with the creation of the 'New Cut' moved the main channel towards the southern shore. This was done in an attempt to maintain the viability of the Port of Chester. The canalisation subsequently facilitated land claim along either side of the original channel in the upper reaches of the estuary. Since 1732 nearly 5,000 ha of land have been claimed from the estuary (NCC, 1978).

The effects of land claim upon the estuary have been substantial although sedimentation had been occurring within the estuary prior to man's intervention. In the Norman period Chester was a flourishing port with direct access to the sea, yet by the 1700s an outport was in use at Parkgate due to siltation making navigation difficult (NCC, 1978). The estuary continues to receive suspended sediment both from the river and the sea. The sea is the most important source with material being carried into the estuary by the process of long shore drift acting in an easterly direction along the North Wales coast, as well as by seabed currents (Binnie and Partners, 1971, in NCC, 1978). The estuary tends to act as a sink for the sediment reaching it for a number of reasons: the alignment of the estuary to the prevailing wind means that waves within the estuary tend to be constructive not destructive (NCC, 1978); the flood currents are stronger than the ebb currents; and finally saltmarsh vegetation within the estuary tends to trap sediment. Sediment flows and fluxes affecting the estuary are of particular importance for estuarine processes and ecology and the morphology of the estuary is constantly changing due to the complex hydrodynamics. Sediment deposits provide material essential to maintenance of the mudflats, sandflats and saltmarsh.

Sea defences now enclose much of the estuary protecting industrial complexes, farmland, railway lines and residential areas built on land claimed from the sea. Historic industrial activity has also left a legacy of contaminated land, along the Welsh shore in particular. There are approximately 30 ha of the European marine site in Wales which are made up of non-natural substrates including seawalls, riprap revetment, outfalls, and tip waste (CCW, 2006). Today the Dee Estuary is an important recreational area; it is also a commercial waterway providing access to the Port of Mostyn, to Shotton and to Broughton. The estuary supports a range of industries along its coast including power stations, paper mills, steel mills, and chemical plants. The Estuary also supports a large cockle fishery of high economic importance as well as smaller fisheries for shrimp and finfish. Alongside all these competing activities, the Estuary supports a wide array of habitats and species of international importance for nature conservation.

The intertidal area is currently dominated by mudflats and sandflats with the remainder being largely saltmarsh. At low water spring tides, over 90% of the estuary dries out. The extensive intertidal flats of the Dee Estuary form the fifth largest such area within an estuary in the UK. Where water movements are greatest towards the estuary mouth the sediments tend to be sandy, and populated with polychaete worms and amphipod crustaceans. Much of the mid-upper part of the estuary consists of fine muddy sand, dominated by ragworms *Hediste diversicolor* and Baltic tellins *Macoma balthica*. Areas of muddy sand are also found in the outer estuary, but here they are often dominated by cockles and polychaetes. The intertidal mud flats of the sheltered inner estuary in particular support populations of marine worms, molluscs and other invertebrates, which often occur at high densities and with high biomass. These invertebrates provide an abundant food source for fish and are of particular importance for waterbirds, with over 120,000 birds visiting the site during the winter months.

The Dee Estuary includes approximately 2,480 ha of saltmarsh representing about 7% of the total area of saltmarsh in the UK (Dargie, 2001). Today, the Dee Estuary saltmarsh is among the few estuarine saltmarshes in the UK showing a full transition from pioneer saltmarsh species through to non-tidal vegetation. The elaborate creek system in the Dee Estuary creates a more diverse array of habitats than are found in more continuous fringing saltmarshes such as those of Morecambe Bay and several nationally scarce plant species also occur. Unlike most western estuaries large areas of the saltmarsh remain ungrazed favouring plants that are otherwise susceptible to grazing. The combination of historical land claim and canalisation of the upper estuary may have reduced the total area of saltmarsh in the Dee from what was present previously, yet the area of saltmarsh within the Dee has expanded rapidly over the last century as the estuary's morphology has adapted to these reclamations.

Saltmarshes have an important role to play in estuarine processes, both through the recycling of nutrients within the estuary and through their role as 'soft' sea defences, dissipating wave energy. They are highly productive biologically, providing nutrients that support other features within the marine ecosystem. They also have an important physical role, acting as a sediment store for the estuary as a whole and in providing roosting sites for waders and wildfowl at high tide. The seeds and foliage of saltmarsh plants provide an important food resource for visiting wildfowl.

The subtidal zone of the Dee is believed to provide an important breeding, sheltering and nursery area for coastal fish species. In recent years, 21 species of fish have been recorded in the Dee Estuary (Potts & Swaby, 1993). The Dee Estuary also supports a number of migratory fish species including river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus*, Atlantic salmon *Salmo salmar*, sea trout *S. trutta*, Twaite shad *Alosa fallax*, smelt *Osmerus eperlanus*, and eels *Anguilla anguilla*. Although lamprey numbers have declined over the last 100 years, the UK is still one of their strongholds. Sea and river lampreys spend their adult life in the sea or estuaries but spawn and spend the juvenile phase in rivers. They use the Dee as a migratory passage to and from their spawning and nursery grounds in the River Dee upstream of the estuary.

In addition to the habitats to be found within the intertidal zone of the estuary, other valuable habitats occur adjacent to the intertidal area that are associated with the estuary's form and function. Talacre Warren and Gronant Dunes to the west of the estuary mouth are the largest remaining areas of a once extensive dune system to be found along the north east coast of Wales. These dunes include the early stages of dune formation (embryonic shifting dunes), mobile dunes with marram grass, and stable 'fixed' dunes, which have been colonised by a variety of grasses and other plants. There are also damp hollows between the dunes known as dune slacks supporting their own specialised plant communities. On the seaward fringe of the dunes accumulations of nutrient rich debris can build up along the strandline and provide habitats for annual plants, such as sea rocket *Cakile maritima* and sea holly *Eryngium maritimum*. The dune habitats associated with the Dee Estuary support many nationally scarce invertebrates including five Red Data Book species such as the sandhill rustic moth *Luperina nickerlii gueneei*, the sand wasp *Podalonia affinis*, and the mining bee *Colletes cunicularis*.

On the English side of the estuary the sandstone Hilbre Islands and Red Rocks form low uneven cliffs and flat intertidal rock platforms. These locations support some of the very few examples of rocky shore and vegetated sea cliff habitats found between the Little Orme to the west and St. Bees Head to the north. The cliffs support a range of plants, including common scurvy grass *Cochlearia officinalis*, thrift *Armeria maritima*, the scarce rock sea lavender *Limonium britannicum celticum* and sea spleenwort *Asplenium marinum* (Dargie, 2001).

Many estuaries in the UK are of great importance to migratory and wintering wildfowl and waders. The Dee Estuary forms part of the complex of estuaries, which provide habitats for migratory waterbirds along the shores of Liverpool Bay, which in turn form part of the chain of such sites along the western coast of the UK. The relatively mild winter weather conditions found here compared to continental Europe can be of additional importance to the survival of wintering waterbirds during periods of severe weather. The Dee Estuary ranks amongst the top ten British estuaries for the size of its wintering waterbird population (Musgrove *et. al*., 2001). Outside of this period, the Dee Estuary is also of particular importance as a staging area for migratory waterbirds on autumn and spring passages, lying on the East Atlantic Flyway route.

2. Qualifying interest features under the EU Habitats and Birds Directives and the Convention on Wetlands of International Importance

2.1 Interest features of the Dee Estuary European marine site under the EU Habitats Directive

The Dee Estuary/Aber Dyfrdwy Special Area of Conservation (SAC), as designated under the Habitats Directive, qualifies as a SAC for the following **Annex I** habitats as listed in the EU Habitats Directive:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide (intertidal mudflats and sandflats)
- *Salicornia* and other annuals colonising mud and sand
- Atlantic salt meadows
- Annual vegetation of drift lines

The Dee Estuary/Aber Dyfrdwy Special Area of Conservation, as designated under the Habitats Directive, also qualifies as a SAC for the following **Annex II** species as listed in the EU Habitats Directive:

- *Lampetra fluviatilis* (river lamprey)
- *Petromyzon marinus* (sea lamprey)

Figures showing the boundary of the Dee Estuary Special Area of Conservation are provided in Appendix I and the entry in the registry of European sites for Wales and England is included in Appendix X.

2.2 Interest features of the Dee Estuary European marine site under the EU Birds Directive

The Dee Estuary Special Protection Area qualifies under **Article 4.1** of the EU Birds Directive, as it supports internationally important populations of regularly occurring Annex I species including:-

- Sandwich tern *Sterna sandicensis*
- Little tern *Sterna albifrons*
- Common tern *Sterna hirundo*
- Bar- tailed godwit *Limosa lapponica*

It also qualifies under **Article 4.2** of the EU Birds Directive in that it supports-

a. internationally important populations of regularly occurring migratory species including;

- Redshank *Tringa totanus*
- Shelduck *Tadorna tadorna*
- Teal *Anas crecca*
- Pintail *Anas acuta*
- Oystercatcher *Haematopus ostralegus*
- Grey Plover *Pluvialis squatarola*
- Knot *Calidris canutus islandica*
- Dunlin *Calidris alpina*
- Black-tailed godwit *Limosa limosa islandica*
- Curlew *Numenius arquata*

and

b. an internationally important assemblage of waterbirds

The Dee Estuary Special Protection Area Phase 1, with an area of 13,065.8 ha was classified on 17 July 1985. The new area of the SPA classified in December 2009 is 14291.56ha.

It is the citation for the SPA Phases 1 and 2, dated December 2000 on which this Regulation 33 advice is based. A map showing the boundary of The Dee Estuary Special Protection Area is provided in Appendix II.

2.3 Interest features of the Dee Estuary European marine site under the Ramsar Convention on Wetlands of International Importance Especially as Waterbirds Habitat

The Dee Estuary Ramsar site qualifies under **Criterion 5** as it regularly supports-

- 20, 000 or more waterbirds.

The Dee Estuary Ramsar site qualifies under **Criterion 6** as it regularly supports-

- 1% or more of the individuals in a population of one species or sub-species of waterbirds.

These species include-

- Redshank *Tringa totanus*
- Shelduck *Tadorna tadorna*
- Teal *Anas crecca*
- Pintail *Anas acuta*
- Oystercatcher *Haematopus ostralegus*
- Grey Plover *Pluvialis squatarola*

- Knot *Calidris canutus islandica*
- Dunlin *Calidris alpina*
- Black-tailed godwit *Limosa limosa islandica*
- Curlew *Numenius arquata*
- Bar-tailed godwit *Limosa lapponica*

The new area of the Ramsar site classified in December 2009 is 14303.02ha.

It is the citation for the Ramsar site Phases 1 and 2, dated December 2000 on which this Regulation 33 advice is based. A map showing the boundary of the Dee Estuary Ramsar site is provided in Appendix III.

2.4 Other qualifying features or features of interest within the SAC, SPA and Ramsar designations outside the European marine Site

The following features also qualify for each designation (SAC, SPA and Ramsar site) but do not, however, occur within the European marine site as they occur above the highest astronomical tide (HAT). Consequently, there are no specific conservation objectives within this document for these habitats and species. Objectives to maintain these features in favourable condition should be identified within Natural England and the Countryside Council for Wales' conservation objectives for the relevant designations within each European site boundary and will be dealt with elsewhere. However, relevant authorities need to have regard to such adjacent interests as they may be affected by activities taking place within, or adjacent to the European marine site.

2.4.1 Dee Estuary/Aber Dyfrdwy SAC

The Dee Estuary also qualifies as a SAC for the Annex I habitats **fixed dunes with herbaceous vegetation ("grey dunes")** (a priority interest feature); **shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"), embryonic shifting dunes, humid dune slacks, vegetated sea cliffs of the Atlantic and Baltic coasts, and Annex 2 species, Petalwort *petalophyllum ralfsii* (Appendix X).** These do not however, occur within the European marine site as they lie above highest astronomical tide and therefore are not considered further within this document.

2.4.2 The Dee Estuary SPA

There are a number of habitats within the SPA, which support the qualifying bird species, but which do not, occur within the European marine site as they occur above highest astronomical tide. These habitats include coastal grazing marsh used by waterbirds for feeding, roosting and loafing, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations 1994.

2.4.3 The Dee Estuary Ramsar site

There are a number of habitats, such as wet grazing marsh**,** which occur within the boundary of the Ramsar site and support the bird species comprising the waterbird assemblage under Criterion 5 and those listed individually under Criterion 6 of the Ramsar Convention on Wetlands of International Importance. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the Ramsar site conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations 1994.

Coastal habitats supporting a breeding colony of Natterjack toads *Bufo calamita* (listed under Criterion 2 of the Ramsar Convention) also occur within the Dee Estuary but are outside the European marine site.

3. Background to favourable condition tables

- The favourable condition table for the SAC can be found in Section 7
- The favourable condition table for the SPA can be found in Section 11
- Separate favourable condition tables have not been produced for the Ramsar site due to the overlapping nature of the features with advice given in other sections.

The favourable condition table specifies the following (in columns from left to right):

- **Features**: interest features for which the SAC, SPA or Ramsar site is selected.
- **Subfeatures**: ecologically important sub-divisions of an interest feature. In the case of a habitat interest feature, subfeatures would be component habitats or communities (e.g. defined by type and/or by geographic location within the site). In the case of species interest features, subfeatures include the population itself, or any ecologically relevant subdivisions of the population, and any habitats or communities on which it/they depend.
- **Attributes**: particular characteristics of the features or sub-features which provide an indication of the condition of the feature (e.g. total population size, extent of a habitat type).
- **Measures**: what exactly about the attributes will be measured, in terms of the units of measurement to be used, arithmetic nature and frequency at which the measurement is taken. An indication of the method that is likely to be used to obtain the observed values of attributes. The method is closely linked to the way in which the measure is expressed. It is important to note that in many cases the precise monitoring method to be used may not be known at this stage.
- **Targets**: These define the attribute values that equate to favourable condition. If changes are observed that are 'significantly' different from the target, this will act as a trigger for further investigation as to the cause of the change, or remedial management action. In general the targets in the favourable condition table are subject to natural processes as set out in the conservation objectives; i.e. where natural processes alone dictate that targets are not met this will not result in the condition of the feature being classed as unfavourable. The term 'subject to natural processes' is explained further in Section 6.1.
- **Comments**: notes on the rationale for the use of each attribute and measure.

The favourable condition table is intended to supplement the conservation objectives, including with respect to the management of established and ongoing activities, future requirements of monitoring and reporting on the condition of the features of the site. Together with the conservation objectives, the table also informs the scope and nature of any appropriate assessment that may be needed. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under the Habitats Regulations. It should be noted that appropriate assessments are a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. Natural England and the Countryside Council for Wales will provide more detailed advice to competent and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

Anyone proposing to permit or undertake plans or projects with a potential impact on site features is encouraged to consult Natural England or the Countryside Council for Wales early in the planning stages to identify possible issues of concern.

The favourable condition table specifies the main types of information that Natural England and the Countryside Council for Wales may use to assess the condition of interest features. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying species and habitats to be able to define measures and associated targets for all attributes. In European marine sites favourable condition is generally harder to define precisely since our knowledge of features is still developing. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on their condition at the time the sites were selected, which may need to be established through baseline surveys in many cases.

The information contained within the favourable condition table is not necessarily what will be monitored but provides the basis for discussions with management and advisory groups. The attributes and associated measures and targets may be modified over time. The selection of attributes is based on the current understanding of the habitats and species and the available measuring techniques. The aim is to produce a single agreed set of attributes that will then be monitored in order to report on the condition of features.

The appropriateness of individual attributes as indicators of condition will be reviewed as more knowledge of the condition of interest features is obtained and/or survey and monitoring techniques develop. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site.

The favourable condition table will be an important, but not the only, driver of the site monitoring programme. Other data, such as results from compliance monitoring and appropriate assessments, will also have an important role in assessing condition of interest features. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. Natural England and the Countryside Council for Wales will be responsible for collating the information required to assess condition, some of which may be collected by other organisations, and for judging the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

4 Advice on operations

Natural England and the Countryside Council for Wales have a duty under Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to 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. Information on how Natural England and the Countryside Council for Wales have developed this advice is given in Section 4.2 and on how it may be reviewed and updated in the future, in Section 4.4.

The advice is provided in summary form in Table 1 with more detail in Tables 3 and 7 and in Sections 8, 12 and 16 including advice in relation to specific interest features and their sub-features.

4.1 Purpose of advice

The aim of this advice is to enable all relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threat to the favourable condition of interest features on the Dee Estuary European marine site. The advice is linked to the conservation objectives for interest features and will help provide the basis for detailed discussions between Relevant Authorities with a view to the possible development of a management scheme for the site. The advice given here will inform on, but is without prejudice to, any advice given under Regulation 48 or Regulation 50 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

4.2 Methods for assessment

To develop this advice on operations Natural England and the Countryside Council for Wales have used a three step process involving:

- an assessment of the **sensitivity** of the interest features or their component sub-features to operations;
- an assessment of the **exposure** of each interest feature or their component sub-features to operations; and
- a final assessment of **current vulnerability** of interest features or their component sub-features to operations.

This three-step process builds up a level of information necessary to manage activities in and around the European marine site in an effective manner. Through a consistent approach, this process enables Natural England and the Countryside Council for Wales to both explain the reasoning behind our advice and identify to competent and relevant authorities those operations which pose the most current threats to the favourable condition of the interest features on the European marine site.

The assessment of relative sensitivity, exposure and vulnerability is derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of our knowledge and understanding of the marine environment.

Information has been gathered from a range of sources including reports such as ABP Research (1999).

4.2.1 Sensitivity assessment

The sensitivity assessment used is an indication of the relative sensitivity of the interest features or the component sub-features of the Dee Estuary European marine site to the effects of broad categories of human activities. In relation to this assessment, sensitivity has been defined as the intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor (Hiscock, 1996). With regard to the SPA features the sensitivity of the supporting habitats has been assessed in relation to the use of habitats by birds. For example, all habitat features are highly sensitive to the physical loss of their component communities by removal; and wintering birds are highly sensitive to loss of their roosting or feeding grounds.

The sensitivity assessments of the interest features or their component sub-features of the Dee Estuary European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SACs LIFE Project (Elliott *et al* 1998, Jones *et al*, 2000), the Countryside Council for Wales Science Report (Holt *et al*, 1995) and the Marine Habitats Review (Jones *et al*., 2000). Boorman (2003) undertook a sensitivity review for saltmarshes.

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. In particular, English Nature and Scottish Natural Heritage commissioned the Marine Biological Association of the UK, through its Marine *Life* Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice which is available online (www.marlin.ac.uk).

4.2.2 Exposure assessment

Exposure assessment has been undertaken for the Dee Estuary European marine site by assessing the relative exposure of the interest features or their component sub-features to the effects of broad categories of human activities currently occurring on the site (as at February 2003). Again for the SPA features the exposure of the supporting habitats has been assessed in relation to the use of these habitats by birds.

4.2.3 Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component sub-features to operations. This is an integration of sensitivity and exposure. Only if a feature is both sensitive and exposed to a human activity will it be considered vulnerable. In this context therefore, 'vulnerability' has been defined as the exposure of a habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive (Hiscock, 1996). The process of deriving and scoring relative vulnerability is laid out in the key to Tables 3 and 7.

4.3 Format of advice

The advice is provided within six broad categories of operations, which may cause deterioration of natural habitats or the habitats of species, or disturbance of species. This approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;
- provides a consistent framework to enable relevant authorities to assess the effects of activities and identify priorities for management within their areas of responsibility; and
- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by Natural England and the Countryside Council for Wales.

These broad categories provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Tables 3 and 7 provides relevant authorities with a context against which to consider an assessment of 'significant effect' or any plans or projects that may affect the site and a basis to inform on the scope and nature of appropriate assessments required in relation to plans and projects. It is important to note that this advice is only a starting point for assessing impacts. It does not remove the need for the relevant authorities to consult Natural England and / or the Countryside Council for Wales formally over individual plans and projects where required to do so under the Regulations.

4.4 Update and review of advice

Information as to the operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, is provided in light of what Natural England and the Countryside Council for Wales know about current activities and patterns of usage in the area of the Dee Estuary European marine site. Natural England and the Countryside Council for Wales expect that the information on current activities and patterns of usage (which was used in part to derive Tables 3 and 7) will be supplemented as part of the process of developing the management of the site, and through further discussion with the relevant authorities. As such, it is important that future consideration of this advice by relevant authorities and others takes account of changes in the usage patterns that have occurred at the site, over the intervening period, since the advice was issued. In contrast, the information provided in this advice on the sensitivity of interest features or sub-features (Tables 3 and 7) is relatively stable and will only change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. Advice for sites will be kept under review and may be periodically updated through discussion with relevant authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

4.5 Summary of advice on operations for the SAC, SPA and Ramsar site interest features

Table 1 is a summary of the advice on operations for the SAC, SPA and Ramsar site interest features. In pursuit of the conservation objectives for all the interest features, the relevant and competent authorities for the Dee Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration or significant disturbance of the habitats through any of the categories of operation listed in the table.

4.6 Plans and projects

Under Regulation 48(1), an appropriate assessment must be undertaken by competent authorities in respect of any plan or project which:

a. either alone or in combination with other plans or projects is likely to have a ***significant effect*** on a European Site; and

b. is not directly connected with or necessary to the management of the site for nature conservation.

This legal requirement applies to all European sites. Regulation 48 is also applied, as a matter of Government policy, to potential SPAs and listed Ramsar sites.

Tables 3 and 7 provide competent authorities with a guide against which to initiate an assessment of the 'significance' of any plans or projects (and ongoing operations or activities) proposed for the site although this will only be the starting point for assessing impacts and does not remove the need for competent authorities to formally consult Natural England or the Countryside Council for Wales over individual plans and projects where required under the Regulations.

4.7 Review of consents

Regulation 50 of the Conservation (Natural Habitats, &c.) Regulations 1994 requires a competent authority to undertake a review of any existing consent or permission to which Regulation 48(1) would apply if it were to be reconsidered as of the date on which the site became a European site. Where a review is required under these provisions it must be carried out as soon as reasonably practicable after classification of the European marine site. Consents will need to be reviewed in the light of these objectives.

Table 1. **Summary of operations that may cause deterioration or disturbance to the Dee Estuary European marine site interest features at current levels of use**[11]

The advice below is not a list of prohibitions but rather a checklist for operations for discussion with the management group, which may need to be subject to some form of management measure(s) or further measures where actions are already in force. Examples of activities under relevant authority jurisdiction are also provided. Operations marked with a tick indicate those features (habitats and/or species) that are considered to be highly or moderately vulnerable to the effects of the operations.

Categories of operations which may cause deterioration or disturbance	**SAC interest features**						
	Estuaries	**Intertidal mudflats and sandflats**	***Salicornia* and other annuals**	**Atlantic salt meadow**	**Annual Vegetation of drift lines**	**Sea lamprey (*Petromyzon marinus*)**	**River lamprey (*Lampetra fluviatilis*)**
Physical Loss							
Removal (e.g. land claim, dredging)	✓	✓	✓	✓	✓	✓	✓
Smothering (e.g. depositing dredge spoil, beach feeding)	✓	✓	✓	✓	✓		

[11] This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at February 2003). This process has used a coarse grading of relative sensitivity, exposure and vulnerability of each interest feature to different categories of operation based on the current state of our knowledge and understanding of the marine environment. The advice is indicative only, and is given to guide relevant authorities and others on particular operations which may cause deterioration of natural habitats or the habitats of species, or significant disturbance of species for which the site has been designated. The advice, therefore, is not a list of prohibitions but rather a check list for operations which may need to be subject to some form of management measure(s) or further measures where actions are already in force.

The precise impact of any category of operation occurring on the site will be dependant upon the nature, scale, location and timing of events. More detailed advice is available from Natural England and the Countryside Council for Wales to assist relevant authorities in assessing actual impacts and cumulative effects. Assessment of this information should be undertaken in the development of management of the site through wider consultation.

In accordance with Government policy guidance, the advice on operations is feature and site specific, and provided in the light of current activities and patterns of usage at the site as at February 2003. As such, it is important that future consideration of this advice by relevant authorities, and others, takes account of changes in usage patterns that have occurred at the site over the intervening period. Advice for sites will be kept under review and may be periodically updated through discussions with relevant authorities, and others, to reflect significant changes in our understanding of sensitivity together with the potential effects of plans or projects on the marine environment. The provision of the statutory advice given here, on operations which may cause deterioration of natural habitats or the habitats of species, or significant disturbance of species, for which the site has been designated, under Regulation 33(2), is provided without prejudice to specific advice given under Regulation 48(3) or Regulation 50 on individual operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

Categories of operations which may cause deterioration or disturbance	SAC interest features						
	Estuaries	**Intertidal mudflats and sandflats**	***Salicornia* and other annuals**	**Atlantic salt meadow**	**Annual Vegetation of drift lines**	**Sea lamprey (*Petromyzon marinus*)**	**River lamprey (*Lampetra fluviatilis*)**
Physical Damage							
Siltation (e.g. dredging, outfalls)	✓	✓					
Abrasion (e.g. recreational activity, vehicles)	✓	✓		✓	✓		
Selective extraction (e.g. aggregate extraction)	✓						
Non-physical disturbance							
Noise (e.g. land/water-based recreation, marine traffic)							
Visual presence (e.g. land/water-based recreation, marine traffic)							
Toxic contamination							
Introduction of synthetic compounds (e.g. TBT, PCBs from industrial effluent outfalls)	✓	✓	✓	✓		✓	✓
Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil)	✓	✓	✓	✓	✓	✓	✓
Introduction of radionuclides							
Non-toxic contamination							
Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls)	✓	✓	✓	✓	✓	✓	✓
Changes in organic loading (e.g. domestic effluent outfalls, aquaculture)	✓	✓	✓	✓	✓	✓	✓

Categories of operations which may cause deterioration or disturbance	**SAC interest features**						
	Estuaries	**Intertidal mudflats and sandflats**	***Salicornia* and other annuals**	**Atlantic salt meadow**	**Annual Vegetation of drift lines**	**Sea lamprey (*Petromyzon marinus*)**	**River lamprey (*Lampetra fluviatilis*)**
Changes in thermal regime (e.g. power station discharges)						✓	✓
Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil)	✓	✓					
Changes in salinity (e.g. water abstraction, effluent outfalls)							
Biological disturbance							
Introduction of microbial pathogens (e.g. domestic/industrial effluent outfalls)							
Introduction of non-native species and translocation	✓	✓	✓	✓		✓	✓
Selective extraction of species (e.g. glasswort collection, bait collection)	✓	✓					

Categories of operations which may cause deterioration or disturbance	SPA interest features			Ramsar site interest features	
	Annex I species	Migratory species	Waterbird Assemblage	Criterion 5: Regularly supports 20,000 or more waterbird species	Criterion 6: Regularly supports 1% or more of a species or sub-species of waterbird
Physical Loss					
Removal (e.g. land claim, dredging)	✓	✓	✓	✓	✓
Smothering (e.g. depositing dredge spoil, beach feeding)	✓				
Physical Damage					
Siltation (e.g. dredging, outfalls)	✓	✓	✓	✓	✓
Abrasion (e.g. recreational activity, vehicles)	✓	✓	✓	✓	✓
Selective extraction (e.g. aggregate extraction)	✓	✓	✓	✓	✓
Non-physical disturbance					
Noise (e.g. land/water-based recreation, marine traffic)	✓	✓	✓	✓	✓
Visual presence (e.g. land/water-based recreation, marine traffic)	✓	✓	✓	✓	✓
Toxic contamination					
Introduction of synthetic compounds (e.g. TBT, PCBs)	✓	✓	✓	✓	✓
Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil)	✓	✓	✓	✓	✓
Introduction of radionuclides					

Categories of operations which may cause deterioration or disturbance	SPA interest features			Ramsar site interest features	
	Annex I species	Migratory species	Waterbird Assemblage	Criterion 5: Regularly supports 20,000 or more waterbird species	Criterion 6: Regularly supports 1% or more of a species or sub-species of waterbird
Non-toxic contamination					
Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls)	✓	✓	✓	✓	✓
Changes in organic loading (e.g. domestic effluent outfalls, aquaculture)	✓	✓	✓	✓	✓
Changes in thermal regime (e.g. power station discharges)					
Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil)	✓	✓	✓	✓	✓
Changes in salinity (e.g. water abstraction, effluent outfalls)					
Biological disturbance					
Introduction of microbial pathogens (e.g. domestic/industrial effluent outfalls)					
Introduction of non-native species and translocation	✓	✓	✓	✓	✓
Selective extraction of species (e.g. samphire picking, bait collection)	✓	✓	✓	✓	✓

Special Area of Conservation

5 The Dee Estuary SAC interest features

The Dee Estuary SAC includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. The marine part of the SAC is termed a European marine site. The seaward boundary of the European marine site is concurrent with that of the SAC. The landward boundary of the European marine site is the upper boundary of the SAC, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats (highest astronomical tide).

Where the SAC qualifying species or habitats occur within the European marine site, they are referred to as interest features. Sub-features (habitats / communities) have also been identified to highlight the ecologically important components of the European marine site for each interest feature (Figure 1). Maps showing the extent of the habitat features of the Dee Estuary SAC and their component sub-features are shown in Appendix IV.

The Dee Estuary European marine site includes seven of the interest features of the Special Area of Conservation that qualify under Annex I and Annex II of the Habitats Directive. This section describes and explains the importance of each of these interest features together with their component sub-features.

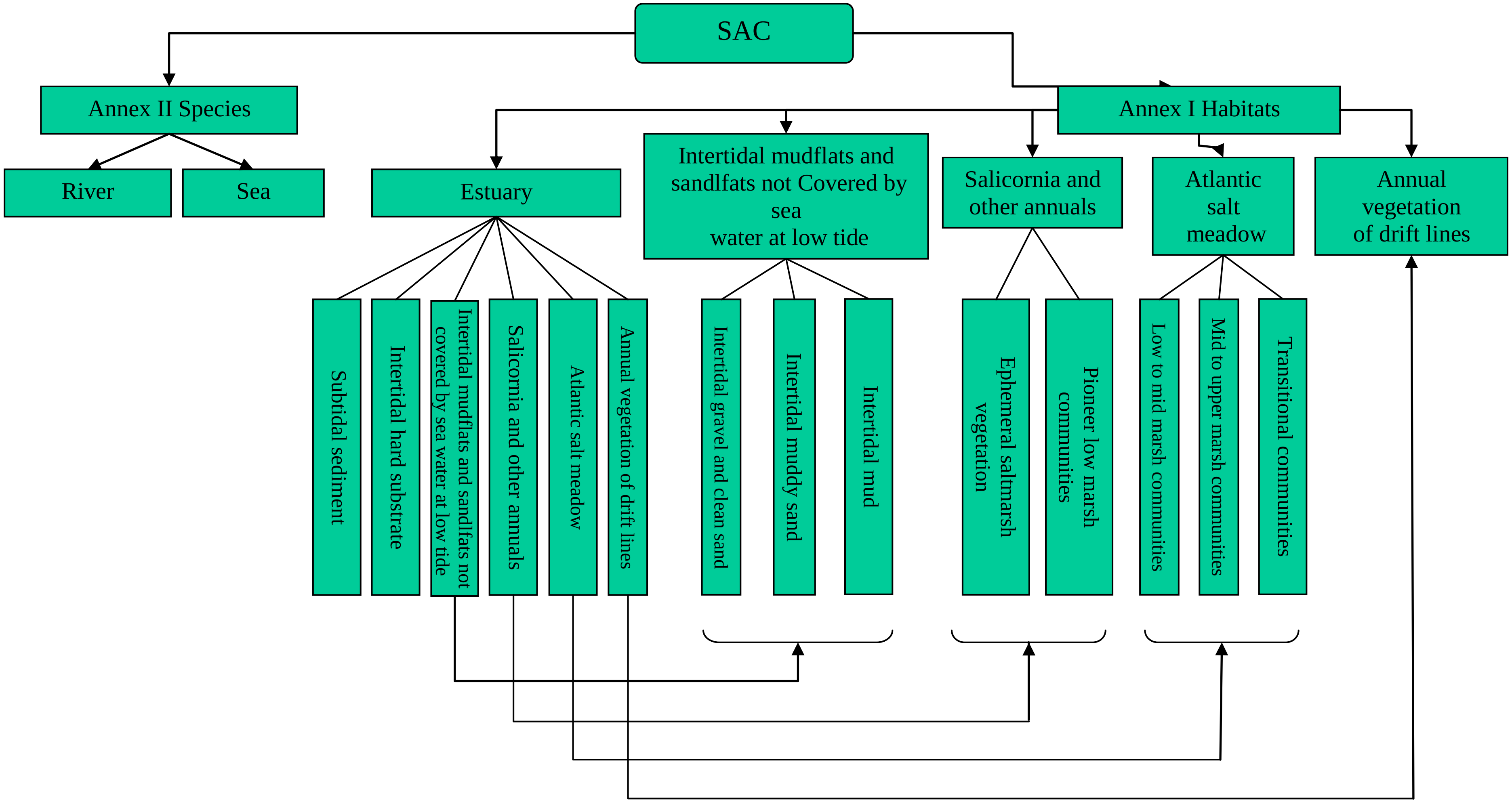
5.1 Estuary

5.1.1 Definition

Estuaries are complex and highly productive ecosystems supporting a wide range of habitats and species. They form the interface between freshwater and marine environments and extend from the upper limit of tidal influence to the open sea. Where freshwater and seawater meet and where current flows are reduced in the shelter of estuaries, fine sediments are deposited, often forming extensive intertidal mudflats and sandflats. These are typically inhabited by a variety of infaunal invertebrates, many of which provide important sources of food for fish, waterbirds and seabirds. At higher elevations within the tidal range the mudflats and sandflats are exposed for sufficient periods to become vegetated with salt-tolerant plants forming saltmarshes, which play an important role in the nutrient and sediment cycling processes within the estuarine ecosystem. Saltmarshes also provide essential feeding and roosting areas for waterbirds. Towards the mouth of an estuary, where the water gradually becomes more saline, the silt content of the sediment declines and infaunal communities are dominated by invertebrates such as polychaete worms and infaunal bivalve molluscs. The prevailing physical conditions within estuaries are the result of geomorphology and the natural processes of tidal flow, the wind and wave environment and river flow. Natural processes within estuaries are a key control on the distribution of estuarine habitats and many of the habitats within an estuary are interdependent and inextricably linked to the structure and functioning of others.

The UK has a particularly large number of estuaries. In fact, more than a quarter of the total area of the north-western European estuaries is to be found in the UK (Brown *et al.*, 1997). The wide range of estuary types occurring in the UK is also unusual in a European context. Sites in the UK have been selected to represent the geographical range of estuaries and include examples of four geomorphological types (coastal plain, bar-built, complex estuaries and rias) and a range of substrates and associated fauna.

Figure 1. Flow chart showing the relationship between the interest features for which the Dee Estuary / Aber Dyfrdwy SAC qualifies under the EU Habitats Directive, and their component sub features. Features are shown in 'open' boxes with sub features in shaded vertical boxes.
NB Some habitats that are sub features of the Annex I estuary feature are also features in their own right with their own sub features.



The intertidal and subtidal sediments of estuaries support biological communities that vary depending on their geographic location, sediment type, tidal currents and the salinity gradients within the estuary.

5.1.2 Importance of the estuary interest feature in the Dee Estuary European marine site

Estuaries in the UK have been selected to take account of the UK's EU responsibility for this habitat type and so the site series contains a high proportion of the total UK resource. Sites have generally been selected as entire units, extending from the tidal limit or extent of brackish influence to the estuary mouth and including all habitats that are important to the integrity of the site. In particular, the entire water column has been included due to its importance not only in the biological functioning of the system, but also as the means by which sediment is mobilised and transported.

The Dee Estuary is a funnel-shaped coastal plain estuary formed partly by erosion of Irish Sea ice moving landward up the estuary (CCW, 1993). It is the sixth largest estuary in the UK, covering an area of around 14,000 ha and contributing approximately 6% of the UK estuarine resource.

The estuary is characteristic of coastal plain estuaries in general having a large width to depth ratio; though long shore drift has caused a spit to form at the estuary mouth, a feature more characteristic of bar-built estuaries. The Dee is a hyper tidal estuary with a mean spring tidal range of 7.7 m at the mouth, which occasionally produces a tidal bore in the upper estuary (NCC, 1978; Parr, 1988). The majority of the estuary is composed of intertidal habitats drying at low tide with less than 10% of the estuary remaining underwater at low water on spring tides. In the outer estuary sand bars and beaches are exposed to constant reworking by wave action and tidal currents in what is a highly dynamic environment, whereas in the upper estuary, flat expanses of mud accumulate in a much more sheltered regime. Freshwater inputs into the Estuary are dominated by the highly regulated flow of the River Dee with other 'stream inputs' accounting for only 8% of the total (Parr, 1988). The history of human influence on estuary morphology has also affected the prevailing conditions that we see today (see Section 1.10).

The Dee Estuary provides conditions covering the complete range of salinities, from fully marine to fresh water, and also of wave exposures from open coasts to fully sheltered environments. As a result of this wide range of physical conditions the estuary is able to support a variety of estuarine habitats and communities; 41 different biotope communities have been recorded from the Welsh side of the estuary alone (CCW, 2006). Some of these habitats qualify as features of the European marine site in their own right; these include the extensive intertidal mud and sandflats, Atlantic salt meadows, *Salicornia* beds and vegetated driftlines. As described in Section 1 several important terrestrial habitats are also associated with the estuary including the dune system between Talacre and Prestatyn to the west of the mouth of the estuary and the vegetated sea cliffs of the Hilbre Islands.

The intertidal mudflats and sandflats of the Dee Estuary comprise the fifth largest area within an estuary in the UK. Large areas of saltmarsh occur at the head of the estuary and along the north-eastern shore. The saltmarsh shows a range of stages of development, from young, recently formed vegetation communities to old, well-established ones.

The elaborate creek system in the Dee Estuary creates a more diverse array of habitats than are found in more continuous fringing salt marshes, such as those of Morecambe Bay.

The subtidal zone of the Dee Estuary is believed to provide an important breeding, sheltering and nursery area for coastal fish species. The estuary also forms an essential part of the route of migratory fish species, which have their breeding grounds in the River Dee. Species present include Atlantic salmon *Salmo salmar,* sea trout *S. trutta*, smelt *Osmerus eperlanus,* twaite shad *Alosa fallax* and eels *Anguilla anguilla* as well as sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis*. The lamprey species qualify as features of both the Dee Estuary SAC and River Dee SAC, whilst Atlantic salmon are an additional feature of the River Dee SAC.

The estuary is important for its waterbird populations, including waders, wildfowl and terns. For this reason the estuary has been designated as a Ramsar site under the Ramsar Convention of Wetlands of International Importance and as a Special Protection Area (SPA) under the EC Birds Directive.

A large grey seal *Halichoerus grypus* ‘haul out’ of 300-500 individuals is to be found on the eastern side of Salisbury Middle, adjacent to Hilbre Island which form part of the North Wales grey seal population. Grey seals are a feature of the Pen Llyn a’r Sarnau SAC and reference should be made to the Regulation 33 advice for this site with respect to the grey seal population within the Dee Estuary European marine site.

5.1.3 Sub-features

Subtidal sediment communities - subtidal areas and the communities they support, are considered to form an important component of the estuarine system. Sub-tidal habitats will act as a refuge for estuarine fish communities at low tide, as well as supporting a variety of benthic species.

The Dee supports important fish stocks; and the outer estuary acts as a nursery ground for species such as bass *Dicentrarchus labrax*, flounder *Pleuronectes flesus*, and grey mullet species *Chelon labrosus* and *Liza ramada* (NRA, 1993; Potts & Swaby, 1993). Indeed the Dee Estuary is a designated bass nursery area under the Sea Fisheries (Bass Regulation) Order 1990. Both salmon and sea trout are commercially important in the estuary and the Dee supports a salmon net fishery controlled by a Net Limitation Order. There is also a fishery for brown shrimp (*Crangon crangon*) between May and July (Mealor, *pers. comm*.). Whitebait and sand eels *Ammodytes* spp. within the estuary create a food resource for the estuaries’ breeding tern colonies (NCC, 1978).

Due to the lack of information regarding the subtidal communities present within the Dee no specific areas are identified as being of sub-feature status at present though this may change if further data becomes available.

Intertidal hard substrate communities - The rocky shore areas around Hilbre Islands provide one of the few localities along this stretch of coastline where communities are found on natural rocky substrata. The 1990 Marine Nature Conservation Review intertidal survey of the coast between Rhos Point and New Brighton (Garwood & Foster-Smith, 1991) identified several sites with rocky shore communities within the site as being of local importance, these include the extensive vertical cliff face at Shell Bay on the west side of

Hilbre Island. The recent intertidal biotope survey of the Welsh shore identified 21 different rocky shore biotopes altogether, though many of these were only present in very small quantities (CCW, 2006).

While there are a large range of hard substrate communities present within the site only those which are considered particularly notable are considered worthy of inclusion as part of hard substrate 'sub-feature' of the estuary feature. Three communities present within the Dee Estuary meet this criteria being either, specialised biotopes, or nationally important biotopes:

- An area of Holocene peat deposits occurs on Salisbury Bank and supports the nationally important biotope *Mytilus edulis* and piddocks on eulittoral firm clay (CCW, 2006).
- The specialised biotope community hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools has recently been recorded south of Mostyn Quay within a mussel bed on the lower shore (CCW, 2006).
- The nationally important biotope and a priority national Biodiversity Action Plan habitat, *Sabellaria alveolata* reefs on sand-abraded eulittoral rock, is recorded on the north west, east and southwest shores of Hilbre Island.

Intertidal mudflats and sandflats communities - 'Mudflats and sandflats not covered by seawater at low tide' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in Section 5.2 below.

***Salicornia* and other annuals -** '*Salicornia* and other annual plants colonising mud and sand' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in Section 5.3 below.

Atlantic salt meadow - **'**Atlantic salt meadows' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in Section 5.4. below.

Annual vegetation of drift lines - 'Annual vegetated drift line' are classified in the Habitats Directive as interest features in their own right and are therefore described separately in Section 5.5 below.

5.2 Mudflats and sandflats not covered by seawater at low tide

5.2.1 Definition

Intertidal mudflats and sandflats are submerged at high tide and exposed at low tide. They form a major component of estuaries and embayments in the UK, but also occur extensively along the open coast. The physical structure of the intertidal flats ranges from the mobile, coarse sand beaches of wave-exposed coasts to the stable, fine sediment mudflats of estuaries and other embayments. This habitat type can be divided into three broad categories, clean sands, muddy sands and muds; although in practice there is a continuous gradation between them. Plant and animal communities present vary according to the type of sediment, its stability and the salinity of the water.

Intertidal mudflats and sandflats are a widespread habitat type that occurs throughout the UK. European marine sites were selected to encompass the ecological variation across the geographical range of this habitat type in the UK. Sites with large areas of intertidal flats, as well as a range of environmental conditions and an associated diversity of communities were favoured (JNCC, 2003).

5.2.2 Importance of the mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site

The intertidal mudflats and sandflats of the Dee Estuary cover an area of over 10,000 ha, comprising approximately 3 % of the total UK resource of this habitat type. Only five other SACs in the UK series have larger areas of intertidal mudflats and sandflats than the Dee Estuary. They are highly dynamic and change in shape from one year to the next.

The estuary has the full range of sand, muddy sand and mud biotopes although the intertidal flats are somewhat sandier than other coastal plain estuaries in the north-eastern Irish Sea, the relatively sandy nature of the upper estuary sediments may be attributed to the shortening of the estuary following canalisation (CCW, 2006). The communities present are highly representative of estuarine mudflats and sandflats in general (CCW, 2002) and the invertebrates provide a rich source of food for the internationally important bird populations of the estuary.

In the inner section of the estuary, large areas are dominated by the ragworm *Hediste diversicolor* and the Baltic tellin *Macoma balthica*. Slightly higher up the shore the sediments are more often dominated by amphipods *Bathyporeia pilosa* and *Corophium arenarium*. Sheltered muddy areas sometimes contain high numbers of invertebrates including the ragworm *H. diversicolor*, the peppery furrow shell *Scrobicularia plana* and polychaete worms such as *Eteone longa*. Some areas of the intertidal are dominated by dense cockle beds, which are harvested by hand raking. These are situated towards the outer section of the estuary, on both the English and Welsh shores. The sandy areas either side of the estuary mouth, between Prestatyn and the Point of Ayr and off the north Wirral coast, mainly consist of mobile sands dominated by amphipods and polychaetes.

5.2.3 Sub-features

Intertidal gravel and clean sand communities - This sub-feature generally occurs particularly on open coast beaches and in estuaries and bays where wave action or strong tidal currents prevent the deposition of finer silt. Sandy communities are very extensive within the Dee Estuary and extend well into the mid and upper estuary, especially on the Welsh side of the estuary where the more mobile sediments are to be found associated with the main channel. The estuaries outer sand banks such as Salisbury Middle and Salisbury Bank consist of moderately exposed sand. These areas experience moderately strong tidal streams particularly along the channel edges. Consequently the sediment is extremely mobile forming large sand waves, the tops of which are dryer and more aerated than the wet compacted sand between them (CCW, 2006). The greater part of these banks comprise extensive areas of fine sand with ripples, small waves and standing water

The nationally scarce thumbnail crab *Thia scutellata* has recently been recorded on the outer sandbanks of the estuary (CCW, 2006).

Strandlines form on the sandy beaches present at the mouth of the Dee. Strandlines provide sheltered, moist conditions for some specialised plants and both terrestrial and marine invertebrate species. The organic matter which is deposited helps to bind sand particles together and stabilise the upper shore. In addition strandlines can act as sand traps initiating sand dune formation. Two nationally scarce species, the woodlouse *Armadillidium album,* and the spider *Enoplagnatha crucifera,* are recorded from the drift line at Talacre (Liverpool Museum, 2003).

The **nationally scarce species** occurring within intertidal gravel and clean sand sub feature of mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site are;

- thumbnail crab *Thia scutellata*
- the woodlouse *Armadillidium album*
- the spider *Enoplagnatha crucifera*

Intertidal muddy sand communities - These communities are found in areas of intermediate exposure including relatively sheltered areas of the outer estuary, large areas of the mid estuary and in the upper estuary close to the main channel. A wide range of species colonise these sediments including dense populations of lugworm *Arenicola marina*, other polychaete worms and bivalve molluscs.

The muddy sand habitats of the Dee support extensive cockle beds of particular importance for the wading birds which depend upon them; they are also a valuable economic resource. The nationally rare species *Ophelia bicornis* was recorded from an area of sandy mud on Mostyn Bank (Record to be confirmed - EA NMMP littoral survey 1999-2000, in CCW, 2006).

The **nationally scarce species** occurring within intertidal muddy sand sub feature of mudflats and sandflats not covered by seawater at low tide interest feature in the Dee Estuary European marine site are;

- the worm *Ophelia bicornis*

Intertidal mud communities - These form in the most sheltered areas of the estuary and are recorded towards the head of the estuary and at the bottom of the saltmarsh in the middle estuary (Environment Agency, 1999-2000). The width of the muddy sediment zone is apparently much wider to the north of the main channel than to the south. The stable sediment supports communities whose component species are often highly abundant, typically they are dominated by polychaete worms such as the lugworm *Arenicola marina* and the rag worm *H. diversicolor*, and by bivalve molluscs including Baltic tellin *M. balthica* and peppery furrow shell *S. plana*. Very high densities of the mud-snail *Hydrobia ulva*e also occur. The high biomass of invertebrates in such sediments provides an important food source for a diverse range and large number of fish and benthic predators. Mudflats also provide a valuable feeding, roosting and resting area for species of wading birds and waterfowl.

5.3 *Salicornia* and other annuals colonising mud and sand (pioneer saltmarsh)

5.3.1 Definition

Pioneer saltmarsh vegetation colonises intertidal mud and sand flats in areas protected from strong wave action and is an important precursor to the development of more stable saltmarsh vegetation. It develops at the lower reaches of the saltmarshes where the vegetation is frequently flooded by the tide, and can also colonise open creek sides, depressions or pans within a saltmarsh, as well as disturbed areas of upper saltmarsh.

There can be up to 13 separate communities that could be considered pioneer saltmarsh in which either cord grasses *Spartina* spp., annual glassworts *Salicornia* spp., annual sea-blite *Suaeda maritima* and/or common saltmarsh-grass *Puccinellia maritima* generally form a prominent component of the vegetation with, more unevenly, sea aster *Aster tripolium* and sea purslane *Atriplex portulacoides* (Rodwell, 2000).

The Annex I habitat '*Salicornia* and other annuals colonising mud and sand (pioneer saltmarsh)' is divided into two main types of vegetation; the first type consists of communities which include open stands of perennial glasswort *Sarcocornia perennis*, annual glassworts *Salicornia* spp., or annual sea-blite *Suaeda maritima* (National Vegetation Classification (NVC) types SM7, SM8 and SM9). Other species that may be found include common saltmarsh-grass *Puccinellia maritima*, common cord grass *Spartina anglica* and sea aster *Aster tripolium*. These communities occur in many saltmarshes in the UK and represent an integral part of a sequence of habitats, from sand and mud flats to more stable saltmarsh vegetation.

The second form of pioneer vegetation consists of ephemeral communities colonising open pans in upper saltmarshes. Characteristic plants of this vegetation type include sea pearlwort *Sagina maritima* and knotted pearlwort *S. nodosa*. Such vegetation corresponds to the SM27 NVC community.

5.3.2 Importance of the *Salicornia* and other annuals colonising mud and sand interest feature in the Dee Estuary European marine site

The Dee Estuary supports around 4% of the national UK resource for this feature based on figures obtained in 2000 by Dargie (2001) as a proportion of the national total from the national saltmarsh survey carried out over seven years in the 1980's (Burd, 1989). Larger areas can be found in only three other SACs: the Wash and North Norfolk Coast SAC, the Essex Estuaries SAC and the Solway Firth SAC. Glassworts *Salicornia* spp. and other annuals such as annual sea-blite *Suaeda maritima* are highly specialised plants, totally dependent on a narrow habitat zone on the seaward fringes of saltmarsh. In the Dee the seaward fringes of the accreting marsh provide ideal conditions and it is here that the feature is concentrated.

Research by Ball and Brown (1970, in NCC 1978) discovered that two different species of *Salicornia* were present within the Dee, common glasswort S*alicornia europaea* and long-spiked glasswort *S. dolichostachya*. Long-spiked glasswort was found to be more abundant in open situations as a primary coloniser whereas common glasswort was more common higher up the marsh in association with other species.

In some places the character of the *Salicornia* community has been affected by the presence of common cord grass *Spartina anglica*, which was introduced in the 1920s.

Pioneer saltmarsh also provides an important feeding area and a food source for many species of waterbirds.

5.3.3 Sub-features

Pioneer low marsh communities - The annual glasswort *Salicornia* community (SM8) is the dominant pioneer marsh community in the Dee Estuary SAC with 105 ha recorded in 2000 (Dargie, 2001). This community forms a classical pioneer vegetation front to the low saltmarsh along the north side of the estuary, forming very extensive swards on areas of sandy mud with reduced tidal scour. The lower limit of the glasswort community is set by the time between tides and the time taken for the seeds to become firmly anchored. Glasswort species are tolerant of frequent tidal inundations, enduring around 600 flooding per year at its lower limits where it forms the familiar pioneer stands. Glasswort is also found in smaller patches higher in the main body of the saltmarsh, here it is concentrated in circular pans linked to shallow creeks. Annual sea-blite *Suaeda maritima* saltmarsh community (SM9) is an annual pioneer community that is rare on the Dee Estuary and very restricted in area. SM9 vegetation on the Dee is dominated by annual sea-blite with associations of common cord grass, with occasional sea purslane *Atriplex portulacoides*, glasswort and sand couch *Elytrigia juncea*. On the Dee this community is developed best on small areas of mud adjacent to creek confluences. Very rarely it forms on creek levees in the pioneer zone, usually close to the transition to middle marsh conditions. This community is considered to be much less frequent in the estuary than in the 1980's (M. Hill, in Dargie 2001).

Ephemeral saltmarsh vegetation - Small quantities of ephemeral saltmarsh vegetation with sea pearlwort *Sagina maritima* (SM27) were recorded by Dargie in 2000. In contrast to the classical pioneer low marsh communities discussed above, this community occurs towards the top of the saltmarsh on well-drained sites and at levels that are rarely flooded by tides. In the Dee Estuary it occurs primarily on sand dune to saltmarsh transitions within the Gronant Dunes and Talacre Warren SSSI at Gronant. The nationally scarce seaside centaury *Centaurium littorale* is found here (Dargie, 2001). The sward is generally open with a high proportion of bare ground being colonised by sea pearlwort *Sagina maritima*. Hard grass *Parapholis strigosa* is also usually present.

The **nationally scarce species** occurring with the ephemeral saltmarsh vegetation sub feature of the *Salicornia* and other annuals colonising mud and sand interest feature in the Dee Estuary European marine site are;

- seaside centaury *Centaurium littorale*

5.4 Atlantic salt meadows *Glauco-Puccinellietalia*

5.4.1 Definition

Atlantic salt meadows *Glauco-Puccinellietalia*, develop when salt-tolerant vegetation colonises intertidal sediments of mud and sand in areas protected from strong wave action. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation occurs with decreasing frequency and duration. The vegetation varies depending on the climate and position in the marsh. In the UK, Atlantic salt meadows occur on the North Sea, English Channel and Atlantic shores, with the largest examples in the sheltered estuaries of England. There are more than 29,000 hectares of this habitat in the UK (Brown *et al*., 1997), which suggests that up to two-thirds of British saltmarshes are represented by this category. Sites have been selected to cover the geographical range and ecological variation of this habitat type, and for the most part they are the largest examples, supporting a well-developed zonation of plant communities. Many have transitions to terrestrial habitat assemblages, such as freshwater reedbed, sand dunes, vegetated shingle and woodland. There are marked regional variations in Atlantic salt meadow communities in the UK and those which are grazed differ significantly from those which are ungrazed, in terms of both structure and species composition.

Saltmarshes play a fundamental role in the life of an estuary, bringing stability to its margins and also operating as a source of primary production. They are a rare and specialised habitat in their own right and many of the plants that occur there survive nowhere else. Saltmarshes provide an important habitat for both marine and terrestrial fauna and serve as roosting and feeding areas for internationally important waterbirds.

5.4.2 Importance of the Atlantic salt meadow interest feature in the Dee Estuary European marine site

The Dee Estuary supports about 7% of the total area of saltmarsh in the UK based on figures obtained in 2000 by Dargie (2001) as a proportion of the national total from the national saltmarsh survey carried out over seven years in the 1980's (Burd, 1989). Unlike many estuaries elsewhere the Dee saltmarsh is presently a predominantly accreting system (Dargie, 2001). Much of the saltmarsh of the Dee Estuary is typical of Atlantic salt meadow, with sea aster *Aster tripolium* forming an important component of most of its subdivisions (CCW, 2002). Approximately 13% (2040 ha) of the Dee Estuary SAC comprises Atlantic salt meadow, and the estuary contains what is probably the third largest single expanse of this habitat in Britain (CCW, 2002).

There is an excellent balance in the types of vegetation present including 31 communities or sub-communities (see Section 6.4 Box 4). These communities support a number of often rare or scarce obligate saltmarsh plant species, including slender hare's-ear *Bupleurum tenuissimum* (Dargie, 2001).

The Dee Estuary saltmarsh also exhibits excellent local and estuary wide habitat zonations. These include the presence of many localities with a complete sequence from low marsh to mid marsh via a middle marsh zone, and excellent examples of succession controlled by grazing. There is also excellent zonation of major habitats in relation to their position within the estuary, including the development of pioneer vegetation as a rolling front to the main saltmarsh, low-middle marsh as the dominant vegetation type overall, upper marsh dominant on the oldest saltmarsh surfaces, extensive swamp on the inner saltmarsh edge where there is groundwater seepage from inland (Dargie, 2001).

The area of saltmarsh in the Dee Estuary has expanded relatively rapidly over the last century. This is most reasonably attributed to a combination of anthropogenic factors affecting the estuary's form; combined with the natural tendency of the estuary to accrete. These factors include the historic land claim in the upper estuary, the diversion and canalisation of the upper estuary channel, the introduction of training walls, regulation of flow volumes in the river Dee, and the introduction of the invasive saltmarsh species, common cord grass *Spartina anglica* in 1928, when 1,000 plants were planted opposite Connah's Quay (Masey, 1937, in NCC 1978). Yet, historically the area of saltmarsh within the Dee Estuary may previously have been greater still, since the overall length of the estuary has been shortened by approximately 30% in the last three hundred years, primarily as a result of the canalisation and land claim in the upper estuary.

The available information indicates that the Dee saltmarsh has changed markedly even over the last two decades with the saltmarsh increasing in both area and in height. The total extent of saltmarsh in the estuary has increased from 2,103 ha in 1983 to 2,832 ha in 2000 (Dargie, 2001). However, this increase has occurred at the same time as saltmarsh erosion has occurred along much of the Welsh shoreline. There has also been a reduction of about 95% in the area of marsh dominated by cord grass *S. anglica*, and the area of other pioneer saltmarsh habitats has also declined (Dargie, 2001). The replacement of *Spartina* dominated vegetation by middle marsh vegetation was evident during the mid 1980's during monitoring by the Nature Conservancy Council (Hill, 1987). This reduction in pioneer habitats has been balanced by gains in the area of common saltmarsh grass *Puccinellia maritima* and sea purslane *Atriplex portulacoides*. Common saltmarsh grass in particular seems to have prospered in areas where cord grass *Spartina anglica* was once dominant. There have also been increases in the area of the middle – upper saltmarsh zones since 1983 (Dargie, 2001). This is also documented within a review of *Spartina anglica* (Lacambra *et al*., 2004). Thus evidence points to conversion of pioneer habitats to middle and upper marsh conditions with new pioneer vegetation becoming established along the seaward edge. Further net accretion is considered likely to generate additional areas of saltmarsh in the short term, though the rate of accretion has reduced in recent years (J. Potter, *pers*. *comm*.).

Unlike most western estuaries, sizable areas of saltmarsh within the Dee Estuary remain ungrazed and therefore plant species which are susceptible to grazing are relatively widespread, for example sea purslane. However, heavy sheep grazing is maintained as a deliberate management policy on some areas of marsh on the Welsh shore in the mid to upper estuary to provide habitat for wildfowl. Heavy grazing also occurs on limited areas of Burton Marsh on the English shore where grazing is concentrated due to stock being repeatedly forced inland by high spring tides (Dargie, 2001).

The invertebrate fauna of the saltmarsh within the Dee Estuary is yet to be studied in detail across most of the site. A survey of saltmarsh habitats at eight locations within the upper estuary in 1993 revealed seven nationally scarce species, including three species characteristic of saltmarsh pools (Liverpool Museum, 1994). The invertebrate saltmarsh fauna at Bagillt, Oakenholt and Burton Point are considered likely to be of regional significance (Liverpool Museum, 1994). A detailed study of coastal habitats within Gronant Dunes and Talacre Warren SSSI, revealed a further seven nationally scarce species associated with very small areas of saltmarsh habitats, including the *Red Data Book* planthopper species *Calligypona reyi* (Liverpool Museum, 2003).

The **nationally scarce, notable and red data book species** occurring with the Atlantic salt meadow feature in the Dee Estuary European marine site are (this list is not exhaustive);

- planthopper *Calligypona reyi*

- beetle *Aphodius plagiatus*
- meniscus midge *Dixella attica*
- water beetle *Haliplus apicalis*
- water beetle *Helophorus fulgidicollis*
- water beetle *Ochthebius auriculatus*
- hoverfly *Platycheirus immarginatus*
- weevil *Polydrusus pulchellus*

5.4.3 Sub-features

Low to mid marsh communities - The low to mid marsh zone is by far the most extensive component of the Dee saltmarsh; lying immediately landward of the pioneer saltmarsh zone, the low to mid marsh communities experience a greater number of tidal inundations than the mid to upper marsh, usually more than 360 a year. As a result of this, the vegetation communities of the low and mid marsh are often relatively species-poor, composed of halophytic plants that can withstand such conditions. Communities of saltmarsh grass and sea purslane typify the low to mid marsh zone.

Mid to upper marsh communities - The mid to upper marsh community is dominated by red fescue *Festuca rubra* and common saltmarsh grass together with sea milkwort *Glaux maritima* and small areas of the saltmarsh rush *Juncus gerardii*. In the mid marsh zone, as the number of tidal inundations becomes less frequent, the vegetation becomes more diverse, with a more complex structure and a greater proportion of herbs. At the upper levels of the marsh, tidal inundation only occurs on the highest spring tides. The vegetation communities here reflect this with a greater diversity of species and some being restricted to this zone.

Transitional communities - A large number of small freshwater streams enter the estuary, especially between Heswall and Shotton, where there are also freshwater springs at the top of the marsh. In areas where there is a significant influence of fresh water in the upper reaches of the estuarine system, and where the marsh joins higher ground, important transitional communities are found.

Sea couch *Elytrigia atherica* vegetation is characteristic of the drift line of the Dee Estuary saltmarsh. This vegetation type is a key element driving the dynamics of vegetation change in the Dee Estuary (Dargie, 2001). As well as occurring on drift lines sea couch can be found extending out into the marsh on creek levees. The stems act as an efficient sediment trap, further raising ground levels beside creeks and thus creating depressions on the high marsh where water logging occurs

Notable areas of brackish swamp vegetation occur at the rear parts of the Dee Estuary saltmarsh, particularly on Burton Marsh and further northwards along the English shore. Most of these communities are found in areas receiving freshwater seepage from slopes inland (Dargie, 2001). Sea club rush *Bolboschoenus maritimus* swamp occurs most frequently but significant areas of reedbed with *Phragmites australis* are also present

Small areas of relatively well-drained *Festuca rubra – Agrostis stolonifera – Potentilla anserina* grazed grasslands which are only subject to a few tidal inundations each year occur on the highest levels of saltmarsh. Even when flooded these communities usually only experience brackish conditions and they represent the transition from saltmarsh to wet grassland (Dargie, 2001).

The upper saltmarsh and wet grassland transitions of the Dee are notable for their populations of nationally and locally scarce plant species; in particular slender hare's-ear *Bupleurum tenuissimum,* seaside centaury *Centaurium littorale* and sea rush *Juncus maritimus* (Dargie, 2001).

The **nationally scarce species** occurring with the transitional communities sub feature of the Atlantic salt meadow interest feature in the Dee Estuary European marine site are;

- slender hare's-ear *Bupleurum tenuissimum*
- seaside centaury *Centaurium littorale*

5.5 Annual vegetation of drift lines

5.5.1 Definition

Annual vegetation of drift lines comprise annuals or annuals and perennials, occupying accumulations of drift material and gravel, rich in nitrogenous organic matter.

Most shingle or sand/shingle beaches are too dynamic to sustain permanent drift-line vegetation. Many of the fringing beaches with drift-line vegetation are small, and annual vegetation may exist in one location in one year but not another. Therefore, although widespread around the UK, sites where this Annex I habitat type is persistent are rare, and even the largest sites probably support less than 10 ha of this habitat. At most sites the habitat is naturally species-poor, and there is a limited range of ecological variation. (JNCC, 2003).

In the UK drift-line vegetation has been divided into two communities – the *Honkenya peploides – Cakile maritima* strandline community (NVC type SD2) and the *Matricaria maritima – Galium aparine* strandline community (SD3). The first (SD2) occurs all around the British coastline, while the second (SD3) is mainly restricted to northern Britain and the west coast.

5.5.2 Importance of the annual vegetation of drift lines interest feature in the Dee Estuary European marine site

Approximately 1.3 ha of the Dee Estuary SAC comprises strandline vegetation (CCW, 2002). This comprises around 0.7 % of the UK national resource. Level, gently sloping, high-level mobile beaches, with little or no human disturbance, support the best examples of this vegetation. The level of human disturbance on the shores of the Dee Estuary is variable, with relatively low disturbance at some sites.

Although much of the strandline vegetation in the Dee Estuary SAC could not be described in terms of the National Vegetation Classification, they still support many characteristic strandline species. Plants of unstable, impoverished sandy beaches such as sea rocket *Cakile maritima* and sea sandwort *Honkenya peploides* occur at various locations around the estuary including at Point of Ayr, Mostyn and Heswall. In addition, these communities also include several locally uncommon species such as grass-leaved orache *Atriplex littoralis* and hard grass *Parapholis strigosa*. About 70 % of the strandline vegetation in the Dee Estuary SAC was classified as a recognised NVC community (CCW, 2002). The remaining stands are thought to represent undescribed vegetation types and have been provisionally labelled as either *Leymus arenaria – Elytrigia repens* strandline or as *Atriplex glabriuscula – A. prostrata* strandline.

The nationally scarce sand dart moth *Agrotis ripae* occurs along the dune frontage between Gronant and Talacre. This is associated with the vegetated drift line, the larvae feeding on sea rocket.

5.6 River lamprey *Lampetra fluviatilis*

5.6.1 Description

Lampreys are one of the most primitive of all living vertebrate animals. They are distinct from all other kinds of fish in the British Isles, as they have no lower jaw. Their mouth is surrounded by a round sucker-like disc within which the adults have strong, rasping teeth. Other characteristic features are their eel-like shape, lack of paired fins or scales and a skeletal structure made of strong but flexible cartilage, rather than bone.

Most species of lamprey have similar life cycles and ecologies that involve the migration upstream into rivers to reach spawning grounds – normally stony or gravely stretches of running water. Here they spawn in pairs or groups, laying eggs in crude 'nests'. After hatching, the young, elongate larvae, known as ammocoetes swim, or are carried downstream by the flow to areas of depositional sediments in slow flowing water. The distribution of the larvae depends on the hydrodynamic regime of the river. Where the gradient of a river is low there may be little downstream movement, in such circumstances ammocoetes burrow within the river sediment. Here they spend the next few years feeding and growing larger.

The metamorphosis from larvae to adult is physiologically demanding and takes place within a relatively short time, usually within a few weeks after several years of larval development. They then migrate downstream, away from the nursery areas and into the estuary where they may remain for some time to allow their osmoregulatory mechanisms to acclimatise to increased salinity before moving offshore to feeding grounds. Young river lampreys are known to congregate in large numbers in the estuaries of major rivers, where they feed upon a variety of estuarine fishes, but particularly herring *Clupea harengus,* sprat *Sprattus sprattus* and flounder *Platichthys flesus* (Life in UK Rivers Project, 2003).

As adults, lampreys feed by attaching to the sides of other fish. They rasp through the skin, feeding on the blood and tissues beneath. Although the lamprey is a parasitic species, there is no evidence of any significant damage to native fish stocks in Europe. Furthermore, it is a beneficial species to the ecology of rivers, both in helping to stabilise and aerate silt beds and in providing food for a range of other wildlife.

On reaching sexual maturity, the adult lamprey stop feeding and migrate up stream to their spawning grounds. After spawning it is thought that they die.

Although considerable information is available on the biology of the river lamprey in freshwater, much less is known about its habits in estuaries and the sea (Maitland, 1997). River lamprey must not be confused with the brook lamprey *Lampetra planeri,* which are confined to the river for the duration of their life-cycle. The average adult length of the river lamprey is around 30cm with a weight of some 60g. It is confined to Western Europe, migrating from the sea to spawn in silt beds of many UK rivers.

5.6.2 Importance of the river lamprey interest feature in the Dee Estuary European marine site

River lampreys are present in the River Dee and must therefore use the Dee Estuary as part of their migratory route. As mentioned above lampreys are known to congregate in large estuaries of major rivers. Such feeding behaviour has yet to be documented for the Dee Estuary. However it is known that several potential river lamprey prey species are found within the Dee Estuary including herring *Clupea harengu*s, sprat *Sprattus sprattu*s, flounder *Platichthys flesu*s and small gadoids such as whiting *Merlangius merlangu*s and pout *Trisopterus luscu*s (Henderson, 2003).

Records of river lamprey caught at the fish trap at Chester weir indicate that mature adults undertake their upstream migration at two different periods of the year, either early spring (March-April) or late summer/autumn (August-November). These records suggest the presence of a ‘praecox’ (early) form, which spend only one year at sea rather than the usual two-three years (Potter & Hatton-Ellis, 2003).

Fish trap counts at Chester over eight years between 1992 and 2002 recorded highly variable numbers of river lamprey each year, counts range between 0 in 1997 and 206 in 2002 with a mean of 81 (I. Davidson, Environment Agency Wales, *pers comm.*). However, these count data should not be viewed as an estimate of population size. The trap at Chester is not designed to sample lampreys, which are able to swim through its bars. The trap therefore operates at low efficiency for lamprey because it is being selective for larger species such as salmon and sea trout. In addition, the trap is inactive for around 40% of the time and lampreys are known to migrate mostly at night when the trap is inoperative. Actual run size may be significantly greater. A survey of ammocoete beds in the lower River Dee in 2002 revealed three cohorts of *Lampetra* spp. ammocoetes, though these may have included both river lamprey and brook lamprey *Lampetra planeri* individuals, which are indistinguishable at this stage of their life history (Potter & Hatton-Ellis, 2003)

5.7 Sea lamprey *Petromyzon marinus*

5.7.1 Description

The sea lamprey is the largest and least common of the three lamprey species found in the UK and may reach a length of 100cm and weigh 2.5kg, although more usually is around 50cm. Relatively little is known about the precise habitats occupied by adult sea lamprey, but it is thought to occur over much of the North Atlantic, both in shallow coastal waters and deep offshore. Like the river lamprey the species is anadromous, growing to maturity in the sea and then migrating into fresh water to spawn. The larvae spend several years in silt beds before metamorphosing and migrating downstream to the sea. Like all species of lamprey, it requires clean gravel for spawning and marginal silt or sand for the burrowing juvenile fish.

Relatively little is known about the precise habitats occupied by adult sea lampreys, nor is it certain which fish species are the main hosts (Life in UK Rivers Project, 2003). There is some anecdotal evidence to indicate that sea lamprey feed on much bigger species than river lamprey including basking sharks (W. Sanderson, *pers. comm.*)

The sea lamprey has a widespread distribution within the UK, although populations have declined over the last hundred years due to pollution and barriers to migration.
Sea lamprey favour warmer water conditions than other species of lamprey and also appear to be particularly poor at ascending obstacles to migration (Hatton-Ellis, *pers. comm*.). They have become extinct in a number of rivers (Maitland, 1997).

5.7.2 The importance of the sea lamprey in the Dee Estuary European marine site

Like river lamprey, sea lamprey are also present in the River Dee and thus the Dee Estuary forms an essential part of their migratory route. Records of sea lamprey caught at the fish trap at Chester Weir indicate that mature adults migrate upstream almost exclusively during the months of May and June (Potter & Hatton-Ellis, 2003). Fish trap counts at Chester over eight years between 1992 and 2002 again recorded highly variable numbers of sea lamprey each year. Counts range between 2, recorded in 2000 and 59, recorded in 2001 with a mean of 20 (I. Davidson, Environment Agency Wales, *pers comm*.). Although the Chester fish trap is more effective at trapping adult sea lampreys due to their larger size in comparison to river lamprey, smaller individuals are still able to pass through the trap and therefore count data should not be viewed as an accurate estimate of population size. The actual run size of sea lamprey may also be significantly greater than these data suggest.

6 The Dee Estuary SAC conservation objectives

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, Natural England and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for the European marine site.

The conservation objectives for the Dee Estuary SAC interest features are provided below and should be read in conjunction with other advice given in this document particularly:

- the maps in Appendix IV showing the extent of the sub-features;
- the description in Section 5 of the features and their importance;
- the favourable condition table in Section 7.

The protection and management of the SAC in accordance with Article 6 of the Habitats Directive, including in particular the consideration of plans and projects under Article 6(3) and 6(4), should be carried out in view of these conservation objectives.

These conservation objectives are subject to review by Natural England and the Countryside Council of Wales.

6.1 Interest feature 1: The conservation objective for the estuary

The conservation objective for the "estuaries" feature of the Dee Estuary SAC is to maintain the feature in favourable condition, as defined below:

The "**estuaries**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the aggregate total extent of all estuarine communities[2] within the site is maintained;

ii. the spatial distribution[3] of estuarine communities[2] within the site is maintained;

iii. the extent of individual estuarine habitat features[4] within the site is maintained;

iv. the variety and relative proportions of sediment and rocky substrates within the estuary is maintained;

v. the variety and extent of any notable subtidal sediment communities[5] is maintained;

vi. the variety and extent of notable intertidal hard substrata communities[6] is maintained;

vii. the spatial and temporal patterns of salinity, suspended sediments and nutrients concentrations are maintained within limits sufficient to satisfy the requirements of statements (i) to (vi) above.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 1**.

NB. Detailed requirements for the maintenance of favourable condition for the other estuarine habitat features[4] and their typical species are provided under their respective conservation objectives.

Box 1: Explanatory information for the "estuaries feature" conservation objective

[1] **Natural processes:**

Each feature may be subject to both natural processes and human influence. Human influence on the interest features is acceptable provided that it is proved to be / can be established to be compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions, which is entirely a result of natural process will not constitute unfavourable condition, but may trigger a review of the definition of favourable condition.

Dynamic physical process within estuaries can stem from variable weather conditions including one off storm events, and result in changes in wave exposure, riverine floods or tidal surges. These events can move large quantities of sediments and alter channel morphology, which affect current patterns and sediment transport within the estuary. Where these processes occur without significant anthropogenic influence they fall under the umbrella of 'natural change'. Because estuaries are dynamic systems we can expect the amount and gross distribution of habitats to change in the future. In general estuarine communities and their supporting habitats are intrinsically more dynamic over short time scales when compared to other marine and terrestrial habitats. Some estuarine communities occur in cycles dependant upon the prevailing physical conditions. Features should not necessarily be considered in unfavourable condition due to the short term disappearance of a particular community due to natural processes.

An important example of natural processes occurring over a longer timescale is that estuaries have a natural tendency to accumulate sediment, thereby changing their form from their original glacial morphology to a state where tidal energy is dissipated by sediment banks and other features such as salt marsh. This, with other forces of natural change, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. Future developments should aim to avoid impact on the future evolution of the system as where this process is constrained by human influence, the capacity of habitats to accommodate readjustment may be affected.

[2] **All estuarine communities**:

- Subtidal sediment communities.
- Intertidal hard substrate communities.
- Intertidal mudflats and sandflats communities.
- *Salicornia* and other annual plants colonising mud and sand.
- Atlantic salt meadow.
- Annual vegetation of drift lines.

Box 1(continued): Explanatory information for the “estuaries feature” conservation objective

[3] **Spatial distribution**

Spatial distribution of estuarine communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Individual estuarine habitat features**:

- Intertidal mudflats and sandflats communities.
- *Salicornia* and other annual plants colonising mud and sand.
- Atlantic salt meadow.
- Annual vegetation of drift lines.

[5] **Notable subtidal sediment communities**:

- Any notable subtidal sediment communities that may be identified including those important for estuarine fish.

[6] **Notable intertidal hard substrata communities**:

- *Mytilus edulis* and piddocks on eulittoral firm clay.
- *Sabellaria alveolata* reefs on sand-abraded eulittoral rock.
- Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools.
- Any other notable intertidal hard substrate communities that may be identified.

NB. The four individual estuarine habitat features[4] together with the notable subtidal sediment communities[5] and the notable hard substrate communities[6] together comprise the six “sub-features” of the “estuary” feature. Maps provided in Appendix IV show the extent of the various habitat features based on best available information.

6.2 Interest feature 2: The conservation objective for mudflats and sandflats not covered by seawater at low tide

The conservation objective for the "mudflats and sandflats" feature of the Dee Estuary SAC is to maintain the feature in favourable condition, as defined below:

The "**mudflats and sandflats**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of mudflat and sandflat communities[2] within the site is maintained;

ii. the proportions of individual mudflat and sandflat communities[2] within the site are maintained;

iii. the topography of the intertidal flats and the dynamic processes of channel migration and sinuosity across the flats are maintained;

iv. the abundance of typical species[3] of the mudflat and sandflat feature within the site is maintained.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 2**.

Box 2: Explanatory information for the "mudflats and sandflats" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in Box 1.

[2] **Mudflat and sandflat communities**:

- Intertidal gravel and clean sand communities

i. Barren coarse sand shores;
ii. Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores;
iii. Burrowing amphipods and polychaetes in clean sand shores.
iv. Talitrid amphipods in decomposing seaweed on the strandline
v. Dense *Lanice conchilega* in tide-swept lower shore sand
vi. Barren shingle or gravel shores

- Intertidal muddy sand communities including cockle beds:

i. Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores
ii. *Bathyporeia pilosa* and *Corophium spp.* in upper shore slightly muddy fine sand shores
iii. *Macoma balthica* and *Arenicola marina* in muddy sand shores.

iv. *Arenicola marina, Macoma balthica* and *Mya arenaria* in muddy sand shores.
v. *Echinocardium cordatum* and *Ensis sp.* in lower shore or shallow sublittoral muddy fine sand

- Intertidal mud communities:

i. *Hediste diversicolor* and *Macoma balthica* in sandy mud shores;
ii. *Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores
iii. *Hediste diversicolor, Macoma balthica* and *Mya arenaria* in sandy mud shores.
iv. *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores
v. *Hediste diversicolor* and oligochaetes in low salinity mud shores

NB. These three community types comprise the "sub-features" of the "Mudflats and sandflats not covered by seawater at low tide" feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

[3] **Typical species of the intertidal mudflats and sandflats include the following**:

Hediste diversicolor
Macoma balthica
Hydrobia ulvae
Arenicola marina
Mya arenaria
Scrobicularia plana
Nephtys hombergii
Cerastoderma edule
Bathyporeia spp.
Corophium spp.
Echinocardium cordatum
Ensis ensis
Eurydice pulchra
Haustorius arenarius
Nephtys cirrosa
Orchestia gammarellus
Talitrus saltator
Lanice conchilega
Scoloplos armiger

Typical species of the intertidal mudflats and sandflats may also include oligochaetes and invertebrates yet to be identified.

6.3 Interest feature 3: The conservation objective for *Salicornia* and other annuals colonising mud and sand

The conservation objective for the "*Salicornia* and other annuals colonising mud and sand" feature of the Dee Estuary SAC is to maintain the feature in favourable condition, as defined below:

The "***Salicornia* and other annuals colonising mud and sand**" feature will be considered to be in favourable condition when both:

- subject to natural processes[1], each of the following conditions (i) to (v) are met:

i. the total extent of pioneer saltmarsh vegetation communities[2] within the site is maintained;

ii. the presence of pioneer saltmarsh vegetation communities[2] as part of transitions from intertidal sediment communities to higher saltmarsh are maintained;

iii. the abundance of the typical species[3] of the pioneer saltmarsh vegetation communities[2] is maintained;

iv. the abundance of the notable species[4] of the pioneer saltmarsh vegetation communities[2] is maintained.

- and, regardless of natural processes[1], condition (v) is also met:

v. the overall extent and abundance of common cord grass *Spartina anglica* is not increasing within the pioneer saltmarsh zone.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 3**.

Box 3: Explanatory information for the "*Salicornia* and other annuals colonising mud and sand" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Pioneer saltmarsh vegetation communities**:

- Pioneer low marsh communities:

i. Annual *Salicornia* saltmarsh SM 8
ii. *Suaeda maritima* saltmarsh SM 9

- Ephemeral saltmarsh vegetation :

i. Ephemeral saltmarsh vegetation with *Sagina maritima* SM 27

NB. These two community types comprise the "sub-features" of the "*Salicornia* and other annuals colonising mud and sand" feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

[3] **Typical species of the pioneer saltmarsh include the following**:

Salicornia spp.
Suaeda maritima

[4] **Notable pioneer saltmarsh species**:

Centaurium littorale [this species occurs within the ephemeral saltmarsh only]

6.4 Interest feature 4: The conservation objective for Atlantic salt meadow

The conservation objective for the "Atlantic salt meadow" feature of the Dee Estuary SAC is to maintain the feature in favourable condition, as defined below:

The "**Atlantic salt meadow feature**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the total extent of Atlantic salt meadow vegetation communities[2] within the site is maintained;

ii. the proportions of individual Atlantic salt meadow vegetation communities[2] within the site are maintained;

iii. the zonation of Atlantic salt meadow vegetation communities[2] and their transitions to fresh water and terrestrial vegetation are maintained;

iv. the morphology of saltmarsh creeks and pans and the process of their evolution are maintained;

v. the extent of ungrazed areas of salt meadow within the estuary is maintained and there is no increase in grazing intensity over the rest of the salt meadow;

vi. the relative abundance of the typical species[3] of the Atlantic salt meadow vegetation communities[2] is maintained;

vii. the abundance of the notable species[4] of the Atlantic salt meadow vegetation communities[2] is maintained.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 4**.

Box 4: Explanatory information for the “Atlantic salt meadow” conservation objective

[1] Natural processes:

The meaning of ‘natural processes’ is explained in **Box 1**.

[2] **Atlantic salt meadow vegetation communities:**

- Low to mid marsh communities:

i. Transitional low saltmarsh with *Puccinellia maritima*, annual *Salicornia* sp. and *Suaeda maritima* SM10
ii. *Aster tripolium* (rayed) saltmarsh SM12
iii. *Puccinellia maritima* saltmarsh SM13
- *Puccinellia maritima* sub-community SM13a
- *Glaux maritima* sub-community SM13b
- *Plantago maritima - Armeria maritima* sub-community SM13d
- *Atriplex portulacoides* saltmarsh SM14
- *Atriplex portulacoides* sub-community SM14a
- *Puccinellia maritima* sub-community SM14c

- Mid to upper marsh communities:

i. *Festuca rubra* salt-marsh SM16
- *Puccinellia maritima* sub-community SM16a
- *Juncus gerardii* sub-community SM16b
- *Glaux maritima* sub-community SM16c
- *Festuca rubra* sub-community SM16d
- *Leontodon autumnalis* sub-community SM16e
- Provisional new *Carex extensa* sub-community SM16x (Dargie, 2001)

ii. *Juncus maritimus* salt-marsh SM18
- *Oenanthe lachenalii* sub-community SM18b

- Transitional high marsh communities:

i. *Elytrigia atherica* saltmarsh SM24
ii. *Elytrigia repens* saltmarsh SM28
iii. *Festuca rubra - Agrostis stolonifera - Potentilla anserina* inundation grassland MG11
iv. *Lolium perenne* sub-community MG11a
v. *Agrostis stolonifera - Alopecurus geniculatus* inundation grassland MG13
vi. *Phragmites australis* reedbed S4
vii. *Phragmites australis* sub-community S4a
viii. *Atriplex prostrata* sub-community S4d
ix. *Bolboschoenus maritimus* swamp S21
x. *B. maritimus* sub-community S21a
xi. *Atriplex prostrata* sub-community S21b
xii. *Agrostis stolonifera* sub-community S21c
xiii. *Phalaris arundinacea* tall-herb fen S28

NB. These three community types comprise the “sub-features” of the “Atlantic salt meadow” feature. Maps provided in Appendix IV show the extent of these sub-features based on the best available information.

Box 4 (continued): Explanatory information for the “Atlantic salt meadow” conservation objective

[3] **Typical species of the Atlantic salt meadow include the following**:

Puccinellia maritima,
Salicornia spp.
Suaeda martitima
Aster tripolium
Glaux maritima
Plantago maritima
Armeria maritima
Atriplex portulacoides
Festuca rubra
Juncus gerardii
Triglochin maritima
Leontodon autumnalis
Trifolium repens
Carex extensa
Agrostis stolonifera
Juncus maritimus
Oenanthe lachenalii
Elymus pycnanthus
Atriplex prostrata
Elymus repens
Potentilla anserina
Lolium perenne
Alopecurus geniculatus
Phragmites australis
Bolboschoenus maritimus
Phalaris arundinacea
Parapholis strigosa

[4] **Notable saltmarsh species:**

Centaurium littorale
Bupleurum tenuissimum

6.5 Interest feature 5: The conservation objective for annual vegetation of drift lines

The conservation objective for the "annual vegetation of drift lines" feature of the Dee Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The "**annual vegetation of drift lines**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the extent of coarse sediment / shingle formations capable of supporting drift line vegetation communities[2] within the site is maintained;

ii. the presence of annual drift line vegetation communities[3] within the site is maintained;

iii. the presence of the typical species[4] of the annual drift line vegetation communities[2] is maintained.

Further explanatory information clarifying the meaning of terms [1-4] above is provided in **Box 5**.

Box 5: Explanatory information for the "annual vegetation of drift lines" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] Coarse sediment / shingle formations capable of supporting annual drift line vegetation communities include:

Coarse sediment / shingle formations at or above mean high-water spring tides, including accumulations of drift material and gravel rich in nitrogenous organic matter, with varying amounts of sand interspersed in the shingle**.**

[3] **Annual driftline vegetation communities include**:

i. SD2 *Honkenya peploides - Cakile maritima* strandline community
ii. SD2 / SD5b Strandline community transitional between SD2 *Honkenya peploides - Cakile maritima* strandline community and SD5b *Leymus arenarius* mobile dune community
iii. SD1 / SD3 Strandline community intermediate between SD1 *Rumex crispus - Glaucium flavum* shingle and SD3 *Tripleurospermum maritimum - Galium aparine* strandline
iv. SDxx *Leymus arenarius - Elytrigia repens* strandline community
v. SDy *Atriplex glabriuscula - A. prostrata* strandline community

NB iv and v were described in Dargie (2001)
Maps provided in Appendix IV show the extent of the feature based on best available information

[4] **Typical species of supporting annual drift line vegetation communities include the following**:

Cakile maritima
Honkenya peploides

6.6 Interest feature 6: The conservation objective for *Lampetra fluviatilis* (river lamprey)

The conservation objective for the "*Lampetra fluviatilis* (river lamprey)" feature of the Dee Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The "**river lamprey**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile river lamprey through the Dee Estuary between Liverpool Bay and the River Dee is unobstructed by physical barriers and / or poor water quality;

ii. the five year mean count of river lampreys recorded by the Chester Weir fish trap is no less than 55 under the monitoring regime[2] in use prior to notification [*i.e. 100% of the mean annual count during the five years for which data are available prior to notification: 1993, 1997-2000*];

iii. the abundance of prey species[3] forming the river lamprey's food resource within the estuary, is maintained.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 6**.

NB. Other conservation objectives are to be produced relating to the requirements of the Dee catchment's river lamprey population; in particular regarding to their use of supporting habitats in the River Dee/Aber Dyfrdwy SAC, which directly abuts the Dee Estuary SAC. These habitats, including spawning and nursery areas are essential for the fulfilment of the species' lifecycle and therefore the Dee Estuary river lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Dee river lamprey feature are also met in full.

Box 6: Explanatory information for the "*Lampetra fluviatilis* (river lamprey)" conservation objective

[1] **Natural processes:**

River lamprey population

The size of the population is subject to external factors such as food / host availability in Liverpool Bay and breeding success in the River Dee SAC.

Supporting habitats

The general meaning of 'natural processes' with respect to the supporting habitats of river lamprey within the estuary is explained in **Box 1**.

[2] **Monitoring regime at Chester Weir fish trap**:

Over the five years for which data are available prior to notification (1993, 1997-2000) Chester Fish trap operated for a mean of 394 hours per month, throughout the year, each year (I. Davidson, *pers. comm*.). Any change in the operation of the fish trap especially changes in the total hours the trap is active for per month or per year may require the count in the objective to be revised.

[3] **Prey species**:

In the estuaries of major rivers river lamprey feed on a variety of fish, particularly herring *Clupea harengus,* sprat *Sprattus sprattus* and flounder *Platichthys flesus* (Maitland, 2003). Sprats are present in the Dee Estuary throughout the year and it is likely that they are one of the most important prey species for river lamprey during the winter months when the adults move inshore (Henderson, 2003). From November to March herring are also common. During the summer months other fish such as flounder and small gadoids such as whiting *Merlangius merlangus* and pouting *Trisopterus luscus* are potential prey (Henderson, 2003). They are also known to feed off sea trout *Salmo trutta* (Bird, 2008).

6.7 Interest feature 7: The conservation objective for *Petromyzon marinus* (sea lamprey)

The conservation objective for the "*Petromyzon marinus* (sea lamprey)" feature of the Dee Estuary SAC is to maintain the feature in a favourable condition, as defined below:

The "**sea lamprey**" feature will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the migratory passage of both adult and juvenile sea lampreys through the Dee Estuary between Liverpool Bay and the River Dee is unobstructed by physical barriers and / or poor water quality;

ii. the five year mean count of sea lampreys recorded by the Chester Weir fish trap is no less than 18 under the monitoring regime[2] in use prior to notification. [*i.e. 100% of the mean annual count during the five years for which data are available prior to notification: 1993, 1997-2000*];

iii. the abundance of prey species[3] forming the sea lamprey's food resource within the estuary, is maintained.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 7**.

NB. Other conservation objectives are to be produced relating to the requirements of the Dee catchment's sea lamprey population; in particular regarding to their use of supporting habitats in the River Dee/Aber Dyfrdwy SAC, which directly abuts the Dee Estuary SAC. These habitats, including spawning and nursery areas are essential for the fulfilment of the species' lifecycle and therefore the Dee Estuary sea lamprey feature can only be in favourable condition if the conservation objectives pertaining to the River Dee sea lamprey feature are also met in full.

Box 7: Explanatory information for the "*Petromyzon marinus* (sea lamprey)" conservation objective

[1] **Natural processes:**

Sea lamprey population

The size of the population is subject to external factors such as food / host availability in Liverpool Bay and breeding success in the River Dee SAC.

Supporting habitats

The general meaning of 'natural processes' with respect to the supporting habitats of sea lamprey within the estuary is explained in Box 1.

[2] **Monitoring regime at Chester Weir fish trap**:

Over the five years for which data are available prior to notification (1993, 1997-2000) Chester Fish trap operated for a mean of 427 hours in May and 367 hours in June (I. Davidson, *pers. comm*.). May and June are the two key months for upstream migration of sea lamprey (Potter & Hatton-Ellis, 2003). Any change in the operation of the fish trap especially changes in the total hours the trap is active in these two months may require the count in the objective to be revised.

[3] **Prey species**:

Sea lamprey feed on a wide variety of marine and anadromous fishes, including herring *Clupea harengus*, salmon *Salmo salar*, cod *Gadus morhua* and haddock *Melanogrammus aeglefinus* (Maitland, 2003). Also known to feed off the European eel *Anguilla anguilla* (Bird, 2008).

7. Favourable Condition Table for SAC interest features of the Dee Estuary European marine site

Table 2 sets out the basis for the development of a monitoring programme to provide information on whether or not the features of the SAC are in favourable condition. This table supplements the conservation objectives in Section 6 of this document. However, with regards to determining the management and protection requirements of the SAC under Article 6 of the Habitats Directive, its importance is secondary to that of the conservation objectives. In particular, the consideration of plans and projects under Article 6(3) and 6(4) of the Habitats Directive should be in view of the conservation objectives.

Background information on the role of favourable condition tables, the information provided in each column, and a concise glossary of terms used is provided in Section 3 of this document.

It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline. Where relevant, abbreviations of National Vegetation Classification codes (NVCs) are used for simplicity (Rodwell, 2000)

Table 2. Favourable Condition Table for SAC interest features of the Dee Estuary European marine site

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Estuary	All sub-features	Extent	Total area (ha) of estuarine communities within the site measured periodically using a combination of remote sensing and ground truthing using GPS (frequency to be determined).	No decrease in extent from an established baseline.	Extent is an attribute on which reporting is required by the Habitats Directive. Estuarine communities comprise the following: • Subtidal sediment communities • Intertidal hard substrate communities • Intertidal mudflats and sandflats communities • *Salicornia* and other annual plants colonising mud and sand • Atlantic Salt meadow • Annual vegetation of drift lines Aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Spatial distribution of estuarine communities	Macro spatial pattern of estuarine communities measured periodically using a combination of remote sensing and ground truthing using GPS (frequency to be determined).	Zonation of clean sands to muddy sands to mud from the mouth of the estuary to the upper estuary is maintained. Salt marsh remains along sheltered shores of the mid to upper estuary.	Together the CCW Intertidal Biotope Survey (CCW, 2006) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. English Nature's biotope survey of the Dee Estuary provides a further baseline (Allen & Hemmingway, 2005). Dargie (2001) provides a baseline for saltmarsh
Estuary	All sub-features	Morphological equilibrium.	Intra and inter-estuarine Tidal Prism/Cross Section ratio (TP/CS ratio) measured during the reporting cycle using remote sensing (frequency to be determined).	The intra- and inter-estuarine TP/CS relationship should not deviate significantly from an established baseline. Baseline to be established.	TP = Tidal Prism = total volume of water crossing a given cross section during the flood tide (m^3). CS = Area of a given cross section at high water springs (m^2). The relationship between TP & CS provides a measure of the way the estuary has adjusted to tidal energy. Substantial departures from this characteristic relationship (determined on a regional basis) may indicate the influence of anthropogenic factors and this would trigger more detailed evaluation of potential problems. Environment Agency LIDAR survey in 2003 may provide baseline.
		Long-term trends in the horizontal location of the saltmarsh/mudflat boundary.	Change in location of saltmarsh / mudflat boundary along a series of fixed transects measured annually or bi-annually during September using GPS (transect locations to be determined).	The location of the saltmarsh / mudflat boundary should not deviate significantly from an established baseline.	Monitoring the saltmarsh boundary is a practical means of securing data that may indicate changes in the TP/CS relationship. Deviation from long-term trends would act as a trigger for a second tier response involving detailed bathymetric survey and evaluation of changes in the TP/CS relationship (as above). In the absence of saltmarsh, vertical change in mudflat position can act as a surrogate for, or in addition to, saltmarsh boundary. Historical aerial photographs allow determination of baseline trends.
		Substrata / geomorphology	Sediment size distribution provided by granulometric sampling within the estuary (sample locations and frequency to be determined).	Sediment size distribution should not deviate significantly from an established baseline. Baseline to be further established.	Granulometric monitoring can provide early warning of changes in degree of exposure and geomorphological processes and providing information on likely changes in the extent of biological communities. Granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Water density - temperature and salinity	Water temperature and salinity over a tidal cycle measured periodically at a series of locations during the reporting cycle (methodology, sample locations and frequency to be determined).	Average temperature and salinity should not deviate significantly from an established baseline. Baseline to be established.	Temperature and salinity are characteristic of the overall hydrography of the area. Changes in temperature and salinity influence the presence and distribution of species (along with recruitment processes and spawning behaviour) including those at the edge of their geographic ranges and non-natives.
Estuary	All sub-features	Nutrient status	Average phytoplankton concentration in summer, measured periodically during the reporting cycle (methodology, sample locations and frequency to be determined).	Average phytoplankton concentration should not increase significantly from an established baseline.	Nutrient enrichment stimulating excessive growth of phytoplankton is a common factor contributing to a reduction in water clarity. Single species-dominated phytoplankton blooms can also have harmful effects on shellfish. Algal cell count data collected by the Environment Agency at seven locations within the estuary between 1998 and 2000 (Howarth *et al*., 2001) may provide a partial baseline.
		Levels of toxic contaminants in the water column	Concentrations of contaminants monitored at intervals during the tidal cycle (methodology, sampling locations and frequency to be determined).	No increase in concentrations of dangerous substances above an established baseline and compliance with all appropriate water quality standards. Baseline to be further established.	Elevated concentrations of toxic contaminants have the potential to cause harm to many features and sub-features. Data already collected by the Environment Agency to fulfil their duties under the Dangerous Substances Directive may provide a partial baseline.
Estuary	Notable subtidal sediment communities	Extent	Total area (ha) of subtidal sediment biotopes, measured periodically during the reporting cycle by remote sensing (frequency to be determined).	No significant decrease in extent from an established baseline. Baseline to be established	No notable subtidal sediment communities have yet been identified within the Dee Estuary European marine site although this may well be due to the paucity of existing survey information. Loss of subtidal sediment communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature. Environment Agency LIDAR survey 2003 may provide a partial baseline.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Different associations of plants, animals and their habitats	Number of different notable subtidal communities measured during reporting cycle (methodology and frequency to be determined).	No decrease in the variety of notable subtidal sediment communities from an established baseline. Baseline to be established	No notable subtidal sediment communities have yet been identified within the Dee Estuary European marine site although this may well be due to the paucity of existing survey information.
Estuary	Notable intertidal hard substrata communities	Extent	Area (ha) of individual notable hard substrata biotopes, measured periodically during the reporting cycle using GPS (frequency to be determined).	No decrease in extent from an established baseline. Baseline to be further established	Notable hard substrate biotopes recorded within the Dee Estuary comprise the following (in each case the source quoted provides the best available baseline): • *Mytilus edulis* and piddocks on eulittoral firm clay [A nationally important biotope recorded on an area of Holocene peat deposits on Salisbury Bank by CCW Intertidal Phase 1 Intertidal Survey (CCW, 2006). Similar biotopes recorded on 'red clay' by Allen & Hemmingway 2005 during the intertidal Biotope Survey in 2004 just south of Hilbre Island and adjacent to a channel at Thurstaston.] • *Sabellaria alveolata* reefs on sand-abraded eulittoral rock [A nationally important biotope and a priority habitat under the UK Biodiversity Action Plan, recorded by Dr. Martin Bailey (English Nature) at Hilbre Island in 2002 and mapped by Allen and Hemmingway in 2004.] • Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools. [A 'specialised biotope' under the JNCC Guidelines (1996) for the selection of biological SSSIs, recorded south of Mostyn Quay by CCW Intertidal Phase 1 Intertidal Survey (CCW, 2006)]
	Intertidal mudflat and sandflat communities	*For information on the attributes of the intertidal mudflat & sandflat communities sub-feature see the sections of this table which relate to the intertidal mudflats and sandflats not covered by seawater at low tide feature, see below.*			
	Salicornia and other annual plants colonising mud and sand	*For information on the attributes of the Salicornia and other annual plants colonising mud and sand communities sub-feature see the sections of this table which relate to Salicornia and other annual plants colonising mud and sand feature, see below.*			
	Atlantic salt meadow	*For information on the attributes of the Atlantic salt meadow communities sub-feature see the sections of this table which relate to Atlantic salt meadow feature, see below.*			
	Annual vegetation of drift lines	*For information on the attributes of the annual vegetation of drift lines communities sub-feature see the sections of this table which relate to annual vegetation of drift lines feature, see below.*			

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	All sub-features	Extent	Total area (ha) of intertidal mudflat and sandflat communities within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined).	No significant decrease in extent of intertidal mudflats and sandflats from an established baseline.	Extent is an attribute on which reporting is required by the Habitats Directive. In the long term loss of intertidal mudflat / sandflat communities is likely to be detrimental to the structure of the interest feature, e.g. associated with a change in sediment budget or geomorphological regime, and may indicate long term changes in the physical conditions of the estuaries interest feature. Some fluctuations in extent may occur which are directly attributable to natural coastal processes. These include reduced extent following storms or due to a change to another feature habitat such as saltmarsh. Such types of change in extent would form under the umbrella of 'natural change'. Significant increase or decrease in extent of pioneer saltmarsh communities may indicate a change in the morphology of the estuary. A significant increase in pioneer saltmarsh communities would result in a decline in extent of the mudflats and sandflats feature. Together the CCW Intertidal Biotope Survey (CCW, 2006), the English Nature ICES survey (Allen & Hemmingway, 2005) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Intertidal mudflat and sand flat communities comprise three biotope types (sub-features): • Intertidal gravel and clean sand biotopes • Intertidal muddy sand biotopes including cockle beds • Intertidal mud biotopes See below for lists of individual biotopes comprising sub-features.
		Topography	Tidal elevation and shore slope, measured along a series of transects across the estuary periodically during the reporting cycle using remote sensing or traditional surveying techniques (transect locations and survey frequency to be determined).	Shore profile should not deviate significantly from an established baseline. Baseline to be established.	In the intertidal zone topography reflects the energy conditions and stability of the sediment, which is key to the structure of the interest feature. Topography is a major influence on the distribution of communities throughout the intertidal flats. Assessing topography also provides information on the position of channels through the interest feature. Environment Agency LIDAR survey 2003 may provide a baseline.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	All sub-features	Sediment character	1. Particle size analysis (PSA). Parameters include percentage sand / silt / gravel, mean and median grain size, and sorting coefficient, used to characterise sediment type; measured at a series of locations across the estuary in summer, once during the reporting cycle (sampling locations to be determined).	Average PSA parameters should not deviate significantly from an established baseline. Baseline to be further established.	Sediment character defined by particle size analysis is key to the structure of the feature, and reflects all of the physical processes acting on it. Particle size composition varies across the feature and can be used to indicate spatial distribution of sediment types thus reflecting the stability of the feature and the processes supporting it. A partial baseline may be provided by granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003).
			2. Sediment penetrability (degree of sinking) measured at a series of locations across the estuary during summer, once during the reporting cycle (methodology and sampling locations to be determined).	Average measure should not deviate significantly from an established baseline. Baseline yet to be established.	Penetrability is an indicator of sediment stability and degree of compaction; it indicates the shear strength of the sediment and thus the susceptibility of that sediment type to erosion. Compaction of the sediment influences the biological community within the sediment. Penetrability of the sediment is determined by a combination of grain size and water content, which may provide a surrogate index of the penetrability of the sediments.
			3. Sediment organic content (% carbon) measured at a series of locations across the estuary, once during the reporting cycle (sampling locations to be determined).	Average organic carbon content should not deviate significantly from an established baseline. Baseline to be further established.	Organic content critically influences the infaunal community and can cause deoxygenation of the feature, which can be detrimental to the biota. However, a balance needs to be struck as organic content provides a measure of the material available to detritivores. A reduction in organic content could lead to a reduction in detritivores, with subsequent knock on effects throughout the food chain. Granulometry data collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline.
			4. Oxidation - reduction potential (depth of black anoxic layer) measured at a series of locations across the estuary, once during the reporting cycle (sampling locations to be determined).	Average black layer depth should not deviate significantly from an established baseline. Baseline yet to be established.	Degree of oxidation / reduction, reflecting oxygen availability within the sediment, critically influences the infaunal community and the mobility of chemical compounds. It is an indicator of the structure of the feature.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	All sub-features	Toxic contamination of sediments	Concentrations of List I and List II substances under the Dangerous Substances Directive measured at a series of locations across the estuary (sampling locations and frequency to be determined).	Comply with Probable Effects Levels (PEL) derived for the interim sediment quality guidelines adopted by Environment Canada (Cole *et al*., 1999). Baseline to be further established	Environmental Quality Standards (EQS) are only applicable in the water column and there are no equivalent standards for sediments used in the UK. In the absence of any UK standards, these Canadian guidelines can be used as a first approximation in assessing whether organisms are at risk from sediment concentrations of toxic substances (Cole *et al*., 1999). Concentrations of metal determinands from sediment samples collected by Environment Agency during AMP3 investigation in 2002 (Potter, 2003) may provide a partial baseline.
	Intertidal gravel and clean sand communities	Community composition	Number of different gravel and clean sand biotopes measured by field visit periodically during the reporting cycle (frequency to be determined).	No decrease in the variety of biotopes from an established baseline. Baseline to be further established	Different associations of plants, animals and their habitat are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline. Intertidal gravel and clean sand biotopes recorded within the European marine site include: • Barren coarse sand shores; • Burrowing amphipods and *Eurydice pulchra* in well drained clean sand shores; • Burrowing amphipods and polychaetes in clean sand shores. • Talitrid amphipods in decomposing seaweed on the strandline • Dense *Lanice conchilega* in tide-swept lower shore sand • Barren shingle or gravel shores

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	Intertidal gravel and clean sand communities	Broad scale distribution of communities within the estuary	Spatial distribution of gravel and clean sand biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined).	Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established.	Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes. The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline.
	Intertidal muddy sand communities	Community composition	Number of different muddy sand biotopes measured by field visit periodically during the reporting cycle (frequency to be determined).	No decrease in the variety of biotopes from an established baseline. Baseline to be further established	Different associations of plants, animals and their habitats are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline. Intertidal muddy sand biotopes recorded within the European marine site include: • Polychaetes and *Cerastoderma edule* in fine sand or muddy sand shores • *Bathyporeia pilosa* and *Corophium* spp. in upper shore slightly muddy fine sand shores • *Macoma balthica* and *Arenicola marina* in muddy sand shores. • *Arenicola marina, Macoma balthica* and *Mya arenaria* in muddy sand shores. • *Echinocardium cordatum* and *Ensis* sp. in lower shore or shallow sublittoral muddy fine sand

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	Intertidal muddy sand communities	Distribution	Spatial distribution of muddy sand biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined).	Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established.	Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes. The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline.
	Intertidal mud communities	Community composition	Number of different mud biotopes measured on field visits periodically during the reporting cycle (frequency to be determined).	No decrease in the variety of biotopes from an established baseline. Baseline to be further established	Different associations of plants, animals and their habitats are an important structural and functional aspect of the feature. Changes in the biotopes present within an area of a particular type of sediment may indicate long-term changes in physical conditions at the site. Littoral mud biotopes often support a high number of polychaete worms and bivalve molluscs, which form an important food source for birds and marine predators such as fish. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline. Intertidal mud biotopes recorded within the European marine site include: • *Hediste diversicolor* and *Macoma balthica* in sandy mud shores • *Hediste diversicolor*, *Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores • *Hediste diversicolor*, *Macoma balthica* and *Mya arenaria* in sandy mud shores • *Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores • *Hediste diversicolor* and oligochaetes in low salinity mud shores

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Mudflats and sandflats not covered by sea water at low tide	Intertidal mud communities	Distribution	Spatial distribution of mud biotopes measured along a series of fixed transects periodically during the reporting cycle using GPS (frequency and transect locations to be determined).	Spatial distribution of biotopes should not deviate significantly from an established baseline. Baseline to be further established.	Changes in the spatial distribution of biotopes within an area of a particular type of sediment may provide the first indications of long-term changes in physical conditions at the site. Some biotopes occur in a natural cycle linked to the dynamism of the prevailing conditions, and these may naturally appear and disappear over time. The feature should not be considered in unfavourable condition due to the short-term disappearance of such ephemeral biotopes. The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline.
***Salicornia* and other annuals colonising mud and sand**	All sub-features	Extent	Area (ha) of individual *Salicornia* and other annuals NVC communities, measured at low water periodically during the reporting cycle using a combination of remote sensing and GPS (frequency to be determined).	No significant decrease in extent of individual pioneer saltmarsh communities from an established baseline	Pioneer saltmarsh communities recorded in the Dee Estuary include: SM8, SM9 and SM27. Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in vegetation types. Significant increase or decrease in extent of pioneer saltmarsh communities may indicate a change in the morphology of the estuary. A significant increase in pioneer saltmarsh communities would result in a decline in extent of the mudflats and sandflats feature. The extent of low pioneer vegetation habitat is dependent on particular combinations of tide and weather conditions in spring and early summer and will naturally vary from year to year. The extent and distribution of ephemeral pioneer saltmarsh within the Dee Estuary saltmarsh is likely to be subject to substantial year on year variation. The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline. Further work is required to attempt to quantify the extent of yearly variation in extent.
	Pioneer low marsh communities	Species composition of characteristic pioneer marsh communities SM8 and SM9	Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of typical species of characteristic pioneer marsh communities should not deviate significantly from an established baseline.	The typical species of pioneer low marsh communities are *Suaeda maritima* and *Salicornia* species The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
***Salicornia* and other annuals colonising mud and sand**	Pioneer low marsh communities	Distribution and extent of common cordgrass *Spartina anglica* community SM6 within the pioneer saltmarsh zone.	Area (ha) of *Spartina anglica* community (SM6), measured at low water once during the reporting cycle using a combination of remote sensing and GPS.	No increase in extent of *Spartina anglica* within the pioneer saltmarsh from an established baseline.	*Spartina anglica* is generally considered to be an invasive species and may impact on pioneer and low-mid marsh communities. However, *Spartina* stands may have a role in sediment trapping following periods of erosion, although under certain tidal conditions, erosion around stands may be greater. Natural dieback of *Spartina* has also been observed along the east and south coasts of England. If *S. anglica* increases to cover 20% or more of a site unit, then an intensive monitoring programme may be advisable, possibly followed by control measures. The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline.
	Ephemeral salt-marsh vegetation	Species composition of the characteristic ephemeral marsh community SM27	Abundance of component species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of component species of characteristic pioneer marsh communities should not deviate significantly from an established baseline.	The very nature of this community means that recurrent assemblages are rare and there is a large element of chance in the floristic composition. For this reason the National Vegetation Classification does not define constant species for this community (Rodwell, 2000). Species recorded on the Dee Estuary from this community include *Sagina maritima*, *Festuca rubra*, *Parapholis strigosa*, *Puccinellia maritima*, *Agrostis stolonifera* and *Spergularia media*. The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline.
		Abundance of the notable ephemeral marsh species *Centaurium littorale*.	Number of discrete locations within the estuary where *Centaurium littorale* is found and its abundance at each location.	No decrease in abundance of *Centaurium littorale* from an established baseline.	The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 provides a baseline

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
Atlantic salt meadows	All sub-features	Extent	Total area (ha) of Atlantic salt meadow communities within the site measured periodically during the reporting cycle using a combination of remote sensing and ground truthing of boundaries between communities using GPS (frequency to be determined).	No significant decrease in total extent of Atlantic salt meadow communities from an established baseline.	Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic random variations in vegetation types. Significant increase or decrease in extent of Atlantic salt meadow communities may indicate a change in the morphology of the estuary. A significant increase in Atlantic salt meadow communities would result in a decline in extent of the mudflats and sandflats feature. Coastal squeeze may result in the replacement of Atlantic salt meadows with pioneer saltmarsh. This could be assessed by a ground survey to look for signs of erosion such as toppled vegetation blocks, signs of roots in intertidal mud, signs of stress/damage to plants. Extent needs to be measured at low tide. Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Atlantic salt meadow communities comprise three sub-features: • Low to mid marsh communities • Mid to upper marsh communities • Transitional high marsh communities See below for lists of individual NVC communities comprising sub-features.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Creek system and salt pan pattern	Density and morphology of creek systems and salt pans measured periodically during the reporting cycle using remote sensing (frequency to be determined)	No anthropogenic alteration of creek patterns or loss off pans from an established baseline.	Meanders in creeks help to absorb tidal energy. Creeks transport sediment to and from the saltmarsh and act as drainage channels. The efficiency of this process depends on creek pattern. Vegetation cover, suspended sediment load and the height and duration of tidal inundation influence creek density. Creeks allow pioneer vegetation to establish along their banks higher in the saltmarsh system than they would normally be found. Widening, lengthening and flattening of creeks are an indication of sea level rise/ increase in tidal energy. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins. Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Environment Agency LIDAR survey in 2003 may provide further data.
Atlantic salt meadows	All sub-features	Zonation of vegetation	Width of pioneer, low-mid marsh, mid-upper marsh, and transitional high marsh saltmarsh zones, measured along a series of transects around the estuary, periodically during the reporting cycle, using a combination of remote sensing and ground survey (transect locations and frequency of survey to be determined).	The zonation of saltmarsh communities around the estuary should not deviate significantly from an established baseline.	Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Environment Agency LIDAR survey in 2003 may provide further data.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Sward structure	Sward height of Atlantic salt meadow communities measured periodically during the reporting cycle in late summer using a combination of remote sensing and field visits.	The extent and distribution of vegetation communities exhibiting different sward heights should not deviate significantly from an established baseline. Baseline to be established	Vegetation structure is largely affected by the impact of grazing (of wild or domesticated herbivores) interacting with different vegetation communities. Not all Atlantic salt meadow within the Dee Estuary is grazed, but where this has been an established practice, the stocking levels need to be appropriate to the interest of the site. Over grazing can lead to a loss of structural diversity of rare plant species and affect bird breeding and feeding habitats while under grazing can lead to a loss of plant diversity by competitive exclusion. Introduction of grazing to previously ungrazed sites can result in deleterious changes to plant community composition. Environment Agency LIDAR survey in 2003 may provide baseline.
		Abundance of locally occurring rare / scare plant species	Number of discrete locations within the estuary where rare / scarce species are found and their abundance at each location.	No decrease in abundance of rare / scarce species from an established baseline.	Nationally scarce species: *Centaurium littorale* and *Bupleurum tenuissimum* Other Locally rare or scarce species: *Puccinellia distans*, and *Zannichellia palustris.* The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline
Atlantic salt meadows	Low to mid marsh communities	Species composition.	Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of typical species of characteristic low to mid marsh communities should not deviate significantly from an established baseline.	The recent NVC survey by Dargie in 2000 recorded the following low to mid marsh NVC communities: SM10, SM12, SM13a, SM13b, SM13d, SM14a, SM14c. The typical species for these NVC communities include: *Puccinellia maritima, Salicornia* spp., *Suaeda maritima, Aster tripolium, Glaux maritima, Plantago maritima, Armeria maritima, Atriplex portulacoides* and *Triglochin maritima.* This NVC survey of saltmarsh in the Dee Estuary provides a baseline

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
	Mid to upper marsh communities	Species composition	Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of typical species of characteristic mid to upper marsh communities should not deviate significantly from an established baseline.	The recent NVC survey by Dargie in 2000 recorded the following mid to upper marsh NVC communities: SM16a, SM16b, SM16c, SM16d, SM16e, SM16x, SM18b. The typical species for these NVC communities include *Puccinellia maritima, Aster tripolium, Glaux maritima, Plantago maritima, Armeria maritima, Festuca rubra, Juncus gerardii, Triglochin maritimum, Leontodon autumnalis, Agrostis stolonifera, Juncus maritimus* and *Oenanthe lachenalii.* This NVC survey of saltmarsh in the Dee Estuary provides a baseline
	Transitional communities	Species composition	Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of typical species of characteristic transitional communities should not deviate significantly from an established baseline.	The recent NVC survey by Dargie in 2000 recorded the following transitional saltmarsh NVC communities: SM24, SM28, MG11a, MG13, S4, S21a, S21b, S21c, S28 The typical species for these NVC communities include *Festuca rubra, Agrostis stolonifera, Elymus pycnanthus, Atriplex prostrata, Elymus repens, Potentilla anserina, Lolium perenne, Alopecurus geniculatus, Phragmites australis, Bolboschoenus maritimus,* and *Phalaris arundinacea.* This NVC survey of saltmarsh in the Dee Estuary provides a baseline
Annual vegetation of drift lines		Frequency of occurrence	Presence of annual vegetation of drift lines at suitable habitats within the site to be assessed at least biannually during the reporting cycle	No decrease in frequency of occurrence at suitable habitats from an established baseline. Baseline to be further established.	This vegetation type is by nature quite ephemeral and may not be present in all years even where suitable conditions exist. Data on frequency of occurrence are currently related to survey frequency and more information is needed to determine the baseline frequency of occurrence within the site.
Annual vegetation of drift lines		Extent	Total area (ha) of annual vegetation of drift lines within the site periodically during the reporting cycle in June using GPS (frequency to be determined).	No decrease in extent of annual vegetation of drift lines communities from an established baseline. Baseline to be further established.	Monitoring will need to take account of the dynamic nature of these habitats and seasonal and periodic variations in vegetation types. The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and the Sand Dune survey of Great Britain (Ashall *et al.,* 1991) together provide a partial baseline.
		Species composition	Abundance of typical species, measured within particular areas by field visit once during the reporting cycle (particular areas to be determined).	Abundance of typical species should not deviate significantly from an established baseline. Baseline to be further established.	The typical species for this feature include: *Cakile maritima* and *Honkenya peploides* The NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and the Sand Dune survey of Great Britain (Ashall *et al.,* 1991) together provide a partial baseline.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
River lamprey *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus*		Population size (returning adults)	Number of returning adults measured using the fish trap at Chester Weir, monitoring should be continuous and data provided for at least fortnightly intervals.	No decline in number of returning adults from existing baseline.	Counts of returning adults passing the fish trap at Chester weir together provide a baseline. The fish trap count data should not be viewed as an accurate measure of true number of adults returning to spawn. The trap at Chester is not designed to sample lamprey, which are able to swim through the bars of the fish trap and the trap therefore operates at low efficiency. In addition, the trap is currently inactive for around 40% of the time. However the counts should provide a consistent indicator of fluctuations in population size. Work may be required to improve the efficiency of the trap and reduce the variability of the estimate. Also in the future there may be a requirement to establish the sex ratio of returning fish.
		Ammocoete population age structure	Abundance of ammocoetes in the River Dee by age class measured using catch depletion electric fishing in $1m^2$ rigid quadrat frameworks to be undertaken at a series of locations once during reporting cycle (survey locations and exact methodology to be determined).	No decrease in the abundance of ammocoetes by age class from existing baseline. Baseline to be further established	At least three distinct size classes should normally be present. Potential locations for sampling on the River Dee include Erbistock downstream of the weir (SJ355425), Bangor-on-Dee (SJ388455), Worthenbury (SJ415475), Holt (SJ414540) and at the Alyn confluence (SJ398561). The survey of ammocoete abundance and distribution in the River Dee undertaken by the Environment Agency in 2002 provides a semi-quantitative baseline (Potter & Hatton-Ellis, 2003). Additional survey in 2003 at nine sites provides a quantitative baseline

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
River lamprey *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus*		Ammocoete distribution within catchment	Spatial distribution of ammocoetes in the River Dee measured using electric fishing to be undertaken at a series of locations once during reporting cycle (survey locations and exact methodology to be determined).	No decrease in the distribution of ammocoetes within the catchment from an established baseline. Baseline to be further established	Distribution in catchment should be appropriate to the natural geomorphology. Surveys should be undertaken at the earliest in July but preferably between August and October. Any silt beds adjacent to or downstream of known *Petromyzon* spawning sites should contain *Petromyzon* ammocoetes. However concentrating sampling effort for ammocoetes immediately downstream of spawning areas is also not recommended as the juveniles appear to disperse quickly away from the spawning area after hatching and optimal habitat for ammocoetes is not necessarily immediately below these sites. Counting of nests is also not recommended since it is considered very unreliable - it is possible that each nest is used by several spawning lamprey, although assessment of gravels (eg fraction analysis) where nests are found can provide useful information on changes in spawning habitats. Where barriers to migration or pollution issues are thought to be a problem, the population should be classed as being in unfavourable condition and targets for an appropriate increase should be set. The survey of ammocoete abundance and distribution in the River Dee undertaken by the Environment Agency in 2002 provides a semi-quantitative baseline (Potter & Hatton-Ellis, 2003). Additional survey at nine sites in 2003 provides a quantitative baseline
		Ammocoete density	Density of ammocoetes in River Dee measured using electric fishing at a series of suitable locations to be undertaken once during reporting cycle (survey locations and exact methodology to be determined).	No decrease in ammocoete density from an established baseline.	*Lampetra* ammocoetes cannot be distinguished in the field, so it will not normally be possible to set separate targets for *L. fluviatilis* and *L. planeri*. However, lampreys upstream of a natural barrier to migration will always be *L. planeri*. *Petromyzon* ammocoetes can be distinguished in the field, but typically occur at very much lower densities than *Lampetra* – approximately 1 ammocoete in 50 in UK rivers is normally *Petromyzon*.

Interest Feature	Sub-feature	Attribute	Measure	Target	Comments
		Water quality (physio-chemical properties)	Water quality measured regularly throughout the reporting cycle (frequency to be determined).	No significant variation in temperature, salinity, turbidity and pH, and no reduction in dissolved oxygen levels, from an established baseline. Environmental Quality Standards (EQSs) are not exceeded.	Significant variation in these physio-chemical parameters may be injurious to lamprey populations or act as barriers to migration. For example, the timing, duration and consistency of lamprey's upstream migration is believed to be closely related to temperature changes as well as pheromone triggers from the juvenile lamprey during periods of high water flow. Peak migration usually coincides with temperatures that remain above $10^{o}C$ and continues until temperatures reach $18^{o}C$. Dissolved oxygen can also be significantly reduced in stretches receiving significant BOD inputs, or through the resuspension of organic rich sediments. Monitoring may be targeted at the most sensitive locations along the migration route such as the canalised section of the upper Dee Estuary and lower River Dee. Water quality sampling undertaken by the Environment Agency provides a baseline.
River lamprey *Lampetra fluviatilis* and **Sea lamprey** *Petromyzon marinus*		Access	Mapping and quantification of potential obstructions in relation to height, type and water depth below obstruction once during the reporting cycle.	No artificial barriers significantly impairing, adults from reaching existing and historical spawning grounds, or juveniles from moving downstream.	Dams, navigation and other weirs may prevent lamprey from reaching their spawning grounds. In particular, sea lamprey are known to be poor at ascending obstacles. Lamprey can pass some potential barriers by attaching themselves to structures or riverbanks by their suctorial discs and creeping up by strong bursts of swimming.

NB: Extreme events (such as storms, reducing or increasing salinities or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary European marine site and may well be missed by routine monitoring

8 Detailed operations advice for the Dee Estuary SAC interest features

8.1 Background

This section provides information to help relate general advice to each of the specific interest features of the Special Area of Conservation. These interest features are:

- Estuary
- Mudflats and sandflats not covered by seawater at low tide
- *Salicornia* and other annuals colonising mud and sand
- Atlantic salt meadows
- Annual vegetation of drift lines
- River lamprey *Lampetra fluviatilis*
- Sea lamprey *Petromyzon marinus*

This advice relates to the vulnerability of the interest features and supporting habitats within the Dee Estuary European marine site boundary, as summarised in Table 1 and set out in more detail in Table 3. A brief explanation of the sensitivity of the interest features or supporting habitats follows, with an explanation of their exposure and consequently their vulnerability to damage or disturbance from the listed categories of operations is also given. This enables links between the categories of operation and the ecological requirements of the European marine site interest features, as set out in Section 6, to be made.

The categories of operation may cause damage or disturbance to the interest features and sub-features of the European marine site, either alone or in combination.

The Dee Estuary European marine site covers a large geographical area and this operations advice refers to the interest features across the estuary. Therefore, activities have been allocated an 'average' exposure score based on their occurrence within the estuary. The following text will reflect where activities only occur in a small area of the site but may be undertaken intensively or frequently. Also, there may often be a difference in the intensity of activities occurring in different parts of the site, especially on either shore of the estuary.

Features are generally dealt with in the order presented above for each operation category. However only the intertidal hard substrate and subtidal sediment subfeatures are considered initially under the estuary feature as all the other estuary sub-features are also features in their own right.

8.2 Physical loss

Physical loss may result from a range of activities causing the removal or smothering of the interest features. The Dee Estuary is a complex system comprising one of the largest estuaries in the UK and supporting several estuarine habitat types, each of which contributes to the biodiversity of the system. In turn, these habitats support a rich variety of marine communities, many of which are dependent upon the ecological functioning of other communities. Therefore physical loss of any single habitat as a result of activities such as coastal development could have wider implications for the survival of other communities, thus detrimentally affecting the favourable condition of the European marine site.

8.2.1 Physical loss by removal

Physical loss by removal may arise from developments such as infrastructure construction and modification, coastal protection works, and land claim. In these instances the physical loss occurs when areas of habitat are used for new purposes. In addition coastal developments and other anthropogenic activities may also cause the indirect loss of estuarine habitats through the interruption of existing coastal processes such as sediment transport. Sediments will enter the estuary either suspended in the water column, in the case of fine sand and silt, or moving along the seabed as 'bedload' in the case of coarser sand and gravel. Sediment supply may be interrupted either at source, for example by placing coastal defences in front of soft cliffs, or during transport where structures such as groynes in particular may disrupt and intercept the movement of bedload sediment. Such interruptions to sediment supply may occur either within the site or outside it. Eventually a lack of sediment supply will tend to cause habitat deterioration and then erosion. Indirect physical loss can also arise from changes to the estuaries morphology affecting the hydro-dynamic regime, for example widening or deepening of channels at the mouth of an estuary may increase the volume of water entering the estuary causing the erosion of sub-tidal sediments or sandbanks higher up the estuary.

In the future the hard frontages such as embankments and sea walls found along much of the estuary coastline will compromise its ability to evolve in response to rising sea levels and climate change. This will result in the erosion of saltmarsh and other intertidal communities. This process of coastal squeeze may result in significant loss of estuarine habitats in the long term, yet in the medium term it is likely that the estuary will continue to accrete and that the effects of coastal squeeze will not be apparent. Thus although the impacts from coastal squeeze may eventually be extensive they are not taken into account in the assessment of current exposure presented here.

Due to the severity of the effects of physical loss all the estuary's habitat communities are considered to be highly sensitive to removal. Lamprey species are also considered highly sensitive to their own 'removal' for example by entrainment in abstracted waters.

The **subtidal sediment communities** within the estuary are subject to physical loss resulting from capital and maintenance dredging associated with the maintenance of navigation channels. Dredging leads to physical loss of subtidal material where removed, and smothering of benthic communities, both in areas adjacent to dredging activity as well as in the vicinity of deposition sites. Due to the scale of recent and proposed dredging operations, and the proportion of the subtidal channel affected, the level of exposure of subtidal sediment communities to both removal and smothering is considered to be high. Thus these communities are **highly vulnerable** to removal.

The communities comprising the **intertidal hard substrate** subfeature are widely distributed around the estuary. They include, an area of Holocene clay on Salisbury Middle in the outer estuary supporting the nationally important biotope mussels *Mytilus edulis* and piddocks *Pholas dacytylus* on eulittoral firm clay, pools with mixed substrata south of Mostyn Quay supporting hydroids and ephemeral seaweeds, and honeycomb worm *Sabellaria alveolata* reefs on the rocky shore at the north end of Hilbre Island. These widely spread communities differ in their individual exposure to removal. Exposure to removal is regarded as high for the Holocene clay deposits, which are currently eroding. This erosion may be exacerbated by dredging activities affecting current flows in the outer estuary. The *Sabellaria* communities on Hilbre Island may be highly exposed to removal as a consequence of possible coastal protection works. Thus the intertidal hard substrate communities are regarded as highly exposed and therefore **highly vulnerable** to physical loss by removal.

Development pressures still exist within the estuary that could result in removal of areas of the **intertidal mudflats and sandflats**. Those areas close to existing terrestrial development may be most at risk. Recent examples of developments resulting the removal of areas of this feature include the expansion of the Port of Mostyn, development of the West Kirby Marine Lake and the tipping of coal waste on the upper shore at Point of Ayr. There is well documented evidence of the migration of the main channel towards the Welsh shoreline, which has resulted in the loss of saltmarsh habitat in this area. This can be attributed to coastal squeeze between the main navigation channel and the sea wall. In addition removal of intertidal mudflat and sandflat communities may also occur due to capital or maintenance dredging operations associated with improving and maintaining vessel access to the Port of Mostyn. Even where dredged material is returned to the estuary, this may lead to direct loss of affected invertebrate communities due to burying or smothering. Mechanical changes to channel structure and flow may also result in consequential changes to the pattern of erosion, scour and deposition elsewhere within the affected channel.

Although the estuary as a whole may be accreting, the overall area of intertidal sediment communities has declined due to the estimated 700 ha expansion in the area of saltmarsh over the last 20 years (Dargie, 2001). This expansion of saltmarsh has principally occurred at the expense of muddy sediments in the upper and middle estuary to the east of the main channel. Saltmarsh expansion is most reasonably attributed to a combination of factors including: fore-shortening of the estuary system caused by historic land claim in the upper estuary leading to in-filling and a narrower equilibrium morphology; diversion and canalisation of the upper estuary channel; introduction of training walls; and the colonisation of the estuary by the invasive saltmarsh species common cord grass *Spartina anglica*. Strictly, none of these factors can be regarded as an ongoing activity/operation, yet the ongoing effects of this historic habitat removal continue to impact upon the morphology of the estuary, in particular the extent of mud communities and this must be taken into account in any assessment of exposure.

Thus the intertidal mud communities are considered to be highly exposed to removal, although this is mainly due to the continued accretion of saltmarsh over the mudflats than any current activity. Muddy sand communities are considered to have a medium exposure to removal as they occur in areas where recent developments requiring land claim have taken place along the Welsh shore. The exposure of the intertidal clean sand and gravel communities found in the mid and outer estuary, was considered to be low due to the much lower development pressures in these areas. Thus **mud** and **muddy sand communities** are therefore **highly vulnerable** to removal, **gravel and clean sand communities** are **moderately vulnerable**.

All the constituent sub-features of the ***Salicornia* and other annuals** and the **Atlantic salt meadow** features are considered highly sensitive to removal. The mid to upper marsh communities, transitional high marsh communities, and ephemeral saltmarsh are similarly highly sensitive to smothering; while the low to mid marsh and both the *Salicornia* and

Suaeda maritima communities are only moderately sensitive due to their adaptations to lower shore conditions.

As discussed for the mudflats and sandflats feature the distribution of saltmarsh within the estuary is currently changing. While there is much accretion of saltmarsh to the east of the main estuary channel, saltmarsh along the Welsh shore to the south of Greenfield, is subject to severe erosion with the lower saltmarsh communities declining or absent. This erosion along the Welsh shore may be attributed to historic human activities, especially the canalisation of the upper estuary and the construction of the training walls. This erosion must be taken into account when considering the exposure of the low to mid marsh sub-feature.

In general, the exposure of the saltmarsh communities including both the *Salicornia* and other annuals, and Atlantic salt meadow features to physical loss through removal was considered to be low. This was however, with the exception of the low to mid marsh communities and the transitional high marsh communities whose exposure to removal was medium. The elevated exposure of the low-mid marsh communities reflects the severe erosion they currently experience along the Welsh shore, although the exposure is not considered high due to the proportion of the sub-feature affected. The medium exposure of the transitional high marsh communities is due to the position they occupy at the top of the marsh. This area is most likely to be affected by even minor coastal developments as well as the maintenance of coastal defences.

Thus the current **vulnerability** assessment for the ***Salicornia* and other annuals**, and **Atlantic salt meadow** features to operations causing loss by removal is **moderate for all their sub-features**, with the **exception of the low to mid marsh communities and the transitional high marsh communities** whose **vulnerability** to physical loss is **high** due to its greater exposure.

Annual vegetation of drift lines within the Dee Estuary European marine site is considered to have a low exposure to removal. Thus its **vulnerability** to removal is **moderat**e, due its high sensitivity.

The level of exposure of **river lamprey** and **sea lamprey** to physical loss through removal in the Dee Estuary is difficult to establish. Unfortunately, very little is known about the way these species make use of benthic habitat within the estuary. There are two possible aspects to physical loss for these species - loss of individual fish and loss of their habitat. Lamprey species can be susceptible to being 'sucked up' in significant numbers by large abstractions, such as those for power station cooling water systems. However, the water intakes at both the Powergen and National Power power stations in the upper estuary were designed to avoid fish entrainment in order to minimise their ability to trap salmon and other migratory fish (Jim Morris, IPC Inspector, EAW, *pers. comm.*). Based on the limited evidence available the exposure of both lamprey species to removal is regarded as low, thus lampreys are considered to have **moderate vulnerability** to removal due to their high sensitivity. Yet the possibility of lamprey entrainment remains and needs to be investigated further.

8.2.2 Physical loss by smothering

Physical loss due to smothering occurs where accretion occurs so rapidly that the nature of the surface substrate is changed, for example gravel habitats may be smothered by rapid deposition of sand. Alternatively the nature of the 'smothering material' may be the same as the existing substrate, yet the rate of deposition is such that the existing community is unable to maintain a presence at the surface. As is the case for removal, smothering may be caused directly by the deposition of dredged spoil or beach feeding, as well as indirectly due to anthropogenic influence on coastal processes; for example, due to construction of coastal structures altering sediment transport patterns resulting in much increased sedimentation.

Again, due to the severity of the effects of physical loss, all the estuary's habitat communities are considered to be highly or moderately sensitive to smothering. Sensitivity to smothering is often less than to removal for some habitats depending upon the likelihood of recovery particularly where this is aided by adaptation. Soft sediment communities and vegetated drift lines are considered moderately sensitive since they occupy niches where smothering naturally occurs due to the dynamic nature of their environment. Low to mid saltmarsh and *Salicornia* and *Suaeda maritima* communities are also moderately sensitive to smothering due to their adaptations to lower shore conditions. Lamprey species are considered to have only a low sensitivity to smothering due to their mobility.

As well as causing removal of **subtidal sediment communities** dredging and disposal of sediment also has the capacity to cause the smothering of benthic communities again resulting in physical loss. Thus as in the case of removal, the exposure of subtidal sediment communities to physical loss due to smothering is considered to be high and therefore these communities are **highly vulnerable** to smothering.

As mentioned above the communities comprising the **notable hard substrate** subfeature are widely distributed around the estuary. Of these communities both the Holocene clay deposits and pools with mixed substrata may be exposed to sedimentation as a result of disposal of dredged sediment in Mostyn Deep, while the others may have a generally low exposure to smothering. Thus overall the intertidal hard substrate communities are regarded as having medium exposure to physical loss by smothering. Due to their high sensitivity to smothering this results in the notable hard substrates being considered **highly vulnerable** to smothering.

Current operations and future proposals for beach recharge along the beach frontage at Talacre could result in the smothering of **clean sand communities** present on the beach. In addition the intertidal mudflats and sandflats may be exposed to smothering in localised areas from jetting and flushing of drainage outfalls. However, across the rest of the intertidal communities exposure to smothering is considered to be low. Thus the overall assessment for exposure to smothering is medium for gravel and clean sand communities and low for mud and muddy sand communities. Therefore the gravel and clean sand communities are considered moderately vulnerable to smothering, the other intertidal sediment sub-features considered to have **low vulnerability**.

The exposure of saltmarsh communities to smothering is considered to be low for all sub-features, with the exception of the transitional high marsh communities, which are considered to have medium exposure, again due to their position towards the top of the shore. Thus only **ephemeral saltmarsh** and **mid to upper marsh communities** have **moderate vulnerability** due to their high sensitivity, while the **vulnerability** of the **transitional high marsh** is **high**.

Annual vegetation of drift lines is considered to have a high exposure to smothering. This is because the habitat tends to occur along the section of coast fronting Gronant Dunes and Talacre Warren SSSI in the general vicinity of where beach recharge is proposed as described above. Thus the feature is considered **highly vulnerable** to smothering.

There is little evidence to indicate the exposure of **lamprey species** to smothering within the estuary. Since these species are regarded as having only low sensitivity to smothering their **vulnerability** to smothering may provisionally be regarded as **low**.

8.3 Physical damage

Physical damage may result from a range of activities causing either siltation, abrasion or selective extraction to affect the interest features.

8.3.1 Physical damage by siltation

Siltation can result from particulate matter being carried in effluent discharged into the estuary, or from maintenance dredging and dredged spoil disposal. Most estuarine communities are not considered to be particularly sensitive to siltation, as estuaries are naturally silty environments. However, hard substrate communities are the exception to this rule, being highly sensitive to siltation. Gravel and clean sand communities, and annual vegetation of drift lines are also moderately sensitive; though the latter is unlikely to be frequently exposed. Silt in the water column can smother or block the feeding and respiratory organs of marine invertebrates living in the substrate. It can also affect recruitment processes of both marine flora and fauna and can contribute to a reduction in light penetration through the water column.

Exposure to siltation varies between different estuarine communities. Exposure to siltation is considered to be high for the estuary's subtidal sediment communities, which are most likely to be affected by proposed dredging operations. The intertidal hard sediment communities located nearest to the area of dredging activity are considered to have medium exposure to siltation. Thus the **hard substrate** communities are considered **highly vulnerable** to siltation due to their high sensitivity whereas the **subtidal sediment communities** are considered **moderately vulnerable** to siltation due to their high exposure.

The intertidal muddy sand, clean sand and gravel communities, many of which are located near to the area of dredging activity are also considered to have medium exposure to siltation. Thus **clean sand and gravel communities** are also considered **moderately vulnerable** due to their combination of medium exposure and moderate sensitivity.

8.3.2 Physical damage by abrasion

Abrasion can physically damage individual marine organisms and plants, as well as causing deterioration to the structure of saltmarshes and sediment communities. The sensitivity to abrasion is moderate for the majority of the estuary's features, though annual vegetation of drift lines is highly sensitive to abrasion due to the potential for damage to succulent plants and their root systems. Abrasion of muddy soft sediment communities can alter the habitat structure and may lead to a change in species composition, though clean sand communities have only low sensitivity. Excessive damage may ultimately result in the destabilisation of the sediment and lead to rapid erosion. Lampreys and hard substrate communities are considered to have a low sensitivity to the effects of abrasion.

Exposure to abrasion varies across the European marine site and it can be attributed to three main sources, dredging operations, fisheries (in particular the commercial gathering of cockles), and recreational pressures, the latter are mainly associated with the upper shore.

Subtidal sediment communities are considered highly exposed to abrasion, mainly due to dredging activities, but also by the use of mobile benthic fishing gear such as beam trawling used to catch shrimp, plaice and Dover sole. Thus the **vulnerability** of the subtidal sediments to physical damage by abrasion is considered **high.**

Both the **mud** and **muddy sand communities** are considered to have potentially a high exposure to abrasion. This is due primarily to the scale of the cockle fishery, while the gravel and clean sand communities are considered to have a medium exposure due to recreational pressure on both the English and Welsh shores. Recently the commercial cockle fishery on the estuary has involved large numbers of people; in 2002 approximately 1000 people were issued with permits to harvest cockles, although there were only 11 fishing days in total. Such intense activity, even over relatively short periods, may cause damage through disturbance to the sediment structure. This may be caused both by raking for cockles but also by trampling or the use of vehicles to gain access to the beds, though such vehicle use is currently prohibited. Tractor dredging for cockles has occurred in the estuary and has the potential to cause a high level of abrasion, though this is also prohibited within the estuary at present.

Bait digging is practised at low intensity within the site in particular on North Wirral Foreshore and recently significant numbers of people have been observed collecting razor fish (*Ensis* spp.) (Keith Williams, Environment Agency Bailiff, *pers. comm*.). As with cockling, such activities disturb the sediment through digging and to a lesser extent trampling. They may be sustainable where traditional methods are employed; however, a distinction should be made between traditional activities and commercial exploitation of the resource. The latter may impact on the favourable condition of the European marine site.

Particularly during the summer months there is a high degree of recreational usage of the **intertidal sandflats** between Gronant and Point of Ayr and between West Kirby and Hoylake. Activities practised include walking, horse riding, use of motorcycles and sand yachts; these contribute to the sandflats' assessment of medium exposure to abrasion, though their vulnerability is low due to low sensitivity.

Thus the **vulnerability** of mud and **muddy sand communities** is considered **high** due to their high exposure. **Gravel and clean sand communities** have **moderate vulnerability** to abrasion due to their moderate sensitivity and exposure.

Annual vegetation of drift lines is an extremely ephemeral plant assemblage, which has been recorded in the vicinity of the Point of Ayr and near Heswall on the English shore (Dargie, 2001). As these areas experience some of the most intense recreation pressure in the European marine site, the vegetation is considered to be highly exposed to abrasion. Thus its **vulnerability** to abrasion is also **high.**

The exposure to abrasion is considered to be low for all the ***Salicornia*** **and other annuals** and the **Atlantic salt meadow** sub-features except for the transitional high marsh communities, which experience medium exposure. This abrasion is primarily caused by recreational pressure including, walking and cycling, though the most severe abrasion results from motorcycle use. Thus **only** the **traditional high marsh communities** experience **moderate vulnerability**.

8.3.3 Physical damage by selective extraction

Selective extraction is the removal of a particular type of substrate from within a habitat or community, for example the removal of fine sand from the gravel and clean sand sub-feature. More indiscriminate removal of habitat such as that involved in dredging to allow port access is dealt with as physical loss through removal. All the estuarine communities within the site are considered to be moderately sensitive to selective extraction, except the rocky shore communities, which are considered highly sensitive due to their dependence on a fixed substrate.

Exposure to selective extraction is low across the European marine site. Despite their low exposure **hard substrate communities** are considered to have **moderate vulnerability** to selective extraction, due to their high sensitivity to such operations.

8.4 Non-physical disturbance

Non-physical disturbance comprises noise and visual presence. Exposure to activities with these impacts varies across the estuary with some areas experiencing high levels of disturbance. However, none of the habitat features of the site have any degree of sensitivity to these activities in their own right. The two lamprey species are both considered to have low exposure and sensitivity to activities causing these categories of impacts.

8.5 Toxic contamination

Toxic contamination of all varieties may reach the European marine site from both marine and terrestrial sources, by a variety of pathways including tidal currents, river flow, terrestrial run-off and atmospheric deposition. Toxic contaminants can be categorised as synthetic compounds, non-synthetic compounds and radionuclides.

Many toxic compounds, especially synthetic compounds such as PCBs, are known to have toxic effects even in very low concentrations, and a high degree of bioaccumulation can occur within many benthic organisms. Such compounds may then ‘biomagnify’ as they are transferred along the food chain if these organisms are predated upon. Thus, even relatively low concentrations of contaminants in discharges can cause impacts upon features towards the top of the food chain such as wading birds. The problem of biomagnification is compounded by the fact that many synthetic compounds such as PCBs are very stable in the environment and are rarely degraded.

The potential effects of toxic pollutants vary according to the state and availability of the compound and the characteristics of the receiving environment. Where the effects are lethal and result in the removal of individual species, key grazers or predators may be lost and a dominance of pollution tolerant organisms may result. Toxic compounds may also have sub-lethal effects on the healthy functioning of an organism affecting its reproductive capacity, physiology or causing genetic mutation, which may ultimately reduce the organism’s fitness for survival. Faunal communities within sediments, which primarily consist of species relying on larval dispersal for recruitment, are recognised as being particularly sensitive to toxic contamination. In sheltered low energy environments such as estuaries, where muddy sediments can act as a sediment sink, synthetic and non-synthetic compounds may bind to fine sediments. They may then be remobilised if the sediment is disturbed (for example by dredging) making them available once more as potential pollutants in the water column.

8.5.1 Toxic contamination by synthetic toxic compounds

Estuarine species and communities are generally highly sensitive to synthetic toxic compounds such as pesticides, PCBs (polychlorinated biphenyls) and biocides such as TBT (tributyltin). The effects of individual synthetic compounds upon many species found within the habitats of the Dee Estuary are poorly understood, but there is evidence from elsewhere of synthetic compounds causing high levels of toxicity to a variety of marine organisms (Cole *et al*., 1999). Some synthetic compounds have the capacity to mimic animal hormones, or prevent their production or break down. These compounds are referred to as endocrine disrupting chemicals, they can affect physiological processes such as immunoresponse, reproduction and development.

The communities of all the habitats of the Dee Estuary except annual vegetation of drift lines are considered highly sensitive to toxic contamination by synthetic compounds. Annual vegetation of drift lines is considered to have a lower sensitivity to synthetic contaminants because it is found on a generally dry and free draining substrate.

As mentioned above toxic compounds, both synthetic and none synthetic, can reach estuarine communities from many sources. Many of these sources discharge both categories of contaminant. Within the Dee Estuary there are numerous legally consented industrial discharges, though these are mainly confined to the Welsh shore. Over the last two decades there is believed to have been a reduction in the level of pollutants discharged to the estuary from industrial sites. Available data have revealed no failures to comply with any of the standards required by the Dangerous Substances Directive in recent years (Howarth *et al*., 2001).

Historic discharges may have left a legacy of pollution due to the persistent nature of many of the contaminants released, therefore these discharges have a bearing upon our assessment of current exposure. Much of this historic contamination of the estuary is likely to be bound within the sediments. Contemporary activities resulting in the disturbance of such contaminated sediments can therefore have an impact upon the levels of toxic substances available to estuarine communities. Historic industry has also left a legacy of contaminated land around the estuary that still presents problems due to contaminants leaching into the estuary, as well as the suspected historic contamination of intertidal sediments. Synthetic substances present at contaminated land sites include asbestos and a variety of solvents.

Studies of synthetic compounds within the species and habitats of the Dee Estuary have provided mixed results. In a general investigation into relative water quality in estuarine waters of the UK, the Dee Estuary was ranked the ninth most contaminated out of the 10 estuaries investigated (Kirby *et al*., 1998). However, a narrower study looking at concentrations of two chemical products emitted during industrial production and from incinerators and car exhausts, polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), found that concentrations within the Dee Estuary were the highest of the six estuaries studied (Tyler *et al*., 1994). Grey seals *Halichoerus grypus* may be regarded as being at the top of the food chain within the Dee Estuary, and therefore most likely to bioaccumulate contaminants within their tissues. Tissue samples taken from seals in the Dee Estuary in 1988 and 1989 were found to be highly contaminated with PCBs (Simmonds, *et al*., 1993).

Due to the dynamic nature of the estuarine environment with tidal mixing and resuspension of sediment, pollutants are readily mobilised within the estuary. Thus the levels of exposure of all intertidal features / sub-features may be reasonably similar; with the possible exception of those habitats located in the outer estuary, where currents flush these habitats more readily, and those in the upper reaches of the intertidal zone which experience less frequent periods of inundation and consequently less exposure to contaminants carried in the water column.

Based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of medium exposure to synthetic toxic contamination for each of the following sub-features: **subtidal sediment communities** and **intertidal hard substrate communities**; all three **mudflats and sandflats sub-features**; ***Salicornia* and other annuals** and the **low to mid marsh communities of Atlantic salt meadow**. All of these sub-features are highly sensitive to the introduction of **toxic synthetic compounds** and thus should be considered **highly vulnerable.**

Despite their low exposure **ephemeral saltmarsh** and the **mid to upper** and **transitional high marsh communities** are **moderately vulnerable** to **synthetic toxic contamination** due to their high sensitivity.

8.5.2 Toxic contamination by non-synthetic toxic compounds

Non-synthetic compounds may naturally be present at very low levels in the environment, but many become toxic at elevated concentrations. They include many hydrocarbons including fuel oils, as well as heavy metals, which occur naturally at low concentrations. Estuarine communities are generally moderately sensitive to non-synthetic compounds, such as heavy metals and hydrocarbons, although annual vegetation of drift lines is considered to be highly sensitive to oil pollution. Oil pollution can cause deterioration of communities in intertidal and shallow subtidal environments, and can persist in low energy environments, where natural degradation and weathering of the oil tends to be slow. Oil can also have a significant smothering effect on marine communities especially in the intertidal and supralittoral (spray) zones. Saltmarshes are sensitive to oil and oil products, even at low levels, mainly due to their ability to trap sediments. Acute events such as an oil spill can be particularly damaging to saltmarsh plants, and the dispersants used to treat the spill can sometimes have an even more toxic effect on the plants than the oil itself. The use of dispersants to clean up oil spills on saltmarshes is therefore, not recommended (Briggs Marine Environmental Services Ltd, 2003). Saltmarshes have been reported to take up to 10 years to recover from chronic oil pollution, although recovery depends largely on the degree to which oil is retained in the sediment and the clean up procedures used.

There are a series of wastewater treatment works around the estuary discharging effluent from the populations of West Kirby, Heswall, Neston, Burton, Queensferry, Connah's Quay, Flint, Greenfield, Mostyn and Llanasa, and although the sewage is treated, toxic contaminants remain. Zinc loadings in sewage effluent discharged to the estuary are much higher than other metals, with Chester and Queensferry wastewater treatment works being the major contributors (Potter, 2003). Water samples taken both upstream and downstream of Queensferry wastewater treatment works between 1997 and 1998 revealed mean zinc concentrations of 15.6 ug/l and 7.1ug/l respectively, both below the UK EQS of 40ug/l although one sample upstream of the works had a concentration of 52ug/l (Potter, 2003).

However some authors have recommended that the EQS should be reduced to as low as 10 ug/l as an annual average due to zinc's effects on species of molluscs and crustaceans (Hunt & Hedgecott, 1992 and Matthiessesn *et al*., 1999, in Potter, 2003). Chester wastewater treatment works is also known to be a high contributor of lead, copper and nickel loadings compared to other wastewater treatment works (Potter, 2003).

As discussed above, there are several sources of industrial effluent within the Dee Estuary. Historically the Courtaulds factories at Flint and Greenfield were a major polluter within the estuary. Prior to 1976 the estuary received high levels of zinc pollution from Courtaulds and moderate levels until 1985 (Jemmett, 1993).

Historic industry has also left a legacy of contaminated land along the coast around the estuary, as described above. Non-synthetic compounds associated with this contamination include a variety of heavy metals, hydrocarbons and organic chemicals.

The Dee Estuary is potentially quite exposed to accidental chemical or oil spillage and maritime pollution due to its proximity to shipping access routes to the Port of Mostyn and the Mersey Ports as well as the development of the Liverpool Bay oil and gas field. Consequently, procedures to respond to oil spill incidents within and adjacent to the Dee Estuary European marine site need to be kept under review.

As described above due to the dynamic nature of the estuarine environment the level of exposure to most contaminants is likely to be comparable between habitats. Again, based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of medium exposure to toxic contamination by non-synthetic compounds for each of the following sub-features: **subtidal sediment communities** and **intertidal hard substrate communities**; all three **mudflats and sandflats sub-features**; ***Salicornia* communities** and ***Suaeda maritima* communities**; and the **low to mid marsh communities of Atlantic salt meadow**. All these communities are considered moderately sensitive to the introduction of **non-synthetic toxic compounds** and are therefore **moderately vulnerable** in this respect. Despite its low exposure **annual vegetation of drift lines** is also considered **moderately vulnerable** to **non-synthetic toxic contamination** due to its high sensitivity**.**

Ammonia loadings from treated sewage effluent have decreased since 1997 at Chester and Queensferry wastewater treatment works (Potter, 2003). However elevated ammonia concentrations may still occur in the upper estuary channel and the lower canalised section of the river, particularly during periods of warm weather and low flows. As **lamprey species** must pass through this area of potentially elevated contamination on migration to and from the waters of the Dee catchment in order to fulfil their life cycle, both species' exposure to non-synthetic toxic contamination is considered to be high, while their exposure to synthetic contaminants is considered to be medium. Thus both sea lamprey and river lamprey are considered **highly vulnerable** to **non-synthetic contamination**.

8.5.3 Toxic contamination by radioactive compounds

The effects of radionuclides have been demonstrated in a number of marine organisms, such as invertebrates and fish (Cole *et al*., 1999). Depending on the radioactive dosage, lethal, genetic or reproductive effects may result. There is also evidence to show that radionuclides accumulate in biota, particularly benthic crustaceans, molluscs and saltmarsh grasses (Cole *et al*., 1999). However sensitivity to radionuclides is generally considered to be low for all communities.

There are currently no major sources of radioactive contamination within the Dee Estuary itself, although there are several discharging installations around Liverpool Bay and the eastern Irish Sea. These include the Sellafield nuclear reprocessing plant, which is the dominant source of radioactive waste discharge to the coastal waters of the UK (Hutchinson, 1994). Airborne gamma spectrometry surveys have revealed elevated levels of ^{137}Caesium in the saltmarshes and tidal flats of major estuaries in the eastern Irish Sea environments including the Dee Estuary (Narayana *et al*., 2001). Doses received by man from exposure to such artificial radionuclides have been the subject of most scientific investigation. In the Dee Estuary the largest dose of radioactivity received by the most exposed group, people working on the marshes, is estimated to be only 6% of the recommended annual dose limit (Rose *et al*., 1996). In the absence of more specific data relating to particular habitats or species the exposure to radioactivity for all features within the site is considered to be low.

Since **all the features** of the site are considered to exhibit only low sensitivity to the introduction of radionuclides, and exposure is universally considered to be low, the features' **vulnerability** to radionuclides is also considered **low**.

8.6 Non-toxic contamination

Certain contaminants can have non-toxic, but nevertheless harmful effects on the features of the European marine site. These non-toxic contaminants are generally present in much higher concentrations than the toxic contaminants discussed above. They can enter the estuarine environment in large quantities from sewage outfalls and industrial discharges, riverine inputs and agricultural run-off. Water quality may be affected by contaminants altering factors such as nutrient levels, organic loading, heat, turbidity and salinity.

There is much variation in the sensitivity of subfeatures of the European marine site to the various categories of non-toxic contamination; this variation is discussed below.

8.6.1 Non-toxic contamination by changes in inorganic nutrient loading

Non-toxic nutrient levels can have profound direct effects upon estuary habitats and result in further indirect effects upon particular species (Cole, *et al*., 1999). Elevated inorganic nutrient (nitrate and phosphate) levels, can contribute to the stimulation of phytoplankton growth, leading to eutrophication and the subsequent deoxygenation of the water column, particularly in areas of limited or reduced water circulation and shallow areas with good light penetration. Increased nutrient levels also have the potential to lead to the localised growth of opportunistic algae such as gutweed *Enteromorpha* species and sea lettuce *Ulva lactuca* on the foreshore, which can cause smothering and deoxygenation of sediment communities (Cole *et al*., 1999). Nutrient pollution may result in reductions in species diversity and some species may be unable to recover, due to their slow growth and low larval dispersal.

Sensitivity to changes in inorganic nutrient loading is considered to be high for the muddy sand and gravel and clean sand communities and moderate for all other subfeatures except the hard substrate communities and the two lamprey species, which have low sensitivity.

As for toxic compounds, both inorganic and organic nutrients, can reach estuarine communities from many sources and many of these sources discharge both categories of contaminant. Thus the exposure and vulnerability of the features of the European marine site to both types of nutrients is discussed together in the next section below.

8.6.2 Non-toxic contamination by changes in organic nutrient loading

Increased levels of organic matter can also lead to a localised depletion of oxygen levels due to the increased activity of aerobic bacteria that break down organic matter. A good supply of oxygen within the sediments and water column is important for the healthy functioning of most marine species. Elevated levels of organic matter can alter this natural balance, potentially causing changes to the species composition and distribution within the sediments and saltmarsh communities. Primarily there will be increased growth of opportunistic species at the expense of more sensitive species (Cole *et al*., 1999).

Studies in North America have suggested that saltmarshes are unlikely to be highly sensitive to changes in water quality due to nutrient enrichment (Holt *et al*., 1995). However, increased growth of algal species, as a result of eutrophication may cause localised smothering of lower saltmarsh species and have been known to have a detrimental effect on glasswort in particular.

Sensitivity to changes in organic loading is considered to be moderate for all sub-features, again with the exception of hard substrate and the lamprey species, which have low sensitivity.

The degree of exposure and vulnerability of the features to non-toxic contamination by changes in the levels of both **synthetic** and **non-synthetic** contaminants is outlined below:

The requirements for wastewater treatment works (WwTW) to be 'secondary treated' in recent years has led to reduction in the amount of organic matter discharged into estuaries and coastal waters. Inorganic nutrients are generally not removed in significant quantities by this process.

There are five main sources of inorganic and organic nutrients present within the Dee Estuary (after Potter 2003):

- *River input* - nutrients flowing into the estuary from the River Dee and other watercourses in the catchment influenced by agricultural runoff, sewage discharges and industry in the catchment;
- *Tidal mixing* - nutrients are carried into the estuary from Liverpool Bay by the tidal regime;
- *Organic production* - biological productivity within the estuary system itself, chiefly comprising inputs from the saltmarsh, benthic communities in the intertidal sands and mudflats and phytoplankton living in the water column;
- *Direct discharge* - nutrients are discharged into the estuary from the numerous water treatment works and combined sewerage outfalls situated around its shores. In addition there are inputs of paper pulp fibres from paper mills.

- *Atmospheric deposition* - nitrogen is discharged to the atmosphere as NO_x from the burning of fossil fuels; this is of particular relevance due to the presence of two power stations and the Padeswood Cement Works close to the estuary.

The relative importance of these input categories is not well understood, although the relative contributions from Liverpool Bay are considered highly significant (Howarth *et al*., 2001). In addition freshwater inputs to the estuary both from the River Dee and other freshwater discharges are considered to contribute significantly to the estuary's nitrogen loading (Howarth *et al*., 2001). Among wastewater treatment works Chester and Queensferry are mainly responsible for the highest nutrient loadings being discharged to the estuary, they contribute the most oxidised nitrogen, phosphate and orthophosphate (Potter, 2003).

In 2001, the Dee Estuary from Chester Weir to its mouth was proposed by EAW as a Sensitive Area to Eutrophication under the Waste Water Treatment Directive, as the estuary exceeded chemical and biological criteria indicative of eutrophic conditions (Howarth *et al*., 2001). Evidence for eutrophication includes chemical data, reduced dissolved oxygen concentration in summer and elevated nitrogen concentrations in winter, Chlorophyll-*a* measurements, and evidence of algal scum. Two algal blooms were reported within the estuary between 1999 and 2001 (Howarth *et al*., 2001).

Recent investigations of faunal communities in the vicinity of the wastewater treatment works around the estuary found that the composition of these communities was generally classified as unbalanced and slightly polluted (Potter, 2003).

In the upper estuary the picture is further complicated by an interaction between nutrient loading and river flows. Nutrient levels in the canalised section of the lower river are believed to be particularly high due to sewage discharges and their limited dilution by freshwater river flow. During low flows and periods of warm weather, elevated water temperatures may still combine with the high nutrient levels to create suitable conditions for an algal bloom, causing oxygen depletion (Hodgson in, Shoreline Management Partnership, 2002). This set of circumstances has resulted in fish kills in the upper estuary in the past.

On the basis of evidence used to support the proposal to designate the Dee Estuary as a Sensitive Area to Eutrophication it was determined that all the sub-features that are subject to frequent inundation are highly exposed to changes in both organic and inorganic nutrient loading. These sub-features are: subtidal sediment communities and rocky shore communities; all three mudflats and sandflats sub-features; *Salicornia* and other annuals colonising mud and sand; and the low to mid marsh communities of Atlantic salt meadow. The ephemeral, upper and high marsh communities and vegetated drift lines are less frequently inundated and considered to have a medium exposure.

The potential exposure of the lamprey species must be regarded as high since to complete their life cycle they must pass along the full length of the river channel, including the section considered prone to periodic eutrophication.

These exposure scores resulted in **most sub-features**, being **moderately or highly vulnerable** to **inorganic and organic nutrient loading**, with the exception of the vegetated strandline communities, and the two lamprey species due to their low sensitivity to eutrophic conditions.

8.6.3 Non-toxic contamination by changes in the thermal regime

Lamprey species are considered highly sensitive to changes in the thermal regime. This is because their upstream migration is thought to be temperature dependent, relying on the detection of a small change in water temperature, as well as the interaction between water temperature and oxygen levels described above. Only subtidal sediment and hard substrate communities have moderate sensitivity to changes in the thermal regime, other communities have lower sensitivity.

Although there are several warm water discharges around the estuary, including cooling water outfalls from two power stations in the upper estuary channel, their effects upon the temperature regime of the estuary are believed to be localised. Heat energy is a dissipating 'pollutant' in this context, thus the impact of these outfalls is thought to be concentrated around the point of discharge. The habitat features of the European marine site were therefore determined to have at most a low exposure to changes in thermal regime. However, the lamprey species were considered to have potentially moderate level of exposure, as they must pass along the full length of the channel to complete their life cycle. Therefore, the **river** and **sea lamprey** were determined to be **highly vulnerable** to changes in thermal regime, while the other features have only low vulnerability.

8.6.4 Non-toxic contamination by changes in turbidity

The Dee Estuary is a naturally turbid system; therefore any increases in turbidity from anthropogenic actions may fall within the natural range that the estuary communities generally experience. The gravel and clean sand communities have the highest sensitivity to turbidity, being moderately sensitive; the sensitivity of all other sub-features is less.

Primarily due to ongoing possibility of dredging works and disposal of dredged materials within the estuary the exposure to changes in turbidity was determined to be high for the subtidal sediment communities and medium for most other communities experiencing frequent tidal inundation. Based on these assumptions, only the **subtidal sediment communities** and **gravel and clean sand communities** are **moderately vulnerable** to turbidity, other sub-features having low vulnerability.

8.6.5 Non-toxic contamination by changes in salinity

Estuaries naturally exhibit a large degree of variability in salinity associated with the interaction between the tidal cycle and river flow. There will be a gradient in the average salinity experience by communities at different stages up the estuary though the salinity at any point will vary substantially. Despite the adaptation of estuarine communities to variable salinity significant changes in salinity due to either discharge of hyper-saline or fresh water can also have indirect effects on community composition. In addition changes in salinity can cause indirect effects on communities as salinity can affect the chemical availability of various contaminants.

Sensitivity to changes in salinity is moderate for all subfeatures apart from subtidal sediments, *Salicornia* and other annual species, subtidal sediment communities, and the lamprey species; these are all considered to have low sensitivity to salinity changes. These less sensitive communities naturally experience a wider variation in salinity than most of the other communities. Hyper-saline discharges may be harmful to most estuarine communities, although these effects will generally be localized. Estuarine communities will generally be unaffected by short term changes in salinity within the limits of their normal exposure, however long term impacts upon the salinity regime, may affect the zonation of communities within the estuary having far reaching effects on community distribution.

Presently only the power stations are thought to discharge hyper-saline water. The main influences on the salinity of the estuary would be tidal inundation and rainfall. Thus exposure to anthropogenic changes in salinity is determined to be low throughout the estuary and **vulnerability** to changes in salinity is therefore **low for all features**.

8.7 Biological disturbance

Biological disturbance includes the introduction of microbial pathogens, introduction and translocation of non-native species, and the selective extraction of species.

8.7.1 Biological disturbance by introduction of microbial pathogens

The sensitivity of the features to the introduction of microbial pathogens is considered to be either low or undetectable for all sub-features.

Mainly as a result of recent improvements to waste water treatment exposure to microbial pathogens within the estuary is generally perceived to be low, although elevated levels may occur in the upper estuary and canalised lower river due to reduced dilution of sewage discharges. This leads to an assessment of medium exposure for the mud communities and lamprey species. Yet the resulting **vulnerability** is **low** for **all features**.

8.7.2 Biological disturbance by introduction of non-native species

Introduced species may thrive at the expense of native species, resulting in a change in the composition of estuarine communities, and affecting the structure and functioning of estuarine habitats. However the sensitivity of the features to introductions of non-native species is considered to be generally moderate or low.

New introductions of non-native marine species may be most likely to occur through the discharge of ballast water within the estuary by ships embarking from foreign ports. A great variety of species have been shown to be able to survive transhipment in ballast water (e.g. Wasson *et al*., 2001; Reise *et al*., 1999). There is also the possibility of non-native species entering the estuary on the hulls of boats. The Dee Estuary has received relatively little long distance trade in recent years although this may change with the expansion of the Port of Mostyn. At the time of making this assessment, small coasters or 'Rhine barges' which visit Mediterranean and Northern European Ports were calling at Mostyn approximately once a week, and may have the potential to bring alien species from Europe and further afield. Further work is needed to establish which non-native marine species may already be present in the waters of the Dee Estuary and to investigate the likelihood of current shipping activities resulting in further introductions. **Subtidal sediment communities**, **hard substrate communities**, and **gravel and clean sand communities** would be most likely to be exposed to the introduction of non-native species through ballast water movements. However due to the low level of traffic currently visiting the estuary the exposure of these subfeatures to introductions of non-native species is provisionally considered to be **low**, as is their **vulnerability**.

As mentioned under Physical Loss, the overall extent of saltmarsh within the estuary continues to expand. Over the last two decades there has been an increase of about 35% in saltmarsh extent, mainly on the north side of the main channel, especially in the mid and upper estuary (Dargie, 2001). This expansion is of particular concern with respect to the loss of **muddy sediment communities** and the potential for displacement of native pioneer saltmarsh communities principally comprising glasswort *Salicornia* species and annual sea-blite *Suaeda maritima*.

Continued saltmarsh expansion is occurring in response to the ongoing siltation within the estuary as a result of historic impacts upon the form of the estuary. The spread of the invasive common cord grass *Spartina anglica* within the estuary is also believed to play an important role in this process. Common cord grass was introduced to the Dee in the late 1920's at Connah's Quay in order to accelerate land claim (Parr, 1988). Once present in an area it acts to accelerate accretion by trapping sediment directly and slowing current speeds causing further deposition (Parr, 1988).

Common cordgrass is a fertile strain of a hybrid between a native and introduced *Spartina* species. It demonstrates vigorous growth and is able to grow low down on the shore where the sediments are highly mobile, being a particularly aggressive coloniser of bare mud. Yet cordgrass encroachment is not restricted to the mud communities; it is also present on the sandy sediments at West Kirby and Hoylake.

Since 1945 the spread of cord grass both within existing vegetation communities and as a pioneer species, has played an important part in the development of the Dee saltmarsh (NCC, 1978). In 1966, the area of cordgrass dominated marsh was estimated to be 405 ha (Hubbard and Stebbings, 1967); by 1983 this had increased to 620 ha (Burd, 1989). However over the last two decades there is good evidence, first from Hill (1986) and most recently Dargie (2001), that succession is occurring within areas previously dominated by *Spartina*, which are being colonised by other saltmarsh species such as saltmarsh grass *Puccinellia maritima*; indeed Dargie was able to map only 34 ha of cord grass dominated marsh in 2000, although Dargie also confirms that the process of saltmarsh expansion continues (Dargie, 2001).

Thus **mud communities** and the native pioneer ***Salicornia* and *Suaeda maritima* communities** are considered to be highly exposed to the introduction and translocation of *Spartina anglica*. **Muddy sand communities** and **low to mid marsh communities** are considered to have **medium** exposure. All of these sub-features are considered to be moderately sensitive to the introduction of non-native species thus their **vulnerability** is the same as their exposure assessment.

8.7.3 Biological disturbance by selective extraction of species

Selective extraction of species within the estuary results from various forms of exploitation of living resources. These include commercial shellfish and finfish fisheries, sport fishing (both sea angling and coarse fishing), and wildfowling.

The unsustainable removal of particular species from estuarine habitats may affect the ecological balance of the marine communities and predator species, such as birds and fish that may rely upon them as a food source.

All the estuarine communities of the European marine site are considered to be moderately sensitive to the selective extraction of their constituent species.

The Dee supports sea fisheries for both shell fish and fin fish: there is a cockle (*Cerastoderma edule*) fishery of high economic importance, and smaller mussel *Mytilus edulis* fishery; in addition there is small scale collection of razor fish *Ensis* spp. and bait digging for lug worms *Arenicola marina*. The Dee supports a notable fishery for species such as flounder *Pleuronectes flesus,* mullet species *Chelon labrosus* and *Liza ramada,* cod *Gadus morhua*, and shrimps *Crangon crangon*, as well as a salmon *Salmo salmar* net fishery controlled by a Net Limitation Order (NRA, 1993; Potts & Swaby, 1993).

Cockles are found within areas of both **mud** and **muddy sand sediments**. As mentioned under the section on physical damage by abrasion the cockle fishery may have undesirable effects caused by raking for cockles and their removal. In addition to direct effects upon the particular bird species that utilise cockles as a food source, the regular disturbance of sediment due to raking during the fishery affect infaunal community composition, either through causing death or injury to other species or through changes in sedimentology (Kaiser *et al*., 2001). Persistent raking activity associated with the cockle fishery may have the potential to lead to long term changes in the sedimentology of the cockle beds by allowing "winnowing" of the fine fraction (Jemmett, 1993). In addition some raking may cause smaller cockles to be damaged, killed or washed from the bed, as well as potentially facilitating the release of toxic metals, bound within the sediment.

At the time of making this assessment, the powers available to the Environment Agency to manage the cockle fishery were limited in scope and resources with no control available upon the numbers of fishermen that may take part. However shellfishery management within the estuary has recently been reviewed and in the future existing problems may be resolved. The limited cockle stocks found on North Wirral Foreshore, and the Gronant Dunes and Talacre Warren shoreline fall under the jurisdiction of North Wales and North Western Sea Fisheries Committee and cockling here is less restricted. In the future any deleterious effects of the cockle fishery could be offset by the potential benefits that arise from sustainable management of the stock according to traditional principles. These include the prevention of widespread 'shelling up' of beds, creation of space to allow improved spat fall, reduced volatility of cockle population dynamics, and the maintenance of a better managed stock within the estuary. In addition a reduction in disturbance would also likely to be of benefit to overwintering birds.

Mussel harvesting within the Dee Estuary is less regulated that the cockle fishery but occurs with less intensity. Within the estuary, mussels occur on hard substrates, especially the 'artificial' rocky shores around Port of Mostyn, and the rocky shore of the Hilbre Islands as well as on the intertidal mudflats and sandflats off West Kirby and Thurstaston. Mussel settlement may also take place on very dense cockle beds, which have undergone or are in the process of 'shelling up'.

Excessive exploitation of mussels resulting in the removal of long established areas of mussel beds, or the total removal of mussels over extensive stretches of rocky shore, is considered highly undesirable as it is likely to result in a significant medium or long term change in community composition. Mussel beds provide habitats for a wide range of other species and repeated removal would be likely to prevent these species from becoming established.

However the impacts of sustainable low intensity mussel collection or the occasional removal of ‘mussel crumble’ from a cockle bed could be minimal.

Bait digging and razor shell collection are practised within the site at low intensity, in particular within the sand communities of the North Wirral Foreshore. As with cockling such activities disturb the sediment through digging and to a lesser extent trampling. This exploitation may also be sustainable at low intensities where traditional methods are employed; however commercial exploitation of these resources may impact on the favourable condition of the European marine site through widespread disturbance of the sediment structure and changes to sediment community composition.

Thus the current exposure of **mud** and **muddy sand communities** to the selective extraction of shellfish is considered to be high due to the current scale of the cockle fishery; the exposure of clean sand and gravel communities is considered to be medium. As the sensitivity of these communities to selective extraction is moderate, their **vulnerability** is **high** and **moderate** respectively.

The majority of the rocky shore communities on artificial substrates around the Port of Mostyn or on Hilbre Island do not form part of the **notable hard substrate communities** sub-feature. The exposure of the notable hard substrate communities within the estuary to selective extraction in general is currently regarded as low. Thus they are also considered to have only **low vulnerability**.

The exposure of the **subtidal sediment communities** to selective extraction is also considered to be moderate due to the continued beam trawling for shrimps, flounder and other flatfish, although this is currently carried out at relatively low intensity. Thus the subtidal sediment communities are also considered to be **moderately vulnerable** to selective extraction.

Both wildfowling and cockling activities are significant with regard to their possible effects upon SPA / Ramsar site features and these are dealt with in the SPA / Ramsar site Advice on Operations Section (Section 12).

Table 3. Assessment of the relative sensitivity, exposure and vulnerability of SAC interest features and sub-features of the Dee Estuary European marine site to different categories of operations (as at February 2003).

Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading, light grey for moderate vulnerability and dark grey for high vulnerability. Table also incorporates the relative sensitivity scores, used in part to derive vulnerability[12]

Key: Matrix used to determine relative vulnerability (i.e. Sensitivity x Exposure = Vulnerability)

High sensitivity	O O O O	**High Exposure**	× × × ×	**High vulnerability**	⊗⊗⊗⊗ ⊗⊗⊗O ⊗⊗⊗×
Moderate sensitivity	O O O	**Medium Exposure**	× × ×	**Moderate vulnerability**	⊗⊗OO ⊗⊗× × ⊗⊗⊗
Low sensitivity	O O	**Low Exposure**	× ×	**Low vulnerability**	⊗⊗O ⊗⊗× ⊗⊗
No detectable sensitivity	O	**No exposure**	×	**No vulnerability**	⊗O ⊗× ⊗

[12] Natural England and the Countryside Council for Wales' advice on operations is derived from an assessment combining relative sensitivity of the features or sub-features with information on human usage of the site (as at February 2003), to identify relative vulnerability to categories of operations. In accordance with Government policy guidance this advice is provided in the light of current activities and patterns of usage at the site. It is important therefore that future consideration of this advice by relevant authorities, and others, takes account of changes in the usage patterns at the site. In contract the sensitivity of interest features, or sub-features, is relatively stable with alterations reflecting improvement in our scientific knowledge and understanding. To this end, information on sensitivity has been included in this table to assist the management and advisory groups with the future management of the site.

Categories of operations which may cause deterioration or disturbance	SAC interest features								
	Estuaries						Mudflats and sandflats not covered by seawater at low tide		
	Subtidal sediments	Intertidal hard substrate communities	Intertidal mudflats and sandflats	*Salicornia* and other annuals	Atlantic salt meadow	Annual vegetation of drift lines	Mud communities	Muddy sand communities	Gravel and clean sand communities
Physical Loss			For information on the exposure of this sub-feature see the mudflats and sandflats not covered by sea water at low tide feature in this table	For information on the exposure of this sub-feature see the ***Salicornia*** and other annuals colonising mud and sand feature in this table	For information on the exposure of this sub-feature see the Atlantic salt meadow feature in this table	For information on the exposure of this sub-feature see the annual vegetation of drift lines feature in this table			
Removal (e.g. land claim, dredging)	⊗⊗⊗⊗	⊗⊗⊗⊗					⊗⊗⊗⊗	⊗⊗⊗O	⊗⊗OO
Smothering (e.g. depositing dredge spoil, beach feeding)	⊗⊗⊗×	⊗⊗⊗O					⊗⊗O	⊗⊗O	⊗⊗⊗
Physical Damage									
Siltation (e.g. dredging, outfalls, coastal development)	⊗⊗××	⊗⊗⊗O					⊗⊗	⊗⊗×	⊗⊗⊗
Abrasion (e.g. recreational activity, vehicles)	⊗⊗⊗×	⊗⊗×					⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗
Selective extraction (e.g. aggregate extraction)	⊗⊗O	⊗⊗OO					⊗⊗O	⊗⊗O	⊗⊗O
Non-physical disturbance									
Noise (e.g. land/water-based recreation, marine traffic)	⊗××	⊗××					⊗×	⊗×	⊗××
Visual presence (e.g. land/water-based recreation, marine traffic)	⊗	⊗××					⊗×	⊗×	⊗××
Toxic contamination									
Introduction of synthetic compounds (e.g. TBT, PCBs from industrial effluent outfalls)	⊗⊗⊗O	⊗⊗⊗O					⊗⊗⊗O	⊗⊗⊗O	⊗⊗⊗O

Categories of operations which may cause deterioration or disturbance	SAC interest features								
	Estuaries						Mudflats and sandflats not covered by seawater at low tide		
	Subtidal sediments	Intertidal hard substrate communities	Intertidal mudflats and sandflats	*Salicornia* and other annuals	Atlantic salt meadow	Annual vegetation of drift lines	Mud communities	Muddy sand communities	Gravel and clean sand communities
Introduction of non-synthetic compounds (e.g. domestic effluent outfalls, crude oil)	⊗⊗⊗	⊗⊗⊗					⊗⊗⊗	⊗⊗⊗	⊗⊗⊗
Introduction of radionuclides	⊗⊗	⊗⊗					⊗⊗	⊗⊗	⊗⊗
Non-toxic contamination									
Changes in nutrient loading (e.g. agricultural run-off, domestic effluent outfalls)	⊗⊗⊗×	⊗⊗× ×					⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×
Changes in organic loading (e.g. domestic effluent outfalls, aquaculture)	⊗⊗⊗×	⊗⊗× ×					⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗×
Changes in thermal regime (e.g. power station discharges)	⊗⊗O	⊗⊗O					⊗⊗	⊗⊗	⊗⊗
Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil)	⊗⊗× ×	⊗⊗×					⊗⊗×	⊗⊗×	⊗⊗⊗
Changes in salinity (e.g. water abstraction, effluent outfalls)	⊗⊗	⊗⊗O					⊗⊗O	⊗⊗O	⊗⊗O
Biological disturbance									
Introduction of microbial pathogens (e.g. domestic / industrial effluent outfalls)	⊗⊗	⊗⊗					⊗⊗×	⊗⊗	⊗⊗

Categories of operations which may cause deterioration or disturbance	SAC interest features								
	Estuaries						Mudflats and sandflats not covered by seawater at low tide		
	Subtidal sediments	Intertidal hard substrate communities	Intertidal mudflats and sandflats	*Salicornia* and other annuals	Atlantic salt meadow	Annual vegetation of drift lines	Mud communities	Muddy sand communities	Gravel and clean sand communities
Introduction of non-native species and translocation	⊗⊗O	⊗⊗					⊗⊗⊗×	⊗⊗⊗	⊗⊗O
Selective extraction of species (e.g. samphire picking, bait collection)	⊗⊗⊗	⊗⊗O					⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗

Categories of operations which may cause deterioration or disturbance	**SAC Interest Features**								
	Salicornia **and other annuals**			**Atlantic salt meadow**			**Annual Vegetation of drift lines**	**Sea Lamprey (*Petromyzon marinus*)**	**River Lamprey (*Lampetra fluviatilis*)**
	Salicornia **communities**	***Suaeda maritima*** **communities**	**Ephemeral saltmarsh (with *Sagina maritima*)**	**Low to mid marsh communities**	**Mid to upper marsh communities**	**Transitional high marsh communities**			
Physical Loss									
Removal (e.g. land claim, dredging)	⊗⊗OO	⊗⊗OO	⊗⊗OO	⊗⊗OO	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗OO
Smothering (e.g. depositing dredge spoil, beach feeding)	⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗O	⊗⊗OO	⊗⊗⊗O	⊗⊗⊗	⊗⊗	⊗⊗
Physical Damage									
Siltation (e.g. dredging, outfalls, coastal development)	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗O	⊗⊗×	⊗⊗×
Abrasion (e.g. recreational activity, vehicles)	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗⊗	⊗⊗⊗⊗	⊗⊗×	⊗⊗×
Selective extraction (e.g. aggregate extraction)	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O
Non-physical disturbance									
Noise (e.g. land/water-based recreation, marine traffic)	⊗×	⊗× ×	⊗× ×	⊗× ×	⊗× ×	⊗× ×	⊗× × ×	⊗⊗	⊗⊗
Visual presence (e.g. land/water-based recreation, marine traffic)	⊗×	⊗× ×	⊗× ×	⊗×	⊗× ×	⊗× ×	⊗× ×	⊗ O	⊗ O
Toxic contamination									
Introduction of synthetic compounds (e.g. TBT, PCBs from effluent outfalls)	⊗⊗⊗O	⊗⊗⊗O	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗	⊗⊗⊗	⊗⊗⊗
Introduction of non-synthetic compounds (e.g. effluent outfalls, crude oil)	⊗⊗⊗	⊗⊗⊗	⊗⊗O	⊗⊗⊗	⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗⊗×	⊗⊗⊗×

Categories of operations which may cause deterioration or disturbance	SAC Interest Features								
	Salicornia and other annuals			Atlantic salt meadow			Annual Vegetation of drift lines	Sea Lamprey (*Petromyzon marinus*)	River Lamprey (*Lampetra fluviatilis*)
	Salicornia communities	*Suaeda maritima* communities	Ephemeral saltmarsh (with *Sagina maritima*)	Low to mid marsh communities	Mid to upper marsh communities	Transitional high marsh communities			
Introduction of radionuclides	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗×	⊗⊗	⊗⊗
Non-toxic contamination									
Changes in nutrient loading (e.g. agricultural run-off, effluent outfalls)	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗	⊗⊗⊗×	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗× ×	⊗⊗× ×
Changes in organic loading (e.g. effluent outfalls, aquaculture)	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗	⊗⊗⊗×	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗× ×	⊗⊗× ×
Changes in thermal regime (e.g. power station discharges)	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗×	⊗⊗⊗O	⊗⊗⊗O
Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil)	⊗⊗×	⊗⊗×	⊗⊗	⊗⊗×	⊗⊗	⊗⊗	⊗⊗	⊗⊗×	⊗⊗×
Changes in salinity (e.g. water abstraction, effluent outfalls)	⊗⊗	⊗⊗	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗	⊗⊗
Biological disturbance									
Introduction of microbial pathogens (e.g. effluent outfalls)	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗×	⊗⊗×	⊗⊗×
Introduction of non-native species and translocation	⊗⊗⊗×	⊗⊗⊗×	⊗⊗O	⊗⊗⊗	⊗⊗O	⊗⊗⊗	⊗⊗×	⊗⊗⊗	⊗⊗⊗
Selective extraction of species (e.g. samphire picking, bait collection)	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O

Special Protection Area

9 The Dee Estuary SPA interest features

The Dee Estuary European marine site includes a Special Protection Area qualifying under the EU Birds Directive. Revisions to the existing SPA were consulted upon in February 2001, including the addition of particular areas and qualifying species.

Where SPA qualifying bird species occur within the European marine site, they are referred to as interest features. Supporting habitat sub-features (or simply supporting habitats) have also been identified to highlight the ecologically important components of the European marine site for each interest feature (Figure 2). The interest features and supporting habitats for the Dee Estuary European marine site are discussed in more detail below and the supporting habitats are mapped in Appendix V to show their distribution and extent.

This section describes and explains the importance of each of the SPA interest features of the Dee Estuary European marine site.

The Dee Estuary SPA includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. The marine part of the SPA is termed a European marine site. The seaward boundary of the European marine site is concurrent with that of the SPA. The landward boundary of the European marine site is the upper boundary of the SPA, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats.

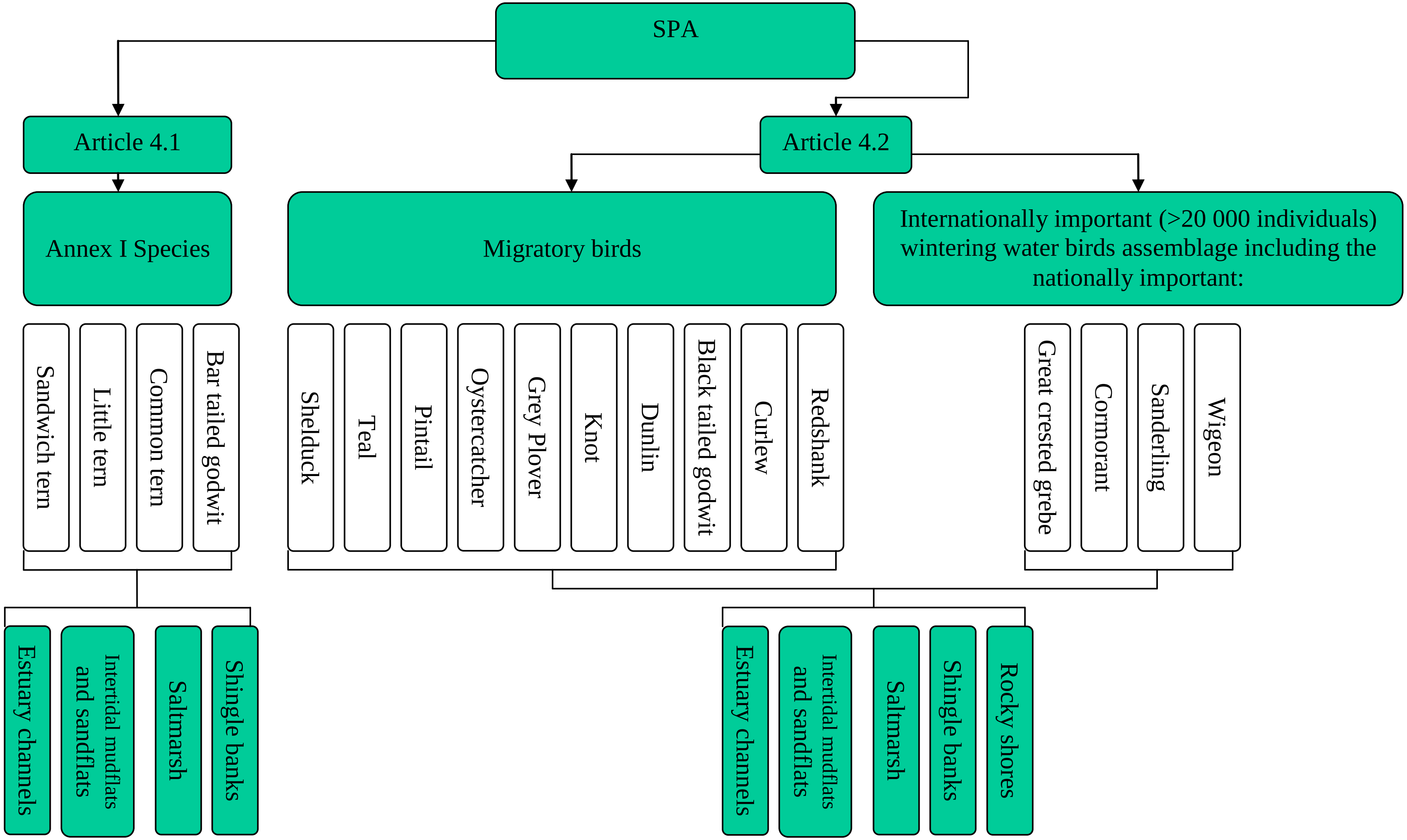
As mentioned in Section 1.9, the area of North Wirral Foreshore SSSI forms part of the Dee Estuary SAC but it is not included within the Dee Estuary SPA. North Wirral Foreshore SSSI does form part of the Mersey Narrows and North Wirral Foreshore potential SPA (pSPA). Regulation 33 Advice relating to Mersey Narrows and North Wirral Foreshore pSPA is therefore not included within this document and will be provided separately in due course.

9.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of qualifying birds in order to ensure their survival and reproduction within the European Union. A key mechanism in achieving this is the classification by Member States of the most suitable sites as SPAs.

Natural England's and the Countryside Council for Wales' conservation objectives at the site level focus on maintaining both the populations of the qualifying species and the habitats used by them. Site management should therefore aim to avoid both damage to the supporting habitats and significant disturbance to the birds. In reporting on conservation status, account will need to be taken both of habitat condition and the status of the bird populations.

Figure 2. Flow chart showing the relationship between the qualifying bird species of The Dee Estuary SPA and their supporting habitat sub features. Bird species are in 'open' vertical boxes with supporting habitat sub features in shaded vertical boxes.



Accordingly, Natural England and the Countryside Council for Wales will use annual counts, in the context of five year peak means for qualifying species, together with available information on population and distribution trends, to assess whether an SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Union.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions be taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may result in alterations in population trends and/or distribution patterns. Avoiding disturbance to qualifying species is mentioned in the favourable condition table accompanying the conservation objectives for the SPA. In this context, five-year peak mean population data from monthly high water Wetland Bird Survey (WeBS) counts will be used in conjunction with information from more infrequent low water WeBS counts as the basis for assessing whether disturbance is significant.

Attention is also directed to the inclusion of disturbance in the advice on operations provided in Section 12. Where disturbance is highlighted in such advice, relevant authorities need to avoid significant disturbance to qualifying species when exercising their functions under the Directive.

9.2 Reduction in organic and inorganic inputs

Under the Urban Waste Water Treatment (UWWT) Directive, all coastal discharges above a certain volume must have had secondary treatment installed by the end of 2000. Secondary treatment of sewage will significantly reduce organic loading and to a lesser extent reduce concentrations of dissolved nutrients. Also, improvements to water quality in the upper catchment may result in a reduction in riverine nutrients. Also, currently Liverpool Bay is one of the most eutrophic areas in the UK, thus the estuary receives an enhanced ‘marine’ input of nutrients. The effects of these reductions on coastal features and the birds they support are difficult to predict. On the one hand, it might be expected that there would be a redistribution of feeding birds or a reduction in the overall capacity of a coastal area to support some bird populations. Wildfowl and waders will prey upon the invertebrates found in the sediments close to wastewater outfalls and other species on the fish that exploit these resources (Burton *et al*., 2002). Improvements to discharges have been shown to lead to reductions in these resources. Recent research has also provided evidence that numbers of waterbirds have declined on two estuaries, the Orwell and the Mersey, following changes to waste water treatment (Burton *et al*., 2002). On the other hand, where bird populations are currently adversely affected by eutrophication, or on the most grossly polluted sites cleaner discharges may contribute to improving site condition.

Natural England and the Countryside Council for Wales support the improvement in coastal discharges. On balance, the overall ecological benefits of cleaner discharges tend to outweigh any subsequent local decline in bird numbers, although there is presently insufficient knowledge to accurately predict the effects on the bird populations of individual SPA sites. Therefore it is necessary that each proposal that may affect nutrient loading with the Dee Estuary European marine site be considered on a case by case basis.

Under The Conservation (Natural Habitats & c.) Regulations, 1994, if significant effects are likely from such activities, the competent authority (in this case the Environment Agency) will be required to undertake an appropriate assessment to determine whether there is an adverse effect on site integrity. An important point is that even if adverse effects are predicted then the project may still proceed if there are imperative reasons of overriding public interest. These include reasons relating to public health and beneficial consequences of primary importance for the environment.

9.3 General description

In recognition of the fact that bird populations on a site may change in response to wider, national or international trends or events, this Regulation 33 advice addresses the habitat conditions on the site necessary to support the bird populations, as well as the bird populations themselves. "Supporting habitats" are identified which describe the key habitats within the European marine site necessary to support the qualifying species. The "favourable condition table" (see Section 3 and 11) contains further detail on habitat conditions.

Bird usage of the site varies seasonally, with different areas being favoured over others at certain times of the year. However, annual counts for qualifying species will be used by Natural England and the Countryside Council for Wales, in the context of five-year peak means, together with available information on UK populations and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species.

Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species. Changes in the habitat may therefore affect species differently. The most important factors related to this are:

- current extent and distribution of suitable feeding and roosting habitat (e.g. saltmarsh, mudflats, shingle and rocky shores);
- sufficient food availability (e.g. crustaceans, small fish, molluscs, worms and seeds);
- avoiding significant levels of disturbance, thereby maintaining suitable conditions for normal bird behaviour including roosting / loafing and levels of feeding activity;
- water quality necessary to maintain intertidal plant and animal communities; and
- fresh water quantity, tidal flows and salinity gradients necessary to maintain saltmarsh conditions suitable for bird feeding and roosting.

As explained in Section 2.4.2, there are a number of habitats within the SPA, which support the qualifying bird species, but which do not, occur within the European marine site as they occur above highest astronomical tide.   These habitats include coastal grazing marsh used by waterbirds for feeding and roosting, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations, 1994.

Some species will also use areas of land and coastal waters outside the boundaries of both the European marine site and the SPA. Relevant authorities need to have regard to such adjacent interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

The generic qualifying features of The Dee Estuary SPA and their associated supporting habitats are identified in Table 4. The individual features are described in more detail in the subsequent Sections 9.4 (Annex I species) and 9.5 (migratory and waterbird assemblages).

Table 4. A summary of the qualifying SPA features and their associated supporting habitats within the Dee Estuary European marine site

Qualifying features	Protected Supporting habitats				
	Estuary channels	Intertidal mudflats and sandflats	Saltmarsh communities	Shingle banks	Rocky shore
Annex I species	√	√	√	√	
Migratory species[18]	√	√	√	√	√
Waterbird assemblage[19]	√	√	√	√	√

9.4 Internationally important populations of the regularly occurring Annex I species

The species listed in Annex I of the Birds Directive are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Species listed on Annex I are in danger of extinction, rare or vulnerable. Annex I species that regularly occur at levels over 1% of the national population, meet the SPA qualifying criteria.

The Dee Estuary SPA supports internationally important populations of four Annex I species (see below and in more detail in Table 5).

The qualifying wintering species that occurs within the European marine site is:

- bar-tailed godwit *Limosa lapponica*

The qualifying breeding species that occur within the European marine site are:

- common tern *Sterna hirundo*
- little tern *Sterna albifrons*

The qualifying species that occur on autumn passage within the European marine site is:

- Sandwich tern *Sterna sandicensis*

The following Annex I species also occur in the Dee Estuary SPA: Leach's petrel *Oceanodroma leucorhoa*, little egret *Egretta garzetta*, Bewick's swan *Cygnus columbianus bewickii*, whooper swan *Cygnus cygnus*, smew *Mergellus albellus*, hen harrier *Circus cyaneus*, merlin *Falco columbarius*, peregrine falcon *Falco peregrinus*, golden plover *Pluvialis apricaria*, ruff *Philomachus pugnax*, wood sandpiper *Tringa glareola*, short-eared owl *Asio flammeus* and kingfisher *Alcedo atthis*. However, they occur in numbers of less than European importance (i.e. less than 1% of the Great Britain population).

[18] Qualifies under article 4.2 of the EC Birds Directive by supporting regularly occurring migratory species in numbers of European importance
[19] Qualifies under article 4.2 of the EC Birds Directive by supporting an internationally important assemblage of waterbirds

9.4.1 Key sub-features for the Annex I species

Estuary channels (subtidal sediment communities and the water column) - common terns, little terns and Sandwich terns all exploit the food resources provided within the estuary. The only breeding little tern colony in Wales is found at Gronant. The largest common tern colony in Wales is found at Shotton Lagoons and Reedbeds SSSI, just outside the European marine site. The estuary also provides a staging post for large numbers of Sandwich terns beginning their autumn migration.

All three species of terns feed on small fish including sprats *Sprattus sprattus* and sandeels *Ammodytes* spp. and the fry of other fish found in the water column, these are confined to the sub-tidal channels at low water. The tern species will also feed on small crustaceans, and marine worms (Kirby *et al*., 2000). When the tide is in, terns fish right across the estuary including in waters covering the intertidal flats.

Common terns make regular feeding flights from their breeding site at Shotton Lagoons to feed within the estuary. They appear to utilise the whole estuary for feeding and can be seen off Hilbre Islands at the mouth of the estuary and within the canalised section of Dee, upstream from Connah's Quay.

Intertidal mudflats and sandflats – The Dee Estuary European marine site possesses an extensive area of intertidal mudflats and sandflats, supporting rich populations of intertidal invertebrate species. In turn these populations provide a crucial food source for many species of waterbirds including the Annex I species, bar-tailed godwit.

Numbers of bar-tailed godwit found feeding on the invertebrate populations of the Dee Estuary's intertidal mudflats are highly variable. At low water bar-tailed godwits occur almost exclusively on the outer estuary, which historically was a more favoured feeding area than is now the case. Currently virtually the entire wintering population of bar-tailed godwit are believed to feed outside the Dee Estuary SPA at Mockbeggar Wharf within North Wirral Foreshore SSSI (Cranswick *et al*., 2005). Mudflats off Mockbeggar Wharf support very high numbers of feeding bar-tailed godwit at low tide, averaging over 8,000 in winter 2001-2002 (Cranswick *et al*., 2005) and they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA. Lower numbers of bar-tailed godwit do feed within the estuary SPA at low tide. Their numbers peak in January with smaller numbers present in December, February and March, very few occur outside this period (Percival & Percival, 1998).

Historically an area of upper shore at West Kirby has provided an important roosting site for bar-tailed godwit (C. Wells, RSPB Warden, *pers. comm*.). In the past much greater numbers of bar-tailed godwit roosted within the estuary than is now the case. More recently many birds have roosted either on the Alt Estuary or along North Wirral Foreshore and it is suspected that this change is due to disturbance of the West Kirby roost area. Birds may still make use of their historic roost site within the Dee Estuary SPA, for example, when tides are smaller during daytime, and at night but the latter requires further investigation. Other species, which feed in the outer estuary including knot, dunlin and grey plover also utilise their historic roost site on smaller tides too.

The beaches at Point of Ayr and Gronant are used as a roosting area by little terns, common terns and Sandwich terns, especially at high water (Nicholas Pearson Associates, 1993).

Terns also make use of the intertidal flats off West Kirby and Hoylake at this time (C. Wells, RSPB Warden, *pers. comm.*) Peak counts of Sandwich terns occur during their late summer/autumn passage in July and are regularly in excess of 1,000 birds (Musgrove *et al.*, 2001). Yet such counts give no idea of the turn over of individuals and the true number of birds visiting the area during each season may be substantially greater. Common terns make particular use of these roosting sites at the end of the breeding season, though it is possible that at this time the breeding population of common terns is augmented by birds from elsewhere beginning their autumn migration (Nicholas Pearson Associates, 1993).

Saltmarsh Communities - Bar-tailed godwit require unrestricted views when roosting, and in general will utilise areas of saltmarsh with short sward heights as a roost site. However although bar-tailed godwit may periodically roost in large numbers in areas of saltmarsh within the site no regular usage is recorded in recent years (C. Wells, RSPB Warden, pers. *comm*.).

Historically, until encouraged to use the Shotton Steelworks lagoons, common terns used to nest on Burton Marshes where they were generally unsuccessful because young and eggs were lost to tidal inundation. They now nest on specially developed habitats on lagoons within the Shotton Steelworks complex outside of the European marine site but within the SPA.

Shingle banks – Since 1989 the little tern colony on a shingle ridge at Gronant has been the sole surviving breeding colony in Wales. The terns nest on a bare sand and shingle ridge above mean high water but below the level of the highest astronomical tide. Prior to moving to the shingle ridge at Gronant in the 1970's the little terns nested on the shingle bank at Point of Ayr where they suffered more frequent tidal inundation

Little terns prefer to nest in an area with little vegetation cover, generally less than 10%, so that they can see approaching predators (Kirby *et al*., 2000). The colony at Gronant has moved over time as the shingle ridges have developed and become vegetated. Active accretion of sand/shingle has meant that new breeding sites have become available as earlier nest sites have become vegetated and unusable. Effective wardening of the dunes at Gronant has increased the success of the tern colony.

9.5 Internationally important populations of regularly occurring migratory bird species

Migratory species that regularly occur at levels of 1% or more of the total biogeographical population meet the SPA criteria and qualify in their own right.

The Dee Estuary SPA supports internationally important numbers of a regularly occurring migratory species on passage:

- redshank *Tringa totanus*

It also supports internationally important numbers of regularly occurring migratory species over winter:

- shelduck *Tadorna tadorna*
- teal *Anas crecca*

- pintail *Anas acuta*
- oystercatcher *Haematopus ostralegus*
- grey plover *Pluvialis squatarola*
- knot *Calidris canutus islandica*
- dunlin *Calidris alpina alpina*
- black-tailed godwit *Limosa limosa islandica*
- curlew *Numenius arquata*
- redshank *Tringa totanus*

9.5.1 Key sub-features for the migratory bird species

Estuary channels (Subtidal sediment communities and the water column) - Pintail make use of the upper estuary channel as a key low water loafing area when they are not feeding on the adjacent saltmarsh or intertidal flats. The main low water loafing area is to be found in the main estuary channel between Oakenholt and Bagillt (C. Wells, RSPB Warden, *pers. comm.*). At certain times nearly the entire Dee Estuary pintail population may utilise this area.

Intertidal mudflats and sandflats - The extensive mudflats and sandflats of the Dee Estuary support rich populations of invertebrate species, which in turn provide an important food source for several species of migratory birds occurring in internationally important numbers. The intertidal flats of the Dee Estuary are among the three the most important areas in the UK for some species of wading birds including oystercatcher, black-tailed godwit, curlew, and redshank (Musgrove *et al*., 2001). These large aggregations of migratory waterbirds are generally highly mobile, feeding and roosting in different areas, depending on food availability and the state of the tide. Within an estuary individual wader species tend to aggregate where their favourite prey species are most common (Prater, 1981). In general, more sheltered areas with relatively high silt content such as Caldy Blacks, support a richer biomass than more exposed areas. The invertebrate community of the Dee Estuary's intertidal mudflats and sandflats includes key wader prey species such as mudsnails *Hydrobia ulvae,* cockles *Cerastoderma edule*, Baltic tellin *Macoma balthica,* polychaete worms such as ragworms *Hediste diversicolor* and lugworms *Arenicola marina* and crustaceans such as the amphipod *Corophium volutator*.

As well as feeding areas the intertidal mudflats and sandflats provide important low tide roosting sites for both wildfowl and waders. In addition the larger sand bars may be used as high water roosting areas on neap tides (Nicholas Pearson Associates, 1993).

Shelduck are dependant upon the rich resources of invertebrates found in the intertidal mudflats. Their common prey species include the mudsnail *Hydrobia* spp, and small crustaceans such as amphipods (Kirby *et al.*, 2000). Shelduck have a particular preference for feeding on areas with very high density of mudsnails in excess of 1,000 snails per square metre (Kirby *et al*., 2000). They are present on the estuary throughout the year but numbers increase rapidly in the autumn with peak counts occurring in October, numbers then decline gradually through the winter until February.

Shelduck feed in groups, on the flats of the mid to outer estuary. At low water the greatest numbers of duck are found feeding on the intertidal flats of Dawpool Bank and Gayton Sands, with peak densities at Caldy Blacks of over 8 birds per hectare in 2001-2002 (Cranswick *et al*., 2005). Other important feeding areas are found on Mostyn Bank to the west. Shelduck also tend to congregate at the same locations over high water, usually spending their time loafing on the water at the saltmarsh edge. The intertidal flats of the Dee Estuary support the third largest wintering population of shelduck of all UK wetlands (Musgrove *et al*., 2001).

In contrast to the wildfowl species most waders feed largely in the outer parts of the estuary at low water, as well as along the North Wirral Foreshore (Waters, *et al*., 1998). They favour areas that have abundant invertebrate prey species and unrestricted views for the early detection of predators.

At low water the most important area for oystercatchers is the area of Caldy Blacks between Caldy and Thurstaston with average densities of over 40 birds per hectare recorded off Thurstaston in 2001-2002 (Cranswick *et al*., 2005). Large numbers of oystercatchers are also recorded at low water on the intertidal flats of Salisbury Bank and Mostyn Bank in the outer estuary, Holywell Bank and Dawpool Bank in the mid estuary, and in the inner estuary along the Welsh shore (Cranswick *et al*., 2005). The intertidal sediments of North Wirral Foreshore are also an important feeding area for the oystercatchers of the Dee Estuary, though this area lies outside of The Dee Estuary SPA. Oystercatcher preferred prey species include cockles and mussels between 15 and 35 mm in length as well as lugworms (Kirby, *et al*., 2000).

Oystercatcher numbers increase substantially in August following the breeding season; peak numbers usually appear in October, there is then a gradual decline through till April (Percival & Percival, 1998). Over 42,500 oystercatchers were recorded on the Dee Estuary in 1981/2 (Wells & Friswell, 2001). However, between 1992/3 and 1999/2000 there was a gradual decline from 34,610 to 12,506. This trend was particularly marked between 1996 and 1999. The species has triggered a 50 % WeBS Alert over the 10-year period prior to 1999/2000 (Armitage, *et al*., 2002.).

At low water the largest concentrations of grey plover occur on North Wirral Foreshore with smaller numbers occurring to the west of Hilbre Island (Cranswick *et al*., 2005). Numbers of grey plover on the estuary begin to increase in the autumn reaching a peak over the winter period. Numbers usually peak in November to January, after which numbers decline as birds move from the estuary to breed. Plovers have the shortest bills of the estuarine waders and feed on a variety of invertebrates on or close to the surface of the sediment (Prater, 1981). Prey species include polychaete worms including ragworms and lugworms, small molluscs and crustaceans (Kirby *et al*., 2000)

The largest concentrations of feeding knot also occur along North Wirral Foreshore at East Hoyle Bank and Mockbeggar Wharf where average bird densities of over 50 birds per hectare were recorded at low water during winter 2001-2002 (Cranswick *et al*., 2005). Knot are also a feature of the Mersey Narrows and North Wirral Foreshore pSPA. Within the estuary very large numbers of knot also feed on the intertidal flats of Dawpool Bank and Caldy Blacks. Knot require an abundance of surface and sub-surface invertebrates including the molluscs: Baltic tellin, mussel spat *Mytilus edulis* and cockle spat, and mud snails (Kirby *et al*., 2000). Numbers of knot normally peak very late in the year or early in the next. Knot abundance tends to fluctuate widely, for example during the 1990’s the maximum number recorded in

1988-1999 was only 6,675 where as in 1996-1997 the maximum count was 58,376 (Wells & Friswell, 2000). In the past one of their principle roosts within the estuary was on the foreshore at West Kirby. Disturbance of this roost due to recreational activities and possibly the extension of the marine lake has seen birds flighting from their low tide feeding areas within the Dee Estuary to the Alt Estuary over the high tide period. Higher counts at low water than high water suggest this continues to be the case (Wells & Friswell, 2001).

The very highest densities of dunlin are to be found along North Wirral Foreshore, though large numbers also feed at the mouth of the estuary, and on Dawpool Bank and in the mid estuary. Dunlin feed on a variety of surface and subsurface invertebrates present on the intertidal flats including ragworms, Baltic tellins, mud snails, brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al.*, 2000). Dunlin show a similar pattern to knot and grey plover increasing gradually from September to a mid winter peak in December and January and a gradual decline through to April.

At low water feeding black-tailed godwit concentrate in areas just of Heswall and Caldy in the mid estuary, and off Flint and Bagillt in the upper estuary (Cranswick *et al*., 2005). Black-tailed godwit winter on the estuary in numbers of international importance and remain in numbers of national importance throughout the rest of the year. This indicates that non-breeding and immature birds are present throughout. The Dee Estuary is now the third most important site in UK for wintering black-tailed godwit (Musgrove *et al*., 2001) and numbers are increasing (Wells & Friswell, 2004). The birds wintering on the estuary are from the Icelandic breeding population, which has been wintering in the British Isles in increasing numbers over the last forty years. Black-tailed godwit feed on molluscs including tellins, cockles and polychaete worms including ragworms (Kirby *et al.*, 2000). Peak over wintering numbers can occur in any month throughout the October to March period and numbers tend to remain at internationally important levels throughout the winter.

Curlew feed across the inner and middle estuary, densities are very low in the outer estuary with the exception of Mostyn Bank. Their favoured prey species include shore crab and ragworms (Kirby *et al*., 2000). Curlew occur in the estuary throughout the year, their numbers increase rapidly in July post-breeding when adult birds return to the coast to moult, reaching a peak in the autumn, frequently in October. From January onwards populations tend to become smaller as birds disperse to return to their breeding grounds.

At low water dunlin, redshank and curlew are much more evenly distributed across the estuary than other wader species. Redshank feed right across the estuary, though the shores at Heswall, Flint, Dawpool Bank and Mockbeggar Wharf are of most importance. Interestingly, the very highest densities of redshank are found on the mudflats within the two redundant flushing lagoons at Point of Ayr and Bagillt (Cranswick *et al*., 2005). Their preferred prey species include the amphipod crustaceans *Corophium* spp., mud snails, Baltic tellins and ragworms (Kirby *et al*, 2000). Redshank numbers peak on the estuary between August and October, though substantial numbers also stay throughout the winter (Percival & Percival, 1998).

Saltmarsh Communities – The Dee Estuary supports about 7% of the total area of saltmarsh in the UK and contains what is probably the third largest single expanse of saltmarsh in Britain found between Heswall and Shotton (CCW, 2002; Dargie, 2001). The majority of the Dee saltmarsh has traditionally been grazed by stock at differing intensities, though the newer areas of marsh remain ungrazed. This management is designed to cater for the needs of internationally important regularly occurring migratory species both grazing wildfowl and roosting waders as well as regionally important breeding populations of redshank and skylark.

The Dee Estuary saltmarshes provide a rich feeding habitat for several species of migratory wildfowl and waders. Wildfowl species feed on a variety of soft leaved and seed bearing saltmarsh plants, as well as many invertebrate species in particular those of the saltmarsh creeks. Wading birds also feed on invertebrates associated with the saltmarsh vegetation as well as those present in the sediments of the pioneer marsh communities, creeks, pans and flashes, such as the mudsnail *Hydrobia ulvae*. The lower edge of the saltmarsh is a valuable feeding area for many species, especially where the larger creeks flow out across the mudflats.

At low water teal are found on the upper saltmarsh off Neston and Parkgate, as well as off Oakenholt and Flint (Cranswick *et al*., 2005). They are again found in similar areas at high-water (Percival & Percival, 1998). Large flocks of teal are attracted to flashes in the grazed upper marsh (Wells & Gouldstone, 1999). Numbers of teal wintering on the estuary increase gradually between August and December, then declining from January to March (Percival & Percival, 1998). Teal feed on seed-bearing saltmarsh plants including glasswort and sea purslane (Kirby *et al*., 2000).

The Dee Estuary is the most important site for wintering pintail in the UK (Wells & Friswell, 2002). The nearby Mersey Estuary is also an important site and birds are known to fly between the two estuaries. Pintail generally feed in shallow water close to the waters edge preferring the pioneer saltmarsh zone along the lower edge of the saltmarsh (Percival and Percival, 1998). As the tide comes in they move up the marsh with the advancing water being found on the mid to upper saltmarsh of Parkgate and Neston at high tide (Percival & Percival, 1998). Pintail feed on a variety of soft leaved saltmarsh plants as well as surface and near surface invertebrates in the low and pioneer saltmarsh, mud snails are among their preferred prey species (Kirby, *et al*., 2000). Pintail are virtually absent from the estuary during summer, their numbers increase rapidly following their arrival in September to a peak in October, numbers than remain high through to December decreasing in January and February (Percival & Percival, 1998).

According to Buxton (1978 In: Nicholas Pearson Associates, 1993), the majority of wintering Shelduck in the estuary tend not to roost over high water, but continue feeding along the saltmarsh between Neston and Heswall at the water's edge.

The saltmarshes have an important function providing a safe haven from the tides that flood the mudflats twice a day. Areas of low-growing vegetation less than 10 cm in height provide a suitable roosting habitat for many waders, which prefer to roost on areas of short vegetation ensuring good visibility (Kirby *et al*., 2000). The saltmarshes throughout the estuary provide an important communal roosting site for oystercatcher, grey plover, knot, dunlin, black-tailed godwit, curlew and redshank. In particular a series of wader roosting areas occur on the mid to upper saltmarsh in the inner estuary.

During spring tides important high tide roosts of oystercatcher occur on the saltmarsh at West Kirby, Gayton Sands, Burton Marsh and Oakenholt (Percival & Percival, 1998). Important roosts of knot, dunlin and grey plover also occur on the upper marsh in the inner estuary on Gayton Sands, Burton Marsh and Oakenholt (Wells & Gouldstone, 1999).

Wintering black-tailed godwit principally use a roost site at Oakenholt Marsh although flocks are occasionally found on the Wirral shoreline. They also make use of the RSPB reserve at Inner Marsh Farm outside the European marine site

Both curlew and redshank also roost in the upper marsh and have important roosts in the marsh off Heswall and further east, with birds being forced onto Burton Marsh on the highest tides (Nicholas Pearson Associates, 1993; Percival & Percival, 1998).

Ungrazed saltmarsh at Point of Ayr forms an important roost site for dunlin, curlew and redshank (Wells & Gouldstone, 1999).

***Shingle banks* -** Banks of shingle occur on the upper shore at Gronant and at Point of Ayr. The shingle spit at Point of Ayr is the largest single oystercatcher roost within the estuary (Percival & Percival, 1998). Other qualifying migratory species that make regular use of these areas as high tide roosts are dunlin and knot.

***Rocky shore* -** Areas of rocky shore on Hilbre Island and Little Eye provide important roosts for several species of wader including oystercatcher (Percival & Percival, 1998).

9.5.2 Internationally important assemblage of waterbirds

The Dee Estuary is one of the key estuaries in the UK for wintering waterbirds. In addition to supporting internationally important species populations, it also qualifies for its wintering waterbird assemblage, since it regularly supports over 20,000 birds (Musgrove *et al.*, 2001). The wintering waterbird assemblage, consisting of over 120,000 birds, includes all regularly occurring waterbirds. It is numerically dominated by wader species with over 84,000 waders regularly occurring compared to only about 26,000 wildfowl (C. Hall, Wildfowl and Wetlands Trust, *pers comm*.). Species present in nationally important numbers or species whose populations exceed 2,000 individuals between 1994/5 and 1998/9 include:

Great crested grebe *Podiceps cristatus*, cormorant *Phalacrocorax carbo*, shelduck, wigeon *Anas penelope*, teal, pintail, oystercatcher, grey plover, lapwing *Vanellus vanellus*, knot, sanderling *Calidris alba*, dunlin, black-tailed godwit, bar-tailed godwit, curlew and redshank.

9.5.3 Key sub-features for the waterbird assemblage

Since a number of species comprising the waterbird assemblage are qualifying species in their own right, their habitat requirements are described in Sections 9.4 and 9.5 above. This section therefore mainly deals with the habitat requirements of the non-qualifying species which form part of the waterbird assemblage.

Estuary Channels (Subtidal sediment communities and the water column) Wigeon winter on the Dee Estuary in numbers of national importance. Like pintail, wigeon also make use of the upper estuary channel between Oakenholt and Bagillt as a key low water loafing area (C. Wells, RSPB Warden, *pers. comm*.).

The Dee Estuary SPA supports nationally important numbers of both cormorant, and great crested grebe. Cormorants occur throughout the year with peaks in June and September, numbers of great crested grebes are highest in the autumn when birds moult on the estuary (Percival & Percival, 1998). Grebes in particular occur in the estuary channel at low water with the majority of birds to be found off Greenfield (Cranswick *et al*., 2005). Cormorants and grebes feed on a variety of small fish of less than 21 and 25 cm in length respectively (Kirby *et al*, 2000). The subtidal channels act as a refuge for small fish species at low water. In the years up to 2004, great crested grebe numbers have fallen dramatically while cormorants have increased. Relatively small numbers of fish eating ducks including goldeneye *Bucephala clangula*, and red-breasted merganser *Margus serrator* are also regularly recorded in the estuary. Scaup *Aythya marila* also occur in the outer channels.

Common scoter *Melanitta nigra* have been observed in significant numbers just outside the boundary of the SPA in the area of the dredged channel off Gronant with a maximum of 4,000 observed during low water counts in 2001-2002 (C. Wells, RSPB Warden, *pers. comm*.; Cranswick *et al*., 2005).

Intertidal mudflats and sandflats - The Dee Estuary supports large populations of birds, including over 120,000 wintering waterbirds. The majority of the wintering waterbird assemblage is composed of wading birds from species of international importance, and the dependence of these birds upon the invertebrate communities of the intertidal mudflats and sandflats is described in detail earlier in this document (see Section 9.5.1). However a variety of other waterbirds regularly winter on the Dee Estuary in variable numbers and like the internationally important migratory species these birds are also generally dependent upon the intertidal invertebrate communities. Other species of waders contributing to the wintering waterbird assemblage include ringed plover *Charadrius hiaticula*, golden plover *Pluvialis apricaria*, lapwing, and sanderling.

Ringed plover winter on the estuary in small numbers with a five year peak mean of 177 individuals between 1994/5 and 1998/9 (C. Hall, Wildfowl and Wetlands Trust, *pers. comm*.). They favour the intertidal flats at the mouth of the estuary on Mostyn Bank, and to west of Hilbre Island. Higher concentrations are found outside the Dee Estuary SPA on North Wirral Foreshore (Cranswick *et al*., 2005). Much higher numbers of ringed plover occur during the autumn passage period in August than winter on the estuary; in recent years passage number have exceed the criterion for national importance (Wells & Friswell, 2004).

With a 5 year mean peak count of approximately 8,000 birds, lapwing are the most numerous species wintering on the estuary not attaining sufficient numbers to meet the criteria for international importance, (Wells & Friswell, 2002). Lapwing make use of a variety of habitats across the estuary including the intertidal flats, saltmarsh and coastal fields. At low water an average of over 1,000 lapwings concentrate off Leasowe Lighthouse on North Wirral Foreshore outside the Dee Estuary SPA, smaller numbers are to be found within the estuary on Dawpool Bank (Cranswick *et al*., 2005).

Sanderling also favour the outer estuary with nationally important numbers feeding on the foreshore between Gronant and Talacre (Wells & Friswell, 2003); though larger numbers may occur on North Wirral Foreshore (Cranswick *et al*., 2005).

At low water cormorants roost on the intertidal flats with the main aggregations occurring at Gronant, where numbers of national importance have been recorded, and in the inner estuary at Oakenholt (Bolas & Day, 1998; Cranswick *et al*., 2005).

Saltmarsh Communities - Large areas of saltmarsh occur throughout the Dee Estuary, providing important feeding and roosting habitats for many of the wildfowl and waders. In addition to the internationally important migratory species, pintail and teal, the saltmarsh of the Dee Estuary also supports substantial numbers of other wildfowl including nationally important numbers of wigeon.

Wigeon particularly favour the saltmarsh of the inner estuary off Parkgate, Neston, Oakenholt and Flint (Cranswick *et al*., 2005). They feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

Mallard *Anas platyrhynchos* also overwinter on the estuary in substantial, though less than nationally significant numbers, feeding on the saltmarsh and their numbers have dropped dramatically in the two years up to 2004. Mallard exhibit a very similar distribution to teal with highest numbers recorded off Parkgate at low water (Cranswick *et al*., 2005). They feed on seed-bearing plants present on the saltmarsh including glasswort, sea purslane *Atriplex portulacoides* and annual sea-blite *Suaeda maritima*; they also feed on invertebrates present on the sediment of the lower marsh including mudsnails (Kirby *et al*., 2000).

As described in detail for the migratory species of international importance, the upper saltmarsh provides a series of roosting sites used by a variety of wader species. The saltmarsh also provides important feeding areas for several species of waders. Large numbers of lapwing are found on Burton Marsh and the saltmarsh at Oakenholt at low water (Cranswick *et al*., 2005). In addition snipe *Gallinago gallinago* overwinter on the saltmarsh within the Dee Estuary with Parkgate Marsh holding the major proportion of the estuary population. Counts are believed to be under-estimates of the true total however an average of 277 snipe were recorded over four low water WeBS counts in 2001-2002 (Wells & Friswell, 2002).

The saltmarsh provides a safe haven for the feeding waders and wildfowl from the tides that flood the mudflats twice a day, the extensive areas of marsh in the mid to upper estuary are especially important in this respect. Areas of upper saltmarsh make ideal high-water roost sites, although the actual levels of usage are affected by the degree of disturbance the birds experience. Waders in particular also require areas of very short vegetation to afford unrestricted views for the early detection of predators.

***Shingle banks* -** Banks of shingle occur on the upper shore at Gronant and at Point of Ayr. These shingle features are of particular importance for roosting sanderling in addition to the qualifying species (Bolas & Day, 1998). Other waders roosting in these areas at high tide include ringed plover (Gouldstone, 1994).

***Rocky shore communities* -** Although not a qualifying as regularly occurring migratory species in their own right turnstone *Arenaria interpres* occur in substantial numbers within the Dee Estuary SPA. They feed on areas of rocky shore including both the natural rocky shore communities to be found around Hilbre Island and on areas of cobbles, small boulders and artificial hard substrates found along the Welsh shore. Turnstone also roost on the upper shore in these areas, in particular on Hilbre Island and on the shore close to Warwick Chemicals at Mostyn. Turnstone are a feature of the adjacent Mersey Narrows and North Wirral Foreshore pSPA. Purple sandpiper *Calidris maritima* is another regularly occurring species in the Dee Estuary that is dependant upon areas of rocky shore habitat feeding and roosting on the rocky shore at Hilbre Island (Nicholas Pearson Associates, 1993). Both turnstone and purple sandpiper feed on a variety of invertebrates amongst rotting algae including mussels, periwinkles *Littorina* spp., whelks *Nucella* spp and kelp-fly larvae (Kirby *et al*., 2000).

In recent years small numbers of light-bellied brent geese *Branta bernicla bernicla* have over-wintered on the Dee Estuary, they feed on green alga in the area of Hilbre Island (Wells & Friswell, 2002).

Table 5. Information on populations of bird species qualifying under the Birds Directive using the Dee Estuary SPA at the time the SPA citation was compiled

Internationally important populations of regularly occurring Annex I species.

Species	Population (5 yr peak mean)[20]	Importance	Period
Bar-tailed Godwit *Limosa lapponica*	1,150 individuals - wintering	2.2 % of GB population	1994/5-1998/9
Common Tern *Sterna hirundo*	392 pairs – breeding (Five year mean)	3.2 % of GB population	1995-1999
Little Tern *Sterna albifrons*	69 pairs – breeding (Five year mean)	2.9 % of GB population	1994-1998
Sandwich Tern *Sterna sandvicensis*	957 individuals – autumn passage	2.3 % of GB population	1995-1999

Internationally important populations of regularly occurring migratory bird species[21]

Species	Population (5 yr peak mean)[20]	Importance	Period
Redshank *Tringa totanus*	8,795 individuals - passage	5.9 % Eastern Atlantic	1994/5 – 1998/9
Shelduck *Tadorna tadorna*	7,725 individuals - wintering	2.6 % North-western Europe	1994/5 – 1998/9
Teal *Anas crecca*	5,251 individuals – wintering	1.3 % North-western Europe	1994/5 – 1998/9
Pintail *Anas acuta*	5,407 individuals – wintering	9.0 % North-western Europe	1994/5 – 1998/9
Oystercatcher *Haematopus ostralegus*	22,677 individuals – wintering	2.5 % Europe & North-western Africa (wintering)	1994/5 – 1998/9
Grey plover *Pluvialis squatarola*	1,643 individuals - wintering	1.1 % Eastern Atlantic	1994/5 – 1998/9
Knot *Calidris canutus islandica*	12,394 individuals - wintering	3.5 % North-eastern Canada / Greenland / Iceland / North-western Europe	1994/5 – 1998/9
Dunlin *Calidris alpina alpina*	27,769 individuals - wintering	2.0 % Northern Siberia / Europe / West Africa	1994/5 – 1998/9
Black-tailed Godwit *Limosa limosa islandica*	1,747 individuals - wintering	2.5 % Iceland (breeding)	1994/5 – 1998/9
Curlew *Numenius arquata*	3,899 individuals - wintering	1.1 % Europe (breeding)	1994/5 – 1998/9
Redshank *Tringa totanus*	5,293 individuals - wintering	3.5 % Eastern Atlantic (wintering)	1994/5 – 1998/9

[20] SPA citation (December 2000).
[21] The Dee Estuary is regularly used by 1% or more of the biogeographical population of a regularly occurring species (other than those listed on Annex I) in any season (Cranswick *et al.*, 1995).

Internationally important numbers of waterbirds

Importance	Population (5 yr peak mean)[20]	Season	Period
The Dee Estuary regularly supports over 20,000 waterbirds	120,726 individuals	Wintering	1994/5 – 1998/9

Nationally important bird populations within the internationally important assemblage of waterbirds

Species	Population (5 yr peak mean)[20]	Importance	Period
Great crested grebe* *Podiceps cristatus*	195 individuals	2.0 % of GB population	1994/5 – 1998/9
Cormorant *Phalacrocorax carbo*	393 individuals	3.0 % of GB population	1994/5 – 1998/9
Sanderling *Calidris alba*	526 individuals	2.3 % of GB population	1994/5 – 1998/9
Wigeon *Anas penelope*	4526 individuals	1.6. % of GB population	1994/5 – 1998/9

* Based on low water WeBS counts

10. The Dee Estuary SPA conservation objectives

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, Natural England and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for the European marine site.

The conservation objectives for The Dee Estuary SPA interest features are provided below and should be read in conjunction with other advice given in this document, particularly:

- the maps in Appendix V showing the extent of the supporting habitats;
- the description in Section 9 of the features and their importance;
- the favourable condition table in Section 11.

The protection and management of the SPA in accordance with Article 4 of the Birds Directive and Article 6 of the Habitats Directive, including in particular the consideration of plans and projects under Article 6(3) and 6(4) of the Habitats Directive, should be carried out in view of these conservation objectives.

These conservation objectives are subject to review by Natural England and the Countryside Council for Wales.

10.1 Interest feature 1: Conservation objective for the internationally important population of the regularly occurring Annex I species: wintering bar-tailed godwit

The conservation objective for the "wintering bar-tailed godwit" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering bar-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering bar-tailed godwit population is no less than 1,150 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent and spatial distribution[3] of vegetation less than 10cm in height across the saltmarsh[5] is maintained;

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[6] and feeding areas;

v. aggregations of bar-tailed godwit roosting[6] or feeding or on the intertidal flats or saltmarsh[4] are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 1**.

NB. Other conservation objectives are to be produced relating to the use of North Wirral Foreshore by bar-tailed godwit because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts The Dee Estuary SPA and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore includes the key feeding areas for the Dee Estuary bar-tailed godwit population and therefore the Dee Estuary wintering bar-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA bar-tailed godwit feature are also met in full.

Box 1: Explanatory information for the “wintering bar-tailed godwit” conservation objective

[1] **Natural processes**:

Each interest feature is subject to both natural processes and human influences. Human influence on the interest features is acceptable provided that it is compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions which is entirely a result of natural processes will not constitute unfavourable condition, but will trigger a review of the definition of favourable condition. This qualification is necessary because:

(a) the bird populations themselves are subject to natural factors, many of which arise outside the SPA, such as breeding success and winter temperatures;

(b) the supporting habitats of the birds are influenced by the evolution of the estuary. Natural adjustments within estuaries can take many forms. One important example is the tendency of estuaries to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by subtidal and intertidal sediment banks or features. This, with other natural processes, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or ‘most probable state’. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. However, where this process is constrained, the capacity of habitats to accommodate readjustment may be affected.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V

[6] **Bar-tailed godwit roosting areas**:

Roosting sites regularly used by bar-tailed godwit are shown in Appendix VI

10.2 Interest feature 2: Conservation objective for the internationally important population of the regularly occurring Annex I species: breeding common tern

The conservation objective for the "breeding common tern" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**breeding common tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean population size for the breeding common tern population is no less than 392 breeding pairs [*i.e. the 5 year mean between 1995-1999*];

ii. the five year mean productivity of the breeding common tern population is no less than 1.34 chicks fledging per breeding pair per year [*i.e. the 5 year mean between 1995-1999*];

iii. the abundance of common tern prey species[2] within the estuary is maintained;

iv. common terns are able to pass freely between the Dee Estuary and their breeding site at Shotton Lagoons and Reedbeds without obstruction;

v. aggregations of common terns roosting[3] on the upper shore over high tide are not subject to significant disturbance;

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 2.**

NB. Additional conservation objectives are provided relating to the use by common terns of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the artificial islands used by the breeding colony at Shotton Lagoons and Reedbeds SSSI. Thus The Dee Estuary SPA breeding common tern feature can only be in favourable condition if the conservation objectives pertaining to their use of Shotton Lagoons and Reedbeds SSSI are also met. These objectives (*a-b*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the size of the breeding colony is not limited by availability of space on artificial nesting platforms;
b) breeding birds are not subject to significant disturbance.

Box 2: Explanatory information for the "breeding common tern" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Common tern prey species**:

Common tern prey species include sand eel and sprat (Kirby *et al*., 2000).

[3] **Common tern roosting areas**:

Areas frequently used by roosting common terns are shown in Appendix VII

10.3 Interest feature 3: Conservation objective for the internationally important population of the regularly occurring Annex I species: breeding little tern

The conservation objective for the "breeding little tern" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**breeding little tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean population size for the breeding little tern population is no less than 69 breeding pairs [*i.e. the 5 year mean between 1995-1999*];

ii. the five year mean productivity of the breeding little tern population is no less than 0.80 chicks fledging per breeding pair per year [*i.e. the 5 year mean between 1995-1999*];

iii. the breeding site[2] is not subject to significant disturbance;

iv. the extent of shingle habitat[3] at Gronant, which is suitable for nesting little terns is maintained;

v. aggregations of little terns roosting on the beach at Gronant or Point of Ayr over high tide are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-3] above is provided in **Box 3**.

Box 3: Explanatory information for the "breeding little tern" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Little tern breeding site**:

The location of the little tern breeding site is shown in Appendix VII.

[3] **Little tern nesting habitat**:

Little terns require shingle banks with vegetation cover of less than 10%, which are high enough on the shore to avoid regular inundation (Bolas & Day, 1998; Kirby *et al*. 2000).

10.4 Interest feature 4: Conservation objective for the internationally important population of the regularly occurring Annex I species: passage Sandwich tern

The conservation objective for the "passage Sandwich tern" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**passage Sandwich tern**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year mean peak population size for the autumn passage sandwich tern population is no less than 957 individuals [*i.e. the 5 year mean peak between 1995-1999*];

ii. aggregations of Sandwich terns roosting[2] on the upper shore over high tide are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-2] above is provided in **Box 4**.

Box 4: Explanatory information for the "passage Sandwich tern" conservation objective
[1] **Natural processes:**
The meaning of 'natural processes' is explained in **Box 1**.
[2] **Sandwich tern roosting areas**:
Areas frequently used by roosting Sandwich terns are shown in Appendix VII

10.5 Interest feature 5: Conservation objective for the internationally important population of the regularly occurring migratory species: passage redshank

The conservation objective for the "passage redshank" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**passage redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met**:**

i. the 5 year peak mean population size for the passage redshank population is no less than 8,795 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 5**.

NB. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding. Thus The Dee Estuary SPA passage redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a*-*f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank roosting or feeding on the coastal fields are not subject to significant disturbance.

Box 5: Explanatory information for the "passage redshank" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types**[4]** is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Redshank prey species**:

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas**:

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas**:

Feeding areas regularly used by redshank are shown in Appendix VI.

10.6 Interest feature 6: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering shelduck

The conservation objective for the "wintering shelduck" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering shelduck**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering shelduck population is no less than 7,725 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of shelduck prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

v. aggregations of loafing[7] or feeding[8] shelduck are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 6**.

Box 6: Explanatory information for the "wintering shelduck" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Shelduck prey species**:

Shelduck prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al,* 2000).

[7] **Shelduck loafing areas**:

Loafing areas regularly used by shelduck are shown in Appendix VIII.

[8] **Shelduck feeding areas**:

Feeding areas regularly used by shelduck are shown in Appendix VIII

10. 7 Interest feature 7: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering teal

The conservation objective for the "wintering teal" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering teal**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering teal population is no less than 5,251 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. greater than 25% cover of seed bearing plants[7] is maintained during winter across the saltmarsh;

v. the extent of standing water pools or 'flashes' in the saltmarsh is maintained;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[8] and feeding areas[9];

vii. aggregations of loafing[8] or feeding[9] teal are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-9] above is provided in **Box 7.**

NB. Additional conservation objectives are provided relating to the use by teal of areas of the Dee Estuary SPA above highest astronomical tide, which are outside The Dee Estuary European marine site. These areas include the coastal fields and pools along the Welsh shore within the Dee Estuary SSSI and at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus The Dee Estuary SPA wintering teal feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of teal loafing or feeding on pools and coastal fields are not subject to significant disturbance.

Box 7: Explanatory information for the "wintering teal" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution:**

Saltmarsh extent and distribution is shown in Appendix V.

[6] **Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

[7] **Seed bearing plants:**

Teal feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

[8] **Teal loafing areas:**

Loafing areas regularly used by teal are shown in Appendix VIII.

[9] **Teal feeding areas**:

Feeding areas regularly used by teal are shown in Appendix VIII.

10.8 Interest feature 8: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering pintail

The conservation objective for the "wintering pintail" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering pintail**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering pintail population is no less than 5,407 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. the abundance and dispersion[7] of pintail prey species[8] is maintained at levels required to support the population size in (i);

v. greater than 25% cover of soft leaved herbs and grasses[9] is maintained during winter across the saltmarsh;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around loafing areas[10], and feeding areas[11];

vii. aggregations of loafing[10] or feeding[11] pintail are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-11] above is provided in **Box 8.**

NB. Additional conservation objectives are provided relating to the use by pintail of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus The Dee Estuary SPA wintering pintail feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of The Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of pintail loafing or feeding on pools and coastal fields are not subject to significant disturbance.

Box 8: Explanatory information for the "wintering pintail" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V.

[6] **Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

[7] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[8] **Pintail prey species**:

Pintail feed on surface and near surface invertebrates including mudsnails *Hydrobia* spp. (Kirby *et al*., 2000).

[9] **Soft leaved herbs and grasses**:

Pintail feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

[10] **Pintail loafing areas:**

Low water loafing areas regularly used by pintail are shown in Appendix VIII

[11] **Pintail feeding areas:**

Feeding areas regularly used by pintail are shown in Appendix VIII.

10.9 Interest feature 9: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering oystercatcher

The conservation objective for the "wintering oystercatcher" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering oystercatcher**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering oystercatcher population is no less than 22,677 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of oystercatcher prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. the extent of rocky shore[7] at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is maintained;

vi. the extent and height of the shingle spit[8] at Point of Ayr is maintained;

vii. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[9] and feeding areas[10];

viii. aggregations of roosting[9] or feeding[10]oystercatcher are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-10] above is provided in **Box 9.**

NB. Additional conservation objectives are provided relating to the use by oystercatcher of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by oystercatcher for feeding and roosting. Thus The Dee Estuary SPA wintering oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of The Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of oystercatcher prey species including earthworms and leatherjackets is maintained;

e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;

f) aggregations of oystercatcher roosting or feeding on the coastal fields are not subject to significant disturbance.

Oystercatcher are known to use North Wirral Foreshore SSSI in numbers of significance. North Wirral Foreshore SSSI directly abuts The Dee Estuary SPA and forms part of the area of both the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary oystercatcher population and therefore the condition of North Wirral Foreshore SSSI is important in maintaining the overall wintering oystercatcher population in the wider estuary.

Box 9: Explanatory information for the "wintering oystercatcher" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Oystercatcher prey species:**

Oystercatcher prey species include cockles *Cerastoderma edule* and mussels *Mytilus edulis* between 15 and 35 mm in length as well as lugworms *Arenicola marina* (Kirby *et al*, 2000).

[7] **Rocky shore extent:**

Rocky shore extent at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is shown in Appendix V.

[8] **Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

[9] **Oystercatcher roosting areas:**

Roosting sites regularly used by oystercatcher are shown in Appendix VI.

[10] **Oystercatcher feeding areas:**

Feeding areas regularly used by oystercatcher are shown in Appendix VI.

10.10 Interest feature 10: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering grey plover

The conservation objective for the "wintering grey plover" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering grey plover**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering grey plover population is no less than 1,643 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of grey plover prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution of saltmarsh vegetation less than 10 cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] grey plover are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 10.**

NB. Grey plover are known to use North Wirral Foreshore SSSI in numbers of national significance. North Wirral Foreshore SSSI directly abuts The Dee Estuary SPA and forms part of the area of both the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary wintering grey plover population and therefore the condition of North Wirral Foreshore SSSI is important in maintaining the overall wintering grey plover population in the wider estuary.

Box 10: Explanatory information for the "wintering grey plover" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types**[4]** is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Grey plover prey species**:

Grey plover prey species include polychaete worms, small molluscs and crustaceans (Kirby *et al*., 2000)

[7] **Grey plover roosting areas:**

Roosting sites regularly used by grey plover are shown in Appendix VI.

[8] **Grey plover feeding areas:**

Feeding areas regularly used by grey plover are shown in Appendix VI.

10.11 Interest feature 11: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering knot

The conservation objective for the "wintering knot" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering knot**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering knot population is no less than 12,394 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of knot prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] knot are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 11.**

NB. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore by knot because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site, which directly abuts The Dee Estuary SPA and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary knot population and therefore the Dee Estuary wintering knot feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site wintering knot feature are also met in full.

Box 11: Explanatory information for the "wintering knot" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Knot prey species:**

Knot prey species include the small molluscs, Baltic tellin *Macoma balthica*, mussel spat *Mytilus edulis* and cockle spat *Cerastoderma edule*, and mud snails *Hydrobia* spp. (Kirby *et al*., 2000).

[7] **Knot roosting areas:**

Roosting sites regularly used by knot are shown in Appendix VI.

[8] **Knot feeding areas:**

Feeding areas regularly used by knot are shown in Appendix VI.

10.12 Interest feature 12: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering dunlin

The conservation objective for the "wintering dunlin" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering dunlin**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering dunlin population is no less than 27,769 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of dunlin prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] dunlin are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 12**.

NB. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by dunlin because they are a feature of this SSSI, which directly abuts The Dee Estuary SPA and forms part of both the area of the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary wintering dunlin population and therefore the Dee Estuary wintering dunlin feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI dunlin feature are also met in full.

Box 12: Explanatory information for the "wintering dunlin" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types**[4]** is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Dunlin prey species:**

Dunlin prey species include ragworms *Hediste diversicolor*, Baltic tellin *Macoma balthica*, mud snails *Hydrobia* spp., brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al*., 2000).

[7] **Dunlin roosting areas**:

Roosting sites regularly used by dunlin are shown in Appendix VI

[8] **Dunlin feeding areas:**

Feeding areas regularly used by dunlin are shown in Appendix VI.

10.13 Interest feature 13: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering black-tailed godwit

The conservation objective for the "wintering black-tailed godwit" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering black-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering black-tailed godwit population is no less than 1,747 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of black-tailed godwit prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] and feeding[8] black-tailed godwit are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 13.**

NB. Additional conservation objectives are provided relating to the use by black-tailed godwit of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by black-tailed godwit for feeding and roosting. Thus The Dee Estuary SPA wintering black-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of The Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of black-tailed godwit prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;

f) aggregations of black-tailed godwit feeding or roosting on the coastal fields are not subject to significant disturbance.

Box 13: Explanatory information for the "wintering black-tailed godwit" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Black-tailed godwit prey species:**

Black-tailed godwit prey species include Baltic tellins *Macoma balthica*, cockles *Cerastoderma edule* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Black-tailed godwit roosting areas:**

Roosting sites regularly used by black-tailed godwit are shown in Appendix VI.

[8] **Black-tailed godwit feeding areas:**

Feeding areas regularly used by black-tailed godwit are shown in Appendix VI.

10.14 Interest feature 14: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering curlew

The conservation objective for the "wintering curlew" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering curlew**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering curlew population is no less than 3,899 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of curlew prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] curlew are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 14.**

NB. Additional conservation objectives are provided relating to the use by curlew of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI used for feeding and roosting. Thus The Dee Estuary SPA wintering curlew feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a*-*f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of curlew prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of curlew feeding or roosting on the coastal fields are not subject to significant disturbance.

Box 14: Explanatory information for the "wintering curlew" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1.**

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types**[4]** is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Curlew prey species:**

Curlew prey species include shore crab *Carcinus maenas* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Curlew roosting areas:**

Roosting sites regularly used by curlew are shown in Appendix VI.

[8] **Curlew feeding areas:**

Feeding areas regularly used by curlew are shown in Appendix VI.

10.15 Interest feature 15: Conservation objective for the internationally important population of the regularly occurring migratory species: wintering redshank

The conservation objective for the "wintering redshank" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering redshank population is no less than 5,293 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10 cm is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 15.**

NB. Additional conservation objectives are provided relating to the use by redshank of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding and roosting. Thus The Dee Estuary SPA wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank feeding or roosting on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by redshank because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site, which directly abuts The Dee Estuary SPA and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore includes some of the key feeding areas for the Dee Estuary redshank population and therefore the Dee Estuary wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site wintering redshank feature are also met in full.

Box 15: Explanatory information for the "wintering redshank" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Redshank prey species:**

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas:**

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas:**

Feeding sites regularly used by redshank are shown in Appendix VI.

10.16 Interest feature 16: Conservation objective for the internationally important assemblage of regularly occurring waterbirds

The conservation objective for the "internationally important assemblage of regularly occurring waterbirds" feature of The Dee Estuary SPA is to maintain the feature in a favourable condition, as defined below:

The interest feature "**internationally important assemblage of regularly occurring waterbirds**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering waterbird assemblage is no less than 120,726 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the relative proportions[2] of waders and wildfowl comprising the wintering waterbird assemblage is maintained;

iii. the extent of intertidal flats[3] and the spatial distribution[4] of their constituent sediment community types[5] is maintained;

iv. the extent of saltmarsh[6] and the spatial distribution[4] of its constituent vegetation community types[7] is maintained;

v. the extent and spatial distribution[4] of saltmarsh vegetation less than 10 cm in height is maintained;

vi. the extent of rocky shore[8] at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is maintained;

vii. the extent and height of the shingle spit[9] at Point of Ayr is maintained;

viii. the abundance of waterbird prey species[10] are maintained at levels sufficient to support the population size in (i);

ix. greater than 25% cover of both seed bearing plants[11] and soft leaved herbs and grasses[12] is maintained during winter across the saltmarsh;

x. existing unrestricted bird sightlines of at least 200m are maintained in every direction around roosting sites[13], loafing[14]and feeding areas[15];

xi. aggregations of roosting[13], loafing[14] or feeding[15] waterbirds are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-15] above is provided in **Box 16.**

NB. Additional conservation objectives are provided relating to the use by waterbirds of areas of The Dee Estuary SPA above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, at Shotton Lagoons and Reedbeds SSSI and at Inner Marsh Farm SSSI, used by waterbirds for feeding, roosting and loafing. Thus The Dee Estuary SPA internationally important assemblage of regularly occurring waterbirds feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of The Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of waterbird prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of waterbirds roosting, loafing or feeding on the coastal fields are not subject to significant disturbance.

Box 16: Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Relative proportions of waders wildfowl and other waterbirds**

Waders currently make up about 70% of the of the wintering waterbird assemblage, wildfowl comprise about 22% and other waterfowl the remaining 8%.

[3] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[5] is shown in Appendices V and IV respectively.

[4] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[5] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[6] **Saltmarsh extent and spatial distribution:**

Saltmarsh extent and spatial distribution of community types is shown in Appendices V and IV respectively.

[7] **Saltmarsh vegetation community types:**

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

[8] **Rocky shore extent**:

Rocky shore extent and distribution is shown in Appendix V.

[9] **Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

[10] **Waterbirds prey species:**

Prey species favoured by the waterbirds of the Dee Estuary include the following:

Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*,
Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis*, cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*;
Crustaceans: amphipods *Corophium* spp., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*;

[11] **Seed bearing plants**:

Wildfowl feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

[12] **Soft leaved herbs and grasses**:

Wildfowl feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

[13] **Waterbird roosting areas:**

Roosting sites regularly used by waders, and other waterbirds are shown in Appendices VI and VIII

[14] **Waterbird loafing areas:**

Loafing areas regularly used by wildfowl are shown in Appendices VIII.

[15] **Waterbird feeding areas:**

Feeding areas regularly used by waders, wildfowl and other waterbirds are shown in Appendices VI and VIII.

11. Favourable Condition Tables for the SPA features' supporting habitats and the SPA interest features of the Dee Estuary European marine site

Background information on the role of favourable condition tables, the information provided in each column, and a concise glossary of terms used is provided in Section 3 of this document.

Numbers of bird of the individual qualifying species using these habitats are given in Table 5.

Tables 6a and 6b set out the basis for the development of a monitoring programme to provide information on whether or not the features of the SPA are in favourable condition. This table supplements the conservation objectives in Sections 10 (and 14) of this document. However, with regards to determining the management and protection requirements of the SPA under Article 6 of the Habitats Directive and Article 4 of the Birds Directive, its importance is secondary to that of the conservation objectives. In particular, the consideration of plans and projects under Article 6(3) and 6(4) of the Habitats Directive should be in view of the conservation objectives.

It will be possible to monitor many of the attributes at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

11. 1 Table 6a. Favourable Condition Table for the SPA features' supporting habitats in the Dee Estuary European marine site

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex I species: bar-tailed godwit, common tern, little tern and Sandwich tern	Estuary channels (subtidal sediment communities and water column)	Food availability	Presence and abundance of small fish including sprats and sandeels, small crustaceans and marine worms measured periodically during the reporting cycle (frequency and methodology to be determined).	Abundance of small fish including sprats and sandeels, small crustaceans and marine worms should not decrease below an established baseline. Baseline to be established.	All three tern species feed within the estuary on small fish, crustaceans and marine worms. These prey species tend to be confined to the sub-tidal channels at low water.
	Intertidal mudflats and sandflats	Habitat extent	Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS.	No decrease in extent of intertidal mudflats and sandflats from an established baseline.	Together the CCW Intertidal Biotope Survey (CCW, 2006), the English Nature ICES survey (Allen & Hemmingway, 2005) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Intertidal mud and sand flats support the invertebrate prey species of bar-tailed godwits, they also provide foraging areas for tern species when covered by the tide.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex I species: bar-tailed godwit, common tern, little tern and Sandwich tern	Intertidal mudflats and sandflats	Distribution of constituent communities	Spatial distribution of sediment community types measured along a series of fixed transects once during the reporting cycle using GPS (transect locations to be determined).	Spatial distribution of sediment community types should not deviate significantly from an established baseline. Baseline to be further established.	The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities. The distribution and extent of these broad community types provides a coarse measure of the ability of the estuary to provide habitat supporting the prey species of waders including bar-tailed godwit. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in prey availability.
	Saltmarsh	Extent of roosting habitat	Total area (ha) of saltmarsh vegetation less than 10 cm in height measured once during the reporting cycle using a combination of remote sensing and ground truthing using GPS (frequency to be determined).	No decrease in total extent of roosting habitat from an established baseline. Baseline to be further established.	Saltmarsh provides an important roosting habitat for wintering bar-tailed godwit. Waders such as bar-tailed godwit prefer to use areas of short vegetation as roost sites as these provide them with unrestricted views. Together the NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a partial baseline. The Environment Agency LIDAR survey of 2003 may provide more detailed information.
		Spatial distribution of roosting habitat	Proportion of saltmarsh vegetation less than 10cm in height present on either shore in the outer, middle and inner estuary measured once during the reporting cycle using methodology given above.	Maintain the existing distribution of suitable roosting habitat in accordance with an established baseline. Baseline to be further established.	The location of suitable roosting habitat around the estuary is of importance in terms of bird's energy requirements. Specifically birds will use less energy and potential feeding time moving between feeding areas and roosting sites where these areas are further apart. Baseline data is as described above.
	Shingle ridges	Extent of shingle banks with less than 10% vegetation cover and avoid regular inundation	Area (ha) of suitable habitat measured periodically during the reporting cycle (frequency to be determined).	At Gronant Dunes, no decrease in the extent of suitable habitat from an existing baseline. Baseline to be established.	Little terns require shingle banks with vegetation cover of less than 10%, which are high enough on the shore to avoid regular inundation (Bolas & Day, 1998; Kirby *et al*. 2000). If these features are unable to keep pace with sea level rise inundation of nesting areas will become more frequent. Together aerial photographs taken in 1999 by Liverpool Bay Coastal Group and the Environment Agency's LIDAR survey of 2003 may provide a baseline.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring migratory species and **Internationally important assemblage of waterbirds**	Intertidal mudflats and sandflats	Habitat extent	Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS.	No decrease in extent of intertidal flats from an existing baseline.	Together the CCW Intertidal Biotope Survey (CCW, 2006), the English Nature ICES survey (Allen & Hemmingway, 2005) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Intertidal mud and sand flats support the invertebrate prey species of bar-tailed godwits, they also provide foraging areas for tern species when covered by the tide.
		Distribution of constituent communities	Spatial distribution of sediment community types measured along a series of fixed transects once during the reporting cycle using GPS (transect locations to be determined).	Spatial distribution of sediment community types should not deviate significantly from an existing baseline. Baseline to be further established.	The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities. The distribution and extent of these broad community types provides a coarse measure of the ability of the estuary to provide habitat supporting the prey species of both waders and wildfowl. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in prey availability The CCW Intertidal Biotope Survey (CCW, 2006) and the English Nature ICES survey (Allen & Hemmingway, 2005) provide a partial baseline.
		Prey abundance and dispersion	Presence and abundance of suitable prey species measured periodically at sampling sites across the estuary during the reporting cycle (sampling locations, methodology and frequency to be determined).	Presence and abundance of suitable prey species should not deviate significantly from an established baseline. Baseline to be established.	Invertebrate prey species favoured by the waders and wildfowl of the Dee Estuary include: Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*; Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis*, cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*; Crustaceans: amphipods *Corophium spp*., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*. Monitoring of cockle stocks has been undertaken on an annual basis by the Environment Agency, e.g. Hazlewood (2002) and this data provides an interim baseline. Research has been undertaken on behalf of The Countryside Council for Wales, English Nature and the Environment Agency by the Centre of Ecology and Hydrology to establish a target stock level sufficient to meet the food requirements of the bird populations using the Dee Estuary. However, further work is still required to refine the model further.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring migratory species **and** **Internationally important assemblage of waterbirds**	Saltmarsh	Habitat extent	Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS.	No decrease in extent of saltmarsh from an existing baseline	Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline.
		Distribution of constituent communities	Spatial distribution of vegetation community types measured once during the reporting cycle (methodology to be determined).	Spatial distribution of vegetation community types should not deviate significantly from an existing baseline. Baseline to be further established.	Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Saltmarsh communities comprise four community types: Pioneer saltmarsh (SM8, SM9) Low to mid marsh communities (SM10, SM12, SM13, SM14) Mid to upper marsh communities (SM16, SM18) Transitional high marsh communities (SM24, SM28, MG11, MG13, S4, S21, S28). The distribution and extent of these broad community types provides an estimate of the area of the marsh able to support different vegetation communities, which in turn provide food for wildfowl species. Changes in the spatial distribution of these communities may provide an early indication of long-term changes in the composition of the marsh and of its capacity to support species favoured by the wildfowl.
		Extent of roosting habitat	Total area (ha) of saltmarsh vegetation less than 10 cm in height measured once during the reporting cycle using a combination of remote sensing and ground truthing using GPS (frequency to be determined).	No decrease in total extent of roosting habitat from an established baseline. Baseline to be further established.	Together the NVC survey of saltmarsh in the Dee Estuary undertaken by Dargie in 2000 and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a partial baseline. An Environment Agency LIDAR survey in 2003 may provide more detailed information. Saltmarsh provides an important roosting habitat for wintering waders. These species prefer to use areas of short vegetation as roost sites as these provide them with unrestricted views.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring migratory species **and** **Internationally important assemblage of waterbirds**	Saltmarsh	Spatial distribution of roosting habitat	Proportion of saltmarsh vegetation less than 10cm in height present on either shore in the outer, middle and inner estuary measured once during the reporting cycle using methodology given above.	Maintain the existing distribution of suitable roosting habitat in accordance with an established baseline. Baseline to be further established.	Baseline data is as described above. The location of suitable roosting habitat around the estuary is of importance in terms of bird's energy requirements. Specifically birds will use less energy and potential feeding time moving between feeding areas and roosting sites where these areas are further apart.
		Extent of standing water pools or 'flashes'	Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS.	No decrease in extent of standing water pools from an existing baseline	Together the CCW Intertidal Biotope Survey (CCW, 2006), the English Nature ICES survey (Allen & Hemmingway, 2005) and aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Standing water pools are important habitats for teal which loaf on the water and feed on adjacent vegetation.
		Food plant abundance	Presence and abundance of suitable food plants measured periodically at sampling sites across the saltmarsh during the reporting cycle (sampling locations, methodology and frequency to be determined).	Presence and abundance of favoured food plants should not deviate significantly from an established baseline. In addition during winter cover of both seed bearing plants and soft leaved herbs and grasses should each be maintained at least 25% averaged across the area of the marsh.	The NVC survey of saltmarsh in the Dee estuary undertaken by Dargie in 2000 provides a baseline. Food plants favoured by the wildfowl of the Dee Estuary include both: a) Seed bearing plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. b) Soft leaved herbs and grasses including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp.
	Rocky shore	Habitat extent	Area (ha), measured once per reporting cycle using a combination of remote sensing and ground truthing using GPS.	No decrease in extent of rocky shore at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks from an existing baseline	Aerial photographs taken in 1999 by Liverpool Bay Coastal Group provide a baseline. Rocky shore provides important roosting sites for several species of wader including oystercatchers
	Shingle Ridges	Habitat extent / height	Area (ha) of unvegetated shingle at Point of Ayr above 9.0m and 10.0m above chart datum using LIDAR or traditional survey techniques combined with GPS	No decrease in extent of shingle habitat above 9.0m and 10.0m above chart datum from an existing baseline	The shingle ridge at Point of Ayr is an important roost site for several species of migratory waders, in particular oystercatcher. Roosting birds require sufficient area for roosting safe from tidal inundation and with sight lines not obscured by high vegetation.

NB. Extreme events (such as storms, reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary and may well be missed by routine monitoring. Other factors such as conditions within migratory flyways or neighbouring sites can all have an influence on both numbers and distribution of birds within the Dee Estuary.

11.2 Table 6b. Favourable Condition Table for the SPA features in the Dee Estuary European marine site

NB - Many of the attributes will be able to be monitored at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex I species: bar-tailed godwit, common tern, little tern and Sandwich tern	Across all sub-features	Population size	Rolling 5 year peak mean number of individuals derived on an annual basis from monthly WeBS counts and breeding tern surveys	Target number of Annex I bird species: wintering bar-tailed godwit: 1,150 individuals; breeding common tern: 392 breeding pairs; breeding little tern: 69 breeding pairs; passage Sandwich tern: 957 individuals. [i.e. not less than the 5 year peak mean between 1994/5 and 1998/9]	Monthly WeBS counters carried out once a month on a high spring tide will provide this information together with additional surveys for breeding terns. The counts are undertaken by volunteers on behalf of the WeBS partners, which include Natural England and the Countryside Council for Wales. Population size is a key attribute of the feature. Use of the five year peak mean as a measure of population size means that short-term fluctuations in population size are 'averaged out' and a measure of population over a five year is used.
		Proportion of biogeographic population	Rolling five year mean proportion of relevant international biogeographic population using annual peak WeBS counts	Target percentage of biogeographic populations for Annex I bird species: wintering bar-tailed godwit: 1.15% breeding common tern: 0.13% breeding little tern: 0.40% passage Sandwich tern: 0.64%	WeBS counts together with the breeding tern survey provide this information. Changes in the proportion of the biogeographic population can be used to determine whether changes in the number of birds using the site may be attributable to 'external factors' affecting the size of the wider biogeographic population.
		Productivity of breeding colonies	Rolling 5 year mean productivity derived annually using the number of chicks fledged within a colony per breeding pair.	Common terns 1.34 chicks per breeding pair. Little terns 0.8 chicks per breeding pair [i.e. not less than the 5 year mean between 1995 and 1999]	Productivity is perhaps the best indication of the current condition of a colony as it is likely to be more sensitive to changes in the habitat condition within the site than the number of pairs returning each year. Factors such as disturbance, food availability, and predation levels may affect productivity.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important Annex I species: bar-tailed godwit, common tern, little tern and Sandwich tern	Across all sub-features	Distribution of individuals within the site	Number and location of WeBS sectors occupied at low tide measured using low water WeBS counts	No decrease in the number of sectors used by each species in significant numbers (5% of the five year mean peak) from an established baseline.	WeBS low tide counts in 2001/2 provide a baseline. Birds tend to use certain sectors to a greater or lesser degree from year to year however the failure of a particular species to use a sector previously favoured by a significant portion of the population could indicate a reduction in habitat quality.
		Disturbance in feeding, and roosting areas	Reduction in bird numbers using the site or displacement of birds within the site measured using both low and high water WeBS counts	No significant reduction in numbers or displacement of birds attributable to disturbance from an established baseline.	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging. Key roosting sites used by bar-tailed godwit and terns are shown in Appendices VI and VII respectively.
		Disturbance at little tern breeding colony	Frequency of incidents of anthropogenic disturbance recorded daily during the breeding season	No increase in the frequency of disturbance incidents from an established baseline.	Wardening is in place at the little tern colony at Gronant throughout the majority of the breeding season. Wardens keep records of disturbance incidents, these records provide a baseline.
		Unimpeded sightlines at feeding, breeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines. Areas of habitat with an effective field size of at least 10 ha.	Bar-tailed godwit require unrestricted views >200m to allow early detection of predators when feeding and roosting. Little terns also benefit from unrestricted views at breeding sites.
		Unimpeded access for common terns between feeding / roosting and breeding sites	Annual tern mortality from road deaths or collision with overhead power cables	No increase in tern mortality associated with traffic or power cables from an existing baseline. Baseline to be established.	Terns require unimpeded passage between the feeding and breeding sites to be able to make enough foraging journeys a day to provide sufficient food for their chicks. Any increase in mortality could result in a reduction in colony size and productivity. Information in the 2002 BTO Study of the risk of collision with power lines by common terns and waterbirds at Shotton Steel Works (Balmer *et al.*, 2002) may provide a partial baseline.

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring migratory species **and** **Internationally important assemblage of waterbirds**	Across all sub-features	Population size	Rolling 5 year peak mean number of individuals derived on an annual basis from WeBS counts	No less than 120,726 individual waterbirds in the assemblage [i.e. the 5 year peak mean between 1994/5 and 1998/9] Target number of Annex II bird species: passage redshank: 8,795 individuals; wintering shelduck: 7,725 individuals; wintering teal: 5,251 individuals; wintering pintail: 5,407 individuals; wintering oystercatcher: 22, 677 individuals; wintering grey plover: 1,643 individuals; wintering knot: 12,394 individuals; wintering dunlin: 27,769 individuals; wintering black tailed godwit: 1,747 individuals; wintering curlew: 3,899 individuals; wintering redshank: 5,293 individuals. [i.e. the 5 year peak mean between 1994/5 and 1998/9].	Monthly WeBS counts carried out once a month on a high spring tide will provide this information. The counts are undertaken by volunteers on behalf of the WeBS partners, which include Natural England and the Countryside Council for Wales. Population size is a key attribute of the feature. Use of the five year peak mean as a measure of population size means that short-term fluctuations in population size are 'averaged out' and a measure of population over a five year is used.
Internationally important populations of regularly occurring migratory species **and** **Internationally important assemblage of waterbirds**	Across all sub-features	Proportion of biogeographic population	Rolling five year mean proportion of relevant international biogeographic population using annual peak WeBS counts	Target percentage of biogeographic populations for Annex II bird species: passage redshank: 5.9% wintering shelduck: 2.6% wintering teal: 1.3% wintering pintail: 9.0% wintering oystercatcher: 2.5% wintering grey plover: 1.1% wintering knot: 3.5% wintering dunlin: 2.0% wintering black tailed godwit: 2.5% wintering curlew: 1.1% wintering redshank: 3.5%	WeBS counts provide this information. Changes in the proportion of the biogeographic population can be used to determine whether changes in the number of birds using the site may be attributable to 'external factors' affecting the size of the wider biogeographic population.

Feature	Sub-feature	Attribute	Measure	Target	Comments
		Distribution of individuals within the site	Number and location of WeBS sectors occupied at low tide measured using low water WeBS counts	No decrease in the number of sectors used by each species in significant numbers (5% of the five year mean peak) from an established baseline.	WeBS low tide counts in 2001/2 provide a baseline. Birds tend to use certain sectors to a greater or lesser degree from year to year however the failure of a particular species to use a sector previously favoured by a significant portion of the population could indicate a reduction in habitat quality.
		Disturbance to feeding, roosting and loafing areas	Reduction in bird numbers using the site or displacement of birds within the site measured using both low and high water WeBS counts	No significant reduction in numbers or displacement of birds attributable to disturbance from an established baseline.	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure. Five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging. Key roosting and loafing sites used by wader and wildfowl species are shown in Appendices VI and VIII. They include areas of estuary channels (used by pintail for loafing), intertidal flats, shingle banks, saltmarsh and rocky shore.
		Unimpeded sightlines at feeding and roosting sites	Openness of terrain unrestricted by obstructions	No increase in obstructions to existing bird sightlines. Areas of habitat with an effective field size of at least 10 ha.	Most waders require unrestricted views >200m and an effective field size of 10 ha to allow early detection of predators when feeding and roosting.

NB. Extreme events (such as storms, reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Dee Estuary and may well be missed by routine monitoring. Other factors such as conditions within migratory flyways or neighbouring sites can all have an influence on both numbers and distribution of birds within the Dee Estuary.

12. Detailed operations advice for The Dee Estuary SPA interest features

12.1 Background

This section provides information to help relate general advice to each of the specific interest features of the Special Protection Area.

This advice relates to the vulnerability of the interest features and supporting habitats of The Dee Estuary SPA, as summarised in Table 1 and set out in more detail in Table 7. An explanation of the sensitivity of the interest features or supporting habitats follows with an explanation of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links between the categories of operation and the ecological requirements of the SPA's interest features, as set out in Section 9, to be made.

The categories of operation may cause damage or disturbance to the interest features and sub-features of the Dee Estuary European marine site, either alone or in combination.

The Dee Estuary European marine site covers a large geographical area and this operations advice refers to the interest features across the estuary. Therefore, activities have been allocated an 'average' exposure score based on their occurrence within the estuary. The following text will reflect where activities only occur in a small area of the site but may be undertaken intensively or frequently. Also, there may often be a difference in the intensity of activities occurring in different parts of the site, especially on either shore of the estuary.

In order to simplify the assessment process the qualifying features are discussed using the three qualifying criteria: internationally important populations of regularly occurring Annex I species, internationally important populations of regularly occurring migratory species, and internationally important assemblage of waterbirds. Furthermore since the species comprising the internationally important populations of regularly occurring migratory species make up such a large proportion of the internationally important assemblage of waterbirds, these two categories are also grouped together in the assessment.

12.2 Physical loss

The Dee Estuary SPA provides important nesting, feeding and roosting habitats for **Annex I species**, and feeding and roosting habitat for **important migratory species** and species comprising the **waterbird assemblage**. The loss by removal or smothering of any of the supporting habitats, on which they depend, is likely to result in the loss of nesting and roosting sites and/or the reduction of food resources. It could also result in increased competition for food and space in areas that are already occupied, and ultimately reduce bird numbers on the estuary.

12.2.1 Physical loss by removal

Physical loss by removal may be caused directly by developments such as infrastructure construction and modification, coastal protection works, and land claim (See also Section 8.2.1). In addition coastal developments and other anthropogenic activities may also cause the indirect loss of estuarine habitats through the interruption of coastal processes such as sediment transport.

The **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are all considered to be **highly sensitive** to removal of **any** of their **supporting habitats** due to the severity and often long term nature of such impacts.

Exposure to physical loss varies across the European site. The **Estuary channels** 'sub-feature' comprises the estuaries subtidal sediment communities as well as the water column that lies above. These channels are important as feeding areas for terns and other species comprising the waterbird assemblage, in addition they provide loafing areas for pintail. As described in Section 8.2.1 the recent scale of dredging operations within estuary channels results in the subtidal sediment communities being highly exposed to removal. However with regard to the SPA features the **exposure** of the 'channels' including the water column is only considered to be **low** as even though the subtidal sediments will provide habitat for some fish and invertebrates most of the prey species which the terns and other waterbird feed on are likely to be carried into the estuary with the flooding tide.

The intertidal **mudflats and sandflats** of the estuary constitute the major feeding resource for virtually all of the wading birds present on the estuary including the Annex I species bar-tailed godwit. Taken as a whole the intertidal mudflat and sandflat communities are considered to have **medium exposure** to removal. This assessment is based upon the development pressures that still exist within the estuary together with the ongoing accretion of saltmarsh within the estuary, which will be reducing the area of intertidal mud communities (See also Section 8.2.1).

Saltmarsh communities provide important high tide roosting sites for waders and key feeding areas for wildfowl species. Across the estuary the **exposure** of these roosting and feeding areas to removal is considered to be **low**, although the rapid erosion of saltmarsh along much of the Welsh shore may be having localised effects.

The **unvegetated shingle ridge** at Gronant provides nesting habitat for the Annex I species, little tern. The shingle ridge which forms the spit at the Point of Ayr is one of the key roost sites for wading birds within the estuary, in particular oystercatcher. The spit at Point of Ayr is a dynamic feature that depends upon a supply of shingle to prevent its erosion. The shingle ridge at Gronant is one of a series of such features that are evident at the site. Over time the ridges become vegetated and unsuitable for nesting, thus the long-term future of the colony at the site is likely to be dependant upon the continued creation of new shingle features. While neither area of shingle is considered to be exposed to physical loss through direct land take both are considered to have **medium exposure** due to the potential for removal resulting from interruption of their sediment supply. This interruption may stem from a combination of the presence of coastal defences to the west of Prestatyn along the North Wales coastline, which starve the beaches of sediment supply; the presence of groynes to trap sediment along particular stretches of coastal frontage preventing the prevailing long shore drift; and changes to the hydrodynamic regime associated with dredging of the main channel that lies off Point of Ayr and Gronant.

The **rocky shore communities** around the Hilbre Islands, which are used as roosting sites by migratory wading birds, are considered to have only **low exposure** to removal. This exposure derives primarily from the ongoing erosion by waves and tides, in particular of Little Eye rather than any anthropogenic impact.

Thus the **Annex I species, important migratory species** and those belonging to the **waterbird assemblage** are considered **highly vulnerable** to removal of **intertidal mudflats and sandflats** and **shingle ridges**, whereas they are **moderately vulnerable** to removal of **estuary channels** and **saltmarsh communities**. The **migratory species** and **waterbird assemblage** are **moderately vulnerable** to the removal **of rocky shore**.

12.2.2 Physical loss by smothering

Physical loss by smothering occurs where accretion occurs so rapidly that the nature of the surface substrate is changed. Alternatively the nature of the 'smothering material' may be the same as the existing substrate yet the rate of deposition is such that the existing community is unable to maintain a presence at the surface. Smothering may be caused either directly, e.g. by deposition of dredged spoil or indirectly by the modification of coastal processes (see also Section 8.2.2).

Annex I species are considered **highly sensitive** to the **smothering of the shingle ridge** at Gronant as this could result in the loss of eggs or chicks if it occurred during the breeding season. **Annex I species, important migratory species and species of the waterbird assemblage** are all considered to be **moderately sensitive** to smothering of **all other supporting habitats.** Sensitivity to smothering is less than for removal due to the generally greater potential for eventual recovery (See also Section 8.2.2).

The exposure of subtidal sediment communities within the estuary is considered to be high due to disposal of dredged sediment within Mostyn Deep, yet the **exposure** to the **estuary channels** sub-feature is considered to be **low** due to the limited impact of smothering upon the aspects of the sub-feature which support the bird features, in particular the presence of small fish in the water column.

The **intertidal mudflats and sandflats**, **saltmarsh communities, shingle ridges and rocky shore communities** are all considered to have a **low exposure** to smothering.

Thus the **Annex I species** are considered to be **moderately vulnerable** to the **smothering** of the **shingle ridge** at **Gronant** due to their high sensitivity; while they and the **important migratory species** and species of the **waterbird assemblage** are all considered to have **low vulnerability** to the smothering of **all other sub-features**.

12.3 Physical damage

Physical damage can alter habitat structure and lead to a change in species composition. It may result from a range of activities causing either siltation, abrasion or selective extraction. These categories of impact are likely to affect the bird species of the European marine site through the loss of the habitat, or through the loss of prey species. Physical damage to intertidal habitats may ultimately lead to sediment destabilisation and increased erosion, and reduce the suitability of the area as feeding, roosting or breeding habitat.

12.3.1 Physical damage by siltation

Silt in the water column can smother or block the feeding and respiratory organs of marine invertebrates living within the substrate. It can also affect recruitment processes and reduce light penetration in the water column. Thus siltation may have the capacity to reduce prey availability or alter community composition in estuarine communities. Despite these potential problems, estuarine communities are highly adapted to siltation, rocky shore communities are the main exception to this rule. Siltation may also have an adverse effect on some birds through increased turbidity levels (see also Section 12.6.4)

The **Annex I species, important migratory species** and species of the **waterbird assemblage** are considered to have only **low sensitivity** to siltation of **estuary channels, intertidal mudflats and sandflats** and **saltmarsh communities** due to their adaptations to siltation. These species are also considered to have **no sensitivity** to siltation of the **unvegetated shingle ridges,** which do not support significant invertebrate food resources. However the **important migratory species** and species of the **waterbird assemblage** are considered **moderately sensitive** to siltation of the **rocky shore communities** around Hilbre Island which provide limited food resources for species such as oystercatcher, turnstone and purple sandpiper.

Exposure to siltation varies across the site with the main factor being proximity to any dredging operations in the estuary channels. Thus the **estuary channels** are considered to have a **high exposure to siltation,** the **intertidal mudflats and sandflats** which lie adjacent to the dredged channel have **medium exposure** while the **saltmarsh, rocky shore communities and shingle ridges** have **low exposure.**

Thus the **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are only considered **moderately vulnerable** to siltation relating to their use of the **estuary channels**, their **vulnerability** to siltation in respect of **other habitats** being **low or none.**

12.3.2 Physical damage by abrasion

Activities that cause direct scouring or abrasion to estuarine habitats may kill or harm particular species of animals and plants, altering community structure particularly within rocky shore or sediment communities. Abrasion may also cause indirect effects on communities by altering the nature of the substrate, e.g. by causing erosion of finer sediments.

The Annex I species, important migratory species and species of the waterbird assemblage are considered to have low sensitivity to abrasion of the estuary channels since the terns and other waterbirds feeding in the channels are believed to depend mainly on fish species carried in by the tide rather that those associated with the subtidal sediment communities.

All three groups of species (**Annex I species**, **important migratory species** and species of the **waterbird assemblage**) are considered to be **moderately sensitive to abrasion of intertidal mudflats and sandflats** and s**altmarsh, migratory species** and those of the **waterbird assemblage** are also **moderately sensitive** to abrasion of the **rocky shore.**

Abrasion of the intertidal flats may harm invertebrate communities which waders and wildfowl feed on, animals living close to the surface such as cockles are especially vulnerable. Similarly abrasion of saltmarshes could harm the food plants of wildfowl species including teal and pintail. Rocky shore communities are also susceptible, trampling can create gaps in communities allowing new species to settle, possible at the expense of prey species such as mussels.

The Annex I species, in particular little terns differ in their sensitivity to abrasion of the shingle ridges from the migratory species and those of the waterbird assemblage since the little terns use the shingle ridge at Gronant as a nesting area while wading species use the shingle ridges simply as a high water roost site. Clearly ground nesting birds should be regarded as highly sensitive to abrasion of the substrate.

Although the subtidal sediment communities experience medium exposure to abrasion arising from both dredging and fishing activities, the exposure of the wider estuary channels feature is considered to be low (see also Section 8.3.2). The intertidal mudflats and sandflats are considered to have a high exposure to abrasion primarily due to the current scale of the cockle fishery, which employs very large numbers of people using hand rakes. As well as the gathering of mature cockles the abrasion caused by raking may damage smaller immature cockles and other invertebrates as well as displacing them from the beds (See also Section 8.3.2). Bait digging for lugworms also occurs within the area although this tends to be concentrated outside of The Dee Estuary SPA along the North Wirral Foreshore. Abrasion of upper shore sediment communities may also result from recreational activities including walking and horse riding as well as sand yachting and motorcycling.

The overall exposure of saltmarsh communities within the estuary is considered to be low, although significant abrasion does occur at localised points where motorcycle scrambling occurs on the upper marsh, this activity is most prevalent along the Welsh shore including Walwen and Bagillt.

The area of the shingle ridge used by the little tern colony at Gronant is fenced off and wardening takes place during the breeding season. While the potential for abrasion from recreational activity in the area is high, the measures in place ensure that actual exposure is low. In contrast the shingle spit at Point of Ayr experiences a high level of abrasion arising from recreational activity. The spit is very close to the main beach access point at Talacre and is a favoured site for walking and beach recreation. Quad biking is also known to occur along this spit.

The rocky shore communities around Hilbre Island are considered to experience only low exposure to abrasion due to visitors arriving on foot.

Thus **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are all considered **highly vulnerable** to abrasion of the **intertidal mudflats and sandflats.** Similarly **all groups** are considered **moderately vulnerable** to the abrasion of **shingle ridges**, though as a result of different combinations of **sensitivity and exposure. Vulnerability** to abrasion of **all other habitats** is **low** for all species.

12.3.3 Physical damage by selective extraction

Selective extraction is the removal of a particular type of substrate from within a habitat or community, for example the removal of large pebbles from the shingle ridges. More indiscriminate removal of habitat falls under physical loss by removal. Selective extraction has the potential to cause similar affects to abrasion, causing direct harm to prey species or changing substrate composition thereby reducing its capacity to support such species.

Sensitivity of the **all** the **SPA species** is **moderate** with respect to **all habitats** with two **exceptions** with **high** sensitivity: **Annex I species**, in particular breeding little terns, to selective extraction of **shingle ridges**; and the sensitivity of **migratory species** especially oystercatcher and of species comprising the **waterbird assemblage** including turnstone to selective extraction affecting **rocky shore communities**. The little terns are considered highly sensitive to changes is the composition of their shingle ridge as this may reduce its suitability as nesting habitat, e.g. by affecting nest camouflage. Prey species of rocky shore are considered highly sensitive due to their dependence upon a fixed substrate.

Exposure to selective extraction is considered to be **low** for **all habitats** within the site. As a consequence **Annex I species** are only considered **moderately vulnerable** to the selective extraction of **shingle,** while **important migratory species** and **species of the waterbird assemblage** are **moderately vulnerable** to selective extraction of **rocky shore communities,** both due to their elevated sensitivity.

12.4 Non-physical disturbance

Birds may be disturbed by both noise and visual cues. Industry, transport and recreational activities may all result in both forms of disturbance. Disturbance may have the effect of displacing birds from feeding, roosting or breeding areas. The most disturbing human activities are those that cause fast or unpredictable movements, or loud and unexpected noises. Species will vary in their susceptibility to different types of disturbance and responses will vary according to the time of year and the intensity of the activity. In general any action or combination of actions which are likely to give rise to changes in the regular pattern of bird behaviour, other than of a transient nature, are of concern. In certain circumstances birds may become habituated to repeated activities, which they learn are non-threatening ie industrial process noise.

Nesting birds are highly sensitive to noise and visual disturbance as this will cause them to expend energy at a time when they require more energy to breed and forage for food.

Feeding birds will tend to concentrate where food is plentiful. Disturbance in these areas can prevent birds from feeding and effectively cause a loss of available habitat. In response to disturbance, birds either decrease their energy intake at their present (disturbed) feeding site through displacement activity, or they will move to an alternative, less favoured site, or one which is already occupied. This increases competition, with a larger number of birds dependent on one particular area. Such a response affects energy budgets and thus survival, and will be of particular concern during prolonged periods of cold weather, when energy requirements are increased and during severe conditions when intertidal flats can freeze. In addition, waders find it difficult to obtain sufficient food in mid to late winter as energy reserves and food resources are at their lowest and foraging for food can be difficult. The response of birds to disturbing events depends on a wide range of factors, therefore. These include the level of disturbance, reactions of other birds nearby, flock size and knowledge from earlier experiences (e.g. habituation). Additional factors determine either their willingness to remain in the same place (scarcity of food, adverse weather, physiological condition of individual birds) or their motivation to leave for another place (daily and annual patterns of movement, related to time of year and tidal level, or the presence of alternative sites).

12.4.1 Non-physical disturbance caused by noise

Due to the serious nature of the potential effects of disturbance at feeding, roosting, loafing or breeding sites **all SPA species** are considered to be **highly sensitive** to noise occurring on all of their supporting habitats.

Exposure to noise is considered to be generally **low** in the vicinity of the **estuary channels** with the noise that does occur primarily resulting from boat traffic, including traffic associated with Port of Mostyn, leisure craft and to a lesser degree fishing boats.

Noise levels across the **intertidal mud and sand flats** are also predominantly low, though they may be high near favoured sites for beach recreation at the top of the shore, particularly at Gronant, Talacre, West Kirby and Thurstaston. At present high levels of noise disturbance are also associated with the cockle fishery, however the overall **exposure** is still considered to be **low**.

Birds utilising areas of **saltmarsh** within the estuary are considered to have a **medium exposure** to disturbance. As with the intertidal mud and sand flats much disturbance is associated with recreational activities occurring towards the top of the marsh, including dog walking, fishing, motorcycle scrambling and the flying of model aircraft. These forms of recreational disturbance are most frequent along the Welsh shore especially at Point of Ayr and Bagillt. Disturbance on the upper marsh can often occur in close proximity to important high tide roost sites. The main Crewe to Holyhead railway line passes very close to the upper marsh along much of the Welsh shore and is a cause of quite frequent disturbance.

Wildfowling also occurs within the estuary, though the area affected is much restricted compared to its former extent. Much of the saltmarsh forms a shooting sanctuary. Shooting currently occurs predominantly over areas of marsh at the head of the estuary, as well as off Heswall, and to a lesser degree along the Welsh shoreline at Oakenholt, Flint and Mostyn. Wildfowling causes disturbance to both quarry species and non-target waterbirds over the areas shot. However as this disturbance is usually transient and studies carried out on the Dee Estuary suggest that it has no long term effect on bird behaviour or numbers (Percival & Percival 1998), disturbance from wildfowling at current levels is not of concern. Repeated shooting in the vicinity of recognised bird roosting and feeding areas would be of concern if this gave rise to changes in the regular pattern of bird movement or behaviour.

The breeding colony of **Annex I species** little terns experience **medium exposure** to noise disturbance at the shingle ridge at Gronant, this results mainly from recreation in the nearby dunes and along the beach. The **internationally important migratory species** utilising the roost site on the shingle spit at Point of Ayr also experience **medium** noise **exposure** again resulting from recreational activities.

Birds using the **rocky shore** of the Hilbre Islands generally experience **low exposure** to noise disturbance, this generally results from recreational usage when people visit the islands over low tide.

Thus **all bird species** are considered to be **highly vulnerable** to noise disturbance on the estuary's **saltmarsh** and **shingle ridges** and **moderately vulnerable** in other habitats.

12.4.2 Non-physical disturbance caused by visual cues

As for noise disturbance due to the serious nature of the potential effects of disturbance at feeding, roosting, loafing or breeding sites **all SPA species** are considered to be **highly sensitive** to visual disturbance affecting **all** of their **supporting habitats.**

Exposure to disturbance due to visual presence is considered to be **medium** for the **estuary channels**, this disturbance results from similar causes as the noise disturbance experienced. However the large size of some of the boats using the channel, particularly those related to wind farm construction, means that the level of exposure is considered to be greater than for noise disturbance.

Visual disturbance is considered to be generally **low** across the **intertidal flats**. Yet significant disturbance does occur in some areas as a result of recreational usage, especially of the upper shore. Water sports at West Kirby are a particular cause for concern for migratory species including redshank roosting on the upper shore (Smith, 2003). Other disturbance to the intertidal flats may result from boat traffic along the estuary channels and also planes and other aircraft passing over the site.

Visual disturbance to the **Annex I little terns** is considered to be **medium** at their breeding site on the **shingle ridge** at Gronant caused by the same recreational activity as the noise disturbance. However for the **migratory species** using the roosting site on the **shingle spit** at Point of Ayr exposure to visual disturbance is considered to be **high**. At weekends it is not unusual to see several people in succession, often with dogs, disturbing high tide roosts of oystercatcher and dunlin.

There is evidence to suggest that the relatively recent introduction of kite surfing at West Kirby, together with ongoing windsurfing, may be causing significant disturbance to oystercatcher utilising Little Eye as a high water roost site (Smith, 2003). As a result, the **migratory species** utilising the **rocky shore** of the Hilbre Islands are considered to have a **high exposure** to visual disturbance.

Thus **all SPA features** are considered to be **highly vulnerable** to visual disturbance affecting the **estuary channels** and **unvegetated shingle ridges**; they are **moderately vulnerable** to visual disturbance affecting the **intertidal flats** and **saltmarsh**. The **important migratory species** and species comprising the **waterbird assemblage** are considered to be **highly vulnerable** to visual disturbance affecting the **rocky shore** of the Hilbre Islands.

12.5 Toxic contamination

Toxic contamination may reach the European marine site from both marine and terrestrial sources, and by a variety of pathways including tidal currents, river flow, terrestrial run-off and atmospheric deposition (see Section 8.5). Toxic contaminants can be categorised as synthetic compounds, non-synthetic compounds or radionuclides. Their potential effects vary according to the state and availability of the compound and the characteristics of the receiving environment.

Birds are subject to the accumulation of toxic contaminants through the food chain, or through direct contact while feeding. Bird populations may also be affected due to contaminants affecting the abundance of their prey items. Pollution-tolerant prey species may become dominant within contaminated communities, reducing species richness. Birds that are specialist feeders may be affected by the loss of a particular prey species, whilst generalist species may benefit from an abundance of opportunistic prey species. In addition contamination can affect the palatability of prey items, thus affecting the birds' opportunity to feed normally.

Thus the two most likely ways in which the SPA bird species are likely to be affected by toxic contamination are ingesting contaminates with their food or indirectly due to reductions in food availability. As a result of this the sensitivity of the SPA features to the toxic contamination of their supporting habitats will be dependant upon their mode of usage by the birds. In general birds are likely to have higher sensitivity to toxic contamination of their feeding habitats than their roosting habitats.

12.5.1 Toxic contamination by synthetic toxic compounds

Many synthetic compounds, such as PCBs are known to have toxic effects even in low concentrations, and are capable of high levels of bioaccumulation within many benthic organisms. Such compounds may then biomagnify as they are transmitted up the food chain, potentially having an adverse effect on bird species. Marine invertebrate groups such as molluscs and polychaete worms, which include the preferred prey species of many of the wintering waterbirds, are known to bioaccumulate toxic substances such as heavy metals within their bodies (Cole *et al*., 1999). Habitats such as saltmarshes can bioaccumulate toxic compounds and acting as sinks areas (Holt *et al*., 1995). This could have implications for the wildfowl, such as teal and pintail that feed on the saltmarsh plants and seeds.

Bird's sensitivity to synthetic toxic contamination is considered to be high with regard to their feeding habitats due to the serious effects of many synthetic toxic compounds and their tendency to bioaccumulate. Thus the **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are considered **highly sensitive** to synthetic toxins affecting the **estuary channels** and the **intertidal mudflats and sand flats**. The **migratory species** and **waterbird assemblage** are also highly sensitive to such contamination of **saltmarsh communities** and **rocky shore communities**.

As discussed in Section 8.5.1 due to the dynamic nature of the Dee's estuarine environment with tidal mixing and resuspension of sediment, pollutants are readily circulated once they have entered the estuary. Thus the levels of exposure of all intertidal habitats will be reasonably similar; with the possible exception of those habitats located in higher energy environment of the outer estuary, and those in the upper reaches of the intertidal zone, which experience less frequent periods of inundation and consequently less exposure to contaminants carried in the water column. Based on this view of the estuary, the wide geographical distribution of potential sources of contaminants and the absence of more precise information, it was determined that there should be an assessment of **medium**

exposure to **synthetic toxic contamination** for **all the supporting habitats** with the exception of the rarely inundated **shingle ridges**.

The **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are all considered **highly vulnerable** to the affects of synthetic contaminants on the **estuary channels**, and **intertidal mudflats and sandflats**, and the migratory species and those of the waterbird assemblage are also considered highly vulnerable to affects on **saltmarsh communities** and **rocky shore communities**.

12.5.2 Toxic contamination by non-synthetic toxic compounds

Non-synthetic compounds may naturally be present at very low levels in the environment, but many become toxic at elevated concentrations. They include many hydrocarbons, as well as heavy metals.

Large oil spills affecting marine habitats can have a detrimental effect on bird populations. Different oils vary in their toxicities, and their effects are dependent upon exact conditions and duration of exposure. Oil spills within the estuary would render food sources unpalatable and birds alighting could become oiled and contaminated. Oil can cause physical damage to plumage and be ingested by the bird as it tries to preen. Oil affects the waterproofing of the bird's feathers by causing them to stick together. This results in waterlogging and the bird may die from hypothermia. Oil on the surface of the water column would present a threat to diving and feeding seabirds. Oil covering the intertidal area will prevent oxygen transport to the sediments, leading to anoxia and the death of infaunal species. The most vulnerable habitats are those that are sheltered mudflats and saltmarshes that may trap the oil. The use of dispersants to remove the oil may also be harmful to both the intertidal habitats and their associated communities, and to the birds themselves.

Birds are generally considered to be moderately sensitive to the contamination of their supporting habitats by non-synthetic toxic compounds; again their sensitivity may be greater to contamination of feeding areas than for example roosting habitat. The **Annex I species**, **important migratory species** and species of the **waterbird assemblage** are all considered **moderately sensitive** to non-synthetic toxic contamination affecting the **estuary channels** and the **intertidal mudflats and sand flats**. The **migratory species** and **waterbird assemblage** are also moderately sensitive to such contamination of **saltmarsh communities** and **rocky shore communities**. The **Annex I little terns** are considered to be **moderately sensitive** with respect to the **shingle ridge at Gronant** due to the possibility of oil contamination**.**

The existing and potential sources of non-synthetic contamination within the estuary are described in detail in Section 8.5.2. Again the dynamic nature of the estuary is likely to result in similar levels of exposure for all intertidal habitats with the exception of those experiencing less infrequent tidal inundation. The exposure of **all** the SPA **supporting habitats** to the effects of non-synthetic toxic contamination is considered to be **medium** with the exception of the **unvegetated shingle ridges**, which have **low** exposure.

Thus the **Annex I species** are considered **moderately vulnerable** to the introduction of non-synthetic compounds to estuary channels and **intertidal mudflats** and **sandflats**; **the internationally important migratory species** and those of the **waterbird assemblage** are

moderately vulnerable with respect to the **estuary channels, intertidal mudflats and sandflats, saltmarsh** and **rocky shore**.

12.5.3 Toxic contamination by radioactive compounds

The effects of radionuclides have been demonstrated in a number of marine organisms, such as invertebrates and fish (Cole *et al*., 1999). Depending on the radioactive dosage, lethal, genetic or reproductive effects may result. There is also evidence to show that radionuclides accumulate in biota, particularly benthic crustaceans, molluscs and saltmarsh grasses (Cole *et al*., 1999). However **sensitivity** to radionuclides is generally considered to be **low for all communities**.

There are currently no major sources of radioactive contamination within the Dee Estuary itself, although there are several discharging installations around Liverpool Bay and the eastern Irish Sea. These include the Sellafield nuclear reprocessing plant, which is the dominant source of radioactive waste discharge to the coastal waters of the UK (Hutchinson, 1994). Airborne gamma spectrometry surveys have revealed elevated levels of ^{137}Caesium in the saltmarshes and tidal flats of major estuaries in the eastern Irish Sea environments including the Dee Estuary (Narayana *et al*., 2001). Doses received by man from exposure to such artificial radionuclides have been the subject of most scientific investigation. In the Dee Estuary the largest dose of radioactivity received by the most exposed group, people working on the marshes, is estimated to be only 6% of the recommended annual dose limit (Rose *et al*., 1996). In the absence of more specific data relating to particular habitats or species the **exposure** to radioactivity for **all features** within the site is considered to be **low**.

Since **all the bird species** of the estuary are considered to exhibit only **low sensitivity** and **low exposure** to the **introduction of radionuclides**, their **vulnerability** to **radionuclides** is also **low.**

12.6 Non-toxic contamination

Certain contaminants can have non-toxic, but nevertheless harmful effects on the bird species of the estuary. Water quality may be affected by contaminants altering factors such as nutrient levels, organic loading, heat, turbidity and salinity. Such contaminants may either harm the birds directly, damage their supporting habitats, or adversely affect their prey species.

Non-toxic contaminants are generally present in much higher concentrations than the toxic contaminants discussed above. They can enter the estuarine environment in large quantities from sewage outfalls and industrial discharges, riverine inputs and agricultural run-off.

12.6.1 Non-toxic contamination by changes in inorganic nutrient loading

Nutrient enrichment can have indirect effects on bird populations, with the potential to both increase or decrease food availability. Nutrient pollution can lead to an increase in benthic populations such as opportunistic marine worms and some birds may benefit from this augmentation; however at the same time the diversity of prey species may be reduced, eliminating the favoured prey items of more specialised feeders.

An excessive supply of nutrients can result in deoxygenation of the sediments and water column and lead to the establishment of anoxic conditions, increasing oxygen demand and stimulating the release of ammonia and hydrogen sulphide which can be toxic to aquatic life. Severe eutrophication can also lead to the death of many benthic invertebrate species (Cole *et al*., 1999), many of which may be key prey species. An increased growth of algal mats on the intertidal area can cause smothering, resulting in deoxygenation of the sediments again leading to the death of invertebrate prey species. Species such as wigeon may benefit from an increase in opportunist algae such as *Enteromorpha*, but other waders and wildfowl that feed on mud-dwelling invertebrates, will experience a reduction in prey and feeding areas.

Eutrophication of shallow coastal waters including estuary channels can have a detrimental effect on the prey species of terns and other waterbirds, which include small fish and invertebrates within the water column. Algal blooms can also cause a reduction in water clarity, which will affect the visibility of prey items. This will impact on sight feeders such as redshank.

Studies in North America have suggested that saltmarshes are unlikely to be highly sensitive to changes in water quality due to nutrient enrichment (Holt *et al*., 1995).

Invertebrate communities in general are considered moderately sensitive to nutrient enrichment, and therefore the bird species that depend on these communities for food are also moderately sensitive. Thus the **Annex I species** are **moderately sensitive** to inorganic enrichment; the **internationally important migratory species** and those of the **waterbird assemblage** are moderately sensitive to enrichments of the **estuary channels**, **intertidal flats**, and **rocky shore communities.**

As described in Section 8.6.2, there are five main sources of nutrient enrichment within the Dee Estuary. These are: river input, tidal mixing, direct discharge, atmospheric deposition, and organic production (organic nutrients only). The relative importance of these input categories is not well understood, although the relative contributions from Liverpool Bay are considered highly significant (Howarth *et al*., 2001). In addition freshwater inputs to the estuary both from the River Dee and freshwater discharges are considered to contribute significantly to the estuary's nitrogen loading (Howarth *et al*., 2001). Among wastewater treatment works Chester and Queensferry are mainly responsible for the highest nutrient loadings being discharged to the estuary. They contribute the most oxidised nitrogen, phosphate and orthophosphate (Potter, 2003).

In 2001, the Dee Estuary from Chester Weir to its mouth was proposed by Environment Agency Wales as a Sensitive Area to Eutrophication under the Waste Water Treatment Directive, as the estuary exceeded chemical and biological criteria indicative of eutrophic conditions (Howarth *et al*., 2001). Evidence for eutrophication includes chemical data, reduced dissolved oxygen concentration in summer and elevated nitrogen concentrations in winter, Chlorophyll-*a* measurements, and evidence of algal scum. Two algal blooms were reported within the estuary between 1999 and 2001 (Howarth *et al*., 2001).

On the basis of evidence described above it was determined that all the supporting habitats that are subject to frequent tidal inundation are **highly exposed** to changes and inorganic nutrient loading. These habitats are: the **estuary channels**, **intertidal mudflats and sandflats**, **saltmarsh**, and **rocky shore communities**.

Thus the **Annex I species** are considered **highly vulnerable** to inorganic enrichment of the **estuary channels** and **intertidal flats** and **moderately vulnerable** with respect to **saltmarsh**. The **migratory species** and species of the **waterbird assemblage** are also considered **highly vulnerable** to enrichment of the **estuary channels**, **intertidal flats and rocky shore communities** and **moderately vulnerable** with respect to **saltmarsh.**

12.6.2 Non-toxic contamination by changes in organic nutrient loading

As described above enrichment of inorganic nutrients can have indirect effects on bird populations, both through increasing and decreasing food availability, and the same applies for organic nutrients. An excessive supply of organic carbon can result in similar consequences to inorganic nutrients, including deoxygenation of the sediments and water column, and growth of algal mats. **Sensitivity** of the SPA features to the organic enrichment of their supporting habitats is therefore the **same as for inorganic enrichment** in Section 12.6.1 above.

The five main sources of organic nutrients present within the Dee Estuary are also the same as described above for inorganic nutrients. Again the relative importance of each is not well understood. However, the requirements for wastewater treatment works (WwTW) to be 'secondary treated' in recent years has led to reduction in the amount of organic matter (BOD) discharged into the estuary and adjacent coastal waters. Recent investigations of faunal communities in the vicinity of the wastewater treatment works around the estuary found that the composition of these communities was generally classified as unbalanced and slightly polluted (Potter, 2003).

Again on the basis of evidence described above that the estuary may be sensitive to eutrophication, all the supporting habitats subject to frequent tidal inundation are considered to be **highly exposed** to changes in organic nutrient loading. These habitats are the **same as** listed **for inorganic enrichment.**

Thus the **Annex I species** are considered **highly vulnerable** to organic enrichment of the **estuary channels** and **intertidal flats** and **moderately vulnerable** with respect to **saltmarsh.** The **migratory species** and species of the **waterbird assemblage** are also considered **highly vulnerable** to enrichment of the **estuary channels, intertidal flats and rocky shore communities** and **moderately vulnerable** with respect to **saltmarsh.**

12.6.3 Non-toxic contamination by changes in the thermal regime

Changes to the thermal regime of the estuarine water column may lead to changes in the distribution and composition of marine organisms, resulting in changes to bird distribution. Ultimately a long-term thermal discharge is likely to lead to a change in community composition, and colonisation by species adapted to warm water temperatures. Changes in species productivity may also occur as some species may thrive in warmer temperatures, whilst others may decline. The impact of heated water discharges are likely to depend on the location of the discharge point, the temperature of the discharge and the nature of tidal currents in the area. In spite of these potential impacts **all the SPA features** are generally considered to have **low sensitivity to changes in the thermal regime** affecting their supporting habitat.

Although there are several warm water discharges around the estuary, including cooling water outfalls from two power stations in the upper estuary channel, their effects upon the temperature regime of the estuary are believed to be localised. Heat energy is a dissipating 'pollutant' and the impact of these outfalls is thought to be concentrated around the point of discharge. **The supporting habitats** are therefore determined to have at most a **low exposure** to **changes in thermal regime.**

The **vulnerability** of **all** the **SPA features** to changes in the thermal regime affecting all their supporting habitats is therefore considered to be **low**.

12.6.4 Non-toxic contamination by changes in turbidity

The Dee Estuary is a naturally turbid system; therefore any localised increases in turbidity from anthropogenic actions are likely to fall within the normal range experienced by estuarine communities. Most estuarine communities can tolerate turbid conditions, however excessive turbidity may have adverse effects on filter-feeding organisms, clogging feeding and respiratory structures that in turn may reduce food availability for the birds. The **Annex I tern species** and other species of the **waterbird assemblage** are considered **moderately sensitive** to increases in turbidity affecting the estuary's water column including the **estuary channels**. These species rely on sight to catch small fish and invertebrates, which may themselves by discouraged by poor water clarity. Clearly increases in turbidity may have adverse impacts on the ability of these species to feed.

Primarily due to ongoing possibility of dredging works and disposal of dredged materials within the estuary the **exposure** to changes in turbidity was determined to be **high** for the **estuary channels** and **medium** for other **habitats experiencing frequent tidal inundation**.

The **Annex I species** and species of the waterbird assemblage are therefore moderately vulnerable to increases in turbidity within the estuary.

12.6.5 Non-toxic contamination by changes in salinity

Estuaries naturally exhibit a large degree of variability in salinity associated with the interaction between the ebb and flow of the tide and river flow. As a consequence most of the estuarine communities are able to tolerate a wide range of salinities. Despite the adaptation of estuarine communities to variable salinity, significant changes in salinity due to discharge of hyper-saline or fresh water can have effects on community composition. Benthic invertebrate communities vary in response to salinity, with diversity decreasing with a decrease in salinity (Cole *et al*. 1999). Thus the principle potential effect on the birds of the SPA to changes in the salinity regime is a change in their food availability (Cole *et al*. 1999). In addition changes in salinity can cause indirect effects on communities as salinity can affect the chemical availability of various contaminants.

Studies carried out in Suffolk and Essex have indicated that freshwater flows over intertidal habitats may be important for waders and wildfowl (Ravenscroft, 2003). The number and density of some waterfowl such as shelduck, wigeon, grey plover and redshank all showed statistically greater densities close to freshwater flows when compared with similar areas of mudflats lacking such flows.

Despite the potential effects of salinity changes mentioned above the **SPA features** are generally considered to have **low sensitivity** to the salinity changes affecting all their supporting habitats**.** Although hyper-saline discharges may be harmful to most estuarine communities, these effects will generally be localised. Estuarine communities will generally be unaffected by short-term changes in salinity within the limits of their normal exposure.

Within the estuary only the power stations are thought to discharge hyper-saline water. The main influences on the salinity of the estuary are tidal inundation and rainfall. Thus **exposure** to anthropogenic changes in salinity is determined to be **low throughout the estuary** and bird's **vulnerability** to changes in salinity is therefore **low** for **all species** and their supporting habitats.

12.7 Biological disturbance

Biological disturbance includes the introduction of microbial pathogens, introduction and translocation of non-native species, and the selective extraction of species.

12.7.1 Biological disturbance by introduction of microbial pathogens

The marine environment provides a generally hostile environment for microbial pathogens, where they tend to die off rapidly, particularly in the presence of sunlight (Cole *et al*. 1999). Yet these pathogens can become associated with suspended particles and accumulate in sediments, surviving for days or weeks (Cole *et al*. 1999). They can also accumulate in filter-feeding organisms to levels that can be harmful to birds (Cole *et al*. 1999). Despite this fact the **sensitivity** of the SPA features to the introduction of microbial pathogens is considered to be either **low** for **all supporting habitats**.

Mainly as a result in recent improvements to waste water treatment **exposure** to microbial pathogens within the estuary is **generally** perceived to be **low**, although elevated levels may occur in the upper estuary and canalised lower river due to reduced dilution of sewage discharges.

Thus the **vulnerability** of the **SPA features** to introduction of microbial pathogens is considered to be **low for all supporting habitats**.

12.7.2 Biological disturbance by introduction of non-native species

The introduction of non-native species, both flora and fauna, could have an impact on the estuarine ecosystem including indirect effects on the bird species. Introduced species may thrive at the expense of native species, resulting in a change in the composition of estuarine communities. Invasive plants including algae may also cause harmful effects changing the structure of habitats.

Birds are generally considered most likely to be affected by the introduction of non-native species to areas of feeding habitat. Thus **all the SPA species** are considered **moderately sensitive** to the introduction of non-native species affecting the **estuary channels** and **intertidal flats**, and the **internationally important migratory species** and those of the **waterbird assemblage** are also **moderately sensitive** with respect to the **saltmarsh** and **rocky shore communities**.

As discussed in Section 8.7.2, new introductions of non-native marine species are perhaps most likely to occur through the discharge of ballast water within the estuary by ships arriving from foreign ports. Further work would be needed to establish which non-native marine species may already be present in the waters of the Dee Estuary and to investigate the likelihood of current shipping activities resulting in further introductions

Common cordgrass *Spartina anglica,* was first planted on the Dee in 1920s to assist in coastal defence and land claim (see also Section 8.2.1). It demonstrates vigorous growth and is able to grow low down on the shore where the sediments are mobile, being a particularly aggressive coloniser of bare mud. Over the last two decades there has been an increase of about 35% in the extent of saltmarsh habitat, mainly on the north side of the main channel, especially in the mid and upper estuary (Dargie, 2001). This expansion is of particular concern with respect to the loss of muddy sediment communities and the potential for loss of feeding areas used by internationally important migratory species including dunlin, redshank and shelduck.

Primarily due to the possibility of further encroachment of common cordgrass the **intertidal mudflats and sandflats** are considered to have a **medium exposure** to the introduction and translocation of non-native species. The exposure of other habitats is considered to be low.

The **Annex I species, migratory species** and those of the **waterbird assemblage** are all considered to be **moderately vulnerable** to the **introduction of non-native species** to the **intertidal mudflats and sand flats**, their vulnerability with regard to other habitats is low.

12.7.3 Biological disturbance by selective extraction of species

Selective extraction of species includes various forms of exploitation of the living resources comprising estuarine communities, such as commercial shellfish and finfish fisheries, sport fishing (both sea angling and coarse fishing). It also covers the exploitation of the birds themselves in the form of wildfowling.

The unsustainable removal of particular species from estuarine habitats may affect the ecological balance of the marine communities reducing the availability of bird's prey species and food plants. In general **the SPA features** are considered to be **moderately sensitive** to selective extraction of potential prey species in their **feeding habitats** and to their own selective extraction due to wildfowling on the saltmarsh.

The Dee Estuary supports fisheries for both shellfish and finfish. There is a cockle (*Cerastoderma edule*) fishery of high economic importance, and smaller mussel *Mytilus edulis* fishery; in addition there is small-scale collection of razor fish *Ensis* spp. and bait digging for lugworms *Arenicola marina*. The Dee Estuary also has a notable fishery for species such as flounder *Pleuronectes flesus*, mullet species *Chelon labrosus* and *Liza ramada*, cod *Gadus morhua*, and shrimps *Crangon crangon*, as well as a salmon *Salmo salmar* net fishery controlled by a Net Limitation Order (NRA, 1993; Potts & Swaby, 1993).

Cockles are an important prey species for several of the Dee Estuary's internationally important migratory species including oystercatcher, knot and black-tailed godwit. Exploitation of cockles has the potential to both reduce the availability of this important prey species as well as to damage undersize cockles and other invertebrates due to effects or raking, trampling and riddling (see also Section 12.3.2.).

As discussed in Section 8.7.3, at the time of making this assessment, the powers available to the Environment Agency to manage the cockle fishery were limited in scope and resources with no control available upon the numbers of fishermen that may take part. However shellfishery management within the estuary has recently been reviewed and in the future existing problems may be resolved. In the future any deleterious effects of the cockle fishery could be offset by the potential benefits that arise from sustainable management of the stock according to traditional principles. These include the prevention of widespread 'shelling up' of beds, creation of space to allow improved spat fall, reduced volatility of cockle population dynamics, and the maintenance of a better managed stock within the estuary.

Mussels are another exploited species that are also an important prey species for oystercatcher and knot. Mussel harvesting within the Dee Estuary is less regulated that the cockle fishery but occurs with less intensity. Within the estuary mussels occur on hard substrates, especially the ‘artificial’ rocky shores around Port of Mostyn, and the rocky shore of the Hilbre Islands as well as on the intertidal mudflats and sandflats off West Kirby and Thurstaston. Mussel settlement may also take place on very dense cockle beds, which have undergone or are in the process of ‘shelling up’. Excessive exploitation of mussels resulting in the removal of long established areas of mussel beds, or the total removal of mussels over extensive stretches of rocky shore, is considered highly undesirable as it is likely to result in changes in the availability of this important prey species.

Bait digging and razor shell collection are practised within the site at lower intensity, in particular within the sand communities of the North Wirral Foreshore. As with cockling such activities disturb the sediment through digging and to a lesser extent trampling potentially causing changes to sediment community composition.

Wildfowling results in the selective extraction of quarry species including both teal and pintail, which are internationally important migratory species as well as mallard and wigeon, which form part of the internationally important waterbird assemblage. Wildfowling within the Dee Estuary is considered to be well managed and now confined to relatively small areas with much of the saltmarsh being a refuge area. Shooting currently occurs predominantly over areas of marsh at the head of the estuary, as well as off Heswall, and to a lesser degree along the Welsh shoreline at Oakenholt, Flint and Mostyn. Percival and Percival (1998) report that between 1993 and 1997 the average annual wildfowling bag was 2,580 birds with wigeon forming over half of this total. Their investigation found no evidence that wildfowling as practised on the Dee Estuary in 1998 was not sustainable (Percival & Percival, 1998).

Considering the variety of potential exposure mechanisms described above **exposure** to selective extraction is considered to be **low** for the **estuary channels** and **unvegetated shingle ridges**, **medium** for the rocky shore communities and **high** for the intertidal flats, due to the potential scale of shell fish gathering.

Selective extraction for the saltmarsh relates primarily to the direct abstraction of SPA species in the form of wildfowling. Here exposure is considered to be **low** for the **Annex I species** as no quarry species are included. Yet, exposure is high for the important migratory species, especially pintail, and species of the waterbird assemblage, in particular wigeon.

Integrating the assessments of sensitivity and exposure, the **Annex I species** are considered to have **low vulnerability** to selective extraction affecting the **estuary channels**, **saltmarsh** and **shingle ridges** and **high vulnerability** with respect to the **intertidal mudflats and sandflats**. The **migratory species** and those of the **waterbird assemblage** also have **low vulnerability** to selective extraction affecting the **estuary channels** and **shingle ridges**; they are **highly vulnerable** with respect to the **intertidal flats** and the **saltmarsh**, and **moderately** vulnerable with respect to the **rocky shore communities**.

Table 7. Assessment of the relative sensitivity, exposure and vulnerability of SPA interest features and sub-features of the Dee Estuary European marine site to different categories of operations (as at February 2003).

Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading, light grey for moderate vulnerability and dark grey for high vulnerability. Table also incorporates the relative sensitivity scores, used in part to derive vulnerability.

Key: Matrix used to determine relative vulnerability (i.e. Sensitivity x Exposure = Vulnerability)

High sensitivity	O O O O	**High Exposure**	× × × ×	**High vulnerability**	⊗⊗⊗⊗ ⊗⊗⊗O ⊗⊗⊗×
Moderate sensitivity	O O O	**Medium Exposure**	× × ×	**Moderate vulnerability**	⊗⊗OO ⊗⊗× × ⊗⊗⊗
Low sensitivity	O O	**Low Exposure**	× ×	**Low vulnerability**	⊗⊗O ⊗⊗× ⊗⊗
No detectable sensitivity	O	**No exposure**	×	**No vulnerability**	⊗O ⊗× ⊗

Categories of operations which may cause deterioration or disturbance	SPA Interest Features								
	Internationally important populations of regularly occurring Annex I species				Internationally important migratory species and waterbird assemblage				
	Estuary channels	Intertidal mudflats and sandflats	Saltmarsh communities	Unvegetated shingle ridges	Estuary channels	Intertidal mudflats and sandflats	Saltmarsh communities	Rocky shore	Unvegetated shingle ridges
Physical Loss									
Removal (e.g. land claim, dredging)	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗⊗O
Smothering (e.g. depositing dredge spoil, beach feeding)	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗O
Physical Damage									
Siltation (e.g. dredging, outfalls)	⊗⊗× ×	⊗⊗×	⊗⊗	⊗×	⊗⊗× ×	⊗⊗×	⊗⊗	⊗⊗O	⊗×
Abrasion (e.g. recreational activity, vehicles)	⊗⊗	⊗⊗⊗×	⊗⊗O	⊗⊗OO	⊗⊗	⊗⊗⊗×	⊗⊗O	⊗⊗O	⊗⊗× ×
Selective extraction (e.g. aggregate extraction)	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗OO	⊗⊗O
Non-physical disturbance									
Noise (e.g. land/water-based recreation, marine traffic)	⊗⊗OO	⊗⊗OO	⊗⊗⊗O	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗⊗O	⊗⊗OO	⊗⊗⊗O
Visual presence (e.g. land/water-based recreation, marine traffic)	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗⊗O	⊗⊗⊗O	⊗⊗OO	⊗⊗OO	⊗⊗⊗O	⊗⊗⊗⊗
Toxic contamination									
Introduction of synthetic compounds (e.g. TBT, PCBs)	⊗⊗⊗O	⊗⊗⊗O	⊗⊗	⊗⊗O	⊗⊗⊗O	⊗⊗⊗O	⊗⊗⊗O	⊗⊗⊗O	⊗⊗
Introduction of non-synthetic compounds (e.g. effluent outfalls, crude oil)	⊗⊗⊗	⊗⊗⊗	⊗⊗×	⊗⊗O	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗
Introduction of radionuclides	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗×

Categories of operations which may cause deterioration or disturbance	SPA Interest Features								
	Internationally important populations of regularly occurring Annex I species				Internationally important migratory species and waterbird assemblage				
	Estuary channels	Intertidal mudflats and sandflats	Saltmarsh communities	Unvegetated shingle ridges	Estuary channels	Intertidal mudflats and sandflats	Saltmarsh communities	Rocky shore	Unvegetated shingle ridges
Non-toxic contamination									
Changes in nutrient loading (e.g. agricultural run-off, effluent outfalls)	⊗⊗⊗×	⊗⊗⊗×	⊗⊗× ×	⊗⊗	⊗⊗⊗×	⊗⊗⊗×	⊗⊗× ×	⊗⊗⊗×	⊗⊗
Changes in organic loading (e.g. effluent outfalls, aquaculture)	⊗⊗⊗×	⊗⊗⊗×	⊗⊗× ×	⊗⊗	⊗⊗⊗×	⊗⊗⊗×	⊗⊗× ×	⊗⊗⊗×	⊗⊗
Changes in thermal regime (e.g. power station discharges)	⊗⊗	⊗⊗	⊗×	⊗	⊗⊗	⊗⊗	⊗×	⊗×	⊗
Changes in turbidity (e.g. effluent outfalls, dredging, depositing dredged spoil)	⊗⊗⊗×	⊗⊗×	⊗× ×	⊗×	⊗⊗⊗×	⊗⊗×	⊗⊗×	⊗⊗	⊗×
Changes in salinity (e.g. water abstraction, effluent outfalls)	⊗⊗	⊗⊗	⊗×	⊗×	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗×
Biological disturbance									
Introduction of microbial pathogens (e.g. effluent outfalls)	⊗⊗	⊗⊗	⊗×	⊗×	⊗⊗	⊗⊗	⊗⊗	⊗⊗	⊗×
Introduction of non-native species and translocation	⊗⊗O	⊗⊗⊗	⊗⊗	⊗⊗	⊗⊗O	⊗⊗⊗	⊗⊗O	⊗⊗O	⊗⊗
Selective extraction of species (e.g. samphire picking, bait collection)	⊗⊗O	⊗⊗⊗×	⊗⊗O	⊗⊗O	⊗⊗O	⊗⊗⊗×	⊗⊗⊗×	⊗⊗⊗	⊗⊗O

Ramsar site

13. The Dee Estuary Ramsar site interest features

The Dee Estuary European marine site also includes a Ramsar site qualifying under the Ramsar Convention. The features of the Ramsar site mirror very closely those of the SPA, with the exception that the three Annex I tern species do not qualify under the Ramsar Convention criteria. This section will indicate which Ramsar site features can be considered directly analogous to which SPA features. To save unnecessary duplication, wherever possible the reader will be referred to the text provided for the SPA features.

The Dee Estuary Ramsar site includes both marine areas (i.e. land covered continuously or intermittently by tidal waters) and land that is not subject to tidal influence. In accordance with previous DEFRA and NAW policy statements, "*Ramsar Sites in England* (November 2006) and *Ramsar Sites in Wales* (February 2001), Ramsar sites must be given the same consideration as European sites. Therefore, the areas of the Ramsar site below highest astronomical tide will be considered as part of the Dee Estuary European marine site. The seaward boundary of the European marine site is concurrent with that of the Ramsar site. The landward boundary of the European marine site is the upper boundary of the Ramsar site, or where that extends above land covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats.

Where the Ramsar site qualifying species occur within the European marine site, they are referred to as interest features. Supporting habitat sub-features have also been identified to highlight the ecologically important components of the European marine site for each interest feature. A flow chart showing how the interest features and supporting habitat sub features are related can be seen in Figure 3.

This section on The Dee Estuary Ramsar site describes and explains the importance of each of these interest features together with their component sub-features.

13.1 Background and context

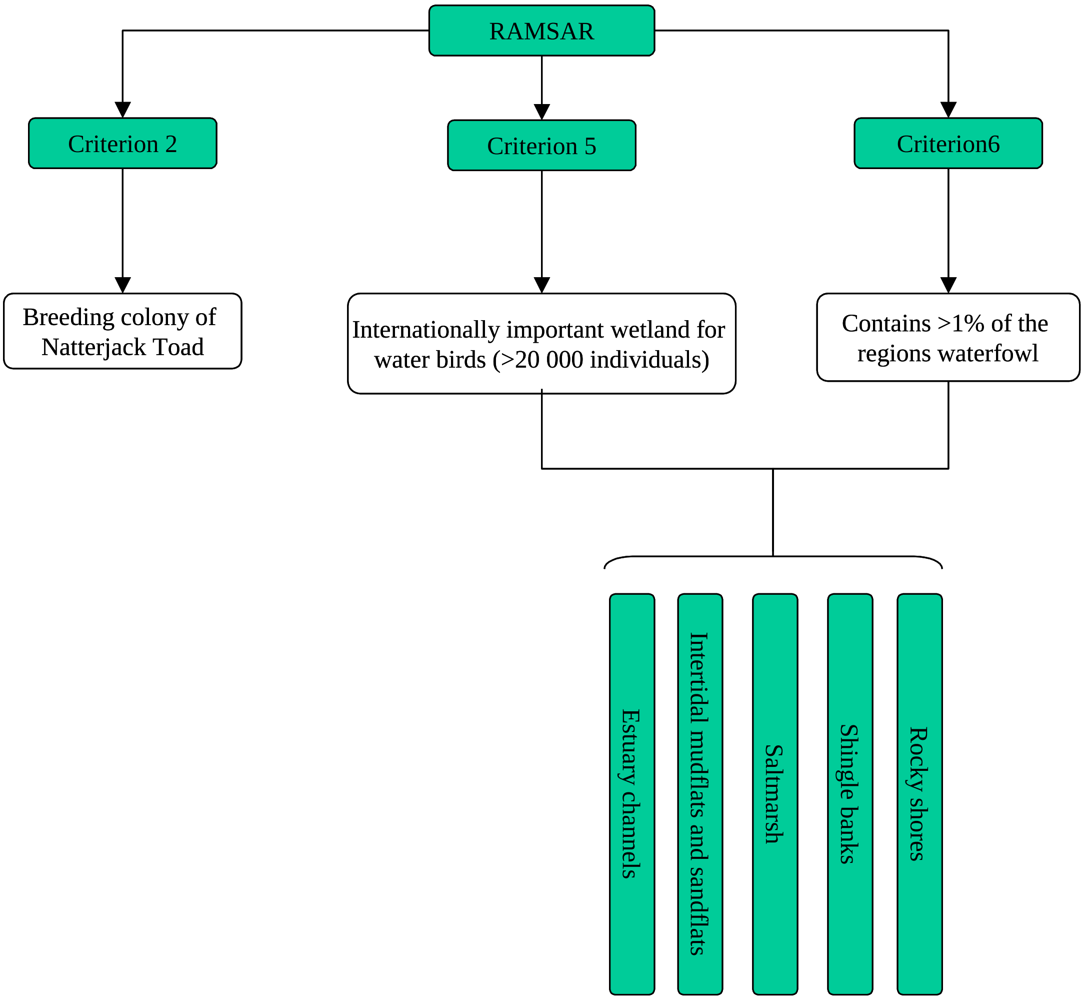
The Convention on Wetlands of International Importance especially as Waterbirds Habitats was signed in Ramsar, Iran in 1971. The broad objectives are to stem the loss and progressive encroachment on wetlands now and in the future through the designation of Ramsar sites. In addition, signatories to the Convention are required to promote the conservation of wetland habitats and wise use of wetlands within their territories.

A habitat can qualify as a Ramsar site for its representation of a wetland, for supporting wetland plant or animal species or for its role in supporting internationally important waterbirds. Interest features are identified within certain criteria.

The Dee Estuary Ramsar site is currently considered to qualify under the following San José criteria:

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities

Figure 3. Flow chart showing the relationship between qualifying interest features and supporting habitat sub features of The Dee Estuary Ramsar site. Qualifying interest features are in 'open' horizontal boxes with supporting habitat sub features in shaded vertical boxes.



Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% or more of the individuals in a population of one species or sub-species of waterbird.

As with SPAs, Natural England and the Countryside Council for Wales' conservation objectives provide information on maintaining the favourable condition of the habitats listed on the citation and/or the habitats used by the qualifying species. Also, the UK Ramsar Committee, led by JNCC, is scoping a review of listed Ramsar sites, which will provide advice to ministers on any changes required. Depending on the conclusions of the review, Natural England and the Countryside Council for Wales may review this advice.

The Ramsar site boundary within the Dee Estuary European marine site is generally concurrent with the corresponding SPA boundary, the major difference being that Red Rocks SSSI is included within the Ramsar site but not the SPA. As explained in Section 2.4.3 there are a number of habitats within the SPA, which support the qualifying bird species, but which do not occur within the European marine site as they occur above highest astronomical tide. These habitats include coastal grazing marsh used by waterbirds for feeding and roosting, and the nesting areas of common terns. Conservation objectives covering the use of such coastal habitats by the qualifying bird species are appended to the SPA conservation objectives. They are provided for information only and do not constitute advice under Regulation 33(2) of the Conservation (Natural Habitats & c.) Regulations 1994. Some species also use areas of land and coastal waters outside the boundaries of the Ramsar site. Relevant authorities need to have regard to such adjacent interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

13.2 Internationally important wetland supports a breeding colony of the vulnerable natterjack toad *Bufo calamita*

The Dee Estuary qualifies as a Ramsar site under Criterion 2 because it supports breeding colony of the vulnerable natterjack toad *Bufo calamita.*

The breeding colony of vulnerable Natterjack Toad *Bufo calamita* at Red Rocks SSSI is dependant on coastal habitats occurring above Highest Astronomical Tide. They are therefore not considered to be a feature of the European marine site. Objectives to maintain the toad's supporting habitats in favourable condition are found within Natural England's conservation objectives for the relevant SSSI within the Ramsar site boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats & c.) Regulations 1994.

13.3 Internationally important wetland, regularly supporting an assemblage of waterbird

The Dee Estuary qualifies as a Ramsar site under **Criterion 5** because it regularly supports 20,000 or more waterbirds (see Table 5).

13.3.1 Key sub-features

The key sub-features for the 20,000 or more waterbirds are similar to those for the SPA, see Section 9.5.3:

- Estuary channels (subtidal sediment communities and the water column)
- Intertidal mudflats and sandflats
- Saltmarsh communities
- Shingle banks
- Rocky shore communities

13.4 Internationally important wetland, regularly supporting populations of waterbird species

The Dee Estuary qualifies as a Ramsar site under **Criterion 6** because it regularly supports 1% or more of the biogeographic populations of waterbirds species

13.4.1 Key sub-features

The key sub-features for the populations of waterbird species are similar to those for the SPA, see Section 9.5.1:

- Estuary channels (subtidal sediment communities and the water column)
- Intertidal mudflats and sandflats.
- Saltmarsh communities.
- Shingle banks.
- Rocky shore communities.

14 The Dee Estuary Ramsar site conservation objectives

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, Natural England and the Countryside Council for Wales have a duty to advise other relevant authorities as to the conservation objectives for European marine sites. Further to UK and Welsh Assembly Government policy to provide Ramsar sites with a similar level of protection to European sites, Natural England and CCW's advice as to the conservation objectives for The Dee Estuary Ramsar site is given in this section.

These conservation objectives should be read in conjunction with other advice given in this document particularly:

- the maps showing the extent of the habitats in Appendices IV and V;
- the description in Section 13 of the features and their importance;
- the favourable condition table in Section 15.

In accordance with UK and Welsh Assembly Government policy, the protection and management of the Ramsar site should be carried out in view of these conservation objectives.

These conservation objectives are subject to review by Natural England and the Countryside Council of Wales.

14.1 Interest feature 1, Criterion 5: Conservation objective for the internationally important wetland regularly supporting 20,000 or more waterbirds

The conservation objective for the "internationally important wetland regularly supporting 20,000 or more waterbirds" feature of The Dee Estuary Ramsar Site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**internationally important wetland regularly supporting 20,000 or more waterbirds** will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering waterbird assemblage is no less than 120,726 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii the relative proportions[2] of waders and wildfowl comprising the wintering waterbird assemblage is maintained;

iii. the extent of intertidal flats[3] and the spatial distribution[4] of their constituent sediment community types[5] is maintained;

iv. the extent of saltmarsh[6] and the spatial distribution[4] of its constituent vegetation community types[7] is maintained;

v. the extent and spatial distribution[4] of saltmarsh vegetation less than 10 cm in height is maintained;

vi. the extent of rocky shore[8] at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is maintained;

vii. the extent and height of the shingle spit[9] at Point of Ayr is maintained;

viii. the abundance of waterbird prey species[10] are maintained at levels sufficient to support the population size in (i);

ix. greater than 25% cover of both seed bearing plants[11] and soft leaved herbs and grasses[12] is maintained during winter across the saltmarsh;

x. existing unrestricted bird sightlines of at least 200m are maintained in every direction around roosting sites[13], loafing[14]and feeding areas[15];

xi. aggregations of roosting[13], loafing[14] or feeding[15] waterbirds are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-15] above is provided in **Box 1.**

NB. Additional conservation objectives are provided relating to the use by waterbirds of areas of The Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee

Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, at Shotton Lagoons and Reedbeds SSSI and at Inner Marsh Farm SSSI, used by waterbirds for feeding, roosting and loafing. Thus The Dee Estuary Ramsar site internationally important assemblage of regularly occurring waterbirds feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;

b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of waterbird prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of waterbirds roosting, loafing or feeding on the coastal fields are not subject to significant disturbance.

Box 1: Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective

[1] **Natural processes**:

Each interest feature is subject to both natural processes and human influences. Human influence on the interest features is acceptable provided that it is compatible with the achievement of the conditions set out under the definition of favourable condition for each interest feature. A failure to meet these conditions which is entirely a result of natural processes will not constitute unfavourable condition, but will trigger a review of the definition of favourable condition. This qualification is necessary because:

(a) the bird populations themselves are subject to natural factors, many of which arise outside the Ramsar Site, such as breeding success and winter temperatures;

(b) the supporting habitats of the birds are influenced by the evolution of the estuary. Natural adjustments within estuaries can take many forms. One important example is the tendency of estuaries to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by subtidal and intertidal sediment banks or features. This, with other natural processes, will therefore cause the width and depth of the estuary to change over time, moving towards a state of dynamic equilibrium or 'most probable state'. As part of this process, the location and extent of saltmarshes and mudflats may change, provided there is capacity to accommodate readjustment. However, where this process is constrained, the capacity of habitats to accommodate readjustment may be affected.

[2] **Relative proportions of waders wildfowl and other waterbirds**

Waders currently make up about 70% of the of the wintering waterbird assemblage, wildfowl comprise about 22% and other waterfowl the remaining 8%.

[3] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[5] is shown in Appendices V and IV respectively.

[4] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[5] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[6] **Saltmarsh extent and spatial distribution:**

Saltmarsh extent and spatial distribution of community types is shown in Appendices V and IV respectively.

[7] **Saltmarsh vegetation community types:**

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

Box 1 (continued): Explanatory information for the "internationally important assemblage of regularly occurring waterbirds" conservation objective

[8] **Rocky shore extent**:

Rocky shore extent and distribution is shown in Appendix V.

[9] **Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

[10] **Waterbirds prey species:**

Prey species favoured by the waterbirds of the Dee Estuary include the following:

Polychaete worms: rag worm *Hediste diversicolor*, lug worm *Arenicola marina*,
Molluscs: Mud snails *Hydrobia* spp., mussels *Mytilus edulis,* cockles *Cerastoderma edule*, Baltic tellins *Macoma balthica*;
Crustaceans: amphipods *Corophium spp*., shore crab *Carcinus maenas*, brown shrimp *Crangon crangon*;

[11] **Seed bearing plants**:

Wildfowl feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

[12] **Soft leaved herbs and grasses**:

Wildfowl feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

[13] **Waterbird roosting areas:**

Roosting sites regularly used by waders, and other waterbirds are shown in Appendices VI and VIII.

[14] **Waterbird loafing areas:**

Loafing areas regularly used by wildfowl are shown in Appendix VIII

[15] **Waterbird feeding areas:**

Feeding areas regularly used by waders, wildfowl and other waterbirds are shown in Appendices VI and VIII.

14.2 Interest feature 2, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more redshank of the eastern Atlantic population on passage

The conservation objective for the "passage redshank" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**passage redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met**:**

i. the 5 year peak mean population size for the passage redshank population is no less than 8,795 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 2**.

NB. Additional conservation objectives are provided relating to the use by redshank of areas of The Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding and roosting. Thus The Dee Estuary Ramsar passage redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank roosting or feeding on the coastal fields are not subject to significant disturbance.

Box 2: Explanatory information for the "passage redshank" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types**[4]** is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Redshank prey species**:

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp., tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas**:

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas**:

Feeding areas regularly used by redshank are shown in Appendix VI.

14.3 Interest feature 3, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering shelduck of the North-western European population

The conservation objective for the "wintering shelduck" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering shelduck**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering shelduck population is no less than 7,725 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of shelduck prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

v. aggregations of loafing[7] or feeding[8] shelduck are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 3**.

Box 3: Explanatory information for the "wintering shelduck" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Shelduck prey species**:

Shelduck prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7]. **Shelduck loafing areas**:

Loafing areas regularly used by shelduck are shown in Appendix VIII.

[8] **Shelduck feeding areas**:

Feeding areas regularly used by shelduck are shown in Appendix VIII.

14.4 Interest feature 4, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering teal of the North-western European population

The conservation objective for the "wintering teal" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering teal**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering teal population is no less than 5,251 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. greater than 25% cover of seed bearing plants[7] is maintained during winter across the saltmarsh;

v. the extent of standing water pools or 'flashes' in the saltmarsh is maintained;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[8] and feeding areas[9];

vii. aggregations of loafing[8] or feeding[9] teal are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-9] above is provided in **Box 4.**

NB. Additional conservation objectives are provided relating to the use by teal of areas of The Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools along the Welsh shore within the Dee Estuary SSSI and at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus The Dee Estuary Ramsar site wintering teal feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of teal loafing or feeding on pools and coastal fields are not subject to significant disturbance.

Box 4: Explanatory information for the "wintering teal" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution:**

Saltmarsh extent and distribution is shown in Appendix V.

[6] **Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

[7] **Seed bearing plants:**

Teal feed on seed-bearing saltmarsh plants including glasswort *Salicornia* spp., and oraches *Atriplex* spp. (Kirby *et al*., 2000).

[8] **Teal loafing areas:**

Loafing areas regularly used by teal are shown in Appendix VIII.

[9] **Teal feeding areas**:

Feeding areas regularly used by teal are shown in Appendix VIII.

14.5 Interest feature 5, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering pintail of the North-western Europe population

The conservation objective for the "wintering pintail" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering pintail**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering pintail population is no less than 5,407 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. the extent of saltmarsh[5] and the spatial distribution[3] of its constituent vegetation community types[6] is maintained;

iv. the abundance and dispersion[7] of pintail prey species[8] is maintained at levels required to support the population size in (i);

v. greater than 25% cover of soft leaved herbs and grasses[9] is maintained during winter across the saltmarsh;

vi. existing unrestricted bird sightlines of at least 200m are maintained in every direction around loafing areas[10], and feeding areas[11];

vii. aggregations of loafing[10] or feeding[11] pintail are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-11] above is provided in **Box 5.**

NB. Additional conservation objectives are provided relating to the use by pintail of areas of The Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields and pools at Inner Marsh Farm SSSI, which are used for loafing and feeding. Thus The Dee Estuary Ramsar site wintering pintail feature can only be in favourable condition if the conservation objectives pertaining to their use of these habitats are also met. These objectives (*a-d*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) aggregations of pintail loafing or feeding on pools and coastal fields are not subject to significant disturbance.

Box 5: Explanatory information for the "wintering pintail" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V.

[6] **Saltmarsh community types**:

The constituent vegetation community types of the Dee Estuary saltmarsh are: pioneer low marsh communities, low to mid marsh communities, mid to upper marsh communities, and transitional high marsh communities.

[7] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[8] **Pintail prey species**:

Pintail feed on surface and near surface invertebrates including mudsnails *Hydrobia* spp. (Kirby *et al*., 2000).

[9] **Soft leaved herbs and grasses**:

Pintail feed on soft-leaved saltmarsh plants including common saltmarsh grass *Puccinellia maritima* and glasswort *Salicornia* spp. (Kirby *et al*., 2000).

[10] **Pintail loafing areas:**

Low water loafing areas regularly used by pintail are shown in Appendix VIII

[11] **Pintail feeding areas:**

Feeding areas regularly used by pintail are shown in Appendix VIII.

14.6 Interest feature 6, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering oystercatcher of the Europe and North-western Africa population

The conservation objective for the "wintering oystercatcher" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering oystercatcher**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering oystercatcher population is no less than 22,677 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of oystercatcher prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. the extent of rocky shore[7] at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is maintained;

vi. the extent and height of the shingle spit[8] at Point of Ayr is maintained;

vii. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[9] and feeding areas[10];

viii. aggregations of roosting[9] or feeding[10]oystercatcher are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-10] above is provided in **Box 6.**

NB. Additional conservation objectives are provided relating to the use by oystercatcher of areas of the Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by oystercatcher for feeding and roosting. Thus The Dee Estuary Ramsar Site wintering oystercatcher feature can only be in favourable condition if the conservation objectives pertaining to their use of these coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;

c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of oystercatcher prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of oystercatcher roosting or feeding on the coastal fields are not subject to significant disturbance.

Oystercatcher are known to use North Wirral Foreshore SSSI in numbers of significance. North Wirral Foreshore SSSI directly abuts The Dee Estuary Ramsar site and forms part of the area of both the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site. North Wirral Foreshore SSSI includes some key feeding areas for the Dee Estuary oystercatcher population and therefore the condition of North Wirral Foreshore SSSI is important in maintaining the overall wintering oystercatcher population in the wider estuary.

Box 6: Explanatory information for the "wintering oystercatcher" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion**:

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Oystercatcher prey species:**

Oystercatcher prey species include cockles *Cerastoderma edule* and mussels *Mytilus edulis* between 15 and 35 mm in length as well as lugworms *Arenicola marina* (Kirby *et al*, 2000).

[7] **Rocky shore extent:**

Rocky shore extent at Hilbre Island, Middle Eye, Little Eye and Tanskey Rocks is shown in Appendix V.

[8] **Shingle ridge extent and height:**

The location of the shingle ridge at Point of Ayr is shown in Appendix V.

[9] **Oystercatcher roosting areas:**

Roosting sites regularly used by oystercatcher are shown in Appendix VI.

[10] **Oystercatcher feeding areas:**

Feeding areas regularly used by oystercatcher are shown in Appendix VI.

14.7 Interest feature 7, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering grey plover of the Eastern Atlantic population

The conservation objective for the "wintering grey plover" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering grey plover**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering grey plover population is no less than 1,643 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of grey plover prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution of saltmarsh vegetation less than 10 cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] grey plover are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 7.**

NB. Wintering grey plover are known to use North Wirral Foreshore SSSI in numbers of national significance. North Wirral Foreshore SSSI directly abuts The Dee Estuary Ramsar site and forms part of the area of both the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site. North Wirral Foreshore SSSI includes some key feeding areas for the Dee Estuary wintering grey plover population and therefore the condition of North Wirral Foreshore SSSI is important in maintaining the overall wintering grey plover population in the wider estuary.

Box 7: Explanatory information for the "wintering grey plover" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Grey plover prey species**:

Grey plover prey species include polychaete worms, small molluscs and crustaceans (Kirby *et al*., 2000)

[7] **Grey plover roosting areas:**

Roosting sites regularly used by grey plover are shown in Appendix VI.

[8] **Grey plover feeding areas:**

Feeding areas regularly used by grey plover are shown in Appendix VI.

14.8 Interest feature 8, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering knot of the North-western Canada to North-western Europe population

The conservation objective for the "wintering knot" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering knot**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering knot population is no less than 12,394 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. The abundance and dispersion[5] of knot prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] knot are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 8.**

NB. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore by wintering knot because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar site, which directly abuts the Dee Estuary Ramsar site and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary wintering knot population and therefore the Dee Estuary wintering knot feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site wintering knot feature are also met in full.

Box 8: Explanatory information for the "wintering knot" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types**:

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Knot prey species:**

Knot prey species include the small molluscs, Baltic tellin *Macoma balthica*, mussel spat *Mytilus edulis* and cockle spat *Cerastoderma edule*, and mud snails *Hydrobia* spp. (Kirby *et al*., 2000).

[7] **Knot roosting areas:**

Roosting sites regularly used by knot are shown in Appendix VI.

[8] **Knot feeding areas:**

Feeding areas regularly used by knot are shown in Appendix VI.

14.9 Interest feature 9, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering dunlin of the Northern Siberia, Europe and Northern Africa population

The conservation objective for the "wintering dunlin" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering dunlin**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering dunlin population is no less than 27,769 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of dunlin prey species[6] are maintained at levels sufficient to support the population size in (i);

iv the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] dunlin are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 9**.

NB. Conservation objectives are also to be produced relating to the use of North Wirral Foreshore SSSI by dunlin because they are a feature of this SSSI, which directly abuts The Dee Estuary Ramsar site and forms part of both the area of the Dee Estuary SAC and the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar Site. North Wirral Foreshore SSSI includes some of the key feeding areas for the Dee Estuary wintering dunlin population and therefore the Dee Estuary wintering dunlin feature can only be in favourable condition if the conservation objectives pertaining to the North Wirral Foreshore SSSI dunlin feature are also met in full.

Box 9: Explanatory information for the "wintering dunlin" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Dunlin prey species:**

Dunlin prey species include ragworms *Hediste diversicolor*, Baltic tellin *Macoma balthica*, mud snails *Hydrobia* spp., brown shrimp *Crangon crangon*, and small shore crabs *Carcinus maenas* (Kirby *et al*., 2000).

[7] **Dunlin roosting areas**:

Roosting sites regularly used by dunlin are shown in Appendix VI

[8] **Dunlin feeding areas:**

Feeding areas regularly used by dunlin are shown in Appendix VI.

14.10 Interest feature 10, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering black-tailed godwit of the Icelandic population

The conservation objective for the "wintering black-tailed godwit" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering black-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering black-tailed godwit population is no less than 1,747 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;

iii. The abundance and dispersion[5] of black-tailed godwit prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] and feeding[8] black-tailed godwit are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 10.**

NB. Additional conservation objectives are provided relating to the use by black-tailed godwit of areas of The Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI, and at Inner Marsh Farm SSSI, used by black-tailed godwit for feeding and roosting. Thus The Dee Estuary Ramsar site wintering black-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of black-tailed godwit prey species including earthworms, leatherjackets and chironomids is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;

f) aggregations of black-tailed godwit feeding or roosting on the coastal fields are not subject to significant disturbance.

Box 10: Explanatory information for the “wintering black-tailed godwit” conservation objective

[1] **Natural processes:**

The meaning of ‘natural processes’ is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Black-tailed godwit prey species:**

Black-tailed godwit prey species include Baltic tellins *Macoma balthica*, cockles *Cerastoderma edule* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Black-tailed godwit roosting areas:**

Roosting sites regularly used by black-tailed godwit are shown in Appendix VI.

[8] **Black-tailed godwit feeding areas:**

Feeding areas regularly used by black-tailed godwit are shown in Appendix VI.

14.11 Interest feature 11, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering bar-tailed godwit of the Western Paleartic population

The conservation objective for the "wintering bar-tailed godwit" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering bar-tailed godwit**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering bar-tailed godwit population is no less than 1,150 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the extent and spatial distribution[3] of vegetation less than 10cm in height across the saltmarsh[5] is maintained;

iv. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[6] and feeding areas;

v. aggregations of bar-tailed godwit roosting[6] or feeding or on the intertidal flats or saltmarsh[4] are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-6] above is provided in **Box 11**.

NB. Other conservation objectives are to be produced relating to the use of North Wirral Foreshore by bar-tailed godwit because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA, which directly abuts The Dee Estuary Ramsar site and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore includes key feeding areas for the Dee Estuary bar-tailed godwit population and therefore The Dee Estuary Ramsar Site wintering bar-tailed godwit feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA bar-tailed godwit feature are also met in full.

Box 11: Explanatory information for the "wintering bar-tailed godwit" conservation objective

[1] **Natural processes**:

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent**:

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Saltmarsh extent and spatial distribution**:

Saltmarsh extent and distribution is shown in Appendix V

[6] **Bar-tailed godwit roosting areas**:

Roosting sites regularly used by bar-tailed godwit are shown in Appendix VI

14.12 Interest feature 12, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering curlew of the European population

The conservation objective for the "wintering curlew" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering curlew**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering curlew population is no less than 3,899 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];

ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained

iii. the abundance and dispersion[5] of curlew prey species[6] are maintained at levels sufficient to support the population size in (i);

iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10cm in height is maintained;

v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] curlew are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 12.**

NB. Additional conservation objectives are provided relating to the use by curlew of areas of the Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include pools and coastal fields along the Welsh shore within the Dee Estuary SSSI for feeding and roosting. Thus The Dee Estuary Ramsar site wintering curlew feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a-f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland and standing water including pools, ditches and channels is maintained;
d) the abundance of curlew prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of curlew feeding or roosting on the coastal fields are not subject to significant disturbance.

Box 12: Explanatory information for the "wintering curlew" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1.**

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices IV and V respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Curlew prey species:**

Curlew prey species include shore crab *Carcinus maenas* and polychaete worms including ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Curlew roosting areas:**

Roosting sites regularly used by curlew are shown in Appendix VI.

[8] **Curlew feeding areas:**

Feeding areas regularly used by curlew are shown in Appendix VI.

14.13 Interest feature 13, Criterion 6: Conservation objective for the internationally important wetland, regularly supporting 1% or more wintering redshank of the Eastern Atlantic population

The conservation objective for the "wintering redshank" feature of The Dee Estuary Ramsar site is to maintain the feature in a favourable condition, as defined below:

The interest feature "**wintering redshank**" will be considered to be in favourable condition when, subject to natural processes[1], each of the following conditions are met:

i. the 5 year peak mean population size for the wintering redshank population is no less than 5,293 individuals [*i.e. the 5 year mean peak between 1994/95-1998/99*];
ii. the extent of intertidal flats[2] and the spatial distribution[3] of their constituent sediment community types[4] is maintained;
iii. the abundance and dispersion[5] of redshank prey species[6] are maintained at levels sufficient to support the population size in (i);
iv. the extent and spatial distribution[3] of saltmarsh vegetation less than 10 cm is maintained;
v. existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites[7] and feeding areas[8];

vi. aggregations of roosting[7] or feeding[8] redshank are not subject to significant disturbance.

Further explanatory information clarifying the meaning of terms [1-8] above is provided in **Box 13.**

NB. Additional conservation objectives are provided relating to the use by redshank of areas of the Dee Estuary Ramsar site above highest astronomical tide, which are outside the Dee Estuary European marine site. These areas include the coastal fields along the Welsh shore within the Dee Estuary SSSI used by redshank for feeding and roosting. Thus The Dee Estuary Ramsar site wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to their use of these pools and coastal fields are also met. These objectives (*a*-*f*) are provided below for information but they do not qualify as Advice under Regulation 33 (2) of the Conservation (Natural Habitats & c.) Regulations, 1994:

a) the extent of coastal grazing marsh is maintained;
b) the extent of all coastal fields is maintained;
c) the extent of wet grassland with standing water including, pools, ditches and channels is maintained;
d) the abundance of redshank prey species including earthworms and leatherjackets is maintained;
e) existing unrestricted bird sightlines of at least 200m are maintained in every direction around both roosting sites and feeding areas;
f) aggregations of redshank feeding or roosting on the coastal fields are not subject to significant disturbance.

Conservation objectives are also to be produced relating to the use of North Wirral Foreshore by wintering redshank because they are a feature of the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar site, which directly abuts the Dee Estuary Ramsar site and forms part of the area of the Dee Estuary SAC. North Wirral Foreshore includes some of the key feeding areas for The Dee Estuary redshank population and therefore The Dee Estuary Ramsar Site wintering redshank feature can only be in favourable condition if the conservation objectives pertaining to the Mersey Narrows and North Wirral Foreshore pSPA and pRamsar site wintering redshank feature are also met in full.

Box 13: Explanatory information for the "wintering redshank" conservation objective

[1] **Natural processes:**

The meaning of 'natural processes' is explained in **Box 1**.

[2] **Intertidal flat extent:**

Intertidal flat extent and the distribution of constituent sediment community types[4] is shown in Appendices V and IV respectively.

[3] **Spatial distribution**

Spatial distribution of intertidal flat / saltmarsh communities refers to the macro spatial pattern in which communities are distributed around the estuary. For example, it concerns the zonation of clean sands being found towards the estuary mouth, muddy sands in the mid estuary and mud in the upper estuary with saltmarsh concentrated along sheltered shores in the mid-upper estuary. The statement does not require micro-distribution of communities e.g. the exact mapped positions of specific communities to be maintained.

[4] **Intertidal flat community types:**

The constituent sediment community types of the Dee Estuary intertidal flats are: intertidal gravel and clean sand communities, intertidal muddy sand communities including cockle beds, and intertidal mud communities.

[5] **Prey dispersion:**

Dispersion of prey species refers to the degree of spreading out of food items across the intertidal flats, irrespective of location, which can affect feeding rates. Where prey species are over dispersed it may take birds a long time to find each food item, yet if prey species are confined to too small an area birds feeding rate can be reduced due to interference between birds (Goss-Custard *et al*., 2001).

[6] **Redshank prey species:**

Redshank prey species include the amphipod crustaceans *Corophium* spp, mud snails, *Hydrobia* spp. tellins *Macoma* spp. and ragworms *Hediste diversicolor* (Kirby *et al*, 2000).

[7] **Redshank roosting areas:**

Roosting sites regularly used by redshank are shown in Appendix VI.

[8] **Redshank feeding areas:**

Feeding sites regularly used by redshank are shown in Appendix VI.

15. Favourable Condition Table for The Dee Estuary Ramsar site interest features of the Dee Estuary European marine site

The information that Natural England and the Countryside Council for Wales will use to assess the condition of Ramsar site interest features within the Dee Estuary is in Section 11.

When making use of the SPA favourable condition tables the information provided for the SPA and features should be considered applicable for the Ramsar site features as detailed below:

- The Ramsar site features 'internationally important waterbird populations', qualifying under Ramsar site Criterion 6 are analogous to the SPA features 'internationally important populations of regularly occurring migratory species'.

- The Ramsar site feature 'assemblage of waterbirds' qualifying under Ramsar site Criterion 5 is analogous to the SPA feature 'internationally important assemblage of waterbirds'.

- The SPA feature 'internationally important populations of regularly occurring Annex I species' includes bar-tailed godwit, which under the Ramsar site designation is a waterbird population qualifying under Ramsar site Criterion 6.

16 Operations advice for The Dee Estuary Ramsar site interest features

The detailed operations advice for the SPA interest features provided in Sections 8 and 12 of this document and summarised in Tables 3 and 7 can be considered applicable to the Ramsar site features of the European marine site as detailed below and therefore that information is not be repeated here.

- The Ramsar site features ‘internationally important waterbird populations’, qualifying under Ramsar site Criterion 6 are analogous to the SPA features ‘internationally important populations of regularly occurring migratory species’.

- The Ramsar site feature ‘assemblage of waterbirds’ qualifying under Ramsar site Criterion 5 is analogous to the SPA feature ‘internationally important assemblage of waterbirds’.

- The SPA features ‘internationally important populations of regularly occurring Annex I species’ include bar-tailed godwit, which under the Ramsar site designation is a waterbird population qualifying under Ramsar site Criterion 6.

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18. Glossary

Abrasion	The process of scraping or wearing down by friction
Advisory Group	A body of representatives from local interests, user groups and conservation groups, formed to advise a management group
Algal bloom	A massive reproduction and growth of algae, often free-floating, in response to the presence of higher than normal levels of nutrients.
Annex I birds	The species listed in Annex I of the Birds Directive are the subject of special conservation measures concerning their habitat. These measures ensure the survival and reproduction of the birds in their area of distribution. Species listed on Annex I are in danger of extinction, rare or vulnerable
Annex I habitat type(s)	A natural habitat(s) listed in Annex I of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex II species	A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected.
Anthropogenic	Produced by human activity.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment but not necessarily interdependent.
Attribute	Characteristic of an interest feature/sub-feature or supporting habitat, which provides an indication of the condition of the feature/sub-feature or supporting habitat to which it applies.
BAP	Biodiversity Action Plan.
Baseline	A standard or value from which it is possible to determine any deviation in the integrity of the interest features for which the site has been designated.
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
Bioaccumulation	The ability of organisms to retain and concentrate substances from their environment. The gradual build-up of substances in living tissue, usually used in referring to toxic substances, may result from direct absorption from the environment or through the food chain.
Biodegradation	Breakdown or decomposition by bacteria or other biological means.
Biodiversity	The total variety of life on earth. This includes diversity within species, between species and ecosystems.
Biogeographic region	A region which is separated from adjacent regions by barriers or a change in environmental conditions which limits the movement of species or prevents their establishment outside their natural geographical range.
Biomagnification	Increasing concentrations of a substance in successive trophic levels of a food chain.
Biomass	The total quantity of living organisms in a given area.
Biotope	The physical habitat with its biological community; a term, which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.
Characteristic	Special to, or especially abundant in, a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Chart datum	Approximately the lowest tidal level due to astronomical effects, and excluding meteorological effects.

Circalittoral	The rocky subtidal zone dominated by animals and below the zone that is dominated by algae (Animal dominated subtidal zone).
Community	A group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups.
Competent authority	Any Minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legislative powers.
Conservation objective	A statement of the nature conservation aspirations for a site, expressed in terms of the favourable condition that we wish to see the species and/or habitats for which the site has been selected to attain. Conservation objectives for European marine sites relate to the aims of the Habitats Directive.
Crustaceans	A class of invertebrates that include crabs, shrimps and barnacles.
Diversity	The richness of different types in a location, including the number of different biotopes and numbers of species.
Epifauna	Benthic animals living on the seabed of sediments or hard substrates.
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacles, mussels, fucoid algae and red algae often abundant on the lower part.
European marine site	A European site that consists of, or in so far as it consists of, areas covered intermittently or continuously by seawater.
European Site	A classified SPA, designated SAC, site of Community importance (a site selected as a candidate SAC, adopted by the European Commission but not yet designated), a candidate SAC (in England only) or a site hosting a priority species in respect of which Article 5 of the Habitats directive applies.
Eutrophication	The over-enrichment of an aquatic environment with inorganic nutrients, especially nitrates and phosphates, often anthropogenic (e.g. sewage, fertiliser run-off), which may result in stimulation of growth of algae and bacteria, and can reduce the oxygen content of water.
Exposure	The relative extent and intensity of the effects of broad categories of human activities currently occurring on the site to which the interest features or their component sub-features on the site are subject.
Fauna	Animal life in an area.
Favourable condition	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function within an individual *Natura 2000* site in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
Favourable conservation status	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function throughout the biogeographic region in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
Habitat	The place in which a plant or animal lives.
Habitats Directive	The abbreviated term for *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora*. It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union.
Halophytic	Plants that thrive in, or tolerate the presence of saline conditions.

Highest Astronomical Tide	The highest tidal level that can be predicted to occur under average meteorological conditions and in any combination of astronomical conditions.
Hydrodynamic regime	The particular conditions of water movement at one particular site, including wave action, tidal streams and residual currents.
Infauna	Benthic animals that live within the seabed.
Infralittoral	The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps.
Interest feature	A natural or semi-natural feature for which a European site has been selected. This includes any Habitats Directive Annex I habitat, or any Annex II species and any population of a bird species for which an SPA has been designated under the Birds Directive.
Littoral	The area of the shore that is occupied by marine organisms which are adapted to or need alternating exposure to air and wetting by submersion, splash or spray. Also called intertidal.
Maintain	The action required for an interest feature when it is considered to be in favourable condition.
Management group	The body of relevant authorities formed to manage the European marine site.
Management scheme	The framework established by the relevant authorities at a European marine site under which their functions are exercised to secure, in relation to that site, compliance with the requirements of the Habitats Directive.
Molluscs	Soft-bodied, unsegmented, invertebrate animals usually with shells and includes cockles, whelks, limpets, oysters and snails.
Nationally scarce/rare	For marine purposes, these are regarded as species of limited national occurrence
Natura 2000	The European network of protected sites established under the Birds Directive and the Habitats Directive
Non-synthetic contamination	Non-synthetic compounds are those materials that occur naturally. They may have to be refined before they are useful to man and could occur in many slightly different forms. Examples of non-synthetic materials are; heavy metals and hydrocarbons (oil and petrol).
Notable species	A species that is considered to be notable due to its importance as an indicator, and may also be of nature conservation importance, and which is unlikely to be a 'characteristic species'.
Operations which may cause deterioration or disturbance	Any activity or operation taking place within, adjacent to, or remote from a European marine site that has the potential to cause deterioration to the natural habitats for which the site was designated, or disturbance to the species and its habitats for which the site was designated.
Opportunistic species	A species that is able to rapidly exploit changes in habitat conditions or circumstances to its own advantage.
Plan or project	Any proposed development that is within a relevant authority's function to control, or over which a competent authority has a statutory function to decide on applications for consents, authorisations, licences or permissions.
Ramsar site	A site listed under the Convention on Wetlands of International Importance especially as Waterbirds Habitat, which was agreed at Ramsar, Iran.
Relevant authority	The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment, or adjacent to, a European marine site.

Reporting period	The cycle within which a definitive report on the condition of features protected within the site series will be produced, set as once in every 6 years.
Restore	The action required for an interest feature when it is not considered to be in a favourable condition.
Sensitivity	The intolerance of a habitat, community or individual species to damage from an external force.
Sub-feature	An ecologically important sub-division of an interest feature.
Sublittoral	The zone of the shore below low water exposed to air only at its upper limit by the lowest spring tides.
Supporting Habitats	The key habitats within the European marine site necessary to support the qualifying species interest features.
Synthetic contamination	Synthetic compounds are those materials that have been manufactured artificially by chemical reaction. Examples of some synthetic compounds are; antifouling paints, detergents, pesticides (Polychloronatedbiphenyls or PCBs) and biocides (tributyltin or TBT).
Turbidity	This is a measure of the attenuation of light in the water column and can be caused by the light adsorption properties of the water, plankton, suspended particulate organic and inorganic matter and dissolved colour.
Typical species	A species that is considered to be a typical component of a feature or sub-feature.
Vulnerability	The exposure of a habitat, community or individual of a species to an external factor to which it is sensitive.
WeBS	Wetland Bird Survey a collaborative national surveillance scheme of the UK's waterbirds based on counts undertaken once per month outside of the breeding season.

Appendix C River Dee and Bala Lake/Afon Dyfrdwy a Llyn Tegid SAC

Cyfoeth Naturiol Cymru
Natural Resources Wales

CORE MANAGEMENT PLAN INCLUDING CONSERVATION OBJECTIVES

FOR

River Dee and Bala Lake/Afon Dyfrdwy a Llyn Tegid SAC

Cyfoeth Naturiol Cymru
Natural Resources Wales

Noddir gan
Lywodraeth Cymru
Sponsored by
Welsh Government

Version	Date	Summary of changes made	Approved by
Version 3	September 2022	Revision of water quality targets for river features, updated formatting, clarification of the relationship between Conservation Objectives and Performance Indicators.	Dave Powell
Version 2	July 2021		Dave Powell
Version 1	March 2008		N.R. Thomas

The LIFE Dee River project commenced in September 2019 and will work to: remove constraints to fish passage; restore or improve natural riverine physical processes; improve agricultural and forestry land management practices to reduce their impact; initiate conservation management for freshwater pearl mussel; and establish and build long-term relationships with stakeholders. LIFE Dee River will also carry out a review the core management plan for the River Dee and Bala Lake SAC by December 2024. Features of management units are based on current ranges but are expected to change in the immediate future as works are completed as part of LIFE Dee River.

Contents

Preface

This document provides the main elements of Natural Resources Wales' management plan for the site(s) named. It sets out what needs to be achieved on the site(s), and advice on the action required. This document is made available through Natural Resources Wales' web site and may be revised in response to changing circumstances or new information. This is a technical document that supplements summary information on the Natural Resources Wales' web site.

One of the key functions of this document is to provide Natural Resources Wales' statement of the Conservation Objectives for the relevant Special Area of Conservation (SAC) and Special Protection Area (SPA) site(s). This is required to implement the changes through the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 in addition to the existing Conservation of Habitats and Species Regulations 2017. As a matter of Welsh Government Policy, the provisions of those regulations are also to be applied to Ramsar sites in Wales.

The River Dee and Bala Lake SAC is a cross-border site between Wales and England; this plan and Conservation Objectives only cover the parts of the SAC which are in Wales. Conservation Objectives for the parts of the River Dee which are in England are available on Natural England's website (Natural England, 2018, 2019).

Vision for the site

This 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.

The purpose of the designation of SAC and SPA sites is to help secure the maintenance or restoration of habitats and species to favourable conservation status *for the foreseeable future*. Given that we foresee a changing climate, despite the uncertainty of the nature, degree and timing of those changes, we must address the need to ensure the resilience of each site to that changing environment. This will be achieved in the first instance by ensuring favourable condition of the important features, since a healthy feature is likely to be more resilient to the effects of climate change than one which is already stressed. Secondly, consideration must be given to those structures, functions and processes which maintain or boost the resilience of ecosystems to climate stress, including the avoidance, reduction or mitigation of other stress factors such as invasive species, nutrient enrichment, habitat and population fragmentation.

This site forms part of a wider network, and is ecologically connected with its surroundings and with other designated sites in the region. Although the focus of this document is on the individual site, the conservation objectives and management requirements need to be considered in the wider context. A connected network of sites is more robust than sites in isolation, and more resilient to pressures such as climate change.

Our vision for the River Dee and Bala Lake SAC is that it will be maintained at, or where necessary restored to, high ecological status with all its features at favourable conservation status. Factors under human control that may significantly affect its feature species or populations in or outside of the site, will be controlled in such a way that the features will sustain themselves as part of a functioning ecosystem. This will be true both for plants and animals whose life cycles remain entirely within the site's boundaries, and for migratory species that only spend certain stages of their lives in the SAC.

Water is clearly fundamental to a riverine SAC. Therefore the quality, quantity and flow variability of water, plus the quality of adjacent habitats, will be maintained or adjusted to a level necessary to maintain the features in favourable condition for the foreseeable future. Natural processes of erosion and deposition will operate without interference.

The protected aquatic and emergent plant communities will continue to characterise parts of the river and lake. In addition to enhancing its appearance, such communities provide a good indication of the overall quality of the river and lake environment and provide important habitats for fish and invertebrates.

The protected fish species found in this SAC, both those that are resident all year round, such as the bullhead and brook lamprey, and migratory species such as the Atlantic salmon, sea and river lampreys, swim up river to spawn and go through their juvenile stages in the river. These species will be present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat.

The migratory fish will be able to complete their migrations and life cycles largely unhindered by artificial barriers such as weirs, disturbance, pollution and external factors such as being caught in the by-catch of fishing operations at sea.

Llyn Tegid is the largest natural lake in Wales. It will have a healthy ecosystem that is not suffering from nutrient enrichment or acidification, and where use as a reservoir does not impinge on its wildlife interest. As a result, it supports flourishing populations of three rare species: gwyniad, glutinous snail, and floating water-plantain.

The abundance of prey and widespread availability of undisturbed resting and breeding sites, will allow a large otter population to thrive. Otters will be found throughout the SAC and in adjacent, supporting habitat.

Site Description

Area and Designations Covered by this Plan

Grid reference(s): SH887311 to SJ287710

Unitary authority(ies): Gwynedd Council, Denbighshire County Council, Wrexham County Borough Council, Flintshire County Council, Snowdonia National Park Authority

Area (hectares): 1151 ha

Designations covered: Llyn Tegid SSSI, Llyn Tegid Ramsar Site, Afon Dyfrdwy (River Dee) SSSI, Afon Dyfrdwy a Llyn Tegid SAC.

Detailed maps of the designated sites are available on the Natural Resources Wales web site.

Outline Description

The source of the River Dee lies within the Snowdonia National Park and its catchment contains a wide spectrum of landscapes from high mountains around Bala, steep-sided wooded valleys, near Llangollen, to the rich agricultural plains of Cheshire and north Shropshire and the vast mudflats of the estuary.

The course and topography of the River Dee and its tributaries were strongly influenced and modified during the last Ice Age. The underlying geology of the Dee ranges from impermeable Cambrian and Ordovician shales in the west, through Silurian to Carboniferous Limestone outcrop at Llangollen to Coal Measures and thick boulder clay overlying the Triassic sandstones of the Lower Dee valley.

The site extends from the western extremity of Llyn Tegid taking in the entire lake and its banks to its outfall into the River Dee. It then takes in the river and its banks downstream to where it joins the Dee Estuary SSSI. A number of the Dee's tributaries are also included, these being the Ceiriog, Meloch, Tryweryn, and Mynach. In its swifter upper reaches, the Dee flows through the broad valley near Corwen, and the spectacular Vale of Llangollen before entering the Cheshire plain at Erbistock where it meanders northwards through the Cheshire plain to Chester. Below Chester Weir, the river is largely Estuarine in character. However there is a tidal influence as far upstream as Farndon, as high tides regularly exceed the weir's height. In its slower, more mature reaches the river is characteristic of a floodplain river with meanders, oxbows and other river-formed landscape features.

Llyn Tegid, the Tryweryn and the Dee form part of the River Dee Regulation System. The flow of water is controlled by Natural Resources Wales, primarily to minimise flooding and for the transportation of water to abstraction points down stream. The level of control is such that the Dee itself is said to be the most regulated river in Europe. However, of the water that reaches Chester, only about a third is regulated (this is based on an average. the proportion varies depending on conditions and operational requirements). Of the tributaries within the SAC and SSSI, the only regulated tributary is the Afon Tryweryn.

Parts of the Rivers Dee and Ceiriog lie within both Wales and England. They have therefore been notified as two separate SSSIs – the Afon Dyfrdwy (River Dee) SSSI in Wales and the River Dee (England) SSSI in England. However, the features for which the SSSIs are notified, in particular migratory fish, depend upon the whole river ecosystem.

Outline of Past and Current Management

The River Dee is probably the most regulated river in Western Europe, providing drinking water for a large population in NW England and NE Wales, in addition to providing water for the Shropshire Union Canal. The regulation also contributes to flood control. Several major lakes and storage reservoirs are situated in the upper part of the basin, including Llyn Tegid; the largest natural lake in Wales.

Llyn Tegid was first used for river regulation in the early 1800s when Thomas Telford constructed a weir at the outlet to permit controlled releases to sustain flows into the Shropshire Union Canal at Llangollen. The most significant changes however occurred in 1956 when the Dee and Clwyd River Board constructed the Bala Lake Scheme, creating the present regulation facilities. The natural lake outlet was lowered by approximately 2 metres, sluice gates were built and the Afon Tryweryn was diverted to join the River Dee, downstream of the lake.

The river is an important fishing and tourist facility. In recent years there have been several pollution incidents arising from industrial and agricultural activity that have caused fish kills.

Llyn Tegid has also been vulnerable to blue-green algal blooms, related to phosphate enrichment from the surrounding catchment. This is being tackled through a multi-agency/local community initiative as well as NRW's River Basin Management Plan measures.

Management Units

The area covered by this plan has been divided into management units to enable practical communication about features, objectives, and management. This will also allow us to differentiate between the different designations where necessary. In this plan the management units have been based on the following:

- SSSI boundaries
- Tributary confluences
- Natural hydromorphology
- Artificial barriers where they mark a change in river character
- National boundaries
- Unitary Authority Boundaries
- The tidal and navigational limit
- The units include one or more of River Basin Management Plan water bodies; as far as is practicable unit boundaries coincide with these water body boundaries.

Maps showing the management units referred to in this plan can be viewed on the Welsh Government's GIS website Map Data Cymru.

The table below gives a brief description of each unit and the reasoning for the location of its boundaries.

Management Unit Descriptions

NRW Internal Reference	SAC Management Unit	Unit Name	Unit Description
14	1781	English Border to Dee Estuary SSSI	Where the Dee emerges from England to where it joins the 'Dee Estuary' SSSI, SAC, SPA, Ramsar. This is a predominately canalised section. At its north-western limit there are two small unconnected parts of the River Dee SSSI. These were areas not included in the Dee Estuary SSSI and were therefore notified as part of the River Dee SSSI.
16	1783	Afon Mynach	The Afon Mynach, a relatively small, low nutrient tributary of the Dee. Flows in this tributary are not regulated.
17	1784	Afon Meloch	The Afon Meloch, a relatively small, low nutrient tributary of the Dee. Flows in this tributary are not regulated.
18	1785	Ceiriog – upstream of Teirw	The Afon Ceiriog is a larger tributary of the Dee. It is a low nutrient river with a 'flashy' storm hydrograph. Flows in this tributary are not regulated. This unit is entirely within Wales.
19	1786	Ceiriog – confluence Dee to Teirw	The Afon Ceiriog is a larger tributary of the Dee. It is a low nutrient river with a 'flashy' storm hydrograph. Flows in this tributary are not regulated. At some locations in this unit, the river flows directly along the Wales/England border but is frequently within one country or the other, though always close to the border. This may reflect the uncontrolled, flashy nature of this river, as it is likely that the river formed the national boundary when first drawn. The Ceiriog also forms part of the Dee SSSI in England and this unit abuts part of Unit 3 of the River Dee (England) SSSI
4	7847	Llyn Tegid	All of Llyn Tegid (Bala Lake) to its outfall
2	7848	Tryweryn - Mynach to Llyn Celyn	The Afon Tryweryn. This carries water from Llyn Celyn to Section R1 from which it may either be allowed to flow down-stream into the main Dee system or upstream into Llyn Tegid. NRW Lease the canoeing and rafting centre on the Tryweryn and to support this, Dwr Cymru / Welsh Water periodically modifies patterns of water release.

NRW Internal Reference	SAC Management Unit	Unit Name	Unit Description
3	7849	Tryweryn - Dee to Mynach	The Afon Tryweryn. This carries water from Llyn Celyn to Section R1 from which it may either be allowed to flow down-stream into the main Dee system or upstream into Llyn Tegid. NRW lease the canoeing and rafting centre on the Tryweryn and to support this, Dwr Cymru /Welsh Water periodically modifies patterns of water release.
6	7850	Dee - Alwen to Llyn Tegid	From the outfall of Llyn Tegid to the confluence of the Dee and the Alwen. This unit includes part of the canalised sections around the Bala sluice system as well as the Bala sluice gate. This section includes the confluence with the Meloch (part of the SSSI/SAC) and the undesignated Hirnant, Caletwr, Ceidiog, Llynor and Trystion.
7	7851	Dee – Ceiriog to Alwen	From the confluence with the Alwen to the confluence with the Ceiriog the river flows over the Horseshoe falls, through Llangollen and passes from Denbighshire to Wrexham in the Vale of Llangollen at Trevor. This unit includes the Dee Bridge (Upper Carboniferous) and the Rhewl Section (fluvial geomorphology) GCR sites.
10	7852	Dee - Chester Weir to Ceiriog	From the confluence with the Afon Ceiriog to the English Border. In places, the river forms the boundary with England and the River Dee (England) SSSI (Units 3, 4 and 5). At Erbistock Weir the nature of the river changes.Above it, the river is relatively steep, flowing through entrenched meanders and gorges, to lose approximately 130 m in height from Bala. Below the weir the gradient tends to be much lower as the Dee flows across the Cheshire Plain. Here it is characterised by complex, sometimes active meanders as it falls only another 25 m or so before reaching Chester. The unit includes the Holt to Worthenbury GCR site, where the SSSI boundary reaches out into the floodplain to incorporate the fluvial geomorphology interest (explained in The Features section)

The following table confirms the relationships between the management units and the designations covered:

NRW Internal Reference	SAC Management Unit	SSSI	Ramsar	Waterbody IDs within Unit
14	1781	Afon Dyfrdwy		GB531106708200 (Transitional)
16	1783	Afon Dyfrdwy		GB111067051990
17	1784	Afon Dyfrdwy		GB111067051960
18	1785	Afon Dyfrdwy		GB111067051610
19	1786	Afon Dyfrdwy		GB111067051910
4	7847	Llyn Tegid	Llyn Tegid	GB31134987 (Lake)
2	7848	Afon Dyfrdwy		GB111067051980
3	7849	Afon Dyfrdwy		GB111067051900
6	7850	Afon Dyfrdwy		GB111067052240
7	7851	Afon Dyfrdwy		GB111067052060
10	7852	Afon Dyfrdwy		GB111067057080 (part of this waterbody is in England).

The Features

Confirmation of Features

Designated feature	Primary Reason for Site Selection?	Relationships, nomenclature etc
1. Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation	Yes	EU Habitat Code: 3260
2. Atlantic salmon *Salmo salar*	Yes	EU Species Code: 1106
3. Floating water-plantain *Luronium natans*	Yes	EU Species Code: 1831
4. Sea lamprey *Petromyzon marinus*	No	EU Species Code: 1095
5. Brook lamprey *Lampetra planeri*	No	EU Species Code: 1096
6. River Lamprey *Lampetra fluviatilis*	No	EU Species Code: 1099
7. Bullhead *Cottus gobio*	No	EU Species Code: 1163
8. European otter *Lutra lutra*	No	EU Species Code: 1355

SSSI and Ramsar features are listed in the tables below.

Where features are also a SAC feature they will share the same conservation objective(s)

Designated Feature	Designated Site	Relationship
9. The lake and aquatic / emergent vegetation.	Llyn Tegid Ramsar Llyn Tegid SSSI	SSSI and Ramsar feature
10. Lake fen /swamp incl. wet woodland.	Llyn Tegid Ramsar Llyn Tegid SSSI	SSSI and Ramsar feature
11. Fish. *Coregonus lavaretus* Gwyniad.	Llyn Tegid Ramsar Llyn Tegid SSSI	SSSI and Ramsar feature
12. Invertebrate. *Myxas glutinosa* Glutinous snail.	Llyn Tegid Ramsar Llyn Tegid SSSI	SSSI and Ramsar feature
Nationally important species. *Luronium natans* Floating water-plantain	Llyn Tegid Ramsar Llyn Tegid SSSI Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
Type VII Mesotrophic upland plateau rivers	Afon Dyfrdwy (River Dee) SSSI	Managed as SAC feature 1
Type VIII Moderate-gradient sand/shale rivers below uplands.	Afon Dyfrdwy (River Dee) SSSI	Managed as SAC feature 1
Type VI Middle reaches of upland rivers traversing more base rich strata.	Afon Dyfrdwy (River Dee) SSSI	Managed as SAC feature 1
Type II Clay rivers with diverse substrates and flow patterns.	Afon Dyfrdwy (River Dee) SSSI	Managed as SAC feature 1
Saltmarsh / freshwater transition habitats	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
A range of habitat types qualifying as a mixture	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Slender hare's-ear *Bupleurum tenuissimum*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Sea barley *Hordeum marinum*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Hard-grass *Parapholis strigosa*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Club tailed dragonfly *Gomphus vulgatissimus*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Scare yellow sally *Isogenus nubecula*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Yellow crucifer weevil *Aulacobaris lepidii*	Afon Dyfrdwy (River Dee) SSSI	SSSI feature
Atlantic salmon *Salmo salar*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
Sea lamprey *Petromyzon marinus*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
Brook lamprey *Lampetra planeri*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature

River Lamprey *Lampetra fluviatilis*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
Bullhead *Cottus gobio*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
European otter *Lutra lutra*	Afon Dyfrdwy (River Dee) SSSI	Managed as a SAC feature
Holt to Worthenbury Section	Afon Dyfrdwy (River Dee) Geological/ Geomorphological SSSI	SSSI feature
Rhewl Section	Afon Dyfrdwy (River Dee) Geological/ Geomorphological SSSI	SSSI feature
Dee Bridge	Afon Dyfrdwy (River Dee) Geological/ Geomorphological SSSI	SSSI feature

Features and Management Units

This section sets out the relationship between the designated features and each management unit. This is intended to provide a clear statement about what each unit should be managed for, taking into account the varied needs of the different special features. All features are allocated to one of seven classes in each management unit. These classes are:

Key Features

KH - a 'Key Habitat' in the management unit, i.e. the habitat that is the main driver of management and focus of monitoring effort, perhaps because of the dependence of a key species (see KS below). There will usually only be one Key Habitat in a unit but there can be more, especially with large units.

KS – a 'Key Species' in the management unit, often driving both the selection and management of a Key Habitat.

Geo – an earth science feature that is the main driver of management and focus of monitoring effort in a unit.

Other Features

Sym - habitats, species and earth science features that are of importance in a unit but are not the main drivers of management or focus of monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as 'Sym' (sympathetic) features because:

(a) they are present in the unit but may be of less conservation importance than the key feature; and/or

(b) they are present in the unit but in small areas/numbers, with the bulk of the feature in other units of the site; and/or

(c) their requirements are broader than and compatible with the management needs of the key feature(s), e.g. a mobile species that uses large parts of the site and surrounding areas: and/or

(d) key features (KH, KS) are closely associated with these features, and the conservation of key features depends on them being managed appropriately.

Nm - an infrequently used category where features are at risk of decline within a unit as a result of meeting the management needs of the key feature(s), i.e. under Negative Management. These cases will usually be compensated for by management elsewhere in the plan, and can be used where minor occurrences of a feature would otherwise lead to apparent conflict with another key feature in a unit.

Mn - Management units that are essential for the management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries, buffer zones around water bodies, etc.

x – Features not known to be present in the management unit.

The tables below set out the relationship between the features and management units identified in this plan:

SAC Management Unit	1783	1784	1785	1786	7847	7848	7849	7850	7851	7852
Unit Name	Afon Mynach	Afon Meloch	Ceiriog u/s of Teirw	Ceiriog -Teirw to Dee	Llyn Tegid	Tryweryn-Mynach to Llyn Celyn	Tryweryn-Dee to Mynach	Dee-Alwen to Llyn Tegid	Dee-Ceiriog to Alwen	Dee-Chester weir to Ceiriog
SAC Features										
Cottus gobio	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Lampetra fluviatilis	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	KS
Lampetra planeri	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Luronium natans					KS		KS	KS		
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Petromyzon marinus	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	KS
Salmo salar	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	KH	KH	KH	KH		KH	KH	KH	KH	KH
SSSI Features										
Aulacobaris lepidii										KS
Bupleurum tenuissimum										
Carex aquatilis					Sym					
Carex aquatilis x *C.acuta*					Sym					
Coregonus lavaretus					KS					
Cottus gobio	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Fluvial geomorphology of Wales									Geo	Geo
Gomphus vulgatissimus										KS
Hordeum marinum										
Inter-tidal										
Isogenus nubecula									KS	KS
Lampetra fluviatilis	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	KS
Lampetra planeri	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS

SAC Management Unit	1783	1784	1785	1786	7847	7848	7849	7850	7851	7852
Limosella aquatica					Sym					
Luronium natans					KS		KS	KS		
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Myxas glutinosa					KS					
Namurian of England and Wales									Geo	
Osmerus eperlanus										Sym
Other: Marginal/inundation										
Petromyzon marinus	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	Sym	KS
Running water	Sym	Sym	Sym	Sym		Sym	Sym	KH	Sym	KH
Salmo salar	KS	KS	KS	KS	KS	KS	KS	KS	KS	KS
Salt-marsh										
Semi-natural woodland	Sym	Sym	Sym	Sym						
Standing water					KH					
Swamp					KH					

Conservation Objectives

Background to Conservation Objectives:

Outline of the legal context and purpose of conservation objectives.

Conservation objectives for individual SACs and SPAs are required by the 1992 'Habitats' Directive (92/43/EEC) as implemented through the Conservation of Habitat and Species Regulations 2017 (As amended). The aim of the Habitats Directive is the maintenance, or where appropriate the restoration, of the 'favourable conservation status' (FCS) of habitats and species listed in the Annexes to the Directive (see Box). Therefore FCS provides the overarching framework for defining the conservation objectives for individual SACs.

Although neither the Birds Directive nor the Ramsar Convention refer to FCS, Natural Resources Wales considers that the overall aim of both those legal instruments is sufficiently similar to FCS to make it practical and proportionate to use the same guiding principle when establishing the conservation objectives for SPAs and Ramsar sites, as well as SACs. Therefore the Habitats Directive definition of FCS is considered to provide the overarching framework for conservation objectives for all SACs, SPAs and Ramsar sites in Wales.

Favourable conservation as defined in Articles 1(e) and 1(i) of the Habitats Directive: "The conservation status of a natural habitat is the sum of the influences acting on it 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. The conservation status of a natural habitat will be taken as favourable when:

- its natural range and 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
- the conservation status of its typical species is favourable.

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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."

The achievement of FCS is not an objective that applies at the level of the individual sites. Rather it is a wider objective to which each individual site contributes. Therefore the conservation objectives for an individual site are intended to express what is considered to be that site's appropriate contribution to achieving FCS. Since SACs are the most important mechanism in the Habitats Directive for achieving FCS, and the sites represent the most important areas for conservation of the Annex I habitat types and Annex II species, the objectives for each individual SAC should seek to ensure that the site makes a substantial contribution which properly reflects its importance in a local, national and European context and the particular reasons why the site was selected for inclusion in the UK National Sites Network of SACs. A similar approach is taken to setting conservation objectives for SPAs and Ramsar sites.

Achieving the conservation objectives of individual sites requires appropriate management and the control of factors which are influencing, or may influence the features.

The conservation objectives have a number of specific roles:

- **Communication:** The conservation objectives should help convey to stakeholders what are the reasons for the designation and what it is intended to achieve.
- **Site planning and management:** The conservation objectives guide management of sites, to maintain or restore the designated habitats and species. They provide the basis for identifying what management is required both within the site boundary, and outside it, where achieving the objectives requires action to be taken outside the site.
- **River Basin Management Planning:** Conservation Objectives for aquatic and water dependent SAC and SPA features are also used as the "standards and objectives" referred to in Article 4 (1c) of the Water Framework Directive (WFD) (2000/60/EC). In 2009, Welsh Ministers decided that where SAC and SPA conservation objectives are more stringent than 'Good Ecological Status' (GES) as defined in the WFD, they (and the standards they contain) are the objectives referred to in Article 4(1c) of the WFD.
- **Assessing plans and projects:** Article 6(3) of the 'Habitats' Directive requires the assessment of proposed plans and projects in view of a site's conservation objectives. Subject to certain exceptions, plans or projects may not proceed unless it is established that they will not adversely affect the integrity of sites. There are similar requirements for the review of existing decisions and consents. Note that the assessment of plans and projects should be made in view of the entirety of the conservation objectives for the site, including the performance indicators.
- **Monitoring and reporting:** In addition to foregoing purposes, conservation objectives provide the basis for defining the evidence that will be used for assessing the condition of a feature and the status of factors that affect it. That evidence is contained in a sub-set of conservation objectives called 'performance indicators'. The performance indicators are those conservation objectives which are quantifiable and measurable, and which provide the basis for monitoring and reporting. The performance indicators are set out in Appendix 1.

The conservation objectives in this document reflect Natural Resources Wales' current information and understanding of the site and its features and their importance in an international context. The conservation objectives are subject to review by Natural Resources Wales in the light of new knowledge.

Format of the conservation objectives

Each conservation objective is a composite statement defining a site-specific aspiration for each designated feature. This composite statement contains clauses that correspond to all the elements of FCS, namely:

For habitat features:

- Extent should be stable in the long term, or where appropriate increasing*;
- Quality (including in terms of ecological structure and function) should be being maintained, or where appropriate improving;
- Populations of the habitat's typical species must be being maintained or where appropriate increasing*;
- Factors affecting the extent and quality of the habitat and its typical species (and thus affecting the habitat's future prospects) should be under appropriate control.

For species features:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term;
- The distribution of the population should be being maintained;
- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- Factors affecting the population or its habitat should be under appropriate control.

The elements above constitute a generic checklist or guide to the elements that should normally be included in the conservation objectives, in order to ensure that the site makes an effective and appropriate contribution to achieving favourable conservation status for the habitats and species for which it is designated.

There is one conservation objective for each designated feature listed above. In some cases, where there are distinct areas or forms of a designated habitat or separate populations of a designated species within a site, the conservation objective is sub-divided into different sections to enable different aspirations to be expressed for different occurrences of the features within the site.

As well as describing the aspirations for the condition of the feature, each conservation objective contains a statement that the factors which significantly affect the feature are under appropriate control.

Conservation Objective for watercourse:

The ecological status of the watercourse is a major factor in determining FCS for all site features. The required conservation objective for the watercourse is defined below. This section is an integral part of the conservation objectives for all features of this SAC.

- The ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature. This will include elements of water quantity and quality, physical habitat and community composition and structure.
- Water quality standards for the river Dee follow those in the revised Common Standards Monitoring Guidance for Rivers (JNCC 2016). These are detailed in Appendix 2. There will be no deterioration in water quality, as defined by these standards, other than that temporarily generated by natural variations in water flow or by man-made variations occurring as a result of operating the River Dee flow control regime within its normal operating parameters.
- The Dee flow regime should remain within 10% of ‘recent actual flow’ as described by Bethune (2006).
- The river planform and profile should be predominantly unmodified. Physical modifications having an adverse effect on the integrity of the SAC will be avoided.
- Artificial factors impacting on the capability of each feature to occupy the full extent of its potential range should be modified where necessary to allow passage, eg. weirs, bridge sills, or other forms of barrier.
- Natural limiting factors such as waterfalls, which may limit the natural range of a feature or its dispersal between naturally isolated populations, should not be modified.
- Levels for nutrients, in particular phosphate, will be agreed for cross-border water bodies between NRW and NE, and measures taken to maintain nutrients below these levels.
- Potential sources of pollution, nutrient enrichment and/or suspended solids that have not been addressed in the Review of Consents such as, but not confined to, diffuse pollution or disturbance to sediments, will be considered in assessing plans and projects.

Conservation Objective for Feature 1: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the watercourse as defined above must be met.
- The extent of this feature within its potential range in this SAC should be stable or increasing
- The extent of the sub-communities that are represented within this feature should be stable or increasing.
- The conservation status of the feature's typical species should be favourable.
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Conservation Objective for Feature 2: Atlantic salmon *Salmo salar* (EU Species Code: 1106)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the watercourse as defined above must be met
- The SAC feature populations will be stable or increasing over the long term.
- The natural range of the features in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- There will be no reduction in the area or quality of habitat for the feature populations in the SAC on a long-term basis
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Conservation Objective for Feature 3: *Luronium natans* / Floating water-plantain

The conservation objective for the lake water body as defined in the conservation objective for features 9 and 10 must be met. The vision for this feature is for it be in favourable conservation status, where all of the following conditions are satisfied:

- There will be no contraction of the current *L. natans* extent and distribution, and the populations will be viable throughout their current distribution & will be able to maintain themselves on a long-term basis. Each *L. natans* population must be able to complete sexual and/or vegetative reproduction successfully.
- The lake will have sufficient habitat to support existing *L. natans* populations within their current distribution and for future expansion.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Features 4, 5, and 6: Sea lamprey *Petromyzon marinus* (EU Species Code: 1095), Brook lamprey *Lampetra planeri* (EU Species Code : 1096), River lamprey *Lampetra fluviatilis* (EU Species Code : 1099)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the watercourse as defined above must be met.
- The SAC feature populations will be stable or increasing over the long term.
- The natural range of the features in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- There will be no reduction in the area or quality of habitat for the feature populations in the SAC on a long-term basis.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Feature 7: Bullhead *Cottus gobio* (EU Species Code: 1163)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the watercourse as defined above must be met.
- The SAC feature populations will be stable or increasing over the long term.
- The natural range of the features in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- There will be no reduction in the area or quality of habitat for the feature populations in the SAC on a long-term basis.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Feature 8: European otter *Lutra lutra* (EU Species Code: 1355)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the watercourse as defined above must be met.
- The SAC otter population is stable or increasing over the long term, both within the SAC and within its catchment.
- There will be no loss of otter breeding or resting sites other than by natural means (such as naturally occurring river processes) within the SAC or its catchment.
- The number of potential resting sites within the SAC will not be a factor limiting that limits the otter population's size or extent.
- There should be no reduction of fish biomass within the SAC or its tributaries except for that attributable to natural fluctuations.
- There should be no loss of amphibian habitat likely to provide a source of prey for members of the SAC otter population.
- The potential range of otters in the within the SAC or its catchment is neither being reduced nor is likely to be reduced for the foreseeable future.
- All known or potential access or dispersal routes within the catchment for otters that might be considered part of the SAC population should be maintained such that their function is not impaired including the incorporation of measures or features required to avoid disturbance.
- Off site habitats likely to function as 'stepping stones' within the catchment for members of the SAC otter population will be maintained for migration, dispersal, foraging and genetic exchange purposes.
- All man-made structures within or likely to be used by otters from the SAC population must incorporate effective measures to facilitate the safe movement and dispersal of otters.
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Conservation Objectives for lake and marginal wetland SAC & Ramsar features 9 and 10: The lake and aquatic /emergent vegetation, Lake fen/swamp inc. wet woodland.

- The total extent of the lake area, including lake fen and swamp shall be maintained. This includes some 10 ha of swamp/fen in total; of which at least 6 ha is attributable to NVC S11 *Carex vesicaria* swamp community.
- The abundance and distribution of rare aquatic and emergent species will be maintained or increased and continue to be self-sustaining.
- The abundance and distribution of typical species of aquatic /emergent species will be common and continue to be self-sustaining. See tables below.

- The fen and swamp layers comprises locally native species, see table below for the relevant species for each vegetation community. The abundance of typical species of each fen and swamp type will be common.
- The abundance and distribution of uncommon / rare plants occurring within each fen and swamp vegetation community will be maintained or increased and continue to be self-sustaining.
- Invasive non-native species such as rhododendron, Japanese knotweed, Canadian pondweed and Himalayan balsam will not be present. This condition is considered under "factors".
- Water quality targets for the lake should be of a standard that will ensure it reaches Good Ecological Status or better as defined by the Water Framewok Directive. The river Dee should reach its water quality targets as set out in Appendix 2.
- Eutrophication of the lake from diffuse and point source pollution will be under control and incidences of blue/green algal blooms will have stopped. The nutrient levels in the lake will similar to the levels inferred from the diatom assemblages for the lake prior to 1925.
- All factors affecting the achievement of these conditions are under control.

Indicative lists of species of the typical emergent, fen / swamp & wet woodland communities

Submerged or Floating Species	DAFOR Scores (Burgess *et at.* 2006)
Isoetes lacustris	D
Littorella uniflora	D
Callitriche hamulata	A
Elatine hexandra	A
Luronium natans	A
Nitella flexilis agg.	A
Eleocharis acicularis	F
Fontinalis antipyretica	F

NVC community name	**Emergent, Fen/swamp community constant species**	**Emergent, Fen/swamp community preferential species**	**Embergent, Fen/swamp community rarities**
NVC S11 *Carex vesicaria* swamp	*Carex vesicaria*, *Equisteum fluviatile* & *Galium palustre*	*Mentha aquatica, Myosotis scorpiodes, Filipendula ulmaria.*	*Carex aquatilis. Carex acuta .* Hybrid of *C. acuta* & *C. aquatilis.*
NVC S9 *Carex rostrata* swamp	*Carex rostrata*	*Polygonum amphibium, M. aquatica. Juncus effusus*.	
NVC S28 *Phalaris arundinacea* tall-herb fen	*Phalaris arundinacea*	*G. palustre Juncus effusus. Myosotis scorpiodes*.	
NVC W1 *Salix cinerea – Galium palustre* woodland	*Salix cinerea. G. palustre*	Field layer: *M. aquatica*, *J. effusus.* Ground layer: Bare ground or patchy bryophyte cover *Eurhynchium praelongum*, *Chiloscyphus polyanthos*.	

Indicative list of rare species of the aquatic / emergent communities.

Feature Species
Mudwort *Limosella aquatica*
Six stamened-waterwort *Elatine hexandra*
Floating water plantain *Luronium natans*
Small water-pepper *Polygonum minus*
Needle spike-rush *Eleocharis acicularis*
Slender-tufted sedge *Carex acuta*
Water sedge *Carex aquatilis*
Hybrid sedge *C. acuta x aquatilis*

Indicative list of typical aquatic /emergent vascular plant species

Vascular plant species name
Lesser marshwort *Apium inundatum*
Pedunculate / Intermediate water starwort *Callitriche brutia / hamulata*
C. stagnalis
Needle spike-rush *Eleocharis acicularis*
Water mint *Mentha aquatica*
Water forget-me-not *Myosotis scorpioides*
Alternate water milfoil *Myriophyllum alterniflorum*
Water pepper *Persicaria hydropiper*
Reed canary grass *Phalaris arundinacea*
Broad leaved pond weed *Potamogeton natans*
Marsh cinquefoil *Potentilla palustris*
Common water crowfoot *Ranunuculus aquatilis*
Round leaved crowfoot *R. omniophyllus*
Water horsetail *Equisetum fluviatile*
Small sweet-grass *Glyceria declinata*
Floating sweet-grass *G. fluitans*
Quillwort *Isoetes lacustris*

Conservation Objective for Feature 11. Gwyniad *Coregonus lavaretus*.

There are fewer than 10 recorded populations of whitefish in the British Isles and the Llyn Tegid population is the only one in Wales. Dwelling mainly in the deeper and cooler offshore waters this carnivorous fish feeds on microscopic animals floating in the water. Each year, between January and February, it moves into the shallower waters of the lake to spawn in clean gravel beds. Between 2004 and 2007 an attempt was made to establish a 'refuge' population at Llyn Arenig Fawr, an upland oligotrophic lake in Migneint-Arenig-Dduallt SAC (Refer to Migneint-Arenig-Dduallt SAC plan).

The conservation objective for the lake water body as defined in conservation objectives for features 9 &10 must be met. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The population of the feature in the SAC is stable or increasing over the long term.
- The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- Suitable habitat is defined in terms of near-natural hydrological regime, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Feature 12. Glutinous snail. *Myxas glutinosa*.

The conservation objective for the lake water body as defined in conservation objective for features 9 &10 must be met. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- This population will continue to thrive and colonise all suitable areas of habitat in the marginal zone. The species will have been extensively studied and its ecology, especially its response to fluctuating water levels, will be better understood so that its niche requirements can continue to be met. In addition, we will fully understand whether the apparently different mean growth rates in snail populations at different locations around the lake is due to minor habitat variance or to isolated sub-population differences.
- Maintenance of the quality and extent of suitable habitat.
- All factors affecting the achievement of these conditions are under control.

Assessment of Status and Management Requirements

This section provides:

- A summary of the assessment of the status of each feature.
- A summary of the management issues that need to be addressed to maintain or restore each feature.

Status and Management Requirements of Feature 1: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Status of Feature 1: Unfavourable unclassified.

This site's most recent vegetation survey was that of Scarlett et al in 2003. Data was collected from twenty three field sites and an attempt was made to classify each site as a 'CB type' (a sub-type of the feature) using the method of Hatton-Ellis and Grieve (2003). Only seven sites conformed to a CB type.

However the authors state that "The majority or sites are rather atypical and could not be placed into any of the CB group. This may be partly attributed to the absence of *Myriophyllum spicatum* and the scarcity of some species due to recent flooding".

In view of these difficulties the condition assessment was based upon a preliminary study undertaken in June 04, which only looked at a small amount of the resource across the site. During the next monitoring cycle (2007-2012) the feature will be monitored against JNCC guidelines, probably using revised methods. This will provide NRW with an improved condition assessment but will not give a clear indication of the extent of the feature throughout the site. It is therefore likely that there will also be some form of rapid, walk over (or rather next to) survey, to provides an indication of where the feature is likely to be present.

Management Requirements of Feature 1

As discussed above, it is important that further knowledge of the condition and extent of this feature is acquired in order to better inform decisions about its management. However, as stated by Hatton-Ellis and Grieve (2003) "There remain many gaps in understanding of the reproductive biology of individual species, the identification and distribution of subspecies, and the ecological tolerances of plant assemblages". So until there is a greater understanding of the requirements of this feature the emphasis will be on promoting and retaining a mosaic of bank-side and emergent vegetation, and of resisting changes to the aquatic environment unless they can be shown as being unlikely to have a significant effect.

Status and Management Requirements of Feature 2: Atlantic salmon *Salmo salar*

Status of Feature 2: Unfavourable

Justification – According to Pisces Conservation Ltd (2007), the Dee fails on the criteria listed as failing on the following table

Attribute	Pass	Fail	Not determined
Population			
Adult run		X	
Juvenile population densities	X		
Water quality			
Biological GQA		X	
Chemical GQA		X	
Soluble reactive phosphorus		X	
Suspended solids		X	
Flow (see below)	X		
River morphology			
Artificial barriers	X		
Maintaining characteristic physical features	X		
River substrate			
Spawning sites			X
Negative indicators			
Stocking of other species	X		
Environmental disturbance			
Management objectives of SAC salmon populations		X	
Screening			X
Sustainable exploitation		X	
OVERALL ASSESSMENT		X	

Flow: Pisces Conservation Ltd (2007) based their result on Naturalised Daily Flow. For the Dee this is not applicable because of the nature of its regulation scheme. Therefore for this river the criterion for being in favourable condition is that flows should, as far as climatic conditions allow, remain within 10% of 'Recent Actual flow' as described by Bethune (2006), (See Conservation Objective for Feature 2: Atlantic salmon *Salmo salar* (EU Species Code: 1106)).

Management Requirements of Feature 2

Attribute	Requirement
Population	
Adult run	Increase to Conservation Limit
Juvenile population densities	Maintain
Water quality	
See Appendix 2. Water Quality Targets for River Waterbodies	Improve to required standard
Suspended solids	Improve to required standard
Flow (see below)	Maintain
River morphology	
Artificial barriers	Maintain or improve
Maintaining characteristic physical features	Maintain or improve
River substrate	
Spawning sites	Location and extent to be determined
Negative indicators	
Stocking of other species	Before any such stocking can take place, it must first be determined whether or not it is likely to have a significant effect on the river's salmon population (or on any other).
Environmental disturbance	
Management objectives of SAC salmon populations	Salmon stocking must only occur in order to compensate for the loss of habitat upstream of the Celyn dam. Stocking beyond this should not be required.
Screening	Screening must be of a standard sufficient to prevent any significant effect on the Salmon population
Sustainable exploitation	Any form of exploitation detrimental to salmon successfully completing their reproductive cycle is difficult to justify until the following criteria have been met:- The salmon population is consistently reaching its targets, There is no salmon stocking, other that compensating for the habitat loss caused by to the construction of Llyn Celyn.

Pisces Conservation Ltd, 2007 also recommend that "Data on spawning site substrates and screening required".

Status and Management Requirements of Feature 3: Floating water-plantain *Luronium natans* (Code: 1831)

Status of Feature 3: Favourable Un-classified

The floating water-plantain is assessed as Favourable Un-classified on the basis of existing survey data. A population has been known from Llyn Tegid since 1780 and again in 1805, but only recently in the 1990s was it realised that a more extensive submerged population was present within Dolfawr and Glanllyn bays at the SW end of the lake. As there is therefore only partial baseline data it is not possible to distinguish trends. Floating water-plantain can thrive in quite eutrophic water conditions in the U.K. There is no reason therefore to suppose, because of current factors operating, that the population has declined over recent years.

Monitoring submerged lake populations of *Luronium natans* is difficult without using diving techniques although there has been some recent exploratory work conducted by Ian Winfield of CEH into using new and more sensitive hydroacoustic survey equipment to monitor submerged vegetation communities.

- A baseline survey of *Luronium natans* should be carried out.

Management Requirements of Feature 3

- Physical damage to floating plants and their habitat from motorised craft should continue to be controlled by limiting the number of motorised boats to emergency craft operated by SNPA warden staff. The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- No lake bottom sediment should be dredged because it could disturb submerged populations and /or destroy suitable substrate for *Luronium natans* to colonise.
- The pools at Glanllyn, where *Luronium natans* has long been recorded, are now dominated by the alien species *Elodea canadensis* Canadian pondweed. Some control such as light mechanical harvesting should be considered if observation/research elsewhere indicates that this management is likely to be successful.

Status and Management Requirements of Feature 4: Sea lamprey *Petromyzon marinus*

Status of Feature 4: Unfavourable Un-classified

This species failed its ammocoete density target, as monitored by APEM (2006). The Performance Indicators for Featues 4, 5 & 6., and the Common Standards Monitoring Guidance (JNCC 2005) state that “ammocoetes should be present in at least 4 sampling sites each not less than 5km apart”. Sea lamprey were only caught in 3 sites.

The low numbers recorded by APEM (2006) make it difficult to draw any firm conclusions as to the distribution of the species within the site but report also expresses concerns over barriers to migration for sea lamprey. This suggests that the river morphology attribute would also fail.

In addition the river also failed its Biological GQA and soluble reactive phosphorus targets (Pisces Conservation Ltd., 2007).

Management Requirements of Feature 4

Currently, we don't have sufficient information about Petromyzon marinus in the Dee SAC to know the size or dynamics of its population, the amount of habitat available for its spawning and subsequent development, or the other main factors that limit its development. In view of this, the management requirements are:

- Identification of spawning sites
- Undertake research to try and determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment.
- Identify which resources are limiting the development of the current population.
- Undertake measures to improve the availability of limiting resources.

This is relevant to the Horseshoe Falls weir. The weir is believed to present a barrier to the upstream migration of lamprey. The structure should therefore be modified to enable such fish to reach the river beyond it.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed. In addition, screening must be of a standard sufficient to prevent any significant effect on the Lamprey population.

Fish stocking can be damaging to ecosystem structure and function through competition, predation and introduction of disease – ensure any fish stocking is very carefully controlled to avoid these problems, and subject to an appropriate assessment.

Status and Management Requirements of Feature 5: Brook lamprey *Lampetra planeri*

Status of Feature 5: Unfavourable Un-classified

APEM (2006) report that *Lampetra* spp. were caught at 36 out of 59 sites (25 out of 29 optimal sites and 11 out of 30 sub-optimal sites). This provides a value for distribution within the catchment of 61% which fails the 66% JNCC target (JNCC 2005).

The river fails the Biological GQA and soluble reactive phosphorus targets (Pisces Conservation Ltd, 2007).

It is not normally possible to distinguish between river and brook lamprey in the field. Results are reported for *Lampetra spp*. Therefore, even if population levels for

Lampetra spp. appear to be acceptable, they cannot be considered as being in favourable condition until values for the individual species can be obtained.

Management Requirements of Feature 5

Currently, due to the complexities of identifying *Lampetra planeri* in the field, we don't have sufficient information about the species in the Dee SAC to know the size or dynamics of its population, the amount of habitat available for its spawning and subsequent development (The Dee Fluvial Audit may be of use here), or the other main factors that limit its development. In view of this, the management requirements are:

- To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC.
- To instigate a survey that identifies spawning sites
- To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment.
- Identify which resources are limiting the development of the current population.
- Undertake measures to improve the availability of limiting resources.

This is relevant to the Horseshoe Falls weir. The weir is believed to present a barrier to the upstream migration of lamprey. The structure should therefore be modified to enable such fish to reach the river beyond it.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed. In addition, screening must be of a standard sufficient to prevent any significant effect on the Lamprey population.

Fish stocking can be damaging to ecosystem structure and function through competition, predation and introduction of disease – ensure any fish stocking is very carefully controlled to avoid these problems, and subject to an appropriate assessment.

Status and Management Requirements of Feature 6: River Lamprey *Lampetra fluviatilis*

Status of Feature 6: Unfavourable Un-classified

APEM (2006) report that *Lampetra* spp. were caught at 36 out of 59 sites (25 out of 29 optimal sites and 11 out of 30 sub-optimal sites). This provides a value for distribution within the catchment of 61% which fails the 66% JNCC target (JNCC 2005).

The river fails the Biological GQA and soluble reactive phosphorus targets (Pisces Conservation Ltd, 2007).

It is not normally possible to distinguish between river and brook lamprey in the field. Results are reported for *Lampetra spp*. Therefore, even if population levels for *Lampetra spp*. appear to be acceptable, they cannot be considered as being in favourable condition until values for the individual species can be obtained.

Management Requirements of Feature 6

Currently, due to the complexities of identifying *L. fluviatilis* in the field, we don't have sufficient information about the species in the Dee SAC to know the size or dynamics of its population, the amount of habitat available for its spawning and subsequent development (The Dee Fluvial Audit may be of use here), or the other main factors that limit its development. In view of this, the management requirements are:

- To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC.
- To instigate a survey that identifies spawning sites
- To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment.
- Identify which resources are limiting the development of the current population.
- Undertake measures to improve the availability of limiting resources.

This is relevant to the Horseshoe Falls weir. The weir is believed to present a barrier to the upstream migration of lamprey. The structure should therefore be modified to enable such fish to reach the river beyond it.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed. In addition, screening must be of a standard sufficient to prevent any significant effect on the Lamprey population.

Fish stocking can be damaging to ecosystem structure and function through competition, predation and introduction of disease – ensure any fish stocking is very carefully controlled to avoid these problems, and subject to an appropriate assessment.

Status and Management Requirements of Feature 7: Bullhead *Cottus gobio*

Status of Feature 7: Unfavourable Un-classified

Attribute	Pass	Fail	Not determined
Population			
Adult pop. densities		X	
Distribution within SAC		X	
Reproduction / Age structure	X		
Water quality			
Biological GQA		X	
Chemical GQA	X		
Soluble reactive phosphorus		X	
Suspended solids	X		
Flow (see below)	X		
River morphology			
Weed cutting	X		
Woody debris	X		
Impediments to fish movement between reaches	X		
SSSI features in favourable condition	X		
Reduction in extent of slack water refuges, etc.			X
Negative indicators			
Non-native crayfish	X		
Stocking of other species	X		
Aspects of environmental disturbance			
Bullhead stocking	X		
Screening			X
OVERALL ASSESSMENT		X	

Except for 'Flow' result, table copied from Pisces Conservation Ltd, 2007.

Flow: Pisces Conservation Ltd (2007) based their result on Naturalised Daily Flow. For the Dee this is not applicable because of the nature of its regulation scheme. Therefore for this river the criterion for being in favourable condition is that flows should, as far as climatic conditions allow, remain within 10% of 'recent actual flow' as described by Bethune (2006), (See Conservation Objectives for Bullhead).

In the Pisces Conservation Ltd (2007) survey, two of the population targets for this species (adult population density and distribution within the SAC) fail.

The river also fails the Biological GQA and soluble reactive phosphorus targets (Pisces Conservation Ltd 2007).

Management requirements of feature 7

Attribute	Requirement
Population	
Adult pop. densities	Increase to CSM target
Distribution within SAC	Increase distribution to all areas of potential habitat. Pisces Conservation Ltd (2007) state that "Distribution within the SAC revealed considerable differences between sites with the species absent from some areas within the SAC". However the Pisces survey only looked a five field sites within the SAC so more data will be required before this opinion can be verified with confidence.
Juvenile population densities	Maintain
Water quality	
See Appendix 2. Water Quality Targets for River Waterbodies	Improve to required standard
Suspended solids	Maintain or improve
Flow (see below)	
River morphology	
Submerged macrophytes	The importance of submerged higher plants to bullhead survival is unclear, but it is likely that where such vegetation occurs it is used by the species for cover against predators. JNCC's Common Standards Monitoring Guidance for Freshwater fauna (2005) states that "Weed cutting should be limited to no more than half of the channel width in a pattern of cutting creating a mosaic of bare substrate and beds of submerged plants". However, in view of the lack of clarity as to the importance of such plants to this species, and as much of the aquatic vegetation is a protected feature of this site in its own right, the precautionary principle should apply. Therefore, there should be no cutting of submerged macrophytes other than that specified in Appendix 1: Performance Indicators.Performance Indicators for Feature 1.
Woody debris	Maintain existing position
Impediments to fish movement between reaches	Maintain existing position
SSSI features in favourable condition	Maintain existing position
Reduction in extent of slack water refuges, etc.	Slack-water areas provide important refuges against high flow conditions. Suitable refuges include pools, submerged tree root systems and marginal vegetation with >5 cm water depth
Spawning habitat	Defined as unsilted coarse (gravel / pebble / cobble) dominated substrate:

	males guard sticky eggs on the underside of stones. Larger stones on a hard substrate providing clear spaces between the stream bed and the underside of pebbles / cobbles are therefore important. Elevated levels of fines can interfere with egg and fry survival (See also 'Woody debris' above)
Negative indicators	
Non-native crayfish	Maintain existing position
Stocking of other species	Maintain existing position
Environmental disturbance	
Bullhead stocking	Maintain existing position
Screening	To be determined

Pisces Conservation Ltd (2007) also make recommendations for the following:

- Further data on any reductions in extent of slack water refuges, etc. required
- Clarification of the extent and timing of brown trout stocking, and its potential effects on bullhead populations is required.
- Information on screening of intakes and discharges is required.
- Information on the status of the bullhead populations needs to be focused in future within the area of the SAC.

Status and Management Requirements of Feature 8: European otter *Lutra lutra*

Status of Feature 8: Favourable Un-classified

The status of "Favourable" is based on the results of a survey by Philip Morgan undertaken in 2003 (Morgan 2004). However, this survey could not make a reliable estimate of population size nor, on its own, identify any trend in population change. i.e. is the population decreasing, stable or increasing? Therefore, until the site can be re-surveyed, the "un-classified" suffix is likely remain in place.

Management requirements of feature 8

Most of the following requirements are based on the main recommendations of Morgan (2004):

- Further survey work is needed in order to better estimate the number of otters in the SAC population. Morgan (2004) states that "It is impossible to judge just how many otters are present on the Dee catchment today. DNA analysis of spraints to identify individual animals is probably the only way by which this might be ascertained with some certainty".
- Establish a procedure to undertake an appraisal of road kill sites. The object being to attempt to identify reasons for otters being on the road – at least 14 otters were killed on roads in the Dee catchment in the six years prior to the survey.
- Undertake further survey work to specifically identify holts and in particular natal holts – Morgan states that such information is particularly sparse but

suggest that it is best gathered by dedicated volunteer groups and suggest that a volunteer survey/monitoring group be established in North East Wales.
- Fencing of river banks with a suitable buffer should be considered a high priority – This will encourage the establishment of areas with a dense understorey of shrub close to the river – a habitat favoured by otters. It will also reduce grazing pressure and disturbance.

Status and Management Requirements of Feature 9: The lake & aquatic / emergent vegetation (Ramsar)

Status of Feature 9: Unfavourable

The lake & aquatic / emergent vegetation is assessed as Unfavourable as the water quality is unfavourable. There is no evidence to suggest that the aquatic/emergent vegetation is unfavourable although there has not been a recent quantitative survey. Good quality presence and absence data from around the lake exists over a long time period. There is no evidence to suggest, that the aquatic/emergent vegetation or the rare plants adapted to the fluctuating water levels, have declined over recent years. We are however concerned that there may be gradual changes in the flora and ecology of the lake as it continues to become more eutrophic.

A project commissioned by the then National Rivers Authority in the early 1990s, aimed at producing a lake classification system, concluded that Llyn Tegid's enrichment or "degree of eutrophication" had increased almost six fold, compared with presumed conditions in 1930. In January 1995 a project was initiated to assess the current nutrient inputs to the lake with a view to using a predictive algal growth model and to determine appropriate management options. A succession of blue/green algal blooms dating from August 1995 has reinforced the urgency of this work. In 2006 there were around 10 blooms but no severe ones and once the wind picked up, such blooms dispersed within about 2 hours. The health concerns for people and livestock have further raised the profile of the study and focused the attention of local people, business users as well as conservationists.

Llyn Tegid should naturally be a low nutrient level lake but human activities in the catchment have increased the level of nutrients such as phosphates. The current nutrient level is too high and any increase beyond current levels is likely to have an increasingly adverse effect on its wildlife. Eutrophication may promote growth of a narrower range of plant species at the expense of the desired species. It also encourages the development of algal "blooms" which smother natural plant populations, de-oxygenate the water and in extreme cases lead to loss of fish or other animal species and nitrates. Enrichment or eutrophication can potentially affect the whole ecology of the lake including the balance of plants and animals living within it.

During the winter the water levels fluctuate widely, from 0.6m to 2.6m (or higher in severe flood) above the sluice cill. Once the rain ceases and the water level downstream of Bala starts to fall, the excess storage in Llyn Tegid is released by raising the sluices clear of the water in order to empty the flood storage prior to the next flood event. During the summer the fluctuations are smaller and less frequent because the lake level is maintained between 1.1m and 1.5 m above the sluice gate cill level by EAW. In summary the lake level is highly regulated between two seasonal band levels with a cill level 2m below the natural pre 1956 level. There are 12 agreed release dates from Llyn Celyn down the Afon Tryweryn for canoeing at Canolfan Tryweryn. On such occasions the water level of Llyn Tegid can rise by 3 inches.

After a prolonged drought there can be a need to ensure water supply to the Dee, so proposals involving pumping water to the Dee and/or supplementing the two other reservoirs which are part of the Dee Regulation Scheme, Llyn Celyn and Llyn Brenig, may be developed, as happened in 1996. Such proposals if implemented could result in a drop in water level in Llyn Tegid (a two metre drop was part of one proposed scheme in 1996). Such major changes in water regulation would be very likely to have a significant effect. The original drop in water level since 1956 has resulted in a drying out of the swamp and loss of water sedge, which is particularly noticeable at the boathouse, on the north eastern shore.

Management Requirements of Feature 9

- To reduce/halt point and diffuse sources of pollution (enrichment) in the catchment.
- Within the catchment, forestry managers should be encouraged to adhere to guidelines for applying fertilisers and the suggestions for minimising the release of sediment at all stages of forestry practice from ground preparation to harvesting.

These sources give rise to the following pollution issues:

- Nitrate is very soluble and excessive application can lead to fertiliser seeping through to groundwater, or being washed into rivers through drains or subsurface flow;
- Phosphorus can also be carried in this way, but more commonly binds tightly to soil and is lost through surface run-off or erosion from ploughed or eroded land;
- Agrochemicals such as sheep dip, fungicides and insecticides can be washed into surface or ground waters if not correctly handled and applied;
- Microbial pathogens from manure can be washed into surface waters by rain or where livestock have direct access to watercourses; and
- River sediment levels can be increased by soil erosion due to inadequate livestock or soil management and when livestock damage riverbanks or churn up sediment within the riverbed.

Efforts have been made to tackle point sources of enrichment such as from sewerage treatment and other discharges within the catchment and more diffuse sources including land run-off. A pilot ‘catchment sensitive farming project’ for two tributary rivers, the Afon Llafar and the Afon Twrch, was initiated in 2005 with the aim of improving water quality by reducing diffuse pollution from agricultural operations. Landowners joining the scheme are offered a farm audit which highlights opportunities for improving nutrient planning, soil erosion control, loss of soil structure and organic matter, manure management and sheep dipping.

The Welsh Assembly Government, through a partnership with NRW legacy bodies and SNPA, led the project, with funding by all partners and European Union

Objective 1 funds. This pilot project finished in 2008 and analysis of the success of the scheme to be published, but we can be confident that a similar scheme for the whole catchment of Llyn Tegid would greatly improve water quality and reduce eutrophication and the frequency of blue-green algal blooms.

In the absence of such a project, then eutrophication can only be addressed by land owners in the catchment joining other voluntary agri-environment schemes. Within the boundary of the SSSI / SAC, operations that may contribute to eutrophication may be mitigated at a very localised level through the consultation for consent process.

Status and Management Requirements of Feature 10: Lake fen / swamp (Ramsar)

Status of Feature 10: Unfavourable

The lake fen/swamp is assessed as Unfavourable as the *Carex vesicaria* swamp was damaged in 1996 by the Environment Agency when they carried out flood bank maintenance work. The land has never been adequately restored, so mounds of spoil stand proud of the level of the swamp. The area of the swamp, from air photos and site visits, has also reduced since 1996 for unknown reasons.

- A survey of the fen / swamp should be carried out.

Management Requirements of Feature 10

Grazing can help prevent sedge swamp communities and other wetland from developing into willow scrub as well as promoting plant diversity in these habitats and grassland. Some plants are however particularly grazing sensitive and will benefit from grazing exclusion or periods without grazing. Marshy grassland, fen and swamp continues to be cattle and sheep grazed at the southern end of the site. The Bala end was horse grazed until the late 1980s-early 1990s after which grazing ceased.

- Fen/swamp requires grazing of different zones with some areas not grazed and others lightly summer grazed by cattle/ponies.

Mowing including topping rushes can be a good way of controlling ranker vegetation growth and increasing diversity. An area of the site at the northern end was managed as meadow in the past and the rushes growing on part of the southern marshy grassland are regularly topped. Mowing or rush topping may however adversely affect the bladder sedge fen if it is too frequent so it is important that this vegetation is monitored.

- Mowing/topping may continue as appropriate.

Scrub control is often needed at Llyn Tegid, particularly at the northern end, as the fluctuating water level, natural changes in the vegetation as well as lack of grazing all tend to result in scrub growth and encroachment onto grassland and drier fen swamp.

- A programme of scrub control should continue.

Water sports and other recreation, including swimming, sailing, canoeing, wind surfing, canoeing and sail boarding, are enjoyed by many visitors to the lake. The use of powerboats at Llyn Tegid is however restricted to rescue craft by SNPA. Water sports have resulted in the development of supporting infrastructure, including boat storage areas, slipways and boathouses and the creation of launching points. Sometimes the creation of launching points involves moving boulders, an operation that may damage the special interest in some locations, so this aspect needs to be carefully assessed before it is consented. Water sports can also result in a demand for dredging (see below), excavating channels and shoreline modifications. It is important that development does not spread further along the foreshore creating extensive areas bare of vegetation and that construction of infrastructure is controlled.

Car parking and amenity areas were formalised in 1995-97 and measures were put in place at the Bala end of the lake to control cars driving onto adjacent grassland. Part of northern end of the shore is managed by SNPA as an amenity area and a car park with picnic benches. Such facilities are important in enabling a range of visitors to enjoy the countryside at Llyn Tegid. Appropriate planning of visitor infrastructure including paths can ensure development without significant damage to the wildlife interest.

- Recreational activity and infrastructure needs to be managed.

Dredging took place in Glanllyn Bay in 1951 and in 1984 when part of the lake area (6700 sq m) was deepened to permit launching of canoes from Glanllyn at times of lower lake levels. An estimated 10,000 tons of sediment was removed from the bay and dumped in an offshore area of the lake. There was another proposal to dredge in 1997. There has also been a proposal to reroute the Afon Llafar, so that it would enter the lake to the east of Glanllyn Bay, presumably to try to reduce sedimentation. Dredging releases nutrients from the sediments and can therefore impact negatively on the nutrient levels of the lake and on the water quality. Small-scale excavation of gravel takes place at a number of locations around the lake. Such operations are only acceptable where the impact on the special interest has been fully assessed and is considered not to be significant.

- There should be a presumption against dredging.

Invasive alien plants such as Japanese knotweed, which was mapped in 1990 and has been controlled by SNPA since then, should not be allowed to re-colonise and spread. New Zealand stone crop and other aliens should not be allowed to establish themselves adjacent to or in feeder streams or the lake itself.

- Control of Japanese knotweed should continue and local agencies should monitor and be notified of the occurrence of any new invasive species.

Status and Management Requirements of Feature 11: Gwyniad / *Coregonus lavaretus* (Ramsar)

Status of Feature 11: Unfavourable

The gwyniad population of Llyn Tegid is assessed as Unfavourable (2007 survey) as it has been considered for a number of years to be threatened by deteriorating environmental conditions, especially those associated with eutrophication. Further research is required to collate more data to inform specific management prescriptions. These have been identified by Winfield (2001) as;

- The continuation of oxygen and temperature profiling.
- An investigation of gwyniad spawning grounds,
- An investigation of the fish community,
- A monitoring programme for gwyniad,
- The management of allochthonous sediment sources.

A refuge population was set up in Llyn Arenig Fawr between 2003 – 2007 and it remains to be seen how many of the fertilised eggs hatched and have attained adulthood. Refer to the Migneint-Arenig-Dduallt management plan.

Management requirements of Feature 11

The management requirements of the lake also apply to the gwyniad (see feature 9 above).

- To reduce diffuse sources of pollution (enrichment and sediments) in the catchment. Refer to feature 9.
- During the spawning season, January – end February the lake water levels should be sufficiently high to ensure that gwyniad fish eggs which are laid in the shallows around the edge of the lake are not exposed.
- There should be a presumption against fish introductions into the lake.
- There should be a presumption against significant dredging or any in-lake works between the end of October and the end of May.

Status and Management Requirements of Feature 12: Glutinous snail / *Myxas glutinosa* (Ramsar)

Status of Feature 12: Favourable

The glutinous snail *Myxas glutinosa* is assessed as Favourable based on the 2006 survey and current trends.

Myxas glutinosa has been known in Llyn Tegid since at least 1852. There was a hiatus in recorded presence in the lake between 1953 and 1998 when a CCW/Snowdonia National Park Authority funded survey relocated the species. The snail was found to be widely distributed around about 8.5km of lake margin (>80% of the total shore margin), but was not found in the silted bay where the River Dee enters the south-western end of the lake. Where present, the snail was found almost exclusively on the lower surface of cobbles and small boulders lying on sand, gravel, cobbles or boulders.

Survey sampling undertaken by divers at several of the monitoring stations in November 1999 found that *Myxas* only lives in the littoral regions of Llyn Tegid, extending to depths of only about 2.4m at 'winter' lake levels (1.4m for low summer levels). This reliance of the snail upon the shallow margins of the lake may make it particularly vulnerable to sudden or extreme lake level changes. Subsequent surveys and studies undertaken at different times of the year between 1998 and 2001 suggest that the snail has an annual life cycle. The adult snails appear to reach maturity in late winter, mostly dying off after reproducing in February/March. In the period April - June snails are very difficult to locate. By

August, partially grown snails are relatively easy to locate around most of the lake margins (at sites previously shown to support the snail). These grow throughout the autumn, whilst population numbers decline due to predation and/or other factors.

When populations of the snail were monitored in September 2001 the whole lake was affected by a 'blue-green algal' bloom which lasted several weeks. Total numbers of snails recorded during the monitoring programme was significantly lower than in the years 1998 - 2001, but, given the increase in numbers in 2002, this is likely, at least in part, to be a consequence of poor visibility hampering searches rather than fluctuating population levels. Monitoring visits should therefore avoid episodes of algal bloom if at all possible. At the time of writing this Conservation Objective, Llyn Tegid supports the only known extant population of *Myxas* on the British mainland and this makes the implementation and regular review of this Conservation Objective of the utmost importance.

This small snail is found at locations in the shallow shoreline with rock substrates of cobbles (100 – 200mm) to boulder (>200mm) grade particle sizes. The snail dwells on the undersides of rocks in shallow waters (15 – 50cm) of the lake marginal zone. The literature suggests that *Myxas* has an annual life cycle with individuals reaching full size in winter and breeding in spring, although this creatures’ habits in the UK are poorly understood.

Management requirements of Feature 12

Water quality

- To reduce diffuse sources of pollution (enrichment) in the catchment. Refer to feature 9.

Maintenance of habitat extent and quality

- Sufficient supply of cobbles and boulders in the marginal zone will be maintained by allowing natural processes to deposit and erode the accretion of substrate materials. Substrate materials should not be added or removed from the marginal zone by human activity. Existing habitats should not be allowed to silt over as a result of human induced activity.

Water level fluctuations

- The winter water level should not be so low as to expose the snail’s habitat for very long periods which may lead to animals desiccating.

Action Plan: Summary

This section takes the management requirements outlined in Assessment of Status and Management Requirements a stage further, assessing the specific management interventions required on each management unit. Below is a summary of the information held in Natural Resources Wales' Actions Database for sites.

Actions in Natural Resources Wales' actions database

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
16	1783	Afon Mynach	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon *Salmo salar*	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: - Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey *Lampetra planeri* Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead *Cottus gobio* Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter *Lutra lutra* Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
17	1784	Afon Meloch	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon *Salmo salar* Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: - Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey *Lampetra planeri* Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC.	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead *Cottus gobio* Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter *Lutra lutra* Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
18	1785	Upper Afon Ceiriog Entirely Within Wrexham CB	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon *Salmo salar*	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: - Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey *Lampetra planeri* And FEATURE 6: River Lamprey *Lampetra fluviatilis* Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead *Cottus gobio* Conservation status Unfavourable un-classified.	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter *Lutra lutra* Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
19	1786	Lower Afon Ceiriog from	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
		English Border to Confluence	on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon *Salmo salar* Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: - Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey *Lampetra planeri* And FEATURE 6: River Lamprey *Lampetra fluviatilis* Conservation status: Unfavourable un-classified	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead *Cottus gobio* Conservation status Unfavourable un-classified. Actions currently identified: -	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter *Lutra lutra* Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
4	7847	Llyn Tegid		Yes
2	7848	Tryweryn - Mynach to Llyn Celyn	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon Salmo salar Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: -Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			FEATURE 5: Brook lamprey Lampetra planeri Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead *Cottus gobio* Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter *Lutra lutra* Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer.	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
3	7849	Tryweryn - Dee to Mynach	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as \`Key habitats? or \`Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon Salmo salar Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: -Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey Lampetra planeri Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead Cottus gobio Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter Lutra lutra Conservation status: Favourable: Un-classified Actions currently identified: - Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer. Section of the lower Teweryn is largely canalise and comprises the sluice controls for water entering the Dee downstream. Sections have an artificial base which has been covered by gravels, silts and sands to create a semi-natural habitat of greval beds, emergent reedbed and willow banks. This is important resting up area for otter. Upstream migrtaion of fish species is currently impeded by the sluice and weirs .	
6	7850	Dee - Alwen confl to	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
		Bala sluice gates	on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon Salmo salar Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: -Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey Lampetra planeri And FEATURE 6: River Lamprey Lampetra fluviatilis Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources.	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			FEATURE 7: Bullhead Cottus gobio Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter Lutra lutra Conservation status: Favourable: Un-classified Actions currently identified: -Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
7	7851	Dee - Alwen confl to Ceiriog confl	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon Salmo salar Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: -Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation FEATURE 5: Brook lamprey Lampetra planeri And FEATURE 6: River Lamprey Lampetra fluviatilis Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead Cottus gobio Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter Lutra lutra Conservation status: Favourable: Un-classified Actions currently identified: -Research or surveys are required in order to more accurately determine: the size of the SAC otter	

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	
10	7852	Dee Lower Chester Weir to Ceiriog	In general, for this SAC there is currently insufficient data to identify management requirements specific to individual units. In view of this, much of the text in this section makes general points about the features on a whole site basis. In the future, as our knowledge improves, management requirements will be developed that are more tailored for each unit. Please note that only requirements for features that have been identified as `Key habitats? or `Key species? for this unit are included here. FEATURE 1: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation Conservation status: Unfavourable unclassified Management Requirements Actions currently identified Map extent of this feature and any of its sub-types within the SAC Identify units where substrate problems may be restricting the extent or quality of this feature from existing fluvial audit or other sources. Raise water quality to required standards FEATURE 2: Atlantic salmon Salmo salar Conservation status: Unfavourable unclassified. Management Requirements Actions currently identified: -Where necessary, raise water quality to required standards Prevent exploitation until population criteria are met Improve the habitat for feature by managing/fencing off bankside vegetation	Yes

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
			FEATURE 5: Brook lamprey Lampetra planeri And FEATURE 6: River Lamprey Lampetra fluviatilis Conservation status: Unfavourable un-classified Actions currently identified: - To instigate a survey that, if necessary includes the destructive sampling of a small numbers of ammocoetes, in order to gain some understanding of the distribution and abundance of the species within the SAC. To instigate a survey that identifies spawning sites To instigate research that attempts to determine what is required by way of resources for there to be a sustainable population of this species within the Dee catchment. Identify which resources are limiting the development of the current population. Undertake measures to improve the availability of limiting resources. FEATURE 7: Bullhead Cottus gobio Conservation status Unfavourable un-classified. Actions currently identified: - Raise water quality to required standards Instigate more detailed survey than that of Pisces Conservation Ltd (2007) to clarify the current status Instigate reasons for distribution problems identified by Pisces survey eg survey slack water refuges, substrate quality, woody debris in units where substrate is sub-optimal FEATURE 8: European otter Lutra lutra Conservation status: Favourable: Un-classified Actions currently identified: -Research or surveys are required in order to more accurately determine: the size of the SAC otter population the extent of the SAC otter population its level of breeding success its age structure the extent of its dispersal and recruitment the routes commonly used for its dispersal and recruitment whether the availability of potential resting sites is a limiting the population size or extent, or whether it is increasing the risk of anthropogenic mortality Establish a procedure to analyse road death locations to try and identify reasons for otter mortality. Where possible initiate the fencing of river banks with a suitable buffer	

Glossary

This glossary defines some of the terms used in this **Core Management Plan**. Some of the definitions are based on definitions contained in other documents, including legislation and other publications of Natural Resources Wales and the UK nature conservation agencies.

Action	A recognisable and individually described act, undertaking or **project** of any kind, specified in Assessment of Status and Management Requirements section or Action Plan: Summary section of a **Core Management Plan** or **Management Plan**, as being required for protecting, managing or enhancing one or more of the **features** for which a site is designated.
Attribute	A quantifiable and monitorable characteristic of a **feature** that, in combination with other such attributes, describes its **condition**.
Common standards	See **JNCC common standards.**
Condition	A description of the state of a feature in terms of qualities or **attributes** that are relevant in a nature conservation context. For example, the condition of a habitat usually includes its extent and species composition and might also include aspects of its ecological functioning, spatial distribution and so on. The condition of a species population usually includes its total size and might also include its age structure, productivity, relationship to other populations and spatial distribution. Aspects of the habitat(s) on which a species population depends may also be considered as attributes of its condition. Condition is considered favourable when all the conservation objectives are being met.
Conservation management	Acts or undertaking of all kinds, including but not necessarily limited to **actions,** taken with the aim of achieving the **conservation objectives** of a site. Conservation management includes the taking of statutory and non-statutory measures, it can include the acts of any party and it may take place outside site boundaries as well as within sites. Conservation management may also be embedded within other frameworks for land/sea management carried out for purposes other than achieving the conservation objectives.

Conservation objective	The expression of the desired state of a **feature,** expressed as a composite statement defining the **condition** that we wish the feature to be in. Each feature has one conservation objective.
Core Management Plan	A Natural Resources Wales document containing the conservation objectives for a site and a summary of other information contained in a full site **Management Plan**.
Factor	Anything that has influenced, is influencing or may influence the **condition** of a **feature**. Factors can be natural processes, human activities or effects arising from natural process or human activities. They can be positive or negative in terms of their influence on features, and they can arise within a site or from outside the site. Physical, socio-economic or legal constraints on management of the site can also be considered as factors.
Favourable condition	See **condition**.
Favourable conservation status	The Habitats Directive definition of **Favourable Conservation Status** (FCS) is given in full in the Conservation Objectives section.
Feature	The species population, habitat type or other entity for which a site is designated. The ecological or geological interest which justifies the designation of a site and which is the focus of **conservation management.**
Integrity	See **Site integrity.**
JNCC common standards	A set of principles developed jointly by the UK nature conservation agencies to help ensure a consistent approach to monitoring and reporting on the features of sites designated for nature conservation, supported by guidance on identification of attributes and monitoring methodologies.
Key Feature	The habitat or species population within a **management unit** that is the primary focus of management and **monitoring** in that unit.
Management Plan	The full expression of a designated site's legal status, **vision**, **features**, **conservation objectives**, **performance indicators** and management requirements. A complete management plan may not reside in a single document, but may be contained in a number of documents (including in particular **the Core Management Plan**) and sets of electronically stored information.

Management Unit	An area within a site, defined according to one or more of a range of criteria, such as topography, location of **features**, tenure, patterns of land/sea use. The key characteristic of management units is to reflect the spatial scale at which site management and **monitoring** can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management and monitoring in different parts of a site, and for facilitating communication with those responsible for management of different parts of a site.
Monitoring	An intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. In monitoring of sites designated for habitat and species conservation, the formulated standard is the quantified expression of favourable **condition** based on **attributes**.
Operational limits	The levels or values within which a **factor** is considered to be acceptable in terms of its influence on a **feature**. A factor may have both upper and lower operational limits, or only an upper limit or lower limit. For some factors an upper limit may be zero.
Performance indicators	A subset of the conservation objectives that are quantifiable and measurable. They consist of **attributes** and factors together with their associated target values (or ranges of values) which provide the standard against which information from **monitoring** and other sources is used to determine the degree to which the **conservation objectives** for a **feature** are being met.
Plan or project	**Project:** Any form of construction work, installation, development or other intervention in the environment, the carrying out or continuance of which is subject to a decision by any public body or statutory undertaker. **Plan**: a document prepared or adopted by a public body or statutory undertaker, intended to influence decisions on the carrying out of **projects.** Decisions on plans and projects which affect SAC, SPA and Ramsar sites are subject to specific legal and policy procedures.
Site integrity	This is defined in Welsh Government policy as the coherence of a site's 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 is designated.

Site Management Statement (SMS)	The document containing Natural Resources Wales' views about the management of a site issued as part of the legal notification of an SSSI under section 28(4) of the Wildlife and Countryside Act 1981, as substituted.
Special Feature	See **feature**.
Specified limits	The levels or values for an **attribute** which define the degree to which the attribute can fluctuate without creating cause for concern about the **condition** of the **feature**. The range within the limits corresponds to favourable, the range outside the limits corresponds to unfavourable. Attributes may have lower specified limits, upper specified limits, or both.
Unit	See **management unit.**
Vision Statement	The statement conveying an impression of the whole site in the state that is intended to be the product of its **conservation management.** A 'pen portrait' outlining the **conditions** that should prevail when all the **conservation objectives** are met. A description of the site as it would be when all the **features** are in **favourable condition**.

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Appendix 1: Performance Indicators

These performance indicators are a sub-set of the conservation objectives and describe the evidence, including in particular evidence to be obtained from monitoring of sites and features, that will be used to inform judgements about whether or not the conservation objectives are being met.

The assessment of plans and projects should be made in view of the entirety of the conservation objectives, including the performance indicators.

Performance Indicators for Feature 1. Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Distribution within catchment	Though surveys have identified this feature at various sample sites, the feature's extent, or the extent of suitable habitat for it, within the protected site has never been mapped (The fluvial audit of the Dee (Hill and Emery, 2004) recorded vegetation cover of the river bed and looked at statistical associations with certain other variables. They did not however identify this SAC feature vegetation community)	*Upper limit:* Insufficient information *Lower limit:* Insufficient information. May occur in all site units except 1 and 14
Typical species	Should conform to Plant community: species composition and abundance targets in Table 1a of the current version of JNCC's Common Standards Monitoring Guidance for Rivers (March 2005)	*Upper limit:* Insufficient information *Lower limit:* See Table 1a of JNCC's *Common Standards Monitoring Guidance for Rivers* 2005.
Plant community Reproduction	For this attribute, the 'Targets', 'Method of assessment', and 'Comments' criteria are as those described in Table 1a of the current version of JNCC's Common Standards Monitoring Guidance for Rivers (Current version – March 2005), except for the lower limit. In the guidance, the 'minimum value is defined in terms of the "total habitat	See comments (to the left) for details of when cutting can occur. *Upper limit:* at least 50% of the habitat / macrophyte population should be left uncut for the full duration of the remaining growing season and there should be no

Performance indicators for feature condition		
	/ macrophyte population that should be left uncut". For the Dee percentages of total habitat area or total macrophyte population cannot be expressed because the total area covered by the habitat is not known. Therefore in this SAC, the value expressed applies to a percentage of the width of channel, but **only at locations where control measures such as weed cutting are an established practice as agreed by NRW**. In all other locations there should be no cutting of feature vegetation.	further cutting at the same location for at least two further growing seasons. *Lower limit:* Nil
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
Bank and riparian zone vegetation	In addition to being integral to SSSI river habitat (plant community) types, it is clear that the various types of semi-natural bank and riparian zone vegetation each contribute to the ecological well being of the site and its features in different ways. Examples include: - • Fallen leaves - these provide of a source of allochthonous vegetative input to the aquatic food web. • Fallen trees and branches – woody debris in the water provides cover for fish and invertebrates, and may generate eddies that aid their movement within the site. • Fringing and emergent vegetation at the waters edge provides cover for juvenile fish and invertebrates • Dense vegetation on river banks provides a buffer between intensively farmed land and the river • Ground layer, dense scrub and woodland vegetation on river banks provide a range of terrestrial habitat for otter.	*Upper limit:* None set *Lower limit:* Bank and riparian zone vegetation should form a semi-natural mosaic. However, where it forms part of a plant community classified as a qualifying SSSI habitat feature, it should remain within its notified classification

Performance indicators for feature condition		
	Conversely, dense woodland excludes light from the river and may limit the extent of this feature. In view of these and other known and unknown associated factors, the “mosaic” objective should ensure that all the wide-ranging interactions between bank-side vegetation and the in-river ecosystem can continue to take place.	
Species indicative of eutrophication	Cover values should not increase significantly from an established baseline. Methods used to establish these values should be as indicated in the current version of JNCC’s Common Standards Monitoring Guidance for Rivers (March 2005), which rely on the method of Holmes (1983) and a standard check-list of macrophyte species. Taxa typically associated with enrichment are considered negative indicators of favourable condition. The species will vary depending on the River Community Type. For most such species, as there has not been an MTR survey on the Dee, a baseline has yet to be established. However, for blanket weed, epiphytic or other algae, the generic CSM value has been used	*Upper limit:* Cover, The Combined cover values of blanket weed, epiphytic or other algae should not exceed 25% *Lower limit:* none set
Alien / introduced species	In the CSM guidance, the SERCON scoring system for naturalness of aquatic and marginal macrophytes and naturalness of banks and riparian zone, are used to assess this attribute. SERCON protocols have not yet been applied in the Dee SAC, therefore assessment of this attribute relies on locally defined thresholds and expert judgement. Details to be confirmed	*Upper limit:* No impact on native biota from alien or introduced species. *Lower limit:* None set
Water quality	Water quality should be compliant with the standards set out in JNCC’s Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	See Appendix 2.

Performance indicators for feature condition		
	To a large extent, water flow in the Dee and certain of its tributaries, is regulated by NRW under a set of rules called the Dee General Directions, a requirement of the Dee and Clwyd River Authority Act 1973. The Dee was made a SSSI and SAC with these directions in place. The meaning of “recent actual flow” is as described by Bethune (2006)	*Upper limit:* +10% of recent actual flow. *Lower limit:* -10% of recent actual flow.
Light levels	This factor is partly addressed above in relation to “Bank and riparian zone vegetation” and “Species indicative of eutrophication”. However, light levels reaching this feature vegetation community may be affected by other factors such as buildings, bridges or other structures. The specific ranges and values of light parameters beyond which this feature would be significantly affected is not known and therefore in all cases of doubt, the precautionary principle should apply	*Upper limit:* Insufficient information *Lower limit:* Insufficient information

Performance Indicators for Feature 2. Atlantic salmon *Salmo salar* (EU Species Code: 1106)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Adult run size	CSM guidance states: Total run size at least matching an agreed reference level, including a seasonal pattern of migration characteristic of the river and maintenance of the multi-sea-winter component. For the river Dee the Conservation Limit (CL) is 5100 spawning adults per year and the Management Limit (ML) is 6300 spawning adults per year (from Davidson (2005) but details also	*Upper limit:* None Set *Lower limit:* Conservation Limit 5100 spawning adults per year complied with at least four years in five.

Performance indicators for feature condition		
	given in Pisces Conservation Ltd, (2007).	
A2. Juvenile densities	CSM guidance states: These should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality. Assessed using electrofishing data.	*Upper limit:* Not Applicable *Lower limit:* Expected densities for each sample site using HABSCORE (Cowx and Fraser, 2003).
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
Water Quality	Water quality should be compliant with the standards set out in JNCC's Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	See Appendix 2.
Flow	To a large extent, water flow in the Dee and certain of its tributaries, is regulated by NRW under a set of rules called the Dee General Directions, a requirement of the Dee and Clwyd River Authority Act 1973. The Dee was made a SSSI and SAC with these directions in place. The meaning of "recent actual flow" is as described by Bethune (2006)	*Upper limit:* +10% of recent actual flow. *Lower limit:* -10% of recent actual flow.
River morphology	a)Artificial barriers	*Upper limit:* No artificial barriers preventing significant numbers of adults from reaching existing and historical spawning grounds, and smolts from reaching the sea. *Lower limit:* Nil
	b)Characteristic physical features "The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the spawning, juvenile and migratory requirements of Atlantic salmon. The close proximity of different habitats facilitates movement to new preferred habitats with age. Operations that widen, deepen and/or straighten	*Upper limit:* Not Applicable *Lower limit:* Maintain or enhance characteristic physical features to a level where habitat can support salmon population targets.

Performance indicators for feature condition		
	the channel reduce variations in habitat. New operations that would have this impact are not acceptable within an SAC, whilst restoration may be needed in some reaches." (Extract from the current version of JNCC's *Common Standards Monitoring Guidance for Freshwater Fauna*). This offers specific guidance to the habitat requirements of some of this species' life stages	
Compensation stocking of salmon populations by NRW	Salmon stocking must only occur in order to compensate for the loss of habitat upstream of the Llyn Celyn dam. Stocking beyond the 200,000 target from the existing compensation scheme or any form or enhancement stocking should not occur	*Upper limit:* 200,000 *Lower limit:* None set

Performance Indicators for Feature 3. *Luronium natans* / Floating water plantain

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Population extent and abundance	Presence of *Luronium natans* recorded as plants that are attached to substrate. Detached fragments (unless obviously detached during monitoring) will not be counted.	Abundant *L. natans* should be found in at least, the pools at Glanllyn, Dolfawr bay and near the River Dee outfall.
A2. Sufficient habitat.	Submerged populations of *L . natans* require substrates comprising of mud or stable fine gravel or silt in depths of clear water up to 3m.	Sufficient good quality habitat should exist to support the expansion of existing populations. Extent of good quality habitat should not be reduced.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Dredging	Dredging could directly damage *L. natans.*	No dredging likely to affect *L. natans* should occur at Glanllyn and Dolfawr bays.

Performance indicators for feature condition		
F2. Disturbance by motorised craft	Motorised craft could directly damage *L. natans*.	Number and usage of motorised craft should not rise from current level of warden's use, emergency craft and as consented for research.
F3. Water quality	L. natans is recorded elsewhere across a spectrum of nutrient levels including fairly eutrophic canals.	The lake should achieve WFD Good Ecological Status or better.

Performance Indicators for Featues 4, 5 & 6. Sea lamprey *Petromyzon marinus* (EU Species Code: 1095) Brook lamprey *Lampetra planeri* (EU Species Code: 1096) River lamprey *Lampetra fluviatilis* (EU Species Code: 1099)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Age Structure (*Lampetra* sp. only)	Electrofishing of suitable habitat using quadrats. Suitable habitat includes silt and sand beds in the river, either at the margins or in the main channel. **Age structure** Lamprey ammocoetes grow at a reasonably steady rate and distinct size classes are usually apparent. Ammocoetes typically range from 10 – 150 mm, corresponding to up to six year classes. The largest ammocoetes are usually brook lampreys (river lampreys metamorphose at about 100 – 120 mm), while the smallest individuals are likely to be young-of-year sea lampreys, since this species spawns later in the year than *Lampetra*. The full range of age classes of ammocoete larvae, from 0+ up to metamorphosis should be present. However, sampling error may make these difficult to discern unless large samples are taken.	*Upper limit: Not applicable.* *Lower limit:* For samples of 50 or less, at least two distinct size classes should normally be present. If more than 50 ammocoetes are collected, at least three size classes should be present.

Performance indicators for feature condition		
A2 Distribution within catchment	Distribution in the catchment should be appropriate to the natural geomorphology. Any accessible silt beds should be expected to contain ammocoetes of *Lampetra spp*, although in practice some beds are likely to be naturally unoccupied (e.g. due to washout). Any silt beds adjacent to or downstream of known *Petromyzon* spawning sites should contain *Petromyzon* ammocoetes. Where barriers to migration or pollution issues are thought to be a problem, the population should be classed as being in unfavourable condition and targets for an appropriate increase should be set.	*Upper limit:* *Lower limit:* Lampreys should be present at not less than 2/3 of sites surveyed. As a minimum, there should be no reduction in the distribution of ammocoetes within the catchment.
A3. Spawning Activity (*Petromyzon* only)	Direct observation or redd counts - sea lamprey ammocoetes are typically much less numerous than river / brook lamprey ammocoetes, so this may be the only cost-effective means of determining that a healthy spawning population is present. They are usually easily observed at traditional spawning sites (*Common Standards Monitoring Guidance for Freshwater fauna*, 2005).	*Upper Limit:* None set *Lower Limit:* No reduction in extent of spawning activity year on year
Flow	To a large extent, water flow in the Dee and certain of its tributaries, is regulated by NRW under a set of rules called the Dee General Directions, a requirement of the Dee and Clwyd River Authority Act 1973. The Dee was made a SSSI and SAC with these directions in place. The meaning of “recent actual flow” is as described by Bethune (2006)	*Upper limit:* +10% of recent actual flow. *Lower limit:* -10% of recent actual flow.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
Water quality	Water quality should be compliant with the standards set	See Appendix 2.

Performance indicators for feature condition		
	out in JNCC's Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	
Hydromorphology		
a) Barriers	The impact of barriers should be assessed on a case-by-case basis. Physical modification of barriers is required where depth/velocity/ duration of flows is unsuitable to allow passage. The impact of acoustic (ie noise/vibration) and sediment/chemical barriers should also be assessed on a case by case basis. When arising from construction or other development related activities it may be necessary to restrict the timing of such activities	*Upper limit:* No artificial barriers significantly impairing adults from reaching existing and historical spawning grounds *Lower limit:* None set Impact of existing structures needs to be evaluated.
b) Spawning site availability	The location and extent of the actual and/or potential area of the SAC that is/ could be spawning habitat is currently unknown	*Upper limit:* None set *Lower limit:* Insufficient information
b) Spawning habitat	Spawning habitat usually consists of well-oxygenated gravel/pebble substrate of >10cm depth in a range of water depths (0.2 to 1.5m). Sea and river lamprey tend to spawn in deeper water than brook lamprey Elevated levels of fines (particles <0.83mm) can interfere with egg survival	*Upper limit:* None set *Lower limit:* No significant reduction in spawning habitat
Exploitation	Exploitation can directly on impact population dynamics through reduced recruitment and survival rates	*Upper limit:* Zero exploitation of sea lamprey until further notice *Lower limit:* nil

Performance Indicators for Feature 7.
Bullhead Cottus gobio (EU Species Code : 1163).

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
Population	Single-pass electrofishing in August / September. Data analysis as in a-c. below. For details see the LIFE in UK Rivers Project protocol	*Upper limit:* *Lower limit*: see sub-attributes in a-c below
a) Population densities	CSM guidance states that densities should be no less than 0.2 m^{-2} in upland rivers (source altitude >100m) and 0.5 m^{-2} in lowland rivers (source altitude ≤100m). A significant reduction in densities may also lead to an unfavourable condition assessment.	*Upper limit:* *Lower limit:* No less than 0.2 m^{-2} in sampled reaches
b) Distribution	In the UK, bullhead are widespread in any flowing water at an altitude of less than 300 m. Well oxygenated water over a gravel / pebble / cobble substrate is preferred (and is essential for successful reproduction). Riffles are a favoured microhabitat. Very sluggish water with a clay / silt substrate or cold, steep-gradient upland sections with numerous cascades and boulder / bedrock substrate should be viewed as sub-optimal. Bullheads can occur in very small channels (<1 m wide) where they may be the only fish species present. Bullhead are very poor colonists, to the extent that catchments may contain many individual subpopulations. It is not feasible to assess each of these individually, but it is very important that there is no loss of these populations, and that access routes between them are not impeded	*Upper limit* *Lower limit:* Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current

Performance indicators for feature condition		
c) Reproduction / age structure	This gives an indication of successful recruitment and a healthy population structure.	*Upper limit:* *Lower limit:* Young-of-year fish should occur at densities at least equal to adults
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
Water quality	Water quality should be compliant with the standards set out in JNCC's Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	See Appendix 2.
Flow	To a large extent, water flow in the Dee and certain of its tributaries, is regulated by NRW under a set of rules called the Dee General Directions, a requirement of the Dee and Clwyd River Authority Act 1973. The Dee was made a SSSI and SAC with these directions in place. The meaning of "recent actual flow" is as described by Bethune (2006)	*Upper limit:* +10% of recent actual flow. *Lower limit:* -10% of recent actual flow.
Hydromorphology		
a) Barriers	CSM guidance: Vertical drops of >18-20 cm are sufficient to prevent upstream movement of adult bullheads. They will therefore prevent recolonisation of upper reaches affected by lethal pollution episodes, and will also lead to constraints on genetic interactions that may have adverse consequences. New in stream structures should be avoided, whilst the impact of existing structures needs to be evaluated	*Upper limit:* No significant artificial barriers to essential fish movement between reaches *Lower limit:* None set Impact of existing structures needs to be evaluated.
b) Woody debris removal	Bullheads are particularly associated with woody debris in lowland reaches, where it is likely that it provides an alternative source of cover from predators and floods. It may also	*Upper limit:* Woody debris removal should be restricted to essential activities such as flood risk management. *Lower limit:* Nil

Performance indicators for feature condition		
	be used as an alternative spawning substrate. Debris dams and woody debris should be retained where characteristic of the river/reach	
f) Bankside tree cover	Maintenance of intermittent tree cover in conjunction with retention of woody debris ensures that habitat conditions are suitable. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches. In reaches without any riparian trees orwhere bullhead may be more reliant on woody debris, it may be desirable to introduce a limited amount of cover.	*Upper limit :* None set. Any proposed change to bankside tree cover must be considered individually taking into account factors mentioned in the comments column (see left) and any other significant local factors *Lower limit:* Nil
a) Non-native crayfish	Bullhead densities have been found to be negatively correlated with densities of non-native crayfish, suggesting competitive and/or predator prey interactions.	*Upper Limit:* none set *Lower Limit:* Non-native crayfish should be absent
b) Stocking of other fish	The presence of artificially high densities of salmonids and other fish will create unacceptably high levels of predatory and competitive pressure on juvenile and adult bullhead. Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges	*Upper limit:* Introductions or restocking should not adversely impact populations. *Lower limit:* Nil
c) Stocking / transfers	Bullheads are relatively sedentary and interactions between populations in different parts of the catchment and in different catchments are likely to be limited, suggesting the existence of genetically discrete populations. Since they are of no angling interest, deliberate transfers between sites are unlikely to have been undertaken in the past, such that the genetic integrity of populations is likely to be intact	*Upper limit :* Stocking / transfers of bullhead should not adversely impact populations. *Lower limit:* Nil

Performance Indicators for Feature 8.
European otter *Lutra lutra (EU Species Code : 1355).*

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1 Population size	In 2004 Morgan provided an intuitive estimate of the catchment population size of 22 breeding pairs. However, he states that this not accurate as it is based on an assessment of the habitat available. The presence of otters can be determined by carrying out standard sign surveys. The main problem with monitoring otter populations is the lack of a clear relationship between the density of signs and the density of otters. There is currently no way of reliably estimating otter density, although the use of DNA extracted from spraints may provide a solution to this in the future (Common Standards Monitoring Guidance for Mammals (2004),). In view of this, some form of survey or more accurate means of assessment is required	*Upper limit: None set* *Lower limit:* Insufficient information
A2. Extent	The limits expressed here are based on the 'Sites', and their numbers, used by the Otter Survey of Wales within the River Dee SSSI's catchments. 46 of the 59 equates to 78% of sites. However, while these values may be useful for monitoring purposes, it is highly likely that otters range throughout the SAC and beyond. Therefore extensive survey work is required in order to adequately determine the extent, distribution and mobility of the SAC otter population. The use of artificial sprainting sites may be necessary in parts of the SAC, and beyond, where natural	*Upper limit:* None set *Lower limit:* Otter signs to be found at 46 of the 59 sites (See comments to the left for the definition of 'sites') More extensive survey work required

Performance indicators for feature condition		
	sprainting sites appear to be sparse.	
A3. Breeding Success	Morgan (2004) identified 77 potential 'Otter Sites'. Of these he could confirm only five as being actual breeding sites but no natal holts were actually identified. A number of live sightings were reported but few of these were of cubs and their survivorship is unknown. In view of this, clearly further survey or research is required.	*Upper limit:* None set *Lower limit:* Insufficient information
A4. Age structure	In order to properly assess the favourable conservation status of this feature it would clearly be beneficial to have some understanding of age structure. The only information currently available for this it that of Morgan (2004), based on road deaths and live sightings. However, the numbers involved were very low. Therefore further information is required	*Upper limit:* None set *Lower limit:* Insufficient information
A5 Dispersal and recruitment	Little is currently known of the extent, rate or direction of dispersal of otters from the SAC population, either within the SAC or in the wider catchment. Similarly, little is known of the of recruitment into the population, either from births within it or from otters dispersing from other populations. Such knowledge would enable assessment of the robustness of the population and its potential ability to recover from losses. It would provide some knowledge of its likely genetic diversity.	*Upper limit:* None set *Lower limit:* Insufficient information
A4. Good quality vegetation for breeding otters	Good quality vegetation for breeding otters includes dense scrub (e.g. bramble, blackthorn and gorse); reed-beds; deciduous woodland with an under-story; young conifer plantations; Rhododendron	*Upper limit:* None set *Lower limit:* No reduction in the quality of or extent of suitable otter habitat

Performance indicators for feature condition		
	thickets; and wetlands (particularly with areas of *Molinia caerulea*).	
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1 Potential Breeding Sites	Though clearly the presence of sites where otters can breed is a critical factor for any population, the *Common Standards Monitoring Guidance for Mammals* (2004), specifically excludes breeding sites as a factor or attribute for assessing conservation status of otter. It does so because "It would also be extremely difficult to decide on a reasonable target and a means of measuring the attribute." However, as the survey of Morgan (2004) collected such data, the number of potential breeding sites has been included here as a factor.	*Upper limit:* None set *Lower limit:* There should be an increase in the number of known potential (in addition to actual) breeding sites on the River Dee from 72 to 76. Lakeside habitat that could provide potential breeding sites for otter should be retained at current levels.
F2 Potential resting sites	Otters use a range of types of resting or laying up sites, and these may vary in type or location depending on conditions and availability. Surveys within the Dee SAC have found many potential sites but there are sections where few have been found. Where these coincide with sections of the site where little otter activity has been detected, research should be undertaken to determine whether the presence of resting sites is a limiting factor. If it is, measures should be undertaken to increase the number of potential resting sites. In addition, where potential resting sites are few, otters may travel further to find them. This may lead to a greater risk of death due to anthropogenic mortality, particularly where road crossing may occur.	*Upper limit:* None set *Lower limit:* Insufficient information

Performance indicators for feature condition		
F2 Food availability	Otters depend on food that comes from a range of aquatic environments, such as streams, marshes, ponds and backwaters. Their diet may, among other things, include fish, amphibians and crustaceans. Eels are thought to be particularly favoured though at times prey, such as frogs, can assume a greater importance than that of fish. Data should be sought on fish stocks from EAW. Specific assessment limits have yet to be devised	*Upper limit :* None set. *Lower limit:* Fish biomass stays within expected natural fluctuations. There should be no loss of amphibian habitat likely to be used by otters from the SAC population. More specific limits to be devised
F3 Dispersal and access routes	Little is currently known of dispersal or access routes used by otters from the SAC population, either within the SAC or in the wider catchment. However, such routes are essential for the dynamics of a healthy population. Therefore further information is required	*Upper Limit:* none set *Lower Limit:* No loss or impairment of any such routes. More specific limits to be devised
F4 Anthropogenic mortality	Road deaths have been noted as a primary threat to the otters conservation status across Wales, and if the numbers reported by Morgan (2004) are compared to his estimate of population size, clearly of such deaths are a significant factor affecting the population of this SAC.	*Upper limit:* No increase in numbers of recorded Road Deaths. Analysis of road death locations should be used to try and identify reasons for such mortality. *Lower limit:* Nil
F5 Disturbance	Otters are sensitive to human disturbance and especially to sudden changes in activity. They are particularly sensitive to disturbance by dogs. The female otter is particularly sensitive to disturbance when she has cubs.	*Upper limit :* No significant increase disturbance to otters. *Lower limit:* Nil

Performance Indicators for lake and marginal wetland SAC & Ramsar features 9 and 10. The lake and aquatic /emergent vegetation, Lake fen/swamp incl. wet woodland.

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A.1 Extent of communities / assemblages		
A1.1. Extent of aquatic /emergent macrophyte assemblages	See Conservation Objectives above which lists aquatic/emergent species. The use of the lake as a reservoir & flood defence has substantially affected the marginal community.	The collated data in Evans and Benoit (1996) provides the lower limit acceptable. Need to monitor to ensure no further deterioration
A1.2. Extent of fen /swamp communities	The location of fen / swamp was mapped at Phase 1 level in early 1990s. Evans & Benoit (1996) also mapped some other areas of swamp (including *Carex vesicaria* swamp/fen). A compilation 1996 Map has been drafted. It appears that the area of swamp has reduced during the period 1996-2008.	Lower limit of extent for fen/ swamp communities is based on the map in annex 1(1996). Sufficient expansion areas for fen/swamp communities should be maintained.
A.2 Distribution of communities / assemblages		
A2.1 Distribution of aquatic /emergent macrophyte assemblages	The extent of aquatic macrophytes is a good indicator of the health of the lake. Growth in deeper water indicates good light penetration through the water column. A full CSM was carried out in 2004, and Llyn Tegid is scheduled for monitoring by NRW. The use of hydroacoustic techniques for mapping vegetation is currently being trialled on the lake.	The collated data in Evans and Benoit (1996) provides the lower limit acceptable. Lower Limit: Maximum depth of plant growth should not be less than 2.5m.
A2.2. Distribution of fen / swamp types	NVC S11 *Carex vesicaria* lower limit is based on 1996 survey map by Evans & Benoit. It appears that the area of *Carex vesicaria* swamp has reduced during the period 1996-2008.	The lower limit of distribution for fen/ swamp communities is based on Map in annex 1 (1996).
A.3 Frequency and abundance of typical & key species		
A3.1 Typical species of aquatic	Dominant species or community constant species	Typical species of aquatic /emergents & fen /

Performance indicators for feature condition		
/emergents & fen / swamp	will continue to be recorded at the expected frequency and abundance for their community. Refer to tables in the Conservation Objective section for aquatic /emergents and fen / swamp. Refer also to Rodwell (1995) and Evans & Benoit (1996).	swamp should continue to be present at previously recorded frequency and abundance. The wet woodland that has developed on swamp should include sedges and a wetland under storey. Aquatic Species Lower Limit: 90% or more of sample points should have one or more of the following species recorded: *Isoetes spp; Littorella uniflora; Luronium natans; Elatine hexandra; Nitella spp; Callitriche hamulata.*
A3.2. Uncommon/key species aquatic /emergents & fen / swamp	Refer to table in Conservation Objective section. *Luronium natans* has separate conservation objectives. (See feature 2).	Uncommon/key species aquatic/emergents & fen / swamp species should continue to be present at previously recorded frequency and abundance. Evans & Benoit (1996).
A3.3. Non- native species	Non- native species can out compete native species and reduce the natural biodiversity of the vegetation.	Invasive non-native species should be absent (NB *Elodea nuttalli* present but rare)
A.4 Habitat Structure and Function		
A4.1. Water quality	Water quality should allow lake to be classed as an oligo-mesotrophic water body. Refer to management requirements section above for details of the research carried out on water quality and actions taken to tackle point and diffuse sources of pollution in the catchment.	Water quality in the lake should be of a standard that will ensure it reaches at Good Ecological Status or better as defined by the Water Framework Directive.
A4.2 Shoreline substrates	Shoreline substrate should be allowed to accrete and erode under the natural influence of the lake's tributaries. The wildly fluctuating lake level, including	Map and photograph existing constraints (2008) on natural erosion/accretion and ensure this does not

Performance indicators for feature condition		
	very high levels, results in gravels being washed up the shore including onto tracks in places. Severe winter storms promotes roller wave action leading to buffeting and erosion of the swamp communities on the north east shoreline.	increase and that opportunity is taken to remove constraints.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water level regulation	Water levels in the lake are regulated and the current regime ensures that a "conservation" level is imposed and this arrangement should be continued.	Continue existing regime unless evidence of a negative impact or adverse trend.
F2. Water sports	Extent or distribution of marginal wetland should not be compromised by recreational infrastructure.	Map and photograph existing infrastructure (2008) and ensure this does not increase and that opportunity is taken to restore habitats as appropriate.
F3. Dredging	Dredging took place in Glanllyn Bay in 1951, 1984 & there was another proposal to dredge in 1997. Small-scale excavation of gravel takes place at a number of locations around the lake. Such operations are only acceptable where the impact on the special interest has been fully assessed and is considered not to be significant.	There is a presumption against dredging.
F4. Flood defence work incl. works on tributaries and re-routing rivers.	Flood embankments maintenance work can result in loss of swamp and damage to the marshy grassland and other grassland if heavy machinery is driven within the SSSI and ruts are left, soil is compacted, disturbed, and/or moved.	No further damage should take place through flood defence or other engineering works. Previously damaged stands should be restored.
F5. Scrub control	Scrub control is often needed at Llyn Tegid, particularly at the northern end, as the fluctuating water level, natural changes in the vegetation as well as lack of grazing all tend to result in	A scrub control programme should continue.

Performance indicators for feature condition		
	scrub growth and encroachment onto grassland and drier fen swamp. The Bala Lake Railway Company regularly fell/coppice trees and scrub along the edge of the railway line in order to maintain views and also as a health and safety measure.	
F6. Mowing	Mowing including rush topping can be a good way of controlling ranker vegetation growth and increasing diversity. An area of the site at the northern end was managed as meadow in the past and the rushes growing on part of the southern marshy grassland are regularly topped. Mowing or rush topping may however adversely affect the bladder sedge fen if it is too frequent so it is important that this vegetation is monitored.	Consented mowing as appropriate.
F7. Grazing	Grazing can help prevent sedge swamp communities and other wetland from developing into willow scrub as well as promoting plant diversity in these habitats and grassland. Some plants are however particularly grazing sensitive and will benefit from grazing exclusion or periods without grazing. Marshy grassland, fen and swamp continues to be cattle and sheep grazed at the southern end of the site. The Bala end was horse grazed until the late 1980s early 1990s after which grazing ceased.	Zoned grazing with some areas not grazed and others lightly summer grazed.

Performance Indicators for Feature 11. Gwyniad *Coregonus lavaretus.*

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1 Population abundance & demographic structure.	Variation in abundance levels at other white fish sites is great, so reference values must be calculated for each site (Bean, 2003). Lack of historical data preclude this calculation for Llyn Tegid so specified limits are provisional until more data is available.	90% of individuals in the 0+/1+ age class (corresponding to gwyniad in the small length class of 40 – 99mm).
A2 Range	The natural range is taken to mean those water columns where predominantly suitable habitat for each life stage exists over the long term.	Deeper cooler waters required in the summer and shallow spawning waters required late winter.
A3 Maintenance of habitat quality for each stage of their lifecycle i.e. spawning & feeding grounds.	Shallow water gravels are used for spawning between January and February. Gwyniad feed in the deeper water columns on a wide variety of invertebrates but predominantly *Daphnia* (water fleas).	Sufficient suitable spawning areas should be available every season.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water level regulation	Low winter water levels could expose the shallow water spawning gravels in January & February.	Sufficient suitable spawning areas shall be available every season. Deeper water feeding columns to be maintained.
F2. Water quality	See performance indicators for feature 9 (the lake).	See performance indicators for feature 9 (the lake).
F4. Environmental conditions; Water temperature profiles.	Coregonids are unable to tolerate a wide range of temperatures and high temperatures can be lethal. Levels are assessed for vertical distribution.	Water column temperatures should not rise above 15°C.
F5. Presence of alien fish species; roach & ruffe.	Roach *Rutilis rutilis* (competition), ruffe *Gymnocephalus cernuus* (predation of gywniad eggs).	Accept presence as only a pragmatic option. Review approach if evidence of adverse impact and

Performance indicators for feature condition		
		suitable control methods are available.
F6. Nutrient state & sediment input.	See performance indicators for feature 9 (the lake).	See performance indicators for feature 9 (the lake).
F8. Dredging	Dredging can directly damage gwyniad spawning areas.	No dredging likely to affect gwyniad spawning areas to be consented between January – end of May.

Performance Indicators for Feature 12. Glutinous snail *Myxas glutinosa*

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1 Population abundance & extent.	These are the targets to maintain the population at a Favourable Conservation Status – separate targets have been compiled should the status change and the population needs to be restored – see Willing, M.J., (2006) Condition assessment of the glutinous snail *Myxas glutinosa* in Llyn Tegid in 2005. CCW Contract Science Report No. 726. Bangor. CCW.	*Lower limit:* The combined total number of semi-grown snails at the 8 monitoring sites is 40 and where the snail is recorded at 6 of the 8 monitoring sites (Map Y showing monitoring stations in Appendix X).
A2 Maintenance of habitat extent and quality.	In water depths of Om - ca 2.5 m (with lake levels between 0.75 - 1.35m) the habitat consists predominantly of cobbles and boulders lying on varying mixtures of sand, gravel and cobbles (but not noticeable amounts of mud or silt). There is little organic detritus between the stones and filamentous and slime forming algal species are scarce or absent from the rock surfaces. The lower surfaces of rocks appear blackened and, with the exception of occasional freshwater sponges, are largely devoid of other living	*Lower limit:* Cobbles and boulders at 6 of the 8 monitoring stations give no more than 20% of the rock surface covered in silt and/or slime forming algae. *Lower limit:* Still, calm lake water should have clarity to 1.5m depth.

Performance indicators for feature condition		
	encrustations. Lake water (judged in still weather with a calm or reasonably calm lake surface) has good clarity such that stones can be seen clearly to at least 1.5m depth. Water is not turbid due to silt suspension or floating algal blooms.	
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water level fluctuations	Very low water levels could expose the shallow gravel shelf and snails could desiccate. (See factors affecting feature no. 11 for details).	Sufficient suitable areas of small gravel substrate with shallow water levels (between 1.4m – 2.4m) shall be available throughout the year.
F2. Water quality.	See performance indicators for feature no. 9 & 10 for lake.	See performance indicators for feature no. 9 & 10 for lake.

Appendix 2. Water Quality Targets for River Waterbodies

(as revised in Common Standards Monitoring guidance for Rivers, JNCC 2016)

River SACs designated under the Habitats Regulations 2017 (UK Gov, 2017) overlap river water bodies designated under Water Framework Directive Regulations (NRW, 2015; UK Gov, 2015). The water quality standards that apply come from the source legislation – i.e. for the water body the WFD Regulations standards and for a SAC the Habitats Regulations standards. Note that the words targets and standards are used under the various documents that sit under these two Regulations. We have interpreted these to mean the same thing and for this document we will use the term standard unless directly quoting from a specific document. Water quality standards for Special Area of Conservation (SAC) rivers are set via agreement at a UK level and presented in the JNCC Common Standards Monitoring (CSM) guidance (JNCC 2016).

However, having two sets of standards for the same area of river can lead to confusion as to which apply in a given situation. This Appendix sets out the standards for water quality attributes for river water bodies in the Afon Dyfrdwy a Llyn Tegid SAC. Where they are more stringent, WFD Regulation 2017 standards are adopted as the CSM standards.

Note that for the transitional (estuarine) waterbody GB531106708200, specific water quality standards are not yet available. Therefore the standard for this waterbody is to achieve WFD Good Ecological Status.

1. Organic pollution

Table A2.1a provides the values for the physio-chemical attributes to be applied across all river types. Standards apply throughout the assessment unit, not just at sparsely distributed monitoring sites.

The standards for DO, BOD and un-ionised ammonia are the same for all river water bodies whereas the standard for total ammonia varies according to river type and previous WFD Regulations classification for ammonia (Table A2.1a). For the 90%ile total ammonia the CSM target is 0.25mg/l. However, if High Status under WFD is being reached for a water body for certain river types then the more stringent WFD standard at 0.2mg/l is applied. This is due to the no deterioration principle. Total ammonia standards for each waterbody are given in Table A2.1b.

Table A2.1a. Organic pollution standards for SAC rivers.

Organic pollution attribute	Unit	Test Statistic	Target
Dissolved Oxygen (DO)	% saturation	10%ile	≥85
Biochemical Oxygen Demand (BOD)	mg l^{-1}	Mean calculated over a 3-year period	≤1.5
Total Ammonia	mg l^{-1}	90%ile	Varies by water body. See Table 2.1b.
95%ile un-ionised ammonia	mg l^{-1}	95%ile	≤0.025

Table A2.1b. Total Ammonia standards for river water bodies in the Afon Dee SAC.

* Reason for total ammonia standard: some water bodies that meet WFD high status for ammonia have the WFD high target of 0.2 mg l^{-1}, all other water bodies have the CSM target of 0.25 mg l^{-1}.

Water Body ID	Water Body Name	Total Ammonia (90%ile, mg l^{-1})	Reason for total ammonia standard*
GB111067051960	Meloch	0.2	WFD (high)
GB111067051990	Mynach	0.2	WFD (high)
GB111067051900	Tryweryn - Dee to Mynach	0.2	WFD (high)
GB111067052060	Dee - Ceiriog to Alwen	0.2	WFD (high)
GB111067052240	Dee - Alwen to Llyn Tegid/ Bala Lake	0.2	WFD (high)
GB111067057080	Dee - Chester Weir to Ceiriog	0.25	CSM

Water Body ID	Water Body Name	Total Ammonia (90%ile, mg l^{-1})	Reason for total ammonia standard*
GB111067051610	Ceiriog - upstream of Teirw	0.2	WFD (high)
GB111067051910	Ceiriog - confluence Dee to Teirw	0.25	CSM
GB111067051980	Tryweryn - Mynach to Llyn Celyn	0.2	WFD (high)

2. Reactive phosphorus

Phosphorous standards are set according to altitude, alkalinity, and river size, with the tightest targets in low alkalinity, high altitude headwater areas, reflecting natural variation (JNCC 2016). River Habitat Survey (EA, 2003) river flow categories are used to determine river size.

The process also includes an alignment procedure to ensure that standards are never less stringent than the Water Framework Directive (WFD) phosphorus standard for the same water body. If the WFD standard is more stringent than the CSM standard then the WFD standard applies.

Individual phosphorus standards for all waterbodies in the Dee SAC are given in Table A2.2. As explained previously, the WFD phosphate standard has been applied where it is more stringent than CSM targets.

Table A2.2. Phosphorus standards and typology for river waterbodies in the Afon Dee SAC. * Phosphorus standard to be applied to annual and growing season means. Standard calculated from annual mean expressed in µg L-1 SRP. ** Reason for phosphorus standard: CSM (near natural/max allowable) are derived from the CSM guidance for Rivers and WFD (good/high) from the relevant Water Framework Directive standard.

Water Body ID	Water Body Name	SAC Manage-ment Unit	Phospho-rus standard * (µg l^{-1})	Reason for phosphorus standard**	CSM_Alt type	CSM_Alk type	River size
GB111067051910	Ceiriog - confluence Dee to Teirw	1786	25	CSM (max allowable)	high Alt >80m	high Alk >50mg/l	river
GB111067051610	Ceiriog - upstream of Teirw	1785	10	CSM (near natural)	high Alt >80m	low Alk <50mgl	river

Water Body ID	Water Body Name	SAC Manage-ment Unit	Phospho-rus standard* (µg l^{-1})	Reason for phosphorus standard**	CSM_Alt type	CSM_Alk type	River size
GB111067052240	Dee - Alwen to Llyn Tegid/ Bala Lake	7850	10	CSM (near natural)	high Alt >80m	low Alk <50mgl	river
GB111067052060	Dee - Ceiriog to Alwen	7851	10	CSM (near natural)	high Alt >80m	low Alk <50mgl	river
GB111067057080	Dee - Chester Weir to Ceiriog	7852	50	CSM (max allowable)	low Alt <80m	high Alk >50mg/l	river
GB111067051960	Meloch	1784	10	CSM (max allowable)	high Alt >80m	low Alk <50mgl	headwater
GB111067051990	Mynach	1783	10	CSM (max allowable)	high Alt >80m	low Alk <50mgl	headwater
GB111067051900	Tryweryn - Dee to Mynach	7849	10	CSM (near natural)	high Alt >80m	low Alk <50mgl	river
GB111067051980	Tryweryn - Mynach to Llyn Celyn	7848	10	CSM (near natural)	high Alt >80m	low Alk <50mgl	river

3. Trophic diatom index

The standard should be equivalent to WFD high ecological status using the current version of the diatom classification tool (via light microscopy). This is a tool developed to measure increases in nutrient concentrations through assessing degree of change in floristic composition in benthic diatoms (algae) in streams and rivers.

4. Acidification

This standard only applies to assessment units whose water body type is classified as siliceous or peat. Other types have good buffering ability and so will not be affected by acidification. See tables 4a and 4b for standards for all water bodies in the Afon Dee SAC.

Two of the WFD water bodies in the Afon Dee SAC are classed at risk of acidification (Hankin *et al*. 2014). However, to comply with CSM guidance, acid targets have been applied for all river water bodies. **Note that monitoring and reporting will only be carried out for water bodies classified as either 'at risk' or 'probably at risk'.** If ANC data is available then water bodies should be assessed against the ANC standard but if ANC data is not available then pH should be used.

Table A2.4a. Acidification targets for SAC rivers.

*Acid Neutralising Capacity; ** Dissolved Organic Carbon

Targets for acidification	Method of assessment
ANC*: Mean ANC for all waters > 80 pH (Clear waters with DOC**<10 mg L-1): mean > 6.54 pH (Humic waters with DOC>10 mg L-1): mean > 5.1	Analysis of water chemistry data from environment agencies. At least 36 samples (3 years of data) are required, which must include winter samples.

Table A2.4b. Acidification targets for river waterbodies in the Afon Dee SAC.

Water Body ID	Water Body Name	Acidification risk	Acid Neutralising Capacity (ANC)	pH
GB111067051910	Ceiriog - confluence Dee to Teirw	Not at risk	>80	>6.54
GB111067051610	Ceiriog - upstream of Teirw	Probably not at risk	>80	>6.54
GB111067052240	Dee - Alwen to Llyn Tegid/ Bala Lake	Probably at risk	>80	>6.54
GB111067052060	Dee - Ceiriog to Alwen	Not at risk	>80	>6.54
GB111067057080	Dee - Chester Weir to Ceiriog	Probably not at risk	>80	>6.54
GB111067051960	Meloch	Probably not at risk	>80	>6.54
GB111067051990	Mynach	Probably not at risk	>80	>6.54
GB111067051900	Tryweryn - Dee to Mynach	Probably not at risk	>80	>6.54
GB111067051980	Tryweryn - Mynach to Llyn Celyn	Probably at risk	>80	>6.54

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Appendix D River Ehen SAC

European Site Conservation Objectives for River Ehen Special Area of Conservation Site Code: UK0030057

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of the habitats of qualifying species**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

S1029*. Margaritifera margaritifera*; Freshwater pearl mussel
S1106*. Salmo salar*; Atlantic salmon

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations..

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Appendix E River Eden SAC

European Site Conservation Objectives for River Eden Special Area of Conservation Site Code: UK0012643

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the ‘Qualifying Features’ listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H3130. Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*; Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels

H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

H91E0. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*); Alder woodland on floodplains*

S1092*. Austropotamobius pallipes*; White-clawed (or Atlantic stream) crayfish

S1095*. Petromyzon marinus*; Sea lamprey

S1096*. Lampetra planeri*; Brook lamprey

S1099*. Lampetra fluviatilis*; River lamprey

S1106*. Salmo salar*; Atlantic salmon

S1163*. Cottus gobio*; Bullhead

S1355*. Lutra lutra*; Otter

* denotes a priority natural habitat or species (supporting explanatory text on following page)

*** Priority natural habitats or species**

Some of the natural habitats and species for which UK SACs have been selected are considered to be particular priorities for conservation at a European scale and are subject to special provisions in the Habitats Regulations. These priority natural habitats and species are denoted by an asterisk (*) in Annex I and II of the Habitats Directive. The term 'priority' is also used in other contexts, for example with reference to particular habitats or species that are prioritised in UK Biodiversity Action Plans. It is important to note however that these are not necessarily the priority natural habitats or species within the meaning of the Habitats Regulations.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix F River Derwent and Bassenthwaite Lake SAC

European Site Conservation Objectives for River Derwent Special Area of Conservation Site code: UK0030253

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

S1095*. Petromyzon marinus*; Sea lamprey

S1099*. Lampetra fluviatilis*; River lamprey

S1163*. Cottus gobio*; Bullhead

S1355*. Lutra lutra*; Otter

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix G Solway Firth SAC

European Site Conservation Objectives for Solway Firth Special Area of Conservation Site Code: UK0013025

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying Conservation Advice document (where available) which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H1110. Sandbanks which are slightly covered by sea water all the time

H1130. Estuaries

H1140. Mudflats and sandflats not covered by seawater at low tide

H1170. Reefs

H1220. Perennial vegetation of stony banks; Coastal shingle vegetation outside the reach of waves

H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand

H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); Atlantic salt meadows

H2130. Fixed dunes with herbaceous vegetation ("grey dunes"); Dune grassland*

S1095*. Petromyzon marinus*; Sea lamprey

S1099*. Lampetra fluviatilis*; River lamprey

* denotes a priority natural habitat or species (supporting explanatory text on following page)

*** Priority natural habitats or species**

Some of the natural habitats and species for which UK SACs have been selected are considered to be particular priorities for conservation at a European scale and are subject to special provisions in the Habitats Regulations. These priority natural habitats and species are denoted by an asterisk (*) in Annex I and II of the Habitats Directive. The term 'priority' is also used in other contexts, for example with reference to particular habitats or species that are prioritised in UK Biodiversity Action Plans. It is important to note however that these are not necessarily the priority natural habitats or species within the meaning of the Habitats Regulations.

This is a cross border site

This site crosses the border between England and Scotland. Some features may only occur in one Country. The advice of Scottish Natural Heritage should therefore be sought separately.

This is a European Marine Site

This site is a part of the Solway Firth European Marine Site (EMS). These Conservation Objectives should be used in conjunction with the Conservation Advice document for the EMS. Natural England's formal Conservation Advice for European Marine Sites can be found via GOV.UK.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 4). This document updates and replaces an earlier version dated 22 February June 2016 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix H River Kent SAC

European Site Conservation Objectives for River Kent Special Area of Conservation Site Code: UK0030256

NATURAL ENGLAND

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

S1029*. Margaritifera margaritifera*; Freshwater pearl mussel

S1092*. Austropotamobius pallipes*; White-clawed (or Atlantic stream) crayfish

S1163*. Cottus gobio*; Bullhead

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix I River Bladnoch SAC

NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

RIVER BLADNOCH SPECIAL AREA OF CONSERVATION (SAC)

CONSERVATION ADVICE PACKAGE

Atlantic salmon © Lorne Gill/SNH

Site Details

Site name:	River Bladnoch
Map:	https://sitelink.nature.scot/site/8355
Location:	South Western Scotland
Site code:	UK0030249
Area (ha):	272.60
Date designated:	17 March 2005

Qualifying feature	SCM assessed condition	SCM visit date	UK overall Conservation Status
Atlantic salmon (Salmo salar) [S1106]	Unfavourable Recovering	September 2011	Unfavourable-Inadequate

Notes:
Assessed condition refers to the condition of the SAC feature assessed at a site level as part of NatureScot's Site Condition Monitoring (SCM) programme.
Conservation status is the overall condition of the feature throughout its range within the UK as reported to the European Commission under Article 17 of the Habitats Directive in 2019.

Overlapping Protected Areas

Kirkcowan Flow Special Area of Conservation (SAC), Kirkcowan Flow Site of Special Scientific Interest (SSSI) and Cree Estuary SSSI.

Key factors affecting the qualifying feature

Atlantic salmon
Atlantic salmon live in both freshwater and marine environments as part of their lifecycle. They hatch and live in freshwater as juveniles and then migrate to sea as adults. After one year or more at sea the adults return to their natal river to spawn. This homing behaviour has resulted in the development of genetically distinct populations of Atlantic salmon between Scottish rivers and several populations may exist within the same river.

Atlantic salmon numbers have declined throughout their geographic range, including in Scottish rivers. They may be impacted by a range of pressures in the freshwater and marine phases of their lifecycle. In the freshwater environment these pressures may include, amongst others: over exploitation, loss of habitat connectivity, habitat degradation, climate change-related changes to surface water temperature and hydrology, built development (such as hydropower), invasive non-native species, direct and diffuse pollution, predation and the inappropriate stocking of conspecifics.

The main natural and artificial pressures on Atlantic salmon populations in the Bladnoch were assessed in a 2007 Catchment Management Plan. This identified 12 major pressures on the river, including: water quality and water resource management; river morphology and riparian habitat; salmon biology and fisheries management.

Like many rivers the Bladnoch was used historically for industry. Woolen mills and sawmills were powered by water, or used water in their processing. Weirs and other embankments channeled and dammed the water and altered the river bank, for example at Barhoise Mill and Waulkmill. All major obstacles such as these have now been addressed and fish can migrate throughout the SAC.

Salmon netting was a local industry on the Bladnoch, for example at Torhouse. There is now no salmon netting in the catchment, with netting stations effectively closed since 1999. This will have removed a potentially significant cause of salmon loss from the Bladnoch.

On a much smaller scale, fish-eating birds will take salmon - an entirely natural process of the river system. Where there is concern about predation by birds, fishery managers can apply for a control license, most commonly for goosander and cormorant. Research has recently been carried out to give a better understanding of predation by fish-eating birds. This may influence the need for licences in future.

Where salmon numbers are low, catch and release policies are implemented.

As a result of this combined conservation effort, aquatic habitats in the river are generally in good condition. Invasive non-native species are not a significant concern for Atlantic salmon on the Bladnoch, although mink and Japanese knotweed are reported. Tackling diffuse pollution remains a priority for river enhancement, with efforts focused on the agriculture, forestry and development sectors.

Acidification of the upper reaches of the Bladnoch is a significant issue for Atlantic salmon. Caused by degradation of peatlands and by expansive coniferous plantations, remedial action will require forest restructuring, peatland restoration and other habitat enhancements. A Bladnoch Restoration Feasibility Study was published in 2018 to address these acidification issues and wider habitat limitations.

Restoring good water quality and river habitat condition is progressed through a regulatory process that involves Dumfries & Galloway Council, Scottish Forestry, SEPA and NatureScot. Proactive enhancement of river ecology is also promoted by these organisations and by Galloway Fisheries Trust and Bladnoch District Salmon Fisheries Board.

In Scotland Atlantic salmon SACs extend to the tidal limit of rivers only. Marine mortality is however one of the key issues facing Atlantic salmon in Scotland and elsewhere. Environmental factors, climate change, marine developments, enhanced sea lice burdens associated with aquaculture, by-catch in pelagic fisheries, over-exploitation, prey availability, pollution and predation are all key factors that could affect this species. However, the exact nature of these interactions is not fully understood.

The feature has been assessed through NatureScot's site condition monitoring programme as being in unfavourable condition at this SAC due to decline in the numbers of adults recorded from rod catch data. Marine mortality of adult fish and the exploitation of post-smolts in commercial marine fisheries by-catch may be contributing to the status of the Atlantic salmon population at this site but are out with the control of this plan. Whilst the feature of interest (Atlantic salmon) is considered to be in unfavourable condition, the freshwater habitats that support this species are undergoing improvements (albeit, over long timescale for pH). For this reason, it is suggested that the site is categorised as being unfavourable for salmon but recovering for habitat. Management measures are however in place to improve water quality and address acidification and diffuse pollution threats through forestry restructuring and agri-environment measures for riparian habitats and field buffers. Catch and release conservation measures for rod catches are also in place to improve spawning rates and longer term, the number of adult fish returning to the catchment. Therefore the overall assessment is unfavourable recovering.

Further information about Atlantic salmon can be found on the JNCC website.

Conservation Priorities

The River Bladnoch SAC partly overlaps with Kirkcowan Flow SAC, which has blanket bog as a Priority Feature. Broadly similar management is likely to be suitable for both blanket bog and the river SAC feature although careful consideration would be needed before planting trees adjacent to the river to benefit the river SAC feature within Kirkcowan Flow SAC.

Any pro-active management for the River Bladnoch SAC or assessment of plans or projects will need to take account of the interests of Kirkcowan Flow SAC where the sites overlap. If any management conflicts were to arise between the qualifying feature of the River Bladnoch SAC and those of Kirkcowan Flow SAC where the sites overlap, blanket bog should be given priority. This is because blanket bog is a Priority Feature and because management to benefit the River Bladnoch SAC could be done outwith Kirkcowan Flow SAC.

Conservation Objectives for Atlantic salmon (*Salmo salar*)

1. To ensure that the qualifying feature of the River Bladnoch SAC is in favourable condition and makes an appropriate contribution to achieving favourable conservation status
Favourable Conservation Status (FCS) is considered at a European biogeographic level. When determining whether management measures may be required to ensure that the conservation objectives for this site are achieved, the focus should be on maintaining or restoring the contribution that this site makes to FCS. When carrying out appraisals of plans and projects against these conservation objectives, it is not necessary to understand the status of the feature in other SACs in this biogeographic region. The purpose of the appraisal should be to understand whether the integrity of the site (see objective 2) would be maintained. If this is the case then its contribution to FCS

across the Atlantic Biogeographic Region will continue to be met. Further details on how these appraisals should be carried out in relation to maintaining site integrity is provided by objective 2 (including parts a, b and c). If broader information on the feature is available then it should be used to provide context to the site-based appraisal.

Note that “appropriate” within this part of the conservation objectives is included to indicate that the contribution to FCS varies from site to site and feature to feature.

2. To ensure that the integrity of the River Bladnoch SAC is restored by meeting objectives 2a, 2b and 2c for the qualifying feature

The aim at this SAC is to restore Atlantic salmon to a favourable condition as a contribution to its wider conservation status. Therefore any impacts to the objectives shown in 2a, 2b or 2c below must not persist so that they prevent the achievement of this overall aim. When carrying out appraisals of plans or projects the focus should be on restoring site integrity, specifically by meeting the objectives outlined in 2a, 2b and 2c. If these are met then site integrity will be restored. Note that not all of these will be relevant for every activity being considered. Any impacts on the objectives shown in 2a, 2b or 2c below must not persist so that they prevent the restoration of site integrity. Temporary impacts on these objectives resulting from plans or projects can only be permitted where they do not prevent the ability of a feature to recover and there is certainty that the feature will be able to quickly recover.

This objective recognises that the qualifying species are exposed to a wide range of drivers of change. Some of these are natural (e.g. population fluctuations/ shifts or habitat changes resulting from natural processes) and are not a direct result of human influences. Such changes in the qualifying species’ distribution and use of the site, which are brought about by natural processes, directly or indirectly, are normally considered compatible with the site’s conservation objectives. An assessment of whether a change is natural or anthropogenic, or a combination of both, will need to be looked at on a case by case basis.

2a. Restore the population of the species, including range of genetic types, as a viable component of the site

The conditions for the species’ long-term existence at the River Bladnoch SAC should be restored. This includes encouraging the number of Atlantic Salmon to increase.

This conservation objective is considered to be met if the conditions for the species’ long-term existence are in place. These conditions include:

- Effects should be avoided that could lead to a permanent reduction in the Atlantic salmon population or that prevent the population recovering, through mortality, injury, or impacts caused by disturbance or displacement. This includes for example the effects caused by the construction of in-stream barriers to migration, changes in water flow rates or water quality. Observed densities therefore need to be assessed in relation to the expectation for the River Bladnoch overall and for each river reach, based on productivity and natural habitat character of the system. However, these should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality.

- The numbers of returning Atlantic salmon should be sufficient to maintain the long-term viability of each life history type. All returning adults and emigrating smolts must have unhindered access between freshwater and marine habitats (see conservation objective 2b). All supporting freshwater habitats must be of sufficient quality and quantity to support both adult and juvenile fish (see conservation objective 2c). Different rivers have different seasonal patterns of adult migration associated with the environmental characteristics of the catchment and river system. Multi-sea winter fish are an important component of a natural Atlantic salmon run and the spring run component has declined considerably in recent years. The seasonal pattern of migration characteristic of the river and, in particular, the multi-sea-winter stock component, should be restored.

However, Atlantic salmon are in unfavourable condition at this site. The focus of this objective is therefore, to increase the number of salmon parr in the river, through increasing the number of adult salmon able to spawn in the river and maintaining access to spawning grounds. The river should not be stocked with young salmon, as they could compete with wild fish for food and be less adapted to life in the river, resulting in an overall reduction in the number of smolts able to go to sea.

When assessing the effects of any plan or project consideration should be given to whether impacts outwith the SAC could affect achievement of this conservation objective. The appraisal should also consider the life history traits of the species, including maintaining all genetic types of Atlantic salmon, and the scale and duration of the impact being assessed. Impacts resulting in the loss of genetically distinct populations of Atlantic salmon would not be considered temporary in nature as these adaptive traits may have evolved over generations and could not be recovered if lost.

2b. Restore the distribution of the species throughout the site

Conditions within the site should allow for the distribution of the species to be expanded or at least restored to their previous known extent.

Atlantic salmon distribution within the site should not be restricted by pollution or human activities.

Access to spawning sites, juvenile rearing sites and areas where adult Atlantic salmon may rest prior to spawning (some may be present within the river for a year prior to spawning), should all be maintained. Juvenile Atlantic salmon should be present in all areas of the catchment to which they, and adult fish, have natural access. This does not include areas above naturally impassable barriers, but areas where access has been limited by man-made obstructions.

There are currently no significant artificial obstacles to migration of Atlantic salmon in the River Bladnoch SAC. Screens on the outflow of three lochs (Loch Heron, Black Loch and Loch Ochiltree) have been fitted to prevent escape of stocked rainbow trout. These lochs are at the upper reaches of the catchment, beyond the SAC boundary.

Although spawning takes place at the upper reaches of the catchment, acidification in these areas has a serious impact on juvenile recruitment. Addressing acidification is likely to be a long-term venture, requiring forest restructuring, peatland restoration and other habitat enhancements.

The distribution of Atlantic salmon within the site may be affected by disturbance originating both within and outwith the site (including estuarine and coastal areas). Plans and projects that cause displacement and barrier effects to the species, for example by impeding access to spawning areas or downstream passage of smolts to the sea, can also affect species distribution. Examples may include: the provision of compensation flows which are inadequate to allow adult Atlantic salmon to reach known spawning areas; the presence of physical in-stream structures such as flow deflectors, coffer dams etc. which may increase flow velocity to that which is beyond the swimming capacity of migrating fish or sustained noise generation (such as that caused by piling) in places that cannot be avoided by migrating Atlantic salmon.

2c. Restore the habitats supporting the species within the site and availability of food
The distribution and extent of Atlantic salmon habitat within the site should be restored, together with the structure, function and supporting processes of the habitat. Sufficiently high water quality and natural flow conditions should be in place to provide the necessary conditions for Atlantic salmon. Atlantic salmon spawn in late autumn and early winter, depositing their eggs in redds which they excavate in gravel and pebble beds. Eggs are often deposited in areas of accelerating flow, such as the tail end of pools and glides, upstream from riffles. However, in upland streams eggs may be deposited in any areas of gravel that can be physically moved by the fish. A good supply of oxygen is essential for eggs to develop and this is facilitated by a flow of water through the gravel. Therefore, clogging these fine sediments with silt and fine sand can reduce the water and oxygen flow resulting in egg mortality. Egg survival is also affected by redd 'washout' during winter spates, resulting in the physical scouring out of eggs from the gravel. Substrate stability, the dynamics of water flow and the weather all influence the extent of siltation and scale of washouts. After hatching the young fry remain in the gravel until March to early May, when they disperse and set up territories. Atlantic salmon fry prefer fast flows (>30 cm/s) and favour areas with surface turbulence (riffle habitat). They require a rough bed of pebble, cobble and gravel and water <20 cm deep. Good cover is essential for maintaining high fry densities, such as cover from stones, plants or debris. Atlantic salmon that have survived their first winter (parr) prefer deeper water than fry (typically 20-40cm) and a coarser substrate of pebbles, cobbles and boulders. Cover remains important for adult Atlantic salmon particularly in smaller streams and rivers. In larger rivers and lochs this type of cover may be less important. Favoured habitat used by adult fish include pools of at least 1.5m depth, with cover from features such as undercut banks, instream vegetation, submerged objects and even surface turbulence. Spawning habitat is defined as stable coarse substrate without an armoured layer, in the pebble to cobble size range (16-256mm) but with the majority being <150mm. Water depth during the spawning and incubation periods should be 15-75cm. Coarse woody debris should be retained where appropriate as it plays a significant role in the formation of new gravel beds. Juvenile Atlantic salmon (fry and parr) maintain feeding stations within rivers and defend these aggressively. The invertebrates which they feed upon are intercepted by juvenile fish as they drift downstream, and may be of aquatic or terrestrial origin. At sea, adult Atlantic salmon feed on a range of prey items, including marine amphipods, shrimps and squid and fish, such as sand eels, capelin and herring. Adults do not feed once they return to freshwater. As a result of their life history Atlantic salmon stocks can be impacted in both freshwater and marine habitats. In freshwater, both water quality and water quantity are key issues. Salmonids require access to rivers with unpolluted and well-oxygenated water with a habitat mosaic which comprises suitable spawning gravels, cobbles and boulders. In terms of water quality, these fish also require enough water to ensure access to and from spawning areas, as well as enough water to maintain an adequate level of juvenile habitat. Over-exploitation, inappropriate stocking activities, riparian land management operations (such as those related to forestry and agriculture), in-stream engineering and alterations to

natural water flow regimes (including those relating to hydropower development), invasive non-native species, physical barriers to migration (such as historic caulds and lades), pollution (direct and diffuse) and direct damage to spawning habitat (e.g. through mineral or gravel extraction) can all impact on the quality of freshwater environments and their value to Atlantic salmon. Climate change, and the rises in water temperatures during summer, may also be a factor in determining the suitability of some waterbodies for Atlantic salmon. Therefore cover is important for Atlantic salmon, particularly in smaller streams. The shade from bushes next to the river or overhanging trees is likely to help to prevent fish from becoming stressed due to high water temperatures which often occur in combination with low water levels. Where the river is larger, this may be less important as deep water can provide cool refuge.

Water quality, hydrology, and habitat standards for Good Ecological Status (GES) under the Water Framework Directive should be met. These targets are intended to support a healthy, naturally functioning riverine ecosystem which protects the whole biological community and individual species to a degree characteristic of the river.

Data from SEPA's Water Environment Hub shows that water quality on 81% of the 16 individual river stretches in the Bladnoch catchment are classed as High or Good (2014). The remaining three catchment areas were classed as Moderate (Loch Maberry and Mochrum Loch) and Poor (Polbae Burn). This condition is not projected to change, either by the 2021 reporting round, or by 2027, although the long term condition is projected to be good.

Acidification is the main cause of poor water quality in the Polbae Burn, to be addressed largely through forest restructuring and peatland restoration. The causes of Moderate water quality in Loch Maberry and Mochrum Loch are thought to be related to nutrient levels.

Conservation Measures

The site overlaps the Kirkcowan Flow SSSI and SAC and Cree Estuary SSSIs and management changes described on the SSSI list of Operations Requiring Consent must have prior consent from SNH (NatureScot).

Current and recommended management for Atlantic salmon

Issue	Measure	Responsible party
Ongoing species protection for salmon	Legislation is in place to manage and protect Atlantic salmon in freshwater and at sea. This includes a statutory close season and catch & release period.	All
	Develop an Atlantic salmon conservation plan for all rivers, or Atlantic salmon management units (if several small rivers are considered to be so close in terms of geography and stock size as to merit a single plan).	Marine Scotland Science Fishery managers NatureScot SEPA
	Voluntary catch and release policy for anglers.	Fishery managers
Forest harvesting operations resulting in silt/nutrients entering the river – may	Planning and implementation of forest harvesting operations should better identify high risk areas. Management should include improved pollution control, blocking of drains and careful harvesting in riparian areas.	Scottish Forestry, Forestry & Land Scotland, Forestry owners and managers
	Promote adherence to the Forest and Water Guidelines, and published best practice, during	Scottish Forestry, Forestry & Land

affect salmon spawning areas	forest restructuring and highlight the need to strictly control fine sediment and other diffuse pollution release into the river. Forestry planting and harvesting in the catchment needs to be planned so that heavy rainfall and droughts are buffered by the forest rather than exacerbating high/low extremes in flow.	Scotland, Forestry owners and managers
	Review the Forest & Water guidelines to reflect the needs of river SACs. This will ensure adequate protection of the water course and development of an appropriate riparian zone across the catchment.	Scottish Forestry (South of Scotland area), Forestry & Land Scotland, NatureScot, forestry industry representatives
Sediment load in river from un-forested land – may affect salmon spawning areas	Ensure minimal poaching, tracking, or trampling by red deer, livestock, visitors and vehicles to prevent an unnatural sediment load from being washed into the river.	Land managers, NatureScot, SGRPID (GEAC)
	Drain blocking in open peatland in the catchment to help to buffer high/low extremes in flow rate and reduce sediment run-off into the river.	Land managers
Water quality	Implement and maintain monitoring of key water quality parameters.	NatureScot/SEPA
	Any development proposals in the catchment should include appropriate measures to minimise sediment run-off and prevent pollutants from entering the river.	Planning authority
	Acidification is considered to be the key water quality issue within the Bladnoch catchment due to extensive afforestation on base poor and granite bedrock and atmospheric scavenging of acid rain from conifer plantations. Diffuse pollution from agricultural and forestry sources. Implement the recommendations in the Bladnoch Restoration Feasibility Study.	All
Beneficial habitat management	Evaluation of diffuse pollution and morphological pressures through the river basin planning process and the implementation of restoration measures to maintain or improve habitat for Atlantic salmon. Removal of barriers to fish passage. No man-made weirs, dams or impoundments are currently known to be preventing or partially preventing the passage of Atlantic salmon to their natural range within the River Baldnoch SAC. However SEPA will address fish passage at River Bladnoch (Tarf Water to Water of Malzie) by 2027.	SEPA

	Promotion of measures to increase resilience to climate change, particularly the creation of native riparian woodland and improved connection with floodplains. Measures to promote coordinated, catchment-scale activity are particularly important. Native tree planting in appropriate locations would help improve the riparian habitat for Atlantic salmon.	All
	Restore riparian and catchment peatlands to reduce fine sediment concentrations, improve floodplain connectivity and restore more natural hydrological regime to benefit Atlantic salmon.	All
Population size	Encourage the natural processes of river flow and morphology through a policy of non-intervention and thereby improve salmonid recruitment and survival.	All
Research – low numbers of adult and/or juvenile Atlantic salmon	Development and introduction of long-term monitoring protocols for juvenile Atlantic salmon in SACs.	Marine Scotland Science
	Develop and implement monitoring protocol to allow robust, catch independent, assessment of adult population size.	Marine Scotland Science
	Monitor the presence and distribution of aquatic non-native species which may adversely impact Atlantic salmon.	SEPA
Marine survival	Monitoring of post-smolt Atlantic salmon to determine their behaviour at sea and better understand the impact of enhanced sea lice burdens.	Marine Scotland (Marine Scotland Science and Farmed Fish Health Inspectorate)
Invasive species	All anglers and other water users (such as canoeists or researchers) should follow the Check, Clean, Dry biosecurity procedures to help prevent the spread of problem non-native species.	All
Water Flow	Manage abstraction and water transfers in Atlantic salmon SAC rivers to ensure that access to essential habitats is maintained and water quality is not compromised.	SEPA, NatureScot, Scottish Water

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Approved on 31 March 2020 by:

Greg Mudge	**Denise Reed**
Principal Advisor	Area Manager
International Designations	Tayside and Grampian

Appendix J Afon Gwyrfai a Llyn Cwellyn SAC.

Cyfoeth Naturiol Cymru
Natural Resources Wales

CORE MANAGEMENT PLAN INCLUDING CONSERVATION OBJECTIVES

FOR

Afon Gwyrfai a Llyn Cwellyn Special Area of Conservation

Cyfoeth Naturiol Cymru
Natural Resources Wales

Noddir gan
Lywodraeth Cymru
Sponsored by
Welsh Government

Version	Date	Summary of changes made	Approved by
Version 2	September 2022	Revision of water quality targets for river features, updated formatting, clarification of the relationship between Conservation Objectives and Performance Indicators. Updated Conservation Objectives and Performance Indicators for Feature 1.	Euros Jones
Version 1	April 2008		Mike Willis

Contents

Preface

This document provides the main elements of Natural Resources Wales' management plan for the site(s) named. It sets out what needs to be achieved on the site(s), and advice on the action required. This document is made available through Natural Resources Wales' web site and may be revised in response to changing circumstances or new information. This is a technical document that supplements summary information on the Natural Resources Wales' web site.

One of the key functions of this document is to provide Natural Resources Wales' statement of the Conservation Objectives for the relevant Special Area of Conservation (SAC) and Special Protection Area (SPA) site(s). This is required to implement the changes through the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 in addition to the existing Conservation of Habitats and Species Regulations 2017. As a matter of Welsh Government Policy, the provisions of those regulations are also to be applied to Ramsar sites in Wales.

Vision for the site

This is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives (part 4) into a single, integrated statement about the site.

The purpose of the designation of SAC and SPA sites is to help secure the maintenance or restoration of habitats and species to favourable conservation status for the foreseeable future. Given that we foresee a changing climate, despite the uncertainty of the nature, degree and timing of those changes, we must address the need to ensure the resilience of each site to that changing environment. This will be achieved in the first instance by ensuring favourable condition of the important features, since a healthy feature is likely to be more resilient to the effects of climate change than one which is already stressed. Secondly, consideration must be given to those structures, functions and processes which maintain or boost the resilience of ecosystems to climate stress, including the avoidance, reduction or mitigation of other stress factors such as invasive species, nutrient enrichment, habitat and population fragmentation.

This site forms part of a wider network, and is ecologically connected with its surroundings and with other designated sites in the region. Although the focus of this document is on the individual site, the conservation objectives and management requirements need to be considered in the wider context. A connected network of sites is more robust than sites in isolation, and more resilient to pressures such as climate change.

Our vision for the Afon Gwyrfai a Llyn Cwellyn SAC is to maintain, or where necessary restore the river and lake to high ecological status, including its largely unmodified and undisturbed physical character, so that all of its special features are able to sustain themselves in the long-term as part of a naturally functioning ecosystem. The natural processes of erosion and deposition will be allowed to operate without undue interference and the physical river habitat will maintain connectivity as the foundation for this ecosystem. The quality and quantity of water, including natural flow variability, and the quality of adjacent habitats, are maintained or restored to a level necessary to maintain the features in favourable condition for the foreseeable future. In places where natural processes may affect urban infrastructure, artificial control measures may be required.

The aquatic plant communities that characterise parts of the river and lake are not only attractive but also give a good indication of the overall quality of the environment. They contain the variety and abundance of species expected for these water bodies of low nutrient status, in conditions of suitably clean water and bed substrate combined with a relatively stable flow regime, and are an outstanding example of a low-nutrient river and lake system. Locally, there are patches of white-flowered water-crowfoots. In the more shaded reaches, aquatic plants may be scarce, consisting mainly of mosses and liverworts.

The largely unmodified lake will continue to support characteristic plants and fish that are special to this area, including the rare Arctic charr, one of only three natural populations in North Wales. Atlantic salmon, which swim up river to spawn and go through their juvenile stages in the river, are present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat. These migratory fish are able to complete their migrations and life cycles largely unhindered by artificial barriers such as weirs, pollution, or depleted flows.

The abundance of prey and widespread availability of undisturbed resting and breeding sites, allows an otter population to thrive. They are found along the entire length of the river and its main tributaries.

The presence of the Afon Gwyrfai a Llyn Cwellyn SAC and its special wildlife enhances the economic and social values of the area, by providing a high quality environment for local people and visitors. The river catchment's functions of controlling flooding and supplying clean water are recognised and promoted through appropriate land management. The river is a focus for education to promote increased understanding of its biodiversity and the essential life support functions of its ecosystems.

Site description

Area and Designations Covered by this Plan

Grid reference(s): 53 04 59N 04 10 15W / SH547 561

Unitary authority(ies): Gwynedd

Area (hectares): 114.29

Designations covered: Afon Gwyrfai a Llyn Cwellyn SAC

Afon Gwyrfai a Llyn Cwellyn SSSI

Y Foryd SSSI

The plan in its present form does not specifically address SSSI features.

The most downstream, tidal unit of the SAC is underpinned by a unit of the Foryd SSSI. The remainder of the SAC is underpinned by Afon Gwyrfai a Llyn Cwellyn SSSI.

Maps showing the management units referred to in this plan are on NRW's website and can also be viewed on Welsh Government' interactive website Map Data Cymru.

Outline Description

This site comprises the Afon Gwyrfai and Llyn Cwellyn. The Gwyrfai flows out of Llyn y Gader near Rhyd Ddu and passes through Llyn Cwellyn on its way to the sea at Y Foryd, Caernarfon Bay. It also includes a tributary of the Gwyrfai, the Afon Treweunydd, and the small lake it flows from on the slopes of Snowdon. Sporadically throughout its course, the SAC is abutted by semi-natural wetland riparian habitat much of which is within the SSSI.

Llyn Cwellyn has long been recognised for its conservation importance and is an excellent example of a deep (maximum depth of 37m, average depth of 23m) oligotrophic lake formed during the last Ice Age. Its nutrient–poor waters support a range of typical macrophytes, and one of the best populations of floating water plantain in the UK.

The whole of the Gwyrfai river system is of outstanding ecological quality. The river is particularly noted for its salmon population, for which it is considered to be one of the best supporting rivers in the United Kingdom. It is also notable for its otter population which occur here in good numbers because of the relative naturalness of its riparian habitats and the abundance of undisturbed dense cover. In addition to the lake, the river supports a discrete community of floating water plantain, and water-crowfoot *Ranunculus spp*, with other associated vegetation including bryophyte assemblages occurring in various sectors of the river.

Outline of Past and Current Management

The relatively low nutrient status of the river and the very clear lake water, reflects the fact that precipitation falls onto a steep sided rock catchment of less than 50km^2. With just 21km of river, water is transported quickly into the glacially deepened Llyn Cwellyn and onto the sea via the Afon Gwyrfai. Under natural conditions the accumulation of nutrients and pollutants are thus unlikely to build up. The main sources of pollution or nutrient enrichment are therefore likely to be anthropogenic in origin, and it is these factors that will need to be managed in the future, to maintain and enhance the scientific features of interest in the SAC.

The upper Gwyrfai flows through Rhyd Ddu and thence into Llyn Cwellyn. From the lake the Afon Gwyrfai passes through the settlements of Betws Garmon, Waenfawr, Bontnewydd and into the Foryd estuary. Associated with this route is a local infrastructure of roads, narrow gauge railway, bridges, revetments and some buildings adjacent to the course of the river. The area is relatively sparsely populated, so pollution of waters and interference with the natural course of the river are not expected to be of major concern. Much of the lake and river are bounded by natural or semi natural habitat. This comprises of broadleaved woodland, marshy grassland and mire, with semi improved land in the lower sections of the river.

A small dam which was completed in 1979, holds back the waters of Llyn Cwellyn, from which water abstraction is permitted. Dŵr Cymru can abstract up to 6.5 million m^3 of water per annum over 60 days in any year at a maximum rate of 20,400 m^3 per day and at 300 l per second. The barrier is not thought to obstruct migration routes of migratory fish species.

Historically, anthropogenic influence upon the upper catchment mainly relates to the occurrence of several disused slate quarries, some afforestation, water abstraction from the partially impounded Llyn Cwellyn, low intensity fishing of the lake and river and relatively low intensity tourism. Reference to county series maps indicates that the upper catchment, above Llyn Cwellyn, was dotted with both active and disused slate quarries in the mid to late 19th century. These are unlikely to have affected water quality, but may have encouraged changes to runoff patterns and river form. Plantation forestry during the same period was limited to areas above Llyn y Gader, thus forested areas above Cwellyn are a relatively new influence upon the landscape. The bulk of Beddgelert Forest, above Llyn Cwellyn and extending along the upper Gwyrfai to Rhyd Ddu was mostly planted between 1943 and 1947, the Glanrafon slate quarry alongside the Afon Treweunydd has since been closed.

The extent of the wooded areas in the lower catchment between Waenfawr and Bontnewydd has remained relatively consistent. Extensive beds of aquatic macrophytes occur from below the lake as far downstream as Bontnewydd.

Diatom analysis suggests that Llyn Cwellyn has suffered from progressive but moderate acidification since the 1860s, with a decline of around 0.8 pH units. From the 1980s to 1995 subtle changes in diatom composition suggest a slight reversal, thought to be caused by a drop in sulphur deposition within the catchment.

Nutrient enrichment and sedimentation from harvesting conifer plantations above the lake could lead to changes in the plant and invertebrate communities which are characteristic of oligotrophic lakes, and an increase of non-target fish species at the detriment of typical species, including the rare fish Arctic Charr.

Similarly, agricultural runoff from fertilisers or lime on nearby fields could have a similar detrimental effect upon the macrophyte vegetation of the Afon Gwyrfai. A large area of riparian habitat is designated as SSSI and maintained alongside the river and will normally provide some buffering. The most likely mechanism for any eutrophication to happen is via seepage into the ditches which ultimately enter the river.

Whilst not seen as a problem currently, woodland should not become so dense that it heavily shades stretches of river or upland streams, especially those which support good macrophyte communities or are important for feeding fish. This needs to be balanced with the requirement to provide good cover for otter throughout the catchment.

Ecological surveys have identified invasive plant species along river banks, with both Japanese Knotweed, *Fallopia japonica,* and Himalayan balsam, *Impatiens glandulifera,* known to be present.

Management Units

The area covered by this plan has been divided into management units to enable practical communication about features, objectives, and management. This will also allow us to differentiate between the different designations where necessary. In this plan the management units have been based on distinctive sections of the river and lake, which can be expected to have characteristic ecological features.

Maps showing the management units referred to in this plan can be viewed on Welsh Government' interactive website Map Data Cymru.

The following table confirms the relationships between the management units and the designations covered:

NRW Internal reference	SAC Management Unit	SSSI	Waterbody IDs within unit
1	1674	Afon Gwyrfai a Llyn Cwellyn	N/A Afon Treweunydd which is not a WFD waterbody.
2	1675	Afon Gwyrfai a Llyn Cwellyn	GB110065054191
3	1676	Afon Gwyrfai a Llyn Cwellyn	GB31034002 (Lake)
4	1677	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
5	1678	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
6	1679	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
7	1680	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
8	1681	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
9	1682	Y Foryd	GB521006501200 (Transitional)

The Features

Confirmation of Features

SAC feature (Annex I habitats and Annex II species)	Primary reason for site selection?	Relationships, nomenclature etc
Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea*	Yes	EU Habitat Code: 3130
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Yes	EU Habitat Code: 3260
Atlantic salmon *Salmo salar*	Yes	EU Species Code 1106
Floating water-plantain *Luronium natans*	Yes	EU Species Code 1831
European otter *Lutra lutra*	No	EU Species Code 1355

SSSI features are listed in the table below.

Designated Feature	Relationships, nomenclature etc
Open Water, standing oligotrophic	Managed as a SAC feature
Open Water, running	Managed as a SAC feature
Floating water-plantain *Luronium natans*	Managed as a SAC feature
Aquatic plant assemblage	
European otter *Lutra lutra*	Managed as a SAC feature
Artic charr *Salvelinus alpinus*	Managed as a sub-feature of the oligotrophic standing waters SAC feature
Atlantic salmon *Salmo salar*	Managed as a SAC feature
GCR – Mineralogy of Wales	

Features and Management Units

This section sets out the relationship between the designated features and each management unit. This is intended to provide a clear statement about what each unit should be managed for, taking into account the varied needs of the different special features. All features are allocated to one of seven classes in each management unit. These classes are:

Key Features

KH - a 'Key Habitat' in the management unit, i.e. the habitat that is the main driver of management and focus of monitoring effort, perhaps because of the dependence of a key species (see KS below). There will usually only be one Key Habitat in a unit but there can be more, especially with large units.

KS – a 'Key Species' in the management unit, often driving both the selection and management of a Key Habitat.

Geo – an earth science feature that is the main driver of management and focus of monitoring effort in a unit.

Other Features

Sym - habitats, species and earth science features that are of importance in a unit but are not the main drivers of management or focus of monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as 'Sym' (sympathetic) features because:

(a) they are present in the unit but may be of less conservation importance than the key feature; and/or

(b) they are present in the unit but in small areas/numbers, with the bulk of the feature in other units of the site; and/or

(c) their requirements are broader than and compatible with the management needs of the key feature(s), e.g. a mobile species that uses large parts of the site and surrounding areas: and/or

(d) key features (KH, KS) are closely associated with these features, and the conservation of key features depends on them being managed appropriately.

Nm - an infrequently used category where features are at risk of decline within a unit as a result of meeting the management needs of the key feature(s), i.e. under Negative Management. These cases will usually be compensated for by management elsewhere in the plan, and can be used where minor occurrences of a feature would otherwise lead to apparent conflict with another key feature in a unit.

Mn - Management units that are essential for the management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries, buffer zones around water bodies, etc.

x – Features not known to be present in the management unit.

The table(s) below sets out the relationship between the features and management units identified in this plan:

SAC Management Unit	1674	1675	1676	1677	1678	1679	1680	1681	1682
NRW internal reference number	1	2	3	4	5	6	7	8	9
SAC features									
Luronium natans			KS		KS				
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS
Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoto-Nanojuncetea*		KH	KH						
Salmo salar	KS	KS	KS	KS	KS	KS	KS	KS	KS
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation		KH	KH	KH	KH	KH	KH	KH	KH
SSSI features									
Assemblage of Red Data Book and/or Nationally Scarce vascular plants			KS		KS				
Luronium natans			KS		KS				
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS
Nitella gracilis	KS		KS						
Running water - Group C rivers-		KH		KH	KH	KH	KH	KH	KH
Salmo salar	KS	KS	KS	KS	KS		KS	KS	KS
Salvelinus alpinus			KS						
Standing water - Oligotrophic-			KH						

Conservation Objectives

Background to Conservation Objectives:

a. Outline of the legal context and purpose of conservation objectives.

Conservation objectives for individual SACs and SPAs are required by the 1992 ‘Habitats’ Directive (92/43/EEC) as implemented through the Conservation of Habitat and Species Regulations 2017 (As amended). The aim of the Habitats Directive is the maintenance, or where appropriate the restoration, of the ‘favourable conservation status’ (FCS) of habitats and species listed in the Annexes to the Directive (see Box). Therefore FCS provides the overarching framework for defining the conservation objectives for individual SACs.

Although neither the Birds Directive nor the Ramsar Convention refer to FCS, Natural Resources Wales considers that the overall aim of both those legal instruments is sufficiently similar to FCS to make it practical and proportionate to use the same guiding principle when establishing the conservation objectives for SPAs and Ramsar sites, as well as SACs. Therefore the Habitats Directive definition of FCS is considered to provide the overarching framework for conservation objectives for all SACs, SPAs and Ramsar sites in Wales.

Favourable conservation as defined in Articles 1(e) and 1(i) of the Habitats Directive

“The conservation status of a natural habitat is the sum of the influences acting on it 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. The conservation status of a natural habitat will be taken as favourable when:

its natural range and 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

the conservation status of its typical species is favourable.

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as ‘favourable’ when:

population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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.

The achievement of FCS is not an objective that applies at the level of the individual sites. Rather it is a wider objective to which each individual site contributes. Therefore the conservation objectives for an individual site are intended to express what is considered to be that site's appropriate contribution to achieving FCS. Since SACs are the most important mechanism in the Habitats Directive for achieving FCS, and the sites represent the most important areas for conservation of the Annex I habitat types and Annex II species, the objectives for each individual SAC should seek to ensure that the site makes a substantial contribution which properly reflects its importance in a local, national and European context and the particular reasons why the site was selected for inclusion in the UK National Sites Network of SACs. A similar approach is taken to setting conservation objectives for SPAs and Ramsar sites.

Achieving the conservation objectives of individual sites requires appropriate management and the control of factors which are influencing, or may influence the features.

The conservation objectives have a number of specific roles:

- Communication

The conservation objectives should help convey to stakeholders what are the reasons for the designation and what it is intended to achieve.

- Site planning and management

The conservation objectives guide management of sites, to maintain or restore the designated habitats and species. They provide the basis for identifying what management is required both within the site boundary, and outside it, where achieving the objectives requires action to be taken outside the site.

- River Basin Management Planning

Conservation Objectives for aquatic and water dependent SAC and SPA features are also used as the "standards and objectives" referred to in Article 4 (1c) of the Water Framework Directive (WFD) (2000/60/EC). In 2009, Welsh Ministers decided that where SAC and SPA conservation objectives are more stringent than 'Good Ecological Status' (GES) as defined in the WFD, they (and the standards they contain) are the objectives referred to in Article 4(1c) of the WFD.

- Assessing plans and projects

Article 6(3) of the 'Habitats' Directive requires the assessment of proposed plans and projects in view of a site's conservation objectives. Subject to certain exceptions, plans or projects may not proceed unless it is established that they will not adversely affect the integrity of sites. There are similar requirements for the review of existing decisions and consents. Note that the assessment of plans and projects should be made in view of the entirety of the conservation objectives for the site, including the performance indicators.

- Monitoring and reporting

In addition to foregoing purposes, conservation objectives provide the basis for defining the evidence that will be used for assessing the condition of a feature and the status of factors that affect it. That evidence is contained in a sub-set of conservation objectives called 'performance indicators'. The performance indicators are those conservation objectives which are quantifiable and measurable, and which provide the basis for monitoring and reporting. The performance indicators are set out in an Appendix to this document.

The conservation objectives in this document reflect Natural Resources Wales' current information and understanding of the site and its features and their importance in an international context. The conservation objectives are subject to review by Natural Resources Wales in the light of new knowledge.

b. Format of the conservation objectives

Each conservation objective is a composite statement defining a site-specific aspiration for each designated feature. This composite statement contains clauses that correspond to all the elements of FCS, namely:

For habitat features:

- Extent should be stable in the long term, or where appropriate increasing;
- Quality (including in terms of ecological structure and function) should be being maintained, or where appropriate improving;
- Populations of the habitat's typical species must be being maintained or where appropriate increasing;
- Factors affecting the extent and quality of the habitat and its typical species (and thus affecting the habitat's future prospects) should be under appropriate control.

For species features:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term;
- The distribution of the population should be being maintained;
- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- Factors affecting the population or its habitat should be under appropriate control.

The elements above constitute a generic checklist or guide to the elements that should normally be included in the conservation objectives, in order to ensure that the site makes an effective and appropriate contribution to achieving favourable conservation status for the habitats and species for which it is designated.

There is one conservation objective for each designated feature listed above. In some cases, where there are distinct areas or forms of a designated habitat or separate populations of a designated species within a site, the conservation objective is sub-divided into different sections to enable different aspirations to be expressed for different occurrences of the features within the site.

As well as describing the aspirations for the condition of the feature, each conservation objective contains a statement that the factors which significantly affect the feature are under appropriate control.

Conservation Objective for the watercourse:

The ecological status of the watercourse is a major determinant of FCS for all features. The required conservation objective for the watercourse is defined below.

- The capacity of the habitats in the SAC to support each feature at near-natural population levels, as determined by predominantly unmodified ecological and hydromorphological processes and characteristics, should be maintained as far as possible, or restored where necessary.
- The ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature. This will include elements of water quantity and quality, physical habitat and community composition and structure.
- Flow regime, water quality and physical habitat should be maintained in, or restored as far as possible to, a near-natural state, in order to support the coherence of ecosystem structure and function across the whole area of the SAC.
- All known breeding, spawning and nursery sites of species features should be maintained as suitable habitat as far as possible, except where natural processes cause them to change.
- Flows, water quality, substrate quality and quantity at fish spawning sites and nursery areas will not be depleted by abstraction, discharges, engineering or gravel extraction activities or other impacts to the extent that these sites are damaged or destroyed.
- The river plan-form and profile should be predominantly unmodified. Physical modifications having an adverse effect on the integrity of the SAC, including, but not limited to, revetments on active alluvial river banks using stone, concrete or waste materials, unsustainable extraction of gravel, addition or release of excessive quantities of fine sediment, will be avoided.
- River habitat SSSI features should be in favourable condition.
- Artificial factors impacting on the capability of each species feature to occupy the full extent of its natural range should be modified where necessary to allow passage, e.g. weirs, bridge sills, acoustic barriers.
- Natural factors such as waterfalls, which may limit the natural range of a species feature or dispersal between naturally isolated populations, should not be modified.
- Flows during the normal migration periods of each migratory fish species feature will not be depleted by abstraction to the extent that passage upstream to spawning sites is hindered.
- Water quality targets for the river Gwyrfai follow those in the revised Common Standards Monitoring Guidance for Rives (JNCC 2016). These are detailed in Appendix 2.
- Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, forestry operations and improvement of riparian habitat, will be considered in assessing plans and projects.
- Levels of suspended solids will be agreed by NRW for the Water Framework Directive water bodies in the Afon Gwyrfai a Llyn Cwellyn SAC. Measures

including, but not limited to, the control of suspended sediment generated by agriculture, forestry and engineering works, will be taken to maintain suspended solids below these levels.

Conservation Objective for Feature 1: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and /or of the *Isoteo-Nanojuncetea* (EU Habitat Code: 3130)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Water quality of the lake is within parameters suitable to support the characteristic flora and fauna.
- The lake shows the characteristic vegetation zonation from the shore to deeper water.
- The lake has a macrophyte flora which includes many of the characteristic species including *Littorella uniflora, Lobelia dortmanna, Isoetes lacustris, Luronium natans* and *Subularia aquatica*, together with a diverse range of associates including *Myriophyllum alterniflorum, Callitriche hamulata, Nitella flexilis* and *Potamogeton berchtoldii*.
- *Nitella gracilis* and *Luronium natans* to be present as characteristic plants.
- There will continue to be a healthy population of Arctic charr (*Salvelinus alpinus*) in Llyn Cwellyn.

Conservation Objective for Feature 2: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the watercourse as defined above must be met.
- The extent of this feature within its potential range in this SAC should be stable or increasing.
- The extent of the sub-communities that are represented within this feature should be stable or increasing.
- The conservation status of the feature’s typical species should be favourable.
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Conservation Objective for Feature 3: Atlantic salmon *Salmo salar* (EU Species Code 1106)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

FCS component	Supporting information / current knowledge
1. The conservation objective for the watercourse as defined above must be met	
2. The population of the feature in the SAC is stable or increasing over the long term.	See below for current assessments of feature populations. Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Fish stocking can adversely affect population dynamics through competition, predation, alteration of population genetics and introduction of disease.
3. The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future. Natural factors such as waterfalls may limit the natural range of individual species. Existing artificial influences on natural range that cause an adverse effect on site integrity, such as physical barriers to migration, will be assessed.	Details of feature habitat suitability are given in the next section. In general, management for one feature is likely to be sympathetic for the other features present in the river, provided that the components of favourable conservation status for the watercourse given above are secured. For example, the abundance of macrophytes provides cover and sub-habitats for fish species. Salmon migration can be affected by acoustic barriers and by high sediment loads, which can originate from a number of sources including construction works.
4.The Gwyrfai will continue to be a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis.	

Conservation Objective for Feature 4: Floating water-plantain *Luronium natans* (Code: 1831)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the watercourse as defined above must be met.
- Llyn Cwellyn will continue to support a peripheral floating water-plantain assemblage, as well as a deeper water assemblage, with a characteristic zonation of vegetation from the shore at two areas of the lake.
- Floating water-plantain will continue to flourish in the Afon Gwyrfai and will continue to occur in every selected section.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Feature 5: European otter *Lutra lutra* (EU Species Code: 1355)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The population of otters in the SAC is stable or increasing over the long term and reflects the natural carrying capacity of the habitat within the SAC, as determined by natural levels of prey abundance and associated territorial behaviour.
- The natural range of otters in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches that are potentially suitable to form part of a breeding territory and/or provide routes between breeding territories. The size of breeding territories may vary depending on prey abundance.
- The population size should not be limited by the availability of suitable undisturbed breeding sites. Where these are insufficient they should be created through habitat enhancement and where necessary the provision of artificial holts. No otter breeding site is subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance are managed.
- The safe movement and dispersal of individuals around the SAC is facilitated by the provision, where necessary, of suitable riparian habitat, and underpasses, ledges, fencing etc at road bridges and other artificial barriers.
- All factors affecting the achievement of these conditions are under control.

Assessment of status and management requirements

This section provides:

- A summary of the assessment of the status of each feature.
- A summary of the management issues that need to be addressed to maintain or restore each feature.

Status and Management Requirements of Feature 1: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea*

Status of Feature 1

The feature is reported as Unfavourable Recovering. This is due to an historic moderate acidification of Llyn Cwellyn since the 1860s. This trend in acidification may be reverting, but patterns need to be monitored. Some concerns over localised nutrient enrichment, sedimentation and from continued water abstraction, Burgess *et al.* (2006).

Management Requirements of Feature 1

Diatom analysis suggests that Llyn Cwellyn has suffered from progressive moderate acidification since 1860 (0.7 – 0.8pH decline). From core samples, the rate of acidification is thought to have increased in 1940's either as a result of background levels or through forestry operations within the catchment. From the 1980's to 1995 subtle changes in diatom composition suggest a slight reversal, thought to be caused by a drop in sulphur deposition within the catchment. Continued monitoring of biological, chemical and physical aspects of the lake should continue to be undertaken.

Future condition assessments should examine whether *J. bulbosus* and *Sphagnum spp*. continue to increase in abundance as a result of nutrient enrichment and sedimentation or whether they decline in abundance, perhaps as a result of a continuing reversal in the historic acidification trend or a reduction in mineral in-wash.

The extent of sediment in-wash to the lake from grassland improvement (liming) and the felling of trees within the catchment should be monitored.

The Red Data Book and Annex II species, *L. natans* and *N. gracilis* should continue to be monitored to ensure that these rare plants are not lost. *L. natans* was frequent in Llyn Cwellyn in 2014 (Goldsmith *et al*. 2014) and is abundant in Llyn y Gader. It is routinely detected by macrophyte monitoring (e.g. Goldsmith *et al*. 2016, 2019), though cover tends to be underestimated. *N. gracilis* has been recorded from Llyn Cwellyn and also occurs in Llyn y Gader (Goldsmith *et al*. 2016), together with *Pilularia globulifera* and a high diversity of other oligotrophic lake species.

Arctic charr in Llyn Cwellyn should continue to be monitored.

Llyn Cwellyn is used as a drinking water abstraction point. It is crucial that sudden changes in water level are avoided in addition to the introduction of fish stock. The use of the lake within the SAC for angling is currently relatively limited.

Status and Management Requirements of Feature 2: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Status of Feature 2

Status: Favourable (2007)

Important stands have been identified in management units 2, 4, 5, 6, 7 & 8. In 2007 the feature was monitored against JNCC guidelines in management units 2, 5, 6 & 7. The most recent published vegetation survey was that of Scarlett *et al*. (2003). Surveys were carried out at 5 locations in management units 2, 4, 6, 7, & 8. These were classified into JNCC river groups. The condition of the plant communities was good at all sites. Invasive species *Impatiens glandulifera* was recorded at two of the sites and *Fallopia japonica* at one site.

Management Requirements of Feature 2

Factors that are important to the favourable conservation status of this feature include flow, substrate quality and water quality, which in turn influence species composition and abundance. These factors often interact, producing unfavourable conditions by promoting the growth of a range of algae and other species indicative of eutrophication. Under conditions of prolonged low flows and high nutrient status, epiphytic algae may suppress the growth of aquatic flowering plants. Favourable management for this feature is therefore largely dependent on ensuring that sufficient depth, velocity and duration of flow and sufficiently low phosphate levels are maintained within the natural range of the vegetation.

Water Framework Directive (WFD) monitoring shows that nutrient levels (phosphate and ammonia) in the Gwyrfai river waterbodies are low and currently meet High WFD status. However the water quality monitoring point for waterbody GB110065054190 (encompassing SAC units 4 to 8) is upstream of Llanfaglan sewage treatment works (STW), and therefore the monitoring data does not reflect any potential effects that STW discharge may have on the water quality of the river downstream of the discharge (approximately 1Km of river before it meets the tidal limit). Therefore additional investigations will be initiated to ascertain potential water quality impacts of the STW discharge on the most downstream stretch of the Gwyrfai.

A favourable flow regime can be defined with reference to naturalised flows (removing the influence of artificial abstractions and discharges from flow records). The Mean Trophic Rate (MTR) scores for all but the downstream management unit were high, being between 74 – 90. This implies that the river is not significantly impacted by phosphate inputs. The slightly lower score on the downstream site suggests only minimal phosphate input, (Scarlett *et al* 2003). Equally, EA monitoring of water quality scored the Afon Gwyrfai as grade 1, which equates to <0.02mg/l phosphate levels.

Invasive non-native plants can have a detrimental impact on this feature. Removal of *Impatiens glandulifera* and *Fallopia japonica* is a priority (Scarlett *et al* 2003, p23).

Status and Management Requirements of Feature 3: Atlantic salmon *Salmo salar*

Status of Feature 3

Status: Unfavourable: Unclassified.

Monitoring of Atlantic salmon in the Afon Gwyrfai and Llyn Cwellyn SAC relies on two methods:

i. Estimation of adult run size from angling catch returns,

ii. Electro-fishing for juveniles in nursery areas.

The current unfavourable status results from a precautionary assessment of feature distribution and abundance, in particular the results of salmon catches and juvenile surveys, and from the presence of adverse factors, in particular flow depletion.

Management requirements of Feature 3

The relatively demanding water quality and spawning substrate quality requirements of this feature mean that reduction in diffuse pollution and siltation impacts is important.

Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg and fry survival. Clean substrate free from excessive siltation should predominate at suitable spawning sites. Spawning habitat is defined as stable coarse substrate without an armoured layer, in the pebble to

cobble size range (16-256 mm) but with the majority being <150 mm. Water depth during the spawning and incubation periods should be 15-75 cm. Fry habitat is indicated by water of <20 cm deep and a gravel/pebble/cobble substrate. Parr habitat is indicated by water 20-40 cm deep and similar substrate. Holding areas are defined as pools of at least 1.5 m depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence. Coarse woody debris should not be removed from rivers as it plays a significant role in the formation of new gravel beds, and provides cover for fish and a source of food for invertebrates.

The most significant sources of diffuse pollution and siltation are from agriculture, including fertiliser run-off, livestock manure, silage effluent and soil erosion. The most intensively used areas such as heavily trampled gateways and tracks can be especially significant sources of polluting run-off. Preventative measures can include surfacing of tracks and gateways, moving feeding areas, and separating clean and dirty water in farmyards. Farm operations should avoid ploughing land which is vulnerable to soil erosion or leaving such areas without crop cover during the winter.

Among toxic pollutants, sheep dip and silage effluent present a particular threat to aquatic animals in this predominantly rural area. Contamination by synthetic pyrethroid sheep dips, which are extremely toxic to aquatic invertebrates, can deprive fish populations of food over large stretches of river. These impacts can arise if recently dipped sheep are allowed access to a stream or hard standing area, which drains into a watercourse. Pollution from organophosphate sheep dips and silage effluent can be very damaging locally. Pollution from slurry and other agricultural and industrial chemicals, including fuels, can kill all forms of aquatic life. All sheep dips and silage, fuel and chemical storage areas should be sited away from watercourses or bunded to contain leakage. Recently dipped sheep should be kept off stream banks. Used dip should be disposed of strictly in accordance with NRW regulations and guidelines. Statutory and voluntary agencies should work closely with landowners and occupiers to minimise the risk of any pollution incidents and enforce existing regulations.

Measures to control diffuse pollution in the water environment, including ‘Catchment Sensitive Farming’, may be implemented as a result of the Water Framework Directive and, along with existing agri-environment schemes, will help to achieve the conservation objectives for the SAC.

Discharges from sewage treatment works, urban drainage, engineering works such as road improvement schemes, contaminated land, and other domestic and industrial sources can also be significant causes of pollution, and must be managed appropriately. Current consents for discharges entering, or likely to impact upon the site should be monitored, reviewed and altered if necessary.

Overhanging trees provide valuable shade and food sources, whilst tree root systems provide important cover and flow refuges for juveniles. At least 50% high canopy cover to the watercourse/banks should be maintained, where appropriate. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.

Artificial barriers should be made passable. The impact of existing barriers in the Afon Gwyrfai a Llyn Cwellyn should be assessed on a case-by-case basis. Physical modification of barriers is required where depth/velocity/duration of flows is unsuitable to allow passage. Complete or partial natural barriers to potentially suitable spawning areas should not be modified or circumvented.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Intake screens must meet statutory requirements under the Salmon & Freshwater Fisheries Act.

There is currently no stocking of salmon into the Afon Gwyrfai a Llyn Cwellyn. The management objectives for SAC salmon populations are to attain naturally self-sustaining populations. Salmon stocking should not be routinely used as a management measure. Salmon stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from brood stock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population. Therefore, there is a presumption against salmon stocking in the Afon Gwyrfai a Llyn Cwellyn SAC.

The presence of artificially high densities of other fish can create unacceptably high levels of predatory and competitive pressure on juvenile salmon and the aim should be to minimise these risks in considering any proposals for stocking. Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges.

Controls on exploitation should include migratory passage to the SAC within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the SAC from rod fisheries. Net Limitation Orders are used to control the estuarine fishery. Exploitation of salmon by rod fisheries is regulated by NRW licensing and byelaws controlling the fishing season and allowable methods.

Status and Management Requirements of Feature 4: Floating water-plantain *Luronium natans*

Status of Feature 4

The habitat is reported as in favourable condition for extent and abundance of peripheral floating water-plantain (2005 SAC Monitoring Report). This status is conditional upon a deeper water survey being undertaken within the next reporting round (2006-2011) to establish the extent and abundance of underwater population(s) of this plant within Llyn Cwellyn. Revised conservation objectives for the distribution of *Luronium natans* within Llyn Cwellyn can be set based on updated survey information (Goldsmith *et al*. 2014, 2016, 2019). The favourable condition status is also conditional upon the water quality status being maintained as defined in the conservation objectives above.

Management Requirements of Feature 4

Infrastructure or river maintenance works, requiring the intentional movement of substrate is the vicinity of known populations of this plant, to be avoided. No intentional disturbance of existing water plants, other than by natural events.

Buffer zones around riverine and lake areas to reduce nutrient input, especially where *Luronium* is known to occur.

Status and Management Requirements of Feature 5: European otter *Lutra lutra*

Conservation Status of Feature 5

The overall status of the otter populations within the SAC is considered to be unfavourable (Liles, 2006). In terms of extent, European otter are considered to be favourable within the SAC, based on the results of the Otter survey of Wales (Jones, 2004). In terms of the quality of the feature, European otter are considered to be in unfavourable condition.

The number and distribution of actual and/or potential breeding sites are too few and they are insufficiently spread throughout the SAC.

Management Requirements of Feature 5

An increase from 5 to at least 8 potential breeding sites is required. These should be located in lower and upper catchments, recommended sites are GW1, GW12, GW14 (Liles, G. 2006).

Action plan: summary

This section takes the management requirements outlined above a stage further, assessing the specific management interventions required on each management unit. The table below is a summary of the information held in Natural Resources Wales' Actions Database for sites

Actions in Natural Resources Wales' Actions Database

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
1	001674	Afon Treweunydd	Conifer plantation not relevant to this unit	Yes
2	001675	Afon Gwyrfai upstream of lake	Assessment required of the long-term impact of any future replanting of conifers adjacent to unit. Japanese knotweed and rhododendron are present in this unit but treatment is underway	Yes
3	001676	Llyn Cwellyn	Invasive species are being tackled - Himalayan balsam and Japanese knotweed identified from the 2011 survey have been treated and are being checked annually. The Nant Mills weir has been removed to prevent impedance of fish and plans are underway to redesign the Cwellyn dam to allow fish passage.	Yes
4	001677	Llyn Cwellyn to weir at Betws Garmon	Investigate potential to re-instate natural river morphology.	Yes
5	001678	Weir to Bryn Gloch caravan park	Investigate potential to re-instate natural river morphology. Bryn Gloch sewage discharge needs investigating to assess impact on low river flow conditions.	Yes
6	001679	Bryn Gloch caravan site to Waenfawr	A survey was undertaken in 2011 and treatment for Himalayan balsam and Japanese knotweed started. Treatment needs to be continued as necessary over the next few years	Yes
7	001680	Waenfawr to Bontnewydd	Control of Himalayan balsam upstream of this unit has been undertaken since 2012. Before a	Yes

			decision is made on whether or not to instigate control within this unit and further downstream, we need to determine how effective that control has been and if we have the necessary resources to tackle the rest of the river. Ongoing control requires input from landowners and other parties.	
8	001681	Bontnewydd to normal tidal limit	Survey for invasive species completed. Further actions identified under the appropriate SSSI units	Yes
9	001682	Estuary	Review impact of drift netting/seine netting in Menai Strait on salmon population.	Yes

Glossary

This glossary defines some of the terms used in this **Core Management Plan**. Some of the definitions are based on definitions contained in other documents, including legislation and other publications of Natural Resources Wales and the UK nature conservation agencies.

Action	A recognisable and individually described act, undertaking or **project** of any kind, specified in a **Core Management Plan** or **Management Plan**, as being required for protecting, managing or enhancing one or more of the **features** for which a site is designated.
Attribute	A quantifiable and monitorable characteristic of a **feature** that, in combination with other such attributes, describes its **condition**.
Common standards	See **JNCC common standards.**
Condition	A description of the state of a feature in terms of qualities or **attributes** that are relevant in a nature conservation context. For example, the condition of a habitat usually includes its extent and species composition and might also include aspects of its ecological functioning, spatial distribution and so on. The condition of a species population usually includes its total size and might also include its age structure, productivity, relationship to other populations and spatial distribution. Aspects of the habitat(s) on which a species population depends may also be considered as attributes of its condition. Condition is considered favourable when all the conservation objectives are being met.
Conservation management	Acts or undertaking of all kinds, including but not necessarily limited to **actions,** taken with the aim of achieving the **conservation objectives** of a site. Conservation management includes the taking of statutory and non-statutory measures, it can include the acts of any party and it may take place outside site boundaries as well as within sites. Conservation management may also be embedded within other frameworks for land/sea management carried out for purposes other than achieving the conservation objectives.
Conservation objective	The expression of the desired state of a **feature,** expressed as a composite statement defining the **condition** that we wish the feature to be in. Each feature has one conservation objective.

Core Management Plan	A Natural Resources Wales document containing the conservation objectives for a site and a summary of other information contained in a full site **Management Plan**.
Factor	Anything that has influenced, is influencing or may influence the **condition** of a **feature**. Factors can be natural processes, human activities or effects arising from natural process or human activities. They can be positive or negative in terms of their influence on features, and they can arise within a site or from outside the site. Physical, socio-economic or legal constraints on management of the site can also be considered as factors.
Favourable condition	See **condition**.
Favourable conservation status	The Habitats Directive definition of **Favourable Conservation Status** (FCS) is given in full in the Conservation Objectives section.
Feature	The species population, habitat type or other entity for which a site is designated. The ecological or geological interest which justifies the designation of a site and which is the focus of **conservation management.**
Integrity	See **Site integrity.**
JNCC common standards	A set of principles developed jointly by the UK nature conservation agencies to help ensure a consistent approach to monitoring and reporting on the features of sites designated for nature conservation, supported by guidance on identification of attributes and monitoring methodologies.
Key Feature	The habitat or species population within a **management unit** that is the primary focus of management and **monitoring** in that unit.
Management Plan	The full expression of a designated site's legal status, **vision**, **features**, **conservation objectives**, **performance indicators** and management requirements. A complete management plan may not reside in a single document, but may be contained in a number of documents (including in particular **the Core**

	Management Plan) and sets of electronically stored information.
Management Unit	An area within a site, defined according to one or more of a range of criteria, such as topography, location of **features**, tenure, patterns of land/sea use. The key characteristic of management units is to reflect the spatial scale at which site management and **monitoring** can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management and monitoring in different parts of a site, and for facilitating communication with those responsible for management of different parts of a site.
Monitoring	An intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. In monitoring of sites designated for habitat and species conservation, the formulated standard is the quantified expression of favourable **condition** based on **attributes**.
Operational limits	The levels or values within which a **factor** is considered to be acceptable in terms of its influence on a **feature**. A factor may have both upper and lower operational limits, or only an upper limit or lower limit. For some factors an upper limit may be zero.
Performance indicators	A subset of the conservation objectives that are quantifiable and measurable. They consist of **attributes** and factors together with their associated target values (or ranges of values) which provide the standard against which information from **monitoring** and other sources is used to determine the degree to which the **conservation objectives** for a **feature** are being met.
Plan or project	**Project:** Any form of construction work, installation, development or other intervention in the environment, the carrying out or continuance of which is subject to a decision by any public body or statutory undertaker.

Plan: a document prepared or adopted by a public body or statutory undertaker, intended to influence decisions on the carrying out of **projects.**

Decisions on plans and projects which affect SAC, SPA and Ramsar sites are subject to specific legal and policy procedures.

Site integrity This is defined in Welsh Government policy as the coherence of a site's 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 is designated.

Site Management Statement (SMS) The document containing Natural Resources Wales' views about the management of a site issued as part of the legal notification of an SSSI under section 28(4) of the Wildlife and Countryside Act 1981, as substituted.

Special Feature See **feature**.

Specified limits The levels or values for an **attribute** which define the degree to which the attribute can fluctuate without creating cause for concern about the **condition** of the **feature**. The range within the limits corresponds to favourable, the range outside the limits corresponds to unfavourable. Attributes may have lower specified limits, upper specified limits, or both.

Unit See **management unit.**

Vision Statement The statement conveying an impression of the whole site in the state that is intended to be the product of its **conservation management.** A 'pen portrait' outlining the **conditions** that should prevail when all the **conservation objectives** are met. A description of the site as it would be when all the **features** are in **favourable condition**.

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Appendix 1. Performance Indicators

These performance indicators are a sub-set of the conservation objectives and describe the evidence, including in particular evidence to be obtained from monitoring of sites and features, that will be used to inform judgements about whether or not the conservation objectives are being met.

The assessment of plans and projects should be made in view of the entirety of the conservation objectives, including the performance indicators.

Table A1.1 Performance indicators for feature 1, Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea* (EU Habitat Code: 3130)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Extent of Oligotrophic to mesotrophic standing waters	Lower limit is based upon current extent as shown in UKLakes.	*Upper limit:* none *Lower limit:* Lake areas must not be permanently less than the following: Llyn Cwellyn: 90ha. Llyn y Gader: 19ha. See F1 for water level regulation.
A2. Macrophyte Community Composition and Structure.	Based on the CSM attributes for this Feature (JNCC 2015).	**A2.1. Characteristic Species Diversity.** Upper Limit: None Lower Limit: Each lake supports at least seven of the following characteristic species: *Isoetes lacustris*; *I. echinospora*; *Littorella uniflora*; *Lobelia dortmanna*; *Subularia aquatica*; *Luronium natans*; *Elatine hexandra*; *Eleogiton fluitans*; *Myriophyllum alterniflorum*; *Nitella gracilis*;

Performance indicators for feature condition		
		N. flexilis agg; *Pilularia globulifera*; *Sparganium angustifolium*; *Utricularia* spp. **A2.2 Loss of Characteristic Species** Upper Limit: None. Lower Limit: Within any ten year period, all characteristic species previously recorded from the site (see A2.1 above) are recorded in at least one of the lakes on the site. **A2.3 Characteristic Species Cover.** Upper Limit: None. Lower Limit: In each lake, at least 60% of vegetated sample points (wader and boat combined) support one or more characteristic species as listed in A2.1. **A2.4 Filamentous Algae** Upper Limit: No more than 20% of sample points (wader and boat combined) have cover values of 3 for filamentous algae.. Lower Limit: None. **A2.5 Maximum Depth of Plant Colonization** Upper Limit: None. Lower Limit: Llyn Cwellyn: 5m; Llyn y Gader: plants grow throughout the lake.
A3. Species of Interest	Based on the CSM attributes for this Feature (JNCC 2015b). *Salvelinus alpinus* targets are included here as a characteristic feature of H3130.	**A3.1 Arctic charr *Salvelinus alpinus*** A reproducing population of Arctic charr (*Salvelinus alpinus*) should be present in Llyn Cwellyn and meeting the following targets: • Juvenile (0+ and 1+ fish) should comprise at least 60% of the total number of individuals in the population; • At least two other age classes (usually 3+ and 4+) should be detected.

Performance indicators for feature condition		
		A3.2 Pillwort *Pilularia globulifera* A population of pillwort (*Pilularia globulifera*) should be present in Llyn y Gader. **A3.3 Slender stonewort *Nitella gracilis*** A population of slender stonewort (*Nitella gracilis*) should be present in at least one of the lakes.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Abstraction	There should be no new abstractions where this could affect the feature.	*Upper limit:* abstraction should not exceed limits of any abstraction licence and should not expose macrophyte communities of the shallow water close to the shore.
F2. Recreational activity	Fishing – stocking with native and non-native fish	*Upper limit:* no stocking with non-native fish and any stocking with native species must be strictly controlled
F3. Alien Species	Based on CSM Guidance (JNCC 2015)	No WFD high-impact alien species or *Elodea canadensis* established in either lake.
F4. Thermal Impacts	Both lakes could be substantially affected by temperature changes. This is especially true for Cwellyn where stratification is a key feature of its ecology.	There should be no discharges or other activities that could significantly alter the thermal regime of the lake

Table A1.2 Performance indicators for feature 2, Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Distribution within catchment	Though surveys have identified this feature at various sample sites, the feature's extent, or the extent of suitable habitat for it, within the protected site has never been mapped.	*Upper limit:* Insufficient information *Lower limit:* Insufficient information May occur in all site units except 3 and 9
A2. Typical species	Should conform to Plant community: species composition and abundance targets in Table 1a of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005).	Upper limit: Insufficient information Lower limit: See Table 1a of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005).
A3. Plant community Reproduction	For this attribute, the 'Targets', 'Method of assessment', and 'Comments' criteria are as those described in Table 1a of the of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005), **except** for the lower limit. In the guidance, the 'minimum value is defined in terms of the "total habitat / macrophyte population that should be left uncut". For the Gwyrfai percentages of total habitat area or total macrophyte population cannot be expressed because the total area covered by the habitat is not known. Therefore	See comments (to the left) for details of when cutting can occur. *Upper limit:* at least 50% of the habitat / macrophyte population should be left uncut for the full duration of the remaining growing season and there should be no further cutting at the same location for at least two further growing seasons.

Performance indicators for feature condition		
	in this SAC, the value expressed applies to a percentage of the width of channel, but only at locations where control measures such as weed cutting are an established practice as agreed by NRW. In all other locations there should be no cutting of feature vegetation.	*Lower limit:* Nil
A4. Bank and riparian zone vegetation	In addition to being integral to SSSI river habitat (plant community) types, it is clear that the various types of semi-natural bank and riparian zone vegetation each contribute to the ecological well being of the site and its features in different ways. Examples include:- · Fallen leaves - these provide of a source of allochthonous vegetative input to the aquatic food web. · Fallen trees and branches – woody debris in the water provides cover for fish and invertebrates, and may generate eddies that aid their movement within the site. · Fringing and emergent vegetation at the waters edge provides cover for juvenile fish and invertebrates · Dense vegetation on river banks provides a buffer between intensively farmed land and the river · Ground layer, dense scrub and woodland vegetation on river banks provide a range of terrestrial habitat for otter. Conversely, dense woodland excludes light from the river and may limit the extent of this feature. In view of these and other known and unknown associated factors, the “mosaic” objective should ensure that all the wide-ranging interactions between bank-side vegetation and the in-river ecosystem can continue to take place.	*Upper limit:* None set *Lower limit:* Bank and riparian zone vegetation should form a semi-natural mosaic. However, where it forms part of a plant community classified as a qualifying SSSI habitat feature, it should remain within its notified classification

Performance indicators for feature condition		
A5. Species indicative of eutrophication	Cover values should not increase significantly from an established baseline. Methods used to establish these values should be as indicated in the JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005), which rely on the method of Holmes (1983) and a standard check-list of macrophyte species. Taxa typically associated with enrichment are considered negative indicators of favourable condition. The species will vary depending on the River Community Type.	*Upper limit:* The Combined cover values of blanket weed, epiphytic or other algae should not exceed 25% *Lower limit:* none set
A6. Alien / introduced species	In the CSM guidance, the SERCON scoring system for naturalness of aquatic and marginal macrophytes and naturalness of banks and riparian zone, are used to assess this attribute. SERCON protocols have not yet been applied in the Afon Gwyrfai SAC, therefore assessment of this attribute relies on locally defined thresholds and expert judgement. Details to be confirmed	*Upper limit:* No impact on native biota from alien or introduced species. *Lower limit:* None set
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quality	Water quality should be compliant with the standards set out in JNCC's Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	See Appendix 2.
F2. Flow	Flow regime should be characteristic of the	*Upper limit*: +10% of

Performance indicators for feature condition		
	river.	naturalised flow *Lower limit*: -10% of naturalised flow.
F3. Light levels	This factor is partly addressed above in relation to "Bank and riparian zone vegetation" and "Species indicative of eutrophication". However, light levels reaching this feature vegetation community may be affected by other factors such as buildings, bridges or other structures. The specific ranges and values of light parameters beyond which this feature would be significantly affected is not known and therefore in all cases of doubt, the precautionary principle should apply	*Upper limit:* Insufficient information *Lower limit:* Insufficient information
F4. Changes to substrate	Substrate types vary naturally, depending upon reach type and hydrodynamic regime. At almost any scale there are varieties of channel substrate. Localised accumulations of silt on the inside of bends or in back channels do not necessarily indicate a problem. However, widespread siltation of riverine sediments, caused by high particulate loads and / or reduced scour within the channel, is a major threat to this and other interest features. For river types characterised by extensive *Ranunculus* beds, there should be a predominance of 'clean' gravels, pebbles and cobbles, with relatively low cover by silt- dominated substrates. Maximum fines content should not be too great to prevent establishment of new	*Upper limit:* Insufficient information *Lower limit:* Insufficient information

Performance indicators for feature condition		
	plants. (Fines are defined as particles <0.83 mm in the CSM Guidance 2005). The SSSI and SAC boundaries do not extend to the entire catchment. This and other site features are susceptible to siltation, the source of which may lie outside the site boundary. Sources of silt could include run-off from agricultural land, forestry plantations, and sewage discharges. The only specified target relating to substrate in Table 1a of CSM guidance 2005 applies specifically to siltation. It states “No excessive siltation. Channels should contain characteristic ranges of substrate types for unmodified rivers.” Therefore, in the absence of any more detailed guidance or information, the precautionary principle should apply in any decisions relating to change or detected damaging impact to any substrate affecting this feature.	

Table A1.3 Performance indicators for feature 3: Atlantic salmon *Salmo salar* (EU Species Code 1106)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Adult run size	As there is no fish counter in the Afon Gwyrfai, adult run size can be calculated using rod catch data.	Total run size at least matching an agreed reference level, including a seasonal pattern of migration characteristic of the river and maintenance of the multi-seawinter component.
A2. Juvenile densities	CSM guidance states: These should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality. Assessed using electrofishing data.	Expected densities for each sample site using HABSCORE
Performance indicators for factors affecting the feature		
F1. Water - biological and chemical	Targets included in the CSM Guidance for Rivers 2016 are used. These targets are intended to support a healthy, naturally functioning river ecosystem which protects the whole biological community and individual species to a degree characteristic of the river. All chemical targets and targets relating to macroinvertebrates are applicable.	See Appendix 2 and sections 4.2 and 4.6.2 of the CSM guidance for rivers 2016.
F2. Flow	Targets are set in relation to river/reach type(s)	Targets agreed in the Review of Consents. As a guideline flow should be +/-10%of the naturalised daily flow throughout the year.
F3. Illegal fish poaching	Removal of salmonids	Insufficient data

Performance indicators for feature condition		
F4. Invasive alien species	Japanese knotweed is found growing next to the watercourses and is usually controlled via herbicides. Herbicide handled inappropriately may enter the watercourse and poison fish and invertebrates	Assessment of plans and projects.
F5. Coarse woody debris (CWD)	It is natural to find CWD in watercourses and it assists with maintaining good water quality and can provide refuge areas for young fish	Presumption against CWD removal from the watercourse except on grounds of health and safety. Assessment of plans and projects

Table A1.4 Performance indicators for feature 4: Floating water-plantain *Luronium natans* (Code: 1831)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Species extent and abundance	Presence of *Luronium natans* recorded as plants that are attached to substrate. Detached fragments (unless obviously detached during monitoring) will not be counted. .	*Upper limit:* None set *Lower limit: Luronium natans* will be present at Site 1 on the periphery of Llyn Cwellyn AND *Luronium natans* will be present within each of Sections 1-6 as identified in the maps in monitoring report (2005). This may be revised following the programmed surveillance. **Site-specific Descriptions** Presence of *Luronium natans*

Performance indicators for feature condition		
A2. Sufficient habitat.	Submerged populations of *L. natans* require substrates comprising of mud or stable fine gravel or silt in depths of clear water up to 3m.	Sufficient good quality habitat should exist to support the expansion of existing populations. Extent of good quality habitat should not be reduced.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quantity (flow):	Refer to performance indicators for feature 2.	Refer to performance indicators for feature 2.
F2. Water quality	Targets included in the CSM Guidance for Rivers 2016 and Lakes 2015 are used.	Refer to Appendix 2 and performance indicators for feature 1.
F3. Dredging	Dredging could directly damage *L. natans* beds.	No dredging likely to affect *L.natans* should where suitable habitat is found.
F4. Competition from other aquatic plant species	*L. natans* cannot compete with other aquatic plant species including algae.	Review to assess if competition is an issue.

Table A1.5 Performance indicators for feature 5: European otter *Lutra lutra*

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Population distribution.	Although Performance Indicators are given it is difficult to assess the condition of the otter population distribution feature because of the relatively small size of the SAC areas compared to the typical home range size of otters. As otters are mobile animals occupying very large home ranges, the condition of the otter feature should be considered at the landscape level.	*Upper limit:* None set. *Lower limit:* Otter signs are found at five of the seven (71%) sites searched within the Gwyrfai.
A2. Breeding activity	Breeding Centres are used to provide an estimate of the number of females breeding in the system. They	*Upper limit:* None set.

Performance indicators for feature condition		
	can only be a “best guess” but are based on our present knowledge of the size of otter home ranges, the juxtaposition of potential breeding sites, and records of breeding activity for the catchment.	*Lower limit:* Breeding Centre: There should be no deterioration in, or loss of, bank side habitats within the assumed breeding centre.
A3. Actual & potential breeding sites.	Within the home range of a single female there may be two or more potential breeding sites. When this is the case, the female may use a different breeding site each year (Liles, 2003). Birth takes place in a Natal Den, either above ground in a small patch of cover (i.e.1m x 1m) such as scrub or a pile of timber, or below ground, for example in a tree root system or a pile of boulders. Females often use a different natal den site each year (Liles, 2003). Although targets are set for the number of Potential Breeding sites within the SAC areas and wider sub catchments, the quality, habitat type, and location of sites is also important. Priority should be given to retaining existing sites. If the number or quality of sites does decline, alternative breeding sites can be created at nearby Habitat Improvement Sites.	*Lower limit:* There should be an increase in the number of mapped potential breeding sites on the Gwyrfai from five to eight. *Upper limit:* None set

Site-specific habitat definitions	
Breeding Centre	A Breeding Centre is an area of the catchment in which otter breeding activity and potential breeding sites have been recorded, and which equates in size (i.e. length of watercourse) to the home range of a female otter (approximately 20km of waterway). A Breeding Centre can be based entirely on one tributary or long stretch of main river, or can incorporate a stretch of main river and one or more tributaries. Because otters are territorial it is assumed that, within a Breeding Centre, only one female will breed at a time.

Site-specific habitat definitions	
Potential Breeding Sites	An area of good quality vegetation for breeding otters usually > 0.5 ha free from flood risk and is within 3km of a good food supply. The risk of flooding at a site is considered to be a problem for breeding if flooding at the site is a regular occurrence (i.e. occurs in most years). Access to a good food supply that is within easy travelling distance for a female is likely to be important so that very young and vulnerable cubs are not left unattended for long periods.
Good quality vegetation for breeding otters	Good quality vegetation for breeding otters includes dense scrub (e.g. bramble, blackthorn and gorse); reed-beds; deciduous woodland with an under-story; young conifer plantations; rhododendron thickets; and wetlands (particularly with areas of *Molinia caerulea*).

Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quality	Targets included in the CSM Guidance for Rivers 2016 are used.	Refer to Appendix 2 and performance indicators for feature 1.
F2. Water quantity (flow):	Refer to performance indicators for feature 2.	Refer to performance indicators for feature 2.
F3. Food availability & riparian habitat	The availability of food within the catchment is likely to be a major factor influencing both the distribution and breeding success of otters.	*Upper limit:* None set. *Lower limit:* Fish & amphibian biomass should stay within expected fluctuations.
F4. Invasive alien species	See factors affecting Atlantic salmon – feature 3	See factors affecting Atlantic salmon – feature 3
F5. Coarse woody debris (CWD)	Where CWD has accumulated alongside the river bank it can create suitable sites for laying up couches and natal dens.	See factors affecting Atlantic salmon – feature 3.
F6. Illegal fish poaching:	See factors affecting Atlantic salmon – feature 3.	See factors affecting Atlantic salmon – feature 3.
F7. Diffuse & point source pollution	See factors affecting feature 2.	See factors affecting feature 2.

Performance indicators for factors affecting the feature		
F8. Agricultural operations	See factors affecting feature 2.	See factors affecting feature 2.
F9. Forestry operations	See factors affecting feature 2.	See factors affecting feature 2.
F10. River engineering	See factors affecting feature 2.	See factors affecting feature 2.
F11. Recreation	Breeding otters can be sensitive to disturbance by humans and dogs so recreational areas should be sited at a distance from suitable breeding habitat and known breeding dens.	To be determined
F12. Deposition atmospheric pollution	Eutrophication and acidification can have an indirect impact on otter by affecting the food chain.	See factors affecting feature 2.
F13. Climate change	Change in rainfall patterns and increased flooding could affect the otter breeding cycle and success rates if natal dens are flooded and feeding patterns disrupted.	See factors affecting feature 2.

Appendix 2. Water Quality Targets for River Waterbodies

(as revised in Common Standards Monitoring guidance for Rivers, JNCC 2016)

River SACs designated under the Habitats Regulations 2017 (UK Gov, 2017) overlap river water bodies designated under Water Framework Directive Regulations (NRW, 2015; UK Gov, 2015). The water quality standards that apply come from the source legislation – i.e. for the water body the WFD Regulations standards and for a SAC the Habitats Regulations standards. Note that the words targets and standards are used under the various documents that sit under these two Regulations. We have interpreted these to mean the same thing and for this document we will use the term standard unless directly quoting from a specific document. Water quality standards for Special Area of Conservation (SAC) rivers are set via agreement at a UK level and presented in the JNCC Common Standards Monitoring (CSM) guidance (JNCC 2016).

However, having two sets of standards for the same area of river can lead to confusion as to which apply in a given situation. This Appendix sets out the standards for water quality attributes for river water bodies in the Afon Gwyrfai SAC. Where they are more stringent, WFD Regulation 2017 standards are adopted as the CSM standards.

Note that for the transitional (estuarine) waterbody GB521006501200, specific water quality standards are not yet available. Therefore the standard for this waterbody is to achieve WFD Good Ecological Status.

1. Organic pollution

Table A2.1a provides the values for the physio-chemical attributes to be applied across all river types. Standards apply throughout the assessment unit, not just at sparsely distributed monitoring sites.

The standards for DO, BOD and un-ionised ammonia are the same for all river water bodies whereas the standard for total ammonia varies according to river type and previous WFD Regulations classification for ammonia (Table A2.1a). For the 90%ile total ammonia the CSM target is 0.25mg/l. However, if High Status under WFD is being reached for a water body for certain river types then the more stringent WFD standard at 0.2mg/l is applied. This is due to the no deterioration principle. Total ammonia standards for each waterbody are given in Table A2.1b.

Table A2.1a. Organic pollution standards for SAC rivers.

Organic pollution attribute	Unit	Test Statistic	Target
Dissolved Oxygen (DO)	% saturation	10%ile	≥85
Biochemical Oxygen Demand (BOD)	mg l^{-1}	Mean calculated over a 3-year period	≤1.5
Total Ammonia	mg l^{-1}	90%ile	Varies by water body. See Table 2.1b.
95%ile un-ionised ammonia	mg l^{-1}	95%ile	≤0.025

Table A2.1b. Total Ammonia standards for river water bodies in the Afon Gwyrfai SAC.

* Reason for total ammonia standard: some water bodies that meet WFD high status for ammonia have the WFD high target of 0.2 mg l^{-1}, all other water bodies have the CSM target of 0.25 mg l^{-1}.

Water Body ID	Water Body Name	Total Ammonia (90%ile, mg l^{-1})	Reason for total ammonia standard*
N/A-not a WFD waterbody	Afon Treweunydd	0.25	CSM
GB110065054191	Gwyrfai - upstream of Cwellyn	0.25	CSM
GB110065054190	Gwyrfai - downstream of Cwellyn	0.2	WFD (high)

2. Reactive phosphorus

Phosphorous standards are set according to altitude, alkalinity, and river size, with the tightest targets in low alkalinity, high altitude headwater areas, reflecting natural variation (JNCC 2016). River Habitat Survey (EA, 2003) river flow categories are used to determine river size.

The process also includes an alignment procedure to ensure that standards are never less stringent than the Water Framework Directive (WFD) phosphorus standard for the same water body. If the WFD standard is more stringent than the CSM standard then the WFD standard applies.

Individual phosphorus standards for all waterbodies in the Afon Gwyrfai SAC are given in Table A2.2. As explained previously, the WFD phosphate standard has been applied where it is more stringent than CSM targets.

Table A2.2. Phosphorus standards and typology for river waterbodies in the Afon Gwyrfai SAC. * Phosphorus standard to be applied to annual and growing season means. Standard calculated from annual mean expressed in µg L-1 SRP. ** Reason for phosphorus standard: CSM (near natural/max allowable) are derived from the CSM guidance for Rivers and WFD (good/high) from the relevant Water Framework Directive standard.

Water Body ID	Water Body Name	SAC Manage-ment Unit(s)	Phosphorus standard* (µg l^{-1})	Reason for phosphorus standard**	CSM _Alt type	CSM _Alk type	River size
N/A-not a WFD water-body	Afon Treweunydd	1674	5	CSM (near natural)	high Alt >80m	low Alk <50m gl	Head-water
GB110065054191	Gwyrfai - upstream of Cwellyn	1675	5	CSM (near natural)	high Alt >80m	low Alk <50m gl	Head-water
GB110065054190	Gwyrfai - downstream of Cwellyn	1677 1678 1679 1680 1681	13	WFD (high)	high Alt >80m	low Alk <50m gl	river

3. Trophic diatom index

The standard should be equivalent to WFD high ecological status using the current version of the diatom classification tool (via light microscopy). This is a tool developed to measure increases in nutrient concentrations through assessing degree of change in floristic composition in benthic diatoms (algae) in streams and rivers.

4. Acidification

This standard only applies to assessment units whose water body type is classified as siliceous or peat. Other types have good buffering ability and so will not be affected by acidification. See tables 4a and 4b for standards for all water bodies in the Afon Gwyrfai SAC.

One of the WFD water bodies in the Gwyrfai is classed at risk of acidification (Hankin *et al*. 2014). However, to comply with CSM guidance, acid targets have been applied for both river water bodies. **Note that monitoring and reporting will only be carried out for water bodies classified as either 'at risk' or 'probably at risk'.** If ANC data is available then water bodies should be assessed against the ANC standard but if ANC data is not available then pH should be used.

Table A2.4a. Acidification targets for SAC rivers.

*Acid Neutralising Capacity; ** Dissolved Organic Carbon

Targets for acidification	Method of assessment
ANC*: Mean ANC for all waters > 80 pH (Clear waters with DOC**<10 mg L-1): mean > 6.54 pH (Humic waters with DOC>10 mg L-1): mean > 5.1	Analysis of water chemistry data from environment agencies. At least 36 samples (3 years of data) are required, which must include winter samples.

Table A2.4b. Acidification targets for river waterbodies in the Afon Gwyrfai SAC.

Water Body ID	Water Body Name	Acidification risk	Acid Neutralising Capacity (ANC)	pH
N/A-not a WFD waterbody	Afon Treweunydd	Probably at risk	>80	>6.54
GB110065054190	Gwyrfai - downstream of Cwellyn	Not at risk	>80	>6.54
GB110065054191	Gwyrfai - upstream of Cwellyn	Probably at risk	>80	>6.54

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Appendix K North Anglesey Marine/Gogledd Môn Forol SAC

Harbour Porpoise (*Phocoena phocoena)*
Special Area of Conservation:
North Anglesey Marine/
Gogledd Môn Forol

Conservation Objectives and
Advice on Operations

March 2019

Advice under Regulation 21 of The Conservation of Offshore Marine Habitats and Species Regulation 2017 and Regulation 37(3) of the Conservation of Habitats and Species Regulations 2017

Further information

This document is available as a pdf file on the JNCC website for download if required (www.jncc.defra.gov.uk).

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Summary of Conservation Objectives and Advice on Operations

The Conservation Objectives and Advice on Operations are set out for the North Anglesey Marine/Gogledd Môn Forol Special Area of Conservation (SAC) for harbour porpoise (*Phocoena phocoena*). The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where Natural Resources Wales (NRW) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities as the Statutory Nature Conservation Body (SNCB).

The general objective of achieving or maintaining Favourable Conservation Status (FCS) for all species and habitat types listed in Annexes I and II of the Habitats Directive needs to be translated into Conservation Objectives for SACs. These objectives describe the condition to be achieved by a site for it to contribute in the best possible way to achieving FCS at the national, bio-geographical and European level[1]. The Advice on Operations is site-specific but based on a broad assessment of the sensitivity of the harbour porpoise to anthropogenic pressures at a UK scale.

The advice in this document has been developed using the best available scientific information and expert interpretation as of February 2019. The advice provided here may be subject to change as our knowledge about the site and the impacts of human activities improves.

To ensure the site contributes in the best possible way to achieving FCS, management of human activities occurring in or around the site is required if these activities are likely to have an adverse impact (directly or indirectly) on the integrity of the site, with regards to its Conservation Objectives. It should be noted that as a European Protected Species under Annex IV of the Habitats Directive, harbour porpoises are already strictly protected throughout their European range. As such, several conservation measures are already in place in the UK.

To achieve the Conservation Objectives for the North Anglesey Marine/ Gogledd Môn Forol SAC, the relevant[2] and competent[3] authorities should consider human activities within their remit which might affect the integrity of the site.

[1] http://jncc.defra.gov.uk/PDF/comm02D07.pdf

[2] Relevant authorities are those who are already involved in some form of relevant marine regulatory function and would therefore be directly involved in the management of a marine site lying within territorial waters. The bodies which may be relevant authorities are listed in Regulation 6 of the Conservation of Habitats and Species Regulations 2017. All relevant authorities are also competent authorities.

[3] Competent authorities are defined in Regulation 5 of the Conservation of Offshore Marine Habitats and Species Regulations 2017 and Regulation 7 of the Conservation of Habitats and Species Regulations 2017. In summary, a competent authority is any person or organisation that has the legally delegated or invested authority (e.g. Minister, government department, public body of any kind or statutory undertaker) to perform a designated function.

Crynodeb o Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau

Mae'r Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau wedi'u cyflwyno ar gyfer yr ymgeisydd Ardal Cadwraeth Arbennig (yACA) North Anglesey Marine / Gogledd Môn Forol ar gyfer yr rhywogaeth Atodiad II, y llamhidydd (*Phocoena phocoena*). Mae'r safle'n cwmpasu dyfroedd y glannau (o fewn 12 morfilltir o'r arfordir) a dyfroedd alltraeth (tu hwnt i 12 morfilltir o'r arfordir) lle mae gan Cyfoeth Naturiol Cymru (CNC), Natural England (NE) a'r Cyd-bwyllgor Gwarchod Natur (JNCC) gyfrifoldebau cynghori perthnasol.

Mae angen trosi'r amcan cyffredinol o gyrraedd neu gynnal Statws Cadwraeth Ffafriol i bob rhywogaeth a math o gynefin sydd wedi'u rhestru yn Atodiadau I a II o'r Gyfarwyddeb Cynefinoedd yn Amcanion Cadwraeth ar lefel safle. Mae rhain yn disgrifio'r cyflwr y dylai rhywogaethau a mathau o gynefin o fewn safle ei wireddu er mwyn i'r safle gyfrannu yn y ffordd orau posibl tuag at wireddu Statws Cadwraeth Ffafriol ar lefel genedlaethol, bio-ddaearyddol ac Ewropeaidd.

Mae'r Cyngor ynglŷn â Gweithgareddau yn benodol i safleoedd ond mae'n seiliedig ar asesiad ehangach o ba mor sensitif yw'r llamhidydd i bwysau anthropogenig ar lefel y DU. Datblygwyd y cyngor gan ddefnyddio'r wybodaeth gwyddonol orau bosibl a dehongliad arbenigol fel yr oedd ym mis Chwefror 2019. Bydd y cyngor a ddarperir yma yn newid wrth i'n gwybodaeth am y safle ac effeithiau gweithgareddau dyn wella.

Er mwyn sicrhau bod y safle'n cyfrannu at Statws Cadwraeth Ffafriol, mae angen rheoli gweithgareddau dyn ar y safle ac o'i gwmpas os ydynt yn debygol o gael effaith andwyol ar gyfanrwydd y safle (yn uniongyrchol neu'n anuniongyrchol) o safbwynt ei Amcanion Cadwraeth. Dylid nodi bod y llamhidydd yn ei warchod drwy Ewrop gyfan fel Rhywogaeth a Warchodir Gan Ewrop yn Atodiad IV y Gyfarwyddeb Cynefinoedd. O ganlyniad mae llawer o fesurau rheoli ar waith eisoes yn y DU.

Er mwyn diwallu Amcanion Cadwraeth safle llamhidydd North Anglesey Marine / Gogledd Môn Forol, dylai'r awdurdodau perthnasol[1] a chymwys[2] ystyried gweithgareddau dyn yn rhan o'u cylch gwaith a allai gael effaith ar gyfanrwydd y safle.

[1] Awdurdodau perthnasol yw'r rhai sydd eisoes yn ymwneud â rhyw fath o swyddogaeth reoleiddiol forol berthnasol a fyddai'n ymwneud yn uniongyrchol felly â rheoli safle morol sydd o fewn dyfroedd tiriogaethol. Mae'r cyrff a all fod yn awdurdodau perthnasol wedi eu rhestru yn Rheoliad 6 Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. Mae'r holl awdurdodau perthnasol hefyd yn awdurdodau cymwys.

[2] Mae awdurdodau cymwys yn cael eu diffinio yn Rheoliad 5, Rheoliadau Cadwraeth Cynefinoedd a Rhywogaethau Morol Alltraeth 2017 a Rheoliad 7, Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. I grynhoi, mae awdurdod cymwys yn unrhyw berson neu sefydliad y rhoddwyd awdurdod cyfreithiol neu ddirprwyedig iddo (e.e. Gweinidog, adran o'r llywodraeth, unrhyw fath o gorff cyhoeddus neu ymgymerydd statudol) i gyflawni swyddogaeth ddynodedig.

Contents

1 Introduction

1.1 Background

Initial advice on a network of sites identified within UK waters for harbour porpoise (*Phocoena phocoena*) was submitted to UK and Devolved Governments as a series of draft SACs in June 2015. The sites were identified within the UK portions of Management Units (MUs[4]) defined for the species (ICES, 2014; IAMMWG, 2015). The Welsh and Northern Ireland Governments, along with Defra on behalf of England and relevant offshore waters, gave approval for sites within their areas of jurisdiction to proceed to consultation (January to May 2016). In light of the responses to the consultation, five sites were submitted to the European Commission as candidate SACs in January 2017. These five sites were adopted by the EC as Sites of Community Importance (SCIs) on 12 December 2017 and designated as SACs by Ministers on 26th February 2019. These sites are shown in Figure 1.

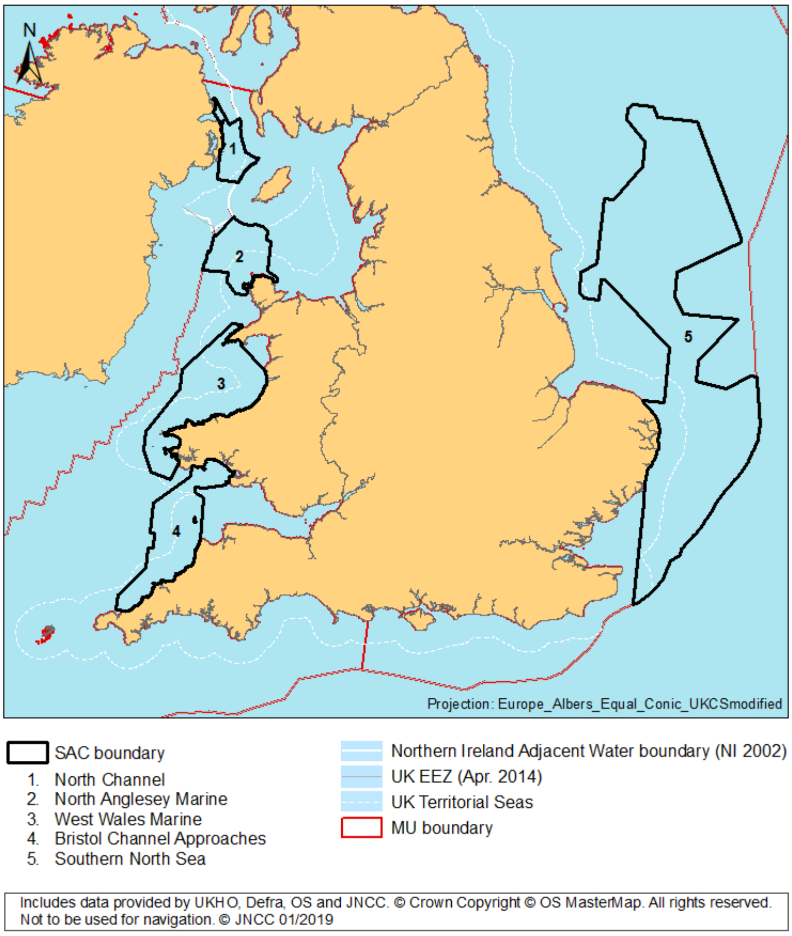


Figure 1: Special Areas of Conservation for the harbour porpoise, *Phocoena phocoena* identified in Northern Ireland, England, Wales and offshore waters. The Management Unit (MU) boundary (red line) refers to the UK portion of the North Sea and Celtic and Irish Seas MUs.

[4] For conservation and management purposes it is practical to divide the population into smaller units, termed Management Units (MUs). These MUs were developed to take account of biological populations of animals but were also be determined by political boundaries and are at an appropriate scale at which to assess human activities. In the UK, three MUs have been defined for harbour porpoise: West of Scotland, Celtic and Irish Seas, and North Sea (IAMMWG, 2015)

This advice document is for the North Anglesey Marine/ Gogledd Môn Forol SAC (Figure 2) which is subject to protection under the Conservation of Habitats and Species Regulations 2017[5] and the Conservation of Offshore Marine Habitats and Species Regulation 2017[6] (collectively referred to as the Habitats Regulations). The advice is given in fulfilment of the duty of the Statutory Nature Conservation Bodies (SNCBs) under the Habitats Regulations to advise Relevant and Competent Authorities as to (a) the Conservation Objectives for the 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. The SNCBs aim to ensure that the Conservation Objectives are up-to-date, accessible and enable the assessment of the potential effects of plans and projects.

2 Responsibilities of Relevant and Competent Authorities

Competent Authorities (including those which are also Relevant Authorities) are required to exercise their functions to comply with the Habitats Regulations. Competent Authorities must, within their areas of jurisdiction, consider both direct and indirect effects on the site. This includes considering operations inside and outside the boundary of the SAC, if the impacts could affect the achievement of the site's Conservation Objectives. Decisions on management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate. Where consent is required and the operation (if considered a plan or project) is likely to significantly affect a European Site, Article 6(3) of the Habitats Directive requires that an Appropriate Assessment (AA) is carried out. The AA is part of the “Habitat Regulations Assessment” (HRA), which is a case-specific assessment made in view of the Conservation Objectives for the affected site or sites. Each HRA requires case-specific advice from the SNCB but the assessment is the responsibility of the competent authority concerned.

The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent deterioration of harbour porpoise presence in the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU).

3 Conservation Objectives for harbour porpoise SACs

3.1 The role of Conservation Objectives

Site level Conservation Objectives (COs) are a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012). Conservation Objectives constitute a necessary reference for:

- identifying any site-based conservation measures that may be required;
- carrying out HRAs of the implications of plans or projects.

The purpose of the HRA is to determine whether a plan or project adversely affects a site’s integrity. The critical consideration in relation to site integrity is not the extent or degree of an impact, or whether an impact is direct or indirect, but whether a plan or project, either

[5] http://www.legislation.gov.uk/uksi/2017/1012/contents/made
[6] http://www.legislation.gov.uk/uksi/2017/1013/contents/made

individually or in combination with other plans or projects, affects the site's ability to achieve its Conservation Objectives and therefore contribute to Favourable Conservation Status.

Harbour porpoise are protected everywhere in European waters under the provisions of the Habitats Regulations. The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.

3.2 Background to Conservation Objectives

The Conservation Objectives are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely. Therefore, the focus of the Conservation Objectives for harbour porpoise sites is on addressing pressures that affect site integrity and would include:

- killing or injuring harbour porpoise (directly or indirectly);
- preventing their use of significant parts of the site (disturbance / displacement);
- significantly damaging relevant habitats; or
- significantly reducing the availability of prey.

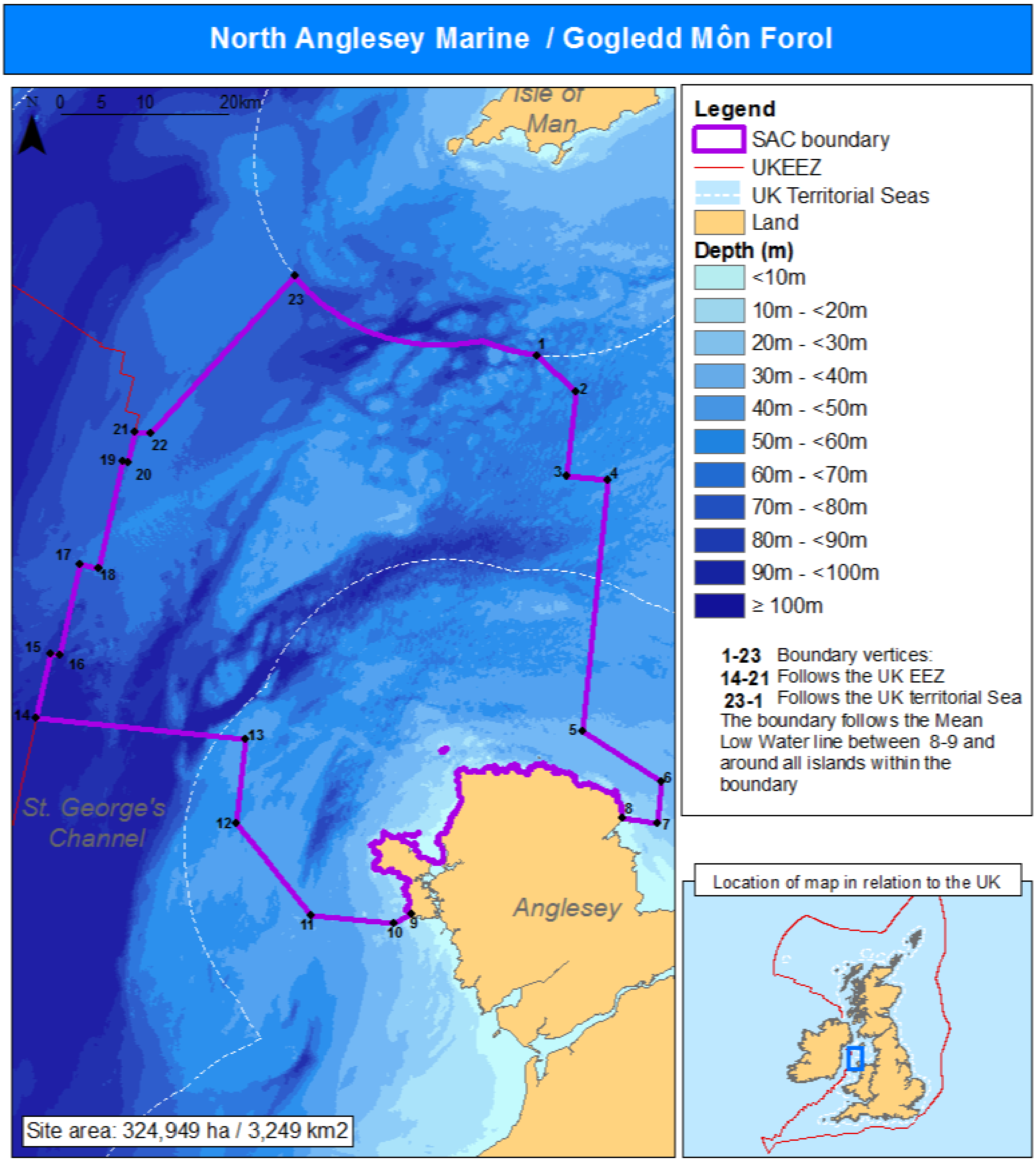
This document includes both a statement of the Conservation Objectives and explanatory text on their intent and interpretation specific to the site. The Objectives have been set taking account of European Commission guidance (EC, 2012). Further guidance on the management of specific pressures of harbour porpoise is being developed.

3.3 The North Anglesey Marine/ Gogledd Môn Forol SAC Conservation Objectives

The qualifying feature of the site is the Habitats Directive Annex II species:

- harbour porpoise (*Phocoena phocoena*)

Seasonal differences in the relative use of the site have been identified based on the analyses of Heinänen and Skov (2015). Harbour porpoise sightings data were modelled seasonally (Summer: April-September and Winter: October-March) for each MU. The outputs of this analysis were maps of areas by season and MU, that persistently contained elevated densities of harbour porpoises. These areas were used as the basis for site identification and as a consequence, sites may have seasonal components which should be considered in the assessment of impacts and proposed management. North Anglesey Marine / Gogledd Môn Forol (Figure 2) has been designated because of its importance to harbour porpoises in the summer months (April to September).



Not to be used for navigation. © JNCC 02/2019. Coordinates displayed in WGS84 geographic coordination system.
Site area calculated using modified Europe Albers Equal Area Conic UK projection.

ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	53° 51' 13.5" N	4° 35' 25.8" W	7	53° 23' 31.3" N	4° 12' 22.2" W	13	53° 23' 20.3" N	4° 57' 33.8" W	19	53° 38' 60" N	5° 17' 0" W
2	53° 49' 25.9" N	4° 30' 32.1" W	8	53° 23' 27.2" N	4° 16' 4.9" W	14	53° 21' 47.7" N	5° 20' 0.0" W	20	53° 38' 60" N	5° 16' 20.4" W
3	53° 44' 5.1" N	4° 29' 34.5" W	9	53° 14' 36.2" N	4° 36' 12.8" W	15	53° 25' 60" N	5° 20' 0" W	21	53° 40' 59.383" N	5° 16' 20.401" W
4	53° 44' 22.0" N	4° 25' 4.0" W	10	53° 13' 49.5" N	4° 37' 45.7" W	16	53° 25' 60" N	5° 19' 0" W	22	53° 41' 6.545" N	5° 14' 35.945" W
5	53° 28' 19.3" N	4° 22' 14.9" W	11	53° 13' 14.7" N	4° 46' 40.1" W	17	53° 32' 0" N	5° 19' 0" W	23	53° 52' 54.106" N	5° 2' 58.412" W
6	53° 26' 11.8" N	4° 12' 49.5" W	12	53° 17' 59.8" N	4° 56' 34.0" W	18	53° 32' 0" N	5° 17' 0" W			

Figure 2: The North Anglesey Marine / Gogledd Môn Forol Special Area of Conservation for harbour porpoise.

The Conservation Objectives for the site are:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters In the context of natural change, this will be achieved by ensuring that: 1. Harbour porpoise is a viable component of the site; 2. There is no significant disturbance of the species; and 3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Conservation Objective 1: Harbour porpoise is a viable component of the site

This SAC has been selected primarily based on the long-term, relatively higher densities of porpoise in contrast to other areas of the MU. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies (e.g. between seasons), there is no exact number of animals within the site.

The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG, 2015).

Harbour porpoise is a European Protected Species (EPS) listed on Annex IV of the Habitats Directive and as such is protected under the Habitats Directive Article 12 and transposing regulations from deliberate killing (or injury), capture and disturbance throughout its range. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States 'shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned'. Site based measures should therefore be aligned with the existing strict protection measures in place throughout UK waters. Significant disturbance within or affecting the site is considered in the second conservation objective.

Conservation Objective 2: There is no significant disturbance of the species

Disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise including, as examples, seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise[7]. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.

This SAC was identified as having persistently higher densities of harbour porpoises (Heinänen and Skov, 2015) compared to other areas of the MU. This is likely linked to the habitats within the site providing good feeding opportunities. Therefore, operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is

[7] http://jncc.defra.gov.uk/page-4273

maintained. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site. Specifically, draft SNCB advice / guidance for assessing the significance of noise disturbance to a site suggests:

Noise disturbance within an SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than: 1. 20% of the relevant area[8] of the site in any given day[9], and 2. an average of 10% of the relevant area of the site over a season[10,11].

Conservation Objective 3: The condition of supporting habitats and processes, and the availability of prey is maintained

Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site. Some evidence shows that the harbour porpoise has a high metabolic rate compared to terrestrial mammals of similar size (Rojano-Doñate et al. 2018) and high feeding rates (Wisniewska et al., 2016). The harbour porpoise is therefore thought to be a species that is highly dependent on a year-round proximity to food sources and its distribution and condition may strongly reflect the availability and energy density of its prey (Brodie 1995 in Santos & Pierce, 2003). The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site. Harbour porpoise eat a variety of prey including gobies, sandeel, whiting, herring and sprat. However, the diet of porpoises when within the sites is not well known but is likely comparable to that in the wider seas.

There are several operations (Table 2) which potentially affect the achievement of this Conservation Objective. Whilst some plans/projects are unlikely to have a significant effect alone, an effect might become significant when considered in combination with other plans/projects and against the background of existing activities/pressures on the site. Further work is needed to assess historic, existing and planned levels of plans/projects in the sites and to better understand their impacts on the habitats and prey within the sites.

4 Advice on Operations

4.1 Purpose of advice

This section details the activities specifically occurring within or close to the North Anglesey Marine/ Gogledd Môn Forol SAC that would be expected to impact the site; this is known as Advice on Operations. Initial assessments were conducted at a UK scale, with subsequent

[8] The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive).
[9] Applicable only in Habitats Regulations Assessments (HRA) due to impracticality of daily noise limit management of activities, but retrospective compliance analysis advised
[10] Summer defined as April to September inclusive, winter as October to March inclusive
[11] For example, a daily footprint of 19% for 95 days would result in an average of 19x95/183 days (summer) =9.86%

site-level assessment detailing our understanding of the operations and their potential to impact the site (Section 5 & 6). Advice is only given where pressures[12] may impact the site and therefore, may require management, if the Conservation Objectives are to be met. Widespread pressures may also act to affect the overall status of harbour porpoise, but their effects are not restricted to specific sites. Such pressures are best dealt with through broader measures. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy (DETR, 2000) has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG *et al.,* 2015), a UK Dolphin and Porpoise Conservation Strategy is being developed.

The advice outlined below should also be used to help identify the extent to which existing operations are, or can be made, consistent with the Conservation Objectives, and thereby focus the attention of Relevant and Competent Authorities and monitoring programmes to areas that may need management measures.

This Advice on Operations will be supplemented through further discussions with the Relevant and Competent Authorities and any advisory groups that may be formed for the site.

4.2 Background

In compiling this Advice on Operations, the SNCBs have considered the pressures that may be caused by human activities and may affect the integrity of the site when considered against the Conservation Objectives. The advice is generated through a broad grading of sensitivity and exposure of the harbour porpoise to pressures associated with activities to gain an understanding of how vulnerable the species is to each activity at a UK level. The activities and their associated pressures to which the harbour porpoise is deemed vulnerable at a UK level are then considered at a site level to inform the risks to achieving the Conservation Objectives along with any potential management that may be required to mitigate against such risks. Annex A details the assessments of the level of impact risk[13] from operations on harbour porpoise populations at a UK-wide scale. This informs on the activities likely to impact the site.

This document is guidance only and activities and their management within or affecting the site will be considered in the context of Habitats Regulations Assessment (HRA) and where applicable through other environmental assessment processes, such as Environmental Impact Assessment (EIA).

5 Operation assessments at UK scale

The assessments have been carried out using all available evidence as of February 2019. If further information is made available in future which would improve our understanding of harbour porpoise vulnerability in UK waters, the assessments may be updated. This advice is provided without prejudice for use by the Relevant and Competent Authorities. The level of any impact will depend on the location, timing and intensity of the relevant operation. This advice is provided to assist and focus the Relevant and Competent Authorities in their consideration of the management of these operations.

The harbour porpoise is a wide-ranging species and occurs throughout the UK Continental Shelf area (JNCC, 2013). It does occur in deeper waters but in very low densities, and perhaps only seasonally. As a predominantly continental shelf species, it is exposed to a wide range of pressures that are both ubiquitous (e.g. pollution) and patchy (e.g. bycatch) in nature, and the list of anthropogenic activities leading to these pressures is long. Based on current

[12] See Annex B for definition of key terms
[13] Risk includes consideration of severity of implications of impact

available information, the operations that pose the most notable risk of impact to UK harbour porpoise are shown in Table 1.

The current levels of impact of the various pressures are based on the Article 17 assessments[14] and the full list of assessed activities and key references can be found in Annex A. Updates to the assessments will occur as more evidence becomes available.

Definitions of pressures are explained in Annex B.

Activities which currently pose a low risk of impact to harbour porpoise at the UK level (Annex A) have not been considered in this advice. The exposure to the pressures associated with these activities is currently very limited. Non-anthropogenic impacts are also not considered, such as attack and predation from other marine mammal species that have the potential to impact harbour porpoise populations.

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Table 1: Key activities (operations) and the relative level of risk of impactson harbour porpoise throughout UK waters. Those pressures ranked 'high' are known to have the greatest impact relative to other pressures on the population of UK harbour porpoises. Activities which currently pose a low risk are not shown.

Operations	**Pressures**	**Impacts**	**Current relative level of risk of impact**
Commercial fisheries with bycatch of harbour porpoise (predominantly static nets)	**Removal of non-target species**	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion • Health issues (e.g. on reproduction)	High
Shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	**Anthropogenic underwater sound**	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium
Shipping, recreational boating, tidal energy installations	**Death or injury by collision**	• Mortality • Injury	Medium/Low
Commercial fisheries (reduction in prey resources)	**Removal of target species**	• Reduction in food availability • Increased competition from other species • Displacement from natural range	Medium

[14] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf . Updated Article 17 reports for 2013-2018 will be available in 2019.

6 Site specific considerations: North Anglesey Marine/ Gogledd Môn Forol SAC

6.1 Sensitivity of harbour porpoise to existing activities within or impacting on the site

The North Anglesey Marine / Gogledd Môn Forol site covers an area of 3,249km^2, reaching north-west from the Isle of Anglesey into the Irish Sea. It sits at the northern extent of St. George's Channel, extending approximately half way across to the Republic of Ireland, skirting the national waters of the Isle of Man. A summary of the site can be found in the Selection Assessment Document on the Site Information Centre [15].

All available information on activities within the site has been used to assess the threats and pressures within the site. However, precise information on some activities within the boundary is not currently available due to lack of targeted data collection to date. Assessing exposure carries certain assumptions about the spatial extent, frequency and intensity of the pressures associated with marine activities.

Table 2 is an overview of activities (operations) occurring within or in proximity to the North Anglesey Marine / Gogledd Môn Forol site to which the harbour porpoise has a current level of impact risk of High or Medium at UK level and therefore may require further consideration concerning options for management. The impact of a pressure at the site level can differ to that at UK level dependent on the amount of activity within or adjacent to the site. GIS layers of spatial activity data as well as review of literature, were used to identify the impact risk within the site (where a pressure is concentrated within a site) and whether it differs from the UK level risk. These assessments include all available information as of February 2019.

In 2012, Defra announced a revised approach to the management of fishing activities within European Marine Sites (EMS) in England[16]. The revised approach is designed to ensure consistency in the management of fishing activities with Article 6 of the Habitats Directive. For SACs or parts of SACs outside of 12 nm, management measures will be introduced by appropriate regulators to ensure adequate protection.

The Welsh Government is assessing new fisheries legislation and permitted activities under Article 6 of the Habitats and Birds Directives. The Welsh Government, in partnership with Natural Resources Wales, are undertaking a structured evaluation of the impacts from fishing activities (from licensed and registered commercial fishing vessels) on the features of Marine Protected Areas (MPA) in Welsh waters is. This is referred to as the Assessing Welsh Fishing Activities (AWFA) Project[17]. The Welsh Government is responsible for decisions relating to whether additional management measures are required to avoid impacts to features of MPAs in Welsh waters. The evidence base provided by the AWFA Project will inform fisheries management decisions and support the aims of The Well-being of Future Generations (Wales) Act 2015, The Environment (Wales) Act 2016 and the Habitats Directive by contributing to the sustainable management of the marine environment.

JNCC and the country SNCBs are working with the Regulators and Industry to ensure that a pragmatic approach to mitigation and management of pressures that may affect the integrity of the site is adopted. Any future guidance documents will be made available on the Site Information Centre on the JNCC website[18].

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[15] SAC Selection Assessment Document: http://jncc.defra.gov.uk/page-7244

[16] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

[17] https://naturalresources.wales/about-us/our-projects/marine-projects/assessing-welsh-fishing-activities/?lang=en

[18] http://jncc.defra.gov.uk/page-7244

Table 2: Operations (activities) occurring within/near to the North Anglesey Marine/Gogledd Môn Forol site which may affect the integrity of the site.

Operations	Pressure	Comment on current level of activity	Management considerations
Fisheries (commercial and recreational) with harbour porpoise bycatch	Removal of non-target (bycatch) species	Bycatch of harbour porpoise in fishing gear is one of the most significant anthropogenic pressures impacting the population at a UK level. The relevant commercial fisheries with harbour porpoise bycatch are bottom set nets, such as gillnets and tangle nets. UK registered vessels >12m: Evidence in Vessel Monitoring System (VMS) data of low levels of static gear vessels crossing over a small portion of the northwest corner of the site boundary[19]. Vessels <12m (the majority, ~92%, of Welsh small scale commercial fleet being <10m) include static nets: Effort is considered low and byatch is thought to be negligible. Recreational netting also occurs at a very low level of effort along the coast with likely negligible (no known) bycatch. EU registered vessels: Evidence in Vessel Monitoring System (VMS) data of low levels of static gears (>12m vessels) crossing over the northwest of the site boundary.	Where bycatch may pose a risk to achieving the site's conservation objectives, mitigation may be required. Where management measures are required, the development of these would be led by fishery managers in discussion with fishing interests and informed by any detailed information about fishing activity that can be made available. Detailed measures, if required, will be developed by the relevant management authority (European Commission/MMO/Defra/Welsh Government) Gillnetters of >12m working within the site operate within ICES area VIIa and are therefore not legally required to use pingers under EU Regulation 812/2004[20]. The risk of bycatch from this sector in the context of the Conservation Objectives of the site may need to be assessed. Although bycatch is thought to be negligible within the site, the greatest risk is posed by the numerous small bottom-set gillnetting vessels (<12m), for which the use of pingers is not mandatory under Regulation 812/2004. Effort by this sector of the fleet in the site is currently considered low and risk of bycatch is likely negligible. The need for further management will need to be fully assessed based on local fisheries data. However, it is currently considered that requirement of further measures is unlikely given current impact.
Discharge/ run-off from land-fill, terrestrial/ offshore industries	Contaminants	Current exposure within/near the site is unknown but historical metal mining operation outfalls potentially exist within the site. Wylfa nuclear power station operation and decommissioning, and re-construction and operation of new proposed nuclear station	This pressure generally cannot be managed effectively at the site level. Most of the pollutants of relevance to marine mammals have been effectively phased out of use by action under the OSPAR Convention and, more recently, the EU (through Council Directives 67/548/EEC and 76769/EEC and the Stockholm convention, which restrict the marketing and use of PCBs;

[19] The fisheries data are aggregated VMS data collected between 2006 and 2013.
[20] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:150:0012:0031:EN:PDF

		will have thermal discharge inputs.	plan for disposal of PCBs; and eliminate or restrict the production and use of persistent organic pollutants [POPs]). However, human activities are the most likely cause of the re-release of these chemically stable chemicals into the environment or for introduction of other contaminants of which the impacts are poorly known. Any novel sources of potential contamination and/or activities likely to cause re-release of pollutants from stores associated with a new plan or project will be assessed under HRA both within and outside the site where there is the potential to impact upon site integrity. Current sources of exposure have to be identified and further efforts to limit or eliminate discharges to the marine environment may still be needed.
Shipping	Anthropogenic underwater sound	The ferry port in Holyhead on Anglesey is the only significant harbour affecting the site. Shipping routes cross the site serving Liverpool Bay and Dublin. There is the traffic separation scheme to the west of the site.	Harbour porpoise use sound for foraging, navigation, communication and predator detection. Underwater noise therefore has the potential to interrupt or affect these behaviours as well as cause hearing damage, particularly at short distances. The peak frequency of echolocation pulses produced by harbour porpoise is 120–130 kHz, corresponding to their peak hearing sensitivity although hearing occurs throughout the range of ~1 and 180 kHz (Southall *et al.,* 2007). The underwater sounds created by large ships are unlikely to cause physical trauma, but could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). However, additional management is unlikely to be required based on current levels of activity. Significant increases in vessel traffic, for example as may be associated with large-scale marine developments in the area,would be routinely assessed in HRA.
Oil and gas drilling		Licensed areas for oil and gas extraction are not currently present in the site.	No management required, other than HRA of any plans/projects that may come forward.
Pile driving		Proposed harbour/breakwater construction likely to utilise impact piling. Other marine developments, eg tidal stream and offshore wind, may utilise	A European Protected Species (EPS) licence may be needed for any construction activity which carries the risk of significant disturbance or deliberate injury to cetaceans.

		impact piling during installation of turbine foundations. The Crown Estate Potential New Leasing Round (2019) for offshore wind may propose leasing regions that overlap or are adjacent to the North Anglesey Marine SAC: Irish Sea (Region 17), Anglesey (Region 15) and North Wales (Region 16)	Developers are advised to follow the 'Statutory Nature Conservation Agency protocol for minimising the risk of injury to marine mammals from piling noise''[21]. A Habitats Regulations Assessment (HRA) is required for any development that might affect site integrity. If mitigation additional to the standard SNCB protocols (as above) is required as a result of environmental assessments (e.g. noise abatement techniques, Acoustic Deterrent Devices), planning and management of pile driving activities and mitigation will be needed within the site to ensure the Conservation Objectives are met. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Dredging and disposal		Maintenance dredging occurs at ports. The Holyhead North disposal site (ISO43) is within/close to the site and planned dredging and disposal activities are likely for Wylfa power station.	Dredging and disposal can cause disturbance leading to changes in harbour porpoise behaviour as well as changes to their habitat and prey. There is also potential for resuspension of pollutants from the sediment. The risk from single plans/projects may be considered relatively low but is assessed through HRA. However, there is currently considerable uncertainty regarding effects on habitat and prey. New dredge and disposal projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.
Aggregate extraction		Limited aggregate resource within the site.	Aggregate extraction can cause disturbance leading to changes to harbour porpoise behaviour as well as to their habitat and prey. However, the risk is considered relatively low for single plans/projects and additional management is unlikely to be required. New aggregate extraction projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.

[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf

Geophysical surveys (including seismic)		Commercial seismic activity is currently of a low level in the site, although large-scale surveys have covered areas within the site boundary in the past. Some acoustic surveys are carried out in relation to marina works. Commercial and research based acoustic seabed surveys using multibeam and/or sidescan sonar occur in parts of the site.	Some geophysical surveys that may affect the integrity of the site may require consent and be subject to HRA. Each case needs to be assessed individually, and the *JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys* (updated August 2017[22]) are available online. Within the guidance, seismic survey is defined as *'Any geophysical survey that uses airguns to generate sound which is sent into the seabed and the reflected energy is recorded and processed to produce images of the geological strata below; described as 2D, 3D and 4D and includes any similar techniques that use airguns.'* It is currently not known whether sub-bottom profilers cause disturbance to harbour porpoise. Further research is needed to understand the sound propagation and effect ranges from these types of equipment. Cumulative impacts of geophysical surveys will need to be considered Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Recreational boating activity		Royal Yachting Association (RYA) cruising routes present around the coast of Anglesey.	Adherence to wildlife codes of conduct is already advocated: WiSe scheme; SeaWatch code of conduct; ZSL code of conduct; The RYA good practice guide - The Green Wildlife Guide for Boaters; Wild Seas Wales; Anglesey and Conwy Marine codes. UK SNCBs are looking at the option of developing an overarching wildlife watching code of conduct to sit alongside the Scottish code.
Acoustic deterrent/mitigation devices		Negligible or not currently present.	Management/assessment would be required for use of devices in the site since they introduce noise to the environment and are designed to disturb marine mammals.
Pinger devices		Some UK and EU registered >12m vessels may be using	See 'Fisheries (commercial and recreational) with harbour porpoise bycatch'.

[22] http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_apr2017.pdf.

		gillnets in the site. Use of pinger devices is unknown.	The use of pingers is required for the >12m sector. However, because vessels <12m are the greatest component of the UK gillnetting fleet, most bycatch occurs in this sector. Effort by <12m of the fleet in the site is currently considered low and, therefore, risk of bycatch is likely to be negligeable. The need for further management will need to be fully assessed based on local fisheries data but it is currently considered unlikely that further measures will be required. If further measures were deemed necessary, one option for management could be to extend the pinger requirement to vessels deploying static nets within site boundaries. However, the impact of potential disturbance as a result of pinger use in the site may need to be assessed and the potential for other mitigation options such as alternative gear types or gear modifications considered.
Military activity		Although no active MOD areas are located within the site, MOD can operate anywhere in UK waters.	Activities take place under Range Standing Orders, command guidance and environmental risk management tools, which include measures to reduce the risk of killing, injury and disturbance of marine mammals (for example live firing trials are subject to confirmation that marine mammals are not present in the vicinity of targets). No further management is considered necessary as the MOD, which are a Competent Authority, incorporates the SACs into their assessments via their MOD Environmental Protection Guidelines (Maritime) and Marine Environment and Sustainability Assessment Tool (MESAT)[23].
Unexploded ordnance (UXOs)		Unknown whether they exist in the site. However, unexploded ordnance from WWII can be found in many areas of UK seas. Projects that could inadvertently explode UXOs must undertake a survey to search for possibly ordnance ahead of the project commencing. Any ordnance found must be exploded on	Although the removal (detonation) of unexploded ordnance (UXOs) is short term, the noise is significant and can cause injury or death to harbour porpoise. A HRA may be required. A European Protected Species licence may also be required. Mitigation is usually required to reduce risk of injury and killing. As a minimum, the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives are applied. A combination of Marine

23 http://www.royalnavy.mod.uk/-/media/royal-navy-responsive/documents/useful-resources/environmental-protection/environmental-protection-guidelines-maritime-v21.pdf?la=en-gb

		site, or removed for health and safety reasons.	Mammal Observers (MMO)s, Acoustic Deterrent Devices (ADD) and occasionally scare charges are used to ensure harbour porpoise and other marine mammals are a sufficient distance from the explosion to prevent death or injury. Discussions are ongoing between industry, regulators and SNCBs on the most appropriate suite of mitigation measures for UXO clearance (including the possible use of bubble curtains). This will depend on the size of UXOs likely to be encountered and the practicality of deployment of the mitigation measure, amongst other factors.
Shipping	Death or injury by collision	The ferry port in Holyhead on Anglesey is the only significant harbour affecting the site. Shipping routes cross the site serving Liverpool Bay and Dublin.	Post mortem investigations of stranded harbour porpoise (Deaville and Jepson, 2011; Deaville 2011:2017) have revealed some deaths caused by trauma (potentially linked with vessel strikes). However, this is not currently considered a significant risk and no additional management is likely to be required.
Recreational boating activity		Sailing and racing routes focussed around the coastal areas, with cruising routes throughout the site.	See ‘Shipping’ (with death or injury by collision) above. Boats conducting recreational activity should adhere to wildlife codes of conduct to avoid risk of collision (see ‘recreational boating activity’ with regards to underwater noise).
Wet renewable energy installations		A variety of wet renewable development projects have been and are proposed within the site, including in the West Anglesey Demonstration zone for tidal energy.	New tidal range, tidal stream and wave projects would be subject to HRA. Additionally, an EPS licence might be suitable if there is a residual risk of significant disturbance or injury. Any consented, but not yet built, tidal stream and tidal range developments likely to impact the SAC will likely undergo a review of consent. Animal detection systems, e.g. active and passive acoustics, are used to monitor animal presence and behaviour around devices for consented projects. These systems might be used to establish any probable collisions and invoke adaptive management decisions. In addition, the use of ADDs is a possible mitigation tool to exclude animals from the vicinity of devices Potential future mitigation related to death or injury by collision will be based on new and emerging research and evidence.

Commercial fisheries (and recreational set nets)	Removal of target (prey) species	UK and EU Fisheries targeting prey species such as whiting, herring, mackerel, sandeel and sprat are present in the Celtic and Irish Seas. However, pelagic fishing effort is low within the site. The majority of the Welsh fleet are vessels <10m length i.e. small scale. Most fisheries within the site are demersal and target shellfish, but there are some vessels that use static nets but fishing effort is considered to be low.	Currently, most commercial species are managed at scales relevant for stock management via the Common Fisheries Policy (CFP), not at the site level. Some species, however, are caught and sold commercially but do not have a Total Allowable Catch (TAC) for the Irish Sea area e.g sandeel, gurnard or stocks are not managed under the CFP eg flounder, black bream. Harbour porpoise diet within UK waters includes a wide variety of fish and they will generally focus on the most abundant local species (De Pierrepont *et al* 2005; Camphuysen *et al* 2006). The predominant prey type in the UK appears to be whiting, gobies and sandeel, although shoaling fish such as mackerel and herring are also taken. Harbour porpoise diets overlap extensively with diets of other piscivorous marine predators (notably seals) and many of the main prey species are also taken by commercial fisheries, although porpoise tend to take smaller fish than those targeted by fisheries (Santos and Pierce 2003). The overlap between commercial fisheries and harbour porpoise prey is unknown within the site. Further research is required to establish whether any management would be required.

6.2 Limitations of the evidence

It is important to note that the information used to catalogue activities/operations occurring within the site is not complete. The available data are drawn from existing monitoring programmes (e.g. the UK's Bycatch Monitoring Scheme for Protected Species and other European datasets linked to VMS monitoring of fishing vessels) but these have limitations, including availability and accessibility of data at the time of preparing this advice. Caveats with how the data have been collected also need to be understood to correctly interpret the information. This has resulted in the use of expert judgement where sufficient evidence is lacking but risk is implied. Below are some points to consider alongside the above table to ensure the information is not taken out of context:

- **Data availability**
    - Globally, the marine environment, particularly in offshore areas, is generally far behind the evidence levels for the terrestrial environment, mainly due to scale and difficulty/cost of data acquisition.
    - There can be sensitivities surrounding data that have been gathered by industry, and some data are not available for use for advice and management purposes. Often these data become available eventually, but not in time to inform management decisions.

- **Fishing: Limitations of fishing Vessel Monitoring System (VMS) data**
    - VMS positional data are transmitted at approximately 2 hour intervals. There is no information transmitted regarding precise vessel activity, therefore assumptions about activity, based on logbook returns and vessel speed profile, are often made.
    - Vessel positional data (VMS) cannot inform regulators regarding extent of static gear deployment or soak times.
    - Fishing vessels under 12m long, (and from 2009 until 2013, vessels under 15m long) are not required to use the VMS.. However, local information can be obtained from fisheries management authorities and will be used to develop more detailed guidance to assist with identification of any management measures where considered necessary.
    - In Wales, the Scallop fishing fleet (mostly <12m long) have vessel tracking devices (Succorfish). There is no evidence of harbour porpoise bycatch associated with this fleet.

- **Contaminants**
    - Although use of many of the relevant substances (e.g. PCBs) has been heavily regulated for many years, including a ban on further production, re-suspension or reintroduction of pollutants may occur. It is difficult to identify sources of contamination when dealing with highly mobile species.

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8 Annex A: Assessment of the level of impact risk from operations (activities) on UK harbour porpoise populations

The relative level of risk of impact to harbour porpoise from a range of pressures was assessed at UK level (Table A1) as part of the 3rd reporting round for Article 17[24].See Annex B for the definitions of pressures as used for the harbour porpoise assessments. For the assessment the relative importance of the pressure was assessed by considering the evidence available of an impact and the nature of that impact (direct/indirect) together with the area over which the pressure is acting in UK waters in relation to the species distribution. The relative levels are assigned according to the Artcile 17 guidance (Evans and Marvela, 2013) as:

Code	Meaning	Comment
H	High importance/impact	Important direct or immediate influence and/or acting over large areas
M	Medium importance/impact	Medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally
L	Low importance/impact	Low direct or immediate influence, indirect influence and/or active over small part of the area/acting only regionally

Table A1 Full assessment of level of the impact risk from operations (activities) on harbour porpoise in UK waters based on considerations for Article 17 assessment for harbour porpoise conservation status[25].

Operations	Pressures	Impacts	Relative level of risk of impact	Evidence		Key references
				Spatial overlap (species & pressure)	Post-mortem examination	
Commercial fisheries with bycatch (predominantly static nets)	Removal of non-target species	• Mortality through entanglement/ bycatch	High	✓	✓	Deaville and Jepson, 2011; Morizur *et al* 1999; Read *et al* 2006; Northridge and Kingston 2010; Northridge *et al* 2016; ICES 2015b
Discharge/run-off from land-fill, terrestrial and offshore industries	Contaminants	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion	High		✓	Jepson *et al* 2005; Jepson *et al* 2016; Deaville & Jepson, 2011; ICES, 2015a; Van De Vijver *et al* 2003; Law *et al* 2012; Pierce *et al* 2008; Murphy *et al* 2015.

[24] http://jncc.defra.gov.uk/page-6564

[25] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf

		• Health issues (e.g. on reproduction)				
Noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	Anthropogenic underwater sound	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium	✓		Deaville & Jepson, 2011; Stone & Tasker, 2006; Stone, 2015; Jepson *et al* 2005; Fernandez *et al* 2005; Würsig & Richardson, 2009; WGMME, 2012.
Shipping, recreational boating, renewable energy installations	Death or injury by collision	• Mortality • Injury	Medium/ Low	✓	✓	Deaville & Jepson, 2011; Dolman *et al* 2006; ICES 2015a
Commercial fisheries, bycatch	Removal of target species	• Reduction in food availability • Increased competition from other species • Displacement from natural range • Habitat change/loss	Medium		✓	Simmonds and Isaac, 2007; OSPAR QSR 2010; MacLeod *et al* 2007a, b; Thompson *et al* 2007; Santos and Pierce, 2003; Pierce *et al* 2007; ICES 2015b
Agriculture, aquaculture, sewage	Nutrient enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓	✓	Craig *et al* 2013
Agriculture, aquaculture, sewage	Organic enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓		Craig *et al* 2013
Waste disposal - navigational dredging (capital, maintenance)	Physical change (to another seabed type)	• Changes in availability of prey species • Habitat change/loss	Low			
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Water flow (tidal current) changes - local	• Changes in location of prey species • Displacement of harbour porpoise • Habitat change/loss	Low			

Terrestrial and at-sea 'disposal'	Litter	• Mortality through entanglement • Ingestion	Low	✓	✓	Deaville and Jepson, 2011
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Barrier to species movement	• Habitat inaccessible • Potential physiological effects • Habitat change/loss	Low	✓		WGMME., 2012; ICES 2015a
Sewage	Introduction of microbial pathogens	• Increased risk of disease	Low		✓	Harvell *et al* 1999; Gulland and Hall, 2007; Van Bressem *et al* 2009

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9 Annex B: Definitions of Pressures as applied within harbour porpoise SAC Advice on Operations

Pressures	Definition in the context of harbour porpoise advice
Removal of non-target species	The removal of species not targeted by the fishery; in this case the bycatch (and probable mortality) of harbour porpoise
Contaminants	Introduced material capable of contaminating harbour porpoise, prey or habitat important to harbour porpoise, with a negative impact directly or indirectly on porpoises
Anthropogenic underwater sound	Introduced noise with the potential to cause injury, stress, or distrubance of harbour porpoise
Death or injury by collision	Introduction of physical objects; mobile or immobile, that may collide with or result in potential collision of harbour porpoise resulting in injury or mortality
Removal of target species	Removal of harbour porpoise prey, resulting in increased competition amongst porpoise and other species, and/or displacement from their natural range

Appendix L North Channel SAC

Harbour Porpoise (*Phocoena phocoena)*
Special Area of Conservation:
North Channel

Conservation Objectives and Advice on Operations

March 2019

Advice under Regulation 21 of The Conservation of Offshore Marine Habitats and Species Regulation 2017 and Regulation 28(2) of The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended)

Further information

This document is available as a pdf file on the JNCC website for download if required (www.jncc.defra.gov.uk).

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Summary of Conservation Objectives and Advice on Operations

The Conservation Objectives and Advice on Operations are set out for the North Channel Special Area of Conservation (SAC) for harbour porpoise (*Phocoena phocoena*). The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where the Department of Agriculture, Environment and Rural Affairs (DAERA) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities as the Statutory Nature Conservation Body (SNCB).

The general objective of achieving or maintaining Favourable Conservation Status (FCS) for all species and habitat types listed in Annexes I and II of the Habitats Directive needs to be translated into Conservation Objectives for SACs. These objectives describe the condition to be achieved by a site for it to contribute in the best possible way to achieving FCS at the national, bio-geographical and European level[1]. The Advice on Operations is site-specific but based on a broad assessment of the sensitivity of the harbour porpoise to anthropogenic pressures at a UK scale.

The advice in this document has been developed using the best available scientific information and expert interpretation as of February 2019. The advice provided here may be subject to change as our knowledge about the site and the impacts of human activities improves.

To ensure the site contributes in the best possible way to achieving FCS, management of human activities occurring in or around the site is required if these activities are likely to have an adverse impact (directly or indirectly) on the integrity of the site, with regards to its Conservation Objectives. It should be noted that as a European Protected Species under Annex IV of the Habitats Directive, harbour porpoises are already strictly protected throughout their European range. As such, several conservation measures are already in place in the UK.

To achieve the Conservation Objectives for the North Chanel SAC, the relevant[2] and competent[3] authorities should consider human activities within their remit which might affect the integrity of the site.

[1] http://jncc.defra.gov.uk/PDF/comm02D07.pdf

[2] Relevant authorities are those who are already involved in some form of relevant marine regulatory function and would therefore be directly involved in the management of a marine site lying within territorial waters. The bodies which may be relevant authorities are listed in Regulation 6 of the Conservation of Habitats and Species Regulations 2017. All relevant authorities are also competent authorities.

[3] Competent authorities are defined in Regulation 5 of the Conservation of Offshore Marine Habitats and Species Regulations 2017 and Regulation 7 of the Conservation of Habitats and Species Regulations 2017. In summary, a competent authority is any person or organisation that has the legally delegated or invested authority (e.g. Minister, government department, public body of any kind or statutory undertaker) to perform a designated function.

Contents

1 Introduction

1.1 Background

Initial advice on a network of sites identified within UK waters for harbour porpoise (*Phocoena phocoena*) was submitted to UK and Devolved Governments as a series of draft SACs in June 2015. The sites were identified within the UK portions of Management Units (MUs[4]) defined for the species (ICES, 2014; IAMMWG, 2015). The Welsh and Northern Irish Governments, along with Defra on behalf of England and relevant offshore waters, gave approval for sites within their areas of jurisdiction to proceed to consultation (January to May 2016). In light of the responses to the consultation, five sites were submitted to the European Commission as candidate SACs in January 2017. These five sites were adopted by the EC as Sites of Community Importance (SCIs) on 12 December 2017 and designated as SACs by Ministers on 26th February 2019. These sites are shown in Figure 1.

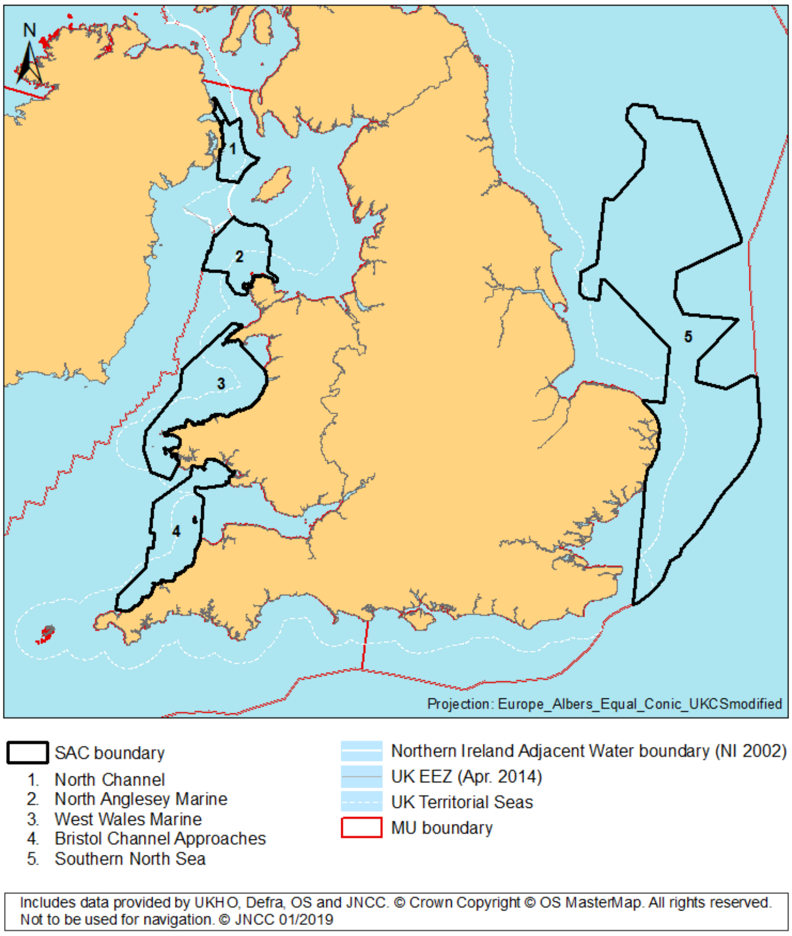


Figure 1: Special Areas of Conservation for the harbour porpoise, *Phocoena phocoena* identified in Northern Ireland, England, Wales and offshore waters. The Management Unit (MU) boundary (red line) refers to the UK portion of the North Sea and Celtic and Irish Seas MUs.

[4] For conservation and management purposes it is practical to divide the population into smaller units, termed Management Units (MUs). These MUs were developed to take account of biological populations of animals but were also determined by political boundaries and are at an appropriate scale at which to assess human activities. In the UK, three MUs have been defined for harbour porpoise: West of Scotland, Celtic and Irish Seas, and North Sea (IAMMWG, 2015)

This advice document is for the North Channel SAC (Figure 2) which is subject to protection under The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended)[5] and the Conservation of Offshore Marine Habitats and Species Regulation 2017[6] (collectively referred to as the Habitats Regulations). The advice is given in fulfilment of the duty of the Statutory Nature Conservation Bodies (SNCBs) under the Habitats Regulations to advise Relevant and Competent Authorities as to (a) the Conservation Objectives for the 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. The SNCBs aim to ensure that the Conservation Objectives are up-to-date, accessible and enable the assessment of the potential effects of plans and projects.

2 Responsibilities of Relevant and Competent Authorities

Competent Authorities (including those which are also Relevant Authorities) are required to exercise their functions to comply with the Habitats Regulations. Competent Authorities must, within their areas of jurisdiction, consider both direct and indirect effects on the site. This includes considering operations inside and outside the boundary of the SAC, if the impacts could affect the achievement of the site's Conservation Objectives. Decisions on management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate. Where consent is required and the operation (if considered a plan or project) is likely to significantly affect a European Site, Article 6(3) of the Habitats Directive requires that an Appropriate Assessment (AA) is carried out. The AA is part of the “Habitat Regulations Assessment” (HRA), which is a case-specific assessment made in view of the Conservation Objectives for the affected site or sites. Each HRA requires case-specific advice from the SNCB but the assessment is the responsibility of the competent authority concerned.

The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent changes in harbour porpoise presence within the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU).

3 Conservation Objectives for harbour porpoise SACs

3.1 The role of Conservation Objectives

Site level Conservation Objectives (COs) are a set of specified objectives designed to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012). Conservation Objectives constitute a necessary reference for:

- identifying any site-based conservation measures that may be required;
- carrying out HRAs of the implications of plans or projects.

The purpose of the HRA is to determine whether a plan or project could adversely affect a site’s integrity. The critical consideration in relation to site integrity is not the extent or degree of an impact, or whether an impact is direct or indirect, but whether a plan or project, either

[5] http://www.legislation.gov.uk/nisr/1995/380/contents/made
[6] http://www.legislation.gov.uk/uksi/2017/1013/contents/made

individually or in combination with other plans or projects, affects the site's ability to achieve its Conservation Objectives and therefore contribute to Favourable Conservation Status.

Harbour porpoise are protected everywhere in European waters under the provisions of the Habitats Regulations. The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.

3.2 Background to Conservation Objectives

The Conservation Objectives are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely. Therefore, the focus of the Conservation Objectives for harbour porpoise sites is on addressing pressures that affect site integrity and would include:

- killing or injuring harbour porpoise (directly or indirectly);
- preventing their use of significant parts of the site (disturbance / displacement);
- significantly damaging relevant habitats; or
- significantly reducing the availability of prey.

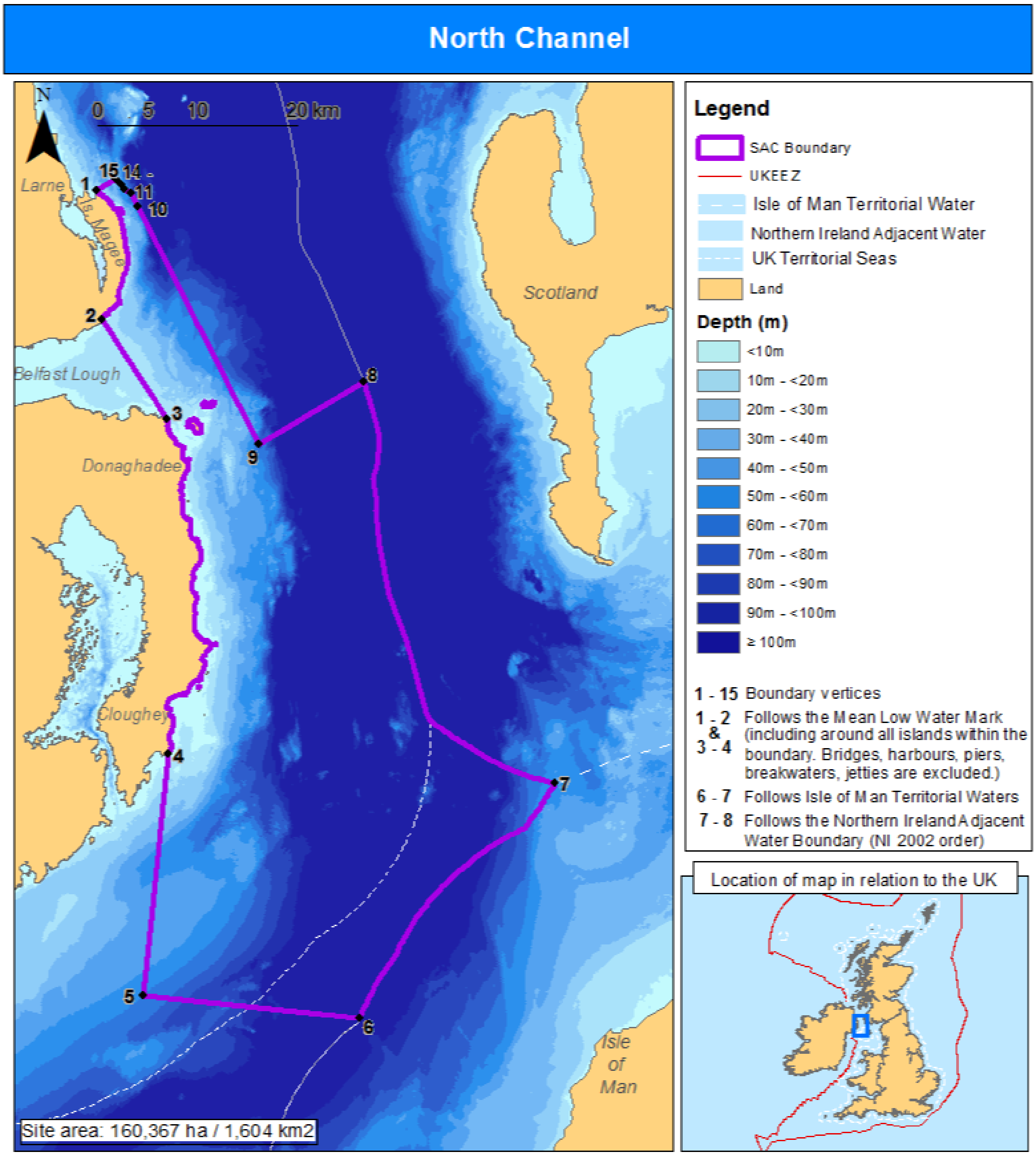
This document includes both a statement of the Conservation Objectives and explanatory text on their intent and interpretation specific to the site. The Objectives have been set taking account of European Commission guidance (EC, 2012). Further guidance on the management of specific pressures on harbour porpoise is being developed.

3.3 The North Channel SAC Conservation Objectives

The qualifying feature of the site is the Habitats Directive Annex II species:

- harbour porpoise (*Phocoena phocoena*)

Seasonal differences in the relative use of the site have been identified based on the analyses of Heinänen and Skov (2015). Harbour porpoise sightings data were modelled seasonally (Summer: April-September and Winter: October-March) for each MU. The outputs of this analysis were maps of areas by season and MU that persistently contained elevated densities of harbour porpoises. These areas were used as the basis for site identification and consequently, sites may have seasonal components which should be considered in the assessment of impacts and proposed management. The North Channel SAC (Figure 2) has been designated because of its importance to harbour porpoise in the winter months (October – March).



Includes data provided by UKHO, Defra, OS and JNCC. © Crown Copyright © OS MasterMap. All rights reserved. Not to be used for navigation. © JNCC 02/2019. Coordinates displayed in WGS84 geographic coordinate system. Site area calculated using modified Europe_Albers_Equal_Area_Conic_UK projection.

ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	54° 51' 34.7" N	5° 45' 46.6" W	6	54° 11' 30.7" N	5° 5' 8.3" W	11	54° 51' 50.6" N	5° 42' 33.9" W
2	54° 44' 55.9" N	5° 42' 33.0" W	7	54° 25' 59.8" N	4° 52' 7.7" W	12	54° 52' 1.0" N	5° 43' 14.3" W
3	54° 40' 30.7" N	5° 34' 37.0" W	8	54° 44' 48.0" N	5° 17' 30.8" W	13	54° 52' 11.2" N	5° 43' 35.8" W
4	54° 23' 6.4" N	5° 27' 40.7" W	9	54° 40' 16.0" N	5° 25' 43.8" W	14	54° 52' 19.8" N	5° 43' 59.1" W
5	54° 10' 8.4" N	5° 25' 0.3" W	10	54° 51' 14.4" N	5° 41' 45.0" W	15	54° 52' 25.8" N	5° 44' 21.3" W

Figure 2: The North Channel Special Area of Conservation for harbour porpoise.

The Conservation Objectives for the site are:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters

In the context of natural change, this will be achieved by ensuring that:

1. Harbour porpoise is a viable component of the site;

2. There is no significant disturbance of the species; and

3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Conservation Objective 1: Harbour porpoise is a viable component of the site

The SACs have been selected primarily based on their long-term, relatively higher densities of porpoise in contrast to other areas of the MU. The implication is that SACs provide relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the sites naturally varies (e.g. between seasons), there is no exact number of animals within the site.

The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG, 2015).

Harbour porpoise is a European Protected Species (EPS) listed on Annex IV of the Habitats Directive and as such is protected under the Habitats Directive Article 12 and transposing regulations from deliberate killing (or injury), capture and disturbance throughout its range. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States 'shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned'. Site based measures should therefore be aligned with the existing strict protection measures in place throughout UK waters. Significant disturbance within or affecting the site is considered in the second conservation objective.

Conservation Objective 2: There is no significant disturbance of the species

Disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise including, as examples, seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise[7]. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.

This SAC was identified as having persistently higher densities of harbour porpoises (Heinänen and Skov 2015) compared to other areas of the MU. This is likely linked to the habitats within the site providing good feeding opportunities. Therefore, operations within or affecting the site should be managed to ensure that the animals' potential usage of the site is

[7] http://jncc.defra.gov.uk/page-4273

maintained. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site. Specifically, draft SNCB advice /guidance for assessing the significance of noise disturbance to a site suggests:

> Noise disturbance within an SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than:
>
> 1. 20% of the relevant area[8] of the site in any given day[9], and
>
> 2. an average of 10% of the relevant area of the site over a season[10,11].

Conservation Objective 3: The condition of supporting habitats and processes, and the availability of prey is maintained

Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site. Some evidence shows that the harbour porpoise has a high metabolic rate compared to terrestrial mammals of similar size (Rojano-Doñate et al., 2018) and high feeding rates (Wisniewska et al., 2016). The harbour porpoise is therefore thought to be a species that is highly dependent on a year-round proximity to food sources and its distribution and condition may strongly reflect the availability and energy density of its prey (Brodie 1995 in Santos & Pierce, 2003). The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site. Harbour porpoise eat a variety of prey including gobies, sandeel, whiting, herring and sprat. However, the diet of porpoises when within the sites is not well known but is likely comparable to that in the wider seas.

There are several operations (Table 2) which potentially affect the achievement of this Conservation Objective. Whilst some plans/projects are unlikely to have a significant effect alone, an effect might become significant when considered in combination with other plans/projects and against the background of existing activities/pressures on the site. Further work is needed to assess historic, existing and planned levels of plans/projects in the sites and to better understand their impacts on the habitats and prey within the sites.

4 Advice on Operations

4.1 Purpose of advice

This section details the advice on activities specifically occurring within or close to the North Channel SAC that would be expected to impact the site; this is known as Advice on Operations. Initial assessments were conducted at a UK scale, with subsequent site-level

[8] The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive).

[9] Applicable only in Habitats Regulations Assessments (HRA / AA stage) due to impracticality of daily noise limit management of activities, but retrospective compliance analysis advised

[10] Summer defined as April to September inclusive, winter as October to March inclusive

[11] For example, a daily footprint of 19% for 95 days would result in an average of 19x95/183 days (summer) =9.86%

assessment detailing our understanding of the operations and their potential to impact the site (Section 5 & 6). Advice is only given where pressures[12] may impact the site and therefore, may require management, if the Conservation Objectives are to be met. Widespread pressures may also act to affect the overall status of harbour porpoise, but their effects are not restricted to specific sites. Such pressures are best dealt with through broader measures. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy (DETR, 2000) has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG *et al,* 2015), a UK Dolphin and Porpoise Conservation Strategy is being developed.

The advice outlined below should also be used to help identify the extent to which existing operations are, or can be made, consistent with the Conservation Objectives, and thereby focus the attention of Relevant and Competent Authorities and monitoring programmes to areas that may need management measures.

This Advice on Operations will be supplemented through further discussions with the Relevant and Competent Authorities and any advisory groups that may be formed for the site.

4.2 Background

In compiling this Advice on Operations, the SNCBs have considered the pressures that may be caused by human activities and may affect the integrity of the site when considered against the Conservation Objectives. The advice is generated through a broad grading of sensitivity and exposure of the harbour porpoise to pressures associated with activities to gain an understanding of how vulnerable the species is to each activity at a UK level. The activities and their associated pressures to which the harbour porpoise is deemed vulnerable at a UK level are then considered at a site level to inform the risks to achieving the Conservation Objectives along with any potential management that may be required to mitigate against such risks. Annex A details the assessments of the level of impact risk[13] from operations on harbour porpoise populations at a UK-wide scale. This informs on the activities/operations likely to impact the site.

This document is guidance only and activities/operations and their management within or affecting the site will be considered in the context of a Habitats Regulations Assessment (HRA) and where applicable through other environmental assessment processes, such as Environmental Impact Assessment (EIA).

5 Operation assessments at UK scale

The assessments have been carried out using all available evidence as of February 2019. If further information is made available in future which would improve our understanding of harbour porpoise vulnerability in UK waters, the assessments may be updated. This advice is provided without prejudice for use by the Relevant and Competent Authorities. The level of any impact will depend on the location, timing and intensity of the relevant operation. This advice is provided to assist and focus the Relevant and Competent Authorities in their consideration of the management of these operations.

The harbour porpoise is a wide-ranging species and occurs throughout the UK Continental Shelf area (JNCC, 2013). It does occur in deeper waters but in very low densities, and perhaps only seasonally. As a predominantly continental shelf species, it is exposed to a wide range of pressures that are both ubiquitous (e.g. pollution) and patchy (e.g. bycatch) in nature, and the list of anthropogenic activities leading to these pressures is long. Based on current

[12] See Annex B for definition of key terms
[13] Risk includes consideration of severity of implications of impact

available information, the operations that pose the most notable risk of impact to UK harbour porpoise are shown in Table 1.

The current levels of impact of the various pressures are based on the Article 17 assessments[14] and the full list of assessed activities (operations) and key references can be found in Annex A. Updates to the assessments will occur as more evidence becomes available.

Definitions of pressures are explained in Annex B.

Activities which currently pose a low risk of impact to harbour porpoise at the UK level (Annex A) have not been considered in this advice. The exposure to the pressures associated with these activities is currently very limited and poses no significant threat to the maintenance of harbour porpoise at FCS. Non-anthropogenic impacts are also not considered, such as attack and predation from other marine mammal species that have the potential to impact harbour porpoise populations.

Table 1: Key activities/operations and the relative level of risk of impact on harbour porpoise throughout UK waters. Those pressures ranked 'high' are known to have the greatest impact relative to other pressures on the population of UK harbour porpoises. Activities which currently pose a low risk are not shown.

Operations	**Pressures**	**Impacts**	**Current relative level of risk of impact**
Commercial fisheries with bycatch of harbour porpoise (predominantly static nets)	**Removal of non-target species**	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion • Health issues (e.g. on reproduction)	High
Shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	**Anthropogenic underwater sound**	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising)	Medium
Shipping, recreational boating, tidal energy installations	**Death or injury by collision**	• Mortality • Injury	Medium/Low
Commercial fisheries (reduction in prey resources)	**Removal of target species**	• Reduction in food availability • Increased competition from other species • Displacement from natural range	Medium

[14] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf . Updated Article 17 reports for 2013-2018 will be available in 2019.

6 Site specific considerations: North Channel SAC

6.1 Sensitivity of harbour porpoise to existing activities within or impacting on the site

The North Channel site spans territorial waters of Northern Ireland and offshore waters and covers an area of 1,604km^2. A summary of the site can be found in the Selection Assessment Document on the Site Information Centre[15].

All available information on activities/operations within or in proximity to the site has been used to assess the threats and pressures within the site. However, precise information on some activities/operations is not currently available due to lack of targeted data collection to date. Assessing exposure carries certain assumptions about the spatial extent, frequency and intensity of the pressures associated with marine activities.

Table 2 is an overview of activities occurring within or in proximity to the North Channel site to which the harbour porpoise has a current level of impact risk of High or Medium at UK level (Table 1) and therefore may require further consideration concerning options for management. The impact of a pressure at the site level can differ to that at UK level dependent on the amount of activity within or adjacent to the site. GIS layers of spatial activity data as well as review of literature, were used to identify the impact risk within the site (where a pressure is concentrated within a site) and whether it differs from the UK level risk. These assessments include all available information as of February 2019.

JNCC and the country SNCBs are working with the Regulators and Industry to ensure that a pragmatic approach to mitigation and management of pressures that may affect the integrity of the site is adopted. Any future guidance documents will be made available on the Site Information Centre on the JNCC website[16].

[15] SAC Selection Assessment Document: http://jncc.defra.gov.uk/page-7242

[16] http://jncc.defra.gov.uk/page-7242

Table 2: Operations occurring within/near to the North Channel site which may affect the integrity of the site.

Operations	Pressure	Comment on current level of activity	Management considerations
Fisheries (commercial and recreational) with harbour porpoise bycatch	Removal of non-target (bycatch) species	Bycatch of harbour porpoise in fishing gear is one of the most significant anthropogenic pressures impacting the population at a UK level. The relevant commercial fisheries with harbour porpoise bycatch are bottom set nets, such as gillnets and tangle nets. UK registered vessels >12m: According to Vessel Monitoring System (VMS) data, there is no evidence of large vessel UK static net fishing activity within the site[17]. UK registered vessels <12m: current exposure is unknown within the site boundary. EU registered >12m vessels: VMS data show potential for low levels of dispersed static netting vessel activity in Northern Ireland waters.	Where bycatch may pose a risk to achieving the site's conservation objectives, mitigation may need to be considered. Where management measures are required, the development of these would be led by fishery managers in discussion with fishing interests and informed by any detailed information about fishing activity that can be made available. Detailed measures, if required, will be developed by the relevant management authority (European Commission/MMO/DAERA /Defra). The site sits within ICES area VIIa and as such, gillnetters > 12m are not legally obliged to use pingers under EU Regulation 812/2004. Additional noise disturbance has to be considered if acoustic deterrent devices are considered to be used as mitigation. A fisheries guidance document will be developed in collaboration with management authorities and stakeholders. Because the effort of static net fisheries within this site is currently considered low, the risk of bycatch is considered low. As such it is unlikely that further management would be required. A revised assessment of the risk would be required where new evidence of activity becomes available.
Discharge /run-off from land-fill, terrestrial/ offshore industries	Contaminants	Current exposure within or near the site is unknown.	This pressure generally cannot be managed effectively at the site level. Most of the relevant pollutants have been effectively phased out of use by action under the OSPAR Convention and, more recently, the EU (through Council Directives 67/548/EEC and 76769/EEC and the Stockholm Convention, which restrict the marketing and use of PCBs; plan for disposal of PCBs; and eliminate or restrict the production and use of persistent organic pollutants [POPs]).

[17] The fisheries data are aggregated VMS data collected between 2006 and 2013.

			However, human activities are the most likely cause of the re-release of these chemically stable chemicals into the environment or for introduction of other contaminants of which the impacts are poorly known. Any novel sources of potential contamination and/or activities likely to cause re-release of pollutants form stores associated with a new plan or project will be assessed under HRA both within and outside the site where there is the potential to impact upon site integrity. Current sources of exposure have to be identified and further efforts to limit or eliminate PCB discharges to the marine environment may still be needed.
Shipping	Anthropogenic underwater sound	The Northern Ireland port of Belfast is near the site resulting in large vessel shipping and ferry routes throughout the site.	Harbour porpoise use sound for foraging, navigation, social activities and predator detection. Underwater noise therefore has the potential to interrupt or affect these behaviours as well as cause hearing damage, particularly at short distances. The peak frequency of echolocation pulses produced by harbour porpoise is 120–130 kHz, corresponding to their peak hearing sensitivity although hearing occurs throughout the range of ~1 and 180 kHz (Southall *et al* 2007). The underwater sounds created by large ships are unlikely to cause physical trauma but could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). However, additional management is unlikely to be required based on current levels of activity. Significant increases in vessel traffic (e.g. associated with the installation of wind farms in the area), would need further assessment.
Oil and gas drilling		The northern-most area of the site overlaps with current licensed blocks for oil and gas.	Any future applications from existing or inactive (exploratory and dry) wells and oil and gas licensed blocks occurring within the site would be subject to an HRA.
Pile driving		There is overlap with an offshore wind resource zone in the southwest of the site, however, there	A European Protected Species (EPS) licence is already required for any construction activity which carries the risk of significant disturbance or injury

		are currently no plans in place for development of that zone. Although there is currently no pile driving within the site there are planned developments at Belfast Harbour that will engage this activity.	to cetaceans. Developers are required to follow the 'Statutory Nature Conservation Agency protocol for minimising the risk of injury to marine mammals from piling noise'[18]. A Habitats Regulations Assessment (HRA) will be considered for all new (or review of consent) developments (coastal and marine) using pile driving within the site **or** within 26km of site boundaries. If additional mitigation (to that required under EPS licence) is required, planning and management of pile driving activities may be needed within the site to ensure the Conservation Objectives are met. There is potential for a reduction or limitation of the disturbance/displacement effects by varying the schedule of piling, particularly if several developments are constructing at the same time and pile driving footprints do not overlap (i.e. maximising area from which porpoise are excluded). Limited spatio-temporal restrictions may be needed. Other examples of mitigation include the use of sound dampers, methods that create a barrier to sound transfer (e.g. bubble curtains) and, more effectively, the use of alternative foundation types (e.g. gravity foundations, suction cups, floating turbines, drilling). Scheduling of activities may minimise cumulative exclusion from areas. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs and Regulators in consultation with industry.
Dredging and disposal		Development and maintenance works at Northern Ireland's primary port at Belfast are ongoing.	Dredging and disposal can cause disturbance leading to changes in harbour porpoise behaviour as well as to their habitat and prey. There is also potential for resuspension of pollutants from the sediment. The risk from single plans/projects may be considered relatively low but is assessed through HRA. However, there is currently considerable uncertainty regarding effects on habitat and prey.

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf

			New dredge and disposal projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.
Geophysical surveys (including seismic) surveys		A range of acoustic ground discrimination surveys are undertaken within the site, including for scientific research and site surveys undertaken in association with various infrastructure projects.	Some geophysical surveys that may affect the integrity of the site may require consent and be subject to HRA. Each case needs to be assessed individually, and the *JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys* (updated August 2017[19]) are available online. Within the guidance, seismic survey is defined as *'Any geophysical survey that uses airguns to generate sound which is sent into the seabed and the reflected energy is recorded and processed to produce images of the geological strata below; described as 2D, 3D and 4D and includes any similar techniques that use airguns.'* It is currently not known whether sub-bottom profilers cause disturbance to harbour porpoise. Further research is needed to understand the sound propagation and effect ranges from these types of equipment. Cumulative impacts of geophysical surveys will need to be considered. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Recreational boating activity		Royal Yachting Association (RYA) cruising routes throughout the site, particularly along coast.	Adherence to relevant existing wildlife codes of conduct is already advocated. UK SNCBs are looking at the option of developing an overarching wildlife watching code of conduct to sit alongside the Scottish code.
Acoustic deterrent/ mitigation devices		No known use within the site.	No further management required

[19] http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_apr2017.pdf.

Pinger devices		The use of pingers is unknown but unlikely in the site given that the vessels >12m are not required to use pingers under Reg 812/2004 in the wider ICES area VIIa.	See 'Fisheries (commercial and recreational) with harbour porpoise bycatch'. No further management required.
Military activity		Although no active MOD areas are located within the site, MOD can operate anywhere in UK waters.	Activities take place under Range Standing Orders, command guidance and environmental risk management tools, which include measures to reduce the risk of killing, injury and disturbance of marine mammals (for example live firing trials are subject to confirmation that marine mammals are not present in the vicinity of targets). No further management is considered necessary as MOD, which are a Competent Authority, incorporates the SACs into their assessments via their MOD Environmental Protection Guidelines (Maritime) and Marine Environment and Sustainability Assessment Tool (MESAT)[20].
Unexploded ordnance (UXOs)		Unknown whether they exist in the site. However, unexploded ordnance from WWII can be found in many areas of UK seas. Projects that could inadvertently explode UXOs must undertake a survey to search for possibly ordnance ahead of the project commencing. Any ordnance found must be exploded on site or removed for health and safety reasons.	Although the removal (detonation) of unexploded ordnance (UXOs) is short term, the noise is significant and can cause injury or death to harbour porpoise. A HRA may be required. A European Protected Species licence may also be required. Mitigation is usually required to reduce risk of injury and killing. As a minimum, the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives are applied. A combination of Marine Mammal Observers (MMO)s, Acoustic Deterrent Devices (ADD) and occasionally scare charges are used to ensure harbour porpoise and other marine mammals are a sufficient distance from the explosion to prevent death or injury. Discussions are ongoing between industry, regulators and SNCBs on the most appropriate suite of mitigation measures for UXO clearance (including the possible use of bubble curtains). This will depend on the size of UXOs likely to be encountered and the practicality of deployment of the

[20] http://www.royalnavy.mod.uk/-/media/royal-navy-responsive/documents/useful-resources/environmental-protection/environmental-protection-guidelines-maritime-v21.pdf?la=en-gb

			mitigation measure, amongst other factors.
Shipping	Death or injury by collision	Busy shipping and ferry routes primarily accessing the port of Belfast.	Post mortem investigations of stranded harbour porpoise have revealed some deaths caused by trauma (potentially linked with vessel strikes). However, this is not currently considered a significant risk and no additional management is likely to be required.
Recreational boating activity		RYA cruising routes cross the site, most are coastal.	See 'Shipping' (with death or injury by collision) above. Boats conducting recreational activity should adhere to wildlife codes of conduct to avoid risk of collision (see 'recreational boating activity' with regards to underwater noise). https://www.daera-ni.gov.uk/publications/watch-out-wildlife-crime-marine-wildlife-disturbance
Wet renewable energy installations		There is a small overlap with a Tidal Energy Resource Zone at the Copeland Islands. However, this zone has not been considered suitable for commercial scale development due to potential significant adverse effects on the environment and other marine users (according to the Offshore Renewable Energy Strategic Action Plan for 2012-2020). Test tidal devices (turbine and kite) are currently in operation at Strangford Narrows just west of the site in the entrance to Strangford Lough.	New tidal range, tidal stream and wave projects would be subject to a Habitats Regulations Assessment (HRA). Additionally, an EPS licence is already required if there is a risk of significant disturbance or injury. Any consented, but not yet built, tidal stream and tidal range developments likely to impact the SAC shall undergo a review of consent if the North Channel SAC has not already been taken into consideration. Animal detection systems, e.g. active and passive acoustics, are used to monitor animal presence and behaviour around devices for consented projects. These systems might be used to automate a shutdown procedure which prevents collisions with moving parts or to establish any probable collisions and invoke adaptive management decisions. In addition, the use of ADDs is a possible mitigation tool to exclude animals from the vicinity of devices Potential future mitigation related to death or injury by collision will be based on new and emerging research and evidence.
Commercial fisheries (and	Removal of target (prey) species	Fisheries (UK and EU) targeting pelagic prey species such as herring	Currently, most commercial species are managed at scales relevant for stock management via the Common

recreational set nets)		and mackerel operate throughout the Celtic and Irish Seas although there is little evidence to suggest that they operate within the site boundaries. By contrast there is some demersal trawl activity in the site that could result in removal of potential prey species (e.g. whiting).	Fisheries Policy and not at the site level. Harbour porpoise diet within UK waters includes a wide variety of fish and they will generally focus on the most abundant local species (De Pierrepont *et al* 2005; Camphuysen *et al* 2006). The predominant prey type appears to be whiting, gobies and sandeel, although shoaling fish such as mackerel and herring are also taken. Harbour porpoise diets overlap extensively with diets of other piscivorous marine predators (notably seals) and many of the main prey species are also taken by commercial fisheries, although porpoises tend to take smaller fish than those targeted by fisheries (Santos and Pierce 2003). The overlap between commercial fisheries and harbour porpoise prey is unknown within the site. Further research is required to establish whether there is any potential for direct overlap.

6.2 Limitations of the evidence

It is important to note that the information used to catalogue activities/operations occurring within the site is not complete. The available data are drawn from existing monitoring programmes (e.g. the UK's Bycatch Monitoring Scheme for Protected Species and other European datasets linked to VMS monitoring of fishing vessels) but these have limitations, including availability and accessibility of data at the time of preparing this advice. Caveats with how the data have been collected also need to be understood to correctly interpret the information. This has resulted in the use of expert judgement where sufficient evidence is lacking but risk is implied. Below are some points to consider alongside the above table to ensure the information is not taken out of context:

- **Data availability**
    - Globally, the marine environment is generally far behind the evidence levels of that on land, particularly in offshore areas, mainly due to scale and difficulty/cost of data acquisition.
    - There can be sensitivities surrounding data that have been gathered by industry, and some data are not available for use for advice and management purposes. Often these data can become available, but not in time to inform management decisions.

- **Fishing: Limitations of fishing Vessel Monitoring System (VMS) data**
    - VMS positional data are transmitted at approximately 2-hour intervals. There is no information transmitted regarding precise vessel activity, therefore assumptions about activity, based on logbook returns and vessel speed profile are often made.

- Vessel positional data (VMS) cannot inform regulators regarding extent of static gear deployment or soak times.
- Fishing vessels under 12m long, (and until 2013, vessels under 15m long) are not required to use the VMS, and therefore VMS data tells us nothing regarding the activity of this segment of the fleet. However, local information can be obtained from fisheries management authorities and will be used to develop more detailed guidance to assist with identification of any management measures where considered necessary.

- **Contaminants**
    - Although use of many of the relevant substances (e.g. PCBs) has been heavily regulated for many years, including a ban on further production, re-suspension or reintroduction of pollutants may occur. It is difficult to identify sources of contamination when dealing with highly mobile species.

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8 Annex A: Assessment of the level of impact risk from operations (activities) on UK harbour porpoise populations

The relative level of risk of impact to harbour porpoise from a range of pressures was assessed at UK level (Table A1) as part of the 3rd reporting round for Article 17[21]. See Annex B for the definitions of pressures as used for the harbour porpoise assessments. For the assessment, the relative importance of the pressure was assessed by considering the evidence available of an impact and the nature of that impact (direct/indirect) together with the area over which the pressure is acting in UK waters in relation to the species distribution. The relative levels are assigned according to the Article 17 guidance (Evans and Marvela, 2013) as:

Code	Meaning	Comment
H	High importance/impact	Important direct or immediate influence and/or acting over large areas
M	Medium importance/impact	Medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally
L	Low importance/impact	Low direct or immediate influence, indirect influence and/or active over small part of the area/acting only regionally

Table A1: Full assessment of level of the impact risk from activities/operations on harbour porpoise in UK waters based on considerations for Article 17 assessment for harbour porpoise conservation status[22].

Operations	Pressures	Impacts	Relative level of risk of impact	Evidence		Key references
				Spatial overlap (species & pressure)	Post-mortem examination	
Commercial fisheries with bycatch (predominantly static nets)	Removal of non-target species	• Mortality through entanglement/ bycatch	High	✓	✓	Deaville and Jepson, 2011; Morizur *et al* 1999; Read *et al* 2006; Northridge and Kingston, 2010; Northridge *et al* 2016; ICES 2015b
Discharge/run-off from land-fill, terrestrial and offshore industries	Contaminants	• Effects on water and prey quality • Bioaccumulation through	High		✓	Jepson *et al* 2005; Jepson *et al* 2016; Deaville & Jepson, 2011; ICES, 2015a; Van De Vijver *et al* 2003; Law *et al* 2012;

[21] http://jncc.defra.gov.uk/page-6564

[22] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf

		contaminated prey ingestion • Health issues (e.g. on reproduction)				Pierce *et al* 2008; Murphy *et al* 2015.
Noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	Anthropogenic underwater sound	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium	✓		Deaville & Jepson, 2011; Stone & Tasker, 2006; Stone, 2015; Jepson *et al* 2005; Fernandez *et al* 2005; Würsig & Richardson, 2009; WGMME, 2012.
Shipping, recreational boating, renewable energy installations	Death or injury by collision	• Mortality • Injury	Medium/ Low	✓	✓	Deaville & Jepson, 2011; Dolman *et al* 2006; ICES 2015a
Commercial fisheries, bycatch	Removal of target species	• Reduction in food availability • Increased competition from other species • Displacement from natural range • Habitat change/loss	Medium		✓	Simmonds and Isaac, 2007; OSPAR QSR 2010; MacLeod *et al* 2007a, b; Thompson *et al* 2007; Santos and Pierce, 2003; Pierce *et al* 2007; ICES 2015b
Agriculture, aquaculture, sewage	Nutrient enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓	✓	Craig *et al* 2013
Agriculture, aquaculture, sewage	Organic enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓		Craig *et al* 2013
Waste disposal - navigational dredging (capital, maintenance)	Physical change (to another seabed type)	• Changes in availability of prey species • Habitat change/loss	Low			

Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Water flow (tidal current) changes - local	• Changes in location of prey species • Displacement of harbour porpoise • Habitat change/loss	Low			
Terrestrial and at-sea 'disposal'	Litter	• Mortality through entanglement • Ingestion	Low	✓	✓	Deaville and Jepson, 2011
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Barrier to species movement	• Habitat inaccessible • Potential physiological effects • Habitat change/loss	Low	✓		WGMME., 2012; ICES 2015a
Sewage	Introduction of microbial pathogens	• Increased risk of disease	Low		✓	Harvell *et al* 1999; Gulland and Hall, 2007; Van Bressem *et al* 2009

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9 Annex B: Definitions of Pressures as applied within harbour porpoise SAC Advice on Operations

Pressures	Definition in the context of harbour porpoise advice
Removal of non-target species	The removal of species not targeted by the fishery; in this case the bycatch (and probable mortality) of harbour porpoise
Contaminants	Introduced material capable of contaminating harbour porpoise, prey or habitat important to harbour porpoise, with a negative impact directly or indirectly on porpoises
Anthropogenic underwater sound	Introduced noise with the potential to cause injury, stress or disturbance to harbour porpoise
Death or injury by collision	Introduction of physical objects; mobile or immobile, that may collide with or result in potential collision of harbour porpoise resulting in injury or mortality
Removal of target species	Removal of harbour porpoise prey, resulting in increased competition amongst porpoise and other species, and/or displacement from their natural range

Appendix M Lleyn Peninsula and the Sarnau/Pen Llyn a`r Sarnau SAC

Cyfoeth Naturiol Cymru
Natural Resources Wales

Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau 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 *Pen Llŷn a’r Sarnau 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 features 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 *Pen Llŷn a’r Sarnau Special Area of Conservation (SAC),* current operations taking place with the SAC and information on modifications as a result of human activity. This section also includes a brief description of the three Special Protection Areas that fall wholly or partly within the SAC boundary.

Section 4 describes habitats and species for which the *Pen Llŷn a’r Sarnau 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 conservation objectives.

Site Name	Designated Features	Conservation Objectives
Pen Llŷn a'r Sarnau SAC	**Habitats:** • Reefs • Large shallow inlets and bays • Sandbanks which are slightly covered by seawater all the time • Estuaries • Coastal lagoons • Mudflats and sandflats not covered by seawater at low tide • Atlantic salt meadows • *Salicornia* and other annuals colonising mud and sand • Submerged or partially submerged sea caves	Conservation objectives
	Species: • Grey seal *Halichoerus grypus* • Bottlenose dolphin *Tursiops truncatus* • Otter *Lutra lutra*	

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Reoliad 37 Rheoliadau Cadwraeth 2017, ar gyfer *Ardal Cadwraeth Arbennig Pen Llŷn a'r Sarnau*, 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) Pen Llŷn a'r Sarnau*, 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 Pen Llŷn a'r Sarnau* 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
Pen Llŷn a'r Sarnau ACA	**Cynefinoedd:** • Riffiau • Cilfachau a baeau mawr bas • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Aberoedd • Morlynnoedd neu Lagynau • Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel • Dolydd ar forfeydd arfordir y gorllewin • *Salicornia* a phlanhigion unflwydd eraill sy'n cytrefu llaid a thywod • Ogofâu môr sy'n danforol neu'n lleddanforol	Amcanion Cadwraethol
	Rhywogaethau: • Morlo llwyd *Halichoerus grypus* • Dolffin trwyn potel *Tursiops truncatus* • Dyfrgi *Lutra lutra*	

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 Pen Llŷn a'r Sarnau 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 Pen Llŷn a'r Sarnau 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 4 (conservation objectives) and 5 (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 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

[5] European Commission (2000). *Managing Natura 2000 sites: the provisions of Article 6 of the Habitats Directive 92/43/EEC*. DGXI, Brussels, p.18.
[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.

“performance indicators” which supports monitoring[8] and allows judgements to be made 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

[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)

[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

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 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

[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)

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.

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 <u>may</u> 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 and Feature Description

3.1 Introduction

The Pen Llŷn a'r Sarnau SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife. The nature of the seabed and coast and the range of environmental conditions present vary throughout the SAC. Differences in rock and sediment type, aspect, sediment movement, exposure to tidal currents and wave action, water clarity and salinity together with biological and food chain interactions have created a wide range of habitats and associated communities of marine plant and animal species, some of which are unique in Wales.

Pen Llŷn a'r Sarnau SAC is a multiple interest site that has been selected for the presence of 9 marine habitat types and associated wildlife (Habitats Directive Annex I habitat types) and 3 mammal species (Habitats Directive Annex II species). For the qualifying habitats and species, the Pen Llŷn a'r Sarnau SAC is considered to be one of the best areas in the UK for:

- Reefs
- Large shallow inlets and bays
- Sandbanks which are slightly covered by seawater all the time
- Estuaries
- Coastal lagoons

and to support a significant presence of:

- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- *Salicornia* and other annuals colonising mud and sand
- Submerged or partially submerged sea caves
- *Halichoerus grypus* – grey seal
- *Tursiops truncatus* – bottlenose dolphin
- *Lutra lutra* – otter

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]. These 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.

Three Special Protection Areas (SPAs) occur within the Pen Llŷn a'r Sarnau SAC: Glannau Aberdaron ac Ynys Enlli SPA, Mynydd Cilan, Trwyn Y Wylfa ac Ynysoed San Tudwal SPA and Aber Dyfi SPA. The conservation objectives and core management plans for these protected sites can be found on the NRW website.

[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.

3.1.1 Sources and limitation of site information

A considerable body of information is available on the marine environment and associated wildlife of the area within the Pen Llŷn a'r Sarnau SAC. Studies relevant to the area go back as far as the mid 1800's, but the majority of information has been collected since the early 1980's when there was a significant increase in studies and research, especially on subtidal areas. Some locations have been subject to a considerable amount of ongoing scientific research such as the Dyfi estuary while for other parts of the SAC there is a much less extensive history of study. Much of the data for the area of the SAC is point source, although since the mid 1990's intertidal and subtidal mapping work has provided both a broader contextual background as well as baseline information that can be used for future monitoring. Most of the Pen Llŷn a'r Sarnau 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 Pen Llŷn a'r Sarnau SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales.

In places the SAC 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) (see Annex 3). The Pen Llŷn a'r Sarnau SAC also overlaps wholly or in part with a number of Special Protection Areas (SPA) classified under the Birds Directive: Glannau Aberdaron ac Ynys Enlli SPA, Mynydd Cilan, Trwyn yr Wylfa ac Ynysoedd Sant Tudwal SPA and Dyfi SPA. The conservation objectives and core management plans for these locations can be found on the NRW website. The location of these protected areas is shown in the site feature map.

a) Range

The Pen Llŷn a'r Sarnau SAC is situated in northwest Wales. The SAC boundary extends from Nefyn on the north coast of Llŷn and includes parts of the seashore and the waters and seabed around the Llŷn Peninsula, in north Cardigan Bay and along the Meirionnydd coast to Clarach in Ceredigion south of the Dyfi estuary, including the Glaslyn/Dwyryd, Artro, Mawddach and Dyfi estuaries[18]. Much of the area of the SAC is subtidal, but there are also extensive intertidal areas. The site covers an area of about 146,023 ha.

The boundary of the SAC encompasses the 9 marine habitat features and areas important for the 3 mammal species for which it was selected as an SAC. 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

[18] The seaward boundaries of marine SACs are drawn as close as possible to include the qualifying interests, but in straight lines between landmarks or buoys or in open sea areas to ensure ease of marking on navigational charts. Where intertidal areas are included the landward boundary of the SAC has been drawn to encompass the wildlife habitats / species of the site and where intertidal areas are not included, the landward boundary generally follows mean low water.

Annex I habitat features of the Pen Llŷn a'r Sarnau SAC are shown in the feature map[19]. The latter includes indicative data as the extent of most features is not known precisely and some, such as sandbanks, are dynamic and can be highly mobile.

b) Structure

i. Geology

The bedrock geology of Pen Llŷn a'r Sarnau SAC is rich and diverse. From Nefyn around the coast to Aberdaron there are ancient Precambrian igneous rocks and early Cambrian sedimentary and volcanic rocks. The majority of the rocks on the southern coast of Llŷn are Ordovician in age including sedimentary rocks and igneous intrusions. The bedrock geology from Criccieth to near Tywyn on the Meirionnydd coast is dominated by the Cambrian rocks of the Harlech Dome, but there is also an area of onshore Tertiary rock which is obscured by the sand dunes at Morfa Harlech and Morfa Dyffryn. From around Tywyn southwards the bedrock geology is Silurian in age and comprises turbidites (repetitive sequences of sandstones, siltstones and mudstones in varying proportions).

Surrounding Llŷn, the offshore bedrock largely reflects the coastal geology apart from just offshore between Harlech and Tywyn where Tertiary rocks are found, and older Permian and Jurassic rocks further out into the fault-bounded Cardigan Bay Basin.

ii. Sedimentology

There is a very wide range of sediments within the site from fine, soft mud in parts of Tremadog Bay, through sands, gravels, including mixed sandy and muddy gravels, consolidated and unconsolidated pebbles and cobble, and cobble and boulder reefs. There are large areas of boulder and cobble, both in the intertidal and subtidal parts of the SAC, the most extensive being the sarnau reefs. Sediment structures vary from uniform to very mixed.

iii Geomorphology

The underlying geology has created a complex coastal morphology. The south-western tip of Llŷn is dominated by rocky cliffs with narrow sandy beaches at points of erosion. On the southern coast of Llŷn the headlands are more prominent with wider beaches backed by Quaternary deposits, for example Aberdaron, Porth Neigwl and Porth Ceiriad. These contribute large boulders and cobbles to the beaches and subtidal areas. Larger expanses of sands are often confined to lower shores. Eastwards from St. Tudwal's there are spectacular fish-hook beaches and small spits while the Meirionnydd coast north of Barmouth is characterised by large areas of dunes with long, swash-aligned, sandy beaches at Morfa Harlech and Morfa Dyffryn. Morfa Harlech includes a well-developed spit across the Glaslyn/Dwyryd estuaries and Morfa Dyffryn includes a fine example of a tombolo linking the dunes with Mochras.

The Mawddach Estuary at Barmouth is similar to the other estuaries on the Meirionnydd coast and is characterised by a prominent spit which has developed in a northward direction due to longshore drift. The Glaslyn/Dwyryd and Mawddach estuaries resulted from glaciation when the Welsh icecap gouged two main valleys into the Cambrian rock. The first valley now terminates in Tremadog Bay as the estuary of the rivers Glaslyn and Dwyryd, and the second in Barmouth as the Mawddach estuary. The Dyfi lies in the slates,

[19] The feature map can be found on the NRW website and information on the map features and any changes can be found in Annex I.

grits and sandstones of the upper Ordovician and lower Silurian rocks and was probably formed as a result of glaciation and subsequent river erosion.

South of the Dyfi estuary in Ceredigion, a shingle-gravel ridge has developed which becomes increasingly sandy northwards forming a prominent beach at Borth. Dunes have developed behind the northern part of the spit which juts out into the Dyfi estuary.

The topography of the seabed within the SAC is varied, with areas of rugged, mainly igneous rocks off north and southwest Llŷn, some of which rise to considerable heights above the surrounding seabed and even extend about the water surface as small islets and islands. Along much of the south Llŷn coast from Porth Neigwl to the Meirionnydd coast, the seabed topography is generally less rugged although the overall geomorphology is still varied. Extensive areas of various types of sediment are present through much of the site, often interspersed with reefs formed of bedrock, boulders and cobbles. Offshore the bed of Cardigan Bay is marked by three major SW-trending low, smooth-topped ridges composed of cobbles and boulders (the sarnau) which are believed to be the remains of glacial moraines. From the north, they are Sarn Badrig, Sarn y Bwch and Sarn Cynfelin. Further exploration offshore has revealed the presence of deep channels in Cardigan Bay such as Muddy Hollow in the northern part of Tremadog Bay.

The bathymetry of the SAC varies with deeper water (over 40m) off the north and southwest Llŷn coasts. In this part of the SAC the 30m isobath comes close inshore (particularly around the southwest tip of the Llŷn and Bardsey Island). Eastwards from southwest Llŷn to Tremadog Bay, there are extensive areas of seabed between 20-30m, whilst the majority of Tremadog Bay is relatively shallow at less than 20m. The Sarnau are shallow reefs structures occurring for the most part in less than 10m surrounded by shallow, smooth-floored sediments at depths of less than 20m.

c) Function

i. Hydrography and meterology

The tidal regime within the SAC generally reflects that of Cardigan Bay, with semi-diurnal tides and a range of 2m at neap tides and 4m at spring tides. For much of the site, spring low waters occur early morning and mid-late afternoon exposing intertidal marine life to significant levels of sunlight and temperature fluctuations.

The tidal flow within the SAC is considered to follow the generalised pattern of tidal flow for the Irish Sea which is northward on the flood tide and to the south on the ebb tide. Tidal streams tend to run parallel to the coastline but are complicated by islands, headlands and seabed topography. Tidal streams are generally relatively weak within Tremadog Bay and the rest of north Cardigan Bay (between 0.05 – 0.5 m/sec on spring tides) compared to areas off the southwest Llŷn, such as Bardsey Sound where, at between 2.5-3 m/sec, they rank amongst the fastest tidal flows in the Irish Sea. Interaction with seabed and coastal topography creates considerable local variation in tidal stream strength, direction and phenomena, including turbulence and tidally induced overfalls and standing waves, particularly around southwest Llŷn.

Much of the SAC is moderately exposed to wave action, but there are localised areas of shelter in the lee of headlands and islands. Islands, headlands and large blocks of reef refract wave action, increasing the exposure of some shores and shallow areas and reducing it in others. Information on non-tidal circulation is sparse but it has been suggested that the distribution of residual surface currents in the SAC flows west along the southwest part of the Llŷn, clockwise in north Cardigan Bay and northerly in south Cardigan Bay, and that the distribution of residual bottom currents within the SAC is northerly in Cardigan Bay and westerly along the south Llŷn.

Sea surface temperature averages around 7ºC in February/March and around 14.5-15ºC in August/September. In summer, surface temperatures in the shallower water of Cardigan Bay and Tremadog Bay can be much higher than the average e.g. 20ºC recorded in Tremadog Bay. Tremadog Bay also has greater overall variation between the minimum winter and maximum summer temperatures than further west in the SAC at Bardsey Island.

Water clarity in the SAC can be high, but periods of strong wave action, heavy rainfall and greater volume of water movement during spring tides can increase the level of suspended particles in the water and the turbidity. Clarity is highest around Llŷn and Bardsey Island although temporarily decreased by seasonal phytoplankton blooms. Within Tremadog Bay and around the Sarnau, the shallower conditions and greater proportion of sediments close to the reefs and the shore means that sediment in this part of the SAC are re-suspended more easily in rough weather.

During the summer the water in Cardigan Bay stratifies with warm, relatively fresh water overlying cooler, more saline water. This stratification breaks down along a line running south of Trwyn Cilan on the south Llŷn coast, known as the Cardigan Bay front, where there are strong horizontal surface gradients of temperature, salinity, density and water clarity.

ii. Water & sediment chemistry

The western part of the SAC around the Llŷn is open coastal waters that are fully saline whereas in Tremadog Bay and around the sarnau the sea water is freshened by the river flow from the estuaries. Observed surface salinities within Cardigan Bay in summer are less than 34‰, decreasing towards the shore and observed to drop by 0.5‰ crossing the Cardigan Bay front from west to east.

There is very little data on water column and sediment dissolved oxygen levels in the SAC but no reason to believe that the water column dissolved oxygen is generally less than 100% saturation. Interstitial sediment dissolved oxygen will vary with sedimentology and infaunal biological activity. Further information on water quality can be found on the water watch Wales website[20].

iii Sediment processes

The distribution of seabed sediments within the SAC is a result of processes that have been occurring over several thousand years with the re-working of glacial moronic and till material that was transported by the ice age glaciers. There is a general direction of fine material drift in a northerly direction through Cardigan Bay and westerly along the south coast of the Llŷn. The northward elongated spits on the southern shores of the Dyfi, Mawddach and Glaslyn/Dwyryd estuaries, as well as at Morfa Dyffryn, were produced by this longshore movement of sediment while Tremadog Bay acts as a sink for offshore fine

[20] http://waterwatchwales.naturalresourceswales.gov.uk/en/ . The relevant waterbodies for Pen Llŷn a’r Sarnau are Cardigan Bay north, Tremadog Bay and Caernarfon Bay south.

sand and mud. Between Bardsey Island and the Glaslyn/Dwyryd estuary, littoral bed load drift is to the east and increases closer to the mouth of the Glaslyn/Dwyryd. The north coast of the Llŷn has low, north eastward littoral bed load drift towards the Menai Strait.

iv Biological interactions

The variety and magnitude of biological interactions 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. Grazing and predation by vertebrate predators (including species features) such as seabirds, waders and wildfowl, marine mammals, fish and crustaceans both remove energy from the habitat features and contribute to nutrient enrichment which may be significant.

d) Typical species

The variety of rock and sediment types in the SAC and their complex formations provide very varied substrata for colonisation by many different species and has a strong influence over the species that will become established in any one location.

Rocky substrates provide habitats and surfaces for attachment for example by seaweeds, anemones, sea squirts, sponges, sea firs (hydroids), sea mats (bryozoans) and soft corals. Cobbles and boulders also provide a hard surface for marine life to attach to as well as providing shelter and space in between the rocks and under boulders for more delicate species that are not able to survive on open rock surfaces. Rocks with fissures, cracks and crevices provide habitat for shade-tolerant species and those less tolerant of wave action and tidal currents. Softer rocks such as calcium carbonate and other soft substrata such as peat and clay provide a habitat for infaunal species such as piddocks and boring sponges that are able to bore into these softer substrates.

Sediment type has a similarly significant influence on the marine life that can live in and on it. The surface of the sediment is often apparently devoid of marine life, although mats and films of micro algae and evidence of burrowing creatures are common. Sediments that include a proportion of coarser material such as gravel, pebble and shell remains often support a surface assemblage of animals and plants attached to the shell and stone. This adds to the overall diversity of such mixed sediment areas which often support a diverse assemblage of burrowing animals as a result of their heterogeneous sediment composition and more complex surface microtopography.

The muddy areas of the SAC are highly productive, containing high levels of organic material. They generally have a high abundance of organisms, but with low diversity and a few rare species. Diversity of various species, including marine worms tends to increase with increasing levels of sand and gravels. However, in areas of coarse sand where the sediment is of similar grain size, the sediment is easily moved by waves and tides and so only a few specialist species survive.

The mixed sediment habitats, such as the sandy and muddy gravel and fine muddy sand support diverse and abundant assemblages of animals. They also support epifaunal communities of animals and plants attached to stones and shell fragments on the surface which increases the overall diversity of species supported by these habitats. The biogenic honeycomb worm reefs support diverse assemblages of animals that differ from those associated with other reef habitats.

Tidal streams play a key role in structuring many of the habitat features of the SAC and their associated species assemblages, particularly along the north and southwest coast of the Llŷn and around headlands and islands. Characteristic communities in these conditions are dominated by filter feeding animals fixed on or in the seabed, typically including soft corals, hydroids (sea firs), bryozoans (sea mats), sponges, sea anemones, sea squirts and mussels. The fast flowing water brings a good supply of food and nutrients supporting the growth of these animals. In areas of extreme tidal currents, such as the central part of Bardsey Sound, species are restricted to those that grow as thin encrusting layers across the seabed, since anything larger would quickly get swept away. Where tidal currents are less, other animal and plant communities develop.

Much of the SAC is moderately exposed to wave action and in intertidal areas this results in rocky shores dominated by a mixture of seaweeds, mussels and barnacle, and sandy shores with characteristic communities of burrowing animals that are able to tolerate the movement of sediment caused by the waves. Where wave action is reduced (such as in the lee of headlands) there is an opportunity for other species to become established and, combined with varied seashore substrate this can result in the development of unusual and more diverse communities (such as in muddy and sandy gravel e.g. *Zostrea*). Waves can also influence the size and shape of animals and plants.

Increases in water temperature due to climate change may have a greater effect on the marine plants and animals within areas like North Wales, which straddle a biogeographic boundary where many southern species reach their northern range limits and many northern species reach their southern range limit[21]. Consequently, increases in mean annual water temperature will result in changes to the distribution of many plants and animals in this area. Changes may be more extreme in areas such as Tremadog Bay which already has elevated summer water temperatures.

The waters of the SAC are relatively clear compared to further north along the North Wales coast, although there are seasonally raised levels of suspended material. The communities present in the site have developed in response to the prevailing and seasonal water clarity. Sediment processes clearly have the potential to greatly influence the sedimentology within the SAC, which in turn has an influence over the types of marine plants and animals that are present in areas of sediment, as well as harder substrata. Some of the marine communities in the SAC are particularly adapted to survive in conditions where there is a high level of scour caused by sediment carried in the water column.

3.3 Glannau Aberdaron ac Ynys Enlli SPA

The Glannau Aberdaron ac Ynys Enlli Special Protection Area (SPA) includes the coast at the tip of the Llŷn peninsula together with Bardsey Island (Ynys Enlli) and two smaller islands, the Gwylan Islands. The area includes a rocky coastline with many crags, screes and low cliffs supporting coastal heath and grassland. The seaward boundary of the SPA is to mean low water. The site was classified in 1992 and was reclassified in 2014 after a public consultation using information arising from the 2001 SPA review[22].

The site now qualifies as an SPA by supporting a breeding population of 12 pairs of chough *Pyrrhocorax pyrrhocorax*, representing 3.5% of the British population and 24

[21] http://ukclimateprojections.metoffice.gov.uk/ & http://www.mccip.org.uk/uk-marine-projections/
[22] Stroud *et al*., (2001).

individuals of non-breeding chough representing at least 3.5% of the non-breeding population (Article 4.1 of the 1979 EC Birds Directive), as well as supporting about 6,930 pairs of Manx shearwater *Puffinus puffinus* representing 2.6% of the British breeding population (Article 4.2 of the EC Birds Directive).

The reclassified site includes a marine extension to allow for rafting behaviour of the breeding population of manx shearwater are dependent on for 'active behaviours' such as preening, bathing and displaying. Prior to dusk during the breeding season, adult shearwaters assemble in flocks or 'rafts' on the sea surface between 1 and 10 km from the colony shore. The rafts can consist of several thousand individuals. When darkness falls, these 'rafting' birds fly to their burrows to feed their chicks, regurgitating partly digested fish[23].

The area of the existing SPA was 509.47 ha and the area of the marine extension is 33,432.95 ha, giving a total area of the extended SPA of 33,942.42 ha. Just over half of the marine extension lies within the Pen Llŷn a'r Sarnau SAC.

The site also supports other notable breeding populations of a number of bird species: cormorant *Phalacrocorax carbo*, shag *P. aristotelis*, peregrine *Falco peregrinus* and puffin *Fratercula arctica*. Whilst these do not specifically qualify the site for classification as an SPA, they are important populations in terms of the conservation of these species. The conservation objectives for the site are contained in the site management plan which can be found on the NRW website.

3.4 Mynydd Cilan, Trwyn Y Wylfa ac Ynysoed San Tudwal SPA

This coastal SPA consists of a 10km stretch of Atlantic vegetated sea cliff and exposed sandy shore. The cliffs have adjacent habitats of interest that include unimproved permanent pasture, maritime grassland, semi-improved grassland, arable farmland, coastal and maritime heath.

The site qualifies for classification as an SPA as it is used regularly by 1% or more of the Great Britain population of chough *Pyrrhocorax pyrrhocorax* in the breeding (9 pairs, 2.6 % GB population) and non-breeding (18 individuals 2.6% GB population) seasons (Article 4.1 of the EC Birds Directive).

The site also supports other species of interest: breeding peregrine *Falco peregrinus,* raven *Corvus corax*, kestrel *Falco tinnunculus*, shag *Phalacrocorax aristotelis*, guillemot *Uria aalge*, razorbill *Alca torda*, kittiwake *Rissa tridactyla* and fulmar *Fulmarus glacialis* nest on the cliffs. The islets around the headland support breeding cormorants *Phalacrocorax carbo*, herring gull *Larus argentatus*, lesser black-backed gull *Larus fuscus* and great black-backed gull *Larus marinus*. Breeding linnet *Carduelis cannabina*, yellowhammer *Carduelis flavirostris*, whitethroat *Sylvia communis*, wheatear *Oenanthe oenanthe* and stonechat *Saxicola torquata* can be found in the large areas of maritime heath and scrub along the mainland coastal strip. The conservation objectives for the site are contained in the site management plan which can be found on the NRW website.

[23] Brooke (1990)

3.5 Aber Dyfi SPA

The Aber Dyfi SPA comprises the Dyfi estuary, with adjoining saltmarsh, marshy grassland and improved grassland. The estuarine complex includes sandbanks, mud-flats, saltmarsh, peat bogs, river channels and creeks, with an extensive sand dune complex across the mouth of the estuary.

The site qualifies as an SPA for the Greenland white-fronted goose *Anser albifrons flavirostris* as it supports 1% of the wintering population in Great Britain (144 individuals representing at least 1% of the wintering population in GB (Article 4.1 of the EC Birds Directive)). The site is of importance as a traditional wintering area for this species and is the most southerly regularly used area for this population in the UK. Until the early 1980s the geese roosted on the estuary and flew inland either to the Cambrian mountains or to the raised bog of Cors Fochno to feed. The geese now use the saltmarsh and grasslands for feeding and roost on the sandbanks and mud-flats. In addition, the site supports significant numbers of breeding waders, especially lapwing *Vanellus vanellus* and redshank *Tringa tetanus* which are the largest populations of these species in Wales. The conservation objectives for the site are contained in the site management plan which can be found on the NRW website.

3.6 Operations within the SAC

The area within and around the Pen Llŷn a'r Sarnau SAC is fundamentally rural with very little, if any, heavy industry. The sea and adjacent land is widely used for a variety of commercial and recreational activities with tourism, farming and fishing providing key sources of income to the local economy. The main settlements of the area are concentrated around the coast (e.g. Pwllheli, Porthmadog, Barmouth and Aberdyfi) although the inland towns of Dolgellau and Machynlleth are in close proximity to the upper reaches of the estuaries of the SAC. Although parts of the coast of the SAC are relatively inaccessible due to their topography or restricted land access, many areas within the SAC can be accessed from the main coastal settlements or from small roads, slipways and beaches throughout the site.

Many parts of the landward boundary of the SAC remain unmodified but others have been altered and there are extensive stretches of coastal and flood defences in some areas. Along the coast these defences comprise mainly sea walls and rock armour and, within the estuaries, flood defence embankments of one sort or another. Smaller stretches of defence using gabions, rock armour and less organised rock rubble are used to protect some properties. Beach re-charge using coarse sediment dredged from the entrance to Pwllheli harbour is being used in conjunction with rock armour defences to protect part of the coastal frontage at Traeth Crugan near Pwllheli.

In the past extensive modifications have been made to the estuaries which have generally resulted in land take from each estuary. This has usually been due to the construction of embankments, sea defence works and land drainage schemes, with the process of land reclamation starting before the end of the 19th century and continuing up until the 1980's in some areas. Many of the historical impacts were as a result of the large scale construction of structures within and adjacent to the estuaries, such as the Cob at Porthmadog, the railway bridge in the Mawddach and the railway embankment in the Dyfi.

Flood embankments have also been constructed to protect agricultural land reclaimed from the estuary.

A wide range of recreational activities take place in and around the SAC. Water-based recreation (such as swimming, sailing, power boating (including jet skis), diving and kayaking) is very popular and a very important part of the tourist-based economy of the area. There are various facilities around the site to support this including marinas, harbours, slipways and associated support services. Several national and international boating events (sail and power boats) take place in the SAC every year, many of them using the marina facilities at Pwllheli. There are a number of beaches that are particularly popular with holidaymakers during the summer season and these see visitor numbers peak during the summer months. Equally, there are many smaller quieter areas around the coast that people specifically come to the area to enjoy. Recreational sea angling is popular in the SAC and takes place from the shore and from boats. Some angling charter boats operate within the SAC. Wildlife watching is increasing in popularity and there are boats which operate during the summer months to take people out to some of the more accessible islands and coast to see the wildlife.

The area of the SAC is important for commercial fishing, with the main fishing being potting for lobsters and crabs, although potting for prawns and whelks also occurs. Some netting (drift and set gill nets and some tangle netting) occurs in the SAC. Historically very little trawling and dredging has taken place in the SAC and scallop dredging is now no longer allowed in the SAC[24]

There has been interest expressed in possible aquaculture/mariculture activities in the SAC although there are no firm proposals to date.

Extensive areas of the adjacent coastal land bordering the SAC are farmed and the saltmarsh areas of the estuaries of the SAC (Glaslyn/Dwyryd, Mawddach and Dyfi) are grazed, mainly by sheep but also cattle and horses.

There have been historical changes in sewage treatment and disposal with a number of improvements over recent years through upgrading of the main sewage treatment plants and installation of small treatment systems for those premises not using the main sewage system (e.g. installation of small individual treatment systems for homes and businesses adjacent to the SAC, e.g. caravan sites). As a result water quality within the SAC should have improved. Diffuse inputs into the SAC, particularly within the estuary catchments, together with discharges via combined sewer outfalls are not well known. With the prospect of increasing rainfall as a result of climate change this input may become a more substantial contribution. Further information on water quality can be found on the water watch Wales website[25].

Forestry is a significant land use within the catchment area of the Mawddach and Dyfi estuaries, with many of the forests here composed of even-aged stands of predominantly mixed conifer.

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[24] The Scallop Fishing (Wales) Order 2010 (http://www.legislation.gov.uk/wsi/2010/269/contents/made)

[25] http://waterwatchwales.naturalresourceswales.gov.uk/en/ . The relevant waterbodies for Pen Llŷn a'r Sarnau are Cardigan Bay north, Tremadog Bay and Caernarfon Bay south.

3.7 Modifications as a result of human activity

Various human activities currently taking place within the SAC have an influence on the 9 habitat and 3 species features. 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) which affect the habitats and species. The structural and functional characteristics of the SAC and its habitat features are inherently important attributes of the marine ecosystem.

Historically the coastal area associated with the SAC has been rural one with a low population density, although it now attracts a high level of tourism activity. The SAC has not been subject to the impacts of industrialisation to the same extent as many other areas and probably remains relatively unimpacted by human activity. Historically local fisheries have been small scale, relying primarily on static gear (pots and nets) to catch fish and shellfish; it is considered that there has been little use of mobile fishing gear within many areas of the SAC and, as a result, rich seabed communities on rock and in sand, mud and gravel are still present such as along the north Llŷn and in Tremadog Bay. Productive fisheries that used to be present around the Llŷn (e.g. herring) have disappeared as a result of local and wider over-exploitation. More recent fisheries such as the scallop fishery off the north Llyn peninsula was restricted to protect the vulnerable *Modiolus* reefs.

In spite of the relatively low impact of human activity we do know that many of the habitats and wildlife of the SAC have been modified in the past: in the estuaries the construction of embankments, sea defence works and land drainage schemes have reduced the overall areas of the estuaries and the habitats within them. The building of the Cob cut the Glaslyn estuary in half and the sediment processes in the remaining Glaslyn/Dwyryd estuarine system are still responding to that change. Past mining operations in many of the estuary catchment areas have left a legacy of contaminated mine water that discharges into the environment. Coastal developments and coastal defences have resulted in a loss of habitat and have modified the coast and coastal process.

The marine habitats and species of Pen Llŷn a'r Sarnau SAC have been, and are being modified by human activity - they are not pristine. The habitats and wildlife are modified but they are still functioning and productive natural habitats, several of which are rare or particularly notable because of unusual species assemblages, and high diversity and/or abundance of species that they support. The SAC contains a wide variety of marine and coastal habitats and wildlife; several of these are believed to be in a good condition (as far as we are able to define this based on our current knowledge), whist others have been highly modified and require restoration if they are to be able to continue to provide the resources we expect from them and are able to respond to global environmental changes in the future.

Many activities have the potential to affect the SAC features by causing direct or indirect damage or deterioration of habitats, disturbance to wildlife or by modifying structural and functional characteristics of the SAC that support the habitats and species. 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. Some activities are localised in a part of the site and may be time limited or more prevalent at certain times of the year (e.g. coastal development proposals, high speed water craft). Other pressures and threats on the wildlife and habitats of the SAC are more long term and may be directly or indirectly caused or influenced by human activity, such as climate change issues (sea level rise, increased storminess, coastal squeeze) and non-native species introduction. 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[26]. Further information about human modifications to the SAC features is provided for each feature in section 4.

Some of the issues directly or indirectly influenced by human activity that are currently believed to be actual threats to the long term sustainability of the habitats and wildlife of the SAC and which either require better management or further investigation include (not in any particular order):

- Coastal flood defence and erosion control (squeeze).
- Agriculture and Land management: Grazing issues.
- Water pollution - diffuse sources
- Invasive non-native species
- Sea fish industries - potting
- Mooring & anchoring
- Harvesting of marine resources including hand gathering of fish / shellfish / seaweed
- Access & Recreation - disturbance

Some of the risks that are potentially a threat to the long term sustainability of the habitats and wildlife of the SAC and which either require better management or further investigation include (not in any particular order):

- Woodland management - upstream of the site
- Pollution and waste / Marine litter
- Access for sea fisheries activities
- Coastal flood defence and erosion control (squeeze)
- Marine wildlife watching / Eco tourism
- Scientific research
- Sea angling

[26] 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 Reefs

Reefs are widespread in northern and southern Europe and occur widely around the UK coast. They are defined in the EU Interpretation Manual[27] 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
- *Sabellaria alveolata* reef
- Carbonate reef
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Horse mussel (*Modiolus modiolus*) beds
- *Musculus discors* beds
- Sabellaria spinulosa reefs
- *Ammodytes marinus*
- *Anotrichium barbatum*
- *Arctica islandica*
- *Clupea harengus*
- *Cruoria cruoriaeformis*
- *Dermocorynus montagnei*
- *Dipturus batis*
- *Haliclystus auricula*

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

- *Lucernariopsis campanulata*
- *Ostrea edulis*
- *Palinurus elephas*
- *Phymatolithon calcareum*
- *Pleuronectes platessa*
- *Raja clavata*
- *Solea solea*

4.1.1 Range

The reef feature occurs throughout the entire SAC and incorporates a range of different habitat types. These include rocky intertidal and subtidal reefs, biogenic reefs (e.g. those formed by the horse mussel *Modiolus modiolus* or the honeycomb worm *Sabellaria alveolata)* and carbonate reef structures formed by methane gas leaking from the seabed (the most prominent of these reefs is known as Holden's Reef). Relatively few *Modiolus* reefs are still known to exist within the Irish Sea, and the north Llŷn reef is considered one of the best examples in this area. The carbonate reef structures are also very unusual; these structures would almost certainly qualify as an additional Annex I habitat under the Habitats Directive - Submarine structures made by leaking gases - but in the meantime they will be addressed as part of the reef feature of the SAC.

The general location of the reef feature within the SAC is indicated on map the feature map[28].

4.1.2 Structure and function

The structure of the reef has a fundamental influence on the type of reef communities that develop. Bedrock provides solid habitat for plants and animals to attach to whilst softer rock (such as the carbonate reef) and clay and peat exposures provide a habitat that certain species (such as sponges and boring molluscs) are able to bore into.

There is a considerable range of reef morphology, topography and associated bathymetry including variations in the slope, aspect, nature of the surface and size of the reefs. Around Pen Llŷn most of the intertidal reef comprises steep bedrock faces, although broader rocky platforms (with rockpools) are present along the north coast of the Llŷn peninsula and between Borth and Clarach in Ceredigion.

Bedrock reefs and boulder reefs extend into the subtidal areas, particularly in the northern part of the site off the north and southwest Llŷn coast, around Bardsey Island and the other smaller islands in the SAC. These reefs can have a very rugged structure, with fissures, cracks and crevices in the rock increasing the complexity of the habitat structure and providing an opportunity for other species (such as shade-loving species) to become established.

Geomorphological processes have shaped and continue to shape the reefs, particularly in the case of the pebble, cobble and boulder reefs. Within Tremadog Bay a significant proportion of the reef habitat in the intertidal and subtidal is derived from glacial till. This includes the stones and rocks that form the sarnau and many of the patch reefs along the south Llŷn coast. The continued erosion of boulder clay cliffs releases further pebble,

[28] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

cobbles, boulders and finer materials into the intertidal and eventually, through wave action, into nearshore areas. Areas of boulder, cobble and pebble reef often provide more complex habitat structure with underboulder spaces providing shelter for some species. However, boulder, cobble and pebble reefs can also be more mobile and, in these instances, support communities that are able to tolerate less stable conditions (such as on the sarnau reefs).

The reefs are surrounded by areas of sediment and some of the reef surfaces will be subject to long or short term sediment deposition affecting the composition of the wildlife communities present. The amount and nature of the sediment will vary with the prevailing hydrodynamic regime and the origin of the supply of sediment. Some of the communities require the presence of sediment such as those characteristic of scour and biogenic reefs formed by the worm *Sabellaria alveolata* and the related *Sabellaria spinulosa*. The extensive subtidal boulder and bedrock reefs along the north Llŷn coast are surrounded by areas of mixed sediment and isolated rocks, creating a mosaic of different habitat types on the seabed.

The depth range of the reef feature varies throughout the site. Around the Llŷn, reef extends from the shore into water depths greater than 30m. Elsewhere much of the reef is in less than 15m (reefs in Tremadog Bay, the sarnau and carbonate reefs).

The sarnau are glacial moraines and are composed entirely of boulders, cobbles, and pebbles mixed with various grades of sediment. They are surrounded by sediment plains and are exposed to tidal currents and wave action with low-lying parts periodically covered and un-covered by sand. Wave action, particularly during winter storms, mobilises the loose rocky material creating a less stable habitat than other areas of bedrock and boulder reef within the SAC.

Biogenic reefs often have very complex 3-dimensional habitat structure that provides many spaces and micro-habitats for other species to live in, and consequently biogenic reefs often support a high diversity of species. The structure of the biogenic reefs varies depending on the dominant species forming the reef and their interaction with physical forces. The horse mussel reefs are a complex 3-dimensional structure up to a metre high created by the binding of individual mussels and incorporating silt and the waste 'sediment' material produced by the mussels. The horse mussel reef comprises undulating waves on the seabed created by the mussels themselves with most of the live mussels living on the crests of each wave and the troughs comprising empty shells. Samples from the north Llŷn horse mussel reef have shown that some of the individual mussels are over 50 years old but juvenile mussels also appear to be recruiting onto the reef.

The *Musculus discors* reef is formed from dense aggregations of this small mussel attached to rock and gravely sediments. As the reef forms it consolidates the sediment surface by binding it and a thick layer of pseudofaeces together with the byssus threads of the mussels, creating a reef structure that is several centimetres high. This low-lying 3-dimensional matrix provides a habitat particularly for small cryptic species.

The honeycomb worm reefs provide a structure that can be inhabited by other species both within and between the network of worm tubes, or attached to the surface. *Sabellaria* reefs in the SAC have high associated species richness due to the complex structure of the reefs themselves, and the fact that the reef structures stabilise and often forms rock pools in what would otherwise be more mobile and free draining shores. The reefs, which are made of sand grains, rely on the supply of sand via unhindered coastal processes. At the same time, by forming a thick crust over rocky surfaces the *Sabellaria* reefs change the nature of the substratum as well as forming reef structures in their own right.

The carbonate reefs are quite low-lying, with a varied topography across their surface and are surrounded by areas of sediment which are used in the chemical process that forms the reefs, but also influences the reef community through scour, and periodic covering and un-covering of the very low lying parts.

A large proportion of these reef habitats are exposed or moderately exposed to wave action and tidal streams. Particularly strong tidal streams occur in the narrow tidal rapid channel of Bardsey Sound between Bardsey Island and the mainland but there are also some localised areas of more sheltered reef in the lee of headlands and islands and within Tremadog Bay.

The level of suspended particles in the water column affects the amount of light reaching the seabed, this leads to a maximum depth of kelp growth around Pen Llŷn of 10-15m. The animal communities on the reef are dominated by filter feeding animals. Whilst these communities are adapted to living in the concentrations of suspended matter present in the SAC, excessive sediment loading above the normal ambient levels could potentially lead to smothering of habitats and species. The reefs may be exposed to intermittent or regular sediment deposition and removal. Those that are low lying and shallowly sloping areas in the shallow subtidal (such as the sarnau) may be subject to large scale deposition and erosion of sediment over part of the reef.

The reefs support many species for some of their life cycle and food requirements. The role that the reefs play in the ecology of the local and wider marine environment, and the fine detail of the interactions between species is not understood. Some of the reef communities are particularly species rich, such as the horse mussel reef where 23,000 animals in a single square meter of reef have been recorded. Productive areas such as this are believed to play a significant role in the marine food chain, providing an important food source for other creatures, including different species of fish and marine mammals. For example, Risso’s dolphins have been observed feeding in the sea area over the horse mussel reef.

Mobile species play structural and functional roles in the reef systems. The reefs contribute directly or indirectly to the food resource of mammals such as otter, grey seal, bottlenose dolphin, harbour porpoise and Risso’s dolphin as well as sea birds and diving birds, many of which breed on the surrounding coastline and offshore islands.

4.1.3 Typical species

The reefs of the Pen Llŷn a’r Sarnau SAC are extremely varied and support a very wide variety of communities of marine animals and plants reflecting the broad range of physiographic factors around the site such as wave action, tidal streams, variation in sea bed type, scour regimes, water clarity and variation in water depth.

Some species are long lived and part of relatively stable populations often with low levels of recruitment. Other species are subject to much greater fluctuations in their distribution and extent and may show much greater dynamism in their recruitment. There are also some that are rare and/or scarce, at or near their biogeographical limit of distribution that have a key role in the ecology of the reefs and wide ecosystem, and/or are components of diverse and/or abundant species assemblages.

Whilst all the reef communities within the site contribute to the overall representation, range and integrity of the feature within the site, a number of notable reef habitats and their associated assemblages of marine plants and animals are of particular conservation importance.

<u>Rocky intertidal reefs</u>
The intertidal reef communities include lichen-dominated communities at the top of the shore and various seaweed-dominated communities in the upper, middle and lower shores. There are specialised communities in rock pools, under boulders and in rocky gullies. Species rich examples of nationally important kelp and brown seaweed-dominated communities are found in lower shore areas exposed to strong tidal currents.

<u>Rocky subtidal reefs around the Llŷn Peninsula</u>
In general, the shallow water reefs around the Llŷn and Bardsey Island are dominated by dense growths of various kelp communities representing conditions of high, medium and low energy conditions; overall the SAC supports a wide range of kelp communities. In areas with strong tidal flow the under story flora and fauna associated with the kelp tends to be very abundant and species-rich.

An extensive and luxuriant turf of red seaweed species grows amongst and below the kelp and there are seaweed communities with high biomass and species richness that occur on reefs in the northwest of the site. Such extensive and luxuriant growth of algae is possibly attributable to relatively low grazing pressure from the common sea urchin *Echinus esculentus* which is more abundant in other parts of the British Isles, particularly throughout Scotland and the English North Sea coasts. Common sea urchins are rarely seen on the reefs of the SAC.

On the boulder and cobble reefs surrounded by sediment, sugar kelp and other brown seaweeds are more common amongst a varied turf of red seaweeds and invertebrate animal species. These communities are particularly prevalent on the south side of the Llŷn and are more akin to the communities on the sarnau. Below the kelp forests and red seaweed zone the reefs are colonised by animal dominated communities. Some are species rich and unusual within a UK context such as those dominated by assemblages of sponges, hydroids, anthozoans and bryozoan turf around Bardsey Island. Another example is the species-rich reef community comprising dense crusts of sand-grain tubes of the worm *Sabellaria spinulosa* supporting a rich animal turf of ascidians (sea squirts) and sponges on the low-lying reefs on the north side of Pen Llŷn. Territorial fish including various species of wrasse, are often associated these species-rich communities as well as areas of kelp forest.

Reef communities in Bardsey Sound (and to a lesser extent around the other headlands in the SAC) are characterised by communities that include scour-tolerant species. Various scour-tolerant seaweeds are often present as part of these scour-tolerant/characterising communities in shallower areas (such as in parts of Tremadog Bay and on the sarnau).

There is a marked difference in the presence and dominance of particular animal species and assemblages around the Llŷn peninsula. Reefs in Bardsey Sound, for example, are characterised by communities that include scour-tolerant species.

Extensive rocky boulder and cobble subtidal reefs – the Sarnau
Usually the sarnau reefs support dense seaweed beds of opportunistic ephemeral, perennial and annual species that are tolerant of sand cover and scour but there are occasional heavy settlements of mussel (*Mytulis edulis*) seed. Bootlace weed (*Chorda filum*), sugar kelp (*Laminaria saccharina*) and red seaweeds flourish on or near the reef crest. On other parts of the sarnau there are extensive forests of the pod weed (*Halidrys siliquosa*) together with a wide variety of other seaweeds forming a species rich community. Animal-dominated biotopes are found in the deeper parts of the reefs, including crustaceans, cnidarians, sponges, hydroids and encrusting bryozoans. The extensive areas of under-boulder spaces provide a habitat for many small animals (such as small crabs and worms) and it is likely that these form an abundant and important food source for larger animals. Aggregations of bottlenose dolphins and red-throated divers have been recorded feeding around the sarnau reefs.

Biogenic reefs
Horse mussel reefs provide a broad range of sub-habitats and the complex microtopography over the reef supports a high biomass of a wide variety of species living in amongst and on the surfaces of the matrix of the mussel bed. Soft coral, molluscs, echinoderms, sea anemones, crustaceans and fish are some of the more conspicuous examples. Honeycomb worm, or *Sabellaria alveolata* reefs also provide a habitat for other species and those in Cardigan Bay are amongst the best examples of this biogenic reef type in the British Isles. *Musculus discors* reefs support an abundance of infauna and epifauna, with the infauna including polychaete worms, bivalve molluscs, crustaceans and other worms[29].

Carbonate reef structure formed by methane gas leaking from the seabed
The carbonate reefs are heavily pitted and bored by bivalve molluscs and sponges and provide refuges for cryptic animals including anthozoans (anemones, soft corals and related animals), crustaceans, molluscs and fish. There also appears to be an abundant assemblage of mobile species associated with the reef in some years.

4.1.4 Natural processes
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 can fluctuate.

The diversity and type of wildlife communities found on reefs varies according to the nature and type of rock habitat present. It 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 brachiopods. Stronger tidal streams often increase

[29] Hopkinson (2011)

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 the mussels of a horse mussel reef 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.

4.1.5 Modifications as a result of human activities

The reefs of the SAC and their associated communities of marine wildlife are most susceptible to physical damage and abrasion and changes in the quality of the surrounding water and the hydrological processes operating throughout the site. Some of the reef communities are relatively robust and are more likely to be able to re-colonise relatively quickly, but there are other species, such as the horse mussel communities that are much more susceptible to damage and less likely to be able to recolonise and recover once damaged or removed from the reef.

In the intertidal, the most likely influences on the reef communities are from constructions on or along the shore, either directly on the reefs or that alter the hydrodynamic processes supporting the reefs, and from pollution (for example run off from land and discharges). In the subtidal, physical damage to the reefs is possible, for example from fishing activities (direct physical impact as well as smothering from sediment that is resuspended by mobile fishing gear), or impacts as a result of changes in the surrounding water quality due to land or sea-based activities.

The extent and quality of the intertidal reef and shallow subtidal reef in the SAC may have been reduced locally by the construction of coastal structures in the past, but this has generally been restricted in location and scale. Coastal defences are modifying the intertidal reef along parts of the open coast of the SAC by hindering the erosion of boulder clay cliffs and the release of new reef material (boulders, cobbles and pebbles) on to the shore. The coastal defences also affect sediment processes which have an important influence on the reef communities and are particularly important for the maintenance of the honeycomb worm reefs. In the longer term, coastal defences prevent the natural coastal processes operating and this can result in lowering of beach levels and changes in the degree of wave exposure of parts of the coast. There are a number of places within the SAC where this is a concern[30].

[30] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)

Trampling by people walking over the intertidal reefs can be a problem if it is sustained over a period of time. The honeycomb worm reefs are particularly susceptible to trampling because the reef structure is made of sand grains and is fragile. There may be a few localised areas in the SAC where trampling is having an effect on the quality of the intertidal reef communities but currently this is considered to be limited in extent.

The distribution and extent of the majority of the subtidal reef is not known to have been reduced by human action. The likely exception to this is the horse mussel reef. Horse mussel beds have been lost from, or significantly reduced in size in other areas due to the impact of activities that have damaged or removed the reef (e.g. trawled bottom fishing gear). The horse mussel reef was recorded in the same location 40 years ago and has probably persisted there for over 150 years. No written records are known to refer to it before this, but it is likely to have existed for much longer because horse mussels are slow growing and the reef takes many, many years to form. Whilst earlier samples confirm the presence of horse mussels and reef in the area where it exists today, it is not known how large the horse mussel reef used to be. Extensive areas of dense horse mussel shell is present over areas of seabed surrounding the reef and wider, and it is possible that the reef used to be more extensive.

The overall depth range of reef is assumed unmodified by human action and there is no known evidence for modification of subtidal reef surface microtopography as a result of human activity, other than as part of gross modification of reef in localized areas. However, use of heavy mobile fishing gear (e.g. trawls and dredges) is known to alter the topography of reef structures. There have been recorded illegal incursions by towed fishing gears into the area closed to scallop dredging and these have caused damage that is likely either to take many years to recover, or to be permanent[31].

Minor temporary modification of suspended particulate concentrations can occur in the SAC due to local or distant activities mobilising or influencing sediment transport (such as coast protection and construction activities, harbour/marina dredging) and/or inputting of sediment into the open coast and watercourses draining into the SAC (e.g. increased land runoff as a consequence of deforestation and modern farming practices). Increased sedimentation in the water will reduce the amount of light reaching the seabed (increased turbidity) and can affect the growth of seaweeds.

Local reductions in salinity occur in the vicinity of freshwater run-off and streams crossing areas of intertidal reef increases corresponding local habitat and species diversity. There is potential for modification by watercourse diversion, abstraction and engineering.

The concentrations of major nutrients and contaminants within the coastal and open sea areas of the SAC are not believed to be above levels that would be of concern for the reefs at present. Further information on water quality can be found on the water watch Wales website[32].

The degree to which reef species populations may have been modified or degraded by human activity is difficult to assess. Species subject to commercial exploitation may be

[31] Roberts *et al*. (2011)
[32] http://waterwatchwales.naturalresourceswales.gov.uk/en/. The relevant waterbodies for Pen Llyn a'r Sarnau are Cardigan Bay north, Tremadog Bay and Caernarfon Bay south.

depleted well below historical pre-exploitation levels – this is thought to be the case for crayfish in the SAC which had a heavy commercial diving fishery in the 1970s-1980s. In terms of the other species that are fished on a commercial and recreational basis there is no specific stock data. Scientific evidence suggests that aspects of ecosystem functioning may be modified or adapted as a consequence of excessive removal of key mobile species, however, the magnitude of such modification is both unknown and, in the absence of pre-exploitation data, unquantifiable.

Discarded and lost artificial materials are present throughout the reef habitat, the scale of this in the SAC is considered to be relatively low. Lost and discarded fishing gear and persistent rubbish continues to form a physical hazard to many species and some are a source of chemical contamination. Modern synthetic fishing gears are capable of 'ghost fishing' both commercial and non-commercial species for prolonged periods. Overall habitat quality of the Pen Llŷn a'r Sarnau SAC reefs is considered to be high.

4.2 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.

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:

- Intertidal mudflats
- Intertidal Underboulder Communities
- Mud habitats in deep water
- Mussel beds
- Peat and clay exposures
- *Sabellaria alveolata* reef
- Seagrass beds
- Seapens and burrowing megafauna
- Sheltered muddy gravels
- Subtidal mixed muddy sediments
- *Anotrichium barbatum*
- *Arctica islandica*
- *Cruoria cruoriaeformis*

- *Dermocorynus montagnei*
- *Ostrea edulis*
- *Phymatolithon calcareum*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.2.1 Range

The large shallow inlet and bay feature of the SAC is the embayment known as Tremadog Bay at the northern end of Cardigan Bay. The feature is referred to either as 'Tremadog Bay' or as 'the bay', or 'bay feature' in this document.

The bay feature extends from Trwyn yr Wylfa in the northwest, to the western tip of Sarn Badrig reef, and northeast to Morfa Dyffryn. It is delineated by part of the south Pen Llŷn coast from Porthmadog to Cilan Head in the north, the Meirionnydd coast at Harlech and Mochras in the east and Sarn Badrig reef in the south and covers approximately 41,570 ha.

4.2.2 Structure and function

The Cardigan Bay basin is aligned NE-SW, following the trend of the Caledonian lines of structural weakness. The basin formed over a long period of time by subsidence of the surface crust and infilling by sediment eroded off the adjacent basement rocks. The seabed and seashore sediments are largely derived from the glacial till (material collected and moved by the action of glaciers) deposited by the Irish Sea and Welsh ice sheets. This was reworked as sea levels rose at the end of the last ice age and this process continues to the present day. In the outer parts of Cardigan Bay the bulk of the seabed sediments are gravely, whereas closer to the coast finer sediments, moved by tidal currents, have accumulated forming thicker sands and areas of accumulated mud.

The seabed and seashore of Tremadog Bay is made up of a high diversity of different sediment types with a wide variation in degree of sorting, each of which supports specific assemblages of animals and plants. The bay acts as a sink for finer sand and mud that is washed in through the action of tidal currents from further offshore in the Irish Sea. Some material is also derived from the local boulder clay cliffs and sediments around the bay.

Some of the sediments in Tremadog Bay are unusual in the context of the inshore areas around Wales in that there are areas of mixed muddy and sandy sediments (particularly in the northwest of the bay) with a high proportion of gravel and pebbles that appear to be relatively consolidated and undisturbed from surface impact. These poorly sorted sediments provide a complex habitat that supports assemblages of animals and plants attached to the larger sediment and stones on the surface and an animals living within the sediment.

The general overall pattern of seabed sediments in Tremadog Bay is;

- moderately well sorted finer and muddier sands in the north eastern and central western
- well-sorted soft muddier sediments in deeper areas (such as the area in the western part of the bay marked as 'muddy hollow' on Admiralty Charts of the area, and in an area to the southeast of Pwllheli)

- well sorted fine and medium sands along the southern part of the bay (along the north side of Sarn Badrig);
- poorly sorted sandy and muddy gravel sediments with cobbles and pebbles over an extensive area in the northwest part of the bay.

Within this overall distribution of different sediment types there are patches of more gravely, poorly sorted sediments and well sorted medium sand as well as areas of bedrock and patches of boulder, cobble and pebble reef (particularly in the northern half of the bay).

The structure of the intertidal habitats is also varied and comprises:

- areas of bedrock around the main headlands of the bay in the north
- mixed sediment shores of boulder and cobble reef with sand and gravel, which in places support biogenic reefs formed by the honeycomb worm *Sabellaria alveolata* (particularly between Pen-y-Chain and Criccieth along the north coast of the bay and at Shell Island);
- muddy sand and gravel (notably at Llanbedrog and to the east of Carreg y Defaid);
- shingle and sand (along the north and east coasts of the bay);
- outcrops of red and grey clay and peat;
- precipitative reef structures (notably at Llanbedrog and southeast of Carreg y Defaid).

Tremadog Bay is a relatively shallow embayment less than 20m deep over much of its area. The shallow areas around the north, east and southern parts of the bay where water depth is less than 10m grade into a deeper central section. The deepest areas of the bay area between 20-30m and are at its western end in the area marked ‘Muddy Hollow’, and to the southeast of Trwyn Cilan and Trwyn-yr-Wylfa.

A large proportion of the shore and seabed of the bay comprises sediment habitat, including soft mud, muddy sand, sandy and muddy gravel sediment, fine, medium and coarse sand, shingle, clay and peat. There are also areas of reef throughout the bay in both the intertidal and subtidal comprising areas of bedrock (mainly around headlands and the St Tudwal’s Islands), boulder, cobble and pebble and biogenic reef structures.

Tremadog Bay is relatively exposed to wind and wave action. Tidal currents within the bay are weak compared to other parts of Cardigan Bay and the Irish Sea. The most tide swept areas are around headlands and the St. Tudwal’s Islands. Elsewhere, apart from localised modifications, average current flows are less than 0.5 m/sec. The deeper parts of Tremadog Bay are deposition areas collecting fine sediments, whilst in the shallow near shore areas there can be considerable onshore and offshore sediment movement, particularly during stormy weather. The tidal range within Cardigan Bay is fairly uniform and is in the range of 2-4m. Tremadog Bay is something of a warm-water summer ‘enclave’ within Cardigan Bay and this in part results in this area supporting an unusual assemblage of plants and animals.

Water clarity in the SAC can be high, although within Tremadog Bay the shallower conditions and greater proportion of seabed and coastal sediments means that sediments in this part of the SAC are re-suspended more easily in rough weather.

Tremadog Bay acts as a sink for finer sand and mud that is washed in through the action of tidal currents from further offshore in the Irish Sea. Within the southern part of Cardigan Bay from St David's Head to the Glaslyn estuary accretion of sediment along this coastline is supplied largely by the erosion of the glacial till cliffs in the southern part of Cardigan Bay. Within the intertidal areas, the adjacent till cliffs supply material to the beach where there is a reworking and transport of sediments to and from the adjacent nearshore areas. This includes material forming the boulder, cobble and pebble reef habitat in Tremadog Bay. Whilst some sediment is derived from the local boulder clay cliffs and sediments around the bay, the specific locations and extents of the sources are not known.

Tremadog Bay contains a variety of habitats that support many different plant and animal species some of which are commercially important to fisheries within the SAC (such as lobster, crab and prawns). The wildlife communities of the bay, particularly those within the sediment habitat are a productive and important food resource for other species. We do not fully understand the role that the bay plays in the ecology of the local and wider marine environment, nor the fine detail of the interactions between species. Observations and records from fishermen, biologists and others indicate that the bay provides a nursery area for juvenile lobster, with the muddy gravel seabed in the northwest of the bay being the main area where these have been recorded. Other parts are believed to act as nursery areas for juvenile fish and may also provide breeding areas for rays.

4.2.3 Typical species

Tremadog Bay contains a wide variety of seabed and seashore habitats that support varied assemblages of animals and plants. A number of notable bay habitats and their associated assemblages of marine plants and animals are of particular conservation importance.

The typical species of the bay include those that are rare and scarce, at or near their biogeographical limit of distribution, those that have a key role in the ecology of the bay and wider ecosystem, and those that are components of diverse and/or abundant species assemblages. Some are long lived and part of relatively stable populations often with low levels of recruitment, whilst others are subject to much greater fluctuations in their distribution and extent and may show much greater dynamism in their recruitment. Several of the bay communities are considered to be relatively stable and unmodified in terms of their physical structure and support diverse, rich and unusual species assemblages. It is not expected that these communities or the inherent nature of their species assemblages would vary greatly over time unless impacted by human activity.

Tremadog Bay is one of two areas in the UK where seasonal concentrations of leatherback turtles (*Dermochelys coriacea*) have been recorded. Their presence here has been linked to the seasonal consistent occurrence of aggregations of barrel jellyfish (*Rhizostoma pulmo*).

<u>Subtidal sediment communities</u>

The sediment communities of the bay support a rich and diverse assemblage of invertebrate species. The diverse infaunal communities are composed of representatives from most of the marine invertebrate phyla, including marine polychaete worms and other marine worms, amphipods, isopods, crabs, molluscs, and echinoderms.

The moderately well sorted finer and muddier sands in the north eastern and central western part of the bay support communities characterised by the bean-like tellin *Fabulina fabula* and the polychaete worm *Magelona spp*, with venerid bivalves (such as the striped venus *Chamelea gallina*) and amphipods. Occurring close to this community in fine sand close inshore in the northeast of the bay is a sediment community dominated by bivalve molluscs such as *Macomangulus tenuis* and polychaetes. North of the estuary mouth near Criccieth and further west at Afon Wen, finer more sheltered sand is colonised by seagrass beds (*Zostera marina*) that extends from the shallow subtidal into the lower shore areas.

Well-sorted soft muddier sediments in deeper areas (such as the area marked as 'muddy hollow' on Admiralty Charts of the area, and in an area to the southeast of Pwllheli) support different communities depending on the proportions of muddy and coarser sediment present. Deeper offshore mud and sandy mud supports an infaunal community characterised by polychaete worms, such as *Levinsenis gracilis* and *Heteromastus filiformis*. Extensive areas of sandy mud in the central and northern inshore areas of the bay support a diverse infaunal community characterised by super-abundant burrowing brittlestars (*Amphiura filiformis*) and small bivalves (*Kurtiella bidentata* and *Abra nitida*) together with different species of worms (polychaetes, sipunculids and cirratulids) as well as sea potatoes (echinoderms) and crustaceans (burrowing mud shrimp and *Eudorella truncata*). Data indicates that rich and diverse assemblages of infauna occur as part of this community; up to 80 species per 0.1 m^2 and over 1,500 individual animals per 0.1 m^2 have been recorded at some locations. Muddy sands to the south of this community are characterised by bivalve molluscs *Kurtiella bidentata* and *Thyasira* spp. This is the similar community to that occurring in the mixed sediments in the northwest of the bay and it supports diverse and abundant infauna - between 40-80 species per 0.1m^2 and abundance of animals between 500-1,500 per 0.1m^2 have been recorded in such areas.

Well sorted fine and medium sands along the southern part of the bay (to the north of Sarn Badrig) are characterised by polychaete worms (in particular *Nephtys cirrosa*) and amphipods (e.g. *Bathyporeia* spp.). This community is typical of sediment subjected to greater physical disturbance, primarily from wave action, than the other sediment habitats of the bay. Sand eels may sometimes be observed in this sediment type.

Poorly sorted sandy and muddy gravel sediments with cobbles and pebbles cover an extensive area in the northwest part of the bay. This habitat supports a rich community of burrowing infauna characterised by bivalve molluscs *Kurtiella bidentata* and *Thyasira* spp. with polychaete worms, small crustaceans and echinoderms, as well as attached epifauna and epiflora. The species diversity of this infaunal community is very high in places with samples recording over 80 species per 0.1 m^2 at some locations. The gravel, shell remains and pebbles and cobbles associated with this sediment habitat also allow a variety of plants and animals (such as sea squirts, sponges, hydroids and bryozoans) to grow attached to the sediment surface, increasing the overall species diversity of this community. Many mobile species such as small fish and crustaceans are present in this habitat. Several of the more unusual species in the bay are associated with this mixed sediment habitat, this includes various species of red seaweed, including individual nodules of maerl *Phymatolithon calcareum*, and the mantis shrimp *Rissoides desmaresti*. Close to this community in medium to coarse gravely sand close to the St Tudwal's Islands is a community dominated by bivalve molluscs (*Moerella* sp. and venerid bivalves) with low numbers of polychaetes and other invertebrates.

Subtidal rocky communities
Bedrock reef around the St. Tudwal's Islands and headlands along the mainland coast together with boulder, cobble, and pebble patch reefs within the bay support communities of kelp and mixed red and brown seaweeds. Animal communities are dominated by filter feeders such as sea firs (hydroids) and sea mats (bryozoans) with sponges, ascidians (sea squirts) and a variety of other sessile and mobile animals. Development of the animal-dominated communities is greatest in deeper water below the kelp and red seaweed zones, and in areas of increased current flow. On the boulder and cobble reefs in shallow water the upper surfaces of the rocks are generally colonized by mixed red and brown seaweeds, whilst the sides of the rock are colonized by a short turf of varied animal species. In areas of mixed sediment with cobbles and pebbles, such as the shallow water between the St Tudwal's Islands and across Oyster Bank in the north of the bay, the cobbles and pebbles support various seaweed species that can tolerate sand scour. The reefs support a variety of mobile species including commercially important crustaceans (such as lobster and crab) and contribute to the role of the bay as a breeding and nursery habitat by providing shelter in underboulder spaces and rocky crevices. Wrasse and dogfish are known to breed on the reefs.

Intertidal communities
Much of the intertidal around the bay is composed of sandy or mixed sediment with rocky areas at a few locations, such as the headlands at Porth Ceiriad, Pen-y-Chain and the St Tudwal's Islands. Mixed sediment shores of sand, gravel, cobbles and boulders that predominate between Pen-y-Chain and Criccieth and at Shell Island, support extensive beds of seaweed, honeycomb worm reefs (built and inhabited by the worm *Sabellaria alveolata*) and rockpools. In contrast there is a muddy sand and gravel area at Llanbedrog and to the east of Carreg y Defaid that supports an unusual and diverse community of carpet shells and other species and there are patchy exposures of red and grey clay that have been colonised by piddocks (an unusual shellfish that can bore into and live in soft rock, clay and peat). At Llanbedrog beach there are also boulder overhangs that support rich assemblages of animal species including sponges, sea squirts and bryozoans. The lower shore at Llanbedrog and to the east of Carreg y Defaid also has unusual precipitative reef structures called beachrock[33]. While these do not appear to support a particularly distinctive assemblage of species they are an unusual geological feature of the lower shore and shallow subtidal areas in this part of the bay. To the east from Carreg y Defaid the steep gravel beach in front of the sand dunes at Pwllheli supports the nationally rare amphipod shrimp *Echinogammarus incertae sedis planicrurus*.

Exposed sand at the mouth of the Glaslyn at Morfa Harlech and Morfa Bychan supports mainly amphipod shrimps and isopods. North of the estuary mouth near Criccieth and further west at Afon Wen, finer more sheltered sand is colonised by seagrass beds (*Zostera marina*) that extends from the shallow subtidal into the lower shore areas.

4.2.4 Natural processes
The distribution, extent and shape of inlets and bays is a reflection of the underlying geology, with some structures of resistant rock, areas of rock amenable to erosion and zones of geological weakness. Sediment shores and submerged sediment plains are much more dynamic features subject to natural change influenced by factors such as tidal flow, tidal range, currents, weather conditions and aspect.

[33] Beachrocks are hard coastal sedimentary formations consisting of various beach sediments, lithified through the precipitation of carbonate cements'. http://www.sciencedirect.com/science/article/pii/S0012825207000955

Shallow inlets and bays are sedimentologically linked with the two couplets of mudflat and saltmarsh, and beach/sandflat and dunes. There is generally an exchange of sediments between these dynamic environments by way of bi-directional sediment transport pathways.

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.

4.2.5 Modifications as a result of human activities

Some of the main influences from human activities on the large shallow inlet and bay have occurred along the coastal area, primarily as a result of construction of hard structures such as shore defences, retaining walls and slipways. Quite a large proportion of the coastline of the bay has been affected by these modifications. Coastal construction, in particular coastal defence, has modified the bay communities through direct impact, and also through modifying coastal processes (hindering release of rocks and sediments from boulder clay cliffs, affecting sediment processes, altering the nature of the beach sediments and preventing natural evolution of the coastline in the longer-term (see also section 4.1.5)).

The gross structure, bathymetry, distribution and extent of the bay are not known to have been modified by human action. Tidal range and exposure to currents and wave action in the bay is predominantly unmodified by human actions except for localised influences in the vicinity of built structures.

It is believed that there has been relatively little modification of the overall sedimentology of the bay, and the seabed is considered to be relatively unimpacted by human activities. This is believed to be one of the main reasons why the area supports unusually species diverse and species-rich seabed communities, including rarely recorded plant and animal species. Past and present use of mobile fishing gear is probably the main human activity that has occurred in the bay that would impact the nature of the seabed sediments although there is only very limited mobile fishing gear currently used within the bay.

Trampling by people walking over some of the intertidal bay communities can be a problem if it is sustained over a period of time. There is impact from vehicles at Morfa Bychan (Black Rock Sands) which results in compaction of the intertidal sediment communities – this impact is greatest in the peak holiday season. There is periodic use of vehicles on other intertidal areas of the bay, generally associated with coastal defence works. Careful planning of these works is required to avoid any potential impact on the bay communities. Historically there have been instances of farmers dragging land ploughs through areas of intertidal sediment in the SAC to clean the plough blades.

Modification of suspended particulate concentrations is complex and influenced by several human activities (e.g. construction activities, dredging and land management practices). These are predominantly relevant to the near coast areas of the bay. There are local reductions in salinity in the vicinity of freshwater run-off and streams crossing areas of intertidal bay, leading to variations in the local habitat and species diversity. There is potential for modification by watercourse diversion, abstraction and engineering.

The concentrations of major nutrients and contaminants within the coastal and open sea areas of the SAC are not believed to be above levels that would be of concern for the bay, but more information about the specific levels is required. Further information on water quality can be found on the water watch Wales website[34].

The degree to which bay species populations may have been modified or degraded by human activity is difficult to assess in any quantifiable way. Species subject to commercial and recreational exploitation may be depleted well below historical pre-exploitation levels; this is known to be the case for some species such as oysters and some elasmobranch species such as skates, rays and angel sharks (*Squatina squatina*). For most of these species there is very little stock data and so the scale of modification to the functioning of the bay ecosystems as a result of removal of these species is unknown and unquantifiable.

Overall habitat quality of the Pen Llŷn a'r Sarnau SAC bay is considered to be high. Discarded and accidentally misplaced artificial materials are present in the bay and are most obvious in the intertidal. Generally the scale of this in the bay is considered to be relatively low, although high in certain areas (e.g. to the east of Criccieth). Lost and discarded fishing gear and persistent rubbish continues to form a physical hazard to many species and some are a source of chemical contamination.

4.3 Sandbanks which are slightly covered by seawater 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'.

[34] http://waterwatchwales.naturalresourceswales.gov.uk/en/. The relevant waterbodies for Pen Llŷn a'r Sarnau are Cardigan Bay north, Tremadog Bay and Caernarfon Bay south.

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;
- 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 Pen Llŷn a'r Sarnau SAC are in the sandbank sub-type 'gravely and clean sands'.

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:

- Subtidal mixed muddy sediments (low confidence)
- *Arctica islandica*
- *Pleuronectes platessa*
- *Raja montagui*
- *Solea solea*

4.3.1 Range

The subtidal sandbanks of Pen Llŷn a'r Sarnau SAC are the Tripods sandbank to the west of Braich Anelog, Bastram Shoal to the south of Bardsey Island and Devil's Ridge to the south east of Aberdaron Bay and also an area west of Barmouth, marked on charts as Four-fathom bank. The general location of the subtidal sandbanks is shown on the feature map[35]. The total extent of the subtidal sandbank feature in the SAC is estimated to be around 12,650 ha which includes: Tripods; Bastram Shoal; Devil's Ridge and Four-fathom bank.

4.3.2 Structure and function

The existence of the subtidal sandbanks, their shape, size, and orientation, are predominantly the result of a combination of interactions between sediment supplies and hydrodynamic processes (tidal streams, water depth, wave action) operating since the end of the last ice age.

The Tripods is a linear sandbank, orientated in a north-south direction. At its base, the sandbank extends into waters around 25-30m and the shallowest part is around 10m. Bastram Shoal is more rounded in shape, and runs northwest-southeast in water depths of 6-30m Devil's Ridge is also relatively rounded in shape, and also runs northwest-southeast with a depth range of 8-25m. Four-fathom bank consists of a raised area, with two tails

[35] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

extending seaward, parallel to Sarn Badrig. The depth of this sandbank ranges from 6-15m.

Sandbanks exposed to stronger tidal and wave action like the Tripods are composed predominantly of coarser sediment compared to those in more sheltered conditions, such as Four-fathom bank. The sediments are mostly medium sands although the landward side of the Devil's Ridge sandbank and seaward side of Bastram Shoal have coarser sediments with a higher proportion of gravel. Four-fathom bank comprises fine sands.

The site includes examples of subtidal sandbanks subject to a range of exposures to prevailing winds, weather and tidal currents. On Devil's Ridge, Bastram Shoal and the Tripods strong tides mean that the sand, shell and gravel sediments are constantly shifting and, as a result, the sandbanks support animals that can tolerate these high levels of disturbance. The more mobile sediments on the upper parts of the sandbanks have relatively species poor communities whilst less mobile and more mixed sediments at the base of the sandbanks support more stable species-rich wildlife communities.

4.3.3 Typical species

The diversity and types of wildlife associated with subtidal sandbanks are determined particularly by the type of sediment together with a variety of other physical, chemical and hydrographic factors. They include burrowing animals such as worms, crustaceans, molluscs and echinoderms that live within the sandbank sediments and more mobile species such as shrimps, molluscs, crabs and fish that live closer to and on the surface.

Within the context of the Welsh SAC series relatively species rich communities have been recorded from the base of Tripods, Bastram Shoal and Devil's Ridge sandbanks. The finer sands of the less-exposed Four-fathom bank support different communities of echinoderms, molluscs, worms and crustaceans.

The millions of tiny microscopic animals that live in the small spaces between the sand grains are also part of the sandbank wildlife and are important in terms of the overall productivity of these sediment communities. Other animal species that live on or just underneath the sediment surface are part of a more mobile assemblage of wildlife. Where there are large stones in the sediment other animals such as hydroids may attach themselves to the surface of the sandbank. Subtidal sandbanks can be important nursery areas for fish, and feeding grounds for seabirds.

4.3.4 Natural processes

Subtidal sandbanks are dynamic features with their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics 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 but their location may change.

4.3.5 Modifications as a result of human activity

There is no known evidence that the gross distribution or extent of subtidal sandbanks within the site, their size or morphology, nor the wave climate, tidal streams or sediment processes creating and maintaining them have been directly modified by human action.

There is no history of sediment extraction from the subtidal sandbanks of the SAC nor disposal of sediment at or nearby the subtidal sandbanks and there are currently no known major impediments to the dynamic factors (physical, chemical and biological) that determine and maintain the sandbanks and their inherent variability. Modification of wave action as a result of anthropogenically-influenced climate change is considered likely to increase.

The degree of exploitation of fish populations associated with the sandbank in terms of its impact on their abundance and biomass is unknown.

There is however the potential for impacts on the subtidal sandbanks from activities that would directly impact them and the wildlife species that are associated with them, or which affect the nature and distribution of the sediment forming the sandbanks.

4.4 Estuaries

Estuaries are defined in the EU Habitats Interpretation Manual as:

“Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal mud and sand-flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.”

“An estuary forms an ecological unit with the surrounding terrestrial coastal habitat types”

There are four major types of estuary recognised within the EC definition:

1. Coastal plain estuaries: formed where pre-existing valleys were flooded at the end of the last glaciation and usually less than 30 m deep, with a large width-to-depth ratio. The main sub-type of estuary, by area, in the UK.

2. Bar-built estuaries: characteristically have a sediment bar across their mouth and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.

3. Complex estuaries: formed by a variety of physical influences, such as glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this sub-type of estuary in the UK.

4. Ria estuaries: drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by freshwater and typically conform to Annex I type ‘large shallow inlets and bays’.

The estuaries of the Pen Llŷn a’r Sarnau SAC are bar-built estuaries.

Estuaries are widespread throughout the Atlantic coasts of Europe, but approximately one quarter of the area of estuaries in north-western Europe occur in the UK.

There are habitats 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
- Mussel beds

4.4.1 Range

The estuary feature of the SAC comprises the three main bar-built estuaries situated along the Meirionnydd and Ceredigion coasts; the Glaslyn/Dwyryd estuary, the Mawddach estuary and the Dyfi estuary. Collectively they comprise about 2% of the UK's estuary resource. The location of the estuaries is shown on the feature map[36] . The boundary of the estuary feature also encompasses adjacent functional areas of sediment, such as sand dunes, that are considered to be an integral part of the functioning of the estuaries.

4.4.2 Structure and Function

The estuaries of the SAC are good examples of bar-built estuaries and exhibit an unusual and specific suite of physical and chemical conditions.

Sediment movement is a core process within each estuary with constant interchange and movement of sediment within the estuary and between the estuary and coastal and marine areas. Associated with each estuary is a sediment spit that extends from the south across the estuary mouth and an ebb tide delta (the 'delta' of sediment banks that forms just offshore from the estuary mouth). The sediments in the estuaries are derived primarily from marine sediments carried in by seawater. They are predominantly sandy and relatively mobile and have built up to a relatively high platform so that the majority (80-90%) of each estuary dries at low tide, with only the main channel continuing to hold water. Across each estuary the average tidal range is probably around half of the quoted tidal range (which refers to the range at a specific point) as a result of the high level of the sediments. There is very little input of fine material into the estuaries via seawater or freshwater and as a consequence the expanses of estuarine sediment are dominated by coarser, sandier sediments. This is in contrast to many other estuaries in the UK (for example along the east coast of England) that have large expanses of muddy sediments. Even the muddy sediments of the Pen Llŷn a'r Sarnau SAC estuaries contain a relatively high proportion of coarser sediment.

The subtidal and intertidal sediments grade from clean sands near the entrance of the estuaries to mud or muddy sands in the sheltered extremes, particularly in association with salt marsh communities. Although the entrance of each estuary is exposed to prevailing winds, the bar at the mouth provides protection from wave action. All three estuaries are predominantly sandy-sandy/mud. Unusually for estuaries, there is also quite a lot of rocky habitat in each estuary. This occurs primarily as a thin band around the shore. Sediment movement within the estuaries and between the estuaries and Cardigan Bay and coastal habitats is vital if the estuaries are to be able to establish and maintain a dynamic equilibrium state.

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[36] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

The estuaries are located within mountainous, rocky catchment areas with only a thin layer of soil covering the surrounding land and relatively little in the way of discharges (industrial in particular) into the rivers and estuary. This provides a specific type of water flow profile (flood hydrograph) within each estuary and has a significant effect on the water and sediment chemistry, with little stratification of fresh and saline water.

The relatively low level of water retention by the catchment also means that the freshwater flow in the estuary can be very low during dry periods, raising an issue about possible concerns over water abstraction upstream and the potential impact of this on minimum water flows during dry periods.

The mountainous, rocky catchments result in rapid runoff of freshwater at times of high rainfall and a correspondingly large input of freshwater into the estuaries at these times in the form of rapidly flowing pulses of freshwater.

The mountainous catchments with little soil cover and the limited input of nutrients from industry mean that the background level of nutrients within each estuary is low, particularly in comparison to other estuarine systems such as on the east coast of the UK where more nutrient enriched catchments drain into the estuaries. However, this low background level of nutrients is likely to have been enriched from a lower background level in past times as a result of increases in the background levels of nitrous oxides and ammonia from sources such as atmospheric deposition on the surrounding land and increases in stocking levels, particularly of sheep, in the catchments.

The Dyfi is the most extensive of the three estuaries and exhibits a number of differences when compared to the other two estuaries. It has more muddy sediment habitat in its upper reaches than the Mawddach and Glaslyn/Dwyryd estuaries and slightly higher background nutrients levels as a result of a higher input of riverine sediment due to the larger river flow in the Dyfi and also as a result of the less mountainous catchment to this estuary which provides a greater opportunity for sediment (and nutrient) input.

4.4.3 Typical species

Similar marine communities have been recorded within each estuary, but there are also notable differences for example because of the different proportions of muddy and coarse sand, the extent of hard rock and the mobility of the sediment.

The more mobile sand in the mid and lower shores is characterised by small burrowing crustacea (amphipods and isopods such as *Eurydice pulchra*). In some areas the sand is very soft and aerated, supporting only burrowing amphipods and occasional bivalve molluscs. In the Mawddach and Glaslyn/Dwyryd mobile sand with the amphipods *Bathyporea* sp. and *Haustoriuous arenarius* characterises the more exposed mobile sand in the lower shore nearer the entrance to the estuary. Where there is less water movement (for example on the outside of meanders and 'blind' channels), well sorted fine sand with burrowing errant polychaete worms and the thin tellin shell *Macomangulus tenuis* occurs. Muddy sand in the mid shore of the estuaries is dominated by the lugworm (*Arenicola marina*) and bivalves such as the cockle *Cerastoderma edule*, the Baltic tellin *Limecola balthica*, the sand gaper *Mya arenaria* and the thin tellin *Angulus tenuis*. Patches of muddy gravel in areas of increased water movement, for example on the outside of meanders, may be characterised by polychaetes and some oligochaetes. Clumps of the edible mussel *Mytilus edulis* have also been recorded from the mid shore on fine mud in both the

Mawddach and the Dwyryd. Within the mobile sand of the estuary, communities of the amphipods *Bathyporea* sp. and *Corophium* sp. are common, whilst in the upper reaches of the estuaries, oligochaete worms are the main species present in the lower shore muddy sand and gravel habitats.

The thin band of intertidal rock which is most extensive in the Mawddach is dominated by yellow and grey lichens and the tar lichen *Verrucaria maura* at higher elevations with fucoid seaweeds (*Pelvetia canaliculata*, *Fucus* spp. and *Ascophyllum nodosum*) lower down. The brown seaweed *Fucus ceranoides* is also present, reflecting the reduced salinity of the estuaries. Lower shore rocky biotopes are not present due to the influence of the sand level. Large dense clumps of the edible mussel *Mytilus edulis* do, however, occur in the lower shore on rocky outcrops in the Mawddach and the Dwyryd.

Saltmarsh is present along the margins of each of the estuaries. Mature saltmarsh dominates the top of the shore while pioneer saltmarsh (*Salicornia* sp. and *Spartina* spp.) grows at the seaward edge. The extent of the saltmarsh varies within each estuary, and is greatest in the Dyfi where there are relatively large expanses of mature saltmarsh. Many of the channels within the saltmarsh, often in the lower and middle reaches of each estuary, are dominated by the polychaete worm *Hediste diversicolor* and the peppery furrow shell *Scrobicularia plana*. In the steep muddy banks adjacent to the saltmarsh a community made up of sparse polychaete and oligochaete worms and the amphipod *Corophium* sp. is often found. The estuaries are also well known for their unusual saltmarsh dwelling algae including *Bostrychia scorpioides* and the free-living *Fucus vesiculosus* and *Pelvetia canaliculata* ecotypes[37]. The Dyfi saltmarshes are notable for the variety and quality of their invertebrate fauna. Characteristic ground beetles such as *Bembidion laterale*, *B. minimum* and *B. iricolor* are present and the scarce scarabaeid *Aphodius plagiatus* is frequent amongst strandline debris. In addition, Roesel's bush-cricket occurs on the upper saltmarsh of the Dyfi, its only location in Wales.

Mobile animal species that form part of the estuary feature include crustaceans, such as crabs and shrimps, and many fish species (thirty species of fish have been recorded from the Dyfi estuary). The estuaries, in particular the saltmarsh creeks, form important nursery areas for different fish species; the three estuaries have been designated as nursery areas for bass *Dicentrarchus labrax*, and the Dyfi is also an important nursery area for mullet. The estuaries also act as essential migratory routes for salmon and sea trout as they make their transitions between fresh and salt water conditions.

The abundance of food provided by the sediment communities supports assemblages of different bird species that feed in and are dependent on the estuaries. The Glaslyn/Dwyryd estuary is nationally important for pintail and the Dyfi estuary is of international importance for its over-wintering population of Greenland white-fronted geese and supports a nationally important population of wigeon. Other species recorded from the estuaries include shelduck, red breasted merganser, teal, dunlin, redshank, oystercatcher and curlew.

The productivity of the estuaries is also important for two of the species features of the site, the otter and bottlenose dolphin. The estuaries are an important habitat for otters, providing food and access to freshwater. They also appear to be important for bottlenose

[37] Brazier *et al*. (2007)

dolphins with observations that these marine mammals frequent the areas just offshore of the estuary mouths, apparently engaged in feeding.

4.4.4 Natural processes

The structure of estuaries is largely determined by geomorphological and hydrographic factors, with the original shaping forces having their beginnings in the geological origins of the adjacent land areas and the influence of major geological events such as ice ages and periods of higher and lower sea levels. The shape of the estuaries, their macro- and micro-topography, and bathymetry, are important components of the character of the habitats and influences the distribution and abundance of marine life, i.e. the features' typical species. It is both determined by, and influences, natural environmental processes and consequently, can be impacted either directly or indirectly (through changes to natural processes) by man.

Estuaries are complex dynamic systems that have a natural tendency to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by sub- and intertidal sediment banks. The width and depth of the estuary will therefore change over time towards a state of dynamic equilibrium or "most probable state".

The velocities of currents passing through the mouth are determined partly by the tidal range and partly by the cross sectional area of the mouth itself. If these velocities are higher than the sediment erosion threshold, erosion will widen the channel and lower velocities will ensue. If velocities are lower than the sediment depositional threshold, deposition will narrow the mouth and higher velocities will ensue. In this way, an equilibrium cross section will evolve which balances tidal prism, velocities and erosion/ depositional thresholds. Sea level rise means that estuaries will show a natural tendency to translate inland (roll-over) and may erode at the mouth. Where changes in extent are attributable to the estuary adjusting to equilibrium, then the feature should be determined favourable. Where this process is constrained by hard sea defence, this would be considered coastal squeeze.

A complex pattern and combination of physical, chemical and biological conditions and processes operates within estuaries, with many parameters varying temporally and spatially. These parameters establish the baseline conditions in the estuary and continually shape the estuaries and the habitats and wildlife they support. The key parameters are: the flood hydrograph; the nature of the catchment and its influence on freshwater flow and nutrient and sediment input; the nature of the estuary sediment; and the relatively high sediment levels in the estuaries resulting in low water retention within the estuary system and exposure of significant proportions of sediment at low tide. The biological communities of the estuaries have developed in response to these prevailing conditions and the daily patterns of water flow, exposure, sediment movement and water chemistry.

4.4.5 Modifications as a result of human activity

Of all the features within the SAC, the estuaries have probably received the greatest degree of impact and physical modification from what might be considered their natural state in the absence of human interventions. This has affected other SAC features that are components of the estuaries (mudflats and sandflats, Atlantic salt meadow and *Salicornia* communities). Past and recent modifications have resulted in loss of estuary habitats, constraining the estuaries' functioning and ability to evolve. Any further constraints or modifications affecting the estuaries may further prejudice the condition of these features.

The modifications and interventions in the estuary systems have generally resulted in land take from each estuary, leading to loss of saltmarsh, swamp and transitional areas extending into brackish, maritime and freshwater habitats. This has in turn resulted in a reduction in tidal area within each estuary. The main causes have been construction of embankments, sea defence works and construction of land drainage schemes. Many of the historical impacts were as a result of the large scale construction of structures within and adjacent to the estuaries that hindered the movement of sediments, and/or reduced the area and shape of the estuaries. Examples include the construction of the Cob at Porthmadog, the railway bridge in the Mawddach and the railway embankment in the Dyfi. Flood embankments have also been constructed to protect agricultural land reclaimed from the estuary. This process of land reclamation started before the end of the 19th century and continued up until the 1980s in some areas. The network of banks has then been maintained and continues to significantly affect the functioning of the estuaries. The Barmouth breakwater on the north side of the estuary was constructed relatively recently to improve navigation and shelter the harbour. This has restricted flows entering the Mawddach and is likely to have resulted in accretion upstream through the impact of this structure on the tidal prism of the estuary.

Restoration of the condition of at least part of the estuary feature is a realistic and positive aspiration in terms of the conservation management of the estuaries. As a general principle, a reduction in the artificial constraints (such as flood banks) on the tidal limits within the estuaries would provide opportunities for improving and restoring the condition of this feature. There is the potential to increase and re-establish estuary communities that have been reduced or lost to past interventions in the estuaries. Of the three estuaries of the SAC, the Mawddach and the Dyfi estuaries provide the greatest potential for restoration in terms of biodiversity benefits. In the light of predicted sea level rise and the potential inundation of coastal habitats (coastal squeeze), restoration may become more critical to the management of the SAC in order for this feature to be in favourable condition[38].

Past interventions in the estuaries of the SAC through human activities have resulted in the estuaries responding to re-establish their equilibrium. The Mawddach and Dyfi are believed to be close to their equilibrium position in response to past modifications of the estuaries, but the Glaslyn/Dwyryd was subject to a much higher degree of intervention, principally through the construction of the Cob at Porthmadog, and this estuary system is still trying to re-establish its equilibrium position in response to these changes.

In the scenario of sea level rise, floodplains along the upper estuary will experience increased tidal inundation and change to saltmarsh. If the estuaries are not able to expand laterally as sea level rises (due to man-made or natural obstructions), it is likely that saltmarshes in the lower estuaries will increasingly be eroded with potential loss of this and other estuary habitats. Constraints on the estuary that prevent them from adapting to these predicted changes are a major issue in terms of the long-term management of the SAC to maintain the estuaries and their component features (mudflats and sandflats, Atlantic salt meadow and *Salicornia*) in favourable conservation status.

[38] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)

Land management practices in the catchment areas of the estuaries are of critical importance in terms of their impact on levels of suspended particulate concentrations and diffuse nutrients and pollutants entering the estuaries. Activities such as forestry and farming practices have an important influence on the rate of rainwater run-off and the levels of suspended sediment and diffuse inputs of nutrients entering the estuaries. For example, felling of trees in forestry areas in the catchments will affect the rate and sediment loading of run-off into the estuaries. It may also have a significant impact on flood events as a result of altering the ability of the catchment area to retain water in periods of heavy rainfall. Increased annual rainfall and frequency of intense rainfall also has an influence on the diffuse discharges into the estuaries. Relatively low nutrient status is an important characteristic of the estuaries. The influence of the land management practices and varying patterns of rainfall on this are not well understood in terms of their actual impact on the estuaries and their wildlife and further work is required in order to determine what this is.

Historical mining operations within the areas surrounding the estuaries have resulted in a legacy of some contaminated water discharging into the estuaries. There is no evidence that these are having an adverse impact on the estuary habitats and wildlife.

The degree to which species populations of the estuaries may have been modified or degraded by human activity is difficult to assess. Certainly some species that have been subject to commercial or recreational exploitation locally or further afield or have been impacted by land management practices may be depleted, e.g. salmon, sea trout, eel. The scale of modification to the functioning of the estuary ecosystems as a result of removal of these species is unknown. Additional information on the assemblage and populations of mobile species of the estuaries is required.

4.5 Coastal lagoons

Coastal lagoons are defined in the EU Habitats Interpretation Manual as:

"… expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sandbanks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange. With or without vegetation from *Ruppietea maritimae*, Potametea, Zosteretea or Charetea….. Salt-marshes form part of this complex."

Coastal lagoons are identified as a priority Annex 1 habitat within the Habitats Directive.

Coastal saline lagoons are an unusual and rare habitat in the UK. Despite this, they show a wide range of geographical and ecological variation and five main sub-types have been identified in the UK as meeting the definition of the Annex I habitat type, on the basis of their physiography:

1. Isolated lagoons - separated completely from the sea or estuary by a barrier of rock or sediment.
2. Percolation lagoons - normally separated from the sea by shingle banks.

3. Silled lagoons. Water in silled lagoons is retained at all states of the tide by a barrier of rock (the ‘sill’).
4. Sluiced lagoons – where the natural movement of water between the lagoon and the sea is modified by artificial structures, such as a culvert under a road or valved sluices.
5. Lagoonal inlets – where seawater enters the inlet on each tide and salinity is usually high, particularly at the seaward part of the inlet.

4.5.1 Range

There is one coastal lagoon within the SAC, this is the Morfa Gwyllt lagoon on the south side of the mouth of the River Dysynni is the only saline lagoon on the Cardigan Bay coast. It is one of only four saline lagoons identified in Wales and the only example of a percolation lagoon in Wales.

4.5.2 Structure and function

The lagoon is the result of man-made changes to the shingle spit at the mouth of the Dysynni river that extended the existing shingle bar and retained a relict depression from the old river course that became established as the percolation lagoon. It is roughly oval in shape, covers approximately 0.25 ha and is shallow, with a maximum depth of 0.7 m (when surveyed in 1998), although the majority of the pool is around 0.25 m deep. Rainfall and seawater percolating through the shingle spit are the two sources of water and the amount held shows considerable seasonal variation. This in turn affects the maximum and minimum water depths and the lateral extent of the lagoon at different times of the year. The lagoon bed is a mosaic of medium sand over/amongst shingle, with muddier patches within the deeper pockets, and scattered larger pebbles. The sediments deposited within the lagoon basin are not very deep, providing little more than a veneer over the shingle in most areas.

The lagoon is protected from the seaward side by a bank of shingle. The structure of this bank and the adjacent beach is important since it allows the ingress of seawater through a slow process of percolation which is, as yet, not well understood, but allows the input of saline water to create brackish conditions in the lagoon. Rainfall has a large influence on the lagoon and during periods of high rainfall the lagoon water will have a lowered salinity.

4.5.3 Typical species

Due to the extreme nature of the environment that they provide, lagoons are stressed habitats, with typically reduced numbers of species and specialist fauna that are able to withstand the extreme conditions. Fourteen species have been recorded from Morfa Gwyllt, some present in very high abundance. Three of these are lagoonal specialists; the amphipod *Lekanosphaera hookeri*, the sea mat (bryozoan) *Conopeum seurati* and the green alga *Chaetomorpha linum*. These species are able to tolerate the comparatively wide range of environmental parameters and the variation in these. Their survival is dependent on particular physical, chemical and biological conditions. *Conopeum seurati*, for example, requires a hard substrate of plant material, stone, wood or artificial substrata since it forms an encrusting colony over the surface.

4.5.4 Natural processes

Lagoons are in a continuous state of development, being gradually filled as sediment settles out into the basin. The result is a range of conditions with some lagoons of ‘open water’ and others which are ‘marshy’ eventually becoming land. There is also the possibility that the whole lagoon may be inundated and destroyed after a major breach of the barrier which separates it from the sea. These stages of development and the different physical and chemical characteristics cause them to be very varied habitats.

4.5.5 Modifications as a result of human activity

The Morfa Gwyllt lagoon a small, shallow lagoon in an easily accessible location and is sensitive to a number of direct and indirect human impacts.

Direct physical impact from motorbikes driving through the lagoon has been observed and motorbike tracks are often seen in the area around the lagoon. As well as the direct disturbance of lagoon habitat, this activity may destabilise the edges of the lagoon, potentially infilling the edges of what is already a very shallow basin. Although there is no direct freshwater or seawater inflow to the lagoon, potential sources of pollutants and enrichment are the motorbikes (hydrocarbons washing off the chain etc.) and dog faeces (it is a very popular dog walking area). Cars and other vehicles used to have access to the shingle spit but this has been prevented in recent years through the placement of a series of large boulders blocking the entrance. The degree to which the species of the lagoon have been modified by human activity (in particular the use of motorbikes and dog fouling) is unknown, but a study in 2006 failed to find a number of species recorded in an earlier survey in 1998, this included the loss of one of the three lagoonal specialist species previously recorded.

Discarded debris and artificial materials are present in the lagoon. These form a physical hazard to some of the lagoon species (e.g. smothering of the bottom of the lagoon basin) and some are a source of chemical contamination, although some of these materials also provide an opportunity for colonisation by some of the lagoon species.

The lagoon is dependent on rainfall for its freshwater input. Anthropogenically influenced climate change may result in changes in the pattern and intensity of rainfall and periods of drought, which have the potential for a major impact on the water levels, salinity and water quality of the lagoon.

4.6 Mudflats and sandflats

***Mudflats and sandflats not covered by seawater at low* tide** are defined in the EU Interpretation Manual 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 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:

- Intertidal mudflats
- Seagrass beds
- Sheltered muddy gravels
- *Pleuronectes platessa*

4.6.1 Range

The intertidal mudflats and sandflats of the SAC are present in two different situations:

- Within the three estuaries of the SAC (the Glaslyn/Dwyryd, Mawddach and Dyfi estuaries); and
- In fully marine open coast situations on moderately exposed and exposed sandy shores at Porth Dinllaen on the north Llŷn coast, along the south Llŷn coast between Pen-ychain and Criccieth and between Criccieth and Afon Glaslyn and along the Meirionnydd coast at Harlech and the mouth of the Mawddach and Dyfi estuaries.

4.6.2 Structure and function

The sediments within the estuaries and open coast intertidal areas are derived primarily from Holocene deposits which, in the case of the estuaries, have been infilling the estuary valleys since the end of the last ice age. The mudflats and sandflats continue to develop and be influenced by the physical forces influencing the movement and settlement of sediment.

The sediments of the estuarine mudflats and sandflats are unusual in that they are predominantly sandy and even communities typically associated with muddier sediments are present in sandier substrate in the estuaries. More mobile coarser sands representative of full salinity seawater are present at the mouth of each estuary and along the main estuary channel, grading into finer muddier sands and mud in more sheltered areas, with communities representative of freshwater conditions present in the upper reaches of each estuary. The level of nutrients within each estuary is also of note in that it is relatively low for an estuarine system, and this will influence on the nature of the biological communities that develop.

Outside of the estuaries, the mudflats and sandflats of the SAC are located around the coast in fully marine conditions (i.e. full salinity sea water) where the degree of wave exposure and exposure to tidal currents are the dominant physical factors influencing these habitats. As a result of the degree of exposure to wave action at these locations, the open coast intertidal mudflats and sandflats are characterised by sandflat communities with fewer muddier sediment communities present.

4.6.3 Typical species

The intertidal mudflat and sandflat communities present in the estuarine and open coast areas are largely determined by the physical nature of the available sediment and the influence of the prevailing physical conditions such as the degree of exposure to wave action and tidal currents and the salinity regime of the surrounding water. Within the estuaries the distribution of the mudflat and sandflat sediment communities reflects the continuous gradient of exposure of different parts of the estuary to these conditions; communities representative of freshwater conditions are present in the upper reaches of each estuary and those representative of fully saline conditions are present near the estuary mouth. Outside of the estuaries the degree of exposure to wave action and tidal currents are the main factors determining the distribution of the different sediment communities of the open coast mudflats and sandflats. The open coast intertidal mudflat and sandflat communities are found on shores that are exposed or moderately exposed to wave action with more mobile sediments and fewer types of marine communities present as the degree of exposure increases

Similar marine communities have been recorded within each estuary, but there are notable differences between them. In the more mobile sand in the mid and lower shores of the estuaries, the communities are characterised by small burrowing crustacea (amphipods and isopods such as *Eurydice pulchra*). Where the sand is very soft and aerated, only burrowing amphipods and occasional bivalve molluscs are present. In areas with less water movement (such as on the outside of meanders and ‘blind’ channels), fine sand with burrowing polychaete worms and the thin telling shell *Macomangulus tenuis* occurs. The mid shore of the estuaries is dominated by the lugworm (*Arenicola marina*) and bivalves such as the cockle (*Cerastoderma edule*), Baltic tellin *Limecola balthica*, sand gaper *Mya arenaria* and the tellin *Macomangulus tenuis*. Patches of muddy gravel, which are usually in areas of slightly increased water movement, may be characterised by polychaete and oligochaete worms. Clumps of mussels *Mytilus edulis* have been recorded from the mid shore on fine mud in all three estuaries.

The saltmarsh channels, particularly in the lower and middle reaches of the estuaries, are dominated by the polychaete worm *Hediste diversicolor* and the peppery furrow shell *Scrobicularia plana*. In the steep muddy banks adjacent to the saltmarsh, a community made up of sparse polychaete and oligochaete worms and the amphipod *Corophium* sp. is often found. In the upper reaches of the estuaries, oligochaete worms are the main species present in the lower shore muddy sand and gravel habitats. Mobile sand in the upper estuary is commonly populated with a community of amphipods *Bathyporeia* sp. and *Corophium* sp.

Outside of the estuaries, the open coast intertidal mudflats and sandflats are characterised by sandflat communities with fewer muddier sediment communities present. The upper part of the open coast shores generally supports relatively species poor areas of sand and shingle often with a strandline community of sandhoppers (amphipods such as *Talitrus saltator*) where decomposing seaweed accumulates on the upper shore. The mid and lower shore sandflats support communities of burrowing amphipod crustaceans such as *Bathyporeia* spp. and *Eurydice pulchra* together with a variety of burrowing polychaete worms such as the lugworm *Arenicola marina*, catworm *Nephtys cirrosa* and other polychaete worm species. In areas more exposed to wave action these mid and lower shore communities differ in terms of the number of amphipod and polychaete worm species that they support (the more exposed sandflats support more amphipod species and fewer polychaete worms). Patches of sand mason worm *Lanice conchilega*, which can be identified by the tubes that the worms make using sand grains and which stick up above the sediment surface, are also found on the moderately exposed sand shores on the lower shore or waterlogged areas in the mid shore.

In more sheltered areas, fine sediments have a chance to settle out producing muddier sand habitats. In these areas other communities develop that are dominated by lugworm and other polychaete worms together with bivalve molluscs such as the Baltic tellin *Macoma balthica*. On the lower shore in these muddier sediments, communities of sea potato sea urchin *Echinocardium cordatum* and bivalve molluscs are present, generally in the lower shore areas of coast that have a slightly greater degree of shelter. Also, patches of the marine flowering plant sea grass *Zostera marina* are present in sheltered areas on the lower shore of the open coast sandflats at Porth Dinllaen, Afon Wen and east of Criccieth.

4.6.4 Natural Processes

Intertidal mudflats and sandflats are dynamic features. Their distribution, extent, shape, topography, aspect and orientation is the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. Hydrographic functions that structure intertidal mudflats and sandflats encompass highly dynamic hydrodynamic and other properties that vary with short and long-term natural cycles, climate influences and stochastic events.

The structure of intertidal mudflats and sandflats varies depending on the physical conditions and forces acting on them (in particular the degree of exposure to wave action and tidal currents) as well as the nature of the sediments occurring in any one location. The sediments vary from mobile coarse sand in more wave exposed areas to stable, fine sediment expanses of mudflat in estuaries and other marine inlets.

Intertidal mudflats and sandflats support a variety of different wildlife 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, its stability and the salinity of the water have a large influence on the wildlife species present.

4.6.5 Modifications as a result of human activity

The mudflats and sandflats in the estuaries have been modified by the same human activities as for the estuaries (see section 4.4.5). Existing data indicates that the extent of the mudflats and sandflats in the estuaries is declining as a result of accretion that is favouring an increase in saltmarsh, particularly the pioneer *Salicornia* saltmarsh communities. There will be natural fluctuations in the relative extent of each of the estuary habitats, but constraints on the functionality of the estuarine systems preventing their development and expansion in response to sea level rise means that the rate of decrease of some of the habitats will be above that which would be expected within the context of natural change. Ultimately it could lead to substantial losses of some of the estuary habitats such as mudflats and sandflats.

Due to the intertidal location of the mudflats and sandflats along the open coast, the main influences are from human activities in the coastal area. Some of the open coast mudflats and sandflats are present in areas where structures such as shore defences, retaining walls and slipways have been constructed. Coastal construction, in particular coastal defence, has modified the mudflat and sandflat communities in a few locations in the SAC through direct impact, and also through modifying coastal processes (hindering release of rocks and sediments from boulder clay cliffs, affecting sediment processes, altering the nature of the beach sediments and preventing natural evolution of the coastline in the longer-term (see also section 4.1.5)).

It is believed that there has been relatively little modification of the overall sedimentology of the open coast mudflats and sandflats, aside from the influence of coastal constructions. Modification of the extent and quality of the seagrass/eelgrass (*Zostera marina*) beds has been recorded at Porth Dinllaen due to trampling, use of vehicles on the beach and boat moorings. The degree of impact varies seasonally, with greatest use of the beach area where the eelgrass extends into the intertidal in the summer. There is seasonal impact on sandflats at Morfa Bychan (Black Rock Sands) from vehicles on the beach. This causes compaction of the intertidal sandflats, with the impact being greatest in the peak holiday season. There is periodic use of vehicles on other open coast sandflats, generally associated with coastal defence works. Careful planning of these works is required to avoid any potential impact on the mudflat and sandflat communities. Non-native species can also impact on mudflats and sandflats e.g. *Sargassum muticum* in the seagrass beds.

The concentrations of major nutrients and contaminants within the coastal sea areas of the SAC are not believed to be above levels that would be of concern for the open coast mudflats and sandflats, but more information about the specific levels is required.

The degree to which species populations of the intertidal mudflats and sandflats may have been modified or degraded by human activity is difficult to assess because of the paucity of biological time series data and, to some extent, information on the distribution and intensity of human activities. The species of the open coast mudflats and sandflats have been less subject to commercial or recreational exploitation compared to some of the other SAC features.

4.7 Atlantic salt-meadow

Atlantic salt-meadow (*Glauco-Puccinellietalia maritimae*) is defined in the EU Habitats Interpretation Manual as:

“Salt-meadows of Baltic, North Sea, English Channel and Atlantic shores”

Eleven different plant communities are represented by this SAC habitat in the UK which occurs on North Sea, English Channel and Atlantic shores.

Atlantic salt meadows develop when plants able to tolerate salty soil conditions colonise soft intertidal sediments of mud and sand in areas protected from strong wave action. The vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration than areas nearer to the low water mark in estuaries and coastal locations.

The vegetation that is present varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, invertebrates and wintering or breeding waterfowl.

There is a variation in the plant communities from the lower reaches of the saltmarsh to the most inland limits. At the lower reaches of the saltmarsh the vegetation is often naturally species-poor and may form an open sward of common saltmarsh-grass *Puccinellia maritima*. Further up the marsh, the vegetation becomes herb-dominated and red fescue *Festuca rubra* becomes more important. The upper saltmarsh shows considerable variation, particularly where there are transitions to other habitats. Communities present may include tussocks of sea rush *Juncus maritimus* dominating a herb-rich vegetation, and saltpans supporting patches of species-poor vegetation dominated by saltmarsh flat-sedge *Blysmus rufus* (in the north) or slender spike-rush *Eleocharis uniglumis*.

There may be transitions from upper saltmarsh to a number of habitats, including sand dune, coastal shingle, freshwater marshes and woodland. This part of the saltmarsh succession has been particularly vulnerable to destruction by enclosure, usually involving the erection of a sea bank to exclude sea water, and remaining areas are regarded as particularly important for biodiversity conservation.

4.7.1 Range

The Atlantic salt meadow within the SAC is located within the estuaries of the Meirionnydd and Ceredigion coasts: the Glaslyn/Dwyryd, Artro, Mawddach and Dyfi estuaries. The most extensive areas occur in the Dyfi Estuary with over 380 ha, whilst the greatest variety of vegetation types occurs in the Mawddach Estuary.

4.7.2 Structure and function

Atlantic salt-meadow is dependent on environmental processes in the main body and waterway of the estuaries. Its distribution and extent is predominantly governed and constrained by the geomorphology and tidal regime and the topography is determined by foreshore breadth, morphology of waterway and sediment processes. The sediment structure is predominantly muddy sand, although the sandy nature of the estuaries means that the muddy substrate is very sandy in nature. A range of Atlantic salt-meadow geomorphology and topography is present with the overall shape determined by the morphology of the estuaries. This is locally influenced by the presence and morphology of rock out crops and wide intertidal sediment flats.

The sediment processes appear to be in a dynamic balance on a broad scale. Sediment deposition and erosion varies within and between areas of salt-meadow dependant on gross sediment inputs and transport within the estuaries, and local topography, hydrodynamics and proximity to drainage channels. Sediment inputs, suspended sediment in the water column and sediment transport patterns result in sediment deposition in many areas, though this is balanced by local sediment erosion within and at the edges of salt-meadows.

4.7.3 Typical species

The saltmarsh communities of the Atlantic salt meadow vary from transitional low marsh vegetation to extreme upper marsh vegetation often dominated by sea couch *Elytrigia atherica*. In total these saltmarshes have zonations which include some seven different communities.

These Atlantic salt meadows are typically characterised by the presence of common saltmarsh-grass, but may also include areas characterised by other common saltmarsh species such as red fescue, sea aster or sea rush. Apart from the seaward pioneer zone of *Salicornia* and other annuals, the Atlantic salt meadow feature constitutes all of the middle and upper saltmarsh communities, and may be divided into several different zones. There are also important transition zones into other habitats such as mires, swamps and sand dune.

A number of unusual communities and species are present in the Atlantic salt meadow. The SAC includes the rare *Eleocharis uniglumis* (slender spike-rush) saltmarsh community which occurs locally along the west coast from the Dyfi Estuary northwards. The Atlantic salt meadow also provides habitat for a variety of rare or uncommon plant species such as sharp rush, spiral tasselweed, lax-flowered sea-lavender, dwarf spike-rush and Welsh mudwort.

Grazing by domestic stock plays a significant role in determining the character of this saltmarsh. Some areas are lightly grazed and have good vegetation structure. These may be important for breeding waders. Other areas are more heavily grazed creating stands of short turf that can form important feeding areas for wildfowl. Wintering waterfowl populations create ecological effects through grazing, nutrient enrichment, trampling effects on vegetation and sediment substrate and seed redistribution.

4.7.4 Natural processes

The location, character, and dynamic behaviour of saltmeadows are governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh:

1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed;
2) a supply of suitable sediment available within the period of tidal cover;
3) water velocities that are sufficiently low for some of the sediment to settle out; and
4) a supply of seeds or other propagules for the establishment of vegetation cover.

The topography and microtopography of areas of Atlantic salt meadow are the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. These can be highly dynamic and vary with short and long-term natural cycles, climate influences and stochastic events, including: tidal range and excursion, salinity, water temperature and suspended particulate concentrations.

The marsh-edge morphology provides information on the short to medium term trends of marsh morphodynamics. Accreting and stable seaward marsh edges have an accretional ramp upon which pioneer and low-marsh vegetation can become established. Erosional margins are characterised either by the presence of mud-mound topography or by marsh-edge cliffs fronted by: toppled cliff blocks with live or dying vegetation; rotational slide and overhanging (cantilever) blocks. Terraced marsh margins indicate episodic erosion and accretion on timescales over decades to centuries.

Creeks and pans of varying size and density are frequent features of the saltmeadows. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. The efficiency of this process depends on creek pattern. Creek density is influenced by vegetation cover, suspended sediment load and tidal influence. Creeks allow pioneer vegetation to be established along their banks higher into the saltmarsh system. Natural salt pans can occur at any level in a saltmarsh. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins. Contaminants may be tied up in saltmarsh sediments for relatively long periods of time and shifts in the dynamics of processes can lead to the remobilisation of sediments. Cyclical patterns of erosion and accretion may lead to the release and re-deposition of pollutants within the system.

Nutrient levels are a strong influence on the growth of estuarine saltmarsh plants. Nutrient cycling within saltmarshes can also have a significant effect on coastal and estuarine water quality. In this respect, healthy, functional saltmarsh habitat may have an important role to play in the control of nutrients, which are important in determining water quality.
Given favourable conditions, depending on sediment supply and hydrodynamic regime, mudflats evolve into saltmarshes by way of substrate stabilisation by algae, diatoms and early pioneer plants, giving rise to enhanced sediment accretion rates.

4.7.5 Modifications as a result of human activity

The Atlantic salt meadow is influenced by the same human activities (land claim and development) as the estuaries of the SAC (see section 4.4.5). There will be natural fluctuations in the relative extent of each of the estuary habitats, but constraints on the functionality of the estuarine systems preventing their development and expansion in response to sea level rise means that the rate of decrease of some of the habitats will be above that which would be expected within the context of natural change. Ultimately it could lead to substantial losses of some of the estuary habitats such as Atlantic salt meadow.

The presence of man-made structures along the landward sides of the estuaries has modified the zonation of the Atlantic salt meadow and the presence and extent of transition communities of upper saltmarsh into other habitat that would be expected to be present in the absence of such barriers.

Much of the Atlantic salt meadow is grazed primarily by sheep and cattle. In the Dwyryd estuary this has reduced the quality of the Atlantic salt meadow communities in specific locations, probably as a result of localised over-grazing.

Localised damage to Atlantic salt meadow communities has occurred as a result of use of vehicles generally by people seeking access to harvest shellfish in the estuaries.

4.8 *Salicornia* and other annuals colonising mud and sand feature

Salicornia and other annuals colonising mud and sand are defined in the EU Habitats Interpretation Manual as;

"Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus *Salicornia* or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes. *Thero-Salicornietea*, *Frankenietea pulverulentae*, *Saginetea maritimae*."

This form of saltmarsh is widely distributed throughout coastal areas of the EU. In the UK it is widespread in the saltmarshes of England and Wales, but the area of this habitat type is restricted in Scotland and Northern Ireland because of a lack of new sediment for saltmarsh development. There is much less variation within this habitat type compared with the Atlantic salt meadow habitat and, in the UK, *Salicornia* and other annuals colonising mud and sand encompasses four different plant communities.

4.8.1 Range

Salicornia pioneer saltmarsh communities colonise intertidal mud and sandflats in areas protected from strong wave action. It is an important precursor to the development of more stable saltmarsh vegetation. *Salicornia* and other annuals colonising mud and sand develops at the lower reaches of the saltmarsh where the plants are frequently flooded by the tide. It can also colonise open creek sides, depressions or pans within saltmarshes, as well as disturbed areas of upper saltmarsh.

Within the SAC, the *Salicornia* and other annuals saltmarsh communities are present as a pioneer zone on the marine fringe of saltmarshes in the Glaslyn/Dwyryd, Artro, Mawddach and Dyfi estuaries and fringing part of Tremadog Bay. The largest proportion of this feature occurs in the Dyfi estuary.

4.8.2 Structure and function

Salicornia grows on a wide variety of marine sediments in intertidal habitats, ranging from gravels and shelly sands, through silts to fine clays, and is invariably associated with saline, brackish or alkaline substrates. Although an early colonist of soft, unconsolidated sediments, the densest stands tend to be on firm silts and clays. The substrates of *Salicornia* span the tidal range and are often waterlogged for much or all of the time, depending on elevation and drainage condition so plants may be shallow rooted. One consequence is that tidal flow, perhaps associated with scouring of the sediment and wave action, can be a major source of mortality for *Salicornia* seedlings at lower elevations on a saltmarsh.

Salicornia is extremely tolerant of regular flooding although growth of *S. europaea* is reduced by cultivation under continuous water-logging, in comparison with free drainage at the same salinity. As a halophyte, *Salicornia* is tolerant of exceptionally low water potentials in its root environment, whether they arise from salinity, drought or a combination of both.

Individual populations and taxa of *Salicornia* may be very sensitive to elevational variations associated with microtopography on the gradient from land to sea of tidal saltmarshes. Populations on the lower shore need to be more tolerant of prolonged submergence, tidal scour and water-logging, whereas those at high elevations may experience hypersalinity in summer.

In temperate regions the growing season is generally 7-8 months, and the *Salicornia* is typically a summer-annual. Flowering occurs mainly from mid-August to mid-September and seeds reach maturity from then falling out of the dead or dying parent plant although some may remain in situ for germination the following spring. Germination tends to coincide with low sediment salinities in winter in Britain. Characteristically lower-marsh populations, such as *S. europaea*, tend to germinate earlier than upper marsh ones, e.g. *S. pusilla*.

The lower limit of establishment of *Salicornia* on saltmarshes often appears to be set by the time necessary for the seedlings to penetrate the sediment and develop a ring of root hairs, in order to become fully anchored. A threshold period of tidal exposure of 2-3 days for rooting sufficient to resist tidal action on the low part of an estuarine marsh has been suggested.

4.8.5 Modifications as a result of human activity

The *Salicornia* communities are influenced by the same human activities (land claim and development) as the estuaries of the SAC (see section 4.4.5) and the Atlantic salt meadow (see 4.7.5). Existing data indicates that accretion in the estuaries is favouring an increase in the extent of the saltmarsh communities, particularly the pioneer *Salicornia* communities, at the expense of the mudflats and sandflats. There will be natural fluctuations in the relative extent of each of the estuary habitats, but constraints on the functionality of the estuarine systems preventing their development and expansion as sea level rises means that the rate of decrease of some of the habitats will be above that which would be expected within the context of natural change. Ultimately it could lead to substantial losses of some of the estuary habitats such as the pioneer *Salicornia* saltmarsh.

There has been modification of the zonation of the saltmarsh communities of the SAC. At the landward edges of the estuary this is mainly due to the presence of man-made structures inhibiting lateral expansion of the saltmarsh. In the case of the *Salicornia* communities it is thought that grazing pressure may also be a contributory factor.

Localised damage to *Salicornia* communities has occurred as a result of use of vehicles generally by people seeking access to harvest shellfish in the estuaries.

4.9 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 vary considerably depending on the structure and extent of the caves system, their degree of submergence and of exposure to scour and wave surge, as well as water clarity and the nature of their geology. 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 sea-caves in Welsh SACs are considered to be of significant conservation value.

4.9.1 Range

Within the SAC, sea caves are present around Pen Llŷn including the Tudwal Islands and also along the Meirionnydd coast north of Tonfannau and the Ceredigion coast north of Clarach. The main locations where sea caves have been recorded are shown on the feature map[39].

Fully intertidal caves are present in the bedrock cliffs from Porth Towyn on the north-west side of Pen Llŷn to Clarach Bay north of Aberystwyth. Most caves in the SAC have an intertidal portion with varying proportions remaining permanently below sea level (e.g. St Tudwal's Islands) or, more unusually, are fully subtidal throughout (such as the subtidal tunnel at Pen y Cil). Between Aberystwyth and Tywyn the caves are predominantly in the intertidal, whilst around Pen Llŷn the caves have both intertidal and subtidal elements and are increasingly exposed to wave and tide energy towards the end of the peninsula and Bardsey Island. Those caves with both intertidal and subtidal parts support a large variety of cave wildlife communities because of the more varied cave habitats that they provide.

4.9.2 Structure and function

Sea caves are formed where the specific geology of an area allows for the weathering and erosion of material to create overhangs, clefts, caves and tunnels that provide very specialised conditions for marine animals and plants. The geology of the SAC is complex and the variety of rock types and other geological features such as folding, fracturing and faulting and erosion have provided the basis for the formation of a wide variety of cave types. They have differing morphology and are exposed to varying degrees of wave action, tidal streams and scour from sand suspended in the water and stones/rocks on the cave floors. The inventory of sea caves of the SAC is incomplete but current information has identified cave types within the SAC that vary from small clefts in the rocks to tunnels whilst others are deep caves extending over 100m into the rock face.

A high proportion of caves are intertidal or in shallow water. These caves often experience conditions of strong wave surge and the base of the cave is usually composed of some sort of coarse sediment, rounded cobbles and/or boulders. Caves that occur in deeper water tend to be subject to less violent water movements from the surrounding sea and silt may accumulate on the cave floor.

4.9.3 Typical species

The wide spectrum of sea cave habitats in the SAC (spanning the intertidal and subtidal zones and exposed to a variety of physical (e.g. light, wave energy, scour) and chemical (e.g. rock type) gradients means that almost all known sea cave communities have been recorded from somewhere in the site.

Thirty biotopes have been recorded from the sea caves of the SAC. These range from scoured sparse communities characterised by lichens, red seaweed (such as the sand-binding seaweed *Rhodochorton purpureum*), and molluscs grazing on biotic films (e.g. at Porth Towyn, Trwyn Cilan, Black Rock, Rhoslefain, and Clarach) to those rich in

[39] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

seaweeds, sponges, anthozoans and sea squirts (e.g. at Porth Llanllawen NE of Bardsey Sound, Ogof Deuddrws at Aberdaron, and East St Tudwal's Island).

In caves with both intertidal and permanently submerged subtidal portions (e.g. St. Tudwal's Islands) and those fully subtidal (e.g. tunnel at Pen-y-Cil), communities present include distinct local variations of tide-swept communities rich in sponges, hydroids and ascidians, scoured sparse communities of calcareous tubeworms, and communities typical of surge gullies that experience strong and violent water surge. Some of the caves that have been surveyed near Hell's Mouth, St. Tudwal's Islands and at Bardsey Island support particularly extensive examples of cave communities. These include dense communities of baked bean sea squirts *Dendrodoa grossularia*, the white lacy sponge *Clathrina coriacea* and the oaten pipes hydroid (sea fir) *Tubularia indivisa*.

The larger caves in the area (those surveyed near Hell's Mouth, St Tudwal's Islands and Pen y Cil) exhibit gradients of environmental facts – vertically from intertidal to subtidal, and horizontally from the sunlit entrances to shaded and permanently dark rears. Gradients of scour, water movement and rock type also influence the layout of different wildlife communities inside the caves. With this variety of sub-habitats and communities these caves also tend to be those with greatest species richness. Species include ephemeral and robust colonisers such as calcareous tubeworms to dense turfs of filter feeding sea squirts and hydroids, and long-lived sponges and cup corals.

The sea caves of the SAC are also home to a number of species that are considered to be rare or scarce in a UK context or are present in unusually high abundance These include three sponge species (*Stelletta grubii*, *Stryphnus ponderosus*, *Thymosia guernei*), an anemone (*Epizoanthus couchii*), a cup coral (*Caryophyllia inornata*), a mollusc (*Otina ovata*), a sea squirt (*Polysyncraton lacazei*) and a red seaweed (*Schmitzia hiscockiana*).

The shingle and rock 'beaches' that form at the back of some of the sea caves are important as seal haul-out and pupping areas in this SAC.

4.9.4 Natural processes

Cave morphology and topography is strongly determined by the underlying geology and erosion processes and has an important influence on the qualities of the cave rock 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.

4.9.5 Modifications as a result of human activity

The distribution and extent of the sea caves are determined by the underlying geology and geomorphological processes that have created the caves. Human activity has modified the distribution and extent of the intertidal sea caves as a result of intentional and consequential, partial or complete infilling of caves as part of coastal defence works and foreshore development. The main area where this has occurred is along part of the Meirionnydd shore where past coastal defence works to safeguard part of the Cambrian coast rail line have resulted in infilling and permanent loss of some of the intertidal caves. Such modifications are not known for those sea caves that are partially or wholly permanently submerged.

There has been localised damage to some of the intertidal sea cave communities at Morfa Bychan (Black Rock Sands) as a result of people scraping off the marine life from the cave walls (rock graffiti). These sea caves are the most easily accessible caves in the SAC and therefore most vulnerable to this sort of disturbance. Other than this localised example, there is no known evidence to suggest that the viability of species populations in sea caves within the SAC has been modified by human action. There is little or no modification of water movement patterns into and within the sea caves.

There is no known evidence of human activity having restricted physical access by grey seals to sea caves, other than possible temporary inhibition caused by human presence. The influence of human activity on sea-caves sedimentology is unknown. Discarded and lost artificial materials are present in some caves. Hydrodynamic conditions tend to mean that materials such as lost and discarded synthetic fishing gear and other durable rubbish is retained in sea caves, particularly those caves with complex shapes and/or boulder/cobble floors. Lost and discarded fishing gear and persistent rubbish form a physical hazard to many species, particularly grey seals and other vertebrate species, and some are a source of chemical contamination.

The gross physical hydrography within, and in the vicinity of sea caves is considered little modified as a result of human activity and any localised effects are small. Suspended particulate concentrations may be modified by localised or distant human activity including, for example, coast protection or construction operations.

Intertidal sea cave caves are exposed to groundwater seeps and these are strongly influenced by agricultural or other management practices on overlying land surfaces. There is no evidence that this is currently having an adverse impact on sea caves of the SAC.

The status of biological interactions structuring the ecology of cave communities is poorly known. Other than the specific examples described above, there is no known documented evidence to suggest that species variety in open coast sea caves has been modified by human action although populations of some typical species of the sea cave feature may be depleted with respect to historical levels.

4.10 Grey seal Halichoerus grypus

The UK population of grey seals (*Halichoerus grypus* Fabricius, 1791) represents about 38% of the world population and 83% of the EU population. The total UK grey seal population size in 2012 was estimated as 112,300 (95% CI: 90,600-142,900)[40]. Based on pup production estimates, the Welsh 'population' forms around 3.3% of the UK or about 2.7% of the European population.

The UK clearly has a special responsibility to protect the grey seal and the selection of SACs has taken account of this. The largest breeding colonies, based on pup production, have been selected, but also sites have been selected to ensure coverage of the geographical range of breeding in the UK. While the SAC series makes a contribution to securing favourable conservation status for this Annex II species, wider measures are also necessary to support its conservation in the UK.

4.10.1 Population dynamics

Grey seals present within the site at any one time do not form a discrete population, but are centred (in terms of abundance) on Cardigan Bay and are considered part of the SW England and Wales management unit[41]. This population itself is not isolated but extends from SW Scotland to SW England and SE Ireland (individuals have been photographically recaptured among these regions[42] and there are movements and exchanges with more distant populations (satellite tracked individuals have been tracked to/from France, west coast of Scotland and Ireland[43]). Tracking data (from a study using satellite tags to track seal movements and diving behaviour) show that seals moved from haul out sites on Bardsey Island and West Hoyle Sandbank to the east coast of Ireland, Inner Hebrides, and Pembrokeshire.

Population size is determined by a complex of density-dependent and independent biological processes, including physiological health, reproductive success and the carrying capacity and quality of the habitat. The fact that grey seals are wide ranging and are thought to inter-mix makes it very difficult to estimate seal numbers in the SAC (and outside of the SAC) with confidence.

Pup production can be used as an index of seal population size, if age structure is stable and where rate of change is constant, or where alternative information on fecundity or survival rates is available[44]. UK grey seal population size is estimated from pup counts using a complex population dynamics, Bayesian state-space model[45]. Pen Llŷn and Bardsey Island have the larger breeding colonies in North Wales. The SAC contains a number of important pupping sites for the grey seals concentrated around the north-west

40 SCOS (2013)
41 IAMMWG, (2013).
42 Keily *et al*. (2000), SCOS (2013), Cornwall Seal Group *pers. comm*., NRW Unpublished data
43 Cronin (2011), Vincent, unpublished data
44 Duck & Thompson, (2007)
45 SCOS, 2013

of the SAC including Bardsey Island. There is currently only limited information available on annual pup production within the SAC. In 2002 grey seal numbers were tentatively estimated at 365 based on pup data and calculations. However, the number of grey seals present in the waters of North Wales at all haul-out sites was, at all times, greater than this, with no less than 700-750 seals in winter and the maximum figure (June, July, August) at around 800. This reflects the extent to which seals circulate around the Irish Sea and perhaps beyond. The south-west Wales ‘population’ size is also determined from pup counts, and has been estimated at approximately 5000 individuals[46].

The main period of pup production in North Wales is September to end November, but with some activity in early August and December. The average number of births annually within the site is not known with any accuracy. A study of pupping sites from Aberystwyth to the Dee recorded a total of 103 pups born in 2001-2002 and 110 pups born in 2002-2003 of which the greatest number (67 pups) were born within the SAC on south west Pen Llŷn and Bardsey Island. A previous pup production study in 1974 estimated annual pup production at 55. Since then, pup production has been recorded annually only at Bardsey Island, where a slow rise appears to have been observed during the past decade.

There is currently insufficient data for the SAC to ascertain within-site pup survival. Data from Pembrokeshire in 2015 recorded combined survival of 77.8% of pup survival to moulting[47] which is above the long-term UK national average.

The age frequency and sex ratio of the population is unknown as are fundamental population demographics such as female fecundity, adult survival / mortality and physiological health. It has been suggested that North Wales is an important area for female grey seals year round. The Tudwals area has, for the most part, been recorded as being almost exclusively used by females while at Rhosgor, on the north coast of the Llŷn, females comprised 75% of all seals counted. In general, males rarely comprise more than 25% of any assembly in the SAC. At no locations in the SAC or in North Wales are juveniles a major component of the seal assemblies. The highest numbers (but not percentages) of juveniles were recorded in the assemblies using Bardsey Island. At four sites (Gwylans Coast, Ynys Arw/North Stack Coast, Trwyn y Gader/Carmel Head and Trwyn Cilan) pups form a high percentage of the total number of seals counted through the year, indicating that these locations are heavily used during the breeding season but little outside that time.

The physiological health of the grey seals in the SAC (and wider west Wales population) is unknown. The limited post-mortem data available does not suggest that the physiological health of grey seals in the SAC is being adversely affected by any specific pollutants or diseases. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals. Disease probably exerts a density dependent population control mechanism. There have been no records of phocine distemper epizootic (PDV) virus in North Wales’ seals, and their physiological health as a regional group is presumed good/intact.

[46] Baines *et al*. (1995)
[47] Newman *et al*. (2015)

4.10.2 Range

Grey seals are highly mobile species[48], which can travel great distances[49]. Only their pupping, haul-out and regular moulting sites may be determined with any precision. Grey seals range throughout the open coast areas of the site, but are more commonly observed within the SAC around the Llŷn, Bardsey Island and the islands along the south Llŷn coast. Recent tracking studies showed wide ranges for individual seals from Northern Irish Sea to SW England.

Seals haul-out singly and in small groups in undisturbed locations throughout the site with some overlap of pupping and non-pupping haul-out sites. Most pupping takes place in the northwest of the SAC and around Bardsey Island in suitable habitat (i.e. physically accessible to the seals, remote and/or undisturbed rocky coast beaches, coves and caves). A high proportion use sea caves in the SAC for pupping. This is similar to the situation in west Wales where secluded coves and caves are used for pupping. This is an unusual breeding behaviour compared to elsewhere in the UK where large females typically pup on open sites.

Moulting and resting haul-out sites are distributed throughout the SAC and non-pupping seals are present year-round at these haul out sites. Frequent counts indicate a great deal of variation throughout the year. On Bardsey Island, for example, numbers of hauled out seals varied from 20 to 228 on the 25 September 2002 and 30 July 2003 respectively. A study of grey seal movements at sea generalised that seals spend a high percentage of time at or near haul-out sites, taking short trips to local offshore foraging areas and conducting dives to the seabed as well as travelling long distances.

The number of seals assembled ashore is generally greater in the summer months for the North Wales region as a whole and locations within the SAC such as Bardsey Island. In contrast much more intensive use is made of the islands off the east coast of Anglesey in the winter than in summer. Use of Bardsey Island and the West Hoyle Sandbank rises to a peak in the summer months; counts of adults at haul out sites on Bardsey Island were at a maximum of 228 in July 2003; winter counts here showed up to 107 seals in November 2002. Smaller but regionally significant assemblies of seals were counted at the Tudwals Islands (up to 66 in August 2002) and the Gwylans coast from Carreg Chwislen to the Gwylan Islands (up to 42 in December 2002). The largest north Wales haul out site, however, is located outside of the SAC at the West Hoyle Sandbank.

4.10.3 Habitat and species

Grey seals require feeding, pupping, moulting and resting haul-out habitat but the exact habitat requirements of the grey seal are unknown as seemingly suitable habitat is often not occupied by seals. Within the SAC and elsewhere in North Wales they use intertidal rocky outcrops, rock and boulder/cobble beaches, sea caves that are tidally exposed, and occasionally sandy beaches and tidally exposed sandflats. Grey seals are assumed to feed throughout the site and some are known to make long foraging trips along the coast and offshore to deeper waters.

For north Wales in general and specifically within the SAC, sea caves are a major supporting habitat with approximately 67% of seals pupping within caves during 2002 and the remainder being born on beaches . The non-pupping haul out sites are concentrated

[48] Russell *et al*. (2013)
[49] e.g. >700km, Cronin (2011), Vincent *unpubl data*

around the NW of the SAC and include Bardsey Island. Preferred pupping sites are those with maximum seclusion (isolation from disturbance), shelter from heavy wave action and all-tide access by females.

Moulting and resting haul-out sites are distributed throughout the SAC and seals are present year-round at these (non-pupping) haul out sites. Details of the moulting / resting haul-out habitat requirements are not known precisely, but habitat that is understood to be suitable is extensive throughout the northwest part of the SAC in particular, and is assumed to be adequate.

Grey seals are generalist feeders, foraging mainly on the sea bed, taking a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling), and flatfish (plaice, sole, flounder, dab)[50]. Among these, sandeels are typically the predominant prey species, but diet varies seasonally and from region to region. Their feeding habits in north Wales are unknown, but there is no reason to assume that they differ significantly from grey seals in other locations. The diet of grey seals in west Wales for example, is known to be highly varied and assumed to be a reflection of local prey availability.

4.10.4 Modifications as a result of human activity

One of the key considerations for the conservation of the grey seal within the SAC specifically, and as part of the management unit, is disturbance of breeding and haul-out sites by human activity. With very few exceptions, seals within the SAC choose to haul-out on rocky shores or in sea caves currently remote from access by humans. In areas that have a high incidence of human presence through coastal walking, boating, fishing or other activity, the grey seal is generally not seen hauled-out. Other issues relate to potential entanglement and incidental capture of seals by fishing gear, pollution and reduction or changes in food availability.

Grey seals inhabit and are adapted to an inherently harsh environment. However, artificially introduced hazards and reductions in the natural quality and suitability of the grey seal habitat in the SAC can occur through:

- the presence and persistence of artificial inert or toxic materials (e.g. plastics, synthetic fibres, hydrocarbons) causing entanglement, smothering or ill-health;
- a decrease in seclusion because of noise and visual disturbance;
- competition with human activities for space causing displacement, collision, noise and visual disturbance;
- contamination of prey.

In general, there has been a very considerable decline in certain fish stocks over the last two centuries, and particularly in the last 50 years. However, the current stock status of likely prey species of grey seal in Wales is generally unknown

As a top predator, seals are prone to accumulation of contaminants present within their food chains, particularly those that are persistent and those that tend to bioaccumulate and biomagnify. Frequency and magnitude of contamination of prey is unknown, but the limited post mortem data for seal contaminant burden appears to indicate that at least some of the prey is contaminated with persistent pollutant.

[50] Brown *et al*. (2012), SCOS (2013).

4.11 Bottlenose dolphin *Tursiops truncatus*

Bottlenose dolphins (*Tursiops truncatus*) are a cosmopolitan species, widely distributed in a range of mainly nearshore coastal habitats from tropical to temperate seas, in sheltered and exposed areas of estuaries, lagoons, continental coasts, and also in pelagic waters offshore and around oceanic island coasts. They have a near-global distribution (except the polar regions) and are widely distributed in North Atlantic, West African, Mediterranean and UK waters (but are scarce in the southern North Sea).

There are two main areas of UK territorial waters where there are semi-resident groups of bottlenose dolphin (where individual identified animals persistently occur in a relatively discrete area): Cardigan Bay and the Moray Firth (Scotland). Away from these two areas, there are smaller groups off south Dorset, around Cornwall and in the Sound of Barra, Outer Hebrides. There is also a resident population in the Shannon Estuary, Ireland and another based around the Channel Islands. In addition small groups have been recorded regularly elsewhere in UK waters, including along the coasts of Cornwall, Devon and Dorset, in the waters around the Hebrides, and occasionally in offshore waters of the North-east Atlantic, Irish Sea and St. George's Channel.

Dolphins from all of these areas may occasionally move some distance from their apparent core range. For example, regular sightings in the Firth of Forth probably involve dolphins from the Moray Firth and sightings in North Wales involve Cardigan Bay dolphins. Other dolphin groups, presumed to be transients, are recorded further offshore in deeper water in the Celtic Deep and to the west of Scotland.

The total population of coastal bottlenose dolphins in UK inshore waters is small[51] (estimates less than 500 individuals) and for offshore bottlenose dolphins abundance estimates from the SCANS II survey were 5,370 for the offshore Celtic Sea area and 12,643 in total for the European Atlantic continental shelf[52]. The species was formerly more widespread, particularly of coastal dolphin groups, especially in the southern North Sea and English Channel and has declined in range.

Bottlenose dolphins are considered of significant importance within Pen Llŷn a'r Sarnau SAC even though they do not appear to form a semi-resident group within the sea area encompassed by this site. Bottlenose dolphins have been seen all around the Welsh coast since the early part of the 20th Century, but mainly throughout Cardigan Bay where they use the area for all essential activities including feeding, socialising and nurture of young.

4.11.1 Population dynamics

Bottlenose dolphins are seen year-round in Cardigan Bay. The number of individuals increases during the summer months, as does group size reaching a peak in late September and October when quite large aggregations of more than 60 individuals may be seen. The dolphins are reported less frequently and in fewer numbers during the winter months, but this may partially be a reflection of poorer weather conditions and fewer observers watching the coast. Aerial surveys in Cardigan Bay in winter 2007 showed a clear preference for the offshore areas of the bay. Bottlenose dolphins do not form a discrete site based population within Pen Llŷn a'r Sarnau SAC but instead should be seen

[51] Reid *et al*. (2003)
[52] Hammond & Macleod, (2006)

as part of a wider population that ranges across waters of the Irish Sea, and includes the Cardigan Bay SAC.

In the early 1990's there were estimated to be about 130 bottlenose dolphins in the wider Cardigan Bay. More recent estimates also indicate a relatively small number of individuals, between 100 - 300. Intensive research of the Cardigan Bay dolphin population started in 2001 using photo-identification and line transects[53]. Since 2007, photo ID has been conducted also in the northern part of Cardigan Bay including Tremadog Bay, encompassing the Pen Llyn a'r Sarnau SAC[54]. In 2011, line-transect surveys were commenced across all of northern Cardigan Bay, thus also providing photo ID information for the entire Bay[55]. Photographic identification studies has revealed that dolphins associated with Cardigan Bay group move into and through Pen Llŷn a'r Sarnau SAC.

Most of the individuals identified during studies have been seen more than once, and a number of these animals have also been recorded in more than one year. Some dolphins have been identified in the Bay every year for periods of five years and more, while others appear to return to the area after a gap of one or two years. There appears to have been an overall increase in population size between 2001-2007 and a decline since then to 2001 levels but there is considerable variability between years and low confidence in some estimates (and the apparent trends are not significant). The decline in recent years may be related to animals moving away from the study area.

Important characteristics relating to population dynamics will be common to bottlenose dolphins in both Pen Llŷn a'r Sarnau and Cardigan Bay SACs. Both sites are within Cardigan Bay where various abundance estimates have been made.

Bottlenose dolphins are highly social animals with group sizes varying seasonally. Although occasionally found alone, they are more often found in groups of anything from a few individuals up to several hundred; the larger aggregations are seen more often in exposed, open coastline or offshore waters (and usually represent the offshore ecotype) rather than sheltered habitats close inshore where coastal bottlenose dolphins are present in small groups.

Calving periods are probably timed to take advantage of seasons when food is particularly abundant. Calving is known to have taken place within Cardigan Bay and new-born and very young calves have been reported in Cardigan Bay from April to September, suggesting a seasonal pattern to calving. There is a likely preference for more sheltered shallow areas for calving. Reproductive rates in Cardigan Bay SAC present healthy crude birth rates of 5.3% and 7.8% using closed and open population models respectively, confirming that this region serves as an important nursery ground for females and their young calves. Birth rates calculated for the entire Bay are even higher, especially when using an open population model (9.4%), suggesting there are additional females nursing their young within other areas of the Bay including Pen Llŷn a'r Sarnau SAC[56]. Calf mortality rates calculated for Cardigan Bay SAC are 18% for each of the first and second years, decreasing to 8% in the third year; a total of 55% of calves survive into their fourth year, when they reach independence from their mother.

[53] Feingold & Evans (2013)
[54] Pesante *et al*. (2008)
[55] Veneruso & Evans (2012)
[56] Feingold & Evans (2013)

Bottlenose dolphins are highly social animals with group sizes varying seasonally. Although occasionally found alone, they are more often found in groups of anything from a few individuals up to several hundred; the larger aggregations are seen more often in exposed, open coastline or offshore waters (and usually represent the offshore ecotype) rather than sheltered habitats close inshore where coastal bottlenose dolphins are present in small groups.

4.11.2 Range

Bottlenose dolphins are present in Welsh coastal waters throughout the year. There is a strong peak in numbers in summer and only a few animals are seen between November and April. They are most commonly seen in Cardigan Bay within 10 miles of the coast, and most concentrated within 2 miles near headlands and estuaries, such as New Quay, Aberporth, Mwnt, Cemaes Head and around the Teifi estuary, from April to October, although they are also seen in North Wales and around Pembrokeshire.

Recent analysis shows that nearly 30% of individuals have been identified in both Cardigan Bay SAC and Pen Llŷn a'r Sarnau SAC as well as north of the Llŷn Peninsula around the Isle of Anglesey, indicating large home ranges that most probably extend to the northern Irish Sea and maybe beyond. However, a proportion of the population shows a more local residency pattern, with relatively small home ranges.

Bottlenose dolphins from Pen Llŷn a'r Sarnau SAC interact with dolphins in Cardigan Bay SAC and probably interact with animals in waters of southwest UK and Ireland, and are likely to be moving and exchanging with more distant populations. Bottlenose dolphins using the SAC contribute to this wider population. It is becoming clear that the dolphins of the Cardigan Bay are not as resident as was once thought. Although the same identified dolphins occur in particular coastal areas of the Bay, during winter they range much more widely. Vessel surveys in North Wales (particularly from Anglesey eastwards towards Liverpool Bay) during 2007-08 have revealed that a sizeable portion of the Cardigan Bay population spends at least part of the winter in this area. Furthermore, even in summer, there are bottlenose dolphins regularly using the waters around North Wales northwards to at least the Isle of Man and Cumbrian coast.

4.11.3 Supporting habitat and species

The precise habitat requirement of bottlenose dolphins is poorly understood, but includes habitat that is of sufficient quality for feeding and calving, as well as resting and travelling. The Pen Llŷn a'r Sarnau SAC provides a proportion of the overall habitat requirements of the bottlenose dolphins that occur within the site. Different areas are used indicating that the habitats required by the bottlenose dolphin are spread throughout the site and include the overlying water column. In coastal waters, bottlenose dolphins appear to favour habitat with uneven topography and/ or strong tidal currents. Some of the habitat requirements of bottlenose dolphin are supported by other Annex I habitats.

Observations of bottlenose dolphins in the SAC have recorded centres of activity for bottlenose dolphins in Tremadog Bay, at the entrances to estuaries and also close to some of the sarnau reefs, indicating that the catchments of the freshwater tributaries entering the site together with the offshore reefs contribute to the overall site integrity for the species.

Bottlenose dolphins are generalist and opportunistic feeders eating a wide range of pelagic and benthic (demersal) fish, crustaceans and molluscs. Prey species include haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, cod *Gadus morhua*, hake *Merluccius merluccius*, mullet *Mugil* spp., eels *Anguilla anguilla* and *Conger conger*, salmon *Salmo salar*, trout *Salmo trutta*, bass *Dicentrarchus labrax* and sand eels Ammodytidae, as well as octopus *Eledone cirrhosa*, *Loligo* spp., and other cephalopods. The only natural predator is the killer whale *Orcinas orca* that has been occasionally sighted in Cardigan Bay.

From visual observations of the surface behaviour of bottlenose dolphins in Cardigan Bay, it is known that they capture pelagic fish such as sea trout (sewin), salmon, bass, mullet, mackerel, and garfish. There is limited knowledge of the degree to which the species preys upon demersal fish or benthic invertebrates. A post-mortem examination of a bottlenose dolphin in North Wales indicated stomach content was dominated by flatfish and interestingly the cause of death was associated with a dab obstructing the blowhole. Several studies have related visual and acoustic behavioural observations to foraging activities and have indicated the importance of sandbank and reef habitats.

The distribution and movement of prey are believed to influence the distribution and movement patterns of cetaceans, and feeding activities have been recorded throughout the inshore waters of the Bay.

As bottlenose dolphins forage widely, a decline in prey species in one area may not immediately impact the population. The status of likely prey species and the degree to which the bottlenose dolphin population is limited by prey availability is generally unknown. Prey availability is likely to be a key factor in determining the abundance and distribution of dolphins in Cardigan Bay.

Food resources appear to be a primary factor in determining movements and site fidelity in bottlenose dolphins. The Pen Llŷn a'r Sarnau SAC contains important potential feeding areas for bottlenose dolphins and they have been observed feeding while in waters of the SAC. Bottlenose dolphins are highly adaptable with respect to diet and feeding strategy and it is likely that variation in group size could be related to foraging strategies and the increased protection from predators provided by large groups.

4.11.4 Modifications as a result of human activity

Bottlenose dolphins are a top predator and are prone to accumulation of contaminants present within their food chains, particularly those that are persistent and those that tend to bioaccumulate and biomagnify. High levels of some contaminants have been found in stranded bottlenose dolphins in Cardigan Bay; 15 bottlenose dolphins were found to have levels of PCBs over 80mg/kg; that is, well over the 17mg/kg threshold for adverse reproductive effects and was considered to be of concern, especially as this is a long-lived apex predator of relatively small population size that only reproduces every 2-6 years..

A likely source of these contaminants is Liverpool Bay considering the use of this area by a sizeable proportion of the bottlenose dolphin population. It is not known how current levels of contaminants are affecting the bottlenose dolphins but they are a cause for concern in a species such as this where contaminants accumulate up the food chain and, in the case of organohalides accumulated in fatty tissue, are passed to the calves in the female's milk.

Strandings provide data on the occurrence and distribution of stranded dolphins and post-mortem analysis provides information on patterns of mortality, disease and diet. This is an important baseline for detecting unusual mortality events and the programme continues to add to a collection of biological samples that can provide additional data on the life history characteristics and foraging ecology of the population.

One of the other key considerations for the conservation of the bottlenose dolphin within the SAC and wider seas is disturbance by human activity. This may occur within close proximity to the dolphins, such as disturbance by power craft, or at some distance away, for example through use of underwater sonar equipment that has to potential to have a disturbance effect on cetaceans. There has been an increase in the number of power craft of all sizes operating within the SAC, and Cardigan Bay as a whole, and minimising disturbance to the bottlenose dolphin may need to be part of the focus of the management of the site. Other issues relate to potential entanglement and incidental capture of bottlenose dolphins by fishing gear and reduction or changes in food availability.

Bottlenose dolphins are adapted to the many challenging aspects of the marine environment. However, artificially introduced hazards and reductions in the natural quality and suitability of the bottlenose dolphin habitat in the SAC can occur through:

- the presence and persistence of artificial inert or toxic materials (e.g. plastics, synthetic fibres, hydrocarbons) causing entanglement, smothering or ill-health;
- competition with human activities for space causing displacement, collision, noise and visual disturbance;
- contamination of prey.

Physiological health affects susceptibility to disease and reproductive success. A range of viral, bacterial and parasitic diseases are known to be endemic within bottlenose dolphin populations but have a limited effect on healthy, unstressed adult animals. They are susceptible to certain diseases of domestic animals such as such as brucellosis and morbilliviruses, as well as cross infections from interactions with humans.

4.12 Otter *Lutra lutra*

The otter *Lutra lutra* is a semi-aquatic mammal which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas. Populations in coastal areas use shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing freshwaters. These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated riverbanks, islands, reed beds and woodland, which are used for foraging, breeding and resting.

At present, the majority of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. Other strong populations survive in Wales and Ireland. The otter is still scarce over much of England, where the highest concentrations are in the south-west. Recent surveys suggest that the otter population is recovering well and recolonising parts of its former range. While the SAC series makes a contribution to securing favourable conservation status for this Annex II species, wider countryside measures are important to its conservation in the UK.

Within the context of this document, the population for this site is considered to be those individuals that use the site and have, as part of their core range, the site and/or the catchments of any freshwater tributaries that enter the site.

4.12.1 Population structure

The number of otters within the SAC is not known, but there is evidence that they use areas of the coast within and adjacent to the SAC. Otters present within the site at any one time do not form a discrete population, but are part of a population living around freshwater habitats in Gwynedd and Ceredigion, which itself is not completely isolated but extends further afield and between which there are movements and exchanges. The proportion of the otter population within the site at any one time and its distribution is likely to be dynamic. It is not known whether the numbers of animals that use the site are an approximately fixed proportion of the wider population, or are a variable proportion with a preference for using marine habitat.

The SAC contributes to supporting the otter population as a foraging ground, access corridor and for social activity.

The site contributes to the population's reproductive success, through physiological health and reproductive capability, and by providing a proportion of food energy requirements. The number of otters that breed within the SAC or details on the movements of breeding animals in and out of the SAC is not known. There is lots of potential good habitat for breeding sites for otter within the SAC; they are known to breed on Llŷn Ystumllyn adjacent to the SAC on the south side of the Llŷn Peninsula and the River Leri that flows into the Dyfi estuary. Otters are also likely to breed inland, along watercourses adjacent to the SAC and use the SAC for foraging. Specific information on the use of the site by juveniles is unavailable.

The age frequency and sex ratio of otters using the site is not known nor is it known whether the age or sex of animals using the site are representative of the wider population, or dominated by animals of a specific age range or sex. Scottish studies suggest that male otters make more use of exposed rocky shores than females.

The physiological health of the otters present within and using the SAC is unknown. A range of viral, bacterial and parasitic diseases are known to affect otter populations, but these apparently have a limited effect on healthy, unstressed adult otters. The dispersed nature of the population may limit disease transmission and the influence of disease as a density dependent population control mechanism. Reproductive capability, exposure and immunity to endemic and anthropogenic disease and contaminant burden of otters within and using the SAC are unknown.

4.12.2 Range

Otters are widespread throughout Pen Llŷn a'r Sarnau SAC, both on the open coast and within the estuaries of the SAC as well as adjacent areas.

The distribution of otters is known primarily from spraint records in the SAC and adjacent areas, including on the foreshore, on access points from watercourses, along watercourses and river and estuarine locations. Whilst it may be considered that otters are more commonly found in and around the estuaries of the SAC, recent surveys have shown that otters have extended their range to other coastal areas around Pen Llŷn. A study of the Llŷn Peninsula in 2002 found otter signs within 1km of the shore at 8 out of 10 sites surveyed. It is reasonable to assume that otters may be found in any of the coastal areas of the SAC. Surveys indicate regular otter use of the Glaslyn/Dwyryd and Dyfi estuaries as well as signs of otters by the Mawddach estuary and in mine adits along the estuary. Information from surveys, sightings, and road casualties suggest that the Soch, Rhydhir, Erch, Dwyfor, Artro and Dysynni rivers are all now used by otters. There is also evidence of otter use of tidal reaches, for example, otter signs are found regularly at Broadwater on the Dysynni River

Availability of essential habitat and accessibility of these habitats to otters within the site and from adjacent areas and watercourses are major influences on the range and distribution of otters in and adjacent to the SAC. Access points and routes with scrub and tree cover from and between watercourses and coastal areas are generally preferred and the availability of these will influence the range that otters are able to inhabit.

4.12.3 Supporting habitat and species

Otters require appropriate habitat for feeding, resting, washing and breeding together with suitable access routes to enable otters to move freely between the SAC and marine habitats and freshwater areas e.g. rivers, streams and pools outside the SAC. Access points to the site from adjacent habitats, e.g. watercourses and vegetated valleys for feeding and other activities are widespread throughout the site. Within the site otters use intertidal and shallow subtidal rocky coasts, estuaries and their associated habitats, lagoons, and watercourses between these habitats.

The SAC contains important potential feeding areas for otters. Coastal fringes where suitable prey habitat is readily accessible are widespread throughout the site. These include sheltered shallow water such as rock-pools, lagoons and estuary shallows all accessible from freshwater habitat. Coastal otters can hunt as far as 100m offshore in water over 10m deep, but most feeding is done close to the shore in water less than 3m deep. The presence of many rivers and streams flowing into the SAC together with long stretches of coast being low lying land with wetland or sand dune habitats provide easy access to the marine environment for foraging.

Over most of their range otters are nocturnal or diurnal, probably due mainly to disturbance and persecution. When inactive they may sleep in areas known as dens, holts or couches. These can be holes in the ground, under tree roots, within rock piles, dense scrub or in quite open places. Otters are known to breed and rest within the SAC but there is little information on numbers and locations. The coast around the SAC is well supplied within rivers and streams and it is highly likely that they travel from one watercourse to another along the coast.

Otters living on the coast must have access to freshwater streams and pools for drinking and washing. Otters need to wash in freshwater in order to maintain the insulating properties of their fur. The lack of available freshwater might explain the restricted distribution of otters living along the coast in some areas of the UK, however the SAC is well served with rivers and streams throughout its length.

Habitat essential for otters, i.e. well vegetated stream and river valleys, access to the shore, access to freshwater, secluded resting habitats, is high throughout much of the site. The structural and functional integrity of this essential habitat is considered to be good.

Otter diet can be highly varied, though it is normally focussed on favoured prey species and a reflection of local prey availability. It is not known specifically what the otters living in and using the SAC feed on, nor the quality of food available to them within the marine environment. The main hunting areas will be largely determined by the habitat preferences of the prey species. Studies in Scotland have shown that fish form a large proportion of the diet with crabs and sea urchins also eaten but in lesser quantities. Various fish species are known to be eaten, such as eelpout *Zoarces viviparous*, rockling *Ciliata mustela*, sea scorpion *Taurulus bubalis*, butterfish *Pholis gunnellus*, corkwing wrasse *Symphodus melops*, eel *Anguilla anguilla* and fifteen-spined stickleback *Spinachia spinachia*. Otters are likely to be able to take advantage of seasonally abundant food sources. It is also likely that otters are not wholly dependent on the coast for food and that they also feed in adjacent rivers.

4.12.4 Modifications as a result of human activity

Historically, otters *Lutra lutra* occurred over most of the UK however, persecution, habitat loss and, more recently, the impact of toxic organochlorine insecticides caused a marked reduction in the range of the species. Otters are re-colonising marine sites at a slower rate than rivers. The regular presence of otters in the SAC makes this an important site for the conservation of this species.

There have been localised modifications that have affected the structural and functional integrity of this habitat, e.g. coastal developments, coastal defences, engineered watercourses, increased human use of coastal areas, and cleared and managed vegetation that has modified the ease of access for otters and reduced the ease of concealment as they move around. Many man-made structures do not appear to be a deterrent to otters, although the extent to which they modify behaviour is unknown.

Human activity causing disturbance with the potential to affect otter behaviour is widespread. Much of this activity is concentrated in residential and urban areas. There is less risk of disturbance from human activities in secluded sections of waterway and coast. The times of day favoured by otters for activity (early morning and dusk) help to minimise the amount of interaction with people.

Whilst good quality essential habitat is available within the SAC and adjacent area, the quality and suitability of this habitat can be reduced in a variety of ways, including:

- the presence and persistence of artificial inert materials (e.g. plastics, synthetic fibres, static fishing gear) leading to entanglement and smothering;
- decrease in seclusion because of noise and visual disturbance as a result of increased human access, habitation and waterborne activities;
- the presence and persistence of toxic contaminants, including the risk of fur contamination from oil discharged into freshwater and marine environments;
- availability and quality of prey.

Most of the common prey species recorded are not commercially exploited and the current stock status of these likely prey species is generally unknown. However, populations of European eel (often the dominant recorded prey species of otter) are below safe biological limits. The level of contamination of otter prey is generally unknown. As a top predator, otters are vulnerable to accumulation of toxic contaminants present within their food chains, particularly those that are persistent and /or bioaccumulate and biomagnify. The current status of contamination of most likely prey species is unknown, although European eels are known to be substantially impacted by a range of contaminants.

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 Pen Llŷn a'r Sarnau

NRW's vision for the Pen Llŷn a'r Sarnau SAC is for a high quality marine and coastal environment which is healthy, productive and biologically diverse, supporting resilient marine ecosystems and communities. The special habitat and species features of the SAC will be maintained and, where necessary, restored so that they will be able to sustain themselves in the long-term as part of naturally functioning ecosystems. The diversity of the wildlife habitats and species in the SAC will not be degraded.

The varied physical character and processes in different parts of the SAC will operate without any undue interference, this includes the natural processes of tides, waves and currents and the associated processes of sediment erosion and deposition. The quality of water in the SAC will be maintained or restored to a level necessary to maintain the features in favourable condition for the foreseeable future. The health and quality of the 12 SAC features are inter-related and will also depend on the state of other non SAC feature marine habitats within the site, as well as structural and functional components of the marine ecosystem.

The reefs of the SAC should continue to comprise a large variety of habitats and their associated biological communities both on the shore and underwater. The different components of the reef habitat should continue to be present with no significant loss of extent, and the quality of the wildlife communities they support should be maintained or enhanced; these components comprise reef formed from different types of hard substrate throughout the site (bedrock, boulders, cobbles and mixed ground), biogenic reefs and carbonate reef. The potential for expansion of the biogenic reef communities on the shore and underwater will be safeguarded through appropriate management.

The large shallow bay feature (Tremadog Bay) should continue to comprise a variety of high quality sediment and hard substrate habitats and their associated biological communities. The special characteristics of the bay will be maintained, including species rich and species diverse subtidal sediments as the dominant habitat type within the bay. The subtidal sediments should comprise a mosaic of sediment types including extensive areas of muddy gravel, fine and muddy sand and mud. On the shore, the condition of the varied habitat types and their associated communities will be expected to be maintained or improved under appropriate management. The intertidal habitat types present will include muddy and sandy gravel, mixed sediment and boulder shores, bedrock, sand and shingle. The natural biological productivity of the bay and its ability to function as a nursery area for fish and shellfish species will be maintained and safeguarded. The potential for expansion of the biogenic reefs and eelgrass (seagrass) communities that are components of the bay feature should be safeguarded through appropriate management.

The subtidal sandbanks for the SAC should continue to comprise mobile or highly mobile sediment habitats and their associated communities. The overall structure, sediment characteristics and biological communities of the Tripods, Bastram Shoal and Devil's Ridge sandbanks will reflect their exposure to the prevailing south-westerly winds and strong tidal flow. The sediment characteristics and biological communities of the Four-fathom bank sandbank will reflect conditions of slightly less exposure to wind and tidal currents. Sediment supply and hydrodynamic processes forming the sandbanks will continue unhindered. The condition of the biological communities within and on the sediment, together with mobile species associated with the sandbanks, will be maintained or improved under appropriate management.

Each of the three estuaries of the SAC will continue to be shallow, bar-built drying estuaries supporting a mosaic of habitats and associated wildlife that reflects the transition from the estuarine to terrestrial habitats. The estuaries will support good quality saltmarsh transitions to other habitats such as shingle, sand dune, peat mire, brackish and freshwater marsh, reed swamp, bog and woodland. The sediments of the estuaries will continue to comprise a high proportion of sandy to muddy sediments, and the sediment type and biological communities associated with them will reflect a gradient from more exposed and saline conditions at the mouth of each estuary to more sheltered freshwater-influenced communities in their landward reaches. The structure and characteristics of each estuary will be determined by unhindered geomorphological and biological processes, including sediment transport, erosion and accretion and the influence of flood events and by appropriate management of the surrounding catchments. Artificial constraints on the estuaries form and functioning will be minimised to ensure the long-term presence and viability of estuary habitats; restore floodplain functions and habitats; and improve the ecosystem resilience to climate change. The estuaries will continue to function as fish nursery areas and to support important populations of migratory fish and birds, and other key species such as otter.

The Morfa Gwyllt coastal lagoon will continue to be present in its current location with no loss of extent or reduction in its ability to provide a specialised brackish water lagoon habitat. Specialist lagoon species will continue to be present as viable populations together with a range of other marine species characteristic of the predominantly sediment habitat in the lagoon basin. The negative impact of disturbance to the lagoon from human activities would be expected to be reduced under appropriate management, thereby improving the ability of Morfa Gwyllt to continue to exist and function as a coastal lagoon.

The intertidal mudflats and sandflats feature should continue to comprise an array of sediment habitats and their associated biological communities, ranging from exposed and moderately exposed sands in open coast situations, through exposed to sheltered sands and muds in estuarine conditions. Complete examples of zonation of exposed and moderately exposed sediment communities will continue to be present. The quality of intertidal mudflat and sandflat communities would be expected to be maintained or improved. The potential for expansion of the nationally scarce eelgrass (seagrass) community should be safeguarded through appropriate management. The long-term viability and quality of the intertidal mudflats and sandflats in estuarine conditions may be enhanced by restoration of more naturally functioning estuary systems.

The site retains its complete sequences of saltmarsh vegetation, from pioneer vegetation, such as glasswort, through to upper saltmarsh. The variety of communities will continue to be present and their quality will be maintained or improved. The long-term viability and quality of the saltmarsh features will be improved through management of the estuaries that restores more naturally functioning estuary systems.

The sea caves feature should continue to comprise intertidal and subtidal caves, clefts, crevices and tunnels in the bedrock substrate within the SAC. The extent of the sea caves and the variety and quality of the biological communities they support will be maintained or improved. Many of the caves (intertidal and subtidal) will continue to support well-developed zonation of sea cave communities. The sea caves of the SAC will continue to provide accessible and high quality breeding places for grey seal.

The SAC will continue to provide a productive and supportive marine area for grey seals. The population of grey seals frequenting the SAC will form and important component of a larger southwest UK population of grey seals. Grey seals will continue to be widespread throughout the SAC predominantly in areas of open coast and sea. Grey seals will have access to, and sufficient availability of prey, and they will have widespread availability and access to good quality essential habitats, including areas for hauling out and pupping, that are free from excessive disturbance. The quality and distribution of haul out and breeding sites for grey seals within the site will be maintained or improved through appropriate management.

The SAC will continue to provide a productive and supportive marine area for bottlenose dolphin. Bottlenose dolphin will continue to be widespread within the waters of the SAC and those frequenting the SAC will reflect a healthy population structure including immature and adult male and female dolphins. The bottlenose dolphins in the SAC will form an important component a larger population of this species present in Cardigan Bay and in the wider sea area around Wales and the north east Atlantic. The animals using the SAC will reflect good physiological health. The bottlenose dolphins will have access to and sufficient availability of prey, and they will have widespread availability and access to good quality essential habitats free from excessive disturbance. The quality and distribution of essential habitats (such as for feeding, calving, resting and travelling) within the site will be maintained or improved through appropriate management.

Otters will continue to be widespread throughout the SAC both in areas of open coast and within the estuaries. Otters will have sufficient availability of prey and widespread availability and access to good quality essential habitats including freshwater and undisturbed resting and breeding sites to allow the otter population to thrive. The distribution, breeding centres and actual/potential breeding sites of otters within the site and adjacent catchments will be maintained or improved through appropriate management.

The landscape quality and conservation value of the area will continue to be high. The presence of the Pen Llŷn a'r Sarnau SAC and its special wildlife enhances the economic and social values of the area by providing a high quality environment for fisheries, outdoor activities, ecotourism, scientific and educational study, and peaceful enjoyment by local people and visitors. The positive contribution of the SAC to the natural, social and economic quality of the area will be recognised and promoted through appropriate sea and land management which ensures compatibility between activities and the sustainable use of the site. Local communities will take pride in their surroundings and work actively to make sustainable improvements for future generations.

5.2 Conservation objectives for the Pen Llŷn a'r Sarnau Special Area of Conservation

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

- Reefs
- Large shallow inlets and bays
- Sandbanks which are slightly covered by seawater all the time
- Estuaries
- Coastal lagoons
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows
- *Salicornia* and other annuals colonising mud and sand
- 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 **reef** feature these include;

- Rocky intertidal reefs
- Rocky subtidal reefs
- Extensive boulder and cobble reefs – the sarnau
- Biogenic reefs (horse mussel *Modiolus modiolus* reef / green crenella *Musculus discors* reef and Honeycomb worm *Sabellaria alveolata* reef
- Carbonate reef formed by methane gas leaking from the seabed.

For the **intertidal mudflat and sandflat** feature these include:

- Mya arenaria and polychaetes in muddy gravel
- Eel grass Zostera marina beds.
- Muddy gullies in the Mawddach estuary.

For the ***Salicornia*** feature this includes:

- Communities characterised by the species *Sarcocornia perennis*.

For the **intertidal mudflats and sandflats** and **sandbanks** features this requires an overall stability or increase in the amount of the feature, taking into account the areas of long term stability and localised losses and additions arising from environmental processes.

For **estuaries** this includes the stability of sandy sediments in proportion to the muddy sediments.

<u>Restoration and recovery</u>
As part of this objective it should be noted that; for the **estuaries** feature additional land which should form an integral part of the estuarine ecosystem should be restored

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.

For **Atlantic saltmeadows** this includes the morphology of the saltmarsh creeks and pans

<u>Restoration and recovery</u>
As part of this objective it should be noted that; for the **estuaries** feature the structure and functions of the estuaries that have been damaged/degraded by the constraints of artificial structures such as flood banks, are restored.

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.

Restoration and recovery
As part of this objective it should be noted that; for the **reefs** feature the potential for expansion of the horse mussel *Modiolus modiolus* community off the north Llŷn coast is not inhibited.

5.2.5 Species Features

- Grey seal *Halichoerus grypus*
- Bottlenose dolphin *Tursiops truncatus*
- Otter *Lutra lutra*

5.2.6 Populations
The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:
- population size
- structure, production
- condition of the species within the site.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**;
- Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression

For **grey seal** populations should not be reduced as a consequence of human activity.

5.2.7 Range
The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**:
- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered
- There are appropriate and sufficient food resources within the SAC and beyond

- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

5.2.8 Supporting habitats and species

The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;

- distribution
- extent
- structure
- function and quality of habitat
- prey availability and quality.

As part of this objective it should be noted that;

- The abundance of prey species subject to existing commercial fisheries needs to be 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 species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
- Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
- Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour

For **otter** there are sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing.

5.2.8 Restoration and recovery

As part of this objective it should be noted that for the **bottlenose dolphin** and **otter**, populations should be increasing.

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 Directives 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 (as amended), 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[57].

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

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.

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

- The ‘features’ columns indicate which Annex 1 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
		Reefs	**Estuaries**	**Mud & sandflats**	**Saltmeadow**	***Salicornia***	**Lagoons**	**Inlets & bays**	**Sandbanks**	**Sea caves**	**Otter**	**Grey seal**	**Bottlenose dolphin**		
DOCKS, MARINAS & SHIPPING															
Dock, harbour & marinas structures: Construction* *Small to medium-scale Ports and, harbours around the Llŷn and Meirionnydd coasts. Medium scale marina at Pwllheli. Marina at Aberystwyth (outside of SAC to the south)*	<u>Geophysical regime</u>: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters</u>: changes to available oxygen; turbidity; suspended sediments <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, crushing, abrasion, smothering visual, noise		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: loss of / reduction in habitat extent; reduction in habitat distribution; particularly intertidal habitats. <u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	
Dock, harbour & marinas structures: Maintenance* *As above*	<u>Environmental quality</u>: addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates) <u>Physical disturbance</u>: displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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 contamination and availability. <u>Conservation status of typical species & species features</u>: likely decrease in species diversity and effects to population dynamics dependant on location and extent of proposed maintenance and	Treat as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and

															materials used. *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; materials (paint, cleaning agents etc.) used; relevant site-specific biotic and abiotic information.*	enforce.
Dredging: capital * *None at present. Future proposals possible associated with port, harbour, marina developments.*	<u>Geophysical regime</u>: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters</u>: changes to available oxygen; turbidity; suspended sediments <u>Environmental quality</u>: increased suspended nutrients; remobilisation of toxic & non-toxic contaminants (increasing bioavailability) <u>Physical disturbance</u>: displacement, abrasion, smothering, visual, noise <u>Other factors</u>: removal of biota	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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). *<u>Operation specific information required</u>: location, extent, scale , timing and duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate. Establish best operational practices suitable to secure features at FCS
Dredging: Maintenance* *Primarily to maintain navigable depths in approaches to relevant harbours and marinas.*	<u>Geophysical regime</u>: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate <u>Fundamental environmental parameters</u>: changes to available oxygen; turbidity; suspended sediments <u>Environmental quality</u>: increased suspended nutrients; toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, abrasion, smothering, visual, noise <u>Other factors</u>: removal of biota	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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, sessile faunal turf communities). *<u>Operation specific information required</u>: location, extent, scale, timing and duration; frequency of operation and proximity to healthy populations for recruitment; relevant location-specific biotic and abiotic information*	Treat as plan or project if appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.
Shipping: vessel traffic *No data available. Most shipping in transit in Irish Sea unlikely to pass through*	<u>Geophysical regime</u>: vessel wash - substrate erosion, local modification of wave exposure regime <u>Fundamental environmental parameters</u>: turbidity <u>Physical disturbance</u>: collision, noise, visual	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: particularly	Determine effects of vessel movement on sediment transport, mobilisation and turbidity. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to

SAC, except to seek shelter on passage.														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 (seals); relevant location-specific biotic and abiotic information*	secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS
Shipping: Mooring* *Main areas for mooring in ports & harbours around the site, and in sheltered embayments. Also St Tudwal's Road area in summer.*	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, 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*	Treat new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations (*i.e.* out with MHPA port limits).
Shipping: anchoring *Limited activity in relation to commercial shipping in SAC.*	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*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of open coastal locations used as commercial anchorages and for casual recreational anchoring
Shipping: Vessel maintenance (incl. antifouling)	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	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and

Not known in site.														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.*	enforce.
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 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.*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS
Shipping: Refuse & sewage disposal *Possibly occurs in SAC, at unknown level – likely low level in site as not on main shipping routes.*	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*	Management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Apply existing legal mechanisms, monitor compliance and enforce, to secure features at FCS
Shipping: operational discharges *Possibly occurs in SAC, at*	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,	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and

unknown level – likely low level in site as not on main shipping routes.														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*	enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: accidents -may be associated with cargo / bunkers discharges *No known recent events. Potential exists for a damaged or struggling vessel to be brought into Tremadog Bay*	Geophysical regime: local modification of substrate structure & topography Environmental quality: addition of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing abrasion; visual; noise	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Structure and function: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) hydrocarbon contaminant burden. Conservation status of typical species & species features: local effects on populations of species sensitive to physical impacts &/or hydrocarbon contamination; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing and duration; type, amount and toxicity of discharges; relevant location-specific biotic and abiotic information*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - fuel oil & / or petrochemical discharges *No known recent events. Potential exists for a damaged or struggling vessel to be brought into Tremadog 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*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents- non-petrochemical cargo losses / discharges *No known recent events.*	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*.	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (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	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	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	Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS; monitor

No known recent events. Potential exists for a damaged or struggling vessel to be brought into Tremadog Bay	debris Physical disturbance: displacement, amputation, crushing, abrasion, noise; visual													contaminants; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale, timing, duration and nature; likely effects and outcome; relevant location-specific biotic and abiotic information*.	compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Provide environmental advice to salvage managers and salvors.
CIVIL ENGINEERING															
Construction* *Widespread throughout the site – mainly linked (but not confined) to centers of population. Scale of developments very variable*	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*	Treat as plan or project, taking into account proposed subsequent operational use and maintenance. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Land claim *# *Majority of past reclamation of land in the estuaries and associated with agricultural activities.*	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, taking into account proposed subsequent operational use and likely effects.
Coast protection: hard defence (sea walls / breakwaters)*#	Geophysical regime: modification of substrate, hydrodynamic regime & sediment transport Fundamental environmental parameters: suspended sediments,	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		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	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.

Present at various locations along the coast – many rock armour defences varying in scale.	turbidity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime														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*	
Coast protection: hard defence (railways)*# *Coastal defence associated with Cambrian Coast line - includes coastal and flood protection works particularly where railway line very close to the sea, also filling in of caves below the railway and Ffriog & Llanfair.*	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.
Coast protection: soft defence*# *At some locations in SAC, but not extensive.*	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.
Coast protection: groynes*# *Present at various locations along the coast (south Llŷn, Barmouth, Towyn, and Borth).*	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	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		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*	Treat as plan or project as appropriate, taking into account long term management requirements and predicted climatic impacts.

	effects from modified hydrodynamic regime													*and duration; construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	
Coast protection: beach replenishment* # *Has taken place on south Llŷn coast (Traeth Crugan) and at Aberdyfi.*	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.
Coast protection: storm surge / tidal barrage *# *None at present.*	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 proposed subsequent operational use and likely effects.
Barrage: amenity*# *None present.*	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	Treat as plan or project as appropriate.

														species ranges (reproductive propagules of sessile biota and movement of mobile biota including vertebrates and species features) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	
Foreshore deposit of rock, rubble etc. *Isolated incidences throughout the SAC.*	<u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: suspended sediments, turbidity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓		✓			✓	✓	✓	<u>Extent & distribution</u>: 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 <u>Structure & function:</u> 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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Continued surveillance and monitoring. Appropriate implementation of SSSI procedures.
Artificial reef *Artificial reef with sea defence and recreational function (surfing) at Borth.*	<u>Geophysical regime</u>: modification of tidal, streams, wave exposure, substrate, sediment transport <u>Fundamental environmental parameters</u>: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance <u>Environmental quality</u>: modification of suspended particulates <u>Physical disturbance</u>: displacement, smothering,	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: loss of / reduction in habitat extent <u>Structure & function:</u> 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) <u>Conservation status of typical species & species features</u>: modification in species variety, distribution, composition, ranges *<u>Operation specific information required</u>: 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
Hard-engineered freshwater	<u>Geophysical regime</u>: substrate, sediment transport <u>Fundamental environmental parameters</u>: modification of salinity,	✓	✓	✓	✓	✓	✓	✓		✓	✓			<u>Structure & function</u>: localised, and potential far-field, modification of salinity regime and water circulation. <u>Conservation status of typical species & species features</u>: localised	Treat as plan or project as appropriate.

watercourses *# *Associated with some locations in SAC - in and adjacent to the estuaries in particular.*	suspended sediments, turbidity Physical disturbance: displacement													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.*	
Power station *# *None at present in SAC.*	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.
Pipelines *#	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. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
Power / communication cables *# *Some present in SAC, e.g. electricity cable across Dyfi.*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise. Potential electro-magnetic effects of electrical cables. Scour effect on benthic habitats from cables due to wave action.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Structure & function: dependent on depth of cable burial in seabed – modification of sediment transport processes and local hydrodynamic regime. Conservation status of typical species & species features: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
WASTE DISPOSAL															
Effluent disposal; domestic & industrial (sewage & chemical)	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: addition of toxic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: water quality directly or indirectly affects habitats feature species and species features. The range of composition of industrial and domestic effluents	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.

There are a number of discharges throughout the catchment and directly into the waters of the SAC. Majority are sewage effluent. Little heavy industry in the area. *NRW and DCWW datasets available on locations and inputs. General trend of improved treatment resulting in discharge with lower solids and nutrients*	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													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 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. *<u>Operation specific information required</u>: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	
Effluent disposal: thermal* *None known*	<u>Fundamental environmental parameters</u>: thermal regime; possibly also salinity, suspended particulates; oxygen depletion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: local modification of thermal regime; possible modification of salinity regimes and water quality depending on content of discharge <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: location, frequency, timing and duration, volume, flow and degree of difference from ambient temperature of discharge; relevant location-specific biotic and abiotic information.*	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
Sludge dumping* *None at present*	<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 nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.

Miscellaneous wastes & debris (including refuse & litter) *Widespread and common from varied sources.*	Geophysical regime: addition of persistent artificial substrates Environmental quality: Addition of toxic & non-toxic contaminants Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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 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*	Maintain, keep under review and improve as appropriate port waste management plans Secure appropriate promotion & enforcement of national and international dumping at sea measures so as to minimise risk to features' FCS Education & awareness raising
Dredge spoil disposal * *Currently no licensed offshore disposal sites within or adjacent to the SAC. Nearest offshore disposal site is at Holyhead Deep (NW Anglesey)*	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*	Treat proposed spoil disposal out with a designated spoil disposal site as plan or project as appropriate. Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off*	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 promulgation 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	Geophysical regime: addition to substrate, modification to hydrodynamic regime & sediment transport Fundamental environmental parameters: elevation of suspended sediments; oxygen depletion Environmental quality: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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 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*	Continued surveillance and monitoring of inputs and water quality by NRW; continued development and promulgation of good practice.
EXPLOITATION OF LIVING RESOURCES															
Trawling: beam	Geophysical regime: modification of substrate; addition of persistent inert	✓	✓	✓				✓	✓			✓	✓	Structure & function: modification of sedimentology – decrease in sediment habitat heterogeneity, sediment transport processes; damage	To secure features at FCS, assess the impacts from the

Some activity in the SAC. Exact scale and location of operation not fully known. Byelaws limit larger vessels fishing within SAC.	debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species													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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	activity on the features of the site.
Trawling: otter *Some activity in the SAC. Exact scale and location of operation unknown. Statutory instrument limit larger vessels fishing within SAC.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓				✓	✓			✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Dredging: toothed *Does not occur in SAC*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓				✓	✓			✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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 *Not known to occur in SAC.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓				✓	✓			✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Dredging: bladed – mussel seed *May have occurred at a few localised areas in SAC.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓				✓	✓			✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Dredging: bladed - oyster *Not known to occur.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓	✓				✓	✓			✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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, 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: deep hydraulic (e.g. WJID) *Prohibited within the SAC under a statutory instrument*	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.
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) *Mainly for Bass.*	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: bottom-set tangle / trammel *Occurs within SAC, scale and location of operations not known.*	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 within SAC. Scale and location of operations not known.*	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: beach seine *May occur in SAC. Frequency and intensity 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	To secure features at FCS, assess the impacts from the activity on the features of the site.

														fragile, erect benthic reef species; entanglement of vertebrate species, including species features. Indiscriminate 'ghost fishing' by lost netting. *<u>Operation specific information required</u>: gear type and effort; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Netting: demersal seine *Not currently known to occur within the SAC.*	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris <u>Physical disturbance</u>: entanglement, displacement (target & non-target species), amputation, abrasion <u>Other factors</u>: removal of target species	✓	✓					✓	✓			✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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: beach-set gill *Occurs within SAC. Scale and location of operations not known.*	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris <u>Physical disturbance</u>: entanglement, displacement (target & non-target species), amputation, abrasion <u>Other factors</u>: removal of target species	✓	✓	✓				✓			✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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) *Not known if occurs in SAC.*	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris <u>Physical disturbance</u>: entanglement, displacement (target & non-target species), amputation, abrasion <u>Other factors</u>: removal of target species		✓					✓			✓			<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Potting: lobster / crab	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert	✓						✓				✓	✓	<u>Structure & function</u>: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species	To secure features at FCS, assess the impacts from the activity on the features of the site.

Widespread and common – main fishing activity in area. Mainly lobster and brown crab. Intensity, location and effort information is unknown	debris Physical disturbance: displacement, crushing & abrasion Other factors: removal of target 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*	
Potting: prawn *Occurs in SAC. Intensity, 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 in SAC. Intensity, 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 in SAC. Intensity, 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.
Line: handline *Occurs in SAC. Intensity, location and*	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	To secure features at FCS, assess the impacts from the activity on the features of the site.

effort information is unknown.														structures. Operation specific information required: *location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
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) *Occasional gathering in estuaries – main interest in Dyfi. Casual private collection in estuaries.*	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) *Occasional gathering from naturally occurring mussel beds throughout site likely. Exact scale and location not known*	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: mussel seed (excluding access issues) *Has occurred in the Dyfi.*	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 Conservation status of typical species & species features: depletion of	This is a permitted fishery and has to undergo a Habitats Regulation Assessment.

	<u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species													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 *<u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	
Hand gathering: razor clam (including salting) *Isolated incidents occur in SAC. Intensity, location and effort information is unknown.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓	✓	✓				✓			✓			<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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 *Frequency and intensity unknown, but probably very low levels in SAC*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓	✓	✓				✓			✓			<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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: winkles *Occurs in SAC on rocky shores. Frequency and intensity unknown.*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species	✓	✓					✓			✓			<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity;*	To secure features at FCS, assess the impacts from the activity on the features of the site.

														relevant location-specific biotic and abiotic	
Hand gathering: crustacean / shellfish *Occurs in SAC. Intensity, 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: algae & plants for human consumption (e.g. *Porphyra, Salicornia*) *Occurs in SAC. Intensity, 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 *Integral to some hand gathering activities. Access by foot and vehicle occurs in different parts of the site.*	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).	To secure features at FCS, assess the impacts from the activity on the features of the site.
Hand / mechanical gathering: algae for chemical extraction / biomass	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 Conservation status of typical species & species features: depletion of	To secure features at FCS, assess the impacts from the activity on the features of the site.

Not known to occur in SAC.	<u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species													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 *<u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic*	
Bait collection: digging *Generally low level of activity. Lug worm, harbour rag and occasional razor fish are collected. Intensity, location and effort information is unknown.*	<u>Geophysical regime</u>: modification of substrate physical structure (direct and indirect through addition of artificial habitat to attract bait species, e.g. 'crab tiles') <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen, local salinity modification ('salting') <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement; possible crushing, amputation & smothering <u>Other factors</u>: removal of target species		✓	✓				✓						<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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 *Generally low level of activity. Intensity, location and effort information is unknown.*	<u>Geophysical regime</u>: modification of substrate physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen, local salinity modification ('salting') <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement; possible crushing, amputation & smothering <u>Other factors</u>: removal of target species		✓	✓				✓						<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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: boulder turning *Generally low level of activity. Intensity, location and effort information is unknown.*	<u>Geophysical regime</u>: modification of substrate physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity; reduced oxygen, local salinity modification ('salting') <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants (digging) <u>Physical disturbance</u>: displacement; possible crushing, amputation & smothering	✓	✓					✓						<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: target species and shore type;*	To secure features at FCS, assess the impacts from the activity on the features of the site. Education & awareness raising

	Other factors: removal of target species													*location, extent, scale, frequency, timing duration and nature of collection activity; relevant location-specific biotic and abiotic information*	
Aggregation devices (e.g. 'crab tiles') *Occurs in SAC. Intensity, location and effort information is unknown*	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, sediment processes; reduction in habitat quality (introduction of artificial substrate); modification of water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, 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*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Collection, for aquarium / curio trade *May occur in SAC. No information.*	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.
Grazing of saltmarsh *Occurs in estuaries.*	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 Physical disturbance: displacement; possible crushing, amputation & smothering Other factors: removal of target species		✓	✓	✓	✓								Structure & function: disturbance or modification of habitat structure by grazing animals Conservation status of typical species & species features: modification of target species population size and structures *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
CULTIVATION OF LIVING RESOURCES															
Aquaculture: algae *Not known to occur in SAC.*	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	✓	✓	✓	✓	✓		✓			✓			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.

	species														
Aquaculture: finfish - sea cages or impoundments * *Not known to occur in SAC.*	<u>Fundamental environmental parameters</u>: oxygen depletion <u>Environmental quality</u>: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors</u>: introduction of non-native species	✓	✓	✓				✓	✓			✓	✓	<u>Extent & distribution</u>: potential decrease in (intertidal) habitat extent <u>Structure & function</u>: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features</u>: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *<u>Operation specific information required</u>: 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.*	<u>Fundamental environmental parameters</u>: oxygen depletion <u>Environmental quality</u>: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors</u>: introduction of non-native species	✓	✓	✓				✓	✓		✓	✓	✓	<u>Extent & distribution</u>: potential decrease in (intertidal) habitat extent <u>Structure & function</u>: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features</u>: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *<u>Operation specific information required</u>: 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'* *Not known to occur in SAC.*	<u>Fundamental environmental parameters</u>: oxygen depletion <u>Environmental quality</u>: toxic & non-toxic contamination, nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors</u>: introduction of non-native species	✓	✓	✓	✓	✓		✓			✓	✓	✓	<u>Extent & distribution</u>: potential decrease in (intertidal) habitat extent <u>Structure & function</u>: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (increase in nutrients, toxic & non-toxic contaminants, oxygen demand) <u>Conservation status of typical species & species features</u>: local modification of species physiological health, variety, composition within zone of influence; modification of behaviour and range of predatory species (including species features) *<u>Operation specific information required</u>: 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 'farming' * (molluscan culture using trestles, ropes, cages or other structures)	<u>Fundamental environmental parameters</u>: oxygen depletion <u>Environmental quality</u>: nutrient & organic enrichment; possible addition of pesticides & antifoulants <u>Other factors</u>: introduction of non-native species	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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, oxygen demand); modification of biological interactions (*e.g.* predator-prey relationships) <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: species and aquaculture structures; location, extent, scale and duration; relevant location-specific biotic and abiotic information*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Aquaculture: land based semi-enclosed / recirculation * *Land-based fish farm at Afon Wen.*	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* *Widespread in catchment area for hydropower, public water supply, industry, agriculture, amenity & fish farming*	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 new proposed developments as plan or project as appropriate. Review existing consents
Aggregate extraction * (mineral & biogenic sands & gravels) *Not 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 duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate.
Oil & gas exploration: seismic survey* *No blocks currently licensed.*	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 new proposed developments as plan or project as appropriate.
Oil & gas exploration & production: drilling operations*	Geophysical regime: substrate modification Environmental quality: hydrocarbon contamination Physical disturbance: displacement, crushing, smothering in immediate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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 new proposed developments as plan or project as appropriate.

	vicinity; noise														
Oil & gas exploration & production: operational* & accidental discharges *No blocks currently licensed.*	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 new proposed developments as plan or project as appropriate.
Renewal energy generation: tidal barrage*# *No proposals at present.*	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 Environmental quality: toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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); 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*	Treat as plan or project as appropriate.
Renewable energy generation: tidal impoundment *# *No proposals at present.*	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 Environmental quality: toxic & non-toxic contaminant accumulation; organic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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,	Treat as plan or project as appropriate.

	enrichment													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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance*	
Alternative energy production: tidal current turbine*# *No proposals at present.*	<u>Geophysical regime</u>: modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance</u>: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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 plan or project as appropriate.
Alternative energy production: tidal current turbine & wave energy*# *Low possibility of development interest; low site suitability.*	<u>Geophysical regime</u>: modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance</u>: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓				✓	✓		✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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 plan or project as appropriate.
Alternative energy generation: offshore wind *#	<u>Geophysical regime</u>: modification of wave and tidal regimes; modification to substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants <u>Physical disturbance</u>: general physical	✓						✓	✓		✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification	Treat as plan or project as appropriate.

No proposals at present.	effects; possible collision													of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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.*	<u>Environmental quality</u>: toxic contamination - petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: noise, visual	✓							✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water chemistry (with purpose of ameliorating degree of modification) <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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 West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – washing *Reactive only. No recent activity*	<u>Geophysical regime</u>: modification & removal of substrate <u>Fundamental environmental parameters</u>: salinity; temperature <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, noise, visual	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	<u>Structure & function</u>: local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or sediment entrapment of hydrocarbon contaminants); <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning - chemical *Reactive only. No recent activity*	<u>Environmental quality</u>: addition / increase petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: including displacement	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	<u>Structure & function</u>: modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources <u>Conservation status of typical species & species features</u>: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning - physical *Reactive only. No recent activity*	<u>Geophysical regime</u>: modification & removal of substrate <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, trampling, noise, visual	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	<u>Structure & function</u>: modification of habitat structure, sedimentology, water & sediment chemistry through remobilisation and transfer of hydrocarbon contamination <u>Conservation status of typical species & species features</u>: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan

Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue) *Reactive only. No recent activity*	Geophysical regime: modification of substrate Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, smothering, collision, noise, visual Other factors: removal of biota	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	Structure & function: modification of habitat structure, sedimentology Conservation status of typical species & species features: acute local modification of species population sizes, structures, physiological health; disturbance and displacement of vertebrate species including species features *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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan Treat as plan or project as appropriate.
RECREATION															
Angling *Widespread and common: from shore, recreational and charter boats. Frequency and intensity 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.
Bait collection: boulder turning *Generally low level of activity. Frequency and intensity not known.*	Geophysical regime: modification of substrate physical structure 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 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 invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *Operation specific information required: target species and shore type (exposure); 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.
Bait collection: digging & other sediment shore collection techniques* *Generally low level of activity. Lug worm, harbour rag and occasional razor*	Geophysical regime: modification of substrate physical structure; sediment transport Fundamental environmental parameters: turbidity; oxygen; salinity Environmental quality: remobilisation of toxic & non-toxic contaminants Physical disturbance: displacement; possible crushing, amputation,		✓	✓				✓			✓			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	Education & awareness raising To secure features at FCS, assess the impacts from the activity on the features of the site.

fish are collected. Frequency and intensity not known.	smothering, visual Other factors: removal of target species													in predatory invertebrate 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 and duration; relevant location-specific biotic and abiotic information*	
Recreational boating: high speed power craft (incl. PWC) *Common in SAC with peak activity during summer season.*	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*	Education & awareness raising Activity surveillance.
Recreational boating: low speed power craft *Common in SAC with peak activity during summer season.*	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*	Education & awareness raising Activity surveillance.
Recreational boating: sail *Common in SAC with peak activity during summer season.*	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*	Education & awareness raising Activity surveillance.
Recreational boating: canoeing *Sea kayaking occurs in SAC. Frequency and intensity 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*	Education & awareness raising Activity surveillance.
Recreational boating: other non-mechanically powered craft (e.g. kite-surfing, board-sailing etc.)	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*	Education & awareness raising Activity surveillance.

Occurs at some locations in SAC. Frequency and intensity unknown.															
Recreational boating: moorings *Main areas for mooring in ports & harbours around the site, and in sheltered embayments. Also St Tudwal's Road area in summer.*	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 new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations
Recreational boating: anchoring *Common in SAC with peak activity during summer season.*	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 practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of open coastal locations used as commercial anchorages and for casual recreational anchoring
Scuba diving, snorkelling *Common at certain locations in SAC (north Llŷn, Bardsey Island, Aberdaron Bay, St Tudwal Island's. Greater level of activity during summer. Unquantified.*	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*	Education & awareness raising; develop participation in environmental site feature observation schemes. Activity surveillance.
Spearfishing *No information available.*	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*	Enforce relevant legislation prohibiting spearfishing
Coastal access for recreation	Environmental quality: organic enrichment, microbial pathogens,	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		Conservation status of typical species & species features: disturbance and modification of range and behaviour of vertebrate species; local	Education & awareness raising

(bathing, dog walking, coasteering etc.) *Substantial, but unquantified. Seasonally and spatially highly variable.*	persistent inert materials Physical disturbance: general physical effects; trampling; noise; visual													modification of benthic species composition *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Vehicles on foreshore *Intensive use at some locations around the SAC (e.g. Black Rock sands/ Ynys Las) and less intensive but widespread at various other locations in SAC – associated with boat launching and recreation. Total scale and frequency unquantified.*	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*	Activity surveillance Education & awareness raising Appropriate implementation of SSSI procedures & access byelaws
Light aircraft *Occasional craft flying over SAC.*	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
Wildfowling *Occurs in SAC, primarily in estuaries.*	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*	Activity surveillance Education & awareness raising Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws
Marine wildlife watching / eco-tourism *Some charter boats operate in area. Some coastal activity.*	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*	Research potential effects on features
Military activity: marine exercises *Not 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*	Research potential effects on features
Military activity: aircraft *Llanbedr airfield*	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
MISCELLANEOUS OPERATIONS AND USES															
Marine archaeology & salvage *Presence of coastal and marine archaeological / historic interests. Two subtidal protected wreck sites within SAC. Unofficial marine salvage may occur. Scale unknown*	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*	Education & awareness raising
Education *A few popular sites, e.g. Dyfi, Artro, Harlech. Other areas*	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,*	Review, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access

visited infrequently.														*frequency, timing and duration; relevant location-specific biotic and abiotic information*	byelaws Development and encouragement of information exchange
Science research *Similar to educational use. NRW, Universities (particularly in Wales) and non-governmental organisations (e.g. Whale & Dolphin Conservation Society; Friends of Cardigan Bay) are main bodies undertaking research in SAC*	<u>Physical disturbance</u>:: displacement, crushing, noise, visual <u>Other factors</u>: species removal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: local modification of geomorphology, biological interactions <u>Conservation status of typical species & species features</u>: local modification of benthic species population structures; disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Review, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws Development and encouragement of information exchange
Animal welfare operations & sanctuaries *Not known in site.*	<u>Environmental quality</u>: potential release of microbial pathogens <u>Physical disturbance</u>: noise, visual <u>Other factors</u>: habituation of wild species to humans										✓	✓	✓	<u>Conservation status of species features</u>: effects on population physiological health (survival and release of low-fitness individuals), potential exposure to domestic disease; potential disturbance and modification of range and behaviour *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Review, develop and/or implement and monitor best practice suitable to secure features at FCS

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See also reports from:
British Geology Survey
Bardsey Bird and Field Observatory
Cardigan Bay Coastal Group.
Countryside Council for Wales
Friends of Cardigan Bay
Marine Nature Conservation Review (Joint Nature Conservation Committee)
Seasearch

Seawatch Foundation

Annexes

Annex 1 Pen Llyn a'r Sarnau SAC feature map: interpretation guide

The data found within the Pen Llŷn a'r Sarnau 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**
- **Coastal lagoons**
- **Estuaries**
- **Atlantic Salt Meadow** (Glauco-Puccinellietalia maritimae)
- **Salicornia** and other annuals colonising mud and sand

All feature definitions are taken from the "Interpretation Manual of European Union Habitats[58]"

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 feature is based on the following information sources:

- CCW Phase 1 Intertidal Habitat Map
- Admiralty Charts

58 http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

- Expert knowledge

No changes in total feature extent have been made except where data errors (e.g. unaligned polygon feature edges) existed in the original map. A small boundary change was made in the mouth of the Mawddach Estuary where the feature was re-aligned to the seaward SSSI boundary, thus more accurately reflecting the presence of the feature to the SSSI low water line.

Definite and Potential areas of mudflat and sandflat habitat are identified in the feature layer to differentiate between areas where the supporting data shows the feature is known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments), part of a mixed sediment shore where other features could also be present (e.g. a mixed shore where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

Sandbanks
The feature extent outline for the sandbank features found within Pen Llŷn a'r Sarnau SAC is based on the following data sources:

- UKHO Admiralty Charts and bathymetry data
- Marine survey data (biology and sediments)
- 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 made since site designation.

A distinction as been made between sandbank areas that are classed as 'Definite' i.e. where the sandbanks adequately meet the criteria set out in the Annex 1 feature definition, and 'Potential' i.e. where there is some uncertainty over whether the bank area adequately meets the Annex 1 feature requirements. This could be due to lack of topographic distinctness or uncertainty over sediment composition and associated biological communities.

Reefs
The indicative reef polygon feature map for Pen Llŷn a'r Sarnau SAC is composed of extensive areas of both intertidal and subtidal habitat. Data sources for the indicative feature extent map are:

- CCW Phase 1 Intertidal Habitat Map (intertidal reef areas)
- Marine acoustic data (sidescan sonar, multibeam echosounder and RoxAnn)
- Marine survey data (biology and sediments)
- Admiralty charts
- British Geological Survey seabed sediment and rock substrate maps
- Expert knowledge

'Definite' and 'Potential' areas of reef are identified in the feature layer to differentiate between areas where the supporting data shows the feature is definitely known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments that could cover rocky outcrops), part of a mixed sediment seabed where other features could also be present (e.g. a mixed shore or mosaic seabed where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

Some areas of subtidal reef have been refined and / or reclassified since the original site designation maps were produced. No changes have been made to the extent of the intertidal reef feature.

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 feature is present in Pen Llŷn a'r Sarnau SAC, namely Tremadog 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.

Coastal lagoons
Only one lagoon is present as a feature in the Pen Llŷn a'r Sarnau SAC at Morfa Gwyllt. The lagoon boundary has been mapped using aerial photos and an Ordnance Survey base map. Slight amendments have been made to the boundary of the lagoon to improve the accuracy of the feature representation compared with that displayed on the original site designation map.

Estuaries
The Estuary feature extents for Pen Llŷn a'r Sarnau SAC are derived from the inland boundary of the SAC and closing lines between bounding headlands at the estuary mouths. Areas of associated sediment also form part of the estuary features; these are considered part of the wider estuary geomorphology and represent areas of sediment that contribute to the functioning of the estuary systems.

A minor change has been made to the estuary closing line in the Glaslyn/Dwyryd estuary to better align the mouth with the bounding headlands. All other feature boundaries are unchanged since site designation.

Atlantic Salt Meadow
The Atlantic Salt Meadow feature extent for Pen Llŷn a'r Sarnau SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data, CCW sand dune vegetation survey data and Dyfi saltmarsh survey data. Slight amendments have been made to the dataset to improve feature accuracy since it was

delineated at the time of site designation (i.e. using newer data that had become available).

Salicornia

The *Salicornia* feature extent for Pen Llŷn a'r Sarnau SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data, CCW sand dune vegetation survey data and Dyfi saltmarsh survey data. Slight amendments have been made to the dataset to improve feature accuracy since it was delineated at the time of site designation (i.e. using newer data that had become available).

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:

- Porth Dinllaen i Borth Pistyll
- Porth Towyn i Borth Wen
- Glannau Aberdaron
- Ynys Enlli
- Wig Bach a'r Glannau i Boreth Alwn
- Porth Ceiriad, Porth Neigwl ac Ynysoeed Sant Tudwal
- Mynydd Tir y Cwmwd a'r Glannau at Garreg Yr Imbill
- Glanllynnau a Glannau Pen – Ychain I Cricieth
- Tiroedd a Glannau rhwng Cricieth ac Afon Glaslyn
- Morfa Harlech
- Morfa Dyffryn
- Aber Mawddach - Mawddach Estuary
- Glannau Tonfanau i Friog
- Broadwater
- Dyfi
- Borth – Clarach

SPAs that are partly or wholly within the SAC:

- Glannau Aberdaron and Ynys Enlli – Aberdaron Coast and Bardsey Island
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal
- Aber Dyfi – Dyfi Estuary

Locations are shown on the associated feature map[59].

[59] 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.

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Appendix N West Wales Marine/Gorllewin Cymru Forol SAC

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Harbour Porpoise (*Phocoena phocoena)* Special Area of Conservation: West Wales Marine / Gorllewin Cymru Forol

Conservation Objectives and Advice on Operations

March 2019

Advice under Regulation 21 of The Conservation of Offshore Marine Habitats and Species Regulation 2017 and Regulation 37(3) of the Conservation of Habitats and Species Regulations 2017

Further information

This document is available as a pdf file on NRW's website for download if required (www.naturalresourceswales.gov.uk).

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Summary of Conservation Objectives and Advice on Operations

The Conservation Objectives and Advice on Operations are set out for the West Wales Marine / Gorllewin Cymru Forol Special Area of Conservation (SAC) for harbour porpoise (*Phocoena phocoena*). The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where Natural Resources Wales (NRW) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities as the Statutory Nature Conservation Body (SNCB).

The general objective of achieving or maintaining Favourable Conservation Status (FCS) for all species and habitat types listed in Annexes I and II of the Habitats Directive needs to be translated into Conservation Objectives for SACs. These objectives describe the condition to be achieved by a site for it to contribute in the best possible way to achieving FCS at the national, bio-geographical and European level[1]. The Advice on Operations is site-specific but based on a broad assessment of the sensitivity of the harbour porpoise to anthropogenic pressures at a UK scale.

The advice in this document has been developed using the best available scientific information and expert interpretation as of February 2019. The advice provided here may be subject to change as our knowledge about the site and the impacts of human activities improves.

To ensure the site contributes in the best possible way to achieving FCS, management of human activities occurring in or around the site is required if these activities are likely to have an adverse impact (directly or indirectly) on the integrity of the site, with regards to its Conservation Objectives. It should be noted that as a European Protected Species under Annex IV of the Habitats Directive, harbour porpoises are already strictly protected throughout their European range. As such, several conservation measures are already in place in the UK.

To achieve the Conservation Objectives for the West Wales Marine / Gorllewin Cymru Forol SAC, the relevant[2] and competent[3] authorities should consider human activities within their remit which might affect the integrity of the site.

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[1] http://jncc.defra.gov.uk/PDF/comm02D07.pdf

[2] Relevant authorities are those who are already involved in some form of relevant marine regulatory function and would therefore be directly involved in the management of a marine site lying within territorial waters. The bodies which may be relevant authorities are listed in Regulation 6 of the Conservation of Habitats and Species Regulations 2017. All relevant authorities are also competent authorities.

[3] Competent authorities are defined in Regulation 5 of the Conservation of Offshore Marine Habitats and Species Regulations 2017 and Regulation 7 of the Conservation of Habitats and Species Regulations 2017. In summary, a competent authority is any person or organisation that has the legally delegated or invested authority (e.g. Minister, government department, public body of any kind or statutory undertaker) to perform a designated function.

Crynodeb o Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau

Mae'r Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau wedi'u cyflwyno ar gyfer yr ymgeisydd Ardal Cadwraeth Arbennig (yACA) West Wales Marine / Gorllewin Cymru Forol ar gyfer yr rhywogaeth Atodiad II, y llamhidydd (*Phocoena phocoena*). Mae'r safle'n cwmpasu dyfroedd y glannau (o fewn 12 morfilltir o'r arfordir) a dyfroedd alltraeth (tu hwnt i 12 morfilltir o'r arfordir) lle mae gan Cyfoeth Naturiol Cymru (CNC), Natural England (NE) a'r Cyd-bwyllgor Gwarchod Natur (JNCC) gyfrifoldebau cynghori perthnasol.

Mae angen trosi'r amcan cyffredinol o gyrraedd neu gynnal Statws Cadwraeth Ffafriol i bob rhywogaeth a math o gynefin sydd wedi'u rhestru yn Atodiadau I a II o'r Gyfarwyddeb Cynefinoedd yn Amcanion Cadwraeth ar lefel safle. Mae rhain yn disgrifio'r cyflwr y dylai rhywogaethau a mathau o gynefin o fewn safle ei wireddu er mwyn i'r safle gyfrannu yn y ffordd orau posibl tuag at wireddu Statws Cadwraeth Ffafriol ar lefel genedlaethol, bio-ddaearyddol ac Ewropeaidd.

Mae'r Cyngor ynglŷn â Gweithgareddau yn benodol i safleoedd ond mae'n seiliedig ar asesiad ehangach o ba mor sensitif yw'r llamhidydd i bwysau anthropogenig ar lefel y DU. Datblygwyd y cyngor gan ddefnyddio'r wybodaeth gwyddonol orau bosibl a dehongliad arbenigol fel yr oedd ym mis Chwefror 2019. Bydd y cyngor a ddarperir yma yn newid wrth i'n gwybodaeth am y safle ac effeithiau gweithgareddau dyn wella.

Er mwyn sicrhau bod y safle'n cyfrannu at Statws Cadwraeth Ffafriol, mae angen rheoli gweithgareddau dyn ar y safle ac o'i gwmpas os ydynt yn debygol o gael effaith andwyol ar gyfanrwydd y safle (yn uniongyrchol neu'n anuniongyrchol) o safbwynt ei Amcanion Cadwraeth. Dylid nodi bod y llamhidydd yn ei warchod drwy Ewrop gyfan fel Rhywogaeth a Warchodir Gan Ewrop yn Atodiad IV y Gyfarwyddeb Cynefinoedd. O ganlyniad mae llawer o fesurau rheoli ar waith eisoes yn y DU.

Er mwyn diwallu Amcanion Cadwraeth safle llamhidydd West Wales Marine / Gorllewin Cymru Forol, dylai'r awdurdodau perthnasol[1] a chymwys[2] ystyried gweithgareddau dyn yn rhan o'u cylch gwaith a allai gael effaith ar gyfanrwydd y safle.

[1] Awdurdodau perthnasol yw'r rhai sydd eisoes yn ymwneud â rhyw fath o swyddogaeth reoleiddiol forol berthnasol a fyddai'n ymwneud yn uniongyrchol felly â rheoli safle morol sydd o fewn dyfroedd tiriogaethol. Mae'r cyrff a all fod yn awdurdodau perthnasol wedi eu rhestru yn Rheoliad 6 Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. Mae'r holl awdurdodau perthnasol hefyd yn awdurdodau cymwys.

[2] Mae awdurdodau cymwys yn cael eu diffinio yn Rheoliad 5, Rheoliadau Cadwraeth Cynefinoedd a Rhywogaethau Morol Alltraeth 2017 a Rheoliad 7, Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. I grynhoi, mae awdurdod cymwys yn unrhyw berson neu sefydliad y rhoddwyd awdurdod cyfreithiol neu ddirprwyedig iddo (e.e. Gweinidog, adran o'r llywodraeth, unrhyw fath o gorff cyhoeddus neu ymgymerydd statudol) i gyflawni swyddogaeth ddynodedig.

Contents

1 Introduction

1.1 Background

Initial advice on a network of sites identified within UK waters for harbour porpoise (*Phocoena phocoena*) was submitted to UK and Devolved Governments as a series of draft SACs in June 2015. The sites were identified within the UK portions of Management Units (MUs[4]) defined for the species (ICES, 2014; IAMMWG, 2015). The Welsh and Northern Irish Governments, along with Defra on behalf of England and relevant offshore waters, gave approval for sites within their areas of jurisdiction to proceed to consultation (January to May 2016). In light of the responses to the consultation, five sites were submitted to the European Commission as candidate SACs in January 2017. These five sites were adopted by the EC as Sites of Community Importance (SCIs) on 12 December 2017 and designated as SACs by Ministers on 26th February 2019. These sites are shown in Figure 1.

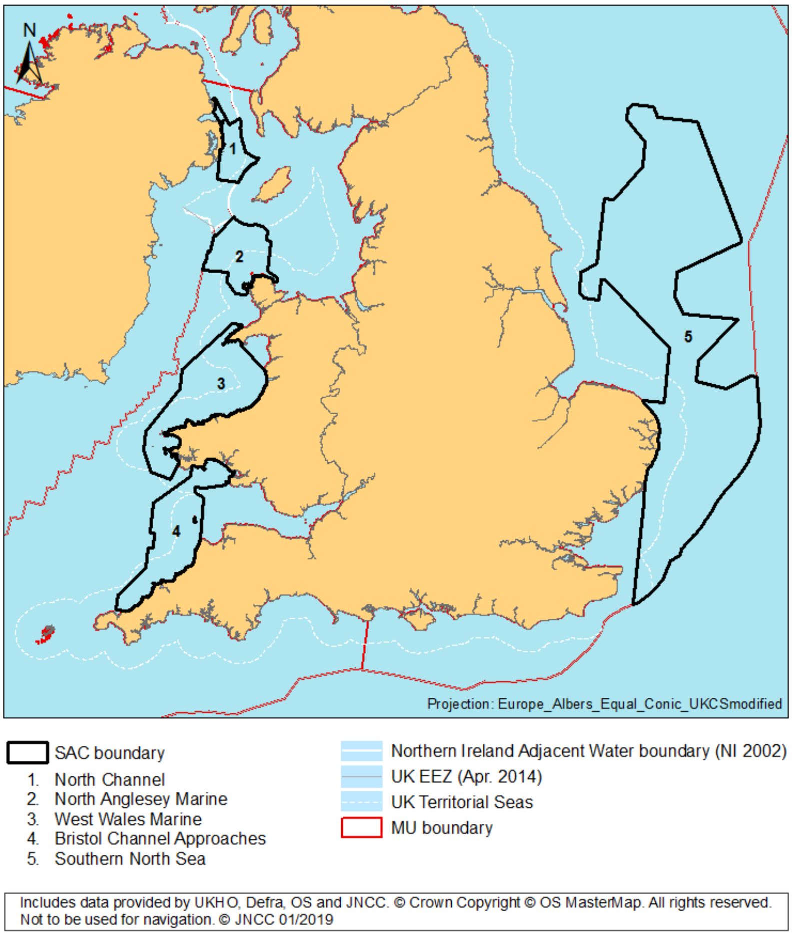


Figure 1: Special Areas of Conservation for the harbour porpoise, *Phocoena phocoena* identified in Northern Ireland, England, Wales and offshore waters. The Management Unit (MU) boundary (red line) refers to the UK portion of the North Sea and Celtic and Irish Seas MUs.

[4] For conservation and management purposes it is practical to divide the population into smaller units, termed Management Units (MUs). These MUs were developed to take account of biological populations of animals but were also be determined by political boundaries and are at an appropriate scale at which to assess human activities. In the UK, three MUs have been defined for harbour porpoise: West of Scotland, Celtic and Irish Seas, and North Sea (IAMMWG, 2015)

This advice document is for the West Wales Marine / Gorllewin Cymru Forol SAC (Figure 2) which is subject to protection under the Conservation of Habitats and Species Regulations 2017[5] and the Conservation of Offshore Marine Habitats and Species Regulation 2017[6] (collectively referred to as the Habitats Regulations). The advice is given in fulfilment of the duty of the Statutory Nature Conservation Bodies (SNCBs) under the Habitats Regulations to advise Relevant and Competent Authorities as to (a) the Conservation Objectives for the 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. The SNCBs aim to ensure that the Conservation Objectives are up-to-date, accessible and enable the assessment of the potential effects of plans and projects.

2 Responsibilities of Relevant and Competent Authorities

Competent Authorities (including those which are also Relevant Authorities) are required to exercise their functions to comply with the Habitats Regulations. Competent Authorities must, within their areas of jurisdiction, consider both direct and indirect effects on the site. This includes considering operations inside and outside the boundary of the SAC, if the impacts could affect the achievement of the site's Conservation Objectives. Decisions on management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate. Where consent is required and the operation (if considered a plan or project) is likely to significantly affect a European Site, Article 6(3) of the Habitats Directive requires that an Appropriate Assessment (AA) is carried out. The AA is part of the “Habitat Regulations Assessment” (HRA), which is a case-specific assessment made in view of the Conservation Objectives for the affected site or sites. Each HRA requires case-specific advice from the SNCB but the assessment is the responsibility of the competent authority concerned.

The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent deterioration of harbour porpoise presence in the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU).

3 Conservation Objectives for harbour porpoise SACs

3.1 The role of Conservation Objectives

Site level Conservation Objectives (COs) are a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012). Conservation Objectives constitute a necessary reference for:

- identifying any site-based conservation measures that may be required;
- carrying out HRAs of the implications of plans or projects.

The purpose of the HRA is to determine whether a plan or project adversely affects a site’s integrity. The critical consideration in relation to site integrity is not the extent or degree of an

[5] http://www.legislation.gov.uk/uksi/2017/1012/contents/made
[6] http://www.legislation.gov.uk/uksi/2017/1013/contents/made

impact, or whether an impact is direct or indirect, but whether a plan or project, either individually or in combination with other plans or projects, affects the site's ability to achieve its Conservation Objectives and therefore contribute to Favourable Conservation Status.

Harbour porpoise are protected everywhere in European waters under the provisions of the Habitats Regulations. The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.

3.2 Background to Conservation Objectives

The Conservation Objectives are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely. Therefore, the focus of the Conservation Objectives for harbour porpoise sites is on addressing pressures that affect site integrity and would include:

- killing or injuring harbour porpoise (directly or indirectly);
- preventing their use of significant parts of the site (disturbance / displacement);
- significantly damaging relevant habitats; or
- significantly reducing the availability of prey.

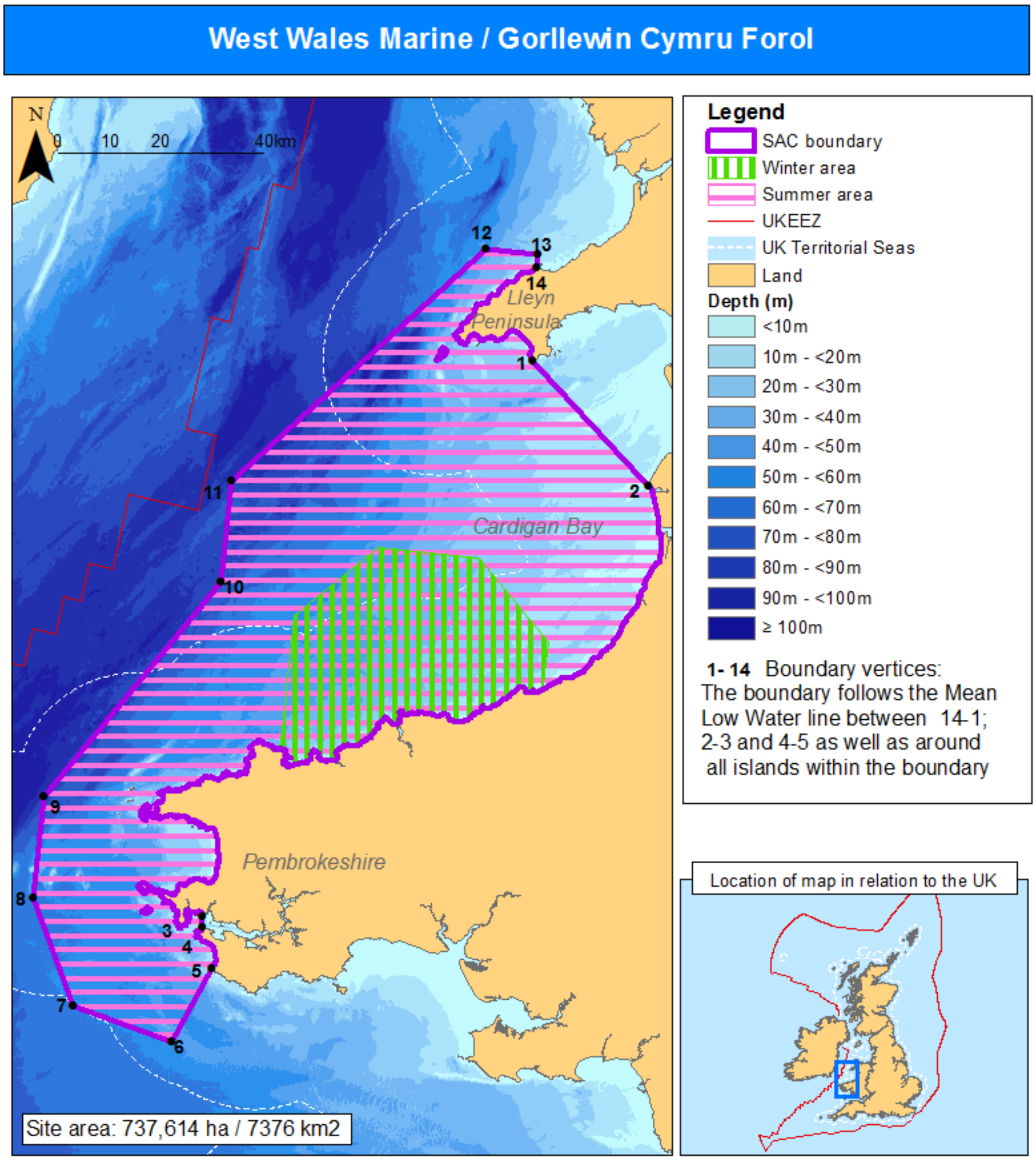
This document includes both a statement of the Conservation Objectives and explanatory text on their intent and interpretation specific to the site. The Objectives have been set taking account of European Commission guidance (EC, 2012). Further guidance on the management of specific pressures of harbour porpoise is being developed.

3.3 The West Wales Marine / Gorllewin Cymru Forol SAC Conservation Objectives

The qualifying feature of the site is the Habitats Directive Annex II species:

- harbour porpoise (*Phocoena phocoena*)

Seasonal differences in the relative use of the site have been identified based on the analyses of Heinänen and Skov (2015). Harbour porpoise sightings data were modelled seasonally (Summer: April-September and Winter: October-March) for each MU. The outputs of this analysis were maps of areas by season and MU, that persistently contained elevated densities of harbour porpoises. These areas were used as the basis for site identification and as a consequence, sites may have seasonal components which should be considered in the assessment of impacts and proposed management. West Wales Marine / Gorllewin Cymru Forol has been designated because of its importance to harbour porpoise in both the summer and winter months (Figure 2).



 Coordinates displayed in WGS84 geographic coordinate system.
Site area calculated using modified Europe_Albers_Equal_Area_Conic_UK projection.

ID	Latitude	Longitude	ID	Latitude	Longitude
1	52° 46' 39.334" N	4° 31' 51.219" W	8	51° 40' 34.936" N	5° 35' 45.826" W
2	52° 36' 23.933" N	4° 7' 44.200" W	9	51° 51' 15.003" N	5° 37' 48.561" W
3	51° 42' 37.788" N	5° 7' 2.965" W	10	52° 17' 8.258" N	5° 16' 24.038" W
4	51° 41' 31.531" N	5° 6' 50.849" W	11	52° 27' 48.796" N	5° 18' 24.819" W
5	51° 37' 27.017" N	5° 3' 46.364" W	12	52° 57' 12.758" N	4° 43' 46.104" W
6	51° 29' 4.939" N	5° 7' 35.762" W	13	52° 57' 47.171" N	4° 34' 54.971" W
7	51° 30' 32.201" N	5° 25' 11.359" W	14	52° 56' 21.129" N	4° 34' 39.841" W

Figure 2: The West Wales Marine / Gorllewin Cymru Forol Special Area of Conservation for harbour porpoise. Summer and winter areas shown.

The Conservation Objectives for the site are:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters

In the context of natural change, this will be achieved by ensuring that:

1. Harbour porpoise is a viable component of the site;

2. There is no significant disturbance of the species; and

3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Conservation Objective 1: Harbour porpoise is a viable component of the site

This SAC has been selected primarily based on the long-term, relatively higher densities of porpoise in contrast to other areas of the MU. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies (e.g. between seasons), there is no exact value for the number of animals expected within the site.

The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG, 2015).

The harbour porpoise is a European Protected Species (EPS) listed on Annex IV of the Habitats Directive and as such is protected under the Habitats Directive Article 12 and transposing regulations from deliberate killing (or injury), capture and disturbance throughout its range. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States 'shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned'. Site based measures should therefore be aligned with the existing strict protection measures in place throughout UK waters. Significant disturbance within or affecting the site is considered in the second conservation objective.

Conservation Objective 2: There is no significant disturbance of the species

Disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise including, as examples, seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise[7]. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.

This SAC was identified as having persistently higher densities of harbour porpoises (Heinänen and Skov, 2015) compared to other areas of the MU. This is likely linked to the habitats within the site providing good feeding opportunities. Therefore, operations within or

[7] http://jncc.defra.gov.uk/page-4273

affecting the site should be managed to ensure that the animals' potential usage of the site is maintained. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site. Specifically, draft SNCB advice / guidance for assessing the significance of noise disturbance to a site suggests:

Noise disturbance within an SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than: 1. 20% of the relevant area[8] of the site in any given day[9], and 2. an average of 10% of the relevant area of the site over a season[10,11].

Conservation Objective 3: The condition of supporting habitats and processes, and the availability of prey is maintained

Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site. Some evidence shows that the harbour porpoise has a high metabolic rate compared to terrestrial mammals of similar size (Rojano-Doñate et al., 2018) and high feeding rates (Wisniewska et al., 2016). The harbour porpoise is therefore thought to be a species that is highly dependent on a year-round proximity to food sources and its distribution and condition may strongly reflect the availability and energy density of its prey (Brodie 1995 in Santos & Pierce, 2003). The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site. Harbour porpoise eat a variety of prey including gobies, sandeel, whiting, herring and sprat. However, the diet of porpoises when within the sites is not well known but is likely comparable to that in the wider seas.

There are several operations (Table 2) which potentially affect the achievement of this Conservation Objective. Whilst some plans/projects are unlikely to have a significant effect alone, an effect might become significant when considered in combination with other plans/projects and against the background of existing activities/pressures on the site. Further work is needed to assess historic, existing and planned levels of plans/projects in the sites and to better understand their impacts on the habitats and prey within the sites.

4 Advice on Operations

4.1 Purpose of advice

This section details the activities specifically occurring within or close to the West Wales Marine / Gorllewin Cymru Forol SAC that would be expected to impact the site; this is known as Advice on Operations. Initial assessments were conducted at a UK scale, with

[8] The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive).
[9] Applicable only in Habitats Regulations Assessments (HRA) due to impracticality of daily noise limit management of activities, but retrospective compliance analysis advised
[10] Summer defined as April to September inclusive, winter as October to March inclusive
[11] For example, a daily footprint of 19% for 95 days would result in an average of 19x95/183 days (summer) =9.86%

subsequent site-level assessment detailing our understanding of the operations and their potential to impact the site (Section 5 & 6). Advice is only given where pressures[12] may impact the site and therefore, may require management, if the Conservation Objectives are to be met. Widespread pressures may also act to affect the overall status of harbour porpoise, but their effects are not restricted to specific sites. Such pressures are best dealt with through broader measures. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy (DETR, 2000) has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG *et al,* 2015), a UK Dolphin and Porpoise Conservation Strategy is being developed.

The advice outlined below should also be used to help identify the extent to which existing operations are, or can be made, consistent with the Conservation Objectives, and thereby focus the attention of Relevant and Competent Authorities and monitoring programmes to areas that may need management measures.

This Advice on Operations will be supplemented through further discussions with the Relevant and Competent Authorities and any advisory groups that may be formed for the site.

4.2 Background

In compiling this Advice on Operations, the SNCBs have considered the pressures that may be caused by human activities and may affect the integrity of the site when considered against the Conservation Objectives. The advice is generated through a broad grading of sensitivity and exposure of the harbour porpoise to pressures associated with activities to gain an understanding of how vulnerable the species is to each activity at a UK level. The activities and their associated pressures to which the harbour porpoise is deemed vulnerable at a UK level are then considered at a site level to inform the risks to achieving the Conservation Objectives along with any potential management that may be required to mitigate against such risks. Annex A details the assessments of the level of impact risk[13] from operations on harbour porpoise populations at a UK-wide scale. This informs on the activities likely to impact the site.

This document is guidance only and activities and their management within or affecting the site will be considered in the context of Habitats Regulations Assessment (HRA) and where applicable through other environmental assessment processes, such as Environmental Impact Assessment (EIA).

5 Operation assessments at UK scale

The assessments have been carried out using all available evidence as of February 2019. If further information is made available in future which would improve our understanding of harbour porpoise vulnerability in UK waters, the assessments may be updated. This advice is provided without prejudice for use by the Relevant and Competent Authorities. The level of any impact will depend on the location, timing and intensity of the relevant operation. This advice is provided to assist and focus the Relevant and Competent Authorities in their consideration of the management of these operations.

The harbour porpoise is a wide-ranging species and occurs throughout the UK Continental Shelf area (JNCC, 2013). It does occur in deeper waters but in very low densities, and perhaps only seasonally. As a predominantly continental shelf species, it is exposed to a wide range of pressures that are both ubiquitous (e.g. pollution) and patchy (e.g. bycatch) in nature, and

[12] See Annex B for definition of key terms
[13] Risk includes consideration of severity of implications of impact

the list of anthropogenic activities leading to these pressures is long. Based on current available information, the operations that pose the most notable risk of impact to UK harbour porpoise are shown in Table 1.

The current levels of impact of the various pressures are based on the Article 17 assessments[14] and the full list of assessed activities and key references can be found in Annex A. Updates to the assessments will occur as more evidence becomes available.

Definitions of pressures are explained in Annex B.

Activities which currently pose a low risk of impact to harbour porpoise at the UK level (Annex A) have not been considered in this advice. The exposure to the pressures associated with these activities is currently very limited. Non-anthropogenic impacts are also not considered, such as attack and predation from other marine mammal species that have the potential to impact harbour porpoise populations.

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[14] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf . Updated Article 17 reports for 2013-2018 will be available in 2019.

Table 1: Key activities (operations) and the relative level of risk of impact on harbour porpoise throughout UK waters. Those pressures ranked 'high' are known to have the greatest impact relative to other pressures on the population of UK harbour porpoises. Activities which currently pose a low risk are not shown.

Operations	Pressures	Impacts	Current relative level of impact
Commercial fisheries with bycatch of harbour porpoise (predominantly static nets)	**Removal of non-target species**	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion • Health issues (e.g. on reproduction)	High
Shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	**Anthropogenic underwater sound**	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium
Shipping, recreational boating, tidal energy installations	**Death or injury by collision**	• Mortality • Injury	Medium/Low
Commercial fisheries (reduction in prey resources)	**Removal of target species**	• Reduction in food availability • Increased competition from other species • Displacement from natural range	Medium

6. Site specific considerations: West Wales Marine / Gorllewin Cymru Forol SAC

6.1 Sensitivity of harbour porpoise to existing activities within or impacting on the site

The West Wales Marine / Gorllewin Cymru Forol SAC covers an area of 7,376 km^2 extending southwards from the western end of the Lleyn Peninsula across Cardigan Bay to Pembrokeshire. A summary of the site can be found in the Selection Assessment Document on the Site Information Centre[15].

All available information on activities within the site has been used to assess the threats and pressures within the site. However, precise information on some activities within the boundary is not currently available due to lack of targeted data collection to date. Assessing exposure

[15] SAC Selection Assessment Document: http://jncc.defra.gov.uk/page-7343

carries certain assumptions about the spatial extent, frequency and intensity of the pressures associated with marine activities.

Table 2 is an overview of activities (operations) occurring within or in proximity to the West Wales Marine / Gorllewin Cymru Forol site to which the harbour porpoise has a current level of impact risk of High or Medium at UK level and therefore may require further consideration concerning options for management. The impact of a pressure at the site level can differ to that at UK level dependent on the amount of activity within or adjacent to the site. GIS layers of spatial activity data as well as review of literature, were used to identify the impact risk within the site (where a pressure is concentrated within a site) and whether it differs from the UK level risk. These assessments include all available information as of February 2019.

In 2012, Defra announced a revised approach to the management of fishing activities within European Marine Sites (EMS) in England[16]. The revised approach is designed to ensure consistency in the management of fishing activities with Article 6 of the Habitats Directive. For SACs or parts of SACs outside of 12 nm, management measures will be introduced by appropriate regulators to ensure adequate protection.

The Welsh Government is assessing new fisheries legislation and permitted activities under Article 6 of the Habitats and Birds Directives. The Welsh Government, in partnership with Natural Resources Wales, are undertaking a structured evaluation of the impacts from fishing activities (from licensed and registered commercial fishing vessels) on the features of Marine Protected Areas (MPA) in Welsh waters is. This is referred to as the Assessing Welsh Fishing Activities (AWFA) Project[17]. The Welsh Government is responsible for decisions relating to whether additional management measures are required to avoid impacts to features of MPAs in Welsh waters. The evidence base provided by the AWFA Project will inform fisheries management decisions and support the aims of The Well-being of Future Generations (Wales) Act 2015, The Environment (Wales) Act 2016 and the Habitats Directive by contributing to the sustainable management of the marine environment.

JNCC and the country SNCBs are working with the Regulators and Industry to ensure that a pragmatic approach to mitigation and management of pressures that may affect the integrity of the site is adopted. Any future guidance documents will be made available on the Site Information Centre on the JNCC website[18].

[16] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

[17] https://naturalresources.wales/about-us/our-projects/marine-projects/assessing-welsh-fishing-activities/?lang=en

[18] http://jncc.defra.gov.uk/page-7343

Table 2: Operations (activities) occurring within/near to the West Wales Marine / Gorllewin Cymru Forol site which may affect the integrity of the site.

Operations	Pressure	Comment on current level of activity	Management considerations
Fisheries (commercial and recreational) with harbour porpoise bycatch	Removal of non-target (bycatch) species	Bycatch of harbour porpoise in fishing gear is one of the most significant anthropogenic pressures impacting the population at a UK level. Those commercial fisheries activities most associated with with harbour porpoise bycatch are bottom set nets, such as gillnets and tangle nets. UK registered vessels >12m: Based on evidence from Vessel Monitoring System (VMS) there is negligible activity from large UK vessels using static net gears within the site[19]. Vessels <12m (the majority, ~92%, of Welsh small scale commercial fleet being <10m) include static nets: Effort is considered low and bycatch is thought to be negligible. Recreational netting also occurs at a very low level of effort along the coast with likely negligible (no known) bycatch. EU registered vessels: Given the relatively small area of the site outside 12nm, there is likely lower effort of static net setting in the site than UK vessels.	Where bycatch may pose a risk to achieving the site's conservation objectives, mitigation may be required. Where management measures are required, the development of these would be led by fishery managers in discussion with fishing interests and informed by any detailed information about fishing activity that can be made available. Detailed measures, if required, will be developed by the relevant management authority (European Commission/MMO/Defra/Welsh Government). Although bycatch is thought to be negligible in the site, the greatest risk is posed by the numerous small bottom set gillnetting vessels (<12m), for which the use of pingers is not mandatory under Regulation 812/2004. However, effort by this sector of the fleet in the site is currently considered low and, therefore, risk of bycatch is likely to be negligible. The need for further management will need to be fully assessed based on local fisheries data. However, it is currently considered that requirement of further measures is unlikely given current impact.
Discharge/ run-off from land-fill, terrestrial/	Contaminants	Current exposure within or near the site is unknown. Historical metal mining operation	This pressure generally cannot be managed effectively at the site level. Most of the pollutants of relevance to marine mammals have been effectively phased out of use by action under the

[19] The fisheries data are aggregated VMS data collected between 2006 and 2013.

offshore industries		outfalls potentially exist within the site.	OSPAR Convention and, more recently, the EU (through Council Directives 67/548/EEC and 76769/EEC and the Stockholm Convention, which restrict the marketing and use of PCBs; plan for disposal of PCBs; and eliminate or restrict the production and use of persistent organic pollutants [POPs]). However, human activities are the most likely cause of the re-release of these chemically stable chemicals into the environment or for introduction of other contaminants of which the impacts are poorly known. Any novel sources of potential contamination and/or activities likely to cause re-release of pollutants form stores associated with a new plan or project will be assessed under HRA both within and outside the site where there is the potential to impact upon site integrity. Current sources of exposure have to be identified and further efforts to limit or eliminate discharges to the marine environment may still be needed.
Shipping	Anthropogenic underwater sound	Ports along the Pembrokeshire coast result in large vessel along shipping/ferry routes through southern parts of the site. St Brides Bay is also regularly used as an anchorage for large ships waiting to enter Milford Haven. This is likely to cause increased shipping related underwater noise.	Harbour porpoise use sound for foraging, navigation, communication and predator detection. Underwater noise therefore has the potential to interrupt or affect these behaviours as well as cause hearing damage, particularly at short distances. The peak frequency of echolocation pulses produced by harbour porpoise is 120–130 kHz, corresponding to their peak hearing sensitivity although hearing occurs throughout the range of ~1 and 180 kHz (Southall *et al* 2007). The underwater sounds created by large ships are unlikely to cause physical trauma but could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). However, additional management is unlikely to be required based on current levels of activity within the site. Significant increases in vessel traffic, for example as may be associated with large-scale marine developments in the area would be routinely assessed in HRA.
Oil and gas drilling		Current licensed blocks for oil and gas extraction are present in the site	Existing and inactive (exploratory and dry) wells and oil and gas licensed blocks occur within the site but any

		along the offshore boundary. Offshore oil and gas licensing rounds have included several blocks that fall inside the site.	future applications would be subject to an HRA.
Pile driving		Licensed areas for offshore wind do not exist within the site. Impact piling from harbour/marina developments is likely. Other marine developments, eg tidal stream, may utilise impact piling during installation of turbine foundations.	A European Protected Species (EPS) licence may be needed for any construction activity which carries the risk of significant disturbance or deliberate injury to cetaceans. Developers are advised to follow the 'Statutory Nature Conservation Agency protocol for minimising the risk of injury to marine mammals from piling noise'[20]. An HRA is required for any development that might affect site integrity. If mitigation additional to the standard SNCB protocols (as above) is required as a result of environmental assessments (e.g. noise abatement techniques, Acoustic Deterrent Devices), planning and management of pile driving activities and mitigation will be needed within the site to ensure the Conservation Objectives are met. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Dredging and disposal		Capital and maintenance dredging and disposal sites occur in the southern part of the site.	Dredging and disposal can cause disturbance leading to changes in harbour porpoise behaviour as well as to their habitat and prey. There is also potential for resuspension of pollutants from the sediment. The risk from single plans/projects may be considered relatively low but is assessed through HRA. However, there is currently considerable uncertainty regarding effects on habitat and prey. New dredge and disposal projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.
Aggregate extraction		No licensed and active areas within the site.	Aggregate extraction can cause disturbance leading to changes to harbour porpoise behaviour as well as to their habitat and prey. However, the risk is considered relatively low for

[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf

			single plans/projects and additional management is unlikely to be required. New aggregate extraction projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.
Geophysical surveys (including seismic)		Commercial seismic activity is currently of a low level in the site, although large-scale surveys have covered areas within the site boundary in the past. Some acoustic surveys are carried out in relation to marina works. Commercial and research based acoustic seabed surveys using multibeam and/or sidescan sonar occur in parts of the site.	Some geophysical surveys that may affect the integrity of the site may require consent and be subject to HRA. Each case needs to be assessed individually, and the *JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys* (updated August 2017[21]) are available online. Within the guidance, seismic survey is defined as *'Any geophysical survey that uses airguns to generate sound which is sent into the seabed and the reflected energy is recorded and processed to produce images of the geological strata below; described as 2D, 3D and 4D and includes any similar techniques that use airguns.'* It is currently not known whether sub-bottom profilers cause disturbance to harbour porpoise. Further research is needed to understand the sound propagation and effect ranges from these types of equipment. Cumulative impacts of geophysical surveys will need to be considered. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with regulators, industry and NGOs.
Recreational boating activity		Recreational boating is present across the site, focussed around the coast at ports and harbours. Activity can be intense at certain locations and times of the year. There are occasional organised powerboat races within the site.	Adherence to wildlife codes of conduct is already advocated: WiSe scheme; SeaWatch code of conduct; ZSL code of conduct; The RYA good practice guide - The Green Wildlife Guide for Boaters; Wild Seas Wales; Pembrokeshire Marine Code, Gwynedd and Ceredigion Marine codes and Ceredigion Recreational Boat Users' Code of Conduct for Cardigan Bay SAC. UK SNCBs are looking at the option of developing an overarching English / Welsh wildlife watching code of conduct to sit alongside the Scottish code.

[21] http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_apr2017.pdf.

Acoustic deterrent/mitigation devices		Negligible, although some use in Aberporth firing range when necessary. May be used as a mitigation tool during activities creating noise.	Management/assessment would be required for use of devices in the site since they introduce noise to the environment and are designed to disturb marine mammals.
Pinger devices		No registered vessels >12m used for gillnetting are known to fish in the site.	See 'Fisheries (commercial and recreational) with harbour porpoise bycatch'. Registered >12m set net vessels do not fish within the site but within VIIa; this area is excluded from the mandatory pinger requirement of Reg812/2004. However, because vessels <12m are the greatest component of the UK gillnetting fleet, most bycatch occurs in this sector. Effort by this sector of the fleet in the site is currently considered low and, therefore, risk of bycatch is likely to be negligeable. The need for further management will need to be fully assessed based on local fisheries data but it is currently considered unlikely that further measures will be required. If further measures were deemed necessary, one option for management could be to extend the pinger requirement to vessels deploying static nets within site boundaries. However, the impact of potential disturbance as a result of pinger use in the site may need to be assessed and the potential for other mitigation options such as alternative gear types, gear modifications or spatial gear restrictions may need to be considered.
Military activity		Active MOD firing and air range facilities across parts of the site (Aberporth and Castlemartin). Regardless of the locations of known firing ranges, the MOD can operate anywhere in UK waters.	Activities include live firing and detonation of explosives in air and on the water surface, vessel use, aviation and active sonar which have the potential to cause underwater noise. Activities take place under Range Standing Orders, command guidance and environmental risk management tools, which include measures to reduce the risk of killing, injury and disturbance of marine mammals (for example live firing trials are subject to confirmation that marine mammals are not present in the vicinity of targets). At Aberporth, procedures have been developed primarily to ensure mitigation of potential impact on the bottlenose dolphin population of the Cardigan Bay

			SAC. No further management is considered necessary as MOD and the Defence Infrastructure Organisation, who are a Competent Authority, incorporates the SACs into their assessments via their MOD Environmental Protection Guidelines (Maritime) and Marine Environment and Sustainability Assessment Tool (MESAT)[22].
Unexploded ordnance (UXOs)		Unknown whether they exist in the site. However, unexploded ordnance from WWII can be found in many areas in UK seas. UXO is also possible from military activity such as within firing ranges. Projects that could inadvertently explode UXOs must undertake a survey to search for possible ordnance ahead of the project commencing. Any ordnance found must be exploded on site, or removed for health and safety reasons.	Although the impact from removal (detonation) of unexploded ordnance (UXOs) is short term, the noise is significant and can cause injury or death to harbour porpoise. An HRA may be required. A European Protected Species licence may also be required. Mitigation is usually required to reduce risk of injury and killing. As a minimum, the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives are applied. A combination of Marine Mammal Observers (MMO)s, Acoustic Deterrent Devices (ADD) and occasionally scare charges are used to ensure harbour porpoise and other marine mammals are a sufficient distance from the explosion to prevent death or injury. Discussions are ongoing between industry, regulators and SNCBs on the most appropriate suite of mitigation measures for UXO clearance (including the possible use of bubble curtains). This will depend on the size of UXOs likely to be encountered and the practicality of deployment of the mitigation measure, amongst other factors.
Shipping	Death or injury by collision	Ports along the Pembrokeshire coast attract large vessel shipping/ferry routes through southern parts of the site.	Post mortem investigations of stranded harbour porpoise (Deaville & Jepson, 2011; Deaville 2011:2017) have revealed some deaths caused by trauma (potentially linked with vessel strikes). However, this is not currently considered a significant risk and no additional management is likely to be required.
Recreational boating activity		Recreational boating is present across the extent of the site, focussed around the coast at ports and	See 'Shipping' (with death or injury by collision) above. Boats conducting recreational activity should adhere to wildlife codes of conduct to avoid risk of collision (see

[22] http://www.royalnavy.mod.uk/-/media/royal-navy-responsive/documents/useful-resources/environmental-protection/environmental-protection-guidelines-maritime-v21.pdf?la=en-gb

		harbours. Occasional powerboat racing within the site. Several wildlife watching organisations operate within the site.	‘recreational boating activity’ with regards to underwater noise).
Wet renewable energy installations		A tidal stream device has been installed, but is currently not operational. An area for wave energy development has been leased off Pembrokeshire and prospects for further wave and tidal stream development in the site exists.	New tidal range, tidal stream and wave projects would be subject to an HRA. Additionally, an EPS licence might be suitable if there is a residual risk of significant disturbance or injury. Any consented, but not yet built, tidal stream and tidal range developments likely to impact the SAC will likely undergo a review of consent. Animal detection systems, e.g. active and passive acoustics, may be used to monitor animal presence and behaviour around devices for consented projects These systems might be used to establish any probable collisions and invoke adaptive management decisions. In addition, the use of ADDs has been suggested as a mitigation tool to exclude animals from the vicinity of devices. Potential future mitigation related to death or injury by collision will be based on new and emerging research and evidence.
Commercial fisheries (and recreational set nets)	Removal of target (prey) species	UK and EU Fisheries targeting prey species such as whiting, herring, mackerel, sandeel and sprat are present in the Celtic and Irish Seas, but few pelagic fisheries operate within the site. The majority of Welsh fleet are vessels <10m length i.e. small inshore vessels. Most fisheries within the site are demersal and target shellfish. There are some vessels that use static nets but fishing effort is considered to be low.	Currently, most commercial species are managed at scales relevant for stock management via the Common Fisheries Policy (CFP), not at the site level. Some species, however, are caught and sold commercially but do not have a Total Allowable Catch (TAC) for the Irish Sea area e.g sandeel, gurnard or are not managed by the CFP eg flounder, black bream. Harbour porpoise diet within UK waters includes a wide variety of fish and they will generally focus on the most abundant local species (De Pierrepont *et al* 2005; Camphuysen *et al* 2006). The predominant prey type in the UK appears to be whiting, gobies and sandeel, although shoaling fish such as mackerel and herring are also taken. Harbour porpoise diets overlap extensively with diets of other piscivorous marine predators (notably seals) and many of the main prey species are also taken by commercial fisheries, although porpoises tend to take smaller fish than those targeted by fisheries (Santos and Pierce 2003).

			The overlap between commercial fisheries and harbour porpoise prey is unknown within the site. Further research is required to establish whether any management may be required.

6.2 Limitations of the evidence

It is important to note that the information used to catalogue activities/operations occurring within the site is not complete. The available data are drawn from existing monitoring programmes (e.g. the UK's Bycatch Monitoring Scheme for Protected Species and other European datasets linked to VMS monitoring of fishing vessels) but these have limitations, including availability and accessibility of data at the time of preparing this advice. Caveats with how the data have been collected also need to be understood to correctly interpret the information. This has resulted in the use of expert judgement where sufficient evidence is lacking but risk is implied. Below are some points to consider alongside the above table to ensure the information is not taken out of context:

- **Data availability**
    - Globally, the marine environment, particularly in offshore areas, is generally far behind the evidence levels for the terrestrial environment, mainly due to scale and difficulty/cost of data acquisition.
    - There can be sensitivities surroundingsur data that have been gathered by industry, and some data are not available for use for advice and management purposes. Often these data become available eventually, but not in time to inform management decisions.

- **Fishing: Limitations of fishing Vessel Monitoring System (VMS) data**
    - VMS positional data are transmitted at approximately 2 hour intervals. There is no information transmitted regarding precise vessel activity, therefore assumptions about activity, based on logbook returns and vessel speed profile, are often made.
    - Vessel positional data (e.g. VMS) cannot inform regulators regarding extent of static gear deployment or soak times.
    - Fishing vessels under 12m long, (and from 2009 until 2013, vessels under 15m long) are not required to use the VMS, and therefore VMS data tells us nothing regarding the activity of this segment of the fleet. However, local information can be obtained from fisheries management authorities and will be used to develop more detailed guidance to assist with identification of any management measures where considered necessary.
    - In Wales, the Scallop fishing fleet (mostly <12m long) have vessel tracking devices (Succorfish). There is no evidence of harbour porpoise bycatch associated with this fleet.

- **Contaminants**
    - Although use of many of the relevant substances (e.g. PCBs) has been heavily regulated for many years, including a ban on further production, re-suspension or reintroduction of pollutants may occur. It is difficult to identify sources of contamination when dealing with highly mobile species.

7. References

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8. Annex A: Assessment of the level of impact risk from operations (activities) on UK harbour porpoise populations

The relative level of risk of impact to harbour porpoise from a range of pressures was assessed at UK level (Table A1) as part of the 3rd reporting round for Article 17[23].See Annex B for the definitions of pressures as used for the harbour porpoise assessments. For the assessment the relative importance of the pressure was assessed by considering the evidence available of an impact and the nature of that impact (direct/indirect) together with the area over which the pressure is acting in UK waters in relation to the species distribution. The relative levels are assigned according to the Artcile 17 guidance (Evans and Marvela, 2013) as:

Code	Meaning	Comment
H	High importance/impact	Important direct or immediate influence and/or acting over large areas
M	Medium importance/impact	Medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally
L	Low importance/impact	Low direct or immediate influence, indirect influence and/or active over small part of the area/acting only regionally

Table A1: Full assessment of level of the impact risk from operations (activities) on harbour porpoise in UK waters based on considerations for Article 17 assessment for harbour porpoise conservation status[24].

Operations	**Pressures**	**Impacts**	**Relative level of risk of impact**	**Evidence**		**Key references**
				Spatial overlap (species & pressure)	**Post-mortem examination**	
Commercial fisheries with bycatch (predominantly static nets)	Removal of non-target species	• Mortality through entanglement/by catch	High	✓	✓	Deaville and Jepson, 2011; Morizur *et al* 1999; Read *et al* 2006; Northridge, S. and Kingston, A. 2010; Northridge *et al* 2016; ICES 2015b
Discharge/run-off from land-fill, terrestrial and offshore industries	Contaminants	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion	High		✓	Jepson *et al* 2005; Jepson *et al* 2016; Deaville & Jepson, 2011; ICES, 2015a; Van De Vijver *et al* 2003; Law *et al* 2012; Pierce *et al* 2008; Murphy *et al* 2015.

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[24] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf

		• Health issues (e.g. on reproduction)				
Noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	Anthropogenic underwater sound	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium	✓		Deaville & Jepson, 2011; Stone & Tasker, 2006; Stone, 2015; Jepson *et al* 2005; Fernandez *et al* 2005; Würsig & Richardson, 2009; WGMME, 2012.
Shipping, recreational boating, renewable energy installations	Death or injury by collision	• Mortality • Injury	Medium/ Low	✓	✓	Deaville & Jepson, 2011; Dolman *et al* 2006; ICES 2015a
Commercial fisheries, bycatch	Removal of target species	• Reduction in food availability • Increased competition from other species • Displacement from natural range • Habitat change/loss	Medium		✓	Simmonds and Isaac, 2007; OSPAR QSR 2010; MacLeod *et al* 2007a, b; Thompson *et al* 2007; Santos and Pierce, 2003; Pierce *et al* 2007; ICES 2015b
Agriculture, aquaculture, sewage	Nutrient enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓	✓	Craig *et al* 2013
Agriculture, aquaculture, sewage	Organic enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓		Craig *et al* 2013
Waste disposal - navigational dredging (capital, maintenance)	Physical change (to another seabed type)	• Changes in availability of prey species • Habitat change/loss	Low			
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Water flow (tidal current) changes – local	• Changes in location of prey species • Displacement of harbour porpoise • Habitat change/loss	Low			

Terrestrial and at-sea ‘disposal’	Litter	• Mortality through entanglement • Ingestion	Low	✓	✓	Deaville and Jepson, 2011
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Barrier to species movement	• Habitat inaccessible • Potential physiological effects • Habitat change/loss	Low	✓		WGMME., 2012; ICES 2015a
Sewage	Introduction of microbial pathogens	• Increased risk of disease	Low		✓	Harvell *et al* 1999; Gulland and Hall, 2007; Van Bressem *et al* 2009

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9. Annex B: Definitions of Pressures as applied within harbour porpoise SAC Advice on Operations

Pressures	Definition in the context of harbour porpoise advice
Removal of non-target species	The removal of species not targeted by the fishery; in this case the bycatch (and probable mortality) of harbour porpoise
Contaminants	Introduced material capable of contaminating harbour porpoise, prey or habitat important to harbour porpoise, with a negative impact directly or indirectly on porpoises
Anthropogenic underwater sound	Introduced noise with the potential to cause injury, stress or disturbance of harbour porpoise
Death or injury by collision	Introduction of physical objects; mobile or immobile, that may collide with or result in potential collision of harbour porpoise resulting in injury or mortality
Removal of target species	Removal of harbour porpoise prey, resulting in increased competition amongst porpoise and other species, and/or displacement from their natural range

Appendix O Cardigan Bay/Bae Ceredigion SAC

Cardigan Bay/ Bae Ceredigion 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 *Cardigan 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 summaries 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 *Cardigan 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 *Cardigan 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	Conservation Objective
Cardigan Bay / Bae Ceredigion SAC	**Habitats:** • Sandbanks which are slightly covered by seawater all the time • Reefs • Submerged or partially submerged sea caves	Conservation Objectives
	Species: • Bottlenose dolphin *Tursiops truncates* • Grey seal *Halichoerus grypus* • River lamprey *Lampetra fluviatilis* • Sea lamprey *Petromyzon marinus*	

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Reoliad 37 Rheoliadau Cadwraeth 2017, ar gyfer *Ardal Cadwraeth Arbennig Bae Ceredigion*, 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) Bae Ceredigion*, 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 Bae Ceredigion*, 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
Bae Ceredigion ACA	**Cynefinoedd:** • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Riffiau • Ogofâu môr sy'n danforol neu'n lleddanforol	Amcanion Cadwraethol
	Rhywogaethau: • Dolffin trwyn potel *Tursiops truncates* • Morlo llwyd *Halichoerus grypus* • Lamprai neu lysywen bendoll yr afon *Lampetra fluviatilis* • Lamprai neu lysywen bendoll y môr *Petromyzon marinus*	

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 Cardigan 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 Cardigan 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 4 (conservation objectives) and 5 (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: the provisions of Article 6 of the Habitats Directive 92/43/EEC*. DGXI, Brussels, p.18.

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

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[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)

[9] The status of the site at a particular moment in time.

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. 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 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].

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[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)

[11] http://jncc.defra.gov.uk/sacselection

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.

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.

[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)

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 and Feature Description

3.1 Introduction

Cardigan Bay is one of the largest bays in the British Isles, measuring over 100km (60 miles) across its westernmost extent from the Lleyn Peninsula to St. David's Head.

A population of bottlenose dolphins forms a primary interest of the Bay and it was for this that the Bay was first selected as a Special Area of Conservation. Early surveys by Greenpeace and others in the 1990's identified the importance of the Bay for bottlenose dolphins. Other research since then, encouraged by the earlier work, has broadened our knowledge of the marine habitats of the bay as well as its more charismatic inhabitants.

Bottlenose dolphins range widely throughout UK waters and considerably further afield, but Cardigan Bay is one of the very few areas around the UK where significant numbers are known to occur regularly.

The *Cardigan Bay SAC* is a multiple interest site which has been selected for the presence of seven interest features that qualify under Annex I and Annex II of the Habitats Directive. For the qualifying habitats and species the SAC is considered to be one of the best areas in the UK for:

- *Tursiops truncatus* – bottlenose dolphin

and to support a significant presence of:

- Reefs
- Submerged or partially submerged sea caves
- Sandbanks which are slightly covered by seawater all the time
- Halichoerus grypus – grey seal
- Lampetra fluviatilis – river lamprey
- Petromyzon marinus – sea lamprey

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]. These 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 also have Biodiversity Action Plans or are on other lists specifying conservation action such as, 'Nationally Rare and Scarce Species'.

3.1.1 Sources and limitation of site information

All feature descriptions are based on best available knowledge at the present time and in some cases this is limited. Detailed information on the bathymetry within Cardigan Bay, for example, is quite poor. The distribution of submerged reefs is mainly derived from marine biological surveys and published bathymetric data, supplemented by a broad-scale

[17] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

acoustic survey. Information that has been used to produce the feature maps for the site is detailed in Annex I.

Although we are building a good baseline on the Cardigan Bay bottlenose dolphin population, there are many aspects requiring further research. Assessing the abundance, health, reproduction and survival rates of such long-lived marine mammals is necessarily a long-term process. International collaboration is important to increase the understanding of cetacean distribution and abundance and interactions with dolphins from other areas. Collecting data from stranded animals provides valuable information on the occurrence and distribution of stranded dolphins and post-mortem analysis provides otherwise hard to obtain information on patterns of mortality, disease and diet. This is an important baseline for detecting unusual mortality events and the UK's Cetacean Strandings Investigation Programme continues to collect biological samples that provide insights into the life history characteristics and foraging ecology of the species.

Summary climate information is available from the UK Meteorological Office and Aberporth RAF and historical and current datasets are available from several local coastal stations however this frequently underrepresents the extremes (particularly wind strength) experienced around the west Pembrokeshire coast (Met Office, *pers comm*). New offshore wave buoy now installed, should assist with our understanding of wave climate in the future.

Our understanding of the reef feature boundaries has been improved by research carried out by Bangor University while researching scallop fishing impact in the bay.

3.2 Site Description

The Cardigan Bay SAC encompasses areas of sea and coast that support a wide range of different marine habitats and wildlife some of which are unique in Wales. Sites of Special Scientific Interest (SSSI) that are partly or wholly within the SAC or adjacent to the SAC are listed in Annex II and shown in the feature map[18].

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

a) Range

The Cardigan Bay SAC is sited off the south Ceredigion and north Pembrokeshire coast, in the southern part of Cardigan Bay. The landward boundary runs along the coast from Aberarth to Ceibwr just south of the Teifi Estuary, typically following the back of the shore or the first hedge line beyond the top of the cliff or coastal slope. The boundary of the site was determined to encompass the features for which the site was selected, primarily what was regarded as the main area of importance for the bottlenose dolphins; it is not a representation of the precise extent of any one feature[19]. The site extends approximately twelve miles offshore and occupies approximately 960 square kilometres.

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[18] The feature map can be found on the NRW website and information on the map features, data sources and any changes can be found in Annex I.

[19] "*As a general principle, site boundaries have been drawn closely around the qualifying habitat types or the habitats of species for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the habitat type(s) or species and to maintain sensible management units.*" McLeod et al, 2002.

b) Structure
i. Geology
The geology of Cardigan Bay consists of an almost complete arc of Pre-Cambrian and Lower Palaeozoic rocks cradling a post-Palaeozoic sedimentary basin. It is oriented south-west to north-east extending from St. George's Channel to the coastline of Tremadoc Bay. The area was subject to periods of intense erosion during glaciations, at which time sediments were deposited, particularly in the Celtic Trough. Quaternary sediments completely cover Cardigan Bay except for small areas of exposed basement rocks, for example off Bardsey and the north Pembrokeshire coast.

Exposed boulders and bedrock mainly occur in regions dominated by strong tidal currents or wave action, such as headlands and the intertidal zone. The distribution and extent of the main intertidal rock types is well known, though the distribution and extent of subtidal rock types is incompletely known and largely inferred.

ii. Sedimentology
Cardigan Bay SAC supports an extremely wide range of sediments, from well sorted, highly homogenous sands to well mixed muddy gravels, pebbles and cobble. The stable seabed in the western part of the SAC is largely sandy and gravely with occasional areas of mega ripples. The eastern and inshore areas are more variable, constituting mixed ground with areas of sand, mud, muddy gravels, pebble, cobble and boulder. The coastal areas are generally dominated by sands, but with some intrusions of gravel such as the area adjacent to New Quay.

iii Geomorphology
Cardigan Bay is a relatively shallow and gently sloping embayment of the Irish Sea, generally reaching 50 m only in the outer parts of the bay towards St. George's Channel. Most of the SAC is less than 30 m deep, with deeper areas off Aberporth and in the south western part of the site. Due to the general shallowness, wind and wave action dominate the physical processes. The seabed is relatively level with gentle banks and troughs but there are areas of greater topographical interest, particularly closer to shore and in the vicinity of headlands.

The coast is dominated by rugged headlands, interspersed by bays and the Teifi inlet. Shores tend to become more rugged and rocky towards the southern end of the site, typically with sandy bays. Towards the north the headlands consist of softer rocks and the shores tend to be dominated by cobble, pebble and boulders. The geomorphology of this area is described in more detail within the West of Wales Shoreline Management Plan[20].

c) Function
i. Hydrography and meterology
The Irish Sea is a relatively enclosed body of water with moderate tidal ranges. In the southern part of Cardigan Bay, for example, mean spring tidal ranges are approximately 4-5 m. Tides in this area are predominantly semi-diurnal, with high and low water times getting progressively later further north. The tide enters the bay via St. George's Channel with a weak average flow northwards of both surface and bottom currents, running north during flood tides and south during the ebb.

[20] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)

Tidal currents are generally low within the bay (max 0.9 m/s) but locally variable, and little is known about water transport patterns. The weakest tidal currents are within Tremadoc Bay, increasing to the south and west. Currents are slightly stronger near headlands and estuaries with some of the strongest currents along the SAC coast run between Cardigan Island and the mainland.

The bay has a mainly open coastline, exposed to the prevailing south-westerly and westerly winds however as the Irish Sea is relatively sheltered, the majority of waves reaching the Cardigan Bay coast are locally generated, of fairly short period and therefore steep. A substantial swell develops during prolonged periods of high winds. During the winter when gales are common, the wave height exceeds 1 m for about half the time, compared to about a quarter of the time during the summer months. Depending on the wind direction, small embayments within the SAC may provide some shelter during stormy conditions in the areas of New Quay, Ynys Lochtyn, Aberporth, Mwnt and the Teifi estuary. The water masses are partly of coastal origin (Bristol Channel and southern Irish Sea circulation) with an oceanic input through the Celtic Sea. The general pattern of near-surface water movement in the Irish and Celtic Seas and south-western approaches indicates the possibility of a certain amount of water recirculation; this is of significance for larvae and spore dispersal. Water circulation is seasonally modified as a result of summer heating and stratification (density layering) in the Celtic and Irish Seas.

Parts of the Irish Sea have a marked seasonal variation in turbidity and this is particularly true in Cardigan Bay. During the summer suspended sediments settle out in the relatively calm bay whereas during the winter when winds increase, bottom sediments are mixed throughout the water column and produce turbid surface waters, particularly close to the coast. Turbidity of inshore waters is also strongly affected by outflow from the rivers such as the Aeron, Ina, and Teifi, as well as smaller outflows. Sediments from the Gwaun and Nevern Rivers adjacent to the southern boundary of the site are also carried into the SAC by tidal currents, and together these turbid waters often form darker coloured bands that spread out from the estuaries and follow the line of the coast. Seasonal phytoplankton blooms temporarily increase particulate concentrations and decrease water clarity.

ii. Water & sediment chemistry

Salinity within Cardigan Bay is influenced not only by incoming Atlantic water, but also by freshwater input from rainfall, run-off from rivers and estuaries within the bay as well as the Severn, and the effects of evaporation, currents and mixing. Surface salinities within the Bay in summer are generally less than 34‰, decreasing towards the shore. During the summer months when the inshore waters of Cardigan Bay are stratified, salinity also varies with depth with fresher water overlying more saline water, particularly near the mouths of rivers and estuaries. Rainfall into the Irish Sea contributes a volume of water equal to about one third of the riverine input. Cardigan Bay receives an average freshwater flow from rivers of 113 m^3s^{-1} with rivers adjacent to the SAC including the Aeron, Ina and Teifi, contributing the greatest input of freshwater into the SAC. Smaller streams and freshwater from the rivers Nevern at Newport and the Gwaun at Fishguard also affect salinity, particularly in the southern inshore waters of the SAC. River discharges are highly variable and the largest inputs to Cardigan Bay occur between December and February and the smallest in July.

The limited marine monitoring undertaken in Cardigan Bay has found the water quality to be good however sediment analysis has found significant levels of contaminants at several locations in the bay. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[21].

iii Sediment processes

Detailed sediment processes in St George's Channel are poorly known but inferred to be dominated by tidal current action on mainly coarse, relict or locally derived strong currents have prevented the accumulation of fine sediment. Long period wave action also has a major local modifying effect. There is a net westward transport of sediments from the Bristol Channel across and into southern Irish Sea. The sand fraction is transported near-bed and the muddier fractions in suspension, possibly resulting in different transport paths. The presence of major sandy bed-forms (well south of Cardigan Bay SAC) indicates the transport of large volumes of material. Shoreline and near shore sediment process have been studied in more detail and are described within the West of Wales Shoreline Management Plan[22].

iv Biological interactions

Species interactions within the SAC are complex and inter-related. Bottlenose dolphin and grey seal, for example, are top predators and therefore are likely to be affected by changes at lower trophic levels in the food chain. These food chains extend beyond the confines of Cardigan Bay SAC, as both the dolphins and seals rely heavily on prey that spend much of their time outside the site and which, in turn, may interact with species populations some distance away. Impacts on biological interactions taking place some distance from the site may can therefore have a significant effect on these predators.

d) Typical species

Current biological survey data provides limited indicative information on the distribution (range) of some species within the site, particularly the most widely distributed and frequent. However, the spatial and temporal resolution of the data is insufficient to show precise distribution or temporal variation in distribution.

3.2 Operations within the SAC

Human activity within Cardigan Bay is relatively light and forms a backdrop to dominant natural forces. The shoreline, backed by agricultural land, is little developed with shoreline activities greatest in the summer months when the small villages, caravan and camping sites become busy with an influx of tourists. Industry is light and limited largely to the fishing sector. Static gear such as pots and set nets predominate, and are focussed close to shore. Scallop fishing is currently contained in one part of the site[23] and has been assessed through a Habitats Regulation Assessment.

Shipping passes by far out to sea and the inshore waters are generally quiet except for the summer months when recreational boaters and tourist boat trips (in particular wildlife tours) are busy along the coast adding to the seasonal increase in fishing activity.

[21] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.
[22] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/)
[23] The Scallop Fishing (Wales) Order 2010 (http://www.legislation.gov.uk/wsi/2010/269/contents/made)

3.4 Modifications as a result of human activity

Various anthropogenic activities currently taking place within the SAC have an influence on the habitat and species features. 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) which affect the habitats and species. Whilst the structural and functional characteristics of the SAC and its 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.

The abundance and range of bottlenose dolphins has declined over the past few centuries as a consequence of human activities. Current human activities impact upon the bottlenose dolphins, such as disturbance (recreational and tourist trip boats), pollution (particularly organohalides), prey depletion (fisheries) and fisheries activities. These can directly or indirectly cause deaths, affect survivorship or reduce reproductive potential. The degree to which these damaging influences are currently significant in terms of site population maintenance is not known.

The limited marine monitoring undertaken in Cardigan Bay has found the water quality to be good. However, sediment analysis has found significant levels of contaminants at several locations within the bay, typically associated with small harbours such as those at Aberystwyth, Aberaeron and New Quay. These have included raised levels of Tributyl Tin (TBT), Polychlorinated Biphenyls (PCBs) and metals such as lead, copper and zinc. Furthermore, analysis of tissue samples from stranded marine mammals in the area show raised levels of heavy metals, mercury and organo-halide compounds. Fish in Cardigan Bay have been recorded with some of the highest prevalence of liver cancer in UK waters. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[24].

The majority of the consented discharges to the SAC are of domestic sewage effluent with a few being from an industrial source. However, diffuse run off and effluent from agricultural land and the continuing impact from historic mining activity (metals) provide the major landward inputs in central Cardigan Bay. The scale and significance of contaminant input from outside the site, via the movement of marine waters and sediments or the movement of marine organisms (e.g. dolphin prey), is not known.

Species subject to commercial fisheries exploitation are known, or inferred, to be depleted below preexploitation levels, some very significantly. Impacts of non-target species bycatch and consequential physical impacts of demersal gear are well documented. Scientific evidence suggests that aspects of ecosystem functioning will have been modified as a consequence. Cardigan Bay has a history of fishery boom and bust, and some species once forming an important industry in the area (e.g. Herring) are now hardly fished at all as a result of wide-spread over exploitation. Strong links exist between fishing and marine mammal features of the SAC when considering predator/prey interactions and changes have undoubtedly taken place as a result of man's activity with possible

[24] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.

implications for other wildlife including the status of the two marine mammal species for which the site has been designated

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[25].

4. Feature Descriptions

4.1 Bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins (*Tursiops truncatus)* are a cosmopolitan species, widely distributed in a range of mainly nearshore coastal habitats from tropical to temperate seas, in sheltered and exposed areas of estuaries, lagoons, continental coasts – a coastal ecotype, and also in pelagic waters offshore and around oceanic island coasts – an offshore ecotype. In Britain, bottlenose dolphins have been recorded most frequently in coastal waters, predominantly in two areas: Cardigan Bay and the Moray Firth. Small groups have been recorded regularly elsewhere including along the Cornish, Devon and Dorset coasts, in the waters around the Hebrides, off the Irish coast particularly in the Shannon Estuary, and frequently in offshore waters of the North-east Atlantic, Irish Sea and St. George's Channel.

Dolphins from all of these areas may occasionally move some distance from their apparent core range. For example, regular sightings in the Firth of Forth probably involve dolphins from the Moray Firth and sightings in North Wales involve Cardigan Bay dolphins. Other dolphin groups, presumed to be transients, are recorded further offshore in deeper water in the Celtic Deep and to the west of Scotland.

The total population of coastal bottlenose dolphins in UK inshore waters is small[26] (estimates less than 500 individuals) and for offshore bottlenose dolphins abundance estimates from the SCANS II survey were 5,370 for the offshore Celtic Sea area and 12,643 in total for the European Atlantic continental shelf[27]. The species was formerly more widespread, particularly of coastal dolphin groups, especially in the southern North Sea and English Channel and has declined in range.

4.1.1 Population dynamics

Bottlenose dolphins are seen year-round in Cardigan Bay. The number of individuals increases during the summer months, as does group size reaching a peak in late September and October when quite large aggregations of more than 60 individuals may be seen. The dolphins are reported less frequently and in fewer numbers during the winter months, but this may partially be a reflection of poorer weather conditions and fewer observers watching the coast. Aerial surveys in Cardigan Bay in winter 2007 showed a clear preference for the offshore areas of the bay.

In the early 1990's there were estimated to be about 130 bottlenose dolphins in Cardigan Bay. More recent estimates also indicate a relatively small number of individuals, between

[25] Joint Nature Conservation Committee. 2013. General Implementation Report - 3rd UK Habitats Directive Reporting 2013. Available from: http://jncc.defra.gov.uk/page-6387
[26] Reid *et al*. (2003)
[27] Hammond & Macleod, (2006)

100 - 300. Intensive research of the Cardigan Bay dolphin population started in 2001 using photo-identification and line transects[28]. Most of the individuals identified during studies have been seen more than once, and a number of these animals have also been recorded in more than one year. Some dolphins have been identified in the Bay every year for periods of five years and more, while others appear to return to the area after a gap of one or two years. There appears to have been an overall increase in population size between 2001-2007 and a decline since then to 2001 levels but there is considerable variability between years and low confidence in some estimates (and the apparent trends are not significant). The decline in recent years may be related to animals moving away from the study area.

Bottlenose dolphins are highly social animals with group sizes varying seasonally. Although occasionally found alone, they are more often found in groups of anything from a few individuals up to several hundred; the larger aggregations are seen more often in exposed, open coastline or offshore waters (and usually represent the offshore ecotype) rather than sheltered habitats close inshore where coastal bottlenose dolphins are present in small groups.

They are a long-lived species that may survive in the wild for 40-50 years or more. Males commonly have a shorter lifespan of 25-35 years, while females are known to have lived over 50 years. The reproductive rate of bottlenose dolphins is low. Females produce a single calf every 2-6 years, following a gestation period of about one year, and the pregnancy rate does not appear to decrease with age. The timing of birth varies greatly and is likely to be influenced by many interacting factors.

Calving periods are probably timed to take advantage of seasons when food is particularly abundant. Calving is known to have taken place within Cardigan Bay and new-born and very young calves have been reported in Cardigan Bay from April to September, suggesting a seasonal pattern to calving. There is a likely preference for more sheltered shallow areas for calving. Reproductive rates in Cardigan Bay SAC present healthy crude birth rates of 5.3% and 7.8% using closed and open population models respectively, confirming that this region serves as an important nursery ground for females and their young calves. Birth rates calculated for the entire Bay are even higher, especially when using an open population model (9.4%), suggesting there are additional females nursing their young within other areas of the Bay including Pen Llŷn a'r Sarnau SAC[29].

Calf mortality rates calculated for Cardigan Bay SAC are 18% for each of the first and second years, decreasing to 8% in the third year; a total of 55% of calves survive into their fourth year, when they reach independence from their mother.

Recent analysis shows that nearly 30% of individuals have been identified in both Cardigan Bay SAC and Pen Llŷn a'r Sarnau SAC as well as north of the Llŷn Peninsula around the Isle of Anglesey, indicating large home ranges that most probably extend to the northern Irish Sea and maybe beyond. However, a proportion of the population shows a more local residency pattern, with relatively small home ranges.

Surveys show that the numbers of bottlenose dolphins are greatest between July and October and only a few animals are seen between November and April, although some

[28] Feingold & Evans (2013)
[29] Feingold & Evans (2013)

animals are present near shore in every month of the year. They are most commonly seen within 10 miles of the coast, from April to October and most concentrated within 2 miles near headlands, estuaries and in embayments.

Most of the dolphins identified in Cardigan Bay have markings, lesions or injuries on their skin. This is common in bottlenose dolphins world-wide, and the severity in Cardigan Bay is about average in comparison with other populations. One study found that temperature and salinity have had a more significant effect on skin condition than pollution.

A range of viral, bacterial and parasitic diseases are known to be endemic within bottlenose dolphin populations but have a limited effect on healthy, unstressed adult animals. Bottlenose dolphins are susceptible to certain diseases of domestic animals such as brucellosis and morbilliviruses.

Pollution is a potential threat to the health of the Cardigan Bay dolphins and their environment. In a recent study, 15 stranded bottlenose dolphins were found to have levels of PCBs over 80mg/kg, which is well over the 17mg/kg threshold for adverse reproductive effects, and was considered to be of concern, especially as this is a long-lived apex predator of relatively small population size that only reproduces every 2-6 years.

4.1.2 Range

The dolphins of Cardigan Bay SAC represent a mobile and wide-ranging population of variable individual residence. Their full range is not known but individuals recorded regularly along the southern coast of the Bay have also been seen both north and south of the SAC. Species range varies from year to year and this variation is likely to be predominantly as a consequence of natural environmental changes such as prey distribution.

Bottlenose dolphins have been seen all round the Welsh coast since the early part of this century, but mainly throughout Cardigan Bay where they are reported most frequently inshore from about Aberystwyth to the Teifi Estuary. Along this southern coastline, dolphins are often sighted within the SAC off headlands and in more sheltered areas near New Quay, Ynys Lochtyn, Aberporth, Mwnt, and the Teifi Estuary. It should be noted that the coast between New Quay and Cemaes Head has been the area of greatest observer effort over the years.

The dolphins of the Cardigan Bay are highly mobile. Surveys in North Wales (particularly from Anglesey eastwards towards Liverpool Bay) during 2007-08 have revealed that some individuals spend at least part of the winter in this area. Even in summer, there are bottlenose dolphins regularly using the waters around North Wales northwards to at least the Isle of Man and Cumbrian coast.

Strandings data indicate that some large changes have occurred for this species in UK waters. From 1948 to 1966 bottlenose dolphin strandings occurred in relative large numbers on north western British coasts, around the Irish Sea and in the south east along the English Channel to East Anglia. Since 1990 most strandings have occurred in West Wales and the Moray Firth reflecting the resident populations concentrated in those regions. The numbers of animals stranding have declined. In the 1940s through to 1960s this species was the second to third most commonly stranded. Over the last 15 years their ranking has dropped to 10th or 11th.

4.1.3 Supporting habitat and species

The precise habitat requirements of bottlenose dolphins are poorly understood, but includes habitat that is of sufficient quality for feeding and calving, as well as resting and travelling. The Cardigan Bay SAC provides a proportion of the overall habitat requirements of the bottlenose dolphins that occur within the site, with different areas being used throughout the site. In coastal waters they appear to favour habitat with uneven topography and/or strong tidal currents and acoustic monitoring has demonstrated the importance of sandbanks and reefs for foraging. The high frequency of sightings along the coast from Aberaeron to Cardigan and around Fishguard suggests these areas may be of particular significance.

The animals make regular use of areas with strong tidal currents, especially near headlands, and behaviour interpreted as feeding has been observed and reported. There are also observations of bottlenose dolphin aggregations in the SAC at the entrances to estuaries. Salmonids are concentrated in estuary mouths during settled weather awaiting rising river levels to make their way upstream indicating that the catchments of freshwater tributaries entering the site contribute to the overall site integrity for this species.

Bottlenose dolphins are generalist and opportunistic feeders eating a wide range of pelagic and benthic (demersal) fish, crustaceans and molluscs. Prey species include haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, cod *Gadus morhua*, hake *Merluccius merluccius*, mullet *Mugil* spp., eels *Anguilla anguilla* and *Conger conger*, salmon *Salmo salar*, trout *Salmo trutta*, bass *Dicentrarchus labrax* and sand eels Ammodytidae, as well as octopus *Eledone cirrhosa*, *Loligo* spp., and other cephalopods. The only natural predator, the killer whale *Orcinas orca* is infrequently sighted in Cardigan Bay.

From visual observations of the surface behaviour of bottlenose dolphins in Cardigan Bay, it is known that they capture pelagic fish such as sea trout (sewin), salmon, bass, mullet, mackerel, and garfish. There is limited knowledge of the degree to which the species preys upon demersal fish or benthic invertebrates. A post-mortem examination of a bottlenose dolphin in North Wales indicated stomach content was dominated by flatfish and interestingly the cause of death was associated with a dab obstructing the blowhole. Several studies have related visual and acoustic behavioural observations to foraging activities and have indicated the importance of sandbank and reef habitats.

As bottlenose dolphins forage widely, a decline in prey species in one area may not immediately impact the population. The status of likely prey species and the degree to which the bottlenose dolphin population is limited by prey availability is generally unknown. Prey availability is likely to be a key factor in determining the abundance and distribution of dolphins in Cardigan Bay.

Feeding activities have been recorded throughout the inshore waters of the Bay, with the distribution and movement of prey believed to influence the distribution and movement patterns of cetaceans.

4.1.4 Modifications as a result of human activity

The population of bottlenose dolphin in the SAC is small, though stable and the resilience of the population to change is unknown. There are various potential human causes for inhibition of calf production and survival, *e.g.* pollutant burdens or modification of prey availability, but there is no evidence to suggest calf production is currently significantly modified by human action. There is also no contemporary evidence to suggest age frequency or sex ratio is being modified by human action.

Data on persistent pollutants burdens is known from limited post-mortem examinations of bottlenose dolphins from within the site and further afield; the limited post mortem data shows tissue levels of persistent pollutants are of concern, although their direct population effects or effects on the site are currently unknown.

The effects of persistent pollutants burdens or modified food resources on health or reproductive capability have not been investigated within the site and any modification caused by burdens of persistent pollutants or modified food resources is unknown. However, contaminants are present within dolphin food chains, including those that are persistent and those that tend to bioaccumulate and biomagnify. Lipophyllic contaminants such as organohalides (e.g. polychlorinated biphenyls) are of particular concern, as they tend to accumulate within fatty tissue and are remobilised during lactation.

The presence of artificial inert or toxic materials, e.g. synthetic plastics and fibres, hydrocarbons, can cause entanglement and incidental capture. There is little evidence to suggest that entanglement in fishing gear or the ingestion of marine debris is a particular problem in Cardigan Bay.

The degree to which range is being affected by change to prey stocks and human disturbance is not known. There has been a decline in commercial fish stocks over the last two centuries, and particularly in the last 50 years. The majority of commercial fish populations assessed in the Irish Sea are currently recorded as being outside safe biological limits.

Disturbance by human activity may occur within close proximity to the dolphins or at some distance, for example through use of underwater sonar equipment that has the potential to disturb cetaceans, although this has not be demonstrated for bottlenose dolphins.

There is a continual increase in the number of power craft of all sizes operating within the SAC and Cardigan Bay as a whole. Bottlenose dolphins in Cardigan Bay were observed to respond to approaching boats at a distance of 150-300 metres by making longer dives and moving away from the source of the sound in a study using recordings of underwater sound. Although relatively quiet in terms of underwater noise, fast manoeuvrable craft such as jet skis were considered to have the potential to startle dolphins with their sudden approach. Elsewhere changes in habitat use and avoidance of previously preferred areas have been associated with increase in boat traffic. Commercial wildlife watching activities has increased in recent years. Separation distances between bottlenose dolphins and passenger boats carrying visitors were significantly greater after the introduction of a boat operator’s code of conduct. A study in 2012 examined the effect of boat disturbance on the social structure of bottlenose dolphins in Cardigan Bay. The results indicated that vessel traffic does impact community structure[30].

Boat collision is a potential risk, there are no records of bottlenose dolphins being killed by boats but propeller injuries have been noted in Cardigan Bay on one female and

[30] Feingold & Evans (2013)

suspected in a young calf. The injury to the female, which is thought to have occurred in 2007, did not seem to impact on her mobility or reproduction as she has since been identified from different locations across the Bay, off Anglesey and the Isle of Man and was later identified with a calf[31].

4.2 Grey Seal (*Halichoerus grypus*)

The UK population of grey seals (*Halichoerus grypus* Fabricius, 1791) represents about 38% of the world population and 83% of the EU population. The total UK grey seal population size in 2012 was estimated as 112,300 (95% CI: 90,600-142,900)[32]. Based on pup production estimates, the Welsh 'population' forms around 3.3% of the UK or about 2.7% of the European population.

The breeding ecology differs from that of grey seals elsewhere in the British Isles as the seals here tend to use secluded coves and caves for pupping instead of forming large congregations of pupping females on open sites[33]. While most of the important pupping beaches, caves and haul-out sites occur in Pembrokeshire, grey seals are known to range throughout Cardigan Bay and North Wales and there are a significant number of pupping sites in south-western Ceredigion.

4.2.1 Population dynamics

Grey seals present within the site at any one time do not form a discrete population, but are centred (in terms of abundance) on Cardigan Bay and are considered part of the SW England and Wales management unit[34]. This population itself is not isolated but extends from SW Scotland to SW England and SE Ireland (individuals have been photographically recaptured among these regions[35] and there are movements and exchanges with more distant populations (satellite tracked individuals have been tracked to/from France, west coast of Scotland and Ireland[36]).

Pup production can be used as an index of seal population size, if age structure is stable and where rate of change is constant, or where alternative information on fecundity or survival rates is available[37]. UK grey seal population size is estimated from pup counts using a complex population dynamics, Bayesian state-space model[38]. The south-west Wales 'population' size is also determined from pup counts, and has been estimated at approximately 5000 individuals[39]. Pup production within the Cardigan Bay site represents a small proportion of the south-west Wales production. Most long-term survey data has been collected from small parts of the Pembrokeshire Marine SAC - namely Skomer Island and Marloes Peninsula with annual data from the 1970's[40], and less frequent data from the North Pembrokeshire coast and Ramsey Island[41] - with trends for the south-west Wales population inferred from this data.

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31 Feingold & Evans (2013)
32 SCOS (2013)
33 Baines *et al.* (1995); Stringell *et al.* (2013)
34 IAMMWG, (2013).
35 Keily *et al*. (2000), SCOS (2013), Cornwall Seal Group *pers. comm*., NRW Unpublished data
36 Cronin (2011), Vincent, unpublished data
37 Duck & Thompson, (2007)
38 SCOS, 2013
39 Baines *et al*. (1995)
40 Newman *et al*. (2015)
41 Strong *et al*. (2006)

The population is not known to be subject to predation although potential predators such as killer whales and large sharks are occasionally recorded within the Irish Sea.

In terms of reproductive success pupping numbers diminish rapidly from the Teifi estuary northwards, with Cemaes being of greatest importance, although pups are also born near Lochtyn, Aberporth and Cardigan. The average number of pups born within the Cardigan Bay SAC between 1992-94 was 66 pups per year representing approx. 1.7% of the total recorded pups born within West Wales. Data from Pembrokeshire in 2015 recorded combined survival of 77.8% of pup survival to moulting[42] which is above the long-term UK national average. There is currently insufficient data for Cardigan Bay SAC to ascertain within-site pup survival.

The age frequency and sex ratio of the population is unknown as are fundamental population demographics such as female fecundity, adult survival / mortality and physiological health. An emerging phenomenon is the appearance of mortal spiral wounds thought to be caused by sudden traumatic events involving the strong rotational shearing force of a rotating blade. These injuries are consistent with the seals being drawn through a ducted propeller[43]. The occurrence of 'corkscrew' injuries is a growing concern in the UK and such occurrences have recently been reported in Wales[44]. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals.

4.2.2 Range

Grey seals are highly mobile species[45], which can travel great distances[46]. There is an increasing need to understand the movement and connectivity of seals identified in SACs to inform conservation planning. Tracking studies can provide powerful insights into animal ecology and usually involves transmitting/recording devices, e.g. satellite telemetry, and/or tagging, e.g. flipper tags, branding or photo-identification. Photo-identification of seals offers the chance to photographically capture permanent and identifiable patterns on the pelage[47] of many animals at repeated times and low cost. Over 3000 individual seals have been photographed throughout Wales over the last two decades (NRW *unpubl data*) and photographically recaptured at multiple distant sites.

Seals are widely distributed within (and travel beyond) the site. A small number make long foraging trips offshore and up the Irish Sea to deeper waters. Only their pupping and regular moulting sites may be determined with precision and these are found throughout the site. Pupping is greatest towards the south-western end of the SAC and takes place throughout the site on open coast in suitable habitat (*i.e.* physically accessible, remote and/or undisturbed rocky coast beaches, coves and caves) and the high proportion of use of sea-caves by the south-west Wales population is a particularly unusual variation in breeding behaviour[48]. Moulting and resting haul-out sites are scattered along the site. None are used as haul-outs by large numbers of seals, instead they generally haul-out singly or in small groups in undisturbed locations throughout the site.

[42] Newman *et al*. (2015)
[43] Bexton *et al*. (2012), Thompson *et al*. (2013)
[44] Penrose *pers. comm.*
[45] Russell *et al*. (2013)
[46] e.g. >700km, Cronin (2011), Vincent *unpubl data*
[47] Hiby *et al*. (2013)
[48] see Stringell *et al*. (2013)

4.2.3 Habitat and species

The exact habitat requirements of grey seals is not known (seemingly suitable habitat is often not occupied) but must include suitable feeding, pupping, moulting and resting haul-out areas. They are assumed to feed throughout the site and they also travel some distance from the site to forage. Preferred pupping habitat tend to be secluded sites, sheltered from heavy wave action and accessible by females at all states of the tide. Pupping tends to occur at a limited number of favourable sites (mostly towards the south-western end of the SAC) with some use of less optimal sites. Moulting / resting haul-out habitat requirements are not known precisely but suitable habitat is extensive throughout the southern part of the site and is assumed to be adequate.

The structure of pupping beaches and caves, moulting and resting haul-out sites and feeding vary throughout the site, and the associated functional processes, are almost entirely determined by inherent coastal geomorphology and hydrography.

Grey seals are generalist feeders, foraging mainly on the sea bed, taking a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling), and flatfish (plaice, sole, flounder, dab)[49]. Among these, sandeels are typically the predominant prey species, but diet varies seasonally and from region to region. A study of grey seal diets from scats collected in Pembrokeshire[50], found that gadoids (mainly whiting) and flatfish (mainly sole) dominated the diet (70% by weight).

4.2.4 Modifications as a result of human activity

Grey seals were historically subject to human exploitation[51]. Although large numbers were killed and taken until early in the twentieth century there is no reliable contemporaneous information on population size at that time, or of likely pre-exploitation numbers. There are occasional, often unattributable, anecdotal reports of seals being shot or accidentally captured and drowned in fishing gear[52], the magnitude or importance of such deaths to population dynamics are unknown but unlikely to have a population level effect.

There is no known evidence that human influences have contributed to the reduction / stabilisation of pup production[53]. Although increased disturbance or suppression of physiological health from various anthropogenic activities remains a possibility.

Artificially introduced hazards and reductions in the natural quality and suitability of grey seal habitat include: the presence and persistence of artificial inert or toxic materials, contamination of prey, disturbance and displacement due to noise and visual disturbance and competition with human activities for space, boat collision, noise and visual disturbance resulting in increased density dependent pressure on preferred sites

The effects of persistent pollutants burdens or modified food resources on health or reproductive capability have not been investigated within the site and any modification caused by burdens of persistent pollutants or modified food resources is unknown. The extremely limited post-mortem data available does not suggest that the physiological health of grey seals in this part of the UK is being adversely affected by any specific

[49] Brown *et al*. (2012), SCOS (2013).
[50] Strong (1996)
[51] Haug *et al*. (2007)
[52] SCOS (2013)
[53] Thompson & Härkönen (2008)

pollutants or diseases. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals.

Minor and temporary modifications of distribution are routinely caused by various coastal and maritime human activities. The inaccessibility and predominantly winter use of moulting haul-out sites minimizes their exposure to human disturbance. However, anecdotal reports and observations suggest that seals maybe becoming increasingly habituated to human presence at certain sites.

4.3 River Lamprey (*Lampetra fluviatilis*) and Sea Lamprey (*Petromyzon marinus*)

Lampreys are primitive vertebrates that have a distinctive suckered mouth, rather than jaws. The river lamprey *Lampetra fluviatilis* is found only in Western Europe, where it has a wide distribution. The sea lamprey *Petromyzon marinus* occurs over much of the Atlantic coastal area of western and northern Europe and eastern North America where it is found in estuaries and easily accessible rivers.

Both species are widespread in the UK. Eggs are laid by the adults in clean river gravels. The larvae (ammocoetes) spend several years buried in sandy sediment in rivers feeding on organic matter before metamorphosing after 3-4 years. Juveniles migrate to estuaries and inshore waters where they feed parasitically on various fish species. Once fully grown, they migrate upstream to spawn. After spawning, the adults die.

During their marine phase, river lampreys are predominantly an estuarine and inshore species feeding on small fish such as herrings and sprats. Sea lampreys are much larger and more oceanic, feeding initially on similar species to river lampreys before switching to larger prey, including sharks and cetaceans[54]. Juvenile sea lampreys have been suggested to prefer migratory species (including shad) as prey in freshwater and estuarine environments, perhaps due to their larger size[55]. At sea they appear not to be very selective and have been recorded feeding on at least 54 different species. Sea lampreys have been recorded 400km or more from the nearest land[56] and at depths of up to 1000m.

4.3.1 Population dynamics

River and sea lampreys are difficult to sample in the marine environment. Inferences about the status of the river lamprey population in the Cardigan Bay SAC are based on condition monitoring of the Afon Teifi SAC, which assesses the extent and density of juvenile lampreys.

Lampreys do not home to their natal river[57], so lampreys using the Cardigan Bay SAC should be viewed as a protected component of a larger population covering the Bristol Channel and possibly a wider area. In particular, the river and sea lamprey populations of the River Wye, River Usk, Afon Tywi, Afon Teifi, Afonydd Cleddau, Carmarthen Bay & Estuaries and Pembrokeshire Marine should be seen as linked to Cardigan Bay SAC.

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[54] Silva *et al*. (2014)
[55] Silva et al. (2013)
[56] Kelly & King (2001)
[57] Bergstedt & Seelye (1995)

Lampreys use the site as an access corridor between the open sea and riverine breeding habitat. The numbers of individuals within the site at any time, and their distributions and proportions of wider populations, are likely to be dynamic and are unknown. Presence is inferred to be highly seasonal.

4.3.2 Range

Adult river lampreys migrate through the SAC to reach the Afon Teifi and River Aeron on their spawning migration, entering freshwater between October and December[58]. Juvenile river lampreys generally migrate downstream into estuaries and inshore waters in spring, though autumn migrations have also been recorded. Since river lampreys feed and grow in estuaries and inshore waters, it should be assumed that juveniles are present in the SAC throughout the year.

Adult sea lampreys migrate through the site between March and June to reach the Afon Teifi and River Aeron. Lampreys from the Rivers Usk, Wye and Teifi may use the inshore waters of the SAC. Mature adults enter the estuaries from April onwards and migrate some distance upstream. Peak migration usually coincides with temperatures that remain above 10^{o}C and continues until temperatures reach 18^{o}C. Juvenile sea lampreys migrate downstream between December and June[59] and spend some time feeding in the estuary and inshore waters before moving off shore in search of larger prey. Accordingly, various stages of sea lamprey should be assumed to be present all year round.

4.3.3 Habitats and species

River lampreys feed on a variety of estuarine and coastal fish, but particularly herring, sprat and flounder. The adults feed on much the same species in both estuaries and coastal waters. Sprats are likely to be abundant during the winter in Cardigan Bay and flounders are also common and therefore these are likely to be a primary food source.

Sea lamprey feed on a wide range of fish, shark and cetacean species. Prey selection is thought to be size rather than taxon-specific and is positively correlated with lamprey size. They are not thought to be restricted to any specific habitat and are likely to follow prey: however a preference for demersal species and sheltered locations has been suggested[60].

4.3.4 Modifications as a result of human activity

Very little is known about impacts of human activity on these species in this site. For example there is no known information on historical or contemporary by-catch within the site, and no known evidence of incidental capture. The absence of known by-catch records suggests a low direct risk from fisheries. There is also no known evidence that shad and lamprey habitat structure is inadequate. Water column contaminants are a threat to physiological health, but water quality is assumed to be sufficiently high in open coastal waters. Water quality obstacles within adjacent river catchments are unknown. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[61].

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[58] Maitland (2003)
[59] Silva *et al*. (2013) summarised the data and found that it varies with increasing latitude: the Irish chronology has been used as being most likely to be similar to the Tywi.
[60] Silva *et al*. (2014)
[61] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Cardigan Bay central & Cardigan Bay north.

There are no known or likely physical impediments to access within or transit though the site, though there are within the adjacent rivers (e.g. weirs).The presence and persistence of artificial inert materials (*e.g.* plastics and synthetic fibres) creates an entanglement risk within the site.

4.4 Reefs

Reefs are widespread in northern and southern Europe and occur widely around the UK coast. They are defined in the EU Interpretation Manual[62] 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
- Sabellaria alveolata reef
- Blue mussel beds
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Subtidal mixed muddy sediments
- *Arctica islandica*
- *Ostrea edulis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

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

4.4.1 Range

Cardigan Bay SAC supports both rocky and biogenic reef types. Its rocky reefs are widespread and in the subtidal form a mosaic with areas of sand and gravel. Reefs in the bay consist largely of boulder, cobble and pebble, but along the beaches and just offshore there are occasional areas of bedrock. Biogenic reefs of the honeycomb worm *Sabellaria alveolata* are common in the intertidal and shallow subtidal environment, particularly in the northeast of the site. Indications are that subtidal reefs of the closely related species *Sabellaria spinulosa* may also be present.

Subtidal reefs are concentrated in the east of the SAC and tend to be more frequent close to shore in the south and west. The seabed of Cardigan Bay appears to be very patchy, forming a mosaic of seabed types, some of which seem to run parallel to the shore. This heterogeneity is greatest in the east and near shore, becoming more homogeneous offshore in the west. The distribution and extent of reefs within the site is therefore uncertain especially for subtidal areas.

4.4.2 Structure and function

The Bay’s reefs fall into three main geomorphological categories;

- Raised areas of hard ground consisting of pebbles, cobbles and boulders. Present both subtidally and intertidally. They cover wide areas and appear to form a patchwork with more mobile patches of sediment.
- Biogenic reefs of the polychaete worm *Sabellaria alveolata*. Present predominantly in the intertidal, but extending into the subtidal. They grow on top of bedrock and hard ground where wave action suspends the sediment particles required by the worm for reef creation.
- Hard bedrock reef. Present subtidally and intertidal. These reefs have considerable topographical character and contain many fissures and crevices. The rocky shores of the south and west are typical of moderately exposed bedrock shores, with a good range of specialised habitats such as gullies, overhangs and pools. These reefs typically consist of bedrock ridges on the shore and into the subtidal, becoming broken bedrock that merges into boulders on sediments before eventually petering out into subtidal sediment plains. At the southern end of the site around Cemaes Head and Cardigan Island these reefs can extend over a kilometre offshore, but this diminishes rapidly up the coast so that bedrock reefs quickly become limited to the shore and immediately adjacent subtidal. Most of the site's sea-caves are also found here.

The majority of reef within Cardigan Bay SAC is moderately exposed, tide and/or sand swept mixed ground. The aggregations of consolidated and unconsolidated hard substrata (such as pebbles, cobbles & boulders) are intermixed with silts, sands and gravels. Although generally being sufficiently stable to support sessile organisms, the mobility of the reef structure and the scouring and smothering effects of the shifting sands and gravels have a strong influence on the habitat's community composition.

Large areas of reef surfaces are subject to intermittent or regular, long or short-term sediment cover depending on depth, topography, exposure to water movement and proximity to sediment sources. Overlying sediments vary from very fine deposits in wave and / or current sheltered locations to extremely coarse sands and fine shell gravel in current exposed offshore locations.

The biological interactions structuring reef ecology are known to be complex and include inter- and intra-species competition for space and resources, grazing and predation. The status of many biological interactions structuring ecology of reef communities and the population structures and dynamics of most key ecological structuring species are poorly known.

4.4.3 Typical species

The limited information on Cardigan Bay reefs suggests that species richness is high, though variable between and within reef habitats and over time. The range of substrate type, topography, depth, wave and tidal current exposures and light contribute to the high species variety.

The population sizes of particular species are unknown or poorly known as is population structure, biomass, physiological health and reproductive capability. Many invertebrate species on reefs have planktonic juvenile stages and are likely to be at least partly dependant on recruitment from outside the site.

The spatial range of most species characteristic of reef habitat is extensive, though the habitat range of many, particularly highly specialised species, is restricted in distribution and / or extent. Because of the hydrodynamic regime and the continuous throughput of water masses of distant and varied origins, species are inferred to be likely to be both capable of recruiting from and contributing to recruitment from both nearby and distant populations. The true ranges of apparently rare or scarce species are unknown.

4.4.4 Natural processes

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 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 animals, biogenic reefs can be very rich in other species as the structure often provides more than one type of habitat. For example the sediment and spaces in and amongst the mussels of a horse mussel reef 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. In Cardigan Bay SAC the only biogenic reefs present are formed by the ross worm *Sabellaria* spp.

4.4.5 Modifications as a result of human activity

Reef features have historically been modified by human activity, for example as a result of coastal defence works, coastal construction, and use of heavy mobile fishing gear.

Reef geomorphology is assumed to be predominantly unmodified throughout the site with the distribution and extent of topographical reef types not known to have been reduced by human action. There is also no known evidence for modification of reef surface microtopography as a result of human activity, other than as part of gross modification of reef, but the use of heavy mobile fishing gear like bottom trawls and dredges is known to alter the topography of reef structures in quite major ways. The degree to which this has occurred within the site is unknown.

Remains of shipwrecks, lost and discarded fishing gear and persistent rubbish are present throughout the reef habitat and create a physical hazard to some species and may also be a source of chemical contamination. Modern synthetic fishing gears are capable of ‘ghost fishing’ both commercial and non-commercial species for prolonged periods. Many inert materials are colonised by marine wildlife (forming ‘artificial reefs’) though usually to the detriment of other, previously existing, species populations. Very small areas of intertidal reef have been covered by anthropogenic structures (e.g. outfall pipes).

There are limited localised anthropogenic influences on turbidity as a consequence of discharges (from sewage treatment works and local industry) and more pervasive influences as a consequence of land use influenced runoff, including farming practice and urban development. Increased storminess as a consequence of climate change is also likely to result in increasing levels of turbidity. Freshwater flows have been locally modified in the vicinity of managed or engineered watercourses where freshwater flow is concentrated. Long term outcome due to modified precipitation as a consequence of anthropogenically influenced climate change is uncertain.

The physiological health and reproductive capability of some species is inferred as potentially modified in areas of contaminant elevation and a variety of population dynamics are likely to have been, and continue to be, degraded by fishing activity. The mobility of commercially exploited species are (obviously) impeded by capture methods.

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

Intertidal sea-caves are distributed widely throughout the site and are common wherever there are suitable geological exposures. The general distribution is generally well known but is poorly documented or mapped. The majority of caves are found towards the south-western end of the site, but are present almost anywhere where there are sea cliffs of relatively hard rock.

Submerged and partially submerged sea caves are distributed throughout the south western part of the site. The distribution of partially submerged sea caves is reasonably well known, though that of submerged sea-caves within the site is not. The extent of partially submerged sea-cave habitat is poorly known and that of submerged sea-caves is almost completely unknown.

The total number of sea caves is unknown and their extent is poorly known (especially for submerged sea caves). Individual sea caves range in size from little more than deep enclosed overhangs to more than 100m long. A few sea caves within the site have been specifically surveyed and based on this the area and volume of sublittoral caves is estimated as small.

4.5.2 Structure and function

Steep cliffs and eroding banks of alternating layers of Ordovician slates, shale and sandstones, characterise the coastline of the Cardigan Bay SAC. This geology along with prevailing hydrodynamics has a dominating effect on cave geomorphology. Rock structure, faulting and folding determine cave structure and axis of orientation. Combined with exposure, these determine erosion which modifies cave structure and function.

The floors of many sea caves are areas of sediment or mixtures of sediment and pebbles, cobbles and boulders, with sheltered locations in caves tending to accumulate silt. The sediments contribute to the habitat and species diversity and composition and have a strong influence on the amount of scouring of cave walls. Caves within the site have a wide range of shape, size, orientation and aspect, resulting in an equally wide range of hydrographic conditions and habitat variation.

Caves with boulder floors at and just below sea level are typically heavily scoured, with walls polished smooth by boulders thrown around by heavy wave action. The seabed slopes gradually away from the coast in much of the area, the seabed here is mixed sediment, predominantly sand, and is easily churned up to add to the scouring action and heavy siltation which is characteristic of this area, particularly in the vicinity of the mouth of the Afon Teifi.

Many of the cave mouths face west where wave action has eroded out the strata of naturally weaker shale and slates leaving the harder sandstones. There are a greater number of caves to the west of Ynys Lochtyn where the rock is more suitable for cave formation and Cardigan Bay caves, particularly those at the western end of the site, can extend 100m into the cliff face due to the frequent vertical orientation of the rock layers.

The hydrography of the water column within and in the vicinity of sea caves is complex and highly variable spatially and temporally. Exposure to water movement varies throughout the site determined by depth / height, orientation, aspect, adjacent seabed / shore topography and sea cave morphology. Most caves are sheltered from currents inside while tidal streams outside can vary considerably. Most of the partially submerged sea caves are subject to at least moderate wave action. Many are regularly subject to extreme wave action and others are sheltered from all but the most severe wave action. Submerged sea caves are particularly exposed to strong wave surge.

The amount of light entering sea caves depends on their location, shape, aspect and adjacent coastal topography, and is a major influence on the species composition and diversity. Ambient light levels can be very different between caves. Caves with large entrances and a generally southern aspect usually receive some natural light in their deepest recesses, though in some cases insufficient to support plant growth. Many others, particularly with different aspects, that are narrow, have small entrances and are deep receive no natural light, like the submerged caves and long, north facing caves on Ramsey Island.

Particulate concentrations are generally significantly higher in sea caves subject to water movement with sediment floors or with a nearby sediment source, than levels in the adjacent external water column but also geographically and seasonally highly variable. The water and sediment chemistry is mostly likely to reflect that of the adjacent water column but modified by any groundwater seeps particularly in intertidal sea caves.

The mobilisation and deposition of sediment as a result of water movement is regular and widespread and many sea caves with sediment floors are therefore subject to rapid and considerable fluctuations in floor height and sedimentology. Intertidal *sea caves* (in particular) in the vicinity of sediments are subject to varying degrees of scouring from sediment movement, particularly low on cave walls.

Many sea caves provide highly favourable environmental conditions for key ecological structuring species (*e.g.* grazing molluscs, scavenging crustaceans). The possible presence of species atypical of areas immediately external to caves provides further opportunity for additional species interactions.

4.5.3 Typical species

The wide range of rock type, cave morphology, topography, depth and exposures to water movement, scour and light contribute to the high species diversity in sea caves within the site. Sea caves also typically support species that seem out of place, because caves provide environmental conditions which differ from those immediately outside the cave, for example sponges typical of deep-water are sometimes found in intertidal caves and mud dwelling anemones in sediments on the floor of caves in exposed rocky areas. The number of marine algal and invertebrate species associated with sea-caves can be high, though highly variable between and within sea-caves.

Species populations in sea caves include those tolerant of scour, of extreme wave surge and cryptic, apparent cave specialist species, including the rare snail *Palludinella littorina*. The range of caves in different rock types increases species variety; caves in limestone have high diversity in part because of the complex microtopography of the rock surface and the species that can bore into the rock. Stable boulders and bedrock on the lower shore portions of the cave floors in the Cardigan area are colonised by *Sabellaria alveolata*. Although not often found as the large hummocks of honeycomb like tubes found on the open coast, the fresh growth of tubes in several of the caves reflect the turbid and sand-scoured conditions not found in caves in the other SACs in Wales.

Above high water mark, deep inside the caves, the walls support little other than biotic films grazed by small molluscs such as the limpet *Patella vulgata*. Where scour from cave floor sediments is high there is generally a largely barren zone of bedrock just above the mobile boulder floor. On the roofs of the caves, if out of reach from main surge, spiders *Meta menardi* are found with thin crusts of bluegreen algae, green algae, red velvety patches of *Audouinella* sp. and lichens where small amounts of light reach the rocky surfaces.

Spirorbid worms and barnacles (*Verruca stroemia* and *Semibalanus crenatus*) with patchy thin crusts of sponge including *Halichondria panicea*, *Myxilla incrustans* and other yellow encrusting sponge species and sparse anemones (*Actinia equina*) cover the less scoured intertidal parts of the cave walls towards the backs of the caves. Barnacles, anemones and limpets are more common towards the cave entrance eventually merging with biotopes normally encountered on open wave-exposed rock all along this stretch of coast.

Where cave walls have a lower shore and shallow subtidal section, for example on the south-west side of Cardigan Island and the east side of Cemaes Head, the sea squirt *Dendrodoa grossularia* is occasionally found at high densities, mixed with smaller patches of the white lace sponge *Clathrina coriacea*. These species are highly characteristic of wave-surge conditions. The most species-rich sections occur just below chart datum between 10-30m into caves. Patches of bright yellow sponge *Aplysilla sulfurea* and red *A. rosea* and *Ophlitaspongia papilla* are found on the walls, interspersed with colonial ascidians *Botrylloides leachii* and encrusting bryozoans such as *Flustrellidra hispida*. Towards the entrance, these short faunal turfs become more species-rich with other hydroids, ascidians and bryozoans.

Sea caves with beaches undisturbed by human activity are a favoured by grey seals for breeding and resting sites and tall sea caves with dry ceilings are favoured as bat hibernation sites. There is very little population data for non-mammalian species in sea caves and population structure is also poorly known or unknown for most species. The population dynamics of the typical reef and sediment living species is most likely to reflect those of the populations from which the species are recruited in the wider environment. The dynamics of species requiring highly specific cave conditions and with restricted range are unknown and the same is true in relation to physiological health, reproductive capability and recruitment.

The range of few cave-dwelling species is constrained by habitat requirements with most species living in sea caves being part of wider populations in nearby suitable habitats. Their distribution is mostly determined by recruitment from populations with widespread distributions both within and outside caves. A few cave specialists have a restricted distribution and are only known from few locations but it is unclear whether this is a function of survey effort or represents truly limited distribution. Species populations with genuinely restricted distribution are more vulnerable than those that may recruit from large, widespread populations.

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 the 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

Sea cave geomorphology is predominantly unmodified by human activity throughout the site. Other than gross modifications arising from sea cave collapse or infilling, there is no known evidence for modification of sea cave structural integrity, distribution, sedimentology or surface microtopography as a result of human activity.

Discarded and accidentally misplaced artificial materials are present in some sea caves. Lost and discarded fishing gear and persistent rubbish form a physical hazard to many species, particularly grey seals and other vertebrate species, and some are a source of chemical contamination. The variation in cave structure and hydrodynamics tends to both retain and flush out chemical contamination, including hydrocarbons, depending on exposure to water and air movements.

The gross physical hydrography and tidal streams within, and in the vicinity of sea caves, is considered little modified as a result of human activity. There is also no known evidence for modification of ambient light levels within sea caves as a result of human activity. Suspended particulate concentrations may be modified by localised or distant human activity including, for example, dredge spoil disposal, coastal protection or construction operations.

There is no known evidence for modification of sea cave air temperatures a result of human activity. However, it is possible that regular use of sea caves for recreational or eco-tourism purposes may increase air exchange (and also introduce atmospheric pollutants *e.g.* hydrocarbon exhaust fumes) No known evidence of modification of salinity in sea caves as a result of human activity but there is the potential for modification from changes in management of overlying land and watercourses.

Species populations in sea caves are exposed to nutrients and contaminants in groundwater seeps strongly influenced by agricultural or other management practices on overlying land surfaces. The magnitude and persistence of elevated hydrocarbons and exhaust gases in sea caves used by powered craft, and the potential consequences of such contaminants are unknown. Ecosystem functioning determined by grazing molluscs has been subject to temporary acute modification by pollution incidents. There is no known documented evidence of human activity having restricted physical access by grey seals to sea caves, other than temporary inhibition caused by human presence.

4.6 Sandbanks which are 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;
- 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 Cardigan Bay SAC are of sub-type gravelly and clean sands.

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

- Mud habitats in deep water
- Subtidal mixed muddy sediments (low confidence)

4.6.1 Range

The sandbanks of Cardigan Bay SAC are largely low-lying and most abundant in the east of the site, to the north and west of New Quay. There have been a few general studies in the bay that have sampled the sand bank areas and only one dedicated survey of sandbank habitat. The precise extent of sandbank features within the site is unknown however the general location of known subtidal sandbanks is shown in the feature map[63].

4.6.2 Structure and function

The Subtidal sandbanks vary considerably throughout the site according to sedimentology, seabed structure, bathymetry and hydrodynamics.

The sandbank features illustrate the variation between exposed (as these sandbanks are) and less exposed (to prevailing winds and weather) sandbanks. Their orientation is primarily along the axis of predominant tidal streams and the aspect varies within variation in axis of the tidal streams.

Very limited data are available on the sedimentology. The micro-distribution of sediments within the larger banks appears likely to be highly dynamic, while the gross distribution of the main banks themselves appears quite stable and stability is likely to increase with depth. The sandbanks are generally more sorted towards their tops with more mixed sediments towards their base. Sediments sampled in detail include banks in the New Quay area where they range from coarser-fine sand through to sandy gravel in the western part. The seaward side has a more mixed muddy sandy gravel substratum. The dune, wave and ripple microtopography of sandbanks are important sandbank microniches that contribute to habitat and species diversity.

Suspended particulate concentrations and water transparency are geographically and seasonally variable, though normally highest in open coast waters. Highest turbidity occurs during and following strong wave action, spring tides and heavy rainfall, typically in the winter months. There are also prolonged periods of low turbidity especially during spring and summer and in areas of weak tidal current streams. Whilst the exposed nature of the sites open coast sandbanks tends to minimise the presence of photosynthesising organisms such as *Zostera* spp, suspended fine particulates are relevant in terms of faunal feeding and respiration.

Nutrient concentrations within sediment structure are likely to be at or close to that of the surrounding water column although localised modification occurs where there are river and wastewater discharges.

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

Sandbanks are important, not just for the range and variation of community types and species present, but for their influence on the wider structural integrity of the surrounding habitats.

4.6.3 Typical species

The prevalent sandy community type along the Cardigan Bay coast is a ‘shallow Venus community’ or an ‘offshore sand association’. Because of the varied sediments the communities correspond with a variety of biotopes, including affinities with the shallow sand faunal communities. The west New Quay bank has a very rich and diverse range of taxa, mainly due to the coarse sands at the seaward side of the bank. Polychaete worms are common across the bank and other species recorded include shrimp-like crustaceans, bristleworms, molluscs, echinoderms and nemerteans

The medium-fine sands of the sandbanks are often dominated by the polychaete worms *Mediomastus fragilis* and *Ampharete finmarchica (*previously *lindstroemi)*, and the crustacean *Bodotria arenosa*. The coarser, more mixed sediments show a different collection of species and greater species diversity. Species found in large densities include the amphipod *Phtisica marina*, the tubeworm *Pomatoceros lamarcki ,* and the Ross worm *Sabellaria spinulosa*. Species found in lesser numbers include the mollusc *Corbula gibba*, the rosy feather star echinoderm *Antedon bifida*, the polychaete worms Eunereis (*Nereis) elittoralis* and *Caulleriellaalata*, and the amphipod *Ampelisca tenuicornis*, along with many other species and taxa that are often only found in mixed sediment environments. Uncommon polychaete worm species such as *Armandia polyophthalma* and the rare mantis shrimp *Rissoides desmaresti* have also been recorded here.

4.6.4 Natural processes

Subtidal sandbanks are dynamic features with their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics 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 but their location may change.

4.6.5 Modifications as a result of human activity

There is no known evidence of modification of exposure of the sandbanks to wave action or tidal streams or any changes in orientation as a result of human activity however the microtopography may have been modified by demersal fishing gear.

Sandbank structure has not been modified by sediment extraction within the site but dredge spoil disposal may have influenced the quality. The sediment composition has been modified such that there are raised levels of metals, particularly lead, due to historical mining activity. Mine waste waters enter the bay via river catchments, the Ystwyth and Rheidol being particularly significant. These continued inputs are of concern and the degree to which this represents a long-term cumulative threat is unknown. Evidence that cetaceans within the bay have raised levels of PCBs (see above) may indirectly reflect levels present in sediments and/or the water column.

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 Cardigan Bay

Our vision for the Cardigan Bay Special Area of Conservation (SAC) is one of a high quality marine environment, where the protected habitats and species of the site are in a condition as good as or better than when the site was selected; where human activities co-exist in harmony with the habitats and species of the site and where use of the marine environment is undertaken sustainably.

5.2 Conservation objectives for the Cardigan Bay Special Area of Conservation

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

- Sandbanks which are slightly covered by seawater all the time
- Reefs
- 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 **reef** feature these include;

- Intertidal bedrock reefs
- Intertidal cobble, pebble with *Sabellaria alveolata* (biogenic) reefs
- Subtidal bedrock reefs
- Subtidal pebble, cobble and boulder reefs
- Sea caves

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.

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.

5.2.5 Species Features

- Grey Seal
- Bottlenosed dolphin
- River Lamprey
- Sea Lamprey

5.2.6 Populations

The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:

- population size
- structure, production
- condition of the species within the site.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**;

- Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression

For **grey seal** populations should not be reduced as a consequence of human activity.

5.2.7 Range

The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that for **bottlenose dolphin** and **grey seal**:

- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered
- There are appropriate and sufficient food resources within the SAC and beyond
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

5.2.8 Supporting habitats and species

The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;

- distribution
- extent
- structure
- function and quality of habitat
- prey availability and quality.

As part of this objective it should be noted that;

- The abundance of prey species subject to existing commercial fisheries needs to be 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 species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
- Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
- Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour

5.2.8 Restoration and recovery
As part of this objective it should be noted that for the **bottlenose dolphin** populations should be increasing.

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, and 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[64].

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

[64] 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 1 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.

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

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
DOCKS, MARINAS & SHIPPING										
Dock, harbour & marinas structures: Construction* *Occasional in harbours*	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. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Dock, harbour & marinas structures: Maintenance* *Common in harbours*	Environmental quality: addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates) Physical disturbance: displacement, crushing, abrasion, smothering visual, noise	✓	✓	✓	✓	✓	✓	✓	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 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.*	Treat as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.
Dredging: capital * *None at present. Future proposals for*	Geophysical regime: modification of hydrodynamic regime & sediment transport processes; alteration / loss of substrate	✓	✓	✓	✓	✓	✓	✓	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	Treat as plan or project as appropriate. Establish best operational practices suitable to secure

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
Teifi estuary possible.	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								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 , timing and duration; relevant location-specific biotic and abiotic information*	features at FCS
Dredging: Maintenance* *Common in harbours*	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, smothering, visual, noise Other factors: removal of biota	✓	✓	✓	✓	✓	✓	✓	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 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, timing and duration; frequency of operation and proximity to healthy populations for recruitment; relevant location-specific biotic and abiotic information*	Treat as plan or project if appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.
Shipping: vessel traffic *Large commercial ships: Unlikely, although some areas may be used for sheltering purposes in poor weather conditions. Visitor passenger boats: Common, but limited in extent as they repeatedly use the same routes (seasonally skewed*	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 (seals);*	Determine effects of vessel movement on sediment transport, mobilisation and turbidity. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS

Activity	**Relevant factors**	**Sea lamprey**	**River lamprey**	**Grey seal**	**Bottlenosed**	**Reefs**	**Sea caves**	**Sandbanks**	**Most likely relevant components & effects** ***Information necessary to further refine / tailor advice to specific operations***	**Advice as to likely required action**
between April – October) *Fishing vessels: widespread but minimal impacts*									*relevant location-specific biotic and abiotic information*	
Shipping: Mooring* *Commercial vessels (fishing vessels): Common and widespread in harbours and the Teifi Estuary* *Recreational vessels: Common and widespread in harbours and the Teifi Estuary (seasonally skewed between April - October)*	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, 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*	Treat new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations.
Shipping: anchoring *Commercial vessels: unlikely although some areas may be used for sheltering purposes in poor weather conditions* *Recreational vessels: Widespread & common (seasonally skewed for recreational vessels between April – October)*	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*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of open coastal locations used as commercial anchorages and for casual recreational anchoring
Shipping: Vessel maintenance (incl. antifouling) *Widespread & common for recreational and local commercial vessels.*	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).	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
									<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; types of antifouling compounds and other materials employed, disposal methods used; proximity to sensitive habitats/communities/populations.	
Shipping: Ballast water discharge *Ballast water convention now in force.*	<u>Environmental quality</u>: organo-metals (antifoulants) <u>Other factors</u>: introduction of non-native species	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: effects on population dynamics and likely decrease of diversity and health 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. *<u>Operation specific information required</u>: 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.*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS
Shipping: Refuse & sewage disposal *Likely to be widespread offshore*	<u>Environmental quality</u>: addition of toxic (metals, synthetic organic compounds, microbial pathogens) & non-toxic (nutrients, inert particulates and materials) contaminants. <u>Physical disturbance</u>: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: operational discharges *Likely to be widespread offshore*	<u>Environmental quality</u>: addition of toxic & non-toxic contaminants particularly hydrocarbons; organic enrichment <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: elevation of water (and sediment) contaminant and / or nutrient burden. <u>Conservation status of typical species & species features</u>: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment *<u>Operation specific information required</u>: 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; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: accidents -may be associated	<u>Geophysical regime</u>: local modification of			✓	✓	✓	✓	✓	<u>Structure and function</u>: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment)	Maintain, keep under review and improve as appropriate, shipping

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
with cargo / bunkers discharges *Rare*	substrate structure & topography <u>Environmental quality</u>: addition of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing abrasion; visual; noise								hydrocarbon contaminant burden. <u>Conservation status of typical species & species features</u>: local effects on populations of species sensitive to physical impacts &/or hydrocarbon contamination; effects on species variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; type, amount and toxicity of discharges; relevant location-specific biotic and abiotic information*	management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - fuel oil & / or petrochemical discharges *Rare*	<u>Environmental quality</u>: addition of toxic & non-toxic contaminants particularly petrochemicals <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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) <u>Conservation status of typical species & species features</u>: lethal and sub lethal physiological effects on species sensitive to hydrocarbons; effects on population variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents- non-petrochemical cargo losses / discharges *Rare*	<u>Geophysical regime</u>: local modification of or addition to substrate <u>Environmental quality</u>: addition of toxic & non-toxic contaminants - potentially wide range of organic & inorganic materials & particulates. <u>Physical disturbance</u>: displacement, amputation, abrasion, smothering	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: elevation of water and sediment contaminant burdens; decrease in habitat quality. <u>Conservation status of typical species & species features</u>: lethal and sub lethal physiological effects on species sensitive to discharge; effects on population variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; type, amount and toxicity of discharge; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - salvage operations *Rare*	<u>Geophysical regime</u>: local modification of or addition to substrate <u>Environmental quality</u>: addition of toxic & non-toxic contaminants - petrochemicals, synthetics & metals debris <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, noise; visual	✓	✓	✓	✓	✓	✓	✓	<u>Structure and function</u>: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) contaminant burdens. <u>Conservation status of typical species & species features</u>: local effects on populations of species sensitive to physical impacts &/or potential contaminants; effects on species variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing, duration and nature; likely effects and outcome; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Provide environmental advice to salvage managers and salvors.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
CIVIL ENGINEERING										
Construction* *Not intensive*	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*	Treat as plan or project, taking into account proposed subsequent operational use and maintenance. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Land claim *# *Occasional*	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, taking into account proposed subsequent operational use and likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Coast protection / defence (including beach replenishment) *# *Widespread adjacent to coastal settlements*	<u>Geophysical regime</u>: modification of substrate, hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: suspended sediments, turbidity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, smothering, noise, visual; indirect effects from modified hydrodynamic regime	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential loss of / reduction in habitat extent. <u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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 proposed subsequent operational use and likely effects.
Barrages (amenity, storm surge, tidal) *# *None at present unlikely in future due to lack of suitable locations.*	<u>Geophysical regime</u>: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure <u>Fundamental environmental parameters</u>: modification of salinity, suspended sediments, turbidity, dissolved oxygen, temperature, seabed illuminance <u>Environmental quality</u>: toxic & non-toxic contaminant build-up; modification of suspended particulates; organic enrichment <u>Physical disturbance</u>: displacement	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: 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 <u>Structure & function:</u> 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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Artificial reef*# *There is artificial reef at Borth with plans for another at Aberaeron*	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
Engineered freshwater watercourses *# *Limited*	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.
Power station *# *None at present within SAC.*	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.
Pipelines *#	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. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
Power / communication cables *# *Present*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise. Potential electro-magnetic effects of electrical cables. Scour effect on benthic habitats from cables due to	✓	✓	✓	✓	✓	✓	✓	Structure & function: dependent on depth of cable burial in seabed – modification of sediment transport processes and local hydrodynamic regime. Conservation status of typical species & species features: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
	wave action.								*specific biotic and abiotic information.*	
WASTE DISPOSAL										
Effluent disposal* (sewage & chemical) *Widespread & common*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: 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 Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: 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 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.*	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
Effluent disposal: thermal* *None at present*	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 new discharges and proposed changes to existing discharges as plan or project as appropriate.
Sludge dumping* *None at present*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates;	✓	✓	✓	✓	✓	✓	✓	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	Treat as plan or project as appropriate.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
	oxygen depletion Environmental quality: addition of nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment Physical disturbance: smothering								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*	
Wastes & debris (including refuse & litter) *Widespread & common*	Geophysical regime: addition of persistent artificial substrates Environmental quality: Addition of toxic & non-toxic contaminants Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	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 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 information*	Maintain, keep under review and improve as appropriate port waste management plans Secure appropriate promotion & enforcement of national and international dumping at sea measures so as to minimise risk to features' FCS Education & awareness raising
Dredge spoil disposal * *Aberystwyth: dredge spoil used to replenish beach immediately north of Aberystwyth south beach. Sediment resuspended and flushed by neap tides.* *Aberaeron: dredge spoil used to replenish Aberaeron North beach. Sediment resuspended and flushed by neap tides.* *New Quay: dredge spoil used to replenish Traeth y Dolau*	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 proposed spoil disposal out with a designated spoil disposal site as plan or project as appropriate. Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off* *Widespread & common*	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,	✓	✓	✓	✓	✓	✓	✓	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,	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

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
	hormone mimics, oxidising and reducing agents, and other organic & inorganic compounds.								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*	information. Include in assessment of plans and projects as appropriate
Agricultural run-off *Widespread & common*	Geophysical regime: addition to substrate, modification to hydrodynamic regime & sediment transport Fundamental environmental parameters: elevation of suspended sediments; oxygen depletion Environmental quality: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.	✓	✓	✓	✓	✓	✓	✓	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 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*	Continued surveillance and monitoring of inputs and water quality by NRW; continued development and promotion of good practice.
EXPLOITATION OF LIVING RESOURCES										
Trawling (beam, otter) & dredging: scallop (and other relatively rapidly towed, heavy seabed gears not listed below)* Scallop dredging takes place in part of the site. Other trawling occurs but intensity and effort information is unknown.	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.*	Scallop fishing has been assessed and is controlled within the site. Other trawling: To secure features at FCS, assess the impacts from the activity on the features of the site
Dredging: mussel and oyster* *None at present, possible development of mussel seeding in the future.*	Geophysical regime: modification of substrate 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 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	To secure features at FCS, assess the impacts from the activity on the features of the site

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
									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.*	
Dredging: hydraulic dredge *None at present,*	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: (gill, tangle, trammel, beach seine, demersal seine, salmon, fyke)* *Gill netting – localised & seasonal. Tangle netting increasing in response to increases in Spider crab Other nets not known to be used within SAC at present*	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
Potting *Widespread & common (inshore waters)*	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

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
Commercial line fishing *Occasional and localised hand fishing (mackerel),*	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
Hand gathering: (collection, boulder turning, digging, raking, spearfishing)* *Widespread but low intensity.*	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 information*	To secure features at FCS, assess the impacts from the activity on the features of the site
Bait collection: commercial* *None known of at present, likely to be present at limited levels.*	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
Collection, for aquarium / curio trade *Intensity 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

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
Gathering algae and higher plants for human consumption (see also vehicles on foreshore) *None known of at present, likely to present at limited levels*	Physical disturbance: displacement, crushing & amputation Other factors: removal of target species					✓			Structure & function: disturbance or modification of habitat structure by mechanical harvesting Conservation status of typical species & species features: modification of target species population size and structures *Operation specific information required: target species; location, extent, scale, frequency, timing duration and nature of collection; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site
CULTIVATION OF LIVING RESOURCES										
Aquaculture: wild stock enhancement / 'ranching' * *None at present*	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.
Aquaculture: finfish, crustaceans; sea or waterway based cages or impoundments * *None at present*	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 'farming' * (molluscan culture using trestles, ropes, cages or other structures) *None at present although interest has*	Fundamental environmental parameters: oxygen depletion Environmental quality: nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓		✓	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, 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)	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
been expressed. Some mussel see trials present.									*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 * # *None at present*	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 from freshwater inputs site-wide.*	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 new proposed developments as plan or project as appropriate. Review existing consents
Aggregate extraction * (mineral & biogenic sands & gravels) *None 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 duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate.
Oil & gas exploration: seismic survey* *Gas exploration in west of site.*	Physical disturbance: noise (dependant on proximity to site)							✓	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 new proposed developments as plan or project as appropriate.
Oil & gas exploration & production: drilling operations* *Gas exploration in west of site.*	Geophysical regime: substrate modification Environmental quality: hydrocarbon contamination Physical disturbance: displacement, crushing, smothering in immediate vicinity; noise	✓						✓	Structure & function: modification of water chemistry (contaminants), habitat quality (presence of artificial substrates); local modification of biological interactions through changes to prey availability Conservation status of typical species & species features: modification of species composition and variety (increase in species typical of hard substrate) *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
Oil & gas exploration & production: operational* & accidental discharges *Gas exploration in west of site.*	<u>Geophysical regime</u>: modification of substrate Environmental quality: petrochemicals, toxic contamination Physical disturbance: general physical effects	✓						✓	<u>Structure & function</u>: water & sediment chemistry: elevation of contaminants (particularly hydrocarbons) and nutrient concentrations. <u>Conservation status of typical species & species features</u>: effects on species variety, composition, population dynamics & physiological health in species sensitive to hydrocarbons, organo-metal compounds, biocides, bleaches etc.; nutrient enrichment. *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.
Alternative energy production: tidal barrage*# *None at present, unlikely due to lack of suitable locations.*	<u>Geophysical regime</u>: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure <u>Fundamental environmental parameters</u>: salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light <u>Environmental quality</u>: toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: 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 <u>Structure & function:</u> 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); 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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate.
Alternative energy production: coastal wave & tidal current *# *None* at *present*	<u>Geophysical regime</u>: modification of wave and tidal regimes; removal & alteration of substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance</u>: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise	✓	✓	✓	✓	✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: type, construction & size; location & extent; timing and duration of installation; permanence; anchoring structures; cabling requirements; maintenance requirements & frequency; relevant*	Treat as plan or project as appropriate.

Activity	**Relevant factors**	**Sea lamprey**	**River lamprey**	**Grey seal**	**Bottlenosed**	**Reefs**	**Sea caves**	**Sandbanks**	**Most likely relevant components & effects** ***Information necessary to further refine / tailor advice to specific operations***	**Advice as to likely required action**
									location-specific biotic and abiotic information	
Alternative energy production: wind *# *Development interest feasible.*	Geophysical regime: modification of wave and tidal regimes; modification to substrate Environmental quality: possible toxic & non-toxic contaminants Physical disturbance: general physical effects; possible collision	✓	✓				✓		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 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*	Treat as plan or project as appropriate.
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 West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – washing *Reactive only. No recent activity*	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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – chemical *Reactive only. No recent activity*	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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Oil spill response: shore cleaning – physical *Reactive only. No recent activity*	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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue) *Reactive only. No recent activity*	Geophysical regime: modification of substrate Environmental quality: toxic contamination - petrochemicals Physical disturbance: displacement, crushing, abrasion, smothering, collision, noise, visual Other factors: removal of biota	✓	✓	✓	✓	✓			Structure & function: modification of habitat structure, sedimentology Conservation status of typical species & species features: acute local modification of species population sizes, structures, physiological health; disturbance and displacement of vertebrate species including species features *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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan Treat as plan or project as appropriate.
RECREATION										
Angling *Occurs extensively throughout the site but intensity 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.
Bait collection: boulder turning *Widespread low intensity*	Geophysical regime: modification of substrate physical structure 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 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 invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *Operation specific information required: target species and shore type (exposure); 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.

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Bait collection: digging & other sediment shore collection techniques* *Widespread low intensity*	<u>Geophysical regime</u>: modification of substrate physical structure; sediment transport <u>Fundamental environmental parameters</u>: turbidity; oxygen; salinity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement; possible crushing, amputation, smothering, visual <u>Other factors</u>: removal of target species	✓	✓		✓	✓			<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *<u>Operation specific information required</u>: target species and shore type; 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 (see also mooring and anchoring) *Present, particularly in summer months close to shore and points of access/safe havens* *Proposal for new marina at Fishguard will increase recreational boating*	<u>Geophysical regime</u>: modification of substrate physical structure; wave exposure regime <u>Fundamental environmental parameters</u>: turbidity <u>Environmental quality</u>: hydrocarbon contaminants; organic enrichment <u>Physical disturbance</u>: displacement, collision, noise, visual	✓	✓	✓	✓	✓			<u>Structure & function</u>: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: low speed power craft (see also mooring and anchoring) *Present, particu*larly in summer months close to *shore and points of access/safe havens*	<u>Geophysical regime</u>: modification of substrate physical structure; wave exposure regime <u>Fundamental environmental parameters</u>: turbidity <u>Environmental quality</u>: hydrocarbon contaminants; organic enrichment <u>Physical disturbance</u>: displacement, collision, noise, visual			✓	✓	✓	✓		<u>Structure & function</u>: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: sail (see also mooring and anchoring) *Present, particularly in summer months*	<u>Physical disturbance</u>: displacement, collision, noise & visual			✓	✓	✓	✓		<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.

Activity	**Relevant factors**	**Sea lamprey**	**River lamprey**	**Grey seal**	**Bottlenosed**	**Reefs**	**Sea caves**	**Sandbanks**	**Most likely relevant components & effects** ***Information necessary to further refine / tailor advice to specific operations***	**Advice as to likely required action**
close to shore and points of access/safe havens.										
Recreational boating: canoeing (see also mooring and anchoring) *Present, particularly in summer months close to shore and points of access/safe havens. Low intensity.*	<u>Physical disturbance</u>: displacement, collision, noise & visual			✓	✓	✓	✓		<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: other non-mechanically powered craft (see also mooring and anchoring) *Low intensity*	<u>Physical disturbance</u>: displacement, collision, noise & visual			✓	✓	✓	✓		<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: moorings* *Localised low intensity.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓			<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: anchoring* *Localised low intensity.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓			<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Casual shore recreation (bathing, dog walking, coasteering etc.) *Present, widespread; seasonally skewed; spatially variable. Numbers and spatial distribution unquantified.*	<u>Environmental quality</u>: organic enrichment, microbial pathogens, persistent inert materials <u>Physical disturbance</u>: general physical effects; trampling; noise; visual	✓	✓	✓	✓	✓	✓		<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species composition *<u>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</u>*	Education & awareness raising
Vehicles on foreshore	<u>Geophysical regime</u>: substrate <u>Physical disturbance</u>: crushing collision,	✓	✓	✓	✓	✓			<u>Structure & function</u>: modification of habitat sedimentology, geomorphology, sediment processes	Activity surveillance

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects *Information necessary to further refine / tailor advice to specific operations*	Advice as to likely required action
Infrequent	noise; visual								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*	Education & awareness raising Appropriate implementation of SSSI procedures & access byelaws
Light aircraft *Occasional*	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
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*	Activity surveillance Education & awareness raising Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws
Marine wildlife watching / eco-tourism *Present, moderate to high intensity. Seasonally skewed.*	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* *Present*	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*	Research potential effects on features
Military activity: marine exercises *Present*	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*	Research potential effects on features
Military activity: aircraft *Present*	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

Activity	Relevant factors	Sea lamprey	River lamprey	Grey seal	Bottlenosed	Reefs	Sea caves	Sandbanks	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
MISCELLANEOUS OPERATIONS AND USES										
Marine archaeology & salvage *No data available*	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*	Education & awareness raising
Education & science *Education unknown; science limited, focussed on dolphins.*	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, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws Development and encouragement of information exchange
Animal welfare operations & sanctuaries *Present*	Environmental quality: potential release of microbial pathogens Physical disturbance: noise, visual Other factors: habituation of wild species to humans								Conservation status of species features: effects on population physiological health (survival and release of low-fitness individuals), potential exposure to domestic disease; potential disturbance and modification of range and behaviour *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Review, develop and/or implement and monitor best practice suitable to secure features at FCS

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Annexes

Annex 1 Cardigan Bay SAC feature map: interpretation guide

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

- **Sandbanks** which are slightly covered by seawater all the time
- **Reefs**
- Submerged or partially submerged **sea caves**

All feature definitions are taken from the "Interpretation Manual of European Union Habitats[65]"

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.

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

- JNCC Astrium Digital Seabed Elevation Model
- Marine survey data (biology and sediments)
- UKHO Admiralty Charts and bathymetry data
- Expert knowledge

The indicative sandbank feature polygons within the SAC have been updated using data developed and refined during a UK-wide sandbank delineation programme (undertaken by JNCC in conjunction with CCW in 2012 for reporting against Article 17 of the Habitats Directive). This programme used a digital elevation model along with acoustic datasets (multibeam and RoxAnn) and habitat survey data (biology and sediments) where available

65 http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

to more accurately delineate areas of seabed that fit within the Annex 1 Sandbanks definition. Survey data has also been used to help delineate areas that are part of the sandbank feature extent. As a result the sandbank boundaries in the Cardigan Bay SAC have been updated and refined.

A distinction has been made between sandbank areas that are classed as 'Definite' i.e. where the sandbanks adequately meet the criteria set out in the Annex 1 feature definition, and 'Potential' i.e. where there is some uncertainty over whether the bank area adequately meets the Annex 1 feature requirements. This could be due to lack of topographic distinctness or uncertainty over sediment composition and associated biological communities.

Reefs

The indicative reef polygon feature map for Cardigan Bay SAC is composed of extensive areas of both intertidal and subtidal habitat. Data sources for the indicative feature extent map are:

- CCW Phase 1 Intertidal Habitat Map (intertidal reef areas)
- Marine survey data (biology and sediments)
- Admiralty charts
- British Geological Survey seabed sediment and rock substrate maps
- Expert knowledge

'Definite' and 'Potential' areas of reef are identified in the feature layer to differentiate between areas where the supporting data shows the feature is definitely known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments that could cover rocky outcrops), part of a mixed sediment seabed where other features could also be present (e.g. a mixed shore or mosaic seabed where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

The reef map from Cardigan Bay SAC has been updated using data from the 2012 Habitats Directive Article 17 reporting process, during which the reef areas were refined based on recent survey data (where available).
A reef point location map has also been provided to show where biological records exist for reef habitats from subtidal survey work.

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:

- Aberarth – Carreg Wylan
- Caeau Crug Bychan, Ty Gwyn a Llwyn Ysgaw
- Afon Teifi

There are no SPAs that are partly or wholly within the SAC

Locations are shown on the associated feature map[66].

[66] 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.

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.

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Appendix P Pembrokeshire Marine/Sir Benfro Forol SAC

Cyfoeth Naturiol Cymru
Natural Resources Wales

Pembrokeshire Marine / Sir Benfro Forol Special Area of Conservation

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

March 2018.

Contents

Summary

This document contains Natural Resources Wales' (NRW) advice issued under Regulation 37 of the Conservation Regulations 2017, for the *Pembrokeshire Marine 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 summaries 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 *Pembrokeshire Marine 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 *Pembrokeshire Marine 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 designated 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	Conservation Objectives
Pembrokeshire Marine SAC	**Habitats:** • Sandbanks which are slightly covered by seawater all the time • Estuaries • Mudflats and sandflats not covered by seawater at low tide • Coastal lagoons • Large shallow inlets and bays • Reefs • Submerged or partially submerged sea caves • Atlantic salt meadows	Conservation Objectives
	Species: • Grey seal *Halichoerus grypus* • Otter *Lutra lutra* • Allis shad *Alosa alosa* • Twaite shad *Alosa fallax* • River lamprey *Lampetra fluviatilis* • Sea lamprey *Petromyzon marinus* • Shore dock *Rumex rupestris*	

Crynodeb

Mae'r ddogfen hon yn cynnwys cyngor gan CNC a roddwyd dan Reoliad 37 Rheoliadau Cadwraeth 2017, ar gyfer *Ardal Cadwraeth Arbennig Sir Benfro Forol*, 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) Sir Benfro Forol*, 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 Sir Benfro Forol* 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
Sir Benfro Forol ACA	**Cynefinoedd:** • Ponciau tywod sydd fymryn dan ddŵr y môr drwy'r amser • Aberoedd • Gwastadeddau llaid neu dywod nas gorchuddir gan y môr ar lanw isel • Morlynnoedd neu Lagynau • Cilfachau a baeau mawr bas • Riffiau • Ogofâu môr sy'n danforol neu'n lleddanforol • Dolydd ar forfeydd arfordir y gorllewin	Conservation Objectives
	Rhywogaethau: • Morlo llwyd *Halichoeurus grypus* • Dyfrgi *Lutra lutra* • Herlyn *Alosa alosa* • Gwangen *Alosa fallax* • Lamprai neu lysywen bendoll yr afon *Lampetra fluviatilis* • Lamprai neu lysywen bendoll y môr *Petromyzon marinus* • Tafolen y traeth *Rumex rupestris*	

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 Pembrokeshire Marine 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 Pembrokeshire Marine 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 4 (conservation objectives) and 5 (operations advice) should be read in conjunction with these explanatory notes.

2.1 Conservation objectives Background

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

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).

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 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

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[5] European Commission (2000). *Managing Natura 2000 sites: the provisions of Article 6 of the Habitats Directive 92/43/EEC*. DGXI, Brussels, p.18.

[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

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 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

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being followed." (*A statement on Common Standards Monitoring*, 1998, Joint Nature Conservation Committee, Peterborough, http://www.jncc.gov.uk/page-2198)

[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)

relevant 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].

2.1 Operations which may cause deterioration or disturbance

2.1.1 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.

2.1.2 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://www.jncc.gov.uk/page-2198
[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.

3. Site Description

[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).

3.1 Introduction

The seas around Pembrokeshire have long been recognised for their marine conservation importance. The area around Skomer Island and the adjacent Marloes peninsula was designated a Marine Nature Reserve (MNR) in 1991 and is now Wales' only Marine Conservation Zone (MCZ). Many characteristics have been identified as being important in the Pembrokeshire marine environment, including the:

- extremely wide range of physical habitats;
- distribution and extent of the physical entity of habitats;
- very wide array of habitat structures and functional (environmental) processes;
- integrity of structures and functional (environmental) processes;
- species diversity;
- extent, sizes and integrity of species populations resulting from the relatively limited modification of distribution and extent of habitat and structure and functional (environmental) processes by human activity;
- presence of specific habitats and species judged to be of particular importance because of their rarity, ecological importance or isolated position at the edge of population ranges.

High habitat and biological diversity is of great importance throughout the site, particularly the well documented *Reefs* habitat and the Milford Haven ria-estuary. The site's location at a biogeographical boundary between northern and southern species distributions contributes to the biological diversity.

The habitat features are characterised by complex interrelationships with and between biotic and abiotic functional (environmental) processes and species populations. It is the combination of all these components together which gives the overall importance to the habitat features of the site. Each of these individual components contributes to the integral, global importance of each feature, and each of the features contributes to the importance of the site.

Pembrokeshire Marine SAC is a multiple interest site that has been selected for the presence of 8 marine habitat types and associated wildlife (Habitats Directive Annex I habitat types) and 7 Annex II species (Habitats Directive Annex II species). For the qualifying habitats and species, the Pembrokeshire Marine SAC is considered to be one of the best areas in the UK for:

- Large shallow inlets and bays (abbreviated to inlets and bays)
- Estuaries
- Reefs
- *Halichoerus grypus* – grey seal

and to support a significant presence of:

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Mud-flats and sand-flats not covered by seawater at low tide (abbreviated to intertidal mud and sand-flats)
- Coastal lagoons
- Submerged or partially submerged sea caves (abbreviated to sea caves)

- Sandbanks which are slightly covered by seawater all the time (abbreviated to subtidal sandbanks)
- *Alosa alosa* - allis shad
- *Alosa fallax* - twaite shad
- *Lampetra fluviatilis* – river lamprey
- *Petromyzon marinus* – sea lamprey
- *Lutra lutra* – otter
- *Rumex rupestris* - shore dock

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]. These 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 also have Biodiversity Action Plans or are on other lists specifying conservation action such as, 'Nationally Rare and Scarce Species'.

3.1.1 Sources and limitation of site information

The history and breadth of marine survey and study within the site is considerable with some areas such as Milford Haven and the Skomer MCZ amongst the most well surveyed near-shore areas in the UK. Much survey work has focussed on reefs within the area with information on habitats and communities including many marine biological surveys over a period of more than 30 years although the precise distribution of, particularly offshore, reefs is incomplete. Coastal processes are relatively less well known, except for broad scale processes and processes in some localities, especially within Milford Haven.

There is a considerable amount of descriptive literature in both published material and limited circulation reports yet, despite this less than 1% of the area of seabed that has been biologically observed or sampled. The limitations of available data are, therefore, substantial.

Most survey data are point source so that extrapolation for areas between survey points is, and will remain necessary. The accuracy and validity of extrapolation and interpretation depends on availability and quality of supplementary, broad-scale contextual information.

Survey data for the site has been collected over a considerable time period, though the majority has been collected since c1960, and most data sets are from single survey events. Another issue is that the development of survey techniques has resulted in data of differing quality and precision. For example, improved accuracy in position fixing techniques means that data from locations for which there are two or more data sets and from surveys conducted during different time periods are not necessarily directly comparable.

There has been a considerable amount of survey work to supply information for specific requirements, particularly in association with commercial development or activity. The outputs from such studies have not necessarily been comparable with other survey data and some have been confidential. Reported outputs placed in the public domain make a

[17] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

valuable contribution to the knowledge base but the information may be out of date and most of the original data unavailable. Development of surveillance and monitoring since the late 1980s has begun to overcome such limitations, but only for a limited suite of functional determinands and species, and at a limited number of locations.

All feature descriptions are based on best available knowledge at the present time. In some cases this is limited but will become more detailed as further survey work is carried out.

3.2 Site Description

The Pembrokeshire Marine SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales. In places the SAC 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) (see Appendix 2). The Pembrokeshire Marine SAC also overlaps wholly or in part with the Skomer MCZ and a number of Special Protection Areas classified under the Birds Directive. For the location of these SACs, MCZ, SSSIs and SPAs see the feature map[18].

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

a) Range

Pembrokeshire Marine SAC extends from just north of Abereiddy on the north Pembrokeshire coast to just east of Manorbier in the south, and includes the coast of the islands of Ramsey, Skomer, Grassholm, Skokholm, the Bishops and Clerks and The Smalls.

b) Structure

i. Geology

The site has a rich and complex geology. The northern part is dominated by both sedimentary and igneous precambrian, cambrian and ordovician rocks; the southern part by old red sandstone and carboniferous rocks, notably the limestone block of the Castlemartin coast, and the silurian volcanics of the Marloes Peninsula, Skomer and offshore rocks and islands. There has been a spectacular degree of rock faulting and folding.

The coastal cliffs of highly faulted Cambrian (northern St Brides Bay shoreline) and old red sandstone (southern St Brides Bay, West Dale, Freshwater West) shorelines have extensive sublittoral extension. Softer, more recent rocks form cliffs behind and underlying sediment on the lower shores on eastern shorelines.

ii. Sedimentology

There is an extremely wide range of sediments within the site from the very fine muds in sheltered areas of the Milford Haven waterway, through sands and gravels, to consolidated and unconsolidated pebbles and cobbles in deep subtidal areas subject to

[18] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

strong currents and storm beaches. Sediment structures vary from uniform to very heterogeneous.

iii Geomorphology

The SAC is dominated by the two major westward projecting peninsulas of St David's and Marloes with their associated series of offshore rocks and islands, the large, square shaped St Brides Bay that lies between the peninsulas, the deep ria (drowned river-valley) of Milford Haven and the broad limestone peninsula of the Castlemartin coast.

The coasts are dominated by rugged headlands of hard igneous rock, interspersed by bays and inlets situated on fault lines and where less resistant rocks have been eroded. Many bays are characterised by shores of pebbles, cobbles and boulders of size ranges reflecting the exposure to wave energy while the larger expanses of sands are confined to lower shores.

The topography of the seabed within the site is dominated by rugged, mainly igneous, but also sandstone and limestone, rocky reefs. Many rise to considerable heights above the surrounding deep seabed, some forming islands and islets. Sandbanks formed in the lee of rocky reefs and in other tidal conditions are also prominent seabed features. Between the elevated areas of seabed are extensive undulating areas of rock, such as west of the Dale peninsula, and plains and gentle slopes of sediments. The geomorphology of this areas is described in more detail within the West of Wales and Lavernock Point to St Ann's Head Shoreline Management Plans[19].

c) Function

i. Hydrography and meterology

The range and times of high and low water varies considerably throughout the site. The maximum mean spring tide range at Dale Roads, in the entrance to Milford Haven, is around 7.8m compared to around 4.4m in Ramsey Sound. This creates an extensive intertidal zone with broad and high shores. Spring tide low water occurs during the middle of the day which is of significance to littoral organisms, exposing them to maximum sunlight and temperature.

Strong tidal streams are a characteristic of the SAC, particularly around the islands, islets and headlands and narrows, including parts of the Milford Haven waterway, with maximum speeds reaching c 5 m/sec through Jack and Ramsey Sounds during spring tides. There are huge variations in the tidal stream patterns and timing over very short distances and, in some areas, tidally induced overfalls and standing waves. Areas of weaker and negligible tidal streams are widespread, particularly in embayments. There are also unusual tidal conditions, such as the modified salt wedge in Milford Haven and rotary tides in central St Brides Bay. Within the site residual currents are generally south to north.

The open coast is exposed to a considerable amount of wave action and to swell from a prevailing south-westerly direction. The west and south-west coasts are most exposed to the frequently large, widely spaced oceanic swell that also penetrates into the Milford Haven waterway but there are also areas of coastline sheltered from all but the heaviest swells.

[19] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/)

Exposure to wave action varies widely with seabed depth, ranging from extreme in shallow, open coast locations with southern to south-western aspects, through shelter from all but the longest wavelength waves in deep areas north of the islands and headlands and in Milford Haven, to almost totally sheltered in tributary estuaries of the Milford Haven waterway.

The water masses in and around the SAC are partly of coastal origin with an oceanic input through the Celtic Sea. Water circulation is seasonally modified as a result of summer heating and stratification in the Celtic and Irish Seas but waters are generally well mixed. The site lies within the overlapping boundaries of two biogeographical provinces: the cold-temperate boreal ('northern') biogeographical province and the warm temperate lusitanean ('south-western') province. The Celtic Sea front forms during summer months and extends west-north-west from the site.

ii. Water & sediment chemistry

Suspended particulate concentrations are highly variable with season, wave action, tidal conditions and freshwater discharge. As a consequence water clarity and seabed and water column light intensity are also highly spatially and seasonally variable. The site is very wind exposed, but variable depending on location and topography.

There is a complex, dynamic salinity regime with in Milford Haven waterway. Published data suggests that offshore salinity remains at a constant 34.5-35‰ although water column data collected in the Skomer MNR from 1992 indicates that inshore salinity is more variable, falling to 33.5‰ during winter months and rising to 36‰ in summer months.

Nutrient and contaminant levels are variable throughout the site. Highly dynamic water movement maintains levels of many contaminants below detectable limits although low level chronic hydrocarbon residues are present in sediment sink areas in St Bride's Bay. Coastal waters are considered to have raised levels of nutrients, predominantly as a consequence of diffuse agricultural sources. The Milford Haven Estuary has high levels of nutrients, levels that are of concern to the extent that a Nitrate Vulnerable Zone (NVC) for the area is being explored. The limited data available for water column nutrient concentrations and fluxes in the open coast water column suggest they are comparable with typical inshore open coast background levels. Water column contaminant concentrations and fluxes are poorly known. Available data suggest that these too are comparable with typical inshore background levels.

Available data suggests water column dissolved oxygen is generally 100% saturation though recent survey suggests that parts of Milford Haven suffer levels at least as low as 86%. Interstitial sediment dissolved oxygen varies with a variety of factors including sedimentology, infaunal biological activity and macroalgal cover. Levels within the estuarine inlets of Milford Haven are of concern as a consequence of the current levels of excessive green algal overgrowth during summer months. A seasonal oxycline (and thermo- and haloclines) develops in Abereiddy quarry lagoon in summer months; during this period the deeper waters are anoxic. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[20]

[20] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Milford Haven Inner, Milford Haven Outer, Pembrokeshire South and Cardigan Bay South.

iii Sediment processes

Detailed sediment processes in St George's Channel are poorly known but inferred to be dominated by tidal current action on mainly coarse, relict or locally derived sediments (from glacial and glacio-fluvial beds) where strong currents have prevented the accumulation of fine sediment. Long period wave action also has a major local modifying effect.

There is a net westward transport of sediments from the Bristol Channel across and into southern Irish Sea although possibly different transport paths for the sand compared to the muddier fractions in suspension. The presence of major sandy bed-forms indicates the transport of large volumes of material.

Deposition, erosion and redistribution of sediments in the site are variable and complex. Detail of local sediment processes is not well known with information limited to Milford Haven where studies indicate a complex of transport paths with inshore transport in a net northerly direction, determined by tidal streams strongly modified by wave action. Areas of medium – long-term sediment deposition are present in the tidal lee of islands and headlands. Sediment processes have been studied in more detail and are described within the West of Wales and Lavernock Point to St Ann's Head Shoreline Management Plans[21].

iv Biological interactions

The variety and magnitude of biological interactions have a major influence on species variety and conservation status. However, the range of interactions is immeasurable. Some examples are included in feature descriptions.

Grazing and predation by vertebrate predators including seabirds, waders and wildfowl, marine mammals and fish 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.

The long history of commercial fisheries and exploitation of other species resources has reduced population sizes of many ecologically important species. The perceived impact of recreational and commercial exploitation of sea urchins, a key ecological structuring species, was one of the initial reasons leading to the designation of the Skomer MNR (now MCZ).

d) Typical species

The different rock and sediment types and their complex formations present throughout the SAC provide very varied substrata for colonisation by many different species of marine plants and animals. This has a strong influence over the types of marine animals and plants that will become established in any one location. These are associated with rocky substrates, areas of soft sediment, tidal current areas and those exposed to different degrees of wave exposure, turbidity and temperature both intertidally and subtidally. Species accounts primarily describe conspicuous macro- and megafauna and macroalgae. With very few exceptions, cryptic macrofauna and meiofauna, microfauna and flora have not been described and demersal species are also poorly documented.

[21] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/)

A major factor in the nature conservation importance of Milford Haven is the continuum of ecological variation within the system. Of particular importance is the transition from the exposed, fully saline conditions near the entrance, through the sheltered fully saline conditions of the central section and up to the variable/low salinity and extremely sheltered conditions in the upper reaches. Subtidal marine communities penetrate deeply into the Haven, well beyond the central section. The transition in environmental conditions up the Haven has similar effects on subtidal and intertidal communities, except that a significant reduction in subtidal species and community diversity caused by decreasing salinity and increasing turbidity does not occur until upstream of Pembroke Dock. Species variety is better known in some habitats and locations (e.g. the Skomer MCZ area, Milford Haven waterway) than others. These include populations that are rare, scarce, new to science, edge of range, particularly well-developed or exceptionally good examples of their type, slow-growing, long-lived, possibly infrequently recruiting, structurally fragile and species with very precise and / or infrequently occurring habitat requirements. Many of these have specific individual scientific and / or conservation interest.
Population sizes of particular species are unknown or poorly known for most species; where data exist it is patchy both spatially and by species group. Quantitative time series data are available for several long-lived reef species and species assemblages in the Skomer MCZ. Biomass is unknown or poorly known for most species as is population structure, reproductive capability, recruitment and the physiological health of most species.

3.3 Operations within the SAC

There is a dichotomy of human activities within the SAC between the Milford Haven estuary and the open coastal waters.

Open coastal waters are relatively quiet. Commercial shipping transits to and from the port or anchors in St Bride's Bay. Recreational and commercial diving, angling and wildlife watching boats frequent the islands and nearshore areas. The coastline is mainly agricultural, with a few small but busy coastal towns. The limited coastal development is focused around the primary centres for tourism. Coastal MoD ranges are dominant along the south coast. Pembrokeshire is one of the most suitable areas of the UK for wave and tidal energy generation. Fishing activity is limited and is dominated by use of static gear (pots, lines and set nets).

Milford Haven estuary is a busy centre of commercial and urban activity. As a deep water shipping port it supports substantial petrochemical industry infrastructure. Civil engineering projects are common and the estuary forms both a busy recreational resource and a means of industrial and urban waste disposal. The estuary, fed by its riverine catchment, is susceptible to impacts from changing land management many miles inland from the coast.

3.4 Modifications as a result of human activity

Various anthropogenic activities currently taking place within the SAC have an influence on the habitat and species 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) which affect the habitats and species. Whilst the structural and functional characteristics of the SAC and its 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.

Human activity has, over the years, modified the marine environment of the Pembrokeshire Marine SAC. The most significant changes have been as a consequence of fisheries, coastal development and land use.

Historic fisheries practices have resulted in major changes to abundance and population dynamics of target and by-caught species of fish, crustacean and mollusc. Species such as herring, crawfish and oyster have all shown major declines in abundance. Use of mobile demersal gear, such as dredges and trawls, have resulted in changes to the seabed and its marine life. With the historic unsustainable exploitation of target species, stock reductions have resulted in declines and changes in fisheries activity.

Currently fisheries are dominated by use of static gear (pots, lines and set nets). Fishing activity continues to impact features of the SAC to a greater or lesser extent through removal of target and non-target species and by impacting seabed habitats and their marine communities. A change in fishing activity since designation that is a cause for concern and in need of management action is a three-fold increase in potting intensity within the Skomer MCZ. Scallop dredging is no longer allowed in the SAC[22] and no scallop dredging has been observed in St. Brides Bay since 2008. Results of scallop (*Pecten maximus*) surveys in the Skomer Marine Conservation Zone show a continued recovery of the population since cessation of exploitation in 1990. In 2012 the mean scallop density was 28/100m^2 compared with 16.9/100m^2 in 2008.

The urbanisation of the coastal zone has resulted in habitat modification and loss. This has been relatively limited on the open coast but very significant within the port of Milford Haven where there has been considerable industrial and urban development over the past 150 years. Development of the estuary since the 1960s, largely associated with the oil industry, has resulted in loss of intertidal flats, hardening of the foreshore, substantial dredging of the seabed, increases in vessel traffic, and associated issues of pollution. While major oil spills have impacted the site infrequently, the ongoing input of chemicals from urban areas, water-borne traffic and the petrochemical industry has likely had the greater long-term effect. Contaminant levels are, in places, well in excess of those known to have deleterious effects on marine biota. Construction projects have significantly impacted the site's maerl bed and restoration is required. New discharges will exacerbate the detrimental effects of the estuary's high nutrient load. Since designation a new power station using once through cooling water has been commission within the waterway. Capital dredging has resulted in permanent modification of the seabed and ongoing maintenance requirements will ensure reduced biodiversity of these areas.

Changes in land use, both urban and agricultural have strongly influenced runoff from river catchments within the site. Water increasingly enters the site's rivers as peak events rather than steady flow. Sediment inputs to coastal waters, particularly estuaries, have increased greatly through increases in surface water flows, reduction in standing vegetation, increased stocking and use of the plough. Nutrients put on the ground to increase crop yields, deposited from the air as products of hydrocarbon combustion and discharged direct to the sea by industry, have increased nutrient loads to our estuaries and coastal water to the extent that Milford Haven supports persistent and damaging blooms of green

[22] The Scallop Fishing (Wales) Order 2010 (http://www.legislation.gov.uk/wsi/2010/269/contents/made)

algae. Nutrient enrichment results in major physicochemical and biological changes in the marine ecosystem, particularly within estuaries and enclosed waters.

The improvements in infrastructure in close vicinity to the wild and spectacular wildlife of the west coast have increased recreational use and tourism of coastal waters. Levels of disturbance to wildlife have consequently been increasing. Part of the attraction of the area is that the site supports breeding seabirds, pupping seals and calving porpoise, all of which make use of the area's food resources. These important life stages are particularly vulnerable and sensitive to the disturbance impacts.

The site has also been modified by wider environmental influences; the most important of these is climate change[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 and species features of the SAC would result. An assessment of the conservation status of each of the features, at a UK level, was first reported in 2001, again in 2007 and most recently in 2013[24].

4 Feature Descriptions

4.1 Large Shallow Inlets and Bays

Large shallow inlets and bays are defined in the EU Habitats Interpretation Manual[25] 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). Those particularly relevant to the Pembrokeshire Marine SAC are the embayment of St Brides Bay (described below) and the ria of Milford Haven. The feature is referred to as inlets and bays 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
- Fragile sponge & anthozoan communities on subtidal rocky habitats

[23] For further information see: http://ukclimateprojections.metoffice.gov.uk/ & http://www.mccip.org.uk/uk-marine-projections/
[24] Joint Nature Conservation Committee. 2013. General Implementation Report - 3rd UK Habitats Directive Reporting 2013. Available from: http://jncc.defra.gov.uk/page-6387
[25] Interpretation Manual of European Union Habitats. EUR27, July 2007. European Commission. DG Environment.

- Intertidal mudflats
- Intertidal Underboulder Communities
- Maerl
- Mud habitats in deep water
- *Musculus discors* beds
- Mussel beds
- *Ostrea edulis* beds
- Seagrass beds
- Seapens and burrowing megafauna
- Sheltered muddy gravels
- Subtidal mixed muddy sediments
- Tide swept channels
- *Arctica islandica*
- *Cruoria cruoriaeformis*
- *Eunicella verrucosa*
- *Haliclystus auricula*
- *Hippocampus guttulatus*
- *Lithothamnion corralioides*
- *Lucernariopsis campanulata*
- *Ostrea edulis*
- *Padina pavonica*
- *Palinurus elephas*
- *Phymatolithon calcareum*
- *Anguilla anguilla*
- *Clupea harengus*
- *Dipturus batis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.1.1 Range
St. Brides Bay is a large, deeply indented, embayment with peripheral embayments and inlets, located within a predominantly rocky coastline and geographically isolated from very large bays to the north and the east (Carmarthen and Cardigan Bays). The only peripheral embayments between St Bride’s Bay and Milford Haven ria is Whitesands Bay.

There are a variety of component habitats within the inlets and bays feature of St. Brides Bay. For example, a large proportion of the seabed is comprised of soft sediments with broad distribution information available through HABMAP. There is also a significant presence of three Annex 1 habitats (reefs, intertidal mudflats and sandflats and sea caves). The broad intertidal sediment flats extend widely around the coasts of the inlets and bays, particularly on the eastern shore of St Brides Bay, while the extent of exposed reef surface varies with sediment movement.

4.1.2 Structure and function
Resilient Precambrian and Silurian igneous rocks form much of the core and western extremities of the northern and southern arms of St Brides Bay and smaller open coast

bays while the southern headland of Freshwater West is formed of carboniferous limestone. Extensive coastal cliffs of highly faulted Cambrian (northern St Brides Bay shoreline) and Old Red Sandstone (southern St Brides Bay, West Dale, Freshwater West) shorelines have extensive sublittoral distribution. Softer, more recent rocks back cliffs and underlie sediment on the lower shores on eastern shorelines.

There is an extremely wide range and complex mosaic of sediment habitats in St. Brides Bay. This includes: moderately sorted medium to very fine sands in shallow and near-shore areas in the northern half of the bay; fine sands inshore; well sorted muddy sediments in deep central areas of the bay: poorly sorted muddy gravel / shell in sheltered near-shore areas in the southern part of the bay, particularly east of the Handmarks and Stack Rocks reefs; and a mosaic of tide swept gravels and cobbles, muddy gravel and well sorted medium sand along the axis of strongest tidal streams at the seaward edge of the bay.

St Brides Bay is a deeply indented, west facing, roughly square shaped embayment. Peripheral embayments are both deeply indented between prominent headlands, and broad bays in a topographically complex coastline. Most of the peripheral bays face south to west. The seabed in central and inner central St Brides Bay and peripheral open coast bays is generally gently sloping; areas of more complex sediment topography (sand waves and ripples) occur in the north-west and south-west generated by tidal streams, and in the vicinity of reefs and islets. Broad sediment flats extend widely around the coasts of the inlets and bays, particularly on the eastern shore of St Brides Bay and within Milford Haven.

Depth generally increases from east to west across St Brides Bay with most of the bay less than 30m deep. Extensive shallow sandy areas extend south from St David's Peninsula in the north of the bay and an extensive shallow reef is present in the southern bay. The seabed within smaller bays is mostly less than 20m.

Broad areas of near-shore and intertidal reef extend along the northern and southern shores of St Brides Bay and large, isolated reefs and islets are also present immediately off both the north and south coasts. The Handmarks is a large horizontal reef in the southern part of the St. Brides Bay and West Dale Bay. The south-eastern coast of Freshwater West is predominantly reef habitat with many sea caves and tunnels particularly along the rocky cliff and reef coastline of St. Brides Bay.

The central outer area of the bay appears to have a rotary (circular) tidal stream during part of the tidal cycle. Tidal streams within St Brides Bay are generally weak, though varying considerably between spring and neap tides and there are also differences in exposure to wave action from very exposed in parts of St Brides Bay, Gateholm – West Dale Bays and Freshwater West, to extremely sheltered in parts of Milford Haven ria. Large areas of wave sheltered stable sediment seabed are present at depth and to the north of the islands and headlands as well as within Milford Haven.

Suspended particulate concentrations and water transparency are seasonally very variable and locally influenced by freshwater inputs with moderately high to high turbidity during and following strong wave action and spring tides. There are also prolonged periods of low turbidity especially during spring and summer and in areas of weak tidal current streams, though seasonal phytoplankton blooms temporarily increase particulate concentrations and decrease water clarity during these periods.

Sediment nutrients status is poorly known and assumed to reflect concentrations in the overlying water column. Open coast bays are fully saline and inlets with freshwater inputs, particularly Milford Haven, are subject to varying salinity during the tidal cycle. There are also local, generally irregular, modifications of salinity near managed watercourses.

Little is known about water column contaminant and nutrient concentrations and fluxes. Available data suggest open coast concentrations of contaminants are comparable with typical inshore background levels and nutrients comparable with typical inshore open coast, Celtic Sea, background levels. Open coast sediment contaminant concentrations appear to be comparable with typical inshore background levels.

Hydrocarbon data for St Brides Bay sediments (mostly from areas within Skomer MCZ) indicates levels near or at typical inshore background levels. Other contaminant concentrations in open coast bay sediments are poorly known. Information on dissolved oxygen is also very limited but indicates that the water column is largely fully saturated throughout bays and inlets. Oxygen availability within sediments is mostly likely to be typical for the sediment structure. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[26]

Detail of local sediment processes in open coast bays is not well known. There are known areas of medium to long-term sediment deposition in deeper depressions and on sediment banks in areas of St Brides Bay. These areas are adjacent to major tidal streams in the southern bay and in areas of weak tidal streams in the central bay; they are inferred in the northern bay from bathymetry. The Handmarks reef in the southern part of the bay has a strong influence on water movement and sediment distribution. There are known areas of erosion at the seaward edge of St Brides Bay where strong tidal streams maintain areas of unconsolidated coarse material free from fine sediments. Some sediment transport processes may be inferred from significant bedforms in St Brides Bay (i.e. sandbanks and sandwaves). The status of depositional areas as sediment sinks is unknown. Seasonal exchange between the intertidal and near-shore subtidal is significant though unquantified, and determined by wave exposure, aspect, granulometry and degree of consolidation.

Biological interactions that influence populations and communities are poorly known. Some examples of ecologically important species for this feature where interactions are poorly understood include echinoderms (e.g. sea urchin, *Echinus esculentus)*, crustaceans (e.g. Spider crab (insert species), molluscs (e.g. the whelk, *Buccinum undatum and* mussels *Mytilus edulis)* and seaweeds (e.g. *Laminara hyperborean)*. Bioturbation and interspecific competition are important processes in stable areas of mostly deeper mixed sediments with high species richness and abundance.

4.1.3 Typical species

Species diversity is high and also highly variable between and within habitats in the Pembrokeshire Marine SAC inlets and bays. They include populations of species typical and characteristic of intertidal and subtidal reefs, sea caves, intertidal sand-flats, tidal stream structured sandbanks, and varied and heterogeneous subtidal sediment habitats.

[26] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Milford Haven Inner, Milford Haven Outer, Pembrokeshire South and Cardigan Bay South.

Areas of deep, wave sheltered, sands are particularly species rich, and stable, relatively wave and current sheltered mixed sediments support a wide variety of species including long-lived macrofauna buried within and living on the sediment surface. Infauna includes populations of long-lived and/or rare and scare species including bivalve molluscs (e.g. Ensis sp., *Arctica islandica*); anthozoans (e.g. *Mesacmaea mitchellii*, *Peachia cylindrica* and *Capnea sanguinea*), tube living polychaetes and echinoderms. Sediment epifauna includes a relatively isolated population of king, or great, scallop (*Pecten maximus*) and a wide variety of species characteristic of reefs living on and in stony material, molluscan shell debris and in association with species consolidating mobile substrates, e.g. ross coral (*Pentapora folicea*).

Areas of coarse, current exposed, shelly gravel are unusual, supporting a low variety of physically resilient species and are a contrast to sheltered fine sands and muds; e.g. shallow fine sands in North Haven, Skomer (including a small bed of eelgrass *Zostera marina* with high epifloral variety). Of the large mobile fauna there are resident and seasonally migrating crustacean including the spiny spider crab, *Maja squinado*, grey seal, otter, fishes (e.g. sand eels - important prey species of seabird populations; herring), seabirds and sea-duck.

Quantitative time series data on population sizes of particular species is patchy, only being available for species in some habitats in the Milford Haven waterway and for several long-lived species and species assemblages in the Skomer MCZ in a few habitats.

Little biomass data has been collected within inlets and bays and current knowledge is poor for most species and most locations. The same is true for the physiological health and reproductive capability of most species.

Some data are available on population structure of several long lived invertebrates in the Skomer MCZ indicating that a proportion is subject to intermittent reproductive success and irregular recruitment. The sex ratio is unknown or poorly known for most species. Specific recruitment information for a few species is known for the Skomer MCZ.

The spatial range of most species characteristic of the habitats within bays is extensive; the habitat range of some highly specialised species is restricted in distribution and/or extent. Because of the hydrodynamic regime and the continuous throughput of water masses of distant and varied origins, species are inferred likely to be both capable of recruiting from and contributing to recruitment, from both nearby and distant populations. True ranges of apparently rare or scarce species are unknown.

4.1.4 Natural processes

The distribution, extent and shape of inlets and bays is a reflection of the underlying geology, with some structures of resistant rock, areas of rock amenable to erosion and zones of geological weakness. Sediment shores and submerged sediment plains are much more dynamic features subject to natural change influenced by factors such as tidal flow, tidal range, currents, weather conditions and aspect.

Shallow inlets and bays are sedimentologically linked with the two couplets of mudflat and saltmarsh, and beach/sandflat and dunes. There is generally an exchange of sediments between these dynamic environments by way of bi-directional sediment transport pathways.

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 bays.

Sediment particle size and structure are primary factors in determining biological community structure. Sediment topography is the product of sediment structure and sediment transport is 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.

4.1.5 Modifications as a result of human activity

The gross structure, bathymetry, distribution and extent of the open coast bays are not known to have been modified by human action. Historically, the structure of solid geology has been locally modified, mostly by quarrying, and obscured or overlain by land claim and structures. Mobile geological features (e.g. boulders, cobbles) have also been modified by human activity, for example as a result of coastal defence works and pollution response and there have been very minor localised modifications to the shape of small inlets and embayments. Overall habitat quality is high except for the presence of persistent marine litter and, locally, the presence of shipwrecks.

Information on modification of dynamic sediment feature change resulting from human activity is sparse. The sedimentology of the open-coast bays is considered largely unmodified by human action except for the addition and possible retention of fine sediments arising from dredge spoil disposal. Tidal range and exposure to currents and wave action in inlets and bays is predominantly unmodified by human actions except for localised influences in the vicinity of built structures.

Modification of suspended particulate concentrations is complex and influenced by several human activities (e.g. dredging, disposal of dredge spoil, agricultural run-off). These are predominantly relevant to Milford Haven but also localised in other areas. Concentrated dinoflagellate blooms (red-tides) commonly occur in bays during calm warm summer weather, probably associated with elevated nutrient concentrations.

As a consequence of the history of commercial fisheries, species subject to commercial exploitation are known, or inferred to be depleted substantially in comparison to pre-exploitation levels. The mobility of commercially exploited species is (naturally) impeded by capture methods. Fisheries activities have also resulted in impacts to seabed habitats and there has been coastal nutrient enrichment. Consequently, aspects of ecosystem functioning are modified or adapted.

The degree to which the inlets and bays species populations may have been modified or degraded by human activity is difficult to assess because of the uneven distribution of historical species survey data and, until relatively recently, of information on the effects of human activities on the marine habitats and species. Changes in population sizes attributable to both natural and anthropogenic causes include: reduction in abundance and or biomass of commercially exploited species, changes in mollusc populations (from both antifouling compounds and unknown causes) and increases in populations of non-native species. Populations of commercially exploited species have been modified by fisheries, and prey and / or competing species are inferred to be modified as a consequence. There are no known major impediments to the recruitment of any species, assuming a viable reproductive reservoir. Many invertebrate species have planktonic juvenile stages and may be at least partly dependant on recruitment from outside the site. The scale of modification of habitat structure and function also suggests that the range of species distributions is likely to be largely unmodified by human activity. Following reduction in extent of habitat in areas lost to development or land claim, the extent of some species populations will have been reduced proportionately.

4.2 Estuaries

The Milford Haven waterway is a single geomorphological, hydrological, ecological and functional unit that encompasses a wide range of estuarine and marine components, distributed in an extremely complex mosaic that varies over time. Most components contribute to two or more of the Habitats Directive features encompassed within the waterway however this section describes the estuary feature. Outside of the Milford Haven there are two small estuaries; the River Alun estuary at Porthclais and the Solva estuary in the north of St. Brides Bay.

Estuaries are defined in the EU Habitats Interpretation Manual as:

“Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal mud and sand-flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.”

“An estuary forms an ecological unit with the surrounding terrestrial coastal habitat types”

There are four major types of estuary recognised within the EC definition:

1. Coastal plain estuaries: formed where pre-existing valleys were flooded at the end of the last glaciation and usually less than 30 m deep, with a large width-to-depth ratio. The main sub-type of estuary, by area, in the UK.

2. Bar-built estuaries: characteristically have a sediment bar across their mouth and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.

3. Complex estuaries: formed by a variety of physical influences, such as glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this sub-type of estuary in the UK.

4. Ria estuaries: drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by freshwater and typically conform to Annex I type ‘large shallow inlets and bays’.

Estuaries are widespread throughout the Atlantic coasts of Europe, but approximately one quarter of the area of estuaries in north-western Europe occurs in the UK. Milford Haven is a high quality example of a ria estuary and considered to be one of the best examples of a ria in Britain.

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
- Fragile sponge & anthozoan communities on subtidal rocky habitats (only one point of confidence)
- Intertidal mudflats
- Intertidal Underboulder Communities
- Maerl
- Mud habitats in deep water
- *Musculus discors* beds
- Mussel beds
- *Ostrea edulis* beds
- Seagrass beds
- Sheltered muddy gravels
- Subtidal mixed muddy sediments
- Tide swept channels
- *Phymatolithon calcareum*
- *Anguilla anguilla*
- *Clupea harengus*
- *Dipturus batis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.2.1 Range

Milford Haven waterway is the only example of a large ria in Wales and the largest ria-estuary complex in the UK. It is approximately 170 km long with an area of around 55 km^2 of which *c*1710 ha (*c* 30%) is intertidal]. This is around 34% UK resource of the estuary type. Tributary estuaries throughout the length of the waterway, particularly in the upper reaches, contribute to the structural complexity and ecological diversity.

The main components are:

- tributary estuaries that drain into the ria-estuary system: Eastern & Western Cleddau; Garron Pill; Carew / Cresswell Rivers; Cosheston Pill; Pembroke River; The Gann; Sandy Haven Pill;
- Daugleddau (from Picton Point downstream to Cosheston - Barnlake Points);

- central waterway (Cosheston - Barnlake Points, to a line between South Hook & Thorn Point);
- outer waterway (seaward of South Hook / Thorn Point line);
- major peripheral embayments (e.g. Angle Bay, Dale Roads, Sandy Haven).

Outside of the Milford Haven there are two small estuaries; the River Alun estuary at Porthclais and the Solva estuary in the north of St. Brides Bay

4.2.2 Structure and function

Post-glacial drowning of the valleys of the Cleddau rivers formed Milford Haven. The underlying geology is responsible for the overall complex shape of the waterway and the diversity of habitats. This complex structure strongly influences hydrographic processes and the structure of individual habitats. The deep, sinuous, steep sided main tidal channel and tributary estuaries are characteristic of a drowned river valley and reflect the underlying geology and major east-west rock faults and folds.

There are an exceptionally wide range of sediment habitats within the waterway including large quantities of coarse, stony and (molluscan) shell debris material in both the intertidal and subtidal. Sediment structure varies in a continuum along the major gradient of wave exposure, modified by gradients in tidal stream strength and salinity. The axes of these gradients are both along and across the main axis of the waterway.

Near the entrance to Milford Haven there are dynamic, predominately sandy, shores exposed to wave action. Upstream from Dale Point and Thorn Island, sediment shores range from coarse cobbles and shingle, through mixed shelly gravels, to fine sands and muds that characteristically become increasingly stable with increasing shelter from wave action. Mixed sediments include coarse stony and shell debris substrates at the sediment surface and are particularly extensive in narrow subtidal channels. A bed of calcareous algal maerl deposits is present in the lower waterway.

Wide intertidal and subtidal sediment flats flank the main deep-water channel and form a large proportion of embayments such as Dale Roads, Sandy Haven and Angle Bay. The topography of intertidal sediment flats is increased by sinuous freshwater drainage channels and there is evidence of ancient river drainage channels in subtidal sediment plains.

Wide, relatively level sublittoral seabed sediment plains dominate the floor of the channel and typically extend from the intertidal mud & sand-flats towards the main tidal channel where the increasing tidal flow tends to result in coarser sediments in the channel's base and on its often steep slopes. The topography of many areas of sediment flats and salt-marsh is complicated by sinuous drainage channels, isolated patches of salt-marsh and pools.

Areas of reef and banks of boulders, cobbles, shell and sediments rise above the flatter sediment areas. These intertidal and subtidal reefs are discontinuous and topographically varied with their morphology constrained by the adjacent cliff, reef, hinterland, main estuary channels and other structural forms. The microtopography of the reefs, sediments and saltmarshes is also variable.

Deep-water penetrates far along the central channel of the waterway with large areas more than 20 metres deep and extensive areas more than 12 metres deep even 23 km from the entrance. Deep areas are also found at the junction of strong tidal streams and rocky substrates like Dockyard Bank and west of Cosheston Pill.

Extensive shallow sediment plains, slopes and reef blocks flank the main deep-water channel, particularly in the lower waterway for example at Dockyard Bank, Dale Roads, Milford Shelf – Sandy Haven Bay and Chapel Rocks. The hydrography of the waterway is complex, with multiple hydrographic gradients distributed, mainly, along and across the waterway and within tributaries of the estuaries and varying with short and long-term natural cycles, climate influences and stochastic events.

Tidal range and time varies throughout the waterway. For example, at the entrance the mean spring range is 6.5 m at Dale Roads and the maximum range of approximately 7.8m. At the confluence of the Cleddau it is around 1m greater than at Milford Haven on spring tides and then decreases rapidly. Tidal excursion up the water way is 8-10km on mean spring tides and 4-5km on mean neap tides. Standing tidal waves are a distinctive characteristic of the waterway as is the asynchronous flood and ebb tide duration. Current speeds are highly variable being moderately strong in upper and lower reaches, strong in middle reaches and low in embayments and over shallow sediment banks to the sides of the main channels. There is a complex water circulation system and net upstream near-bed water movement. The rapid flushing time in the Daugleddau and slow flushing in the lower waterway despite high tidal range and volume is a distinctive characteristic.

Wave action varies from ‘exposed’ in the entrance to ‘ultra sheltered’ in the lagoons and smaller tributaries. Most of the waterway east of a line between Thorn Island and Littlewick Point is sheltered from wave swell and the very wave exposed southern shore close to the entrance gives way to moderately exposed shores along the north side of the Angle peninsula and gradually more sheltered shores further east.

Sea temperatures within the waterway are generally closely comparable with adjacent sea temperatures with localised variation for example in shallow tributary estuaries, particularly during cold winters and hot summers, and in vicinity of fresh water flows. There is a wide variation of incident and ambient seabed light caused by range of aspect, topography and, in the Daugleddau, local shading by woodland.

The suspended sediment load is relatively low compared with estuaries with less rock although spatially and seasonally variable. Turbidity is generally lowest towards the open coast, though increased both widely and locally in areas affected by strong wave action, spring tides or heavy freshwater runoff. There are prolonged periods of low turbidity, especially during spring and summer months and in areas of weak tidal current streams. Algal growth within the waterway is limited by available light, determined by water transparency.

The freshwater input, mainly from rivers, is low relative to the volume of the waterway. There is a complete transition from fully saline (a significant distance upstream) to brackish along the main axis of waterway and complete and partial transitions within tributary estuaries. Strong vertical salinity gradients and modified salt-wedge tidal incursion are distinctive characteristics of the waterway.

Riverine flow is the major source of the nitrogen load with nitrates concentrations exhibiting biologically dominated seasonal variation. Sediment nutrient levels are poorly known but are inferred to reflect concentrations in overlying water column. The extensive mud-flats and salt-marshes are important in buffering nutrients within the waterway.

Sediment contaminant levels are broadly comparable with moderately polluted estuaries with fine sediments. Sediment transport patterns tend to retain and concentrate contaminants in the waterway. Synthetic organic pollutant concentrations are unknown and temporal trends in other contaminants are poorly known.

Dissolved oxygen is at or close to 100% saturation throughout waterway, throughout the year. The extent of local depletion in coastal lagoons and areas with limited water exchange is largely unknown. Studies in the Pembroke River have recorded levels down to 86%. Sediment dissolved oxygen concentrations are poorly known, but the limited information available suggests that oxygen availability within sediments is typical... Many of the estuarine inlets of the Haven are currently subject to excessive green macro algae growth and consequently show raised levels of anoxia. Surface sediments in these areas commonly show anoxic conditions directly beneath the algae.

There is an extremely wide range of intertidal and subtidal sediment substrates and degree of sorting, discontinuously distributed within waterway and largely determined by the complex interactions between wave exposure and current speed. Erosion and deposition processes and sediment transport paths are complex. Flood dominated, up-stream, residual sediment transport in the central and northern side of channels leads to net deposition and accumulation, and consequent contaminant concentration in Pembroke River, Garron Pill & Western Cleddau. The ebb-dominated, down-stream, residual transport along southern side of main channel dilutes and exports contaminants to open sea.

Important and complex food web links occur within the waterway. Examples are links within and between sediment invertebrate populations and biomass and waterfowl numbers; ecological effects of waterfowl populations on sediment flats, salt-marsh and salt-meadow structure, function and community structure; substantial energy input to the waterway in the form of roe from the local spring-spawning herring population – estimated as up to 100 tonnes per annum during the late 1980s.The status of many biological interactions structuring ecology of communities and of populations of non-avian ecological structuring species is poorly known as are any long-term and inter-annual trends.

4.2.3 Typical species

The species richness of the waterway complex is extremely high because of the range and variety of habitats, functional variation and the waterway's biogeographical position in a region of overlap between northern and southern species distribution. Few biomass data are available and current knowledge of population size is poor for most species and highly variable between the different waterway habitats. Species abundances vary throughout the waterway from the most wave exposed area within the entrance. Wide, horizontal intertidal mudflats fringing the estuaries draining into the main waterway support abundant and productive invertebrate (mainly annelid and mollusc) communities. Muds typically support a greater biomass than other intertidal sediments, the abundance of bivalve and polychaete species being particularly high. The intertidal sediment infauna is an important food source that supports large numbers of overwintering waders and wildfowl. Many species populations in lower shore mud banks have high biomass, particularly in the Pembroke River and at Pwllcrochan, and are an important source of food for both fish and birds, contributing to the importance of Milford Haven as a wintering area for waders and wildfowl.

There has been an increase in the number of opportunistic colonisers indicative of a degree of degradation but, except for small areas of local impoverishment, such as those regularly dredged for navigation, the infauna is very diverse and abundant. Many sponge populations are abundant with high biomass and there are mature beds of perennial algal species.

There is some information on the distribution of many species within the waterway, particularly the most widely distributed and frequent but with limited spatial and temporal resolution. Species ranges within the waterway are limited by availability of suitable substrate and hydrodynamic and hydrological gradients, and are likely to vary over time and space. Species populations are variously distributed within the waterway along the main physical and chemical gradients and include those typical of sediment and rocky substrates.

Sediment substrates

There is a spatially varying mosaic of intertidal sediments in the SAC supporting different characteristic species depending on the conditions. The predominately sandy shores exposed to wave action in the lower waterway, for example, typically support a small number of specialised hardy species. This is in contrast to stable, moderately wave-sheltered, sandy-mud shores in full salinity e.g. Gann Flats, Dale Beach, Angle Bay, Gelliswick and Pwllcrochan that support stable infaunal populations of a wide variety of species. The Gann Flats are the most biologically diverse intertidal sediment site in the Haven, despite being used heavily for bait digging. This area of very mixed substrate supports a mosaic of distinct communities including sandy *Echinocardium cordatum* and muddy sand *Limecola balthica* communities. The muddy gravel *Venerupis corrugata* community at the Gann is considered to the richest in south-west Wales.

At Pwllcrochan and other shores on the central waterway the generally stable sediments enables the recruitment and survival of a variety of long-lived and slow growing infaunal species; coarse stony and shelly substrates at the sediment surface also enables epibiotic species of both algae and animals to occur in the same habitat. Variety is highest in areas of shore subject to moderate tidal flow.

The continuum of sediment structure along and across the seabed of the waterway creates suitable habitat for a wide variety of sediment-living species with varying distributions in the central channel, the shallower areas at the sides of the channel and within embayments and estuaries. Except in the most exposed area, sediment communities contain many species. The infauna includes widely distributed burrowing anemones, polychaetes, crustaceans and echinoderms. Fine, moderately wave sheltered, sediments support eelgrass (*Zostera marina*) which in turn supports a wide variety of epifloral algal species. There are also wave sheltered sediments overlain with a bed of maerl supporting a wide variety of epifloral algal species, other epibiota and infauna. This is the only known maerl bed in Welsh waters.

Rocky substrates

The rocky shores of different rock types and topography exposed to strong gradients of wave exposure, tidal streams, salinity, water clarity and other functional processes are colonised by a wide variety of algae, sponges, polychaetes, crustaceans, molluscs and ascidians. There is a higher species diversity where there are crevices, overhangs, rock-pools and boulders (and thus underboulder surfaces) however wave sheltered shores support a particularly wide variety of algae and tidal-stream exposed lower shore bedrock and boulder shores support good assemblages of sponges and ascidians. The stable, tidal-stream swept, consolidated stony / shingle / shell shores at Wear Spit, for example supports a wide variety of algal species, including several rare species, and also sponges.

Species present on the variety of subtidal bedrock reefs and rocky substrates range from those typical of exposed open coastal reefs including soft corals, echinoderms, bryozoans and hydroids, to species typical of wave-shelter and tolerant of reduced salinity or water clarity. The deep, fully or near fully saline, tidal-stream swept, wave-sheltered rock and consolidated stony cliffs and steep slopes in locations such as Dockyard Bank, Burton Reach, and Castle Reach support a particularly wide variety of sponge species some of which are inferred from their size and growth forms to be a substantial age.

In the upper water and areas such as the Daugleddau where there are stable, consolidated stony and shell substrates with sediment pockets in fully or near fully saline, wave sheltered, tidal-stream swept conditions, there are a wide variety of sponges, burrowing and tube dwelling species of worms and anemones, crustaceans, ascidians and, in shallow water, a wide variety of algae, particularly fine filamentous red algae.

4.2.4 Natural Processes

The structure of estuaries is largely determined by geomorphological and hydrographic factors, with the original shaping forces having their beginnings in the geological origins of the adjacent land areas and the influence of major geological events such as ice ages and periods of higher and lower sea levels. The shape of the estuaries, their macro- and micro-topography, and bathymetry, are important components of the character of the habitats and influences the distribution and abundance of marine life, i.e. the features' typical species. It is both determined by, and influences, natural environmental processes and consequently, can be impacted either directly or indirectly (through changes to natural processes) by man.

Estuaries are complex dynamic systems that have a natural tendency to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by sub- and intertidal sediment banks. The width and depth of the estuary will therefore change over time towards a state of dynamic equilibrium or "most probable state".

The velocities of currents passing through the mouth are determined partly by the tidal range and partly by the cross sectional area of the mouth itself. If these velocities are higher than the sediment erosion threshold, erosion will widen the channel and lower velocities will ensue. If velocities are lower than the sediment depositional threshold, deposition will narrow the mouth and higher velocities will ensue. In this way, a dynamic equilibrium cross section will evolve which balances tidal prism, velocities and erosion/ depositional thresholds. Sea level rise means that estuaries will show a natural tendency to translate inland (roll-over) and may erode at the mouth. Where changes in extent are attributable to the estuary adjusting to equilibrium, then the feature should be determined favourable. Where this process is constrained by hard sea defence, then this would be considered as coastal squeeze[27].

A complex pattern and combination of physical, chemical and biological conditions and processes operates within estuaries, with many parameters varying temporally and spatially. These parameters establish the baseline conditions in the estuary and continually shape the estuaries and the habitats and wildlife they support. The key parameters are: the flood hydrograph; the nature of the catchment and its influence on freshwater flow and nutrient and sediment input; the nature of the estuary sediment; and the relatively high sediment levels in the estuaries resulting in low water retention within the estuary system and exposure of significant proportions of sediment at low tide. The biological communities of the estuaries have developed in response to these prevailing conditions and the daily patterns of water flow, exposure, sediment movement and water chemistry.

4.2.4 Modifications as a result of human activity

The Milford Haven waterway complex encompasses a wide range of habitats, including several which are SAC features in their own right. Modifications to the latter are discussed in the relevant sections. Gross distribution of the estuaries feature is unmodified, though distribution and extent of parts of habitats have been locally reduced or modified. Land claim and permanent freshwater impoundment for industrial and recreational developments has reduced the area of the waterway complex by over 100 ha since the 1860s and by around 70 ha since the 1950s. Former, land-claimed, modified or excluded tributaries lie adjacent to or drain into the site (including Hubberston Pill, Castle Pill, Westfield Pill, East and West Llanion Pills, and west Pembroke River).

The major intertidal eelgrass beds appear to have maintained their extent and recent WFD data demonstrates bed extent is generally increasing. It should be noted that older observations have shown small beds in tributary estuaries including Sandy Haven and at Pwllcrochan Flats that were present up to the 1970s were no longer present in the late 1990s, however there is evidence of new beds becoming established in locations including Picton Point in the upper reaches of the estuary. WFD data demonstrate intertidal eelgrass within the Milford Haven waterway complex is currently achieving High ecological status. The extensive subtidal *Zostera marina* bed in shallow water between Gelliswick Bay and South Hook Point appears to have maintained its area and decreased its shoot density.

Deepening, widening and maintenance of navigational channels and vessel berths has locally modified areas of sediment seabed topography. Modifications have been caused by constructions on and reduction in extent of the foreshore by tidal defences. There are also many ancient quays and quarry workings, many of which are now wholly or partially naturalised. However overall gross sediment transport processes are inferred not to be significantly modified as a result of human activity, though local, chronic and acute, modification occurs in the vicinity of maintained navigational channels, vessel moorings, anchorages and berths, built structures and from shipping movements.

Changes to water movement are greatest in the vicinity of the modifications and the gross physical hydrography of the waterway is considered little modified as a result of human activity. The degree of modification of sedimentology by human action is unknown, though

[27] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/)

the effects of agricultural run-off and of capital and maintenance dredging are inferred as having had a negative influence.

There are anticipated modest coastal squeeze impacts due to sea-level rise and hold the line policies in the West of Wales Shoreline Management Plan[28].

A wide variety of activities, including pipeline and cable crossings, discharge outfall installations, harbour installations and intensive bait digging have resulted in localised modification of seabed and intertidal sediment topography. Other localised modifications include sediment load, ambient light, and salinity.

Exposure to wave action has been locally modified in the vicinity of built structures as has water temperature near domestic and industrial discharges. In the past there was significant local modification in the vicinity of the power station cooling water outfall, with wider consequential effects along virtually the entire waterway. The original power station closed in 1996 and was demolished. A new Pembroke Power Station has since been built, and began operation in 2012. This station uses once through cooling water with a warm water discharge. The once through cooling system results in entrainment of adult and juvenile fish, planktonic organisms and benthic species. Because of concerns regarding both the impacts of temperature rises and entrainment, a monitoring programme has been in place since before the station began operating.

There are likely long-term adverse consequences as a result of climatic warming - local seas show in increasing temperature trend[29].

Water quality data for the Milford Haven waterway demonstrate the waterway is hypernutrified compared to WFD nutrient standards. Phytoplankton blooms do not occur in the waterway, but within the sheltered bays and inlets there is widespread and often dense growth of opportunistic macroalgae species, primarily *Ulva* sp.

Evidence from WFD monitoring in the Milford Haven Inner water body shows that dissolved inorganic nitrogen (DIN) levels are Moderate and this is reflected in the opportunistic macroalgae classification, which also achieves Moderate status. Therefore, this transitional water body is currently failing to meet Good status, which is required for WFD compliance by 2027[30].

The WFD DIN classification demonstrates that the waters of the Milford Haven Outer water body are also at Moderate status and are hyper-nutrified according to WFD standards, but assessments did not demonstrate failures of phytoplankton or opportunistic macroalgae quality elements at water body level. The vast majority of the DIN entering the waterway from the catchment area comes from agricultural land. Only ~8% of the DIN load is attributable to continuous point sources such as sewage treatment plants and industrial discharges, while other potential sources such as intermittent discharges and other urban sources are believed to be relatively insignificant. A higher proportion of the dissolved inorganic phosphorus (DIP) load (~42%) comes from continuous point sources. Previous

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[28] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/)
[29] For further information see: http://ukclimateprojections.metoffice.gov.uk/ & http://www.mccip.org.uk/uk-marine-projections/
[30] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Milford Haven Inner, Milford Haven Outer, Pembrokeshire South and Cardigan Bay South.

modelling studies have indicated that both nitrogen and phosphorus concentrations may be important in controlling algal growth, depending on location within the waterway, time of year, weather and tidal state. However, based on the observational data, it was suggested that, on balance, nitrogen limitation is more likely. There is no evidence of an increasing trend in nutrient (DIN or DIP) loads entering the waterway or nutrient concentrations within the waterway. The status of the water bodies within the site including nutrient levels and chemicals is available on Water Watch Wales[31]

Long-term average hydrocarbon concentrations are marginally elevated over near-shore coastal background and there are elevated metal concentrations (including chromium, cobalt, cadmium, nickel, vanadium and zinc) in the central industrialised section of the waterway and in known or inferred sediment sink areas and attributed to chronic anthropogenic inputs. Levels in many of the estuarine inlets of Milford Haven are above levels known to have adverse effects on biota (e.g. Cosheston Pill, Angle, and Carew/Creswell). Elevations are predominantly attributed to chronic (domestic, industrial discharges) rather than acute inputs. Formerly extensive contamination from TBT antifouling paints has decreased from *c* 1990 and continues. Biological tissue metal concentrations are lower than in industrial estuaries such as the Dee and Severn.

Ecosystem functioning, determined by intertidal grazing molluscs, has been subject to temporary acute modification by pollution incidents and locally to chronic influences from discharges and antifoulant paints. Accidental and deliberate introductions of non-native species that have become successfully established have affected biological interactions.

Interactions have also been indirectly but substantially altered through modification of components of structure and function. For example, modification of community structure at Gann Flats through bait digging disturbance and substrate alteration has resulted in decline in several species of molluscs and worms and an increase in Alitta virens (*Nereis virens*)(king ragworm) abundance and associated increase in predation on other invertebrates by this species. The degree to which gross species richness may have been modified within the waterway complex or encompassed habitats as a consequence of human activity is not known.

Populations of some species have been subject to local and wide-scale, short and long-term reduction (and recovery) following both acute perturbations (e.g. pollution accidents, harbour dredging) and chronic habitat modification, contamination or exploitation (e.g. domestic and industrial discharges, fishing operations, e.g. native oyster, molluscs near refinery outfalls and crustaceans following the Sea Empress oil spill. Other species populations have declined from unknown or uninvestigated causes. Biomass is inferred to be typical of encompassed habitats except possibly in areas of organic enrichment or chronic disturbance.

Anthropogenic effects on population structures are generally unknown or poorly known for most invertebrate and algal species. Known effects include temporary perturbation of some populations (mostly of crustacean and mollusc species), following the Sea Empress oil spill in 1996; the effects of TBT antifoulant on some mollusc species populations and the historic effects of fisheries on target and non-target species such as herring and native oyster, though incidental effects are unstudied.

[31] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Milford Haven Inner, Milford Haven Outer, Pembrokeshire South and Cardigan Bay South.

Milford Haven waterway has a high intensity of shipping and recreational boating visits compared with many other parts of Wales[32] additionally it is situated in an area where natural dispersal via prevailing currents means that the risk of marine INNS introductions from the Continent is greater than in some other parts of Wales[33]. These two factors create a marine NNS 'hotspot' and contribute to the greater number marine NNS that The Waterway hosts compared to the rest of Wales.

One of these species, the invasive mollusc *Crepidula fornicata* slipper limpet, is abundant within the Haven in both the intertidal and subtidal at a level that is likely to be at the expense of native species. *C. fornicata* has the ability to smother species and alter the nature of sediment substrata, smothering areas previously dominated by bivalves[34]. Change in species composition has been recorded, including reduced species diversity and dominance by individual species[35].

4.3 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
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Intertidal Underboulder Communities
- *Musculus discors* beds (only one record)
- Mussel beds

[32] Tidbury (2014)
[33] Tidbury *et al* (2014)
[34] Minchin *et al*. (1995)
[35] Vallet *et al*. (2001)

- *Ostrea edulis* beds
- Subtidal mixed muddy sediments
- Tide swept channels
- *Anguilla anguilla*
- *Clupea harengus*
- *Cruoria cruoriaeformis*
- *Dipturus batis*
- *Eunicella verrucosa*
- *Haliclystus auricula*
- *Hippocampus guttulatus*
- *Lucernariopsis campanulata*
- *Ostrea edulis*
- *Padina pavonica*
- *Palinurus elephas*
- *Phymatolithon calcareum*
- *Pleuronectes platessa*
- *Raja clavata*
- *Solea solea*

4.3.1 Range

Reefs are distributed throughout the site (see feature map[36]). Much of the intertidal zone is reef habitat particularly along the open coast. Extensive areas of sublittoral rocky reefs stretch offshore from the west Pembrokeshire coast and around the islands and many small rocky islets. There are large, isolated reefs and islets immediately offshore of both the north and south coasts of St. Brides Bay. West Dale Bay and the south-eastern coast of Freshwater West predominantly comprise reef habitat and the Handmarks is a major extensive horizontal reef in the southern part of St. Brides Bay.

The Milford Haven waterway has a variety of sizes and shapes of reefs at different depths including large, extensive and smaller discrete reefs such as the Mid-channel and Chapel Rocks complex and Stack Rocks. As reefs are predominately a feature of exposed coasts, the range of reefs in the sheltered conditions of the Milford Haven waterway is exceptional. Specific, geographically defined, areas of *reefs* that may be considered recognisable within the site are:

- Offshore, extremely exposed, Grassholm to The Smalls and the Bishops & Clerks reef complexes;
- Skomer / Marloes Peninsula
- Ramsey / St David’s Peninsula
- Skokholm – St Anne’s Head and south St. Brides Bay
- Milford Haven (reefs at entrance contiguous with above)
- South Pembrokeshire limestone

The extent of exposed reefs varies substantially due to covering and uncovering by sediment. The linear extent of intertidal reef is large, but the overall area restricted because of the high proportion of steeply sloping shore. The extent of sublittoral reef is large but not known precisely. Within the approximately 7% of the site surveyed by

[36]All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

advanced acoustic bathymetric techniques *c* 47% (4356 ha) was identified as reef. Further bathymetric work is being carried out in 2016 to refine knowledge of feature habitats and reef extent within the SAC.

4.3.2 Structure and function

Rock types forming reefs within the site include extensive areas of igneous rock, relatively friable old red sandstone and limestone. Habitat variety is increased by the presence of rock types that favour rock-boring and crevice-dwelling species. Rock folding, faulting, fracturing and the variability of erosion underlie the complex and ecologically important reef geomorphology within the site.

Large areas of reef are covered by sediment intermittently or regularly, and on a long or short-term basis. The overlying sediments vary from very fine deposits in wave and / or current sheltered locations to extremely coarse sands and fine shell gravel in current exposed offshore locations. Several reef types can be distinguished within the SAC but only their broad distribution is known.
These include;

- massive shallow reefs and reef platforms;
- complex isolated reefs;
- vertical and steep surfaces over wide depth ranges from above sea level to 50 metres below sea level (many contiguous with sea-cliffs);
- discontinuous, irregular and continuous, even reef slopes;
- deep, roughly horizontal reef;
- islands and islets.

There is also variety in the Milford Haven reef types from the Mid-Channel Rocks complex at the entrance to isolated, mainly low lying reefs in the upper Daugleddau. Reefs within the site are subject to an exceptional variation in strength of tidal streams and wave exposure with many extending onto the shore and provide examples of both the most exposed and the most sheltered intertidal rock communities in southern Britain.

Reef habitat diversity is increased by caves, tunnels and surge gullies in both subtidal and intertidal zones and the wide range of rock surface microtopography as well as the depth range over which they occur, including extensive areas of deep (>30m) reef.

There are few comparable areas in UK with such a range and extent of reef habitats exposed to such extreme wave exposure and tidal streams. Specific broadly defined combinations include:

- reefs exposed to both strong to very strong tidal streams and strong wave action. Extensive areas of open coast reef, offshore complexes of pinnacles and islets, and the west coasts of islands exposed to extreme wave and tide-swept conditions.
- reefs exposed to strong to very strong tidal streams and sheltered from wave action. Extensive areas of deep, offshore reef sheltered from prevailing swell; Milford Haven waterway.
- reefs sheltered from tidal streams and exposed to strong to very strong wave action and surge. Many long, narrow or tapered inlets and sea-caves, particularly on Ramsey and Skomer islands and Castlemartin coast.
- reefs sheltered from strong water movement. Deep sheltered reef off north and east coasts of islands and within bays; Milford Haven waterway. The deep, lagoonal, former slate quarry at Abereiddy is an extreme example. Ultra-sheltered from water

movement. Water exchange, mixing and flushing are exceptionally limited, resulting in establishment of seasonal thermoclines, oxyclines & haloclines.

Reefs in areas exposed to intermittent, or occasionally reduced water movement are subject to intermittent or regular sediment deposition and removal. Areas of reefs adjacent to sediment habitats, particularly low lying and shallowly sloping areas in the shallow subtidal or intertidal reefs, are subject to large scale deposition and erosion of sediment.

The biological interactions structuring reef ecology are known to be complex and include inter- and intra-species competition for space and resources, grazing and predation. Status of many biological interactions structuring ecology of communities and the population structures and dynamics of most key ecological structuring species (*e.g.* sea urchin, *Echinus esculentus,* and crustaceans) are poorly known.

4.3.3 Typical species

The wide range of substrate type, topography, depth, wave and tidal current exposures, and light are major contributors to high species diversity on the reefs. This is supported by species migration and the potential for recruitment of reproductive products from a wide area. They include: limestone and other architectured and / or friable rock which support a variety of rock boring and crevice-dwelling species, including species restricted to limestone, specialised micro-habitats such as surge gullies and crevices which support rich variety of many species including encrusting sponges, ascidians and anemones and fully saline, extremely wave-sheltered, tidal stream-swept bedrock and consolidated boulder / cobble (*e.g.* Milford Haven sponge populations).

Information on the population dynamics is available for a range of reef species in the Skomer MCZ and intertidal habitats in the Milford Haven waterway. Many populations exhibit spatial and temporal patchiness. Many long-lived, slow-growing species populations show apparent long-term stability but sporadic recruitment. Biomass is highly variable between different reef habitats, species, seasons and between years.

Time series data for several long-lived reef species and species assemblages in the Skomer MCZ indicate that some are subject to intermittent reproductive success and irregular recruitment. Many species are at least partly dependent on recruitment from outside the site and the variations in population structure contribute to the complexity of community mosaics and to biodiversity.

The spatial range of most species characteristic of reef habitat is extensive, though the habitat range of many, particularly highly specialised species, is restricted in distribution and / or extent. Because of the hydrodynamic regime and the continuous throughput of water masses of distant and varied origins, species are inferred likely to be both capable of recruiting from and contributing to recruitment from both nearby and distant populations. The true ranges of apparently rare or scarce species are unknown.

4.3.4 Natural processes

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 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 animals, 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 the mussels of a horse mussel reef 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 and nursery areas for many other species.

4.3.5 Modifications as a result of human activity

There is a history of local modification of reef distribution mostly within the Milford Haven waterway, largely through topographical modification, covering with structures or because of sediment accretion as a consequence of human activity. The extent of littoral reef has been locally reduced by the construction of harbour infrastructures and landing facilities at a few locations, particularly in Milford Haven.

Although subtidal reef topography has been historically modified by capital dredging in Milford Haven, and a resulting increase in sedimentation is likely to have covered reef areas, the gross distribution and extent of subtidal reef within the waterway is not known to have been reduced. Mobile reef features (i.e. boulders, cobbles etc.) have historically been modified by human activity, for example as a result of coastal defence works, coastal construction, and pollution response. Reef geomorphology is predominantly unmodified except for localised exceptions within the Milford Haven waterway.

Distribution and extent of topographical reef types are not known to have been reduced by human action, the overall depth range of reef is assumed unmodified by human action and there is no known evidence for modification of reef surface microtopography as a result of human activity. However, use of heavy mobile fishing gear (e.g. trawls and dredges) is known to alter the topography of reef structures in quite major ways. The degree to which this has occurred within the site is unknown.

Localised modifications of orientation and aspect within the Milford Haven waterway have resulted from widening and deepening navigational channels.

Discarded and accidentally misplaced artificial materials are present throughout reef habitat. These include the remains of shipwrecks, lost and discarded fishing gear and persistent rubbish which can be a physical hazard to some species and for some, a source of chemical contamination. Modern synthetic fishing gears are capable of ‘ghost fishing’ both commercial and non-commercial species for prolonged periods. Many inert materials are colonised by marine wildlife (forming ‘artificial reefs’) though usually to the detriment of other, previously existing, species populations.

The gross physical hydrography is considered little modified as a result of human activity, except in the case of artificially created habitat such as flooded coastal quarries. Reef exposure to tidal water movement and wave action is predominantly unmodified by human action except for localised influences in the vicinity of built structures such as navigational installations in Milford Haven and in the artificial lagoon of Abereiddy quarry.

The power station thermal outfall in Milford Haven modifies temperature regimes within the waterway and there are likely to be long-term adverse consequences as a result of climatic warming - local seas show an increasing temperature trend.

There is localised modification of incident light within Milford Haven in vicinity of built developments. Reduced light penetrating the water is likely as a consequence of modern farming practices, increased land runoff and consequential increase in water turbidity. Minor temporary modification of suspended particulate concentrations during and following offshore dredge spoil disposal operations have occurred when an inshore disposal site was in operation. Concentrations may also be modified by local or distant activities mobilising or influencing sediment transport, such as coast protection or construction operations. Modification of suspended particulate concentrations within Milford Haven is influenced by several human activities and is more complex. Concentrated dinoflagellate blooms (red-tides) commonly occur in bays during calm, warm summer weather, and are possibly associated with elevated nutrient concentrations.

Local reductions in salinity occur in the vicinity of freshwater run-off and streams crossing areas of intertidal reef increases corresponding local habitat and species diversity. There is potential for modification by watercourse diversion, abstraction and engineering.

Concentrations of major nutrients in the Milford Haven waterway are generally above near-shore background values and concentrations of a number of contaminants are above background values.

Mobilisation or deposition of sediment into the water column by human action is regular and widespread. Sediment processes may have been locally modified by changes in water movement patterns in the vicinity of artificial structures upstream from reefs and are inferred to have been modified by dredge spoil disposal and fishing operations. There is reasonable evidence that reefs in the path of residual currents from spoil disposal sites and watercourses with elevated sediment loads have been subject to modified levels of deposits of, mostly, fine sediments for varying periods of time depending on the hydrodynamic regime at each reef’s location. Localised, transient modifications of reef sediment burdens are inferred to have been caused in the vicinity of other operations; *e.g.* civil engineering, modification of navigational channels and fishing.

Species subject to commercial exploitation are known, or inferred, to be depleted well below historical pre-exploitation levels. Scientific evidence suggests that aspects of ecosystem functioning may be modified or adapted as a consequence. However, the magnitude of such modification is both unknown and, in the absence of pre-exploitation data, unquantifiable. The mobility of commercially exploited species is (obviously) impeded by capture methods.

Ecosystem functioning determined by intertidal grazing molluscs, has been subject to temporary acute modification by pollution incidents (e.g. oil spills) and, locally, to chronic influences from discharges and diffuse sources (e.g. antifouling paints).

The degree to which reef species populations may have been modified or degraded by human activity is difficult to assess. The physiological health of some species and their reproductive capability is inferred as potentially modified in areas of contaminant elevation e.g. dog whelks as a result of tin-based antifoulant paints.

4.4 Grey seal (*Halichoerus grypus*)

The UK population of grey seals (*Halichoerus grypus* Fabricius, 1791) represents about 38% of the world population and 83% of the EU population. The total UK grey seal population size in 2012 was estimated as 112,300 (95% CI: 90,600-142,900)[37].

Based on pup production estimates, the Welsh 'population' forms around 3.3% of the UK or about 2.7% of the European population. The Pembrokeshire coast contains the main colony in Wales and is the most southerly in Europe of any significant size[38].

The breeding ecology differs from that of grey seals elsewhere in the British Isles as the seals here tend to use secluded coves and caves for pupping instead of forming large congregations of pupping females on open sites[39]. While most of the important pupping beaches, caves and haul-out sites occur in Pembrokeshire, grey seals are known to travel widely and range throughout the Irish and Celtic seas (and beyond) and there are a significant number of pupping sites in south-western Ceredigion, Gwynedd, Anglesey as well as other counties surrounding the Irish/Celtic Seas (e.g. Cornwall, Ireland, Isle of Man)[40].

4.4.1 Population dynamics

Grey seals present within the site at any one time do not form a discrete population, but are centred (in terms of abundance) on the Pembrokeshire coast and are considered part of the SW England and Wales management unit[41]. This population itself is not isolated but extends from SW Scotland to SW England and SE Ireland (individuals have been photographically recaptured among these regions[42] and there are movements and

[37] SCOS (2013)
[38] Baines *et al.* (1995)
[39] Baines *et al.* (1995); Stringell *et al.* (2013)
[40] see SCOS (2013) for further details
[41] (IAMMWG, 2013).
[42] Keily *et al*. 2000, SCOS 2013, Cornwall Seal Group pers. Comm., NRW Unpublished data

exchanges with more distant populations (satellite tracked individuals have been tracked to/from France, west coast of Scotland and Ireland[43]).

Pup production can be used as an index of seal population size, if age structure is stable and where rate of change is constant, or where alternative information on fecundity or survival rates is available[44]. UK grey seal population size is estimated from pup counts using a complex population dynamics, Bayesian state-space model[45]. The south-west Wales 'population' size is also determined from pup counts, and has been estimated at approximately 5000 individuals[46]. Most long-term survey data has been collected from small parts of the Pembrokeshire Marine SAC - namely Skomer Island and Marloes Peninsula with annual data from the 1970's[47], and less frequent data from the North Pembrokeshire coast and Ramsey Island[48] - with trends for the south-west Wales population inferred from this data.

Pup production from 1992 to 2008 in the Skomer MCZ remained fairly consistent with the expected natural fluctuations with an average of 208 pups. From 2009 to 2015 there has been a steady increase in pup production with the greatest increase being at the mainland sites, although in 2014 and 2015 increases at the island sites have also been recorded. Pup production for the past 3 years has shown the highest totals ever recorded with average production for 2013-15 at 357 pups[46].

The age frequency and sex ratio of the population is unknown as are fundamental population demographics such as female fecundity, adult survival / mortality and physiological health. An emerging phenomenon is the appearance of mortal spiral wounds thought to be caused by sudden traumatic events involving the strong rotational shearing force of a rotating blade. These injuries are consistent with the seals being drawn through a ducted propeller[49]. The occurrence of 'corkscrew' injuries is a growing concern in the UK and such occurrences have recently been reported in Wales[50]. A range of viral, bacterial and parasitic diseases are known to be endemic within seal populations but appear to have limited effect on healthy, unstressed, adult seals.

4.4.2 Range

Grey seals are highly mobile species[51], which can travel great distances[52]. There is an increasing need to understand the movement and connectivity of seals identified in SACs to inform conservation planning. Tracking studies can provide powerful insights into animal ecology and usually involves transmitting/recording devices, e.g. satellite telemetry, and/or tagging, e.g. flipper tags, branding or photo-identification. Photo-identification of seals offers the chance to photographically capture permanent and identifiable patterns on the pelage[53] of many animals at repeated times and low cost. Over 3000 individual seals have been photographed throughout Wales over the last two decades (NRW *unpubl data*) and photographically recaptured at multiple distant sites. Seals are widely distributed within

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[43] Cronin 2011, Vincent, unpublished data
[44] Hiby & Duck, 2003; Duck & Thompson, 2007
[45] SCOS, 2013
[46] Baines et al 1995
[47] Skomer MCZ annual report 2015
[48] Strong et al 2006
[49] Bexton *et al*. (2012), Thompson *et al*. (2013)
[50] Penrose *pers. comm.*
[51] Russell *et al*. 2013
[52] e.g. >700km, Cronin (2011), Vincent *unpubl data*
[53] Hiby *et al*. (2013)

and travel far beyond the Pembrokeshire Marine SAC[54]. Pupping takes place throughout the site on open coast in suitable habitat (*i.e.* physically accessible, remote and/or undisturbed rocky coast beaches, coves and caves) and the high proportion of use of sea-caves by the south-west Wales population is a particularly unusual variation in breeding behaviour[55].

Moulting and resting haul-out sites are distributed throughout the site, though only a small number of sites are regularly used as haul-outs by large numbers of seals[56]. Known winter moulting haul-outs and non-moulting / resting haul-outs are limited to offshore islands and remote, undisturbed and inaccessible rocky shores and beaches.

4.4.3 Habitat and species

The exact habitat requirements of grey seals is not known (seemingly suitable habitat is often not occupied) but must include suitable feeding, pupping, moulting and resting haul-out areas. Adults and weaned pups are assumed to feed throughout the site and some are known to make long foraging trips offshore to deeper waters from south through south-west to north-west off the Pembrokeshire coast[57].

Rocky coast beaches, coves and caves along most of the coast provides pupping habitat but preferred sites tend to be the most secluded, sheltered from heavy wave action and accessible by females at all phases of the tide. Pupping tends to occur at a limited number of favourable sites (towards the south-western end of the SAC) with some use of less optimal sites[58]. Moulting / resting haul-out habitat requirements are not known precisely but suitable habitat is extensive throughout the southern part of the site and is assumed to be adequate.

The structure of pupping beaches and caves, moulting and resting haul-out sites and feeding vary throughout the site, and the associated functional processes are almost entirely determined by inherent coastal geomorphology and hydrography. Occasional use of artificial substrates (e.g. jetties) for pupping and haul-out has been recorded.

Grey seals are generalist feeders, foraging mainly on the sea bed, taking a wide variety of prey including sandeels, gadoids (cod, whiting, haddock, ling), and flatfish (plaice, sole, flounder, dab)[59]. Among these, sandeels are typically the predominant prey species, but diet varies seasonally and from region to region. A study of grey seal diets from scats collected in Pembrokeshire[60], found that gadoids (mainly whiting) and flatfish (mainly sole) dominated the diet (70% by weight).

4.4.4 Modifications as a result of human activity

Grey seals were historically subject to human exploitation[61]. Although large numbers were killed and taken until early in the twentieth century there is no reliable contemporaneous information on population size at that time, or of likely pre-exploitation numbers. There are

[54] SCOS (2013), Cornwall Seal Group *pers. Comm*., NRW *unpubl data*
[55] see Stringell *et al*. (2013)
[56] e.g. Baines *et al*. (1995)
[57] Thompson (2011); Jones *et al*. (2013)
[58] see Baines *et al*. (1995)
[59] Brown *et al*. (2012), SCOS (2013).
[60] Strong (1996)
[61] Haug *et al*. (2007)

occasional, often unattributable, anecdotal reports of seals being shot or accidentally captured and drowned in fishing gear[62], the magnitude or importance of such deaths to population dynamics are unknown but unlikely to have a population level effect.

There is no known evidence that human influences have contributed to the reduction / stabilisation of pup production[63]. Although increased disturbance or suppression of physiological health from various anthropogenic activities remains a possibility. Entanglement in persistent synthetic debris (particularly fishing gear debris) causes low-level mortality and there are historical records of pup deaths (Skomer and Ramsey Islands) caused by oil spills.

The effects of persistent pollutants burdens or modified food resources on health or reproductive capability have not been investigated within the site and any modification caused by burdens of persistent pollutants or modified food resources is unknown.

Seals are regularly recorded entangled in persistent synthetic materials[64] (predominantly fishing nets). Minor, temporary, modifications of distribution may be caused by various coastal and maritime human activities. For example, pupping activity may become modified by avoidance of sites easily accessible to and often used by humans, or by increasing tolerance (habituation) of human presence. The inaccessibility and predominantly winter use of moulting haul-out sites minimizes their exposure to human disturbance. However, anecdotal reports and observations suggest that seals maybe becoming increasingly habituated to human presence at certain sites.

4.5 Atlantic salt meadow

Atlantic salt-meadow (*Glauco-Puccinellietalia maritimae*) is defined in the EU Habitats Interpretation Manual as “Salt-meadows of Baltic, North Sea, English Channel and Atlantic shores”

Eleven different plant communities are represented by this SAC habitat in the UK which occurs on North Sea, English Channel and Atlantic shores.

Atlantic salt meadows develop when plants able to tolerate salty soil conditions colonise soft intertidal sediments of mud and sand in areas protected from strong wave action. The vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration than areas nearer to the low water mark in estuaries and coastal locations.

The vegetation that is present varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, invertebrates and wintering or breeding waterfowl.

4.5.1 Range

Atlantic salt-meadow is present together with lower salt-marsh and adjacent transitional / freshwater marsh throughout the Milford Haven waterway. Tributary estuaries and lagoons

[62] SCOS (2013)
[63] Thompson & Härkönen (2008)
[64] Skomer MCZ Annual report 2015

within the waterway are characterised by extensive pioneer salt-marsh and Atlantic salt-meadows and the habitat is distributed discontinuously on upper shores throughout and flanking both sides of the central-lower waterway, and extending into the large shallow bays of Dale, Angle Bay and Sandy Haven (see feature map[65]). Small fringes and ribbons of salt-meadow in the central waterway have not been surveyed.

The area covered by Atlantic salt-meadow increased by around 25% to approximately 173 ha between 1982 and 2002, although the total extent of salt-marsh (mainly the *Spartina sp*. community) declined by around 15% during the same period. Relative proportions of the component salt-meadow communities also changed but the reasons are not clear.

4.5.2 Structure and function

Atlantic salt-meadow is dependent on environmental processes in the waterway and water column both local to its immediate vicinity and of the Milford Haven waterway as a whole. Its distribution and extent is predominantly governed and constrained by the geomorphology and tidal regime and the topography is determined by foreshore breadth, morphology of waterway and sediment processes. The sediment structure is predominantly muds, though many fringes and ribbons have developed in areas of mixed muddy gravels and stones and, in places, are associated with rocky substrate. A range of Atlantic salt-meadow geomorphology and topography is present in the waterway with the overall shape determined by the morphology of the Milford Haven particularly the hinterland and the main waterway and estuary channels. This is locally influenced by the presence and morphology of rocky reef and wide intertidal sediment flats.

Geomorphological ‘variants’ of salt-meadow such as ‘saltings’, fringing, and ‘perched’ marsh above rocky substrates, occur throughout the site. Extensive saltings are present in tributary estuaries where most slope gently across muddy shores toward drainage channels. The only large area of horizontal marsh is within the Gann Estuary.

The shape and topography of fringing and perched salt-meadow reflects shore topography and so occurs predominantly as narrow ribbons. The microtopography reflects the flooding / drainage regime and sediment erosion / accretion balance as determined by slope, exposure to water movement and local sediment transport processes. It is highly varied within and between individual areas of salt-meadow. Areas of open sediment and saltpans are mainly limited to horizontal saltings. Most are relatively uniform, gentle slopes with complex drainage channels and localized erosion ‘cliffs’, in places more than 0.5 m high. The most complex and varied microtopography is in horizontal marshes with pools and patches of bare mud. Microtopographical heterogeneity is also high in ribbons and patches in association with rock and gravel / shingle.

Most of the Atlantic salt-meadow, and the largest extents, are in wave-sheltered tributary estuaries. The ribbons and areas of salt-meadow closest to relatively open waters of central waterway, such as the outer Gann Estuary and Angle Bay, are variously exposed to the effects of the heaviest swell wave action and locally wind generated wave action. Suspended particulate concentrations are a product of riverine, marine and anthropogenic inputs. The water and sediment chemistry in the waterway is inferred to reflect the chemistry of adjacent sediments and the water column.

[65] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

The sediment processes appear to be in a dynamic balance on a broad scale. Sediment deposition and erosion varies within and between areas of salt-meadow dependent on gross sediment inputs and transport within Milford Haven waterway, and local topography, hydrodynamics and proximity to drainage channels. Sediment inputs, suspended sediment water column load and sediment transport patterns result in sediment deposition in many areas, though this is balanced by local sediment erosion within and at the edges of salt-meadows.

Wintering waterfowl populations create ecological effects through grazing, nutrient enrichment, trampling effects on vegetation and sediment substrate, and seed distribution. The effect of the increase and subsequent decrease in *Spartina s*p. population since its introduction in the late 1940s – early 1950s on the salt-meadow (as distinct from endemic pioneer salt-marsh) is unknown, though there was a considerable increase in salt-meadow extent coincident with a decrease in extent in *Spartina* sp. in the two decades to 2002. The status of salt-meadow prior to *Spartina* sp. introduction is unknown.

4.5.3 Typical species

Species and community richness is proportionately high relative to the extent of saltmarsh and comparable areas of Atlantic salt-meadow in south Wales [66] but also highly variable between and within areas of Atlantic salt-meadow. The range of substrates and topography are particularly important in contributing to this diversity. Communities, species and species assemblages of particular nature conservation importance, including nationally rare and scarce Atlantic salt-meadow / salt-marsh transition species have been recorded. Populations of notable salt-marsh species include: *Limonium humile, L. procerum, Salicornia pusilla, Althaea officinalis, Apium graveolens, Carex punctata, Hordeum secalinum* and *Lathyrus palustris*.

Species composition, variation and complexity of communities within and between areas of Atlantic salt-meadow, community structure, temporal patchiness in community distribution and extent, and variation in sward height together indicate species populations are dynamic, reproducing and recruiting successfully and self-maintaining.

The range, distribution and frequency of salt-meadow species is widespread through the waterway, but is inferred as restricted by geomorphology and habitat availability.

4.5.4 Natural Processes

The location, character, and dynamic behaviour of saltmeadows are mainly governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh: (1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed; (2) a supply of suitable sediment available within the period of tidal cover; (3) water velocities that are sufficiently low for some of the sediment to settle out; and (4) a supply of seeds or other propagules for the establishment of vegetation cover.

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[66] Prosser & Wallace, (2002) ibid

The topography and microtopography of areas of Atlantic salt meadow are the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. These can be highly dynamic and vary with short and long-term natural cycles, climate influences and stochastic events, including: tidal range and excursion, salinity, water temperature and suspended particulate concentrations. The marsh-edge morphology provides information on the short to medium term trends of marsh morphodynamics. Accreting and stable seaward marsh edges have an accretional ramp upon which pioneer and low-marsh vegetation can become established. Erosional margins are characterised either by the presence of mud-mound topography or by marsh-edge cliffs fronted by:

- toppled cliff blocks with live or dying vegetation
- rotational slide
- overhanging (cantilever) blocks.

Terraced marsh margins indicate episodic erosion and accretion on timescales over decades to centuries.

Creeks and pans of varying size and density are frequent features of the saltmeadows. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. The efficiency of this process depends on creek pattern. Creek density is influenced by vegetation cover, suspended sediment load and tidal influence. Creeks allow pioneer vegetation to be established along their banks higher into the saltmarsh system. Natural salt pans can occur at any level in a saltmarsh. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins. Contaminants may be tied up in saltmarsh sediments for relatively long periods of time and shifts in the dynamics of processes can lead to the remobilisation of sediments. Cyclical patterns of erosion and accretion may, therefore, lead to the release and re-deposition of pollutants within the system.

Nutrient levels are a strong influence on the growth of estuarine saltmarsh plants. Nutrient cycling within saltmarshes can also have a significant effect on coastal and estuarine water quality. In this respect, healthy, functional saltmarsh habitat may have an important role to play in the control of nutrients, which is important in determining water quality.

Given favourable conditions, depending on sediment supply and hydrodynamic regime, mudflats evolve into saltmarshes by way of substrate stabilisation by algae, diatoms and early pioneer plants, giving rise to enhanced sediment accretion rates.

There are implications as a consequence of sea-level rise for future extent of this habitat that unless there is the capacity for the habitats to roll back or transgress landwards, that rising sea-level is likely to reduce extent over time.

4.5.5 Modifications as a result of human activity

The feature has been historically modified as a result of land-claim and development as well suffering minor localised modification as a result of stock grazing. Losses are predicted for this feature due to coastal squeeze/sea level rise[67] .

[67] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/).

Many areas of salt-meadow have been subject to oil pollution and response since the 1940s; small areas have also been used for experimental investigations into the effects of oil pollution and cleaning techniques on salt-marsh. The resulting damage has been variable and mostly, apparently, short-term. Persistent hydrocarbon horizons remain in several locations such as Martin’s Haven (Pwllcrochan) where they have persisted for more than 25 years. Subsurface oil from historical pollution incidents is present within sediments in areas of salt-meadow in, or adjacent to, the central waterway however the buried oil does not appear to impede ecological processes.

A wide range of persistent, discarded and accidentally lost, artificial materials are present in salt-meadow in the vicinity of developed areas and on the strand line. This may modify sediment processes, particularly accretion, and salt-meadow topography. The presence of unstable mud ‘cliffs’ at salt-marsh edges in wave sheltered locations but in the proximity of vessel activity suggests localized acceleration of erosion by vessel wash.

Livestock grazing mainly takes place on upper areas of salt-meadow. Light grazing may have locally increased microtopographical heterogeneity and influenced vegetation structure. Poaching by cattle has locally decreased the structural integrity of salt-meadow and increased the potential for erosion for example in Western Cleddau, Carew/Cresswell, and Daugleddau. It is not possible to determine the long-term effects of the intermittently recorded pattern and history of grazing.

Suspended particulate concentrations are modified by agricultural run-off and raised nutrient levels are known to affect saltmarsh with cover by green macroalgae. This has been observed to smother salt-meadow. There are also intermittent to regular local short-term modifications in the vicinity of vessel traffic and irregularly from dredging operations.

As a consequence of the history of human impact on the structure and function of the Milford Haven waterway, it is inferred that salt-meadow species populations are likely to be modified to some degree; however, the magnitude and extent are unknown and, because of the paucity of historical information, not likely to be quantifiable. Oil pollution has had localised effects on salt-meadow since the 1960s, but the degree of resultant long-term modification of species population sizes is unknown. There is no known evidence of anthropogenic modification of the species richness of the Atlantic salt-meadow or known major impediments to species recruitment from viable species population reservoirs.

4.6 Mud-flats and sand-flats not covered by seawater at low tide

Mudflats and sandflats not covered by seawater at low tide are defined in the EU Interpretation Manual 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 green 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 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:

- Intertidal mudflats
- Seagrass beds
- Sheltered muddy gravels
- Tide swept channels
- *Haliclystus auricula* (an old record)
- *Lucernariopsis campanulata*
- *Anguilla anguilla*
- *Clupea harengus*
- *Dipturus batis*
- *Pleuronectes platessa*
- *Raja clavata*
- *Raja montagui*
- *Solea solea*

4.6.1 Range

Intertidal mudflats and sandflats are widespread in the site, occurring from lowest to highest astronomical tide to the highest influence of tidal waters. They are distributed throughout embayments, inlets, estuaries and on the open coast within the site (see feature map[68]). Sediment flats in open coast bays are often extensive, separated by rocky headlands, and often restricted in the upper shore by rock features at the base of cliffs. Flats in more sheltered bays, inlets and estuaries range from ‘pockets’ of sediment restricted by coastal geomorphology to extensive mudflats fringing inlets and estuaries.

The extent of open coast sandflats is constrained by cliffs, upper shore rock and, occasionally by cobble berms and / or coastal defences. Middle shore sediments are characteristically gently sloping and restricted in area; lower sediment shores within embayments are much flatter and therefore much more extensive. The extent and height of all open coast sediment shores varies considerably over time with wave generated sediment accretion and erosion. In more exposed locations the variation is significant, often within short periods of time but also inter-annually.

[68] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

Tributary estuaries and other wave-sheltered areas in the Milford Haven waterway are characterised by extensive upper, mid and low shore mudflats, supporting extensive pioneer salt-marsh and Atlantic salt-meadows. Moderately sheltered embayments in the lower Milford Haven waterway have very extensive lower shore flats with either sloping, or constrained mid-upper shores similar to open coast embayments, or grading into adjacent tributary estuary mud-flats.

Sediment flats in Milford Haven in particular are considerably constrained by the geomorphology of the waterway complex. They are accreting slowly in places but expansion is curtailed by channel structure throughout much of the waterway.

4.6.2 Structure and function

The sedimentology of the intertidal mudflats and sandflats is highly variable throughout the site depending on aspect, coastal topography, shore morphology, wave exposure and sediment budget. The open coast embayment sediment shores are characteristically comprised of well-sorted sands while the sediment flats within the Milford Haven waterway range from well sorted fine sands to fine muddy sediments. Many of the latter contain varying amounts of stony material – gravel, shingle and shell – which increases habitat diversity. The extensive lower shore flats in moderately sheltered embayments within the waterway are predominantly composed of fine, in places muddy, sands.

The morphology and topography of open coast sediment flats is seasonally and inter-annually variable within the constraints of natural upper shore structures (e.g. cliff, rock or, in Milford Haven waterway, vegetated hinterland) and lower shore sediment accretion / erosion and estuary / ria low water channels or wave action.

A variety of sediment types are present including wide gently sloping exposed sandy shores on the open coast, particularly St Brides Bay and Freshwater West; steeply sloping exposed sandy shores on the open coast and in the entrance to inlets and muddy sediment flats within small estuaries and inlets and the Milford Haven estuary complex. The shape of sediment flats within Milford Haven is more complex than on the open coast where many are crossed by sinuous freshwater drainage channels and the sediments vary considerably, from wide gently sloping mud, muddy sand or muddy gravel shores to steeper muddy mixed sediments.

The open coast sediment flats are predominantly south to west facing, occur on the lower shore and are mostly bounded by natural coastal structures. Topography is shaped by these and natural processes, particularly wave action and sediment supply. Together with the moderately sheltered sands, these open coast sediment flats characteristically comprise well-drained smooth slopes to smooth to rippled lower shore flats. Low shore sediment pools are infrequent, the pools mostly associated with local erosion in the immediate vicinity of rock. Shores crossed by freshwater discharges are characterised by dynamic drainage channels.

Muddy shores within Milford Haven waterway vary from extensive and even to topographically complex structures with vegetated patches (salt-marsh and meadow) and intricate drainage channels. They are predominantly lower shore flats in the lower reaches of the waterway complex and become increasingly whole shore or upper shore with increasing distance up stream in the main channel and tributary estuaries. All aspects are present within Milford Haven because of the complex shape of the waterway complex.

The large tidal range contributes to the extensiveness of intertidal sediment flats and the tidal streams, as well as to the channel structure within Milford Haven, shape and limit the down-shore extent of sediment flats. Some intertidal areas are subjected to raised tidal streams, particularly in Milford Haven, in narrows, and on surf beaches where beach topography generates rip currents. Detailed patterns and strength of tidal streams are largely unknown except for mid-lower Milford Haven waterway, and then not generally for intertidal areas.

The exposure of intertidal mudflats and sand-flats to wave action varies from ultra-sheltered (e.g. Cosheston Pill and Cleddau River mud-flats) to extremely exposed (e.g. west and south-west facing sands such as at Freshwater West and Newgale). A large proportion of open coast intertidal mudflat and sandflat is exposed to at least moderate to heavy wave action. The highly variable wave climate impacting open coast and moderately sheltered Milford Haven sediment shores is a major influence on the dynamics of sandflat extent and height.

Subsurface sediment water and water chemistry are primarily determined by tidal seawater influence, surface and coarse-grained sediments are potentially strongly influenced by air temperature, precipitation and wind.

The intertidal mudflats and sandflats are distributed across salinity gradients from fully saline to almost fresh-water. Muddy sediments in the upper reaches of the site's estuaries tend towards very low salinity, increasing along a gradient towards fully saline on the open coast. The sediment surface salinity is inherently variable, varying with rainfall, evaporation and tidal rise and fall. Subsurface interstitial salinity and oxygen concentrations vary inherently with sedimentology and biological processes and are buffered in a similar manner to temperature changes.

The sediment processes are highly variable between sediment shore types depending on sedimentology, exposure to water movement and sediment budget. On open coast sediment flats sediment processes are dominated by wave action. Seasonal storm and tidally generated on and off-shore movement of sediment between the intertidal and near-shore subtidal is significant though unquantified, and determined by wave exposure, aspect, granulometry and degree of consolidation. Significant short-term changes occur in open coast sediment flats as a result of strong wave action. Sediment transport processes within the Milford Haven waterway are complex and dominated by tidal streams.

The biological interactions are highly variable, complex and characteristically functionally important. They are dependent on sedimentology and type and abundance of species present. Examples include: predation (e.g. by birds and other organisms) in all sediment habitats, including hardy species inhabiting highly dynamic, high stress, coarse mobile sands; nutrient enrichment and sediment stabilisation through incorporation of plant material into sediments; nutrient enrichment of stable muddy sediments from seasonally large populations of wildfowl and waders; complex bioturbation in fine and mixed sediment flats with dense and varied populations of sediment living species.

4.6.3 Typical species

The wide range of sediment flat topography, particularly slope and associated bathymetry, is a major contribution to sediment flats biodiversity within the site. The overall species diversity is high but varies considerably between and within communities, sediment types and individual sediment flats. The exposed, coarser sand-flats typically have low diversity of species highly adapted to dynamic mobile substratum. Homogeneous mudflats also characteristically support a relatively low variety of species. Other sediment flats, depending on habitat complexity and stability are typically very rich in species, including worms, burrowing crustaceans and bivalve molluscs. Whilst macroalgae are limited to coarser sheltered sediments, *Zostera noltii*, pioneer saltmarsh and unicellular algal species are important photosynthesising components of the intertidal sediment flat habitat.

Naturally mobile sediments typically support rapidly reproducing and recruiting or extremely hardy species. The population sizes of rapidly recruiting species are inherently very variable so, for example, those characteristic of mudflats tend to be highly dynamic, frequently productive and with high biomass. Many species populations inhabiting relatively stable sediments also have high biomass but are relatively long lived and slow growing. Sediment flat populations with high biomass are a rich food source for birds and fish.

Although the biology of many species characteristic of sediment flats is reasonably well known, the dynamics of most sediment flat species populations within the site have not been studied. Time series data for several, differing sediment flat shores in the Milford Haven waterway indicate considerable spatial, seasonal and inter-annual variation in population size and distribution for many species.

Species abundance varies throughout the site, contributing to community structure, diversity and biomass. Population structure, physiological health and the reproductive capability is unknown or poorly known for most species. Many invertebrate species have planktonic juvenile stages and may be at least partly dependant on recruitment from outside the site and certainly outside the local discrete intertidal sediment flats. Biomass is highly variable between the different sediment flat habitats. Flats with high organic input typically support high species biomass, contributing significantly to the maintenance of typical predatory species such as nationally and internationally important populations of waders and wildfowl.

The range of most species characteristic of sediment flats is extensive. Species are likely to be both capable of recruiting from and contributing to recruitment in populations both within and outside the site. While there is good information on the distribution of many species within the site, particularly the most widely distributed and frequent, the spatial and temporal resolution of the data is mostly insufficient to show precise distribution or temporal variation.

4.6.4 Natural processes

Intertidal mudflats and sandflats are dynamic features. Their distribution, extent, shape, topography, aspect and orientation is the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. Hydrographic functions that structure intertidal mudflats and sandflats encompass highly dynamic hydrodynamic and other properties that vary with short and long-term natural cycles, climate influences and stochastic events.

The structure of intertidal mudflats and sandflats varies depending on the physical conditions and forces acting on them (in particular the degree of exposure to wave action and tidal currents) as well as the nature of the sediments occurring in any one location. The sediments vary from mobile coarse sand in more wave exposed areas to stable, fine sediment expanses of mudflat in estuaries and other marine inlets.

Intertidal mudflats and sandflats support a variety of different wildlife 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, its stability and the salinity of the water have a large influence on the wildlife species present.

There are implications as a consequence of sea-level rise for future extent of this habitat that unless there is the capacity for the habitats to roll back or transgress landwards, that rising sea-level is likely to reduce extent over time[69].

4.6.5 Modifications as a result of human activity

Historical land claim and coastal development has resulted in loss and modification of sheltered sediment flats within the Milford Haven ria-estuary but outside the SAC. Within the SAC extent has been reduced through intertidal land claim, shoreline development and indirectly as a consequence of navigational dredging. The total degree of modification of sediment flat sediments by human activity is unknown but is clearly substantial. Open coast flats, as well as being more robust, appear to have been impacted to a far lesser degree.

Some intertidal mud and sand-flat in the central and lower Milford Haven waterway are bounded by artificial structures, which have resulted in varying degrees of modification of slope (and sediment structure). Topography has been locally modified in the vicinity of built structures (e.g. as a result of locally accelerated tidal streams, deposition of construction materials and modified sediment processes) and historical land claim within Milford Haven waterway. Microtopography has also been locally modified in the vicinity of built structures through their influence on water movement and sediment transport.

Intertidal mud and sandflats habitat has been locally modified by the presence and persistence of artificial inert or toxic materials (e.g. building rubble, glass & ceramics, metal work, synthetic plastics and fibres, and hydrocarbons), particularly adjacent to the most industrialised and urbanised sections of the coast. Some sediment flats appear largely free from anthropogenic debris (e.g. relatively exposed sandflats). At these sites debris characteristically accumulates in particular areas, particularly high up the shore (strandline) and can be quite substantial.

Intertidal mud and sandflats are subject to local modification in the vicinity of engineered watercourses in some locations. The sediment structures of flats favoured for bait digging have been locally modified.

The gross hydrography of the site is largely natural though some localised modification in the vicinity of intertidal mud & sandflats has occurred. The degree to which human activities influence hydrodynamic processes affecting intertidal mud and sandflats is not known.

[69] See West of Wales Shoreline Management Plan (http://www.westofwalessmp.org/) and Lavernock Point to St. Ann's Head SMP (http://www.southwalescoast.org/)

Temperatures are locally and temporarily modified by physical disturbances such as bait digging and by concentrated freshwater flow. The thermal regime is also modified within the Milford Haven estuary by a power station discharge. There are likely long-term adverse consequences as a result of climate change - local seas show an increasing temperature trend[70].

Concentrations of major nutrients in the Milford Haven waterway are generally above near-shore background values and concentrations of a number of contaminants are above background values Green macroalgal abundances on sheltered flats within Milford Haven are considered to be excessive, having adverse effects on biota, and present as a consequence of the high levels of nutrient. Concentrations are locally modified by freshwater, domestic and industrial discharges. Concentrations of many contaminants are elevated above typical background levels in sediment flats in the Milford Haven waterway, particularly in sediment sink areas. Sediments in the flats of estuarine inlets contain levels of many contaminants, predominantly hydrocarbons, which exceed levels known to have adverse effects on biota. The status of the water bodies within the site including levels of nutrients and chemicals is available on Water Watch Wales[71]

Dissolved oxygen is assumed to be unmodified in high-energy environments but potentially modified in low energy areas subject to organic enrichment (e.g. estuarine inlets such as Pembroke River). Although sediment transport processes and budgets in open coast bays are generally poorly known, there is no evidence to suggest wide scale processes have been modified although there may be local, chronic and acute, modification in the vicinity of vessel moorings.

Changes in land use and surface water management have increased the likelihood of heavy rainfall creating spate events, which increase short-term flow rates, soil erosion and particulate suspension. Gross salinity gradients are unmodified but there are local, short term, regular, modifications near modified discharges from managed or engineered watercourses.

The effect of human action on biological interactions has not been quantified. However, changes to habitat structure and function and the introduction of non-native species will have resulted in changes to biological interactions. These will probably have been greatest within the Milford Haven Waterway where there has been, for example, habitat modification, introduction of non-natives, changes to nutrient and contaminant levels, fisheries and recreational activity.

Changes in structure and function alter the competitive balance between species (*e.g.* increased nutrients favouring growth of green macroalgae, bait digging at the Gann flats favouring *Alitta virens (Nereis virens)* (king ragworm) even though it is the target species. Species variety has been modified within the Milford Haven waterway by anthropogenic sediment and water inputs, physical disturbance and alteration of the habitat. The physiological health and reproductive capability of some species is inferred from toxicological knowledge as potentially modified in areas of contaminant elevation.

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[70] http://ukclimateprojections.metoffice.gov.uk/ & http://www.mccip.org.uk/uk-marine-projections/
[71] http://waterwatchwales.naturalresourceswales.gov.uk/en/ relevant waterbodies for this site include: Milford Haven Inner, Milford Haven Outer, Pembrokeshire South and Cardigan Bay South.

The degree to which the intertidal mud and sandflats' species populations may have been modified or degraded by human activity is difficult to assess because of the paucity of biological time series data and relevant information on the distribution and intensity of human activities. Conclusions can however be inferred from knowledge of environmental impacts and the affects they tend to have on biota. Exceptions include targeted studies following pollution incidents in Milford Haven waterway.

The major intertidal eelgrass beds appear to have maintained their extent and recent WFD data demonstrates bed extent is generally increasing. It should be noted that older observations have shown small beds in tributary estuaries including Sandy Haven and at Pwllcrochan Flats that were present up to the 1970s were no longer present in the late 1990s, however there is evidence of new beds becoming established in locations including Picton Point in the upper reaches of the estuary. WFD data demonstrate intertidal eelgrass within the Milford Haven waterway complex is currently achieving High ecological status. The extensive subtidal *Zostera marina* bed in shallow water between Gelliswick Bay and South Hook Point appears to have maintained its area and decreased its shoot density.

4.7 Coastal lagoons

Coastal lagoons are defined in the EU Habitats Interpretation Manual as "… expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sandbanks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange. With or without vegetation from *Ruppietea maritimae, Potametea, Zosteretea* or *Charetea*" Salt-marshes form part of this complex.

Coastal saline lagoons are an unusual and rare habitat in the UK. Despite this, they show a wide range of geographical and ecological variation and five main sub-types have been identified in the UK as meeting the definition of the Annex I habitat type, on the basis of their physiography:

1. Isolated lagoons - separated completely from the sea or estuary by a barrier of rock or sediment.
2. Percolation lagoons - normally separated from the sea by shingle banks.
3. Silled lagoons. Water in silled lagoons is retained at all states of the tide by a barrier of rock (the 'sill').
4. Sluiced lagoons – where the natural movement of water between the lagoon and the sea is modified by artificial structures, such as a culvert under a road or valved sluices.
5. Lagoonal inlets – where seawater enters the inlet on each tide and salinity is usually high, particularly at the seaward part of the inlet.

There is a species of conservation importance (Environment (Wales) Act Section 7 that occurs within this habitat. This is:

- *Alkmaria romijni*

4.7.1 Range

Three small coastal lagoons are located in the upper extremities of tributary estuaries in the upper, middle and lower Milford Haven waterway (see feature map[72]). All are naturalised impoundments formed by artificial structures.

- Gann Estuary (Pickleridge Lagoon; established as saline lagoon between 1950s and 1980s)
- Westfield Pill (Neyland Weir Pool; established as saline pool mid-1980s)
- Carew River (Carew Castle Millpond; date of establishment as saline lagoon unknown, history of flushing via sluices variable over time).

Lagoon areas, particularly in the case of Pickleridge Lagoon and Neyland Weir pool, are dynamic over tidal cycles as well as longer time scales as a result of sediment accretion and erosion). Approximate areas as measured in 1998 were 5.6ha for Pickleridge, 0.3ha for Neyland Weir Pool and 4.8ha for Carew Castle Millpond. The extents of the coastal lagoons are primarily determined by the morphology of the hinterland and the artificial impoundment structures. Pickleridge Lagoon and Carew Millpond are subject to slow sediment accretion while Neyland Weir Pool is subject to encroachment by salt-meadow, possibly accelerated by anthropogenically elevated water column suspended sediments.

4.7.2 Structure and function

The range of sediment substrates and degree of sorting is poorly known, but differs between each lagoon and will be determined by the differing shapes as well as the freshwater and saline flow regimes. Pickleridge Lagoon sediments consist of mud, gravel, shingle and poorly sorted sand mosaic. There is well sorted medium sand in the vicinity of inflow channel. Neyland Weir Pool sediments are muddy gravel (*c* 20% mud with *c* 65% “flaked” gravel - possibly former railway line ballast) and terrestrial plant debris. Carew Castle Millpond is mostly muddy/sandy gravel (*c* 35% gravel, 45% sand, 20% silt/clay) with boulders at least around the periphery.

The gross shapes of the coastal lagoons are wholly or partially artificial, as a result of either impoundment of tributary estuaries or creation of artificial basin and channel structures. For Pickleridge Lagoon in particular this has changed greatly since its creation as a combination of natural processes and human modifications of the connecting channel to the Gann Estuary. The morphology of hinterland, estuary channels, banks other structural forms constrains the morphology of the lagoons.

Pickleridge Lagoon has an irregular shape and an approximate orientation SW – NE. There is a boulder/cobble/shingle embankment facing SE across Gann Flats toward Milford Haven waterway. It has a ‘potholed’, irregular bed, and is steeply sloping adjacent to embankment. The south west end is mostly open water and the north eastern end has some drying sandy islets. The lagoon is apparently undergoing slow successional change. Neyland Weir Pool is an irregular shape shallow pool with a boulder/part concrete topped embankment facing south into Westfield Pill. The lagoon is apparently undergoing successional change. Carew Castle Millpond is an area of estuary dammed by a sluiced stone weir. The lagoon bed is generally flat with a sinuous central drainage channel.

[72] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

All three coastal lagoons are shallow (depth below sill level) and their depths are decreasing, apparently slowly, because of sediment deposition. Maintenance of the impoundment structures contributes to maintenance of the lagoons' bathymetry. Pickleridge Lagoon is mostly *c* 0.1–0.3 m, max 1.5 m; bathymetry dynamic depending on integrity of outlet channel. The depth of Neyland Weir Pool varies between 0 – *c* 0.4 m, apparently reducing rapidly because of sediment accumulation while Carew Castle Millpond is less than 1 m deep.

Tidal ranges within the lagoons are determined by sill heights and are considerably less than those in the Milford Haven waterway. These ranges have not been measured but in each lagoon are estimated to be one meter or less. The strength and patterns of tidal streams within the lagoons are the product of impoundment and channel structures and morphology of the lagoon. A longer ebb tide is a distinctive characteristic of the Pickleridge and Carew lagoons.

The water circulation, exchange and flushing time are determined by sill height and lagoon morphology, varying considerably with tidal height and freshwater flow. The sill structure of Pickleridge Lagoon has been modified historically by wave action. The salinity is variable and inflow and outflow occurs through the channel on most high tides although there may also be some percolation of saline water through embankment. Neyland Weir Pool has a reported sill height of 6.9 m but this may be incorrect. Salinity is variable and saline intrusion occurs during spring high tides. Water circulation and flushing is extremely low in Carew Castle Millpond with saline intrusion limited to high spring tides therefore the water salinity is extremely low.

Neyland Weir Pool and Carew Castle Millpond are extremely sheltered from wave action while the embankment and outfall channel of Pickleridge is exposed to local wave generated wave action from E to SE. Water temperatures have not been recorded but inferred to be more variable than either adjacent sea or freshwater temperature. They are likely to reflect adjacent sea temperatures during tidal inundation whilst low water neap tide temperatures are likely to be higher and lower in hot and cold weather respectively because of shallow bathymetry, low water volume and influence of air temperature.

Suspended particulate concentrations and water transparency is determined by a continuously variable combination of freshwater inflow and marine inputs but is unrecorded. Dissolved oxygen concentrations in the sediments and water column are unknown as are sediment nutrient concentrations, water column and sediment contaminant levels. These are likely to be determined by a combination of freshwater inflow and marine inputs. Concentrations of major nutrients (phosphates and nitrates) in Milford Haven waterway indicate hypertrophication and there are regular summer blue-green algal blooms indicative of eutrophication in freshwater input to Neyland Weir Pool.

Sediment movement and distribution is mostly unknown and thought to be mainly determined by saline tidal flow regimes and strongly influenced by height, breadth and structure of seawater flow channel and strongly influenced by height, breadth and structure of seawater flow channel. Historical aerial images of Pickleridge Lagoon indicate considerable temporal variation in sediment transport processes with a complex known history of sediment accretion and erosion. Sediment processes are most active at NE end, particularly in vicinity of outflow channel. Neyland Weir Pool is an apparently active sediment sink and in Carew Castle Millpond there is a slow accumulation of fluvial sediments.

The presence and abundance of a variety of waders, wildfowl and sea-birds at Pickleridge and Neyland lagoons are inferred as likely major ecological influences but biological interactions are largely unknown.

4.7.3 Typical species

A limited number of typically estuarine, brackish water or lagoonal species are present in the coastal lagoons[73]. Pickleridge Lagoon has a typically estuarine/marine sandy substratum fauna at SW end and sparse fauna at NE end. The lagoon cockle, *Cerastoderma glaucum* is present and there is fringing salt-marsh. Neyland Weir Pool has a sparse fauna. This includes the tentacled lagoon worm, *Alkmaria romijni* and the amphipod, *Gammarus chevreuxi*. There are fragments of salt-marsh around the pool and on retaining weir. Carew Castle Millpond has a low diversity, sparse estuarine community with patchily dense oligochaete worms. The tentacled lagoon worm, *Alkmaria romijni* is present.

All species population sizes are inferred to be strongly influenced by or dependent on the extent, morphology and functional processes of the lagoons as moderated by the artificial impoundment structures. Recruitment and biological interactions structuring lagoon species populations and population recruitment reservoirs are unknown.

Pickleridge lagoon: has possibly the largest lagoon cockle population in Wales with the population is inferred (from history of lagoon development) to have established during 1980s. The population structure is indicative of irregular recruitment or survival. The tentacled lagoon worm population in Neyland Weir pool is apparently very small and that of *Gammarus chevreuxi* “sparse”. In Carew Castle Millpond the tentacled lagoon worm population is in low numbers.

Biomass, physiological health and reproductive capability are unknown or poorly known for most species and the relative degree of endemic recruitment is unknown. The isolation of the lagoons from similar habitats is inferred to present a barrier to recruitment of lagoonal specialist species however the establishment of an apparently viable lagoon cockle population in Pickleridge Lagoon within a relatively short period following development of the lagoon habitat suggests opportunistic recruitment of some lagoonal specialist species.

The range of lagoonal specialist species is severely limited by habitat availability and recruitment. The ranges of the species present in the site’s coastal lagoons are enabled, rather than engendered, by the artificially impounded water bodies. The ranges are within constraints of each species’ adaptation to physical factors and biological interaction, and are temporally and spatially variable. Habitat isolation and strong physico-chemical gradients are major impediments to species access.

4.7.4 Natural processes

Lagoons are in a continuous state of development, being gradually filled as sediment settles out into the basin. The result is a range of conditions with some lagoons of ‘open water’ and others which are ‘marshy’ eventually becoming land. There is also the

[73] Bamber *et al*. (2000) *ibid*

possibility that the whole lagoon may be inundated and destroyed after a major breach of the barrier which separates it from the sea. These stages of development and the different physical and chemical characteristics cause them to be very varied habitats.

All three, but particularly the Pickleridge and Neyland lagoons, are actively undergoing successional change. All are integral parts of the waterway, and are inextricably dependent on the waterway's functional processes.

4.7.5 Modifications as a result of human activity

The gross shapes of the coastal lagoons are wholly or partially artificial, as a result of either impoundment of tributary estuaries or creation of artificial basin and channel structures. Pickleridge Lagoon has changed shape greatly since its creation, as a result of natural processes and subsequent human modifications of the connection channel to the Gann Estuary. Discarded debris and artificial and moved natural (stone) materials are present in each lagoon.

Agricultural run-off and management of freshwater flows are inferred as having had an influence. For example suspended particulate concentrations and water transparency are potentially modified by agricultural run-off and Neyland Weir Pool is likely to have been modified by marina dredging operations.

The degree to which the coastal lagoons' species populations have been created and / or modified by human activity is unknown, though clearly the artificial creation of the habitats provided the initial opportunity for colonisation.

Pickleridge Lagoon has high nutrient content, evidenced by algal blooms. Carew millpond is silting up and has a leaking sluice gate and wall (2016).

4.8 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 sea caves in Welsh SACs are considered to be of significant conservation value.

There have been few specifically directed surveys of sea caves within the site. Additional information is available for some sea caves (particularly within Skomer MCZ) from the wide range of marine habitat surveys undertaken within the site, of the distribution and size of sea caves used by seals from seal breeding censuses, and of the distribution of sea caves in the Castlemartin limestone coast from a survey of bat hibernation sites.

4.8.1 Range

Sea caves are distributed widely throughout much of the SAC with most of the known examples at the land/sea interface or rock/sediment interface where marine erosion processes are most intense. The largest known concentrations of intertidal sea caves are on St. David's peninsula, Ramsey Island, Skomer Island and the Castlemartin coast. There are also probably many small, inconspicuous or inaccessible intertidal caves that are undetected. Individual sea caves range in size from little more than deep enclosed overhangs to larger structures like some on Ramsey Island that are more than 50m long and the high and wide caves in limestone along the Castlemartin coast.

The distribution and extent of subtidal sea caves is less well known as most have been discovered opportunistically. These tend to be from just below the surface down to around 20m. As sea levels were up to 40m below present levels during previous glacial periods many more are likely to have been formed, including in deeper water. The total area of both intertidal and subtidal sea caves is small relative to the size of the SAC.

Sea caves are predominantly a feature of exposed coasts therefore their presence within the shelter of Milford Haven is particularly unusual.

4.8.2 Structure and Function

The predominantly rocky coastline of the SAC is geologically complex, both in the range of rock types and the complexity of faulting and folding and is highly predisposed to sea cave formation. Structural integrity is mainly determined by hydrodynamic and geomorphological processes such as erosion, rock falls.

Sea caves in the SAC can be broadly grouped on the basis of their underlying geology with those on Skomer and Ramsey in rocks of volcanic origin, the south Pembrokeshire coast caves in limestone and those on Ramsey, north and south St. Brides Bay, St. David's and Marloes Peninsulas in areas of faulted sedimentary rock and complex geology. Habitat variety is increased by the presence of limestone, slates and shales that support rock boring and crevice dwelling species.

The floors of many sea caves are areas of sediment or mixtures of sediment and pebbles, cobbles and boulders, with sheltered locations in caves tending to accumulate silt. The sediments contribute to the habitat and species diversity and composition and have a strong influence on the amount of scouring of cave walls. Caves within the site have a wide range of shape, size, orientation and aspect, resulting in an equally wide range of hydrographic conditions and habitat variation.

Sea cave morphology and topography is varied and determined by the underlying geology. There are long and narrow caves and tunnels; tall and narrow fissure-like caves; deep, broad overhangs; massive high, wide and occasionally long caves; complex, multiple-armed / chambered / floored sea caves with two or more entrances; straight and sinuous caves and tunnels; and small, shallow caves that are little more than large depressions in rock surfaces.

The microtopography is a further important dimension to habitat variation. Cave surfaces range from smooth, unbroken rock walls to fractured, fissured and perforated. A few cave ceilings are comprised of massive boulder chokes and cave floors range from rock through cobble / boulder to sand. Individual sea caves range in size from little more than deep enclosed overhands to larger structures like some on Ramsey Island that are more than 50m long , and the high and wide caves in limestone along the Castlemartin coast. Their position on the shore means that some dry entirely at low water.

The depths and heights of known subtidal sea caves are not as great with the greatest being Paynes Rock, Skomer which has an estimated depth of 4.5 m.

Sea caves of every orientation and aspect are present in the site providing differing degrees of shelter to water movement and exposure to light, orientation and aspect which are important influences on sea cave ecology. The hydrography of the water column within and in the vicinity of sea caves is complex and highly variable spatially and temporally.

Tidal streams in the vicinity of sea caves vary from nil to extremely strong (>5 m sec^{-1}; *e.g.* Jack Sound, Ramsey Sound). The inside of the majority of sea caves themselves are inherently current sheltered, though many tunnel-caves, particularly those in headlands and islands, are exposed to, and accelerate moderate to strong tidal streams.

Exposure of sea caves to wave action varies extremely widely within the site and over time. Most partially submerged sea caves are subject to at least moderate wave action; many are regularly subject to extreme wave action, others are sheltered from all but the most severe wave action. Submerged sea caves are particularly exposed to strong wave surge. Tidal streams in the vicinity of sea caves vary from nil to extremely strong (>5 m sec^{-1}; *e.g.* Jack Sound, Ramsey Sound). The inside of the majority of sea caves themselves are inherently current sheltered, though many tunnel-caves, particularly those in headlands and islands, are exposed to and accelerate moderate to strong tidal streams.

Ambient light levels within sea caves differ considerably between sea caves within the site. Many caves with large entrances and a generally southern aspect receive some natural light in their deepest recesses, though in some cases insufficient to support plant growth. Others, like the submerged caves and long, north facing caves on Ramsey Island, with different aspects, that are narrow, have small entrances and are deep receive no natural light.

Suspended particulate concentrations are generally significantly higher in sea caves subject to water movement with sediment floors or with a nearby sediment source, than levels in the adjacent external water column. They are also geographically and seasonally highly variable.

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. The species populations in different sea caves reflect the differing balance between these effects.

Particulate concentrations are generally significantly higher in sea caves subject to water movement with sediment floors or with a nearby sediment source than levels in the adjacent external water column but also geographically and seasonally highly variable.

The water and sediment chemistry is mostly likely to reflect that of the adjacent water column but modified by any groundwater seeps particularly in intertidal sea caves.

The mobilisation and deposition of sediment as a result of water movement is regular and widespread and many sea caves with sediment floors are subject to rapid and considerable fluctuations in floor height and sedimentology as a result of sediment mobilisation or deposition caused by constantly varying water movement. Intertidal sea caves (in particular) in the vicinity of sediments are subject to varying degrees of scouring from sediment movement, particularly low on cave walls.

Many sea cave habitats provide highly favourable environmental conditions for key ecological structuring species (*e.g.* grazing molluscs, scavenging crustaceans). The possible presence of species atypical of areas immediately external to caves provides further opportunity for development of additional species interactions.

4.8.3 Typical species

The wide range of rock type, cave morphology, topography, depth and exposures to water movement, scour and light contribute to the high species diversity in sea caves within the site. Sea caves also typically support species that seem out of place, because caves provide environmental conditions which differ from those immediately outside, for example sponges typical of deep-water in intertidal caves and mud dwelling anemones in sediments on the floor of caves in exposed rocky areas. The number of marine algal and invertebrate species associated with sea-caves can be high, but highly variable between and within sea-caves

Species populations in sea caves include those tolerant of scour, of extreme wave surge and cryptic, apparent cave specialist species, including the rare snail *Palludinella littorina*. The range of caves in different rock types increases variety of species; caves in limestone have high species variety in part because of the complex microtopography of the rock surface and the species that can bore into the rock. Sea caves with beaches undisturbed by human activity are used by grey seals for breeding and resting sites and particularly tall sea caves with dry ceilings are used as bat hibernation sites.

Very little population data exists for non-mammalian species in sea caves and population structure is also poorly known or unknown for most species (information is available for seals and bats and some limited data are held for a few rare or scarce species in caves in the Skomer MCZ and South Pembrokeshire).

Most species living in sea caves are part of wider populations in nearby suitable habitats. Their distribution is mostly a determined by recruitment from populations with widespread distributions both within and outside caves. A few cave specialists have a restricted distribution and are only known from a few locations but it is unclear whether this is a function of survey effort or a truly limited distribution. Species with genuinely restricted distribution are more vulnerable than those that may recruit from large, widespread populations.

4.8.4 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, 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.

4.8.5 Modifications as a result of human activity

Changes to the distribution of sea caves is by human action is poorly known, although there are examples of intentional and consequential, partial or complete blockage of entrances, and infill of small caves near foreshore development (*e.g.* former jetty works on offshore islands). Natural structural changes to sea caves occasionally occur as a consequence of rock falls.

There is no known evidence to suggest that the viability of species populations in sea caves has been modified by human action or that such action has created major impediments to the physiological health, reproductive capability or recruitment of any cave dwelling species. Invertebrate species with planktonic juvenile stages are likely to be at least partly dependant on recruitment from outside the site. The mobility of invertebrate and algal species reproductive products and young are inferred, from the little or no modification or impedance of water movement into and within sea caves, to be unimpeded by human activity.

There is no known evidence of human activity having restricted physical access by grey seals to sea caves, other than temporary inhibition caused by human presence or any modifications to their structural integrity although there are examples of collapse or infill adjacent to development (*e.g.* jetty works on offshore islands).

The influence of human activity on sea-caves sedimentology is unknown. Discarded and accidentally misplaced artificial materials are present in some caves. Hydrodynamic conditions tend to retain such materials as lost and discarded synthetic fishing gear and other durable rubbish in sea caves, particularly those caves with complex shapes and / or boulder/cobble floors. Lost and discarded fishing gear and persistent rubbish form a physical hazard to many species, particularly grey seals and other vertebrate species, and some are a source of chemical contamination. The variation in cave structure and hydrodynamics tends to both retain and flush out chemical contamination, including hydrocarbons, depending on exposure to water and air movements.

The gross physical hydrography within, and in the vicinity of sea caves is considered little modified as a result of human activity and any localised effects are small. Suspended particulate concentrations may be modified by localised or distant human activity including, for example, dredge spoil disposal, coast protection or construction operations. There is no known evidence for modification of sea cave air temperatures a result of human activity however, it is possible that regular use of sea caves for recreational or eco-tourism purposes may increase air exchange.

Species populations in sea caves are exposed to nutrients and contaminants in groundwater seeps which are strongly influenced by agricultural or other management practices on overlying land. The magnitude and persistence of elevated hydrocarbons and exhaust gases in sea caves used by powered craft, and the potential consequences of such contaminants are unknown. Sediment transport in the vicinity of sea caves may be modified by many activities but such effects are unknown.

The status of biological interactions structuring the ecology of cave communities is poorly known although ecosystem functioning, determined by grazing molluscs, has been subject to temporary acute modification by pollution incidents.

4.9 Sandbanks which are slightly covered by seawater 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;
- 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 Pembrokeshire Marine SAC are of sub-types gravelly and clean sands, and muddy sands.

There have been several surveys of the subtidal sandbanks within the site. Additional relevant data and information is available from a series of sediment infauna surveys in the Skomer MCZ, other general surveys of sediment habitats and studies associated with identification of dredge spoil disposal grounds.

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:

- Mud habitats in deep water
- Subtidal mixed muddy sediments (low confidence)
- *Arctica islandica*
- *Pleuronectes platessa*
- *Solea solea*

4.9.1 Range

Subtidal sandbanks are distributed throughout the site, typically associated with headlands, islands, islets or sublittoral reefs which modify tidal streams to favour sandbank establishment and maintenance, but include the southern part of a major offshore linear sandbank (see feature map[74]). The depth ranges in which the banks are distributed vary significantly, resulting in diversity of bank structure, function and associated species.

The major known subtidal sandbanks include: Bais Bank, Turbot Bank, sandbanks in the vicinity of Skokholm (The Knoll). There are also sandbanks associated with St Govan’s Shoals reefs, and in south-west St Brides Bay. The gross distribution of the main subtidal sandbanks themselves appears quite stable and stability is likely to increase with depth.

4.9.2 Structure and Function

The distribution, extent and shape of subtidal sandbanks are determined by complex interactions between hydrodynamic processes (tidal streams and wave action), sediment supply and transport processes, and seabed and coastal morphology.

Their sedimentology varies according to local seabed topography, bathymetry, hydrodynamics and sediment processes is largely unknown. Typically well-sorted medium sand occurs on uppermost parts of sandbank, becoming coarser down the flanks and poorly sorted with increased silt and coarse sediments around the base. Micro-distribution of sediments within each bank appears highly dynamic due to the strong tidal streams and high wave exposure. Bais Bank is mostly uniform medium sand and Turbot Bank fine to medium sand. South St.Brides Bay is medium-coarse sand to gravely sand.

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[74] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

Subtidal sandbanks within the site are broadly distinguished into those that are distinct (from surrounding sediments) structures (Bais Bank is most distinct example), and those which are extensions of near-shore sediments (*e.g.* sandbanks in St Brides Bay). They are largely elongate or ovoid and lie along the axis of tidal streams, and are strongly influenced by land-masses (headlands and islands). The Knoll and Turbot Bank are relatively broad.

All the subtidal sandbanks in the site lie in relatively deep-water (between 20–40 metres) and rise up to 40m metres above the surrounding seabed. The aspects of the subtidal sandbanks vary within the site. For example Bais Bank is orientated north-east – south-west, parallel to prevailing long period wave action; The Knoll and Turbot Bank lie approximately north-west – south-east, roughly perpendicular to long period wave action.

Dune, wave and ripple microtopography of sandbanks provide important sandbank micro-niches that contribute to habitat, community and species diversity are likely to be present as significant features on all of the subtidal sandbanks. Tidal streams are strong to very strong, though variable, in the vicinity of all sandbanks in the site, for example around 1-1.5 m/sec across Bais Bank and Turbot Bank) to 2-2.5 m/sec on other sandbanks during spring tides.

All subtidal sandbanks within the site are exposed or extremely exposed to wave action and exposure is also highly variable across individual sandbanks. Most of the sandbanks are orientated roughly perpendicular to the prevailing wave direction and have an exposed southern or western flank and a more sheltered northern or eastern flank although Bais Bank lies roughly parallel to prevailing wave action. Associated islands or headlands provide a degree of shelter to at least a part of most of the sandbanks.

The nutrient concentrations within sediment structures are likely to be at or close to that of the surrounding water column. Both calcium carbonate and organic carbon content vary considerably within and between the three surveyed sandbanks with organic carbon is lowest in Bais Bank sands.

Sediment transport processes have a major effect on topography and microtopography at all depths. However, sediment movement and circulation on short (*e.g.* tidal) and long-term time scales and sediment budgets are unknown.

Modification of tidal streams by landmasses and reef blocks has a considerable influence on sediment processes and sandbank morphology. Fate of dredge spoil studies indicate a net south to north transport of fine and very fine sediment through the area of the site and the apparently temporary inclusion in some sandbank structures and potentially longer deposition in others (St Brides Bay). Biological interactions are thought to be dominated by predation by fish and, in less current and wave exposed locations, by molluscs, echinoderms and crustaceans.

4.9.3 Typical species

The depth and exposed and mobile nature of the sites' open coast subtidal sandbanks tends to minimise the presence of photosynthesising organisms. Suspended fine particulates also affect faunal feeding and respiration and coarse sediments cause abrasion. Most sediment processes involve movement of bed load, local high strength tidal streams result in the suspension and transport of a wide size range of sediment grains.

Species richness is higher in deeper, more heterogeneous sediments toward the lowest extremities of the banks and where there is less exposure to waves and currents. It is lowest in the dynamic well-sorted sands on the upper parts of the banks. Species colonising sandbanks provide a rich food source for birds and fish. Infauna of surveyed banks is dominated by polychaete worms, crustaceans and molluscs.

The limited time series data for the south St Brides Bay bank and Turbot Bank indicate species richness is spatially and temporally highly variable, in part determined by variation in sedimentology. Samples from the shallowest areas of Turbot Bank indicate a, possibly seasonally, related variation in numbers of taxa of an order of magnitude. Epifaunal species richness is generally lower in distinct (from surrounding sediments) sandbanks and generally higher in sandbanks forming extensions of near-shore sediments.

The only information on species population dynamics for sandbanks within the site is for Bais Bank in southern St Brides Bay. Species abundances are very low on Bais Bank, and strongly influenced by ephemeral species populations at other locations. It is therefore inferred that species populations of all sandbanks are likely to be dynamic and a reflection of recent hydrographic conditions and species recruitments.

The infaunal species population sizes are unknown but assumed to be typical of habitat for many species. Population structure, physiological health and biomass is unknown or poorly known for most species. Many invertebrate species have planktonic juvenile stages and may be at least partly dependant on recruitment from outside the site and certainly from beyond each individual sandbank. Biomass is likely to be highly variable between the different sandbank habitats and species.

The species typical of the sandbanks have a wide range both within and outside the site especially as there is a large extent of suitable habitat near-shore and deep sandy-gravel sediment habitats within the site, and large tidal sand ridges in the Celtic Sea. The spatial and temporal resolution of the data is mostly insufficient to show precise distribution or temporal variation in distribution.

4.9.4 Natural processes

Subtidal sandbanks are dynamic features with their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics 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 but their location may change.

4.9.5 Modifications as a result of human activity

There is no known evidence that the gross distribution or extent of subtidal sandbanks within the site has been directly modified by human action. Any effects of climate change on subtidal sandbanks location, size or morphology are unknown.

There is no information to suggest modification of subtidal sandbanks sedimentology by human action.

The subtidal sandbanks in the immediate vicinity of Milford Haven (Turbot Bank) and Skokholm and Skomer Islands and St Brides Bay are inferred to have been historically influenced by disposal of dredge spoil at the former dump site immediately south of the Milford Haven entrance but not by sediment extraction within the site. Sediment tracer studies suggest that a proportion of the spoil dumped at the former disposal site is likely to have deposited in the vicinity of Skokholm and Skomer Islands and southern St Brides Bay. There is no known evidence of gross modification of subtidal sandbanks geomorphology as a result of human activity.

Tidal streams in vicinity of subtidal sandbanks are not known to be modified by human activity. Exposure of sandbanks to wave action is not currently considered significantly modified by human activity, though modification of wave action as a result of anthropogenically influences climate change is considered likely to increase.

Turbidity is likely to have increased as a consequence of increased nutrient enrichment of coastal waters (and consequential phytoplankton growth) and increased suspended sediments in coastal waters due to changes in land use. Sediment transport is inferred, from the absence of local modification of hydrodynamic processes, not to be locally modified as a result of human activity. Any effects from sediment disposal and long-term effects of land use change are unknown.

Long-term exploitation of fish populations is inferred to have depleted abundance and biomass and affected biological interactions of sandbanks populations. The mobility of species larvae and juveniles are inferred, from the absence of modification or impedance of water movement, to be unimpeded. Non-commercial fish (as well as commercial) species are influenced and, potentially locally impeded by, commercial fishing gear.

4.10 Allis Shad (*Alosa alosa*) and Twaite shad (*Alosa fallax*)

Shad are herring-like fish that spend most of their adult lives in the sea but spawn in rivers (or, occasionally, in the upper reaches of estuaries) in early summer. Breeding populations occur in several British rivers, the most important populations being in the Tywi, Usk, Wye and Severn. They migrate through estuaries in March-May on their way to the spawning grounds, with a water temperature of 10-12ºC acting as a trigger for migration. Most adults die after spawning but a proportion of UK fish are known to repeat spawn: these presumably migrate back to sea immediately after spawning in June-July.

Juveniles generally migrate estuaries between August and October, where they spend some time feeding. Further seaward migration is triggered by falling temperatures in winter, but it is possible that at least a proportion of the juvenile fish overwinter in the estuary. In their first spring, juveniles make an onshore migration to the estuary and inshore waters[75]. Older fish are typically found in shoals in deeper water and are capable of migrating in excess of 1000km. The principal feeding grounds of Welsh shad are unknown but relatively frequent catches of subadult shad by fishermen off the Devon and Cornwall coasts in both the Bristol and English Channels[76] suggests that these may be important.

[75] Aprahamian *et al*. (2002)
[76] Hillman (2002)

The two British species are closely related and produce fertile hybrids. Adult allis shad feed predominantly on marine crustaceans such as mysids, whereas adult twaite shad predominantly take small fish such as sprats. Juveniles of both species feed on zooplankton when small and larger crustaceans such as mysids as they grow.

At all stages of their life cycle, shad are pelagic fish, and in estuaries the juveniles predominantly occur in the surface layers of the water column. Adults have been recorded at depths of up to 150m, though twaite shad also favour shallower waters <50m deep[77].

4.10.1 Population dynamics

There are a few *ad-hoc* records of shad from the SAC which is used as an access corridor between the sea and riverine breeding habitat. They use the site as an access corridor between the open sea and riverine breeding habitat. The numbers of individuals within the site at any time, and their distributions and proportions of wider populations, are likely to be dynamic and highly seasonal but are unknown. The age, sex and physiological health of shad using the site are also unknown.

4.10.2 Range

There are little data available on the areas used and therefore the range of shad within the site.

4.10.3 Habitat and species

The marine habitat requirements of shad in the Pembrokeshire Marine SAC have not been studied, but data from elsewhere indicate that important habitats include the salt wedge at the head of the tide[78] and warm shallow inshore waters and estuaries[79], both of which are extensive within the SAC. Adult twaite shad are likely to feed mainly off-shore.

Suitable habitats must include abundant, suitable prey and adequate water quality. The water column throughout the site is assumed to be suitable habitat and the water quality to be of sufficiently high quality in open coastal water. The importance of the site for feeding, the feeding requirements, the status of preferred prey species within the site, and any potential contamination load of prey species is unknown.

4.10.4 Modifications as a result of human activity

There are no known physical impediments to access within or transit though the site, though there are at the boundary between the marine site and the adjacent rivers (weirs and fish passes). A few shad have been observed traversing the fish pass at Haverfordwest Weir. There are very occasional records of individuals caught by anglers.

There is no known evidence that shad habitat structure is inadequate. There are no known or likely physical obstructions to passage and although there are entrainment hazards (*e.g.* seawater intakes) within the site there is no known evidence of incidental capture. The presence and persistence of artificial inert materials (*e.g.* synthetic fibres) may create an entanglement risk.

[77] Taverny & Elie (2001)
[78] Maitland & Hatton-Ellis (2003)
[79] Aprahamian *et al*. (2002)

4.11 River lamprey (*Lampetra fluviatilis*) and Sea lamprey (*Petromyzon marinus*)

Lampreys are primitive vertebrates that have a distinctive suckered mouth, rather than jaws. The river lamprey *Lampetra fluviatilis* is found only in Western Europe, where it has a wide distribution. The sea lamprey *Petromyzon marinus* occurs over much of the Atlantic coastal area of western and northern Europe and eastern North America where it is found in estuaries and easily accessible rivers.

Both species are widespread in the UK. Eggs are laid by the adults in clean river gravels. The larvae (ammocoetes) spend several years buried in sandy sediment in rivers feeding on organic matter before metamorphosing after 3-4 years. Juveniles migrate to estuaries and inshore waters where they feed parasitically on various fish species. Once fully grown, they migrate upstream to spawn. After spawning, the adults die.

During their marine phase, river lampreys are predominantly an estuarine and inshore species feeding on small fish such as herrings and sprats. Sea lampreys are much larger and more oceanic, feeding initially on similar species to river lampreys before switching to larger prey, including sharks and cetaceans[80]. Juvenile sea lampreys have been suggested to prefer migratory species (including shad) as prey in freshwater and estuarine environments, perhaps due to their larger size[81]. At sea they appear not to be very selective and have been recorded feeding on at least 54 different species. Sea lampreys have been recorded 400km or more from the nearest land[82] and at depths of up to 1000m.

4.11.1 Population dynamics

River and sea lampreys are difficult to sample in the marine environment. Inferences about the status of the river lamprey population in the Pembrokeshire Marine SAC are based on condition monitoring of the Afonydd Cleddau SAC, which assesses the extent and density of juvenile lampreys, augmented by other data if available.

Lampreys do not home to their natal river[83], so lampreys using Pembrokeshire Marine SAC should be viewed as a protected component of a larger population covering the Bristol Channel and possibly a wider area. In particular, the river and sea lamprey populations of the River Wye, River Usk, Afon Tywi, Afon Teifi, Severn Estuary, Afonydd Cleddau and Carmarthen Bay & Estuaries should be seen as linked to Pembrokeshire Marine.

4.11.2 Range

Adult river lampreys migrate through the SAC to reach the Afonydd Cleddau on their spawning migration, entering freshwater between October and December[84]. Juvenile river lampreys generally migrate downstream into estuaries and inshore waters in spring, though autumn migrations have also been recorded. Since river lampreys feed and grow in estuaries and inshore waters, it should be assumed that juveniles are present in the SAC throughout the year.

Adult sea lampreys migrate through the site between March and June to reach the Afonydd Cleddau. Lampreys from the Rivers Usk, Wye and Teifi are also quite likely to use

[80] Silva *et al*. (2014)
[81] Silva et al. (2013)
[82] Kelly & King (2001)
[83] Bergstedt & Seelye (1995)
[84] Maitland (2003)

the inshore waters of the SAC. Mature adults enter the estuaries from April onwards and migrate some distance upstream. Peak migration usually coincides with temperatures that remain above 10ºC and continues until temperatures reach 18ºC. Juvenile sea lampreys migrate downstream between December and June[85] and spend some time feeding in the estuary and inshore waters before moving off shore in search of larger prey. Accordingly, various stages of sea lamprey should be assumed to be present all year round.

4.11. 3 Habitats and species

River lampreys feed on a variety of estuarine and coastal fish, but particularly herring, sprat and flounder. The adults feed on much the same species in both estuaries and coastal waters. Sprats are abundant during the winter in Pembrokeshire Marine SAC and flounders are also common and therefore these are likely to be a primary food source.

Sea lamprey feed on a wide range of fish, shark and cetacean species. Prey selection is thought to be size rather than taxon-specific and is positively correlated with lamprey size. They are not thought to be restricted to any specific habitat and are likely to follow prey: however a preference for demersal species and sheltered locations has been suggested[86].

4.11.4 Modifications as a result of human activity

Very little is known about impacts of human activity on these species in this site. For example there is no known information on historical or contemporary by-catch within the site. There is also no known evidence that shad and lamprey habitat structure is inadequate. Water column contaminants are a threat to physiological health, but water quality is assumed to be sufficiently high in open coastal waters. Water quality obstacles within Milford Haven waterway are unknown.

There are no known physical impediments to access within or transit though the site, though there are at the boundary between the marine site and the adjacent rivers (weirs and fish passes). The level of modification along the Milford Haven ria may have affected habitat quality and extent for river lamprey and juvenile sea lampreys. There are entrainment hazards[87] (*e.g.* seawater intakes) and the presence and persistence of artificial inert materials (*e.g.* plastics and synthetic fibres) may create an entanglement risk within the site. There is no known evidence of incidental capture. The absence of known by-catch records suggests low risk from fisheries.

4.12 Otter (*Lutra lutra*)

The (Eurasian) otter *Lutra lutra* is a semi-aquatic mammal which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas. Populations in coastal areas use shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing freshwaters. These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated riverbanks, islands, reed beds and woodland, which are used for foraging, breeding and resting.

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[85] Silva *et al*. (2013) summarised the data and found that it varies with increasing latitude: the Irish chronology has been used as being most likely to be similar to the Tywi.

[86] Silva *et al*. 2014

[87] Approximately 100 sea lamprey were entrained annually in 2013 and 2014.

At present, the majority of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. Other strong populations survive in Wales and Ireland. Recent surveys suggest that the otter population is recovering well and recolonising parts of its former range. While the SAC series makes a contribution to securing favourable conservation status for this Annex II species, wider countryside measures, in particular implementation of the UK's Biodiversity Action Plan[88], are important to its conservation in the UK.

4.12.1 Population dynamics

The otter population in Wales is increasing and there has been an increase in locations used by otters. Otters present within the site are part of a wider population living around freshwater habitats in Pembrokeshire, which itself is not completely isolated but extends further afield and between which there are movements and exchanges. The proportion of the otter population within the site at any time and its distribution is likely to be dynamic and it is not known whether the numbers of animals that use the site are a fixed or variable proportion of the wider population with a preference for using marine habitat.

Females with cubs have been recorded very occasionally on the foreshore in, and in the vicinity of, the site but breeding activity is not known within the site and specific information on the use of the site by juveniles is unavailable.

The age frequency and sex ratio of otters using the site is not known, nor is it known whether the age or sex of animals using the site are representative of the wider population, or are dominated by animals of a specific age range or sex.

Many aspects of the population dynamics of otters using the SAC are unknown. These include their physiological health, reproductive capability, exposure and immunity to endemic and anthropogenic disease and contaminant burden. A range of viral, bacterial and parasitic diseases are known to otter populations but these apparently have limited effect on healthy, unstressed, adult otters. The dispersed nature of the population may limit disease transmission and the influence of disease as a density dependent population control mechanism.

4.12.2 Range

Otters are widespread on, and close to, the coastline throughout the site, both on the open coast and within the Milford Haven waterway, particularly within the Daugleddau and Cleddau Rivers. Spraint records and analysis and distribution of suitable feeding locations indicate a wide feeding range. Distribution is mostly associated with foreshore access via small river and stream valleys with sufficient scrub or tree cover, suitable feeding locations (rock-pools, sheltered boulder shores, with freshwater pools/streams for washing off salt) and ease of access to and along the shore. Sightings records suggest that otters use both the sea and foreshore to move between freshwater watercourses.

4.12.3 Habitat and species

Otters appear to use most foreshore habitats in the site, other than the steepest rock, and especially moderately sheltered waters close to the shore. There is evidence that the site contributes to supporting the otter population, as a foraging ground, access corridor and for social activity but there is no evidence for cub production within the site, though it is

[88] The reviewed Species Action Plan for otters in Pembrokeshire: http://ukbars.defra.gov.uk/project/show/36401

known and inferred in riverine habitat adjacent to the site and connected to it via vegetated watercourses and valleys.

There are many widely distributed access points to the site from adjacent habitats such as watercourses and vegetated valleys. Coastal fringes where suitable prey habitat is readily accessible to otters is widespread throughout the site; i.e. sheltered shallow water such as rock-pools, lagoons and estuary shallows, accessible from freshwater habitat. The small size of many of the inland rivers and streams means they are considered unlikely to be capable of providing all the otters' food requirements throughout the year, though details are unknown.

Potential resting sites amongst dense vegetation cover on coastal streams draining into the site, cavities amongst rocks, reed beds, tree root systems and scrub are widespread. Variously sized watercourses draining into the sea and the Milford Haven waterway that are suitable for bathing are found distributed widely throughout the site. No holts are known but potential holt (breeding) sites are present within the site in the Milford Haven waterway, mostly in the Cleddau / Daugleddau.

The structural and functional integrity of habitat essential for otters like well-vegetated stream and river valleys, access to the shore, rock-pools with salt and fresh water, secluded resting habitats, is high throughout much of the site.

Otter diet can be highly varied, though is normally focused on favoured prey species and a reflection of local prey availability. Fourteen marine species (mostly fish) were recorded from spraint collected within the site in 2002; European (freshwater) eels were the most important single component of their diet (present in 67% spraint samples). A wider variety of marine species was present in spraint from Milford Haven waterway than those from open coast sites.

4.12.4 Modifications as a result of human activity

Habitat quality and suitability for use has been reduced by, amongst other things:

- the presence and persistence of artificial inert materials (e.g. plastics, synthetic fibres, static fishing gear) presenting entanglement & smothering risk;
- decrease in seclusion because of noise and visual disturbance, as a result of increased human access, habitation and waterborne activities;
- the presence and persistence of toxic contaminants;
- risks of fur contamination from oil discharged into either freshwater or marine environments;
- availability & quality of prey

Feeding habitat and access corridors between riverine habitats and foreshore have been historically acceptance of man-made structures for access, the scale of any impedance to access or former range is unknown. Whether the apparent regular use of areas close to human habitation and activity is indicative of tolerance or of pressure on (feeding) habitat or access between watercourses and the foreshore is unknown.

Scrub and vegetated areas suitable for resting or breeding are vulnerable to clearance for agricultural and recreational requirements but the extent of such modification is unquantified. Localised modification of other habitat, mainly near urban areas, e.g. coastal defences, engineered watercourses (culverts etc.) and managed vegetation, has reduced ease of access and concealment. However, man-made physical structures do not appear to be a deterrent to otters although the extent to which they modify behaviour is unknown.

Human activity causing disturbance with the potential to affect behaviour is widespread but concentrated in residential and urbanised areas. The times of day favoured by otters for activity (early morning and dusk) also tend to minimise interaction with people. There is no known information to suggest human activity has modified the production and survival of young of animals using the site, or the age structure and sex of otters using the site.

As a top predator, otters are vulnerable to accumulation of toxic contaminants present within their food chains, particularly those that are persistent and /or bioaccumulate and biomagnify. The current status of contamination of most likely prey species is unknown although European eels are known to be substantially impacted by a range of contaminants. PCB contamination of otter prey species has been an issue elsewhere in the UK.

Most of the common prey species recorded are not commercially exploited and their stock status is generally unknown although for European eel (the dominant recorded prey species) populations are thought to be below safe biological limits.

4.13 Shore dock (Rumex rupestris)

The Shore dock (*Rumex rupestris*) is one of Europe's most threatened endemic vascular plants. The species is locally extinct in former parts of its range and is currently known from about 40 locations in south-west Britain, only three off which are in Wales. Colonies supporting 50 -100 individuals are considered large as most, especially those on rocky shores, generally hold fewer than ten individuals. The total UK population is estimated to comprise less than 650 plants.

In the following text the term 'population' is used to describe those individuals present within the site.

4.13.1 Population dynamics

Data for 2000-2014 indicate a fairly stable population in the SAC with an average count of 76 mature plants, which is large for this species. Flowering plants, vegetative plants and seedlings have been observed as has successful annual fruiting. The health of the populations is therefore not considered to be significantly compromised.

4.13.2 Range

Historically shore dock has been present at two locations within the SAC, with two sub-populations in each.

4.13.3 Habitat and species

There is limited suitable habitat for this species within the SAC as it requires cliff niches and constant freshwater. One sub-population was lost in 2014 and one colony is known to have been affected by cliff falls.

4.13.4 Modifications as a result of human activities

The known existing colonies are in locations at low risk from human activities.

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 Pembrokeshire Marine

Our vision for the Pembrokeshire Marine Special Area of Conservation (SAC) is one of a high quality marine environment, where the protected habitats and species of the site are in a condition as good as or better than when the site was selected; where human activities co-exist in harmony with the habitats and species of the site and where use of the marine environment is undertaken sustainably

5.2 Conservation objectives for the Pembrokeshire Marine Special Area of Conservation

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

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

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 **inlets and bays** feature these include;

- The embayment of St. Brides Bay
- The ria of Milford Haven
- Peripheral embayments and inlets

For the coastal lagoons feature this is subject to the requirements for maintenance of the artificial impoundment structure and maintenance of the lagoons for the original purpose or subsequent purpose that pre-dates classification of the site.

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.

<u>Restoration and recovery</u>

As part of this objective it should be noted that; **the Milford Haven waterway complex** would benefit from restorative action, for example through the removal of non-natural beach material, and the removal, replacement or improved maintenance of rock filled gabions. There is also need for some restoration of the populations of several typical species of the Milford Haven waterway complex that are severely depleted with respect to historical levels as a consequence primarily of human exploitation.

In the **Milford Haven waterways complex** inputs of nutrients and contaminants to the water column and sediments derived from human activity must remain at or below levels at the time the site became a candidate SAC.

For the lagoons feature this is subject to the requirements for maintenance of the artificial impoundment structures of **coastal lagoons** and maintenance of the **lagoons** for their original purpose or subsequent purpose that pre-dates classification of the site.

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 health,
- 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.

<u>Restoration and recovery</u>

For the **inlets and bays** features this includes the need for some restoration of the populations of several typical species which are severely depleted with respect to historical levels as a consequence primarily of human exploitation.

In the **Milford Haven waterways complex** inputs of nutrients and contaminants to the water column and sediments derived from human activity must remain at or below levels at the time the site became a candidate SAC.

5.2.5 Species Features

- Grey Seal *Halichoeurus grypus*
- Otter *Lutra lutra*
- Allis shad *Alosa alosa*
- Twaite shad *Alosa fallax*
- River lamprey *Lampetra fluviatilis*
- Sea lamprey *Petromyzon marinus*
- Shore dock *Rumex rupestris*

5.2.6 Populations

The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements include:

- population size

- structure, production
- condition of the species within the site.

As part of this objective it should be noted that for **otter** and **grey seal**;

- Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression

For **grey seal and otter,** populations should not be reduced as a consequence of human activity.

5.2.7 Range

The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that for **otter** and **grey seal**:

- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered
- There are appropriate and sufficient food resources within the SAC and beyond
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

5.2.8 Supporting habitats and species

The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;

- distribution
- extent
- structure
- function and quality of habitat
- prey availability and quality.

As part of this objective it should be noted that;

- The abundance of prey species subject to existing commercial fisheries needs to be 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 species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
- Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
  Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour
- For **otter** there are sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing.

Restoration and recovery
In the **Milford Haven waterways complex** inputs of nutrients and contaminants to the water column and sediments derived from human activity must remain at or below levels at the time the site became a candidate SAC.

As part of this objective it should be noted that for the **otter,** populations should be increasing.

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 are 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[89].

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

[89] 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 1 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	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
DOCKS, MARINAS & SHIPPING															
Dock, harbour & marinas structures: Construction* *Widespread in inlets (notably Milford Haven waterway)*	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.	Treat as plan or project as appropriate. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Dock, harbour & marinas structures: Maintenance* *Widespread & common in inlets (notably Milford Haven waterway)*	Environmental quality: addition of toxic and non-toxic contaminants (biocides, oxidising and reducing agents, petrochemicals, suspended particulates) Physical disturbance: displacement, crushing, abrasion, smothering, visual, noise	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	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 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.*	Treat as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Dredging: capital * *Mainly in Milford Haven waterway*	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 , timing and duration; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate. Develop long-term, whole-Haven maintenance dredging strategy. Establish best operational practices suitable to secure features at FCS
Dredging: Maintenance* *Widespread & regular in inlets (notably Milford Haven waterway)*	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, smothering, visual, noise Other factors: removal of biota	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	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 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, timing and duration; frequency of operation and proximity to healthy populations for recruitment; relevant location-specific biotic and abiotic information*	Treat as plan or project if appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Develop long-term, whole-Haven maintenance dredging strategy.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Shipping: vessel traffic (commercial) *Widespread & common*	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 marine mammals; 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 (seals); relevant location-specific biotic and abiotic information*	Continue to monitor shipping movement within port limits. Determine effects of vessel movement on sediment transport, mobilisation and turbidity. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS
Shipping: Mooring* *Widespread & common*	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, 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*	Treat new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations (*i.e.* outwith MHPA port limits).
Shipping: anchoring (commercial and recreational)	Geophysical regime: local modification of substrate structure & sediment transport	✓	✓		✓		✓	✓	✓					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	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Widespread & common	Physical disturbance: crushing, abrasion & displacement.													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*	secure features at FCS; monitor compliance and enforce. Secure appropriate management of open coastal locations (*i.e.* outwith MHPA port limits) used as commercial anchorages and for casual recreational anchoring
Shipping: Vessel maintenance (incl. antifouling) *Widespread & common (notably in Milford Haven waterway)*	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; monitor compliance and enforce.
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 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*	Review, revise or establish management practices and spatial, temporal & technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														and status) on non-indigenous species present within the site.	
Shipping: Refuse & sewage disposal	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; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS. Apply existing legal mechanisms, monitor compliance and enforce, to secure features at FCS
Shipping: operational discharges	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; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS
Shipping: accidents -may be associated with cargo / bunkers discharges *Rare*	Geophysical regime: local modification of substrate structure & topography Environmental quality: addition of toxic & non-toxic contaminants Physical disturbance: displacement, amputation, crushing, abrasion; visual, noise	✓	✓		✓		✓	✓	✓				✓	Structure and function: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) hydrocarbon contaminant burden. Conservation status of typical species & species features: local effects on populations of species sensitive to physical impacts &/or hydrocarbon contamination; effects on species variety, abundance, dynamics, physiological health. *Operation specific information required: location, extent, scale,*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														timing and duration; type, amount and toxicity of discharges; relevant location-specific biotic and abiotic information	transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - fuel oil & / or petrochemical discharges *Occasional (notably in Milford Haven Waterway)*	<u>Environmental quality</u>: addition of toxic & non-toxic contaminants particularly petrochemicals <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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) <u>Conservation status of typical species & species features</u>: lethal and sub lethal physiological effects on species sensitive to hydrocarbons; effects on population variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; types and toxicity of discharge; relevant location-specific biotic and abiotic information*	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents- non-petrochemical cargo losses / discharges *Rare*	<u>Geophysical regime</u>: local modification of or addition to substrate <u>Environmental quality</u>: addition of toxic & non-toxic contaminants - potentially wide range of organic & inorganic materials & particulates. <u>Physical disturbance</u>: displacement, amputation?, abrasion, smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: elevation of water and sediment contaminant burdens; decrease in habitat quality. <u>Conservation status of typical species & species features</u>: lethal and sub lethal physiological effects on species sensitive to discharge; effects on population variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing and duration; type, amount and toxicity of discharge; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agency (NRW)
Shipping: accidents - salvage operations *Rare*	<u>Geophysical regime</u>: local modification of or addition to substrate <u>Environmental quality</u>: addition of toxic & non-toxic contaminants - petrochemicals, synthetics & metals debris <u>Physical disturbance</u>: displacement, amputation, crushing, abrasion, noise, visual	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	<u>Structure and function</u>: physical damage to local substrate, geology & morphology; degradation of habitat quality; elevation of water (and sediment) contaminant burdens. <u>Conservation status of typical species & species features</u>: local effects on populations of species sensitive to physical impacts &/or potential contaminants; effects on species variety, abundance, dynamics, physiological health. *<u>Operation specific information required</u>: location, extent, scale, timing, duration and nature; likely effects and outcome; relevant location-specific biotic and abiotic information*.	Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
															Provide environmental advice to salvage managers and salvors.
CIVIL ENGINEERING															
Construction* *Widespread in inlets (notably Milford Haven Waterway)*	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, introduction of invasive non-natives. 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*	Treat as plan or project, taking into account proposed subsequent operational use and maintenance. Consenting bodies ensure appropriate integration, inclusion and consultation Consenting bodies ensure assessment of cumulative effects in association with others plans and projects
Land claim *#	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-*	Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														specific biotic and abiotic information.	
Coast protection / defence (including beach replenishment) *# *Widespread in urban areas*	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 & predicted climatic impacts.
Barrages (amenity, storm surge, tidal) *# *Historical and recent structures at extremities of and immediately out with tributary estuaries (Carew, Neyland, Cleddau rivers). No major barrages within main water-bodies.*	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)	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														Operation specific information required: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.	
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
Engineered freshwater watercourses *# *Occasional throughout site, mainly in bays and inlets*	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.
Power station *# (potentially also related to shipping, water abstraction & waste disposal operations) *Pembroke Power Station operational as of 2012.*	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.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Pipelines *# *Present mainly in the Milford Haven Waterway*	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. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
Power / communication cables *# *Present*	Geophysical regime: addition of artificial substrate; local modification of water movement Physical disturbance: displacement, visual, noise. Potential electro-magnetic effects of electrical cables.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: dependent on depth of cable burial in seabed – localised modification of species composition, variety. Modification of behaviour caused by electro-magnetic effects. *Operation specific information required: location, extent, scale, frequency, timing and duration; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate, taking into account long term management requirements & likely effects.
WASTE DISPOSAL															
Effluent disposal* (sewage & chemical) *Widespread & common*	Geophysical regime: modification of & addition to substrate Fundamental environmental parameters: elevation of suspended particulates; oxygen depletion Environmental quality: 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 Physical disturbance: smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Structure & function: 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. Conservation status of typical species & species features: 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;	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														- 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 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. *<u>Operation specific information required</u>: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	
Effluent disposal: thermal* *Pembroke Power Station operational as of 2012.*	<u>Fundamental environmental parameters</u>: thermal regime; possibly also salinity, suspended particulates; oxygen depletion	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: local modification of thermal regime; possible modification of salinity regimes and water quality depending on content of discharge <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: location, frequency, timing and duration, volume, flow and degree of difference from ambient temperature of discharge; relevant location-specific biotic and abiotic information.*	Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
Sludge dumping* *None at present*	<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 nutrients; suspended; toxic & non-toxic contaminants; microbial pathogens; organic enrichment <u>Physical disturbance</u>: smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: type, amount, content and toxicity of discharge; location, extent, scale, frequency, timing*	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														and duration; relevant location-specific biotic and abiotic information	
Wastes & debris (including refuse & litter) *Widespread & common*	Geophysical regime: addition of persistent artificial substrates Environmental quality: Addition of toxic & non-toxic contaminants Physical disturbance: entanglement, smothering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	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 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 information*	Maintain, keep under review and improve as appropriate port waste management plans Secure appropriate promulgation & enforcement of national and international dumping at sea measures so as to minimise risk to features' FCS Education & awareness raising
Dredge spoil disposal * *Former disposal site immediately outside Milford Haven; routine disposal of Milford Haven waterway spoil at licensed offshore disposal sites adjacent to site; trickle-feed disposal authorised within waterway*	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. Marine non-native issues. *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 proposed spoil disposal out with a designated spoil disposal site as plan or project as appropriate. Develop and implement best practice appropriate for disposal sites
Urban & industrial run-off* *Widespread & common*	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*	Continued surveillance and monitoring of inputs and water quality by NRW. Continued development and promulgation of good practice. Maintain review of consents to take account of new scientific information. Include in assessment of plans and projects as appropriate

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	**Most likely relevant components & effects** ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
														information	
Agricultural run-off *Widespread & common*	<u>Geophysical regime</u>: addition to substrate, modification to hydrodynamic regime & sediment transport <u>Fundamental environmental parameters</u>: elevation of suspended sediments; oxygen depletion <u>Environmental quality</u>: addition of toxic & non-toxic contaminants - nutrient & organic carbon enrichment, biocides (herbicides, pesticides, fungicides), surfactants.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water & sediment chemistry – nutrient enrichment; contaminant increases; increase in suspended particulates/turbidity; decrease in light penetration through water column, increased oxygen demand. <u>Conservation status of typical species & species features</u>: modification of physiological health and consequential effect on species reproduction, composition and variety; contrary effects on 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. *<u>Operation specific information required</u>: location, extent, scale, frequency, timing, duration, composition of run-off; relevant location-specific biotic and abiotic information*	Continued surveillance and monitoring of inputs and water quality by NRW; continued development and promulgation of good practice.
EXPLOITATION OF LIVING RESOURCES															
Trawling (beam, otter) & dredging: scallop (and other relatively rapidly towed, heavy seabed gears not listed below)* *Tooted dredging does not occur Other dredging: Widespread & common offshore; limited within site.*	<u>Geophysical regime</u>: modification of substrate; addition of persistent inert debris <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates. <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion, entanglement, collision, visual, noise <u>Other factors</u>: removal of target species	✓	✓		✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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). <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: gear type and size; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	Tooted dredging: This activity has been assessed and is not permitted within the site. Other trawling: To secure features at FCS, assess the impacts from the activity on the features of the site.
Dredging: mussel and oyster* *Does not occur at present*	<u>Geophysical regime</u>: modification of substrate <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates <u>Physical disturbance</u>: displacement, crushing, amputation, abrasion,	✓	✓		✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	entanglement, collision, visual, noise <u>Other factors</u>: removal of target species													features) <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: gear type and size; target species; location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information.*	
Dredging: hydraulic dredge *Limited activity anecdotally - Carmarthen Bay/St Bride's Bay*	<u>Geophysical regime</u>: modification of substrate <u>Fundamental environmental parameters</u>: elevation of turbidity & suspended particulates <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement, crushing, amputation, smothering <u>Other factors</u>: removal of target species	✓	✓		✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Netting: (gill, tangle, trammel, beach seine, demersal seine, salmon, fyke)* *Widespread & common (inshore waters)*	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris <u>Physical disturbance</u>: entanglement, displacement (target & non-target species), amputation, abrasion <u>Other factors</u>: removal of target species	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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. <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Potting *Widespread & common (inshore waters)*	<u>Geophysical regime</u>: modification of substrate -addition of persistent inert debris <u>Physical disturbance</u>: displacement, crushing & abrasion <u>Other factors</u>: removal of target species	✓	✓				✓	✓	✓			✓	✓	<u>Structure & function</u>: modification of biological interactions (ecosystem effects) through depletion of target species (predators & scavengers), potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features</u>: 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. *<u>Operation specific information required</u>: 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.
Commercial line fishing *Occasional hand fishing (bass/salmonids), occasional long-lining offshore*	<u>Physical disturbance</u>: displacement <u>Other factors</u>: removal of target species	✓	✓		✓		✓		✓		✓	✓	✓	<u>Structure & function</u>: potential reduction of prey availability for predators (including species features) <u>Conservation status of typical species & species features</u>: depletion of target & non-target species populations and modification of population structures. *<u>Operation specific information required</u>: 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.
Hand gathering: (collection, boulder turning, digging, raking, spearfishing)*	<u>Geophysical regime</u>: modification of substrate, physical structure <u>Fundamental environmental parameters</u>: elevation of turbidity;	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	<u>Structure & function</u>: 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	To secure features at FCS, assess the impacts from the activity on the features of the site.

Activity	**Relevant factors**	**Inlets & bays**	**Estuaries**	**Saltmeadow**	**Mud & sandflats**	**Coastal lagoons**	**Reefs**	**Sea caves**	**Subtidal sandbanks**	**Shore dock**	**Shad & lampreys**	**Otters**	**Seals**	**Most likely relevant components & effects** ***Information necessary to further refine / tailor advice to specific operations***	**Advice as to likely required action**
Widespread. Commercial winkle collection in Milford Haven waterway	reduced oxygen Environmental quality: remobilisation of toxic & non-toxic contaminants (digging) Physical disturbance: displacement, possible crushing & amputation, visual Other factors: removal of target species													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 information*	
Bait collection: commercial* *Commercial bait digging common especially at 'hot spots'; commercial collection of other species (crustaceans, molluscs, sand-eels) as bait poorly known*	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.
Collection, for aquarium / curio trade *Restricted and small scale.*	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.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Grazing of salt-marsh * *Occasional on upper reaches of Milford Haven Waterway*	<u>Geophysical regime</u>: modification of substrate structure <u>Environmental quality</u>: organic enrichment <u>Physical disturbance</u>: displacement, crushing, amputation & smothering <u>Other factors</u>: removal of 'target' species	✓	✓	✓	✓									<u>Extent & distribution</u>: possible reduction in extent of salt-marsh <u>Structure & function</u>: modification of habitat structure (sedimentology, topography, microtopography, sward height), sediment processes <u>Conservation status of typical species</u>: modification of target and non-target species population size and structures; species composition and variety *<u>Operation specific information required</u>: location, extent, scale, frequency, timing, duration and type of grazing; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
Gathering algae and higher plants for human consumption (see also vehicles on foreshore) *One SSSI consent issued, other interest expressed in seaweed gathering, small scale. Large scale gathering of laver bread occurring between Swansea and Cardigan Bay.*	<u>Physical disturbance</u>: displacement, crushing & amputation <u>Other factors</u>: removal of target species	✓	✓	✓	✓		✓							<u>Structure & function</u>: disturbance or modification of habitat structure by harvesting <u>Conservation status of typical species & species features</u>: modification of target species population size and structures *<u>Operation specific information required</u>: target species; location, extent, scale, frequency, timing duration and nature of collection; relevant location-specific biotic and abiotic information*	To secure features at FCS, assess the impacts from the activity on the features of the site.
CULTIVATION OF LIVING RESOURCES															
Aquaculture: wild stock enhancement / 'ranching' * (*i.e.* deposition of juveniles on seabed, semi-managed on growing and later collection of commercially sized individuals; see also *mussel dredging*) *None at present although interest has been expressed*	<u>Geophysical regime</u>: modification of substrate structure, sedimentology, sediment transport <u>Fundamental environmental parameters</u>: oxygen depletion <u>Environmental quality</u>: organic enrichment <u>Physical disturbance</u>: displacement, smothering <u>Other factors</u>: introduction of non-native species	✓	✓		✓	✓	✓							<u>Structure & function</u>: modification of habitat structure, sedimentology, sediment processes, water & sediment chemistry (nutrients, contaminants, pseudofaeces, sediment oxygen depletion); modification of biological interactions (*e.g.* predator-prey relationships) <u>Conservation status of typical species</u>: 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 *<u>Operation specific information required</u>: 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	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Aquaculture: finfish, crustaceans; sea or waterway based cages or impoundments * *One historic salmonid farm on the Daugleddau, currently non-operational*	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 'farming' * (molluscan culture using trestles, ropes, cages or other structures) *None at present although interest has been expressed and consents sought.*	Fundamental environmental parameters: oxygen depletion Environmental quality: nutrient & organic enrichment; possible addition of pesticides & antifoulants Other factors: introduction of non-native species	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	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, oxygen demand, pseudofaeces); 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*	This would be a permitted activity and would have to undergo a Habitats Regulation Assessment.
Aquaculture: land based semi-enclosed / recirculation * # *None at present although interest has been expressed.*	Fundamental environmental parameters: oxygen availability; turbidity Environmental quality: nutrient & organic enrichment; biocides, antibiotics Other factors: introduction of non-native species	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	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*	Geophysical regime: modification of flow regime Fundamental environmental	✓	✓	✓	✓	✓	✓				✓	✓		Structure & function: local modification of hydrography, temperature, water chemistry & salinity regime Conservation status of typical species & species features:	Treat new proposed developments as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Regular in upper reaches of tributaries to the Milford Haven waterway	parameters: salinity													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*	Review existing consents
Oil & gas exploration: seismic survey* *Gas exploration in west of site.*	Physical disturbance: noise (dependant on proximity to site)										✓		✓	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 new proposed developments as plan or project as appropriate.
Oil & gas exploration & production: drilling operations* *Gas exploration in west of site.*	Geophysical regime: substrate modification Environmental quality: hydrocarbon contamination Physical disturbance: displacement, crushing, smothering in immediate vicinity; noise	✓					✓	✓	✓		✓		✓	Structure & function: modification of water chemistry (contaminants), habitat quality (presence of artificial substrates); local modification of biological interactions through changes to prey availability Conservation status of typical species & species features: modification of species composition and variety (increase in species typical of hard substrate) *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Treat new proposed developments as plan or project as appropriate.
Oil & gas exploration & production: operational* & accidental discharges *None 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 new proposed developments as plan or project as appropriate.
Aggregate extraction * (mineral & biogenic sands & gravels)	Geophysical regime: removal and alteration of substrate; modification of sediment transport, wave and tidal stream regimes Fundamental Environmental Parameters: elevation of turbidity /	✓	✓		✓		✓	✓	✓		✓		✓	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	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
None within site at present	suspended particulates <u>Physical disturbance</u>: displacement, smothering <u>Other factors</u>: removal of biota;													<u>Conservation status of typical species & species features</u>: modification of species composition and variety, including decline in species adapted to sandbank habitat conditions; effects on population sizes, physiological health, reproduction, and biomass. *<u>Operation specific information required</u>: target aggregate & method of extraction; location, extent, volume, frequency, timing and duration; relevant location-specific biotic and abiotic information*	
Alternative energy production: tidal barrage*# *None at present.*	<u>Geophysical regime</u>: modification of tidal regime, streams & amplitude, substrate, sediment transport, wave exposure <u>Fundamental environmental parameters</u>: salinity, suspended particulates, turbidity, dissolved oxygen, temperature, seabed light <u>Environmental quality</u>: toxic & non-toxic contaminant accumulation; organic enrichment	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	<u>Extent & distribution</u>: 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 <u>Structure & function:</u> 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); 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. <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: location, extent, scale of impoundment; potential modification of tidal and freshwater flow; timing and duration of construction; maintenance requirements & frequency; relevant location-specific biotic and abiotic information.*	Treat as plan or project as appropriate.
Alternative energy production: coastal	<u>Geophysical regime</u>: modification of wave and tidal regimes; removal & alteration of substrate	✓	✓		✓		✓	✓	✓		✓	✓	✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on	Treat as plan or project as appropriate.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
wave & tidal current *# *Current tidal turbine trials underway; applications and/or expressions of interest in wave energy and tidal stream developments.*	<u>Environmental quality</u>: possible toxic & non-toxic contaminants; modification of suspended particulates <u>Physical disturbance</u>: displacement, crushing, smothering by structures or anchoring mechanisms; collision; noise													nature, construction and scale of structures. Modification of habitat structure, sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, distribution, physiological health (collision, entrainment); modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: 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*	
Alternative energy production: wind *# *None at present.*	<u>Geophysical regime</u>: modification of wave and tidal regimes; modification to substrate <u>Environmental quality</u>: possible toxic & non-toxic contaminants <u>Physical disturbance</u>: general physical effects; possible collision	✓					✓	✓	✓				✓	<u>Extent & distribution</u>: potential habitat loss within footprint of generating structures <u>Structure & function</u>: potentially highly variable dependent on nature, construction and scale of structures. Modification of sedimentology & sediment processes, hydrodynamic regime <u>Conservation status of typical species & species features</u>: modification of species variety, & distribution; modification of species ranges (disturbance; artificial reef effects) *<u>Operation specific information required</u>: type, construction & size; location & extent; timing and duration of installation; permanence; cabling requirements; maintenance requirements & frequency; relevant location-specific biotic and abiotic information*	Treat as plan or project as appropriate.
POLLUTION RESPONSE															
Oil spill response: at sea *Rare*	<u>Environmental quality</u>: toxic contamination - petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: noise, visual	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Structure & function</u>: modification of water chemistry (with purpose of ameliorating degree of modification) <u>Conservation status of typical species & species features</u>: 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) *<u>Operation specific information required</u>: 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 West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – washing	<u>Geophysical regime</u>: modification & removal of substrate	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	<u>Structure & function</u>: local modification of habitat structure, salinity, thermal regime; water & sediment chemistry (remobilisation and/or	Develop and maintain appropriate pollution response

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Rare	<u>Fundamental environmental parameters</u>: salinity; temperature <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, noise, visual													sediment entrapment of hydrocarbon contaminants); <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: location, extent, scale, timing and duration; relevant location-specific biotic and abiotic information*	contingency plans Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – chemical *Rare*	<u>Environmental quality</u>: addition / increase petrochemicals, surfactants, demulsifiers <u>Physical disturbance</u>: including displacement	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	<u>Structure & function</u>: modification of water & sediment chemistry; modification of biological interactions through changes in abundance and contamination of food resources <u>Conservation status of typical species & species features</u>: acute local modification of species physiological health (sublethal and possibly lethal); population structure & dynamics *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan
Oil spill response: shore cleaning – physical *Rare*	<u>Geophysical regime</u>: modification & removal of substrate <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, trampling, noise, visual	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	<u>Structure & function</u>: modification of habitat structure, sedimentology, water & sediment chemistry through remobilisation and transfer of hydrocarbon contamination <u>Conservation status of typical species & species features</u>: acute local modification of species physiological health (sub lethal and possibly lethal); population structure & dynamics *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue) *Rare*	<u>Geophysical regime</u>: modification of substrate <u>Environmental quality</u>: toxic contamination - petrochemicals <u>Physical disturbance</u>: displacement, crushing, abrasion, smothering, collision, noise, visual <u>Other factors</u>: removal of biota	✓	✓	✓	✓	✓	✓			✓		✓	✓	<u>Structure & function</u>: modification of habitat structure, sedimentology <u>Conservation status of typical species & species features</u>: acute local modification of species population sizes, structures, physiological health; disturbance and displacement of vertebrate species including species features *<u>Operation specific information required</u>: 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 on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan Treat as plan or project as appropriate.
RECREATION															
Angling *Widespread & common*	<u>Environmental quality</u>: metals, persistent inert debris <u>Physical disturbance</u>: displacement, entanglement <u>Other factors</u>: removal of target species	✓	✓		✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: 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) <u>Conservation status of typical species & species features</u>: 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 *<u>Operation specific information required</u>: 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.
Bait collection: boulder turning *Widespread & common*	<u>Geophysical regime</u>: modification of substrate physical structure <u>Physical disturbance</u>: displacement, possible crushing & amputation, visual <u>Other factors</u>: removal of target species;	✓	✓		✓		✓					✓		<u>Structure & function</u>: modification of habitat structure, sedimentology, topography and microtopography; 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 <u>Conservation status of typical species & species features</u>: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*eg* increase in predatory invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *<u>Operation specific information required</u>: target species and shore type (exposure); 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.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Bait collection: digging & other sediment shore collection techniques* *Common, widespread with 'hot spots' of activity*	<u>Geophysical regime</u>: modification of substrate physical structure; sediment transport <u>Fundamental environmental parameters</u>: turbidity; oxygen; salinity <u>Environmental quality</u>: remobilisation of toxic & non-toxic contaminants <u>Physical disturbance</u>: displacement; possible crushing, amputation, smothering, visual <u>Other factors</u>: removal of target species	✓	✓		✓							✓		<u>Structure & function</u>: 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 <u>Conservation status of typical species & species features</u>: depletion of target species populations and modification of population structures; modification of non-target species composition and variety (*e.g.* increase in predatory invertebrate species) in sediment habitats; potential depletion of vertebrate predator prey species. *<u>Operation specific information required</u>: target species and shore type; 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 and low speed power craft (see also mooring and anchoring) *Widespread & common (seasonally skewed to Apr-Oct)* *Proposal for new marina at Martello Quays will increase recreational boating*	<u>Geophysical regime</u>: modification of substrate physical structure; wave exposure regime <u>Fundamental environmental parameters</u>: turbidity <u>Environmental quality</u>: hydrocarbon contaminants; organic enrichment <u>Physical disturbance</u>: displacement, collision, noise, visual	✓	✓	✓	✓		✓				✓	✓	✓	<u>Structure & function</u>: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Activity surveillance.
Recreational boating: non-mechanically powered craft (see also mooring and anchoring) *Widespread & common (seasonally skewed to Apr-Oct)*	<u>Geophysical regime</u>: modification of substrate physical structure; wave exposure regime <u>Fundamental environmental parameters</u>: turbidity <u>Environmental quality</u>: hydrocarbon contaminants; organic enrichment <u>Physical disturbance</u>: displacement,	✓	✓		✓		✓		✓			✓	✓	<u>Structure & function</u>: local modification of sediment structures (erosion), wave exposure in wave sheltered locations (vessel wash); local modification of water quality (hydrocarbon and other contaminants) <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of species composition *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic and*	Education & awareness raising Activity surveillance.

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
	collision, noise, visual													*abiotic information*	
Recreational boating: moorings* *Common and widespread in Milford Haven and other sheltered locations.*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Installation – treat as plan or project.
Recreational boating: anchoring* *Present, in both sensitive and non-sensitive locations*	<u>Physical disturbance</u>: displacement, collision, noise & visual	✓	✓	✓	✓	✓	✓							<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species population structures *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising. Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS
Casual shore recreation (bathing, dog walking, coasteering etc.) *Widespread, common*	<u>Environmental quality</u>: organic enrichment, microbial pathogens, persistent inert materials <u>Physical disturbance</u>: general physical effects; trampling; noise; visual	✓	✓	✓	✓	✓	✓			✓		✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; local modification of benthic species composition *<u>Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information</u>*	Education & awareness raising. Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS
Vehicles on foreshore *Widespread*	<u>Geophysical regime</u>: substrate <u>Physical disturbance</u>: crushing collision, noise; visual	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	<u>Structure & function</u>: modification of habitat sedimentology, geomorphology, sediment processes <u>Conservation status of typical species & species features</u>: local modification of benthic species composition and population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Appropriate implementation of SSSI procedures & access byelaws
Light aircraft *Occasional/Common Use of drones common on site*	<u>Physical disturbance</u>: noise & visual											✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance
Wildfowling	<u>Environmental quality</u>: metals,	✓	✓	✓	✓	✓						✓		<u>Structure & function</u>: modification of sediment chemistry (heavy	Activity surveillance

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Common on upper reaches of Milford Haven waterway	persistent inert materials <u>Physical disturbance</u>: crushing; noise; visual													metal contamination); habitat modification (manipulation to encourage target species) <u>Conservation status of typical species & species features</u>: local modification of sediment benthic species population structures, particularly sediment habitats; disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Education & awareness raising Review, monitor and enforce spatial, temporal and effort operational limits suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws
Marine wildlife watching / eco-tourism *Common, esp. in summer, (trips out to the islands etc.)*	<u>Physical disturbance</u>: noise & visual											✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising
MILITARY ACTIVITIES															
Military activity: ordnance ranges* *Regular (South Pembrokeshire)*	<u>Environmental quality</u>: metals, persistent inert materials <u>Physical disturbance</u>: noise; visual	✓			✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: modification of water quality <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species; potential effects of contaminants on physiological health *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Research potential effects on features
Military activity: marine exercises *Regular (South Pembrokeshire)*	<u>Environmental quality</u>: metals, persistent inert materials <u>Physical disturbance</u>: noise; visual	✓			✓		✓	✓	✓		✓	✓	✓	<u>Structure & function</u>: modification of water quality <u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Research potential effects on features
Military activity: aircraft *Occasional*	<u>Physical disturbance</u>: noise & visual											✓	✓	<u>Conservation status of typical species & species features</u>: disturbance and modification of range and behaviour of vertebrate species *<u>Operation specific information required</u>: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance
MISCELLANEOUS OPERATIONS AND USES															

Activity	Relevant factors	Inlets & bays	Estuaries	Saltmeadow	Mud & sandflats	Coastal lagoons	Reefs	Sea caves	Subtidal sandbanks	Shore dock	Shad & lampreys	Otters	Seals	Most likely relevant components & effects ***Information necessary to further refine / tailor advice to specific operations***	Advice as to likely required action
Marine archaeology & salvage *Regular visits to wrecks by recreational divers*	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*	Education & awareness raising
Education & science *Regular use of favoured sites*	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, develop and/or implement and monitor best practice suitable to secure features at FCS Appropriate implementation of SSSI procedures & access byelaws Development and encouragement of information exchange
Animal welfare operations & sanctuaries *Regularly operating in Pembrokeshire*	Environmental quality: potential release of microbial pathogens Physical disturbance: noise, visual Other factors: habituation of wild species to humans											✓	✓	Conservation status of species features: effects on population physiological health (survival and release of low-fitness individuals), potential exposure to domestic disease; potential disturbance and modification of range and behaviour *Operation specific information required: location, extent, scale, frequency, timing and duration; relevant location-specific biotic and abiotic information*	Activity surveillance Education & awareness raising Review, develop and/or implement and monitor best practice suitable to secure features at FCS

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Sea Empress Environmental Evaluation Committee reports
Marine Nature Conservation Review survey reports
Institute for Petroleum from Field Studies Council, Oil Pollution Research Unit, Pembroke

Annexes

Annex 1 Pembrokeshire Marine SAC feature map: interpretation guide

The data found within the Pembrokeshire Marine 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**
- **Coastal lagoons**
- **Estuaries**
- **Atlantic Salt Meadow** (Glauco-Puccinellietalia maritimae)

All feature definitions are taken from the "Interpretation Manual of European Union Habitats[90]"

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 feature is based on the following information sources:

- CCW Phase 1 Intertidal Habitat Map
- Admiralty Charts

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

- Expert knowledge

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

Definite and Potential areas of mudflat and sandflat habitat are identified in the feature layer to differentiate between areas where the supporting data shows the feature is known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments), part of a mixed sediment shore where other features could also be present (e.g. a mixed shore where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

Sandbanks
The feature extent outline for the sandbank features found within Pembrokeshire Marine SAC is based on the following data sources:
- JNCC Astrium Digital Seabed Elevation Model
- Multibeam echosounder data
- Marine survey data (biology and sediments)
- UKHO Admiralty Charts and bathymetry data
- Expert knowledge

The indicative sandbank feature polygons within the SAC have been updated using data developed and refined during a UK-wide sandbank delineation programme (undertaken by JNCC in conjunction with CCW in 2012 for reporting against Article 17 of the Habitats Directive). This programme used a digital elevation model along with acoustic datasets (multibeam and RoxAnn) and habitat survey data (biology and sediments) to more accurately delineate areas of seabed that fit within the Annex 1 Sandbanks definition. As a result the sandbank boundaries in the Pembrokeshire Marine SAC have been updated and refined. A bank previously identified off Grassholm has been removed from the feature dataset as this does not fit the Annex 1 description of a sandbank that is slightly covered by seawater all the time (the bank is too deep), and two new 'Potential' sandbank areas have been added off Middleholm and St. Martin's Haven.

A distinction has been made between sandbank areas that are classed as 'Definite' i.e. where the sandbanks adequately meet the criteria set out in the Annex 1 feature definition, and 'Potential' i.e. where there is some uncertainty over whether the bank area adequately meets the Annex 1 feature requirements. This could be due to lack of topographic distinctness or uncertainty over sediment composition and associated biological communities.

Reefs
The indicative reef polygon feature map for Pembrokeshire Marine SAC is composed of extensive areas of both intertidal and subtidal habitat. Data sources for the indicative feature extent map are:
- CCW Phase 1 Intertidal Habitat Map (intertidal reef areas)
- Marine acoustic data (sidescan sonar, multibeam echosounder and RoxAnn)
- Marine survey data (sediments and biology)
- Admiralty charts
- British Geological Survey seabed sediment and rock substrate maps
- Expert knowledge

‘Definite’ and ‘Potential’ areas of reef are identified in the feature layer to differentiate between areas where the supporting data shows the feature is definitely known to be present (Definite), and where the feature could be either transient in nature (e.g. due to mobility of sediments that could cover rocky outcrops), part of a mixed sediment seabed where other features could also be present (e.g. a mixed shore or mosaic seabed where both soft sediments and hard substrate are interspersed), or where supporting data is less reliable (Potential).

The reef map from Pembrokeshire Marine SAC has been updated using data from the 2012 Habitats Directive Article 17 reporting process that refined the reef areas based on more up to date survey.

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
Two Large Shallow Inlet and Bay (LSIB) features are present in Pembrokeshire Marine SAC, namely Milford Haven and St. Bride’s Bay. The Bay extents use the landward boundary of the SAC on the coast and a line between the bounding headlands for closure on the seaward side. A small change has been made to the LSIB closing line in Milford Haven to better align it with its bounding headland features. No changes have been made to the St. Bride’s Bay LSIB.

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.

Coastal lagoons
The lagoon boundaries in Pembrokshire Marine have been mapped using aerial photos and an Ordnance Survey base map. No amendments have been made to the feature boundaries since site designation.

Estuaries
The estuary feature extents for Pembrokeshire Marine SAC are derived from the inland boundary of the SAC and a closing line either between bounding headlands at the estuary mouth or where there is a return to fully saline conditions. No changes have been made to the Estuary features within Pembrokeshire Marine SAC since designation.

Atlantic Salt Meadow
The Atlantic Salt Meadow feature extent for Pembrokeshire Marine SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data and CCW sand dune vegetation survey data. Slight amendments have been made to the dataset to improve feature accuracy since it was delineated at the time of site designation (i.e. using newer data that had become available as part of the Article 17 reporting process).

Salicornia

The *Salicornia* feature extent for Pembrokeshire Marine SAC has been derived from CCW Phase 1 intertidal survey data, CCW Phase 2 vegetation mapping survey data, and CCW sand dune vegetation survey data. Slight amendments have been made to the dataset to improve feature accuracy since being delineated at the time of site designation (i.e. using newer data that had become available as part of the Article 17 reporting process).

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 Abereiddi
- St.David's Peninsula Coast
- The offshore islets of Pembrokeshire/Ynysoedd Glannau Penfro
- Ramsey/Ynys Dewi
- Arfordir Niwgwl – Aber Bach/Newgale to Little Haven Coast
- De Porth Sain Ffraid/St Bride's Bay South
- Skomer Island and Middleholm
- Grassholm/Ynys Gwales
- Skokholm
- Dale and south Marloes coast
- Milford Haven Waterway
- Hook Wood
- Afon Cleddau Gorllewinol/Western Cleddau River
- Slebech Stable Yard Loft, Cellars & Tunnels
- Afon Cleddau Dwyreiniol/Eastern Cleaddau River
- Minwear Wood
- Carew Castle
- Arfordir Penrhyn Angle/Angle Peninsula coast
- Broomhill Burrows
- Castlemartin Cliffs and Dunes
- Stackpole
- Stackpole Quay – Trewent Point
- Freshwater East Cliffs to Skrinkle Haven

SPAs that are partly or wholly within the SAC:

- Ramsey and St.David's Peninsula coast
- Grassholm
- Skokholm and Skomer
- Castlemartin Coast

Locations are shown on the associated feature map[91].

[91] All features are contained in interactive PDF maps available on the NRW website, details of data used in the maps can be found in Annex 1. For Pembrokeshire Marine a more detailed insert of the Milford Haven waterway has also been produced.

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.

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Appendix Q Bristol Channel Approaches/Dynesfeydd Môr Hafren SAC

Harbour Porpoise (*Phocoena phocoena)*

Special Area of Conservation:

Bristol Channel Approaches / Dynesfeydd Môr Hafren

Conservation Objectives and Advice on Operations

March 2019

Advice under Regulation 21 of The Conservation of Offshore Marine Habitats and Species Regulation 2017 and Regulation 37(3) of the Conservation of Habitats and Species Regulations 2017

Further information

This document is available as a pdf file on the JNCC website for download if required (www.jncc.defra.gov.uk).

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Summary of Conservation Objectives and Advice on Operations

The Conservation Objectives and Advice on Operations are set out for the Bristol Channel Aproaches / Dynesfeydd Môr Hafren Special Area of Conservation (SAC) for harbour porpoise (*Phocoena phocoena*). The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where Natural England (NE), Natural Resources Wales (NRW) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities as the Statutory Nature Conservation Body (SNCB).

The general objective of achieving or maintaining Favourable Conservation Status (FCS) for all species and habitat types listed in Annexes I and II of the Habitats Directive needs to be translated into Conservation Objectives for SACs. These objectives describe the condition to be achieved by a site for it to contribute in the best possible way to achieving FCS at the national, bio-geographical and European level[1]. The Advice on Operations is site-specific but based on a broad assessment of the sensitivity of the harbour porpoise to anthropogenic pressures at a UK scale.

The advice in this document has been developed using the best available scientific information and expert interpretation as of February 2019. The advice provided here may be subject to change as our knowledge about the site and the impacts of human activities improves.

To ensure the site contributes in the best possible way to achieving FCS, management of human activities occurring in or around the site is required if these activities are likely to have an adverse impact (directly or indirectly) on the integrity of the site, with regards to its Conservation Objectives. It should be noted that as a European Protected Species under Annex IV of the Habitats Directive, harbour porpoises are already strictly protected throughout their European range. As such, several conservation measures are already in place in the UK.

To achieve the Conservation Objectives for the Bristol Channel Aproaches / Dynesfeydd Môr Hafren SAC, the relevant[2] and competent[3] authorities should consider human activities within their remit which might affect the integrity of the site.

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[1] http://jncc.defra.gov.uk/PDF/comm02D07.pdf

[2] Relevant authorities are those who are already involved in some form of relevant marine regulatory function and would therefore be directly involved in the management of a marine site lying within territorial waters. The bodies which may be relevant authorities are listed in Regulation 6 of the Conservation of Habitats and Species Regulations 2017. All relevant authorities are also competent authorities.

[3] Competent authorities are defined in Regulation 5 of the Conservation of Offshore Marine Habitats and Species Regulations 2017 and Regulation 7 of the Conservation of Habitats and Species Regulations 2017. In summary, a competent authority is any person or organisation that has the legally delegated or invested authority (e.g. Minister, government department, public body of any kind or statutory undertaker) to perform a designated function.

Crynodeb o Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau

Mae'r Amcanion Cadwraeth a Chyngor ynglŷn â Gweithgareddau wedi'u cyflwyno ar gyfer yr ymgeisydd Ardal Cadwraeth Arbennig (yACA) Bristol Channel Approaches/Dynesfeydd Môr Hafren ar gyfer yr rhywogaeth Atodiad II, y llamhidydd (*Phocoena phocoena*). Mae'r safle'n cwmpasu dyfroedd y glannau (o fewn 12 morfilltir o'r arfordir) a dyfroedd alltraeth (tu hwnt i 12 morfilltir o'r arfordir) lle mae gan Cyfoeth Naturiol Cymru (CNC), Natural England (NE) a'r Cyd-bwyllgor Gwarchod Natur (JNCC) gyfrifoldebau cynghori perthnasol.

Mae angen trosi'r amcan cyffredinol o gyrraedd neu gynnal Statws Cadwraeth Ffafriol i bob rhywogaeth a math o gynefin sydd wedi'u rhestru yn Atodiadau I a II o'r Gyfarwyddeb Cynefinoedd yn Amcanion Cadwraeth ar lefel safle. Mae rhain yn disgrifio'r cyflwr y dylai rhywogaethau a mathau o gynefin o fewn safle ei wireddu er mwyn i'r safle gyfrannu yn y ffordd orau posibl tuag at wireddu Statws Cadwraeth Ffafriol ar lefel genedlaethol, bio-ddaearyddol ac Ewropeaidd.

Mae'r Cyngor ynglŷn â Gweithgareddau yn benodol i safleoedd ond mae'n seiliedig ar asesiad ehangach o ba mor sensitif yw'r llamhidydd i bwysau anthropogenig ar lefel y DU. Datblygwyd y cyngor gan ddefnyddio'r wybodaeth gwyddonol orau bosibl a dehongliad arbenigol fel yr oedd ym mis Chwefror 2019. Bydd y cyngor a ddarperir yma yn newid wrth i'n gwybodaeth am y safle ac effeithiau gweithgareddau dyn wella.

Er mwyn sicrhau bod y safle'n cyfrannu at Statws Cadwraeth Ffafriol, mae angen rheoli gweithgareddau dyn ar y safle ac o'i gwmpas os ydynt yn debygol o gael effaith andwyol ar gyfanrwydd y safle (yn uniongyrchol neu'n anuniongyrchol) o safbwynt ei Amcanion Cadwraeth. Dylid nodi bod y llamhidydd yn ei warchod drwy Ewrop gyfan fel Rhywogaeth a Warchodir Gan Ewrop yn Atodiad IV y Gyfarwyddeb Cynefinoedd. O ganlyniad mae llawer o fesurau rheoli ar waith eisoes yn y DU.

Er mwyn diwallu Amcanion Cadwraeth safle llamhidydd Bristol Channel Approaches/Dynesfeydd Môr Hafren, dylai'r awdurdodau perthnasol[1] a chymwys[2] ystyried gweithgareddau dyn yn rhan o'u cylch gwaith a allai gael effaith ar gyfanrwydd y safle.

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[1] Awdurdodau perthnasol yw'r rhai sydd eisoes yn ymwneud â rhyw fath o swyddogaeth reoleiddiol forol berthnasol a fyddai'n ymwneud yn uniongyrchol felly â rheoli safle morol sydd o fewn dyfroedd tiriogaethol. Mae'r cyrff a all fod yn awdurdodau perthnasol wedi eu rhestru yn Rheoliad 6 Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. Mae'r holl awdurdodau perthnasol hefyd yn awdurdodau cymwys.

[2] Mae awdurdodau cymwys yn cael eu diffinio yn Rheoliad 5, Rheoliadau Cadwraeth Cynefinoedd a Rhywogaethau Morol Alltraeth 2017 a Rheoliad 7, Rheoliadau Gwarchod Cynefinoedd a Rhywogaethau 2017. I grynhoi, mae awdurdod cymwys yn unrhyw berson neu sefydliad y rhoddwyd awdurdod cyfreithiol neu ddirprwyedig iddo (e.e. Gweinidog, adran o'r llywodraeth, unrhyw fath o gorff cyhoeddus neu ymgymerydd statudol) i gyflawni swyddogaeth ddynodedig.

Contents

1 Introduction

1.1 Background

Initial advice on a network of sites identified within UK waters for harbour porpoise (*Phocoena phocoena*) was submitted to UK and Devolved Governments as a series of draft SACs in June 2015. The sites were identified within the UK portions of Management Units (MUs[4]) defined for the species (ICES, 2014; IAMMWG, 2015). The Welsh and Northern Ireland Governments, along with Defra on behalf of England and relevant offshore waters, gave approval for sites within their areas of jurisdiction to proceed to consultation (January to May 2016). In light of the responses to the consultation, five sites were submitted to the European Commission as candidate SACs in January 2017. These five sites were adopted by the EC as Sites of Community Importance (SCIs) on 12 December 2017 and designated as SACs by Ministers on 26th February 2019. These sites are shown in Figure 1.

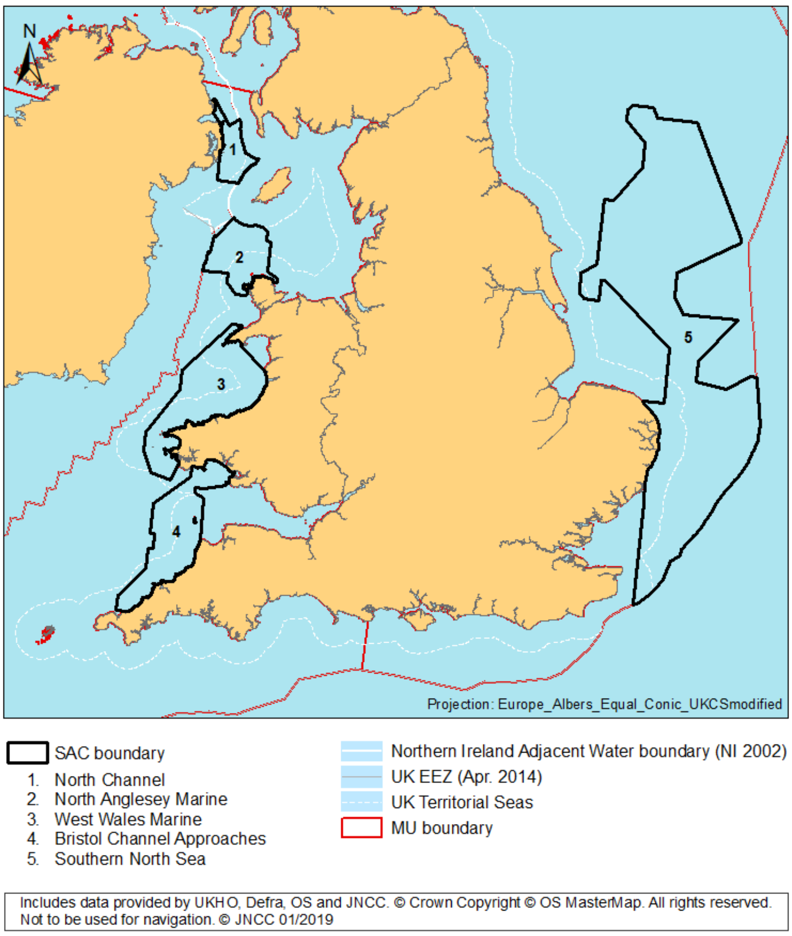

Figure 1: Special Areas of Conservation for the harbour porpoise, *Phocoena phocoena* identified in Northern Ireland, England, Wales and offshore waters. The Management Unit (MU) boundary (red line) refers to the UK portion of the North Sea and Celtic and Irish Seas MUs.

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[4] For conservation and management purposes it is practical to divide the population into smaller units, termed Management Units (MUs). These MUs were developed to take account of biological populations of animals but were also determined by political boundaries and are at an appropriate scale at which to assess human activities. In the UK, three MUs have been defined for harbour porpoise: West of Scotland, Celtic and Irish Seas, and North Sea (IAMMWG, 2015)

This advice document is for the Bristol Channel Aproaches / Dynesfeydd Môr Hafren SAC (Figure 2) which is subject to protection under the Conservation of Habitats and Species Regulations 2017[5] and the Conservation of Offshore Marine Habitats and Species Regulation 2017[6] (collectively referred to as the Habitats Regulations). The advice is given in fulfilment of the duty of the Statutory Nature Conservation Bodies (SNCBs) under the Habitats Regulations to advise Relevant and Competent Authorities as to (a) the Conservation Objectives for the 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. The SNCBs aim to ensure that the Conservation Objectives are up-to-date, accessible and enable the assessment of the potential effects of plans and projects.

2 Responsibilities of Relevant and Competent Authorities

Competent Authorities (including those which are also Relevant Authorities) are required to exercise their functions to comply with the Habitats Regulations. Competent Authorities must, within their areas of jurisdiction, consider both direct and indirect effects on the site. This includes considering operations inside and outside the boundary of the SAC, if the impacts could affect the achievement of the site's Conservation Objectives. Decisions on management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate. Where consent is required and the operation (if considered a plan or project) is likely to significantly affect a European Site, Article 6(3) of the Habitats Directive requires that an Appropriate Assessment (AA) is carried out. The AA is part of the “Habitat Regulations Assessment” (HRA), which is a case-specific assessment made in view of the Conservation Objectives for the affected site or sites. Each HRA requires case-specific advice from the SNCB but the assessment is the responsibility of the competent authority concerned.

The variability of harbour porpoise distribution and abundance within sites is in part due to their mobility and wide-ranging nature as well as natural and anthropogenic changes in habitat and prey. Relevant and Competent Authorities are not required to undertake any actions to ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes. It is therefore important to contextualise any apparent changes in harbour porpoise presence within the site in terms of natural variability and the abundance and distribution patterns at the population level (i.e. MU).

3 Conservation Objectives for harbour porpoise SACs

3.1 The role of Conservation Objectives

Site level Conservation Objectives are a set of specified objectives designed to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012). Conservation Objectives constitute a necessary reference for:

- identifying any site-based conservation measures that may be required;
- carrying out HRAs of the implications of plans or projects.

The purpose of the HRA is to determine whether a plan or project could adversely affect a site’s integrity. The critical consideration in relation to site integrity is not the extent or degree of an impact, or whether an impact is direct or indirect, but whether a plan or project, either

[5] http://www.legislation.gov.uk/uksi/2017/1012/contents/made
[6] http://www.legislation.gov.uk/uksi/2017/1013/contents/made

individually or in combination with other plans or projects, affects the site's ability to achieve its Conservation Objectives and therefore contribute to Favourable Conservation Status.

Harbour porpoise are protected everywhere in European waters under the provisions of the Habitats Regulations. The harbour porpoise in UK waters are considered part of a wider European population and the highly mobile nature of this species means that the concept of a 'site population' is not considered an appropriate basis for expressing Conservation Objectives for this species. Site based conservation measures will complement wider ranging measures that are in place for the harbour porpoise.

3.2 Background to Conservation Objectives

The Conservation Objectives are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely. Therefore, the focus of the Conservation Objectives for harbour porpoise sites is on addressing pressures that affect site integrity and would include:

- killing or injuring harbour porpoise (directly or indirectly);
- preventing their use of significant parts of the site (disturbance / displacement);
- significantly damaging relevant habitats; or
- significantly reducing the availability of prey.

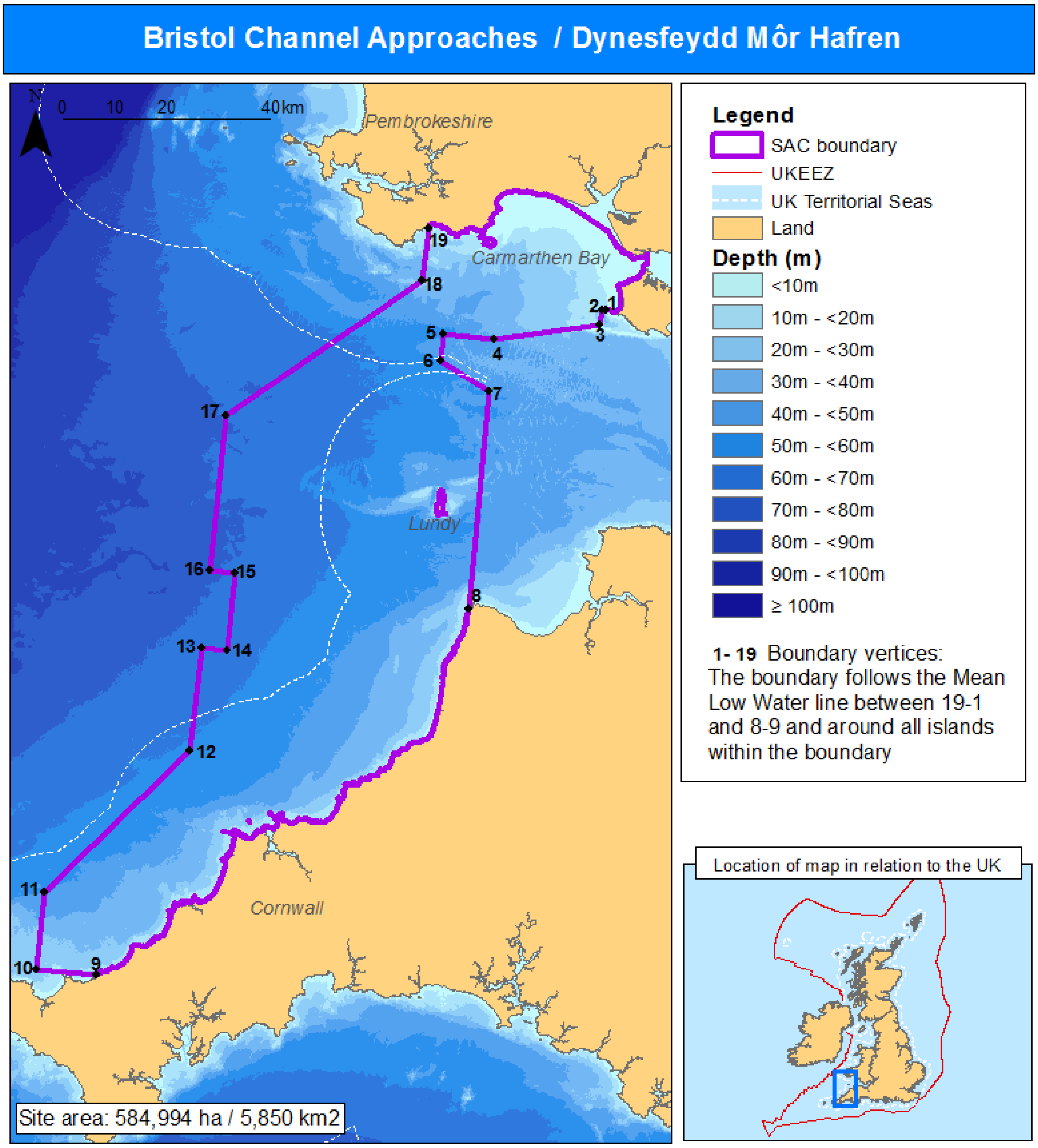
This document includes both a statement of the Conservation Objectives and explanatory text on their intent and interpretation specific to the site. The Objectives have been set taking account of European Commission guidance (EC, 2012). Further guidance on the management of specific pressures on harbour porpoise is being developed.

3.3 Bristol Channel Approaches / Dynesfeydd Môr Hafren SAC Conservation Objectives

The qualifying feature of the site is the Habitats Directive Annex II species:

- harbour porpoise (*Phocoena phocoena*)

Seasonal differences in the relative use of the site have been identified based on the analyses of Heinänen and Skov (2015). Harbour porpoise sightings data were modelled seasonally (Summer: April-September and Winter: October-March) for each MU. The outputs of this analysis were maps of areas by season and MU, that persistently contained elevated densities of harbour porpoises. These areas were used as the basis for site identification and as a consequence, sites may have seasonal components which should be considered in the assessment of impacts and proposed management. Bristol Channel Approaches / Dynesfeydd Môr Hafren (Figure 2) has been designated because of its importance to harbour porpoise in the winter months (October to March).



ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	51° 33' 50.9" N	4° 20' 1.3" W	**8**	51° 0' 32.0" N	4° 32' 9.0" W	**14**	50° 51' 6.0" N	5° 9' 27.8" W
2	51° 33' 48.3" N	4° 20' 44.1" W	**9**	50° 15' 17.4" N	5° 18' 49.2" W	**15**	50° 59' 6.7" N	5° 10' 52.6" W
3	51° 32' 12.4" N	4° 20' 28.6" W	**10**	50° 14' 35.3" N	5° 28' 27.3" W	**16**	50° 58' 48.7" N	5° 15' 6.3 W
4	51° 28' 26.2" N	4° 37' 7.9" W	**11**	50° 22' 35.6" N	5° 29' 53.4" W	**17**	51° 14' 49.8" N	5° 17' 59.2" W
5	51° 27' 52.1" N	4° 45' 44.3" W	**12**	50° 40' 7.3" N	5° 11' 48.0" W	**18**	51° 32' 55.6" N	4° 50' 56.4" W
6	51° 25' 11.8" N	4° 45' 17.1" W	**13**	50° 50' 48.2" N	5° 13' 40.9" W	**19**	51° 38' 16.5" N	4° 51' 52.1" W
7	51° 23' 5.2" N	4° 36' 17.1" W						

Figure 2: Bristol Channel Aproaches / Dynesfeydd Môr Hafren Special Area of Conservation for harbour porpoise.

The Conservation Objectives for the site are:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters In the context of natural change, this will be achieved by ensuring that: 1. Harbour porpoise is a viable component of the site; 2. There is no significant disturbance of the species; and 3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Conservation Objective 1: Harbour porpoise is a viable component of the site

This SAC has been selected primarily based on the long-term, relatively higher densities of porpoise in contrast to other areas of the MU. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies (e.g. between seasons), there is no exact number of animals within the site.

The intent of this objective is to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoises using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range. The reference population for assessments against this objective is the MU population in which the SAC is situated (IAMMWG 2015).

The harbour porpoise is a European Protected Species (EPS) listed on Annex IV of the Habitats Directive and as such is protected under the Habitats Directive Article 12 and transposing regulations from deliberate killing (or injury), capture and disturbance throughout its range. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States ‘shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned’. Site based measures should therefore be aligned with the existing strict protection measures in place throughout UK waters. Significant disturbance within or affecting the site is considered in the second conservation objective.

Conservation Objective 2: There is no significant disturbance of the species

Disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise including, as examples, seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise[7]. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.

This SAC was identified as having persistently higher densities of harbour porpoises (Heinänen and Skov 2015) compared to other areas of the MU. This is likely linked to the habitats within the site providing good feeding opportunities. Therefore, operations within or

[7] http://jncc.defra.gov.uk/page-4273

affecting the site should be managed to ensure that the animals' potential usage of the site is maintained. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site. Specifically, draft SNCB advice / guidance for assessing the significance of noise disturbance to a site suggests:

> Noise disturbance within an SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than:
>
> 1. 20% of the relevant area[8] of the site in any given day[9], and
>
> 2. an average of 10% of the relevant area of the site over a season[10,11].

Conservation Objective 3: The condition of supporting habitats and processes, and the availability of prey is maintained

Supporting habitats, in this context, means the characteristics of the seabed and water column. Processes encompass the movements and physical properties of the habitat. The maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site. Some evidence shows that the harbour porpoise has a high metabolic rate compared to terrestrial mammals of similar size (Rojano-Doñate et al. 2018) and high feeding rates (Wisniewska et al., 2016). The harbour porpoise is therefore thought to be a species that is highly dependent on a year-round proximity to food sources and its distribution and condition may strongly reflect the availability and energy density of its prey (Brodie 1995 in Santos & Pierce, 2003). The densities of porpoise using a site are likely linked to the availability (and density) of prey within the site. Harbour porpoise eat a variety of prey including gobies, sandeel, whiting, herring and sprat. However, the diet of porpoises when within the sites is not well known but is likely comparable to that in the wider seas.

There are several operations (Table 2) which potentially affect the achievement of this Conservation Objective. Whilst some plans/projects are unlikely to have a significant effect alone, an effect might become significant when considered in combination with other plans/projects and against the background of existing activities/pressures on the site. Further work is needed to assess historic, existing and planned levels of plans/projects in the sites and to better understand their impacts on the habitats and prey within the sites.

4 Advice on Operations

4.1 Purpose of advice

This section details the activities specifically occurring within or close to the Bristol Channel Aproaches / Dynesfeydd Môr Hafren SAC that would be expected to impact the site; this is

[8] The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive).
[9] Applicable only in Habitats Regulations Assessments (HRA) due to impracticality of daily noise limit management of activities, but retrospective compliance analysis advised
[10] Summer defined as April to September inclusive, winter as October to March inclusive
[11] For example, a daily footprint of 19% for 95 days would result in an average of 19x95/183 days (summer) =9.86%

known as Advice on Operations. Initial assessments were conducted at a UK scale, with subsequent site-level assessment detailing our understanding of the operations and their potential to impact the site (Sections 5 and 6). Advice is only given where pressures[12] may impact the site and therefore, may require management, if the Conservation Objectives are to be met. Widespread pressures may also act to affect the overall status of harbour porpoise, but their effects are not restricted to specific sites. Such pressures are best dealt with through broader measures. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy (DETR, 2000) has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG *et al* 2015), a UK Dolphin and Porpoise Conservation Strategy is being developed.

The advice outlined below should also be used to help identify the extent to which existing operations are, or can be made, consistent with the Conservation Objectives, and thereby focus the attention of Relevant and Competent Authorities and monitoring programmes to areas that may need management measures.

This Advice on Operations will be supplemented through further discussions with the Relevant and Competent Authorities and any advisory groups that may be formed for the site.

4.2 Background

In compiling this Advice on Operations, the SNCBs have considered the pressures that may be caused by human activities and may affect the integrity of the site when considered against the Conservation Objectives. The advice is generated through a broad grading of sensitivity and exposure of the harbour porpoise to pressures associated with activities to gain an understanding of how vulnerable the species is to each activity at a UK level. The activities and their associated pressures to which the harbour porpoise is deemed vulnerable at a UK level are then considered at a site level to inform the risks to achieving the Conservation Objectives along with any potential management that may be required to mitigate against such risks. Annex A details the assessments of the level of impact risk[13] from operations on harbour porpoise populations at a UK-wide scale. This informs on the activities/operations likely to impact the site.

This document is guidance only and activities/operations and their management within or affecting the site will be considered in the context of a Habitats Regulations Assessment (HRA) and where applicable through other environmental assessment processes, such as Environmental Impact Assessment (EIA).

5 Operation assessments at UK scale

The assessments have been carried out using all available evidence as of February 2019. If further information is made available in future which would improve our understanding of harbour porpoise vulnerability in UK waters, the assessments may be updated. This advice is provided without prejudice for use by the Relevant and Competent Authorities. The level of any impact will depend on the location, timing and intensity of the relevant operation. This advice is provided to assist and focus the Relevant and Competent Authorities in their consideration of the management of these operations.

The harbour porpoise is a wide-ranging species and occurs throughout the UK Continental Shelf area (JNCC, 2013). It does occur in deeper waters but in very low densities, and

[12] See Annex B for definition of key terms
[13] Risk includes consideration of severity of implications of impact

perhaps only seasonally. As a predominantly continental shelf species, it is exposed to a wide range of pressures that are both ubiquitous (e.g. pollution) and patchy (e.g. bycatch) in nature, and the list of anthropogenic activities leading to these pressures is long. Based on current available information, the operations that pose the most notable risk of impact to UK harbour porpoise are shown in Table 1.

The current levels of impact of the various pressures are based on the Article 17 assessments[14] and the full list of assessed activities and key references can be found in Annex A. Updates to the assessments will occur as more evidence becomes available. Definitions of pressures are explained in Annex B.

Activities which currently pose a low risk of impact to harbour porpoise at the UK level (Annex A) have not been considered in this advice. The exposure to the pressures associated with these activities is currently very limited. Non-anthropogenic impacts are also not considered, such as attack and predation from other marine mammal species that have the potential to impact harbour porpoise populations.

[14] EU Habitats Directive Article 17 assessment, harbour porpoise report: http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf . Updated Article 17 reports for 2013-2018 will be available in 2019.

Table 1: Key activities (operations) and the relative level of risk of impact on harbour porpoise in UK waters. Those pressures ranked 'high' are known to have the greatest impact relative to other pressures on the population of UK harbour porpoises. Activities which currently pose a low risk are not shown.

Operations	Pressures	Impacts	Current relative level of risk of impact
Commercial fisheries with bycatch of harbour porpoise (predominantly static nets)	**Removal of non-target species**	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion • Health issues (e.g. on reproduction)	High
Shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	**Anthropogenic underwater sound**	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium
Shipping, recreational boating, tidal energy installations	**Death or injury by collision**	• Mortality • Injury	Medium/Low
Commercial fisheries (reduction in prey resources)	**Removal of target species**	• Reduction in food availability • Increased competition from other species • Displacement from natural range	Medium

6 Site specific considerations: Bristol Channel Approaches/ Dynesfeydd Môr Hafren SAC

6.1 Sensitivity of harbour porpoise to existing activities within or impacting on the site

The Bristol Channel Approaches / Dynesfeydd Môr Hafren site covers an area of 5,850km^2 and stretches along the north Cornish coast and across the Bristol Channel north towards Carmarthen Bay in Wales. Further detail on the site can be found in the Selection Assessment Document on the Site Information Centre[15].

All available information on activities within the site has been used to assess the threats and pressures within the site. However, precise information on some activities within the boundary is not currently available due to lack of targeted data collection to date. Assessing

[15] Site Information Centre for BCA: http://jncc.defra.gov.uk/page-7241

exposure carries certain assumptions about the spatial extent, frequency and intensity of the pressures associated with marine activities.

Table 2 is an overview of activities (operations) occurring within or in proximity to the Bristol Channel Approaches / Dynesfeydd Môr Hafren site to which the harbour porpoise has a current level of impact risk of High or Medium at UK level (Table 1) and therefore may require further consideration concerning options for management. The impact of a pressure at the site level can differ to that at UK level dependent on the amount of activity within or adjacent to the site. GIS layers of spatial activity data as well as review of literature, were used to identify the impact risk within the site (where a pressure is concentrated within a site) and whether it differs from the UK level risk. These assessments include all available information as of February 2019.

In 2012, Defra announced a revised approach to the management of fishing activities within European Marine Sites (EMS) in England[16]. The revised approach is designed to ensure consistency in the management of fishing activities with Article 6 of the Habitats Directive. Risk based prioritisation of managing the fishing activities of UK and non-UK vessels has been applied to relevant SAC features within the English 12 nm territorial limit. For SACs or parts of SACs outside of 12 nm, management measures will be introduced by appropriate regulators to ensure adequate protection.

The Welsh Government is assessing new fisheries legislation and permitted activities under Article 6 of the Habitats and Birds Directives. The Welsh Government, in partnership with Natural Resources Wales, are undertaking a structured evaluation of the impacts from fishing activities (from licensed and registered commercial fishing vessels) on the features of Marine Protected Areas (MPA) in Welsh waters. This is referred to as the Assessing Welsh Fishing Activities (AWFA) Project[17]. The Welsh Government is responsible for decisions relating to whether additional management measures are required to avoid impacts to features of MPAs in Welsh waters. The evidence base provided by the AWFA Project will inform fisheries management decisions and support the aims of The Well-being of Future Generations (Wales) Act 2015, The Environment (Wales) Act 2016 and the Habitats Directive by contributing to the sustainable management of the marine environment.

JNCC and the country SNCBs are working with the Regulators and Industry to ensure that a pragmatic approach to mitigation and management of pressures that may affect the integrity of the site is adopted. Any future guidance documents will be made available on the Site Information Centre on the JNCC website.

[16] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

[17] https://naturalresources.wales/about-us/our-projects/marine-projects/assessing-welsh-fishing-activities/?lang=en

Table 2: Operations (activities) occurring within/near to the Bristol Channel Approaches/ Dynesfeydd Môr Hafren site which may affect the integrity of the site.

Operations	Pressure	Comment on current level of activity	Management considerations
Fisheries (commercial and recreational) with harbour porpoise bycatch	Removal of non-target (bycatch) species	Bycatch of harbour porpoise in fishing gear is one of the most significant anthropogenic pressures impacting the population at a UK level. The commercial fisheries most associated with harbour porpoise bycatch are bottom set nets, such as gillnets and tangle nets. Data obtained from the UK Bycatch Monitoring Programme shows higher levels of fishing effort in parts of the site, with small vessels (<12m) deploying both static and drift nets throughout the site, resulting in particularly high effort along the Cornish coast. The high effort is partly located within the site, but extends around Penzance and along the south coast of England. Bycatch has been recorded within the site, but is higher in the surrounding areas, particularly in the South Western Approaches, although with differing vessel types/metiers (ICES 7d-g) (e.g. Northridge *et al* 2016). According to Vessel Monitoring System (VMS) data, there is some static net effort from larger (≥12m) UK vessels in western offshore waters of the site but limited evidence	Where bycatch may pose a risk to achieving the site's conservation objectives, the site may have to be assessed and where necessary, mitigation may need to be considered. Where management measures are required, the development of these would be led by fishery managers in discussion with fishing interests and informed by any detailed information about fishing activity that can be made available. Detailed measures, if required, will be developed by the relevant management authority (European Commission/MMO/IFCA/Defra/Welsh Government). Current measures in place to mitigate bycatch are the use of pingers to comply with Reg812/2004. However, gillnetters of >12m working within the site operate within ICES area VIIa and are not legally required to use pingers under EU Regulation 812/2004[18]. The bulk of the bycatch in the UK is taken by the numerous small bottom-set gillnetting vessels (<12m), for which the use of pingers is not mandatory under Regulation 812/2004.

[18] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:150:0012:0031:EN:PDF

		for non-UK vessel activity. Recreational netting also occurs at a low level of effort along the coast (at least in Wales) but bycatch here is thought to be negligible.	
Discharge/ run-off from land-fill, terrestrial/ offshore industries	Contaminants	Current exposure within/near the site is unknown. Historical metal mining operation outfalls potentially exist within the site.	This pressure generally cannot be managed effectively at the site level. Most of the relevant pollutants have been effectively phased out of use by action under the OSPAR Convention and, more recently, the EU (through Council Directives 67/548/EEC and 76769/EEC and the Stockholm convention, which restrict the marketing and use of PCBs; plan for disposal of PCBs; and eliminate or restrict the production and use of persistent organic pollutants [POPs]). However, human activities are the most likely cause of the re-release of these chemically stable chemicals into the environment or for introduction of other contaminants of which the impacts are poorly known. Any novel sources of potential contamination and/or activities likely to cause re-release of pollutants form stores associated with a new plan or project will be assessed under HRA both within and outside the site where there is the potential to impact upon site integrity. Current sources of exposure have to be identified and further efforts to limit or eliminate PCB discharges to the marine environment may still be needed.
Shipping	Anthropogenic underwater sound	Moderate levels of shipping through the site, predominantly running parallel to the coast of SW England and SW Wales into Bristol Channel ports (Cardiff, Newport, Barry and Avonmouth). Some aggregate is landed at Burry port in the north of the site.	Harbour porpoise use sound for foraging, navigation, communication and predator detection. Underwater noise therefore has the potential to interrupt or affect these behaviours as well as cause hearing damage, particularly at short distances. The peak frequency of echolocation pulses produced by harbour porpoise is 120–130 kHz, corresponding to their peak hearing sensitivity although hearing occurs throughout the range of ~1 and 180 kHz (Southall *et al* 2007). The underwater sounds created by large ships are unlikely to cause physical trauma, but could make preferred habitats less attractive as a result of disturbance (habitat

			displacement, area avoidance). However, additional management is unlikely to be required based on current levels of activity within the site. Significant increases in vessel traffic, for example as may be associated with the installation of large-scale marine developments in the area, would be routinely assessed in HRA.
Pile Driving		There are currently no plans for the development of a commercial offshore windfarm within/close to the site although there are proposals for trials of small numbers of floating turbines at Wave Hub off the N Cornwall coast within the site. Harbour/marina developments and other marine developments, may utilise impact piling during construction.	A European Protected Species (EPS) licence may be needed for any construction activity which carries the risk of significant disturbance or deliberate injury to cetaceans. Developers are advised to follow the 'Statutory Nature Conservation Agency protocol for minimising the risk of injury to marine mammals from piling noise'[19]. Management measures will be assessed if and when new plans or projects come forward. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Dredging and disposal		Small overlap of a dredge disposal site close to the English coast.	Dredging and disposal can cause disturbance leading to changes in harbour porpoise behaviour as well as to their habitat and prey. There is also potential for resuspension of pollutants from the sediment. The risk from single plans/projects may be considered relatively low but this is assessed through a formal HRA. However, there is currently considerable uncertainty regarding effects on habitat and prey. New dredge and disposal projects (or licence renewals) are subject to HRA. Cumulative impacts will be considered within the HRA.
Aggregate extraction		An active aggregate extraction site is located within the site (Nobel Bank).	Aggregate extraction can cause disturbance leading to changes to harbour porpoise behaviour as well as to their habitat and prey. However, the risk is considered relatively low for single plans/projects and additional management is unlikely to be required. New aggregate extraction projects (or licence renewals) are subject to HRA.

[19] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf

			Cumulative impacts will be considered within the HRA.
Geophysical surveys (including seismic)		Commercial seismic activity is currently of a low level in the site, although large-scale surveys have covered areas within the site boundary in the past. Some acoustic surveys are carried out in relation to marina works. Commercial and research based acoustic seabed surveys using multibeam and/or sidescan sonar occur in parts of the site.	Some geophysical surveys that may affect the integrity of the site may require consent and be subject to HRA. Each case needs to be assessed individually, and the *JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys* (updated August 2017[20]) are available online. Within the guidance, seismic survey is defined as *'Any geophysical survey that uses airguns to generate sound which is sent into the seabed and the reflected energy is recorded and processed to produce images of the geological strata below; described as 2D, 3D and 4D and includes any similar techniques that use airguns.'* There may also need to be a consideration of sub-bottom profilers in HRA on a case by case basis. It is currently not known whether these could cause disturbance to harbour porpoise. Further research is needed to understand the sound propagation and effect ranges from these types of equipment. Cumulative impacts of geophysical surveys will need to be considered. Further advice on assessment and management of noisy activities within the sites is being developed by the SNCBs in consultation with Regulators, industry and NGOs.
Recreational boating activity		Royal Yachting Association (RYA) cruising routes throughout the site. Some pockets of higher sailing and racing activity around Tenby, Padstow and between Barnstaple and Lundy Island.	Adherence to wildlife codes of conduct is already advocated, e.g: WiSe scheme; SeaWatch code of conduct; ZSL code of conduct; The RYA good practice guide - The Green Wildlife Guide for Boaters; Cornwall Marine and Coastal Code; Wild Seas Wales and Swansea code of conduct. UK SNCBs are looking at the option of developing a wildlife watching code of conduct to sit alongside the Scottish code.
Acoustic deterrent/mitigation devices		Negligible or not currently present but may be used as a mitigation tool during	Management/assessment would be required for use of devices in the site since they introduce noise to the environment and are designed to disturb marine mammals.

[20] http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_apr2017.pdf.

		noise-generating activities.	
Pinger devices		Requirement on >12m vessels (EC Reg812/2004). All southwest based (e.g ICES area VIIe,f,g,h) >12m vessels have the Dolphin Deterrent Device (DDD) pingers. But none of the registered set net vessels >12m are known to fish in the site.	See 'Fisheries (commercial and recreational) with harbour porpoise bycatch'. The use of pingers is already required under Reg812/2004 for >12m sector but the relevant registered set net vessels do not fish within the site. However, because vessels <12m are the greatest component of the UK gillnetting fleet, most bycatch occurs in this sector. Effort by this sector of the fleet in the site is currently considered low and, therefore, risk of bycatch is also likely to be low. The need for further management will need to be fully assessed based on local fisheries data but it is currently considered unlikely that further measures will be required. If further measures were deemed necessary, one option for management could be to extend the pinger requirement to vessels deploying static nets within site boundaries. However, the impact of potential disturbance as a result of pinger use in the site may need to be assessed and the potential for other mitigation options such as alternative gear types or gear modifications could be considered.
Military activity		Pendine and Pembrey MOD firing ranges are situated in Carmarthen Bay but out with the site. Pendine regularly has firing activity directly into the sea whereas activity at Pembrey is usually limited to low flying aircraft and terrestrial target practice. Regardless of the location of known firing ranges, the MOD can operate anywhere in UK waters.	Activities take place under Range Standing Orders, command guidance and environmental risk management tools, which include measures to reduce the risk of killing, injury and disturbance of marine mammals (for example live firing trials are subject to confirmation that marine mammals are not present in the vicinity of targets). No further management is considered necessary as MOD, which are a Competent Authority, incorporates the cSACs into their assessments via their MOD Environmental Protection Guidelines (Maritime) and Marine Environment and Sustainability Assessment Tool (MESAT)[21].
Unexploded ordnance (UXOs)		Unknown whether they exist in the site. However, unexploded ordnance from WWII	Although the impact from removal (detonation) of unexploded ordnance (UXOs) is short term, the noise is significant and can cause injury or

[21] http://www.royalnavy.mod.uk/-/media/royal-navy-responsive/documents/useful-resources/environmental-protection/environmental-protection-guidelines-maritime-v21.pdf?la=en-gb

		can be found in many areas in UK seas. UXO is also possible from military activity such as within firing ranges. Projects that could inadvertently explode UXOs must undertake a survey to search for possible ordnance ahead of the project commencing. Any ordnance found must be exploded on site, or removed for health and safety reasons.	death to harbour porpoise. A HRA may be required. A European Protected Species licence may also be required. Mitigation is usually required to reduce risk of injury and killing. As a minimum, the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives are applied. A combination of Marine Mammal Obervers (MMO)s, Acoustic Deterrent Devices (ADD) and occasionally scare charges are used to ensure harbour porpoise and other marine mammals are a sufficient distance from the explosion to prevent death or injury. Discussions are ongoing between industry, regulators and SNCBs on the most appropriate suite of mitigation measures for UXO clearance (including the possible use of bubble curtains). This will depend on the size of UXOs likely to be encountered and the practicality of deployment of the mitigation measure, amongst other factors.
Shipping	Death or injury by collision	Relatively low levels of shipping (see above).	Post mortem investigations of stranded harbour porpoise (Deaville and Jepson, 2011; Deaville 2011:2017) have revealed some deaths caused by trauma (potentially linked with vessel strikes). However, this is not currently considered a significant risk and no additional management is likely to be required.
Recreational boating activity		Cruising routes throughout the site. Some pockets of higher sailing and racing activity around Tenby, Padstow and between Barnstaple and Lundy Island. Wildlife watching organisations also operate in the SAC.	See 'Shipping' (with death or injury by collision) above. Boats conducting recreational activity should adhere to wildlife codes of conduct to avoid risk of collision (see 'recreational boating activity' with regards to underwater noise).
Wet renewable energy installations		South Pembrokeshire demonstration zone for wave energy is situated directly outside of the boundary. North Cornwall 'Wavehub' wave energy leasing areas exists within the site.	New tidal range, tidal stream and wave projects would be subject to a HRA. Additionally, an EPS licence might be suitable if there is a residual risk of significant disturbance or injury. Any consented, but not yet built, tidal stream and tidal range developments likely to impact the SAC will likely undergo a review of consent. Animal detection systems, e.g. active and passive acoustics, may be used to monitor animal presence and behaviour

			around devices for consented projects. These systems might be used to establish any probable collisions and invoke adaptive management decisions. In addition, the use of ADDs has been suggested as a mitigation tool to exclude animals from the vicinity of devices. Potential future mitigation related to death or injury by collision will be based on new and emerging research and evidence.
Commercial fisheries (and recreational set nets)	Removal of target (prey) species	Demersal fisheries operate within the site, targeting species such as flatfish, whiting and other demersal round fish as well as other potential harbour porpoise prey. Also, pelagic fisheries target sandeel, sprat, herring and mackerel. The prey of harbour porpoise when in the site is currently unknown.	Currently, most commercial species are managed at scales relevant for stock management via the Common Fisheries Policy (CFP), and not at the site level. Harbour porpoise diet within UK waters includes a wide variety of fish and they will generally focus on the most abundant local species (De Pierrepont *et al* 2005; Camphuysen *et al* 2006). The predominant prey type in UK appears to be whiting, gobies and sandeel, although shoaling fish such as mackerel and herring are also taken. Harbour porpoise diets overlap extensively with diets of other piscivorous marine predators (notably seals) and many of the main prey species are also taken by commercial fisheries, although porpoise tend to take smaller fish than those targeted by fisheries (Santos and Pierce 2003). The overlap between commercial fisheries and harbour porpoise prey is unknown within the site. Further research is required to establish whether any management will be required.

6.2 Limitations of the evidence

It is important to note that the information used to catalogue activities occurring within the site is not complete. The available data are drawn from existing monitoring programmes (e.g. the UK's Bycatch Monitoring Scheme for Protected Species and other European datasets linked to VMS monitoring of fishing vessels) but these have limitations, including availability and accessibility of data at the time of preparing this advice. Caveats with how the data have been collected also need to be understood to correctly interpret the information. This has resulted in the use of expert judgement where sufficient evidence is lacking but risk is implied. Below are some points to consider alongside the above table to ensure the information is not taken out of context:

- **Data availability**

- Globally, the marine environment, particularly in offshore areas, is generally far behind the evidence levels for the terrestrial environment, mainly due to scale and difficulty/cost of data acquisition.
- There can be sensitivities surrounding data that have been gathered by industry, and some data are not available for use for advice and management purposes. Often these data can become available, but not in time to inform management decisions.

- **Fishing: Limitations of fishing Vessel Monitoring System (VMS) data**
    - VMS positional data are transmitted at approximately 2 hour intervals. There is no information transmitted regarding precise vessel activity, therefore assumptions about activity, based on logbook returns and vessel speed profile, are often made.
    - Vessel positional data (VMS) cannot inform regulators regarding extent of static gear deployment or soak times.
    - Fishing vessels under 12m long, (and until 2013, vessels under 15m long) are not required to use the VMS, and therefore VMS data tells us nothing regarding the activity of this segment of the fleet. However, local information can be obtained from fisheries management authorities and will be used to develop more detailed guidance to assist with identification of any management measures where considered necessary.
    - In Wales, the Scallop fishing fleet (mostly <12m long) have vessel tracking devices (Succorfish). There is no evidence of harbour porpoise bycatch associated with this fleet.

- **Contaminants**
    - Although use of many of the relevant substances (e.g. PCBs) has been heavily regulated for many years, including a ban on further production, re-suspension or reintroduction of pollutants may occur. It is difficult to identify sources of contamination when dealing with highly mobile species.

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8 Annex A: Assessment of the level of impact risk from operations (activities) on UK harbour porpoise populations

The relative level of risk of impact to harbour porpoise from a range of pressures was assessed at UK level (Table A1) as part of the 3rd reporting round for Article 17[22]. See Annex B for the definitions of pressures as used for the harbour porpoise assessments. For the assessment the relative importance of the pressure was assessed by considering the evidence available of an impact and the nature of that impact (direct/indirect) together with the area over which the pressure is acting in UK waters in relation to the species distribution. The relative levels are assigned according to the Artcile 17 guidance (Evans and Marvela, 2013) as:

Code	Meaning	Comment
H	High importance/impact	Important direct or immediate influence and/or acting over large areas
M	Medium importance/impact	Medium direct or immediate influence, mainly indirect influence and/or acting over moderate part of the area/acting only regionally
L	Low importance/impact	Low direct or immediate influence, indirect influence and/or active over small part of the area/acting only regionally

Table A1 Full assessment of level of the impact risk from operations (activities) on harbour porpoise in UK waters based on considerations for Article 17 assessment for harbour porpoise conservation status[23].

Operations	**Pressures**	**Impacts**	**Relative level of risk of impact**	**Evidence**		**Key references**
				Spatial overlap (species & pressure)	**Post-mortem examination**	
Commercial fisheries with bycatch (predominantly static nets)	Removal of non-target species	• Mortality through entanglement/bycatch	High	✓	✓	Deaville and Jepson, 2011; Morizur *et al* 1999; Read *et al* 2006; Northridge, S. and Kingston, A. 2010; Northridge *et al* 2016; ICES 2015b
Discharge/run-off from land-fill, terrestrial and offshore industries	Contaminants	• Effects on water and prey quality • Bioaccumulation through contaminated prey ingestion	High		✓	Jepson *et al* 2005; Jepson *et al* 2016; Deaville & Jepson, 2011; ICES, 2015a; Van De Vijver *et al* 2003; Law *et al* 2012; Pierce *et al* 2008; Murphy *et al* 2015.

[22] http://jncc.defra.gov.uk/page-6564
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		• Health issues (e.g. on reproduction)				
Noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	Anthropogenic underwater sound	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising) • Habitat change/loss	Medium	✓		Deaville & Jepson, 2011; Stone & Tasker, 2006; Stone, 2015; Jepson *et al* 2005; Fernandez *et al* 2005; Würsig & Richardson, 2009; WGMME, 2012.
Shipping, recreational boating, renewable energy installations	Death or injury by collision	• Mortality • Injury	Medium/ Low	✓	✓	Deaville & Jepson, 2011; Dolman *et al* 2006; ICES 2015a
Commercial fisheries, bycatch	Removal of target species	• Reduction in food availability • Increased competition from other species • Displacement from natural range • Habitat change/loss	Medium		✓	Simmonds and Isaac, 2007; OSPAR QSR 2010; MacLeod *et al* 2007a, b; Thompson *et al* 2007; Santos and Pierce, 2003; Pierce *et al* 2007; ICES 2015b
Agriculture, aquaculture, sewage	Nutrient enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓	✓	Craig *et al* 2013
Agriculture, aquaculture, sewage	Organic enrichment	• Effects on water quality • Increased risk of algal blooms may present health issues • Habitat change/loss	Low	✓		Craig *et al* 2013
Waste disposal - navigational dredging (capital, maintenance)	Physical change (to another seabed type)	• Changes in availability of prey species • Habitat change/loss	Low			
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Water flow (tidal current) changes - local	• Changes in location of prey species • Displacement of harbour porpoise • Habitat change/loss	Low			

Terrestrial and at-sea ‘disposal’	Litter	• Mortality through entanglement • Ingestion	Low	✓	✓	Deaville and Jepson, 2011
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Barrier to species movement	• Habitat inaccessible • Potential physiological effects • Habitat change/loss	Low	✓		WGMME., 2012; ICES 2015a
Sewage	Introduction of microbial pathogens	• Increased risk of disease	Low		✓	Harvell *et al* 1999; Gulland and Hall, 2007; Van Bressem *et al* 2009

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9 Annex B: Definitions of Pressures as applied within harbour porpoise SAC Advice on Operations

Pressures	**Definition in the context of harbour porpoise advice**
Removal of non-target species	The removal of species not targeted by the fishery; in this case the bycatch (and probable mortality) of harbour porpoise
Contaminants	Introduced material capable of contaminating harbour porpoise, prey or habitat important to harbour porpoise, with a negative impact directly or indirectly on porpoises
Anthropogenic underwater sound	Introduced noise with the potential to cause injury, stress or disturbance of harbour porpoise
Death or injury by collision	Introduction of physical objects; mobile or immobile, that may collide with or result in potential collision of harbour porpoise resulting in injury or mortality
Removal of target species	Removal of harbour porpoise prey, resulting in increased competition amongst porpoise and other species, and/or displacement from their natural range

Appendix R Isles of Scilly Complex SAC

European Site Conservation Objectives for Isles of Scilly Complex Special Area of Conservation
Site Code: UK0013694

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks

H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats

H1170. Reefs

S1364*. Halichoerus grypus*; Grey seal

S1441*. Rumex rupestris*; Shore dock

This is a European Marine Site

This site is a part of the Isles of Scilly Complex European Marine Site. These Conservation Objectives should be used in conjunction with the Conservation Advice document for the EMS. Natural England's formal Conservation Advice for European Marine Sites can be found via GOV.UK.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix S Lundy SAC

European Site Conservation Objectives for Lundy Special Area of Conservation Site Code: UK0013114

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks

H1170. Reefs

H8330. Submerged or partially submerged sea caves

S1364*. Halichoerus grypus*; Grey seal

This is a European Marine Site

This site is a part of the Lundy European Marine Site. These Conservation Objectives should be used in conjunction with the Conservation Advice document for the EMS. Natural England's formal Conservation Advice for European Marine Sites can be found via GOV.UK.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Appendix T The Maidens SAC

THE MAIDENS SAC

UK0030384

CONSERVATION OBJECTIVES

Document Details

Title	*The Maidens SAC Conservation Objectives*
Prepared By	*L. Pothanikat*
Approved By	*J. Breen*
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V1	January 2016	Internal working document	LP
V2	March 2017	Complete review	LP

Department of Agriculture, Environment and Rural Affairs
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INVESTORS IN PEOPLE

1. INTRODUCTION

EU Member States have a clear responsibility under the Habitats and Birds Directives[1] to ensure that all habitats and species of Community Interest are maintained or restored to Favourable Conservation Status (FCS). Natura 2000 sites have a crucial role to play in achieving this overall objective since they are the most important core sites for these species and habitats. Each site must therefore be managed in a way that ensures it contributes as effectively as possible to helping the species and habitats for which it has been designated reach a favourable conservation status within the EU.

To ensure that each Natura 2000 site contributes fully to reaching this overall target of FCS, it is important to set clear conservation objectives for each individual site. These should define the desired state, within that particular site, of each of the species and habitat types for which the site was designated.

Once a site has been included in the Natura 2000 network, Member States are required to implement, on each site, the necessary conservation measures which correspond to the ecological requirements of the protected habitat types and species of Community Interest present, according to Article 6.1 of the Habitats Directive. They must also prevent any damaging activities that could significantly disturb those species and habitats (Article 6.2) and to protect the site from new potentially damaging plans and projects likely to have a significant effect on a Natura 2000 site (Article 6.3, 6.4).

Conservation measures can include both site-specific measures (i.e. management actions and/or management restrictions) and horizontal measures that apply to many Natura 2000 sites over a larger area (e.g. measures to reduce nitrate pollution or to regulate hunting or resource use).

In Northern Ireland, Natura 2000 sites are usually underpinned by the designation of an Area of Special Scientific Interest (ASSI) under the Environment (NI) Order 2002 (as amended).

[1] 92/43/EEC and 2009/147/EC (codified version of Directive 79/409/EEC as amended)

2. ROLE OF CONSERVATION OBJECTIVES

Conservation Objectives have a role in

- Conservation Planning and Management – guide management of sites, to maintain or restore the habitats and species in favourable condition

- Assessing Plans and Projects, as required under Article 6(3) of the Habitats Directive - Habitats Regulations Assessments (HRA) are required to assess proposed plans and projects in light of the site's conservation objectives.

- Monitoring and Reporting – Provide the basis for assessing the condition of a feature, the factors that affect it and the actions required.

3. DEFINITION OF FAVOURABLE CONSERVATION STATUS

Favourable Conservation Status is defined in Articles 1(e) and 1(i) of the Habitats Directive:

The conservation status of a natural habitat is the sum of the influences acting on it 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. The conservation status of a natural habitat will be taken as favourable when:

- Its natural range and 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
- The conservation status of its typical species is favourable as defined in Article 1(i).

For species, favourable conservation status is defined in Article 1(i) as when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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 population on a long term basis.

3.1 DEFINITION OF FAVOURABLE CONDITION

Favourable Condition is defined as "**the target condition for an interest feature in terms of the abundance, distribution and/or quality of that feature within the site"**.

The standards for favourable condition (Common Standards) have been developed by JNCC and are applied throughout the UK. Achieving Favourable Condition on individual sites will make an important contribution to achieving Favourable Conservation Status across the Natura 2000 network.

4. SITE INFORMATION

COUNTY: DOWN

REFERENCE COORDINATES: 54.9436 -5.7519

AREA: 7461.36 ha

5. SUMMARY SITE DESCRIPTION

The Maidens proposed SAC is a group of rocky reefs detached from the coast, north east of Larne, Northern Ireland. The Maidens (or Hulin Rocks) are identified on the Admiralty Charts as a group of small rocky reefs either awash or just emergent. In only two cases are they large enough to be termed islands and to carry buildings, namely the West Maiden, which has a disused lighthouse and the East Maiden, which supports the present lighthouse (cover photograph inset). As well as the main reef plateau of East and West Maiden, there are also four other reef areas that form a part of the proposed SAC: North Klondyke Shoal which is a large submerged reef or shoaling, approximately 9 km north of West Maiden; Outer Klondyke Pinnacle, a submerged pinnacle 6km east of West Maidens; an unnamed small deep reef 8km north west of West Maiden; and Hunter Rock 5km to the south of West Maiden.

The primary reason for the proposed designation of The Maidens as an SAC is for the Annex I habitat *Reef*. Most of the reef area of The Maidens is bedrock reef with a smaller proportion of stony reef. From the multibeam echo sounding (MBES) survey analysis, combined with video tow ground truthing, some of the area has been classified as 'rock with sand infill'. It is suggested that most of this 'rock with sand infill' should be classed as Annex I *Reef* as the ground truthing suggests that the mobile sand veneer would cover and uncover that reef area.

A small area to the south of East Maiden island has been shown by diving surveys to be shallow stable sandy gravels (partially sheltered by East and West Maiden islands) that includes maerl and other long lived species and this small area has therefore been classed as Annex I *Sandbanks slightly covered by sea water all of the time*.

Like Annex I *Sandbanks slightly covered by seawater all the time*, Annex II *Grey seals* are not the primary feature of The Maidens proposed SAC. However, these relatively remote rocks, islands and the waters surrounding them in the North Channel are important for providing haul-out sites, resting sites and foraging areas for *Grey seals*, with a maxima count of 70 adults recorded in a July 2000 survey. Recent surveys in 2009 confirmed use of the site for both pupping and breeding.

Further details of the site are available on the NIEA website (https://www.daera-ni.gov.uk/publications/reasons-designation-special-area-conservation-maidens).

5.1 BOUNDARY RATIONALE

The boundary around The Maidens site has been drawn using the guidance provided by the JNCC (2004, amended by Aish *et al*. 2008), and was defined through GIS modelling using data from the mapping survey and considered against the guidelines. The key parts of this guidance are that the boundary should be restricted to only include Annex I habitat or that which is required for the maintenance of that habitat and the boundary line defined in whole degrees and minutes and seconds where possible. NIEA have used minutes to two decimal places as an equivalence of seconds as it is more commonly displayed on vessel GPS/Chartplotter systems. The guidance also states that the boundary should include as little non-Annex I habitat as possible, and should also be sufficient to allow for elimination of potential damage to the area from activities such as trawling and dredging.

The Maidens site is made up of five blocks of Annex I Reef:

1. The Maidens plateau
2. North Klondyke shoal
3. Deep reef west of North Klondyke
4. Outer Klondyke pinnacle
5. Hunter Rock

The North Klondyke shoal and the Outer Klondyke pinnacle are separated from each other and from the main Maidens plateau by deep sediment channels, over 200m deep in places, and these deep sediment channels have been excluded from the SAC area.

The Annex I sandbank (maerl and sandy gravel) feature is small and sited on The Maidens plateau reef area south of the East Maiden lighthouse.

The site is almost entirely subtidal and is remote from the coast. At the small islands of East Maiden and West Maiden and on the emergent outlying rocks the boundary of the proposed SAC extends up to Mean High Water. These intertidal areas include haul-outs for Annex II Grey seal and Common seal and are already designated in national legislation as an Area of Special Scientific Interest (ASSI).

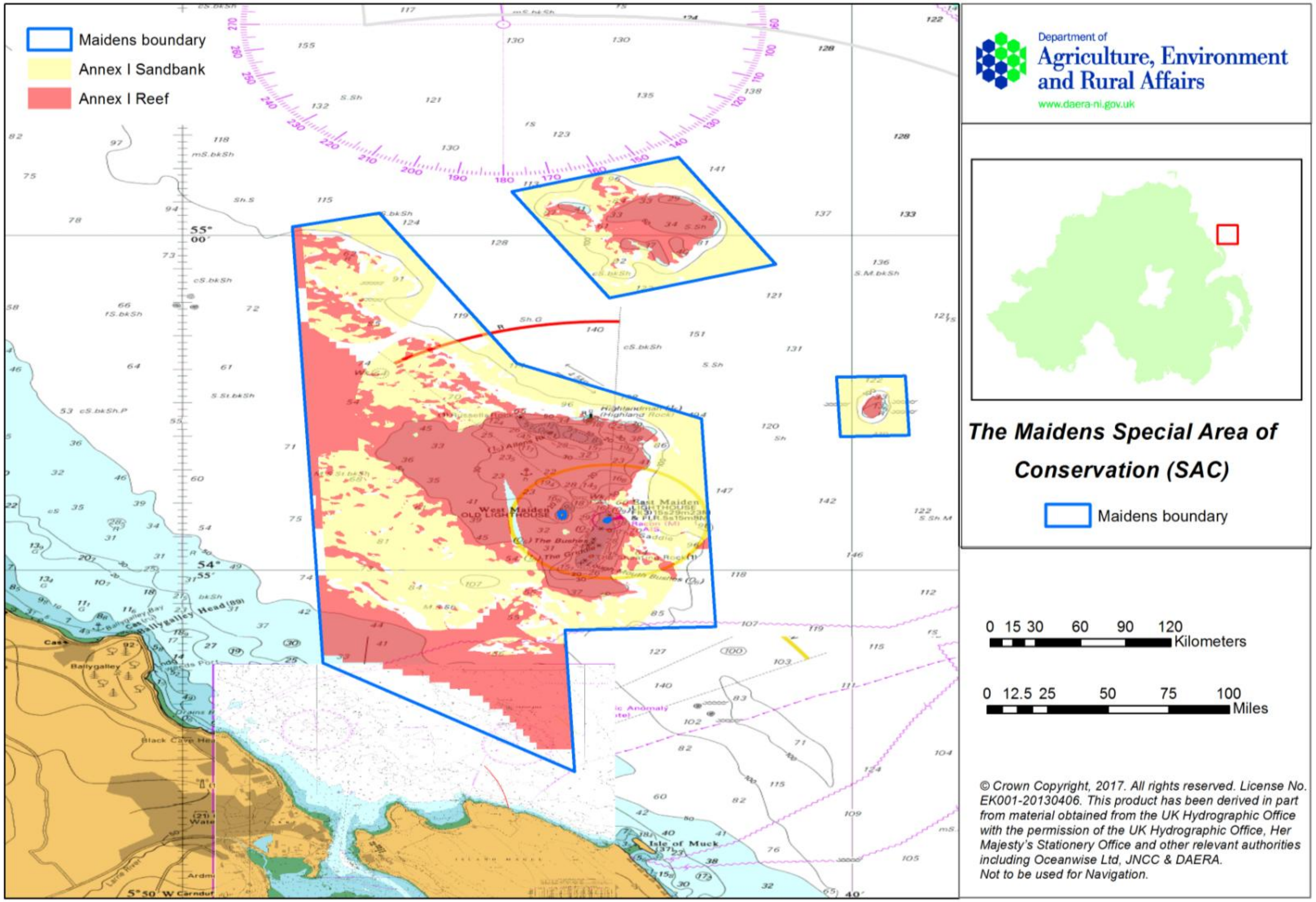

Figure 1 The Maidens SAC with Annex I habitats Reef and Sandbanks which are slightly covered by seawater all of the time

6. SAC SELECTION FEATURES

Feature type	Feature	Global Status	Size/ extent/ pop.
Habitat	Reef	A	2550 ha
Habitat	Sandbanks which are slightly covered by sea water all the time	B	200 ha
Species	Grey Seal *Halichoerus grypus*	C	50 individuals
Species	Common Seal *Phoca vitulina*	D	
Species	Harbour Porpoise *Phocoena phocoena*	D	

Table 1. List of SAC selection features. Those with global status A-C will be referred to in ANNEX I.

The global status is an expert judgement of the overall value of the site for the conservation of the relevant Annex I habitat. Sites have been graded A, B or C - in the UK these gradings have been interpreted as follows:

A - Sites holding outstanding examples of the habitat in a European context.

B - Sites holding excellent stands of the habitat, significantly above the threshold for SSSI/ASSI notification but of somewhat lower value than grade A sites.

C - Examples of the habitat which are of at least national interest (i.e. usually above the threshold for SSSI/ASSI notification on terrestrial sites) but not significantly above this. These habitats are not the primary reason for SACs being selected.

D - Habitat present but not of sufficient extent or quality to merit listing as SAC feature.

There is therefore a distinction between the principal features for which sites have been selected (those graded A or B) and those which are only of secondary interest (those graded C). This is a useful distinction but it is important to note that all three grades are qualifying SAC interest features.

Click here to go to the Natura 2000 Standard Data Form for The Maidens SAC.

6.1 ASSI SELECTION FEATURES

The Maidens ASSI

Feature Type	Feature	Size/ extent/ pop~
Habitat	Intertidal rock	XXha
Species	European Shag breeding population	97 individuals
Species	Common Seal (*Phoca vitulina*)	20[2] individuals
Species	Grey Seal (*Halichoerus grypus*)	60[2] individuals

[1] Population given as number of nests/individuals recorded during the Seabird 2000 survey
[2] Population given as number of individuals recorded during the 2008 seal survey

Table 2 List of ASSI features

7. CONSERVATION OBJECTIVES

The ***Conservation Objective*** for this site is:

To maintain (or restore where appropriate) the

- **Reefs**
- **Sandbanks which are slightly covered by sea water all the time**
- **Grey Seal *Halichoerus grypus***

to favourable condition.
Maintain implies that the feature is in favourable condition and will, subject to natural change, remain at its condition at designation. Restore implies that the feature is degraded to some degree and that activities will have to be managed to reduce or eliminate negative impact(s). Restoration in the marine environment can refer to natural recovery through the removal of unsustainable physical, chemical and biological pressures, as well as intervention.

For each SAC feature, there are a number of component objectives which are outlined in the table below. These include a series of attributes, measures and targets which form the basis of *Condition Assessment*. The results of this will determine whether the feature is in favourable condition or not. The feature attributes and measures are found in Annex I.

8. SAC SELECTION FEATURE OBJECTIVE REQUIREMENTS

Feature	Global Status	Component Objective
Reefs	A	Maintain and enhance, as appropriate the extent of the reefs
		Allow the natural processes which determine

		the development, structure, function and distribution of the habitats associated with the reefs, to operate appropriately.
		Maintain and enhance, as appropriate, the viability, distribution and diversity of typical species within this habitat.
Sandbanks which are slightly covered by sea water all the time	**B**	Maintain the extent and volume of sandbanks which are slightly covered by sea water all the time, subject to natural processes.
		Allow the natural processes which determine the development, structure and extent of sandbanks which are slightly covered by sea water all the time, to operate appropriately.
		Maintain and enhance, as appropriate, the viability, distribution and diversity of typical species within this habitat.
Grey Seal *Halichoerus grypus*	**C**	Maintain (and if feasible enhance) population numbers and distribution of Grey Seal.
		Maintain and enhance, as appropriate, physical features used by Grey Seals within the site.

9. ASSI FEATURE OBJECTIVE REQUIREMENTS

Feature	**Component Objective**
European Shag breeding population	No significant decrease in population against national trends, caused by on-site factors
Intertidal Rock	Maintain and enhance species diversity within the maritime communities
	Maintain and enhance, as appropriate, transitions to other communities
Grey Seal *Halichoerus grypus*	See SAC Selection Feature Objective Requirements table
Common Seal *Phoca vitulina*	No significant decrease in population against national trends, caused by on-site factors

10. MANAGEMENT CONSIDERATIONS

The following issues relate to many marine sites and in certain circumstances may have some bearing on the management of the Maidens SAC.

11. MAIN THREATS, PRESSURES AND ACTIVITIES WITH IMPACTS ON THE SITE

Both on-site and off-site activities can potentially affect SAC/ASSI features. The list below is not exhaustive, but deals with the most likely factors that are either affecting The Maidens, or could affect it in the future. Although **Reefs, Sandbanks which are slightly covered by sea water all the time, and Grey Seal *Halichoerus grypus*** are the qualifying SAC features, factors affecting coastal ASSI features are also considered.

NOTE - Carrying out any of the Notifiable Operations listed in The Maidens ASSI schedule could affect the site.

Aggregate extraction/Maerl extraction
Extraction of aggregates or extraction of maerl, either within or adjacent to the SAC, have the potential to cause direct loss or deterioration of qualifying habitats and communities; including the deterioration of qualifying habitats and communities by smothering and increased turbidity from re-suspended material.

Agriculture and Forestry Operations
Diffuse run-off from agricultural practices has the potential to cause deterioration of qualifying habitats and communities, primarily through the alteration of water quality by discharge of organic or inorganic pollutants. Changes in agricultural (including grazing regimes) or forestry practices or changes of land use have the potential to cause deterioration of qualifying habitats and communities through changes in the nature and loading of sediments in rivers that discharge to coastal areas.

Aquaculture – Finfish farming
Finfish farming has the potential to cause deterioration of qualifying habitats and communities through changes in water quality, smothering from waste material and physical disturbance from mooring systems. There is potential for accidental introduction of new non-native species and increasing the spread of existing non-native plants and animals which are already widely distributed in the UK. Invasive species have the potential to cause deterioration of the qualifying interests by altering community structure and quality.

Aquaculture – Shellfish farming
Shellfish farming has the potential to cause deterioration of the qualifying habitats and communities through physical damage (e.g. installation of mooring blocks and continued scouring by riser chains) and changes in community structure caused by smothering from pseudo-faeces (undigested waste products) and debris (including dead shells) falling from the farm. There is also potential for accidental introduction of new non-native species and increasing the spread of existing non-native plants and animals through importation or translocation of

shellfish stocks. Invasive species have the potential to cause deterioration of the qualifying interests by altering community structure and quality.

Coastal and Marine Development and Infrastructure Maintenance
The construction and maintenance of structures, both within and adjacent to the sea, have the potential to cause direct loss or deterioration of qualifying habitats and communities. An example of this may be coastal defence structures that may change local patterns of sediment suspension or deposition. Other examples include: renewable and other energy installations (including offshore wind, tide and wave energy and oil and gas installations); pipelines and cables; and marina and harbour developments and maintenance including the dredging of harbours, marinas and navigation channels. In many of these cases disturbance of the seabed may cause increased turbidity and smothering in adjacent areas as well as the direct impact in the area of operation.

Discharge of Commercial effluent or sewage
Commercial effluent has the potential to cause deterioration of qualifying habitats and communities, through pollution or nutrient enrichment, which may cause subsequent changes in community structure. Contaminants may enter species food chains, including those that are persistent and those that tend to bioaccumulate and biomagnify. Lipophyllic contaminants such as organohalides are of particular concern as they tend to accumulate within fatty tissue and are remobilised during lactation in seals. Contamination of female seals by hydrocarbon residues may be detrimental to suckling pups.

Disposal of dredge spoil
The disposal of either capital or maintenance dredge spoil, either within or adjacent to the SAC, has the potential to cause deterioration of qualifying habitats and communities, through smothering, increased turbidity, or re-suspension of pollutants.

Commercial Fishing – Mobile gear (dredging and bottom trawling)
Benthic dredging and bottom trawling have the potential to cause deterioration and damage to qualifying habitats and communities (particularly maerl, Hall-Spencer, 2000) through direct contact with the dredge gear, and sedimentation when dredging occurs close to the qualifying interest. Loss of certain species through targeted catch or by-catch has the potential to cause deterioration of qualifying habitats and communities. The Department is currently engaging with the fishing community to gather detailed evidence on the locations of specific gear usage with a view to producing a fisheries management plan for the SAC. This includes a full analysis of all known fishing activities gathered over recent years.

Commercial Fishing – Pelagic mid-water trawling
Pelagic mid-water trawling has minimal potential to cause deterioration of qualifying habitats and communities through direct contact, as the trawl gear is

mostly well above the seabed (except occasionally for vessel turning in shallow water). However loss of certain species through targeted catch or by-catch has the potential to cause deterioration of qualifying habitats and communities.

Commercial Fishing – Static gear (creel/pot fishing)
The use of creels and / or pots in a localised area has the potential to cause deterioration of qualifying habitats and communities through direct contact, particularly during their deployment and / or recovery. Loss of certain species through targeted catch or by-catch has the potential to cause deterioration of qualifying habitats and communities. Seals can be accidentally captured and drowned in static fishing gear and persistent synthetic fishing gear debris, in particular, pups.

Marine Traffic – Boat maintenance and antifoulant use
Most antifoulant products are designed to kill or discourage naturally occurring organisms and, as such, cause damage to the water environment if used carelessly. Under such circumstances use of antifoulant has the potential to cause deterioration of qualifying habitats and communities within this site.

Marine Traffic – Commercial and recreational vessels
The Maidens SAC is within the confines of the North Channel, a busy shipping route. The ferry route between Larne and Lough Ryan passes through The Maidens SAC boundary. The Port of Larne has a Port Marine Safety Code and the following documents should be reviewed: 'Safety Management System' and 'Safety Policy Objectives'. The pumping of bilges, discharge of ballast water, accidental grounding, or accidental oil (or other chemical) spillage from commercial vessels could therefore all occur close to the SAC. Such incidents have the potential to cause deterioration of qualifying habitats and communities through direct or indirect impacts. Emergency and oil spillage contingency plans should take into account specific qualifying interests and recognise the importance of marine SACs should such incidents occur. Smaller recreational and fishing vessels also have the potential to cause deterioration of qualifying habitats and communities through fuel spillage and grounding.

There is also potential for accidental introduction of new non-native species and increasing the spread of existing non-native plants and animals through bilge or ballast water, sea chests, and bio-fouling on hulls (identified as a particular risk on vessels for sale that are in the water for some time before being moved to a new location). Invasive species have the potential to cause deterioration of the qualifying interests by altering community structure and quality.

Disturbance at seal haul-outs may disrupt the mother-pup bond and cause separation. Disturbance during the breeding season may lead to modifications of pupping activity as seen through avoidance of sites easily accessible by boats or through habituation to human presence.

Marine Traffic – Boat anchorages and moorings
Anchors and moorings have the potential to cause deterioration of qualifying habitats and communities through the direct impact of the anchor/mooring and the riser chains.

Marine Renewables
The Strategic Environmental Assessment (SEA) of Offshore Wind and Marine Renewable Energy by the Department of Energy, Trade and Investment (DETI, 2009) assessed the potential for commercial and test/demonstration sites in NI waters. This assessment identified potential impacts of such developments and related mitigating actions to be considered at the project developments stage. A possible commercial scale Tidal Resource Zone was identified off the North Coast within which the Crown Estate as managers of the seabed has offered development rights to two consortia, Tidal Ventures Ltd and Fair Head Tidal. However there are no tidal energy developments in this area at present and the Department is engaging with the developers in considering their respective marine licence applications.

The UK's Department of Business, Energy and Industrial Strategy (UK BEIS) administers marine environmental regulations associated with oil and gas exploration and production and the decommissioning of marine installations, wells, pipelines and associated infrastructure in the UK marine area (excluding internal waters). At present there is no oil or gas exploration licence for the 5 offshore blocks in the Antrim Coast (the Maidens SAC lies approximately 22km from this area).

The development of marine renewables has the potential to cause deterioration of qualifying habitats and communities through direct alteration, removal or manipulation of these qualifying interests and their associated species. Furthermore, deterioration of qualifying habitats and disturbance of species may occur through the use of pile driving or powerful sonar required for surveys or construction phases as these may directly harm marine mammals or act as a barrier to marine mammals using the area.

Scientific research
Research activities have the potential to cause deterioration of qualifying habitats and communities through direct alteration, removal or manipulation of these qualifying interests and their associated species. In addition, disturbance of seals may occur through various research activities, including the use of remotely operated technology (e.g. drones) especially when hauled out. These activities should be communicated to the Department for specific advice about the potential of impact and subsequent mitigation.

Geological surveys and military exercises
Geological and other surveys and military exercises all have the potential to cause deterioration of qualifying habitats and species, particularly through the use of

seismic surveys or powerful sonar that may harm cetaceans or act as a barrier to cetaceans using the area. These activities should be communicated to the Dept for specific advice for the potential of impact and subsequent mitigation.

Wildlife watching trips

Wildlife watching trips (boat and land based) have the potential to cause disturbance to species if operators are not appropriately trained in how to approach species while minimising potential disturbance. In addition, damage to sensitive habitats may occur through lack of knowledge of their location. Various wildlife training courses are available which teach best practice when dealing with wildlife.

Climate Change

Northern Ireland faces changes to its climate over the next century. Indications are that we will face hotter, drier summers, warmer winters and more frequent extreme weather events. The Northern Ireland Climate Change Adaptation Programme was published in January 2014. This contains the Northern Ireland Executive's response to the risks and opportunities identified in the Climate Change Risk Assessment for Northern Ireland (published January 2012) as part of the overall UK Climate Change Risk Assessment. The Adaptation Programme provides the strategic objectives in relation to adaptation to climate change, the proposals and policies by which each department will meet these objectives and the timescales associated with the proposals and policies identified in the period up to 2019.

12. MONITORING

The SACs are surveyed using two forms of monitoring:

Site Integrity Monitoring (SIM) is carried out to ensure compliance with the ASSI/ SAC conservation objectives. The most likely processes of change will either be picked up by SIM (e.g. fishing, disturbance etc.) or will be comparatively slow (e.g. gradual degradation of the habitat). Although the Maidens are remote, SIM is combined with regular seal counts as well as through the active marine ranger programme.

Site Condition Assessment of the designated features is carried out on a rolling 6 year basis to pick up subtle changes in the condition of the feature.

Site condition assessments include a variety of techniques such as diving, remote cameras, sediment sampling and acoustic seabed mapping. Marine mammal monitoring programmes also contribute.

12.1 MONITORING SUMMARY

1. *Monitor the integrity of the site (SIM or Compliance Monitoring)*
This SIM should be carried out at least once a year.

2. Monitor the condition of the site (Condition Assessment)
Monitor the key attributes for each of the SAC selection features. This will detect if the features are in favourable condition or not. Refer to Annex I.

The favourable condition table provided in Annex I is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring condition of the site and its features. It does not by itself provide a comprehensive basis on which to assess plans and projects, but it does provide a basis to inform the scope and nature of any Habitats Regulations Assessment (HRA) that may be needed. It should be noted that completion of a HRA is a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

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ANNEX I

The marine Annex I habitats are very broadly defined habitats that are often represented by large and complex sites. To effectively describe, monitor and manage such complex features, it has been necessary to divide some of them into smaller units called *sub-features*. Sub-features are distinctive biological communities (e.g. eelgrass beds, maerl beds, horse-mussel reefs), or particular structural or geographical elements of the feature. Due to the broad nature of marine Annex I features, it has often proved helpful, both in the development of conservation objectives, and of monitoring programs, to separate the feature into a number of constituent sub-features, and then to identify attributes and targets for the sub-features. The use of sub-features has been found to be particularly helpful for those marine Annex I features that represent whole physiographic units and permits a level of flexibility in the application of the UK's Common Standards Monitoring which has been found necessary when applying the standards at the site level.

Feature 1 (SAC) – Reef (status A)

*=primary attribute. One failure among primary attribute = unfavourable condition

Feature	Sub-feature	Attribute	Measure	Targets	Comments
Reef	Subtidal Rock and Boulder Communities Subtidal Rocky Reef Communities Intertidal Rock and Boulder Communities	* Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-feature.	Presence of the selected biotopes at selected sites measured once sure the reporting cycle.	Results should not deviate significantly from the established baseline, subject to natural change.	Baseline survey conducted by the Department with NMNI 2006-2009 and as a contract with AFBI (Strong, 2010). Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
		* Species composition of selected biotopes at	Species composition of the selected biotopes measured once during the	Composite species of selected biotopes	Species composition will be used to determine the biotope classification. A list of selected indicator species identified by field surveys will be

		monitoring sites.	reporting cycle.	should not deviate significantly from the established baseline, subject to natural change.	utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites. The species composition of some biotopes may provide further information on changes/trends in these communities.

Feature 2 (SAC) – Sandbanks which are slightly covered by seawater all of the time (status B)
*=primary attribute. One failure among primary attribute = unfavourable condition

Feature	Sub-feature	Attribute	Measure	Targets	Comments
Subtidal sandbanks		*Extent	Area (ha) of the subtidal sandbanks to be measured periodically (frequency to be determined).	Ensure that quality and extent of sandbank are not threatened by aggregate removal.	Currently there is no licensed aggregate removal activity within or near to this SAC.
		*Sediment character	Particle size analysis (PSA). Parameters include percentage sand/silt/gravel, mean and median grain size, and sorting coefficient, used to characterise sediment type. Sediment character to be measured once during the reporting cycle.	Average PSA parameters should not deviate significantly from an established baseline subject to natural change.	Sediment character defined by PSA is key to the structure of the feature, and reflects all of the physical processes acting on it. Particle size composition varies across the feature and can be used to indicate spatial distribution of sediment types thus reflecting the stability of the feature and the processes supporting it. This is currently addressed through WFD monitoring programme.
		*Topography	Depth distribution of sandbanks from selected sites, measured periodically (frequency to	Depth distribution should not deviate significantly from an established	Depth and distribution of the sandbank reflects the energy conditions and stability of the sediment, which is key to the

			be determined).	baseline, subject to natural change.	structure of the feature. Depth of the feature is a major influence on the distribution of communities throughout. The baseline for this feature was delivered through work carried out by AFBI (2010) on to provide habitat maps.
	Subtidal Sand and Gravel Communities Subtidal Fine Sand and Mud Communities	*Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of the selected biotopes as identified by the NI Sublittoral survey at selected sites measured once during the reporting cycle	Results should not deviate significantly from the established baseline, subject to natural change.	Baseline survey required. Changes in extent and distribution may indicate long term changes in the physical conditions at the site
		*Species composition of selected biotopes at monitoring sites.	Species composition of the selected biotopes as identified by the NI Sublittoral survey measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities.

Feature 3 (SAC) – Grey Seal *Halichoerus grypus* (status C)

*=primary attribute. One failure among primary attribute = unfavourable condition

Attribute	Measure	Targets	Comments
*Number of Adults	Maintain and enhance the population as appropriate.	The number of adults to be at least 50 individuals.	Data generated by ongoing DAERA Marine and Fisheries Division survey.
*Distribution of adults	Maintain the range and distribution of grey seals.		Ensure individuals operations or activities (in combination with other operations or activities) do not cause a change in range, distribution or population structure which would result in unfavourable conditions for the future conservation interests of this species.
*Habitat availability	Number of areas used for moulting, haul-out and breeding.	Ensure that there is a sufficiently large habitat (haul-outs) of suitable quality available to support the long term survival of this species.	

Appendix U Strangford Lough SAC

STRANGFORD LOUGH SAC

UK0016618

CONSERVATION OBJECTIVES

Document Details

Title	*Strangford Lough SAC Conservation Objectives*
Prepared By	*R. McKeown*
Approved By	*P. Corbett*
Date Effective From	*20/03/2017*
Version Number	*V4*
Next Review Date	November 2020
Contact	cdp@daera-ni.gov.uk

Revision History:

Version	Date	Summary of Changes	Initials
V1	June 2013	Internal working document	PC
V2	January 2015	Complete review	RMK
V3	February 2017	Review marine features	LP
V4	November 2018	Review seal targets	LP

Site relationships

To fully understand the conservation requirements of this site, it is necessary to also refer to the Conservation Objectives for Strangford Lough SPA and the Strangford Lough and Lecale Heritage Management Strategy 2013-2018.

Strangford Lough SAC boundary overlaps with the boundary for Strangford Lough SPA and adjoins Outer Ards SPA. Strangford Lough SAC and SPA also lie within Strangford Lough Marine Conservation Zone (MCZ).

1. INTRODUCTION

EU Member States have a clear responsibility under the Habitats and Birds Directives[1] to ensure that all habitats and species of Community Interest are maintained or restored to Favourable Conservation Status (FCS). Natura 2000 sites have a crucial role to play in achieving this overall objective since they are the most important core sites for these species and habitats. Each site must therefore be managed in a way that ensures it contributes as effectively as possible to helping the species and habitats for which it has been designated reach a favourable conservation status within the EU.

To ensure that each Natura 2000 site contributes fully to reaching this overall target of FCS, it is important to set clear conservation objectives for each individual site. These should define the desired state, within that particular site, of each of the species and habitat types for which the site was designated.

Once a site has been included in the Natura 2000 network, Member States are required to implement, on each site, the necessary conservation measures which correspond to the ecological requirements of the protected habitat types and species of Community Interest present, according to Article 6.1 of the Habitats Directive. They must also prevent any damaging activities that could significantly disturb those species and habitats (Article 6.2) and to protect the site from new potentially damaging plans and projects likely to have a significant effect on a Natura 2000 site (Article 6.3, 6.4).

Conservation measures can include both site-specific measures (i.e. management actions and/or management restrictions) and horizontal measures that apply to many Natura 2000 sites over a larger area (e.g. measures to reduce nitrate pollution or to regulate hunting or resource use).

In Northern Ireland, Natura 2000 sites are usually underpinned by the designation of an Area of Special Scientific Interest (ASSI) under the Environment (NI) Order 2002 (as amended).

2. ROLE OF CONSERVATION OBJECTIVES

Conservation Objectives have a role in

- Conservation Planning and Management – guide management of sites, to maintain or restore the habitats and species in favourable condition

- Assessing Plans and Projects, as required under Article 6(3) of the Habitats Directive - Habitats Regulations Assessments (HRA) are required to assess proposed plans and projects in light of the site's conservation objectives.

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[1] 92/43/EEC and 2009/147/EC (codified version of Directive 79/409/EEC as amended)

- Monitoring and Reporting – Provide the basis for assessing the condition of a feature, the factors that affect it and the actions required.

3. DEFINITION OF FAVOURABLE CONSERVATION STATUS

Favourable Conservation Status is defined in Articles 1(e) and 1(i) of the Habitats Directive:

The conservation status of a natural habitat is the sum of the influences acting on it 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. The conservation status of a natural habitat will be taken as favourable when:

- Its natural range and 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
- The conservation status of its typical species is favourable as defined in Article 1(i).

For species, favourable conservation status is defined in Article 1(i) as when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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 population on a long term basis.

3.1 DEFINITION OF FAVOURABLE CONDITION

Favourable Condition is defined as "**the target condition for an interest feature in terms of the abundance, distribution and/or quality of that feature within the site"**.

The standards for favourable condition (Common Standards) have been developed by JNCC and are applied throughout the UK. Achieving Favourable Condition on individual sites will make an important contribution to achieving Favourable Conservation Status across the Natura 2000 network.

4. SITE INFORMATION

COUNTY: DOWN

GRID REFERENCE: IJ 560579

AREA: 15398.54 ha

5. SUMMARY SITE DESCRIPTION

Strangford Lough is a large (150 km^2) marine inlet on the east coast of County Down, of which about 50 km^2 lies between high water mark mean tide (HWMMT) and low water mark mean tide (LWMMT). Its northern end lies some 15 km east of Central Belfast (6 km from the outskirts). Downpatrick lies 5 km west of the south west corner. Strangford, Killyleagh, Whiterock, Comber, Newtownards, Greyabbey, Kircubbin and Portaferry are situated on the edge of the Lough. About 60,000 people live around its shores and about one million people live within one hour's drive.

Almost land-locked, Strangford Lough is separated from the Irish Sea by the Ards Peninsula to the east and is bounded to the south by the Lecale coast. It is connected to the open sea by the Strangford Narrows, an 8 km long channel with a minimum width of 0.5 km. The Lough is 30 km long from head to mouth and up to 8 km wide.

This sea inlet is made up of a drowned drumlin field (created by inundation of the landscape which emerged from under the melting ice-sheets of the Ice Age) which is for the most part less than 10 m in depth and a deeper Y-shaped channel (possibly an old river-valley or geological fault-line) which is up to 66 m deep. The underlying rock is largely Silurian. The surface of the bed and shore of the Lough ranges from bedrock in areas with strong currents to fine mud in sheltered waters.The narrow entrance channel is an important feature with extremely strong currents of up to 8 knots (4 m/sec).

The tidal flats of Strangford Lough form extensive deposits around its northern limits in a partially eroded drumlin and late-glacial landscape. The sedimentary dynamics of the contemporary tidal flats are controlled by exposure to waves and tidal currents and vary from current- to wave-dominated sandy areas to suspension-dominated muddy areas. At a number of locations indicators of former sea levels are preserved which offer the opportunity to define the evolution of the area.

The triangular area around the Lough mouth is subject to greater wave energy. It has broad, almost level rock platforms, steeply-shelving rocky shores, sandy beaches and a largely sandy sea-bed. The water in the Lough is virtually fully saline except at the mouths of the two moderate-sized rivers and several streams which drain into it from the catchment of about 900 km^2 where it may be somewhat brackish. The area enjoys an equable climate with low rainfall, infrequent frosts and prevailing west to south west winds.

The Lough supports an impressive range of marine habitats and communities with over 2,000 recorded species. It is important for marine invertebrates, algae and saltmarsh plants, for wintering and breeding wetland birds, and for marine mammals.

Further details of the site are available on the DAERA website (https://www.daera-ni.gov.uk/publications/reasons-designation-special-area-conservation-strangford-lough).

5.1 BOUNDARY RATIONALE

The landward boundary of the SAC is entirely coincident with the landward boundary of the following five Areas of Special Scientific Interest: Strangford Lough Part 1, Strangford Lough Part 2, Strangford Lough Part 3, Killard and Ballyquintin Point. Marine areas below mean low water are also included.

6. SAC SELECTION FEATURES

Feature type	Feature	Global Status	Size/ extent/ pop~
Habitat	Large shallow inlet and bay	A	15090.6 ha
Habitat	Coastal lagoons	B	45.0 ha
Habitat	Mudflats and sandflats not covered by sea water at low tide	B	2000.0 ha
Habitat	Reefs	B	1600.0 ha
Habitat	Annual vegetation of drift lines	C	250 km
Habitat	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	C	75.0 ha
Habitat	Perennial vegetation of stony banks	C	30.0 ha
Habitat	*Salicornia* and other annuals colonising mud and sand	C	
Species	Harbour (Common) Seal *Phoca vitulina*	C	210

Table 1. List of SAC selection features. Those with global status A-C will be referred to in ANNEX I.

The global status is an expert judgement of the overall value of the site for the conservation of the relevant Annex I habitat. Sites have been graded A, B or C - in the UK these gradings have been interpreted as follows:

A - Sites holding outstanding examples of the habitat in a European context.

B - Sites holding excellent stands of the habitat, significantly above the threshold for SSSI/ASSI notification but of somewhat lower value than grade A sites.

C - Examples of the habitat which are of at least national interest (i.e. usually above the thresholdfor SSSI/ASSI notification on terrestrial sites) but not significantly above this. These habitats are not the primary reason for SACs being selected.

D - Habitat present but not of sufficient extent or quality to merit listing as SAC feature.

There is therefore a distinction between the principal features for which sites have been selected (those graded A or B) and those which are only of secondary interest (those graded C). This is a useful distinction but it is important to note that all three grades are qualifying SAC interest features.

Click here to go to the Natura 2000 Standard Data Form for Strangford Lough SAC.

6.1 ASSI SELECTION FEATURES

Strangford Lough ASSI

Feature Type	Feature	Size/ extent/ pop~	Comments
Habitat	Intertidal Rock	1645 ha	
Habitat	Mudflats	2000 ha	
Habitat	Coastal Vegetated Shingle	250km	
Habitat	Coastal Saltmarsh	75 ha	
Habitat	Maritime Cliff & Slope		
Species	Higher Plant Assemblage		
Species	Invertebrate Assemblage		
Species	Waterbird Assemblage		
Species	Harbour (Common) Seal *Phoca vitulina*		
Earth Science	Contemporary coastal processes – the inter-tidal zone between Greyabbey and Ardmillan Bay		This refers to the entire inter-tidal zone
Earth Science	Holocene sea-level history – buried and semi-buried components within the inter-tidal and adjoining areas		Key localities are at Rough Island, Greyabbey Bay, Ringneill Quay
Earth Science	Pleistocene – Late Glacial Sediments		

Table 2. *List of ASSI features*

7. CONSERVATION OBJECTIVES

The *Conservation Objective* for this site is:

To maintain (or restore where appropriate) the

- **Large shallow inlet and bay**
- **Coastal lagoons**
- **Mudflats and sandflats not covered by sea water at low tide**
- **Reefs**
- **Annual vegetation of drift lines**
- **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)**
- **Perennial vegetation of stony banks**
- ***Salicornia* and other annuals colonising mud and sand**
- **Harbour (Common) Seal *Phoca vitulina***

to favourable condition.
Maintain implies that the feature is in favourable condition and will, subject to natural change, remain at its condition at designation. Restore implies that the feature is degraded to some degree and that activities will have to be managed to reduce or eliminate negative impact(s). Restoration in the marine environment can refer to natural recovery through the removal of unsustainable physical, chemical and biological pressures, as well as intervention.

For each SAC feature, there are a number of component objectives which are outlined in the table below. These include a series of attributes, measures and targets which form the basis of *Condition Assessment*. The results of this will determine whether the feature is in favourable condition or not. The feature attributes and measures are found in the attached annex.

8. SAC SELECTION FEATURE OBJECTIVE REQUIREMENTS

Feature	Global Status	Component Objective
Large shallow inlet and bay	A	Maintain the extent of the large shallow inlet and bay
		Allow the natural processes which determine the development, structure, function and extent of the large shallow inlet and bay, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.

Coastal lagoons	**B**	Maintain the extent of the coastal lagoons
		Allow the natural processes which determine the development, structure, function and extent of the coastal lagoons, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.
Mudflats and sandflats not covered by sea water at low tide	**B**	Maintain the extent of mudflats and sandflats not covered by sea water at low tide
		Allow the natural processes which determine the development, structure and extent of mudflats and sandflats not covered by sea water at low tide, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.
Reefs	**B**	To restore the reefs and their characteristic species to favourable condition, allowing for natural change.
		Allow the natural processes which determine the development, structure, function and extent of the reefs, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.
Annual vegetation of drift lines	**C**	Maintain and enhance the extent of annual vegetation of drift lines subject to natural processes
		Allow the natural processes which determine the development and extent of annual vegetation of drift lines to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this community including the presence of notable species

Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	**C**	To restore the Atlantic salt meadows and their characteristic species to favourable condition, allowing for natural change.
		To maintain or enhance, as appropriate, the composition of the saltmarsh communities
		To maintain transitions between saltmarsh communities and to other adjoining habitats
		To permit the continued operation of formative and controlling natural processes acting on the saltmarsh communities
Perennial vegetation of stony banks	**C**	To restore the perennial vegetation of stony banks and their characteristic species to favourable condition, allowing for natural change.
		Allow the natural processes which determine the development and extent of perennial vegetation of stony banks to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this community including the presence of notable species
***Salicornia* and other annuals colonising mud and sand**	**C**	To restore the *Salicornia* and other annuals colonising mud and sand and their characteristic species to favourable condition, allowing for natural change.
		Allow the natural processes which determine the development and extent of *Salicornia* and other annuals colonising mud and sand, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.
Harbour (Common) Seal *Phoca vitulina*	**C**	Maintain and enhance, as appropriate, the Harbour (Common) Seal population

		Maintain and enhance, as appropriate, physical features used by Harbour (Common) Seals within the site

9. ASSI FEATURE OBJECTIVE REQUIREMENTS

Feature	Component Objective
Intertidal Rock	See SAC Selection Feature Objective Requirements table.
Mudflats	See SAC Selection Feature Objective Requirements table.
Coastal Vegetated Shingle	See SAC Selection Feature Objective Requirements table.
Coastal Saltmarsh	See SAC Selection Feature Objective Requirements table.
Maritime Cliff & Slope	To be finalised
Higher Plant Assemblage	To be finalised
Invertebrate Assemblage	To be finalised
Waterbird Assemblage	See SPA Conservation Objectives.
Harbour (Common) Seal *Phoca vitulina*	See SAC Selection Feature Objective Requirements table.
Contemporary coastal processes – the inter-tidal zone between Greyabbey and Ardmillan Bay	Permit the continued operation of formative and controlling natural processes acting on the inter-tidal system. Maintain natural site morphology subject to natural processes.
Holocene sea-level history – buried and semi-buried components within the inter-tidal and adjoining areas	Maintain the potential for access to buried and semi-buried components necessary for the demonstration of sea-level history as related to this site.
Pleistocene - Late Glacial Sediments	Maintain extent and quality of exposure, together with access to the features subject to natural processes.

10. MAIN THREATS, PRESSURES AND ACTIVITIES WITH IMPACTS ON THE SITE

Both on-site and off-site activities can potentially affect SAC/ASSI features. The list below is not exhaustive, but deals with the most likely factors that are either affecting Strangford Lough SAC, or could affect it in the future.

Although Reefs, Large shallow inlet and bay, Coastal lagoons, Mudflats and sandflats not covered by sea water at low tide, Atlantic salt meadows, Perennial vegetation of stony banks, Annual vegetation of drift lines, *Salicornia* and other annuals colonising mud and sand and Common Seal *Phoca vitulina* are the qualifying SAC features, factors affecting ASSI features are also considered.

NOTE - Carrying out <u>any</u> of the Notifiable Operations listed in the ASSI schedule could affect the site.

Changes in Surrounding Land Use Impacts
Activities occurring outside the site (e.g. land surrounding Strangford Lough such as agricultural intensification, coastal engineering, and development) may be detrimental to the site through remote affects – some of these outside impacts are considered, as follows:

Housing and Industrial Development
Pressure for development around the Lough is evident from the number of planning applications submitted in recent years. Substantial housing developments have proceeded at Portaferry, Greyabbey, Kircubbin and Killyleagh and others are under consideration. The area also attracts applications for individual houses in rural locations which may be effect wildlife or landscape.

Development close to the shore may have adverse effects on areas of saltmarsh and other habitats or lead to disturbance of feeding and nesting birds. The cumulative effect of such development is difficult to assess accurately but is unlikely to be insignificant. There are also indirect impacts associated with development, for example the increased load on sewage treatment plants or additional septic tanks and the effects of storm water drainage.

Shoreline housing may also create demand for further sea defences, causeways and boat slips.

Coastal Engineering
Much of the larger scale sea defences are located in the northern end of the Lough. The sea defences at Newtownards have recently been repaired and improved. A monitoring programme has been set up by the Rivers Agency to assess the effects of these major repair works on the ecology of the Lough.

In recent years rock armouring has been a favoured strategy for road protection against erosion. Unlike the traditional sea walls, armouring helps to dissipate wave energy with less drawdown of sediment. However, it is rarely aesthetically pleasing and tends to encroach onto the shore. There have also been attempts by some landowners to prevent erosion by using rocks and boulders from the intertidal area.

Coastal engineering works have affected a number of shallow bays, saltmarshes and areas of tidal flat around the Lough. Causeways, boat slips and other restrictions have modified current and tidal flow patterns and, in turn, affected sediment transport patterns. In some cases this has resulted in the incidental creation of new habitat including saltmarsh, brackish ponds and wetlands.

The effect of rising sea levels and changing weather patterns in the long-term may create a desire for new or additional flood defences at existing settlements.

Sand and Gravel Extraction
Traditional rights to remove sand, gravel and shingle from the shores are attached to the folios of some land-holdings in the area. These materials were formerly extracted by shovel and horse-drawn cart for use on the land. Nowadays tractors, trailers and earth-moving machinery are more likely to be used. The removal of intertidal sediments increases the risk of erosion by removing some of the wave-absorbing materials and altering the beach profile. The exercise of extraction rights is not, however, currently a major issue within the SAC/SPA.

Farming
Farmers and landowners have helped to shape the Strangford Lough landscape and its habitats and contributed to the conservation interests around the Lough. For example, many of the islands which are important for wildfowl or nesting terns are grazed by sheep or cattle. By and large farmers have tolerated the habit of Brent Geese to graze agricultural land when eelgrass is in short supply. Some farming practices, however, can cause localised damage.

Livestock which are free to wander onto the shore may result in damage to strandline vegetation and saltmarsh. Their trampling can seriously poach the ground and exacerbate erosion. The practice of sand-ploughing on the shore to clean the plough can have damaging effects both on eel-grass beds and on invertebrates in the sand. Recovery from this seemingly harmless activity can take years in some situations.

ACTION: Reduce the risk of surrounding agricultural intensification by encouraging owner/occupiers to enter into agri-environment schemes. Use appropriate assessments, through the planning process, to minimise any development risks adjacent to the SAC.

Recreational & Educational Impacts

Tourism
Areas of high scenic and amenity value such as Strangford Lough are an important part of Northern Ireland's tourism product. Investment in tourism capital projects and support systems such as environmental and heritage visitor centres has helped bring employment and new prosperity to rural towns and presents diverse business opportunities for local communities. As the trend towards activity and special interest holidays increases, Strangford Lough's environmental designations may provide additional impetus to the promotion of the marine life as a tourist attraction.

Increasing pressure from the public for access to the water and the surrounding countryside for recreation and enjoyment has to be balanced with the need to sustain the environment and the fabric of local communities.

Informal Recreation
Strangford Lough is an attractive and popular venue for a variety of informal recreational pursuits, such as walking (often with dogs), bathing and wildlife watching.

Individuals or small groups of walkers rarely cause any problems for conservation. Walkers can, however, cause considerable disturbance to bird-life in certain sensitive locations. Localised problems have been experienced with dogs disturbing birds, particularly on the upper shore at low tides and at nesting islands. The problem is particularly acute with loose dogs and at certain periods of the year critical to the bird's feeding cycles.

Efforts to keep beaches suitable for recreation often include the removal of drift seaweed along with litter. Seaweed is an important component of the marine ecosystem and in most instances is better left in place unless there are compelling reasons for its removal. There have been proposals to create or extend sandy beaches for bathing. In addition to loss of natural foreshore, such efforts can be counterproductive if they fail to take account of the local sediment regime. There may also be a desire to provide amenities such as promenades and car parking areas. These are likely to increase the numbers of people using the area with the consequent risk of increased disturbance.

The Lough's international reputation for waterfowl is underlined by the number of bird-watchers who are attracted to the area, many from Britain or overseas. The National Trust and the Wildfowl and Wetlands Trust have provided hides from which the birds may be observed by the public. Seal watching from the car park at Cloghy Rocks is also popular.
The observation of wildlife for enjoyment is a popular activity. However some enthusiasts fail to consider either owners' property rights or the welfare of the wildlife. Disturbance can prevent wildlife feeding and can cause desertion of nests with eggs or young birds. Litter and discarded angling materials are unsightly and may cause injury to wildlife. There has been an increase in charter boats specialising in wildlife watching trips, which without appropriate training may cause disturbance to protected species.

Boating and Sailing
About 2000 yachts are located around the Lough and there are approximately 5000 active boaters. Most yachting is organised through the eleven clubs around the Lough. Club races and regattas take place throughout the summer with frequent all-Ireland and international events for particular classes. Yachting instruction takes place at several centres and clubs have their own cadet classes.

Most cruisers are moored on permanent swing moorings close to club premises. There are also a few public moorings and scattered private moorings elsewhere. Some craft are mud-berthed and a few are berthed at marina type jetties. Some areas, particularly Whiterock, are popular for water-skiing. There is limited public access to the shore for boats. Cook Street Pier owned by Ards Borough Council and the Pontoons at Portaferry are the two main areas.

Windsurfing (sailboarding) has become increasingly popular over recent years, particularly at Cunningburn, Kircubbin and Whiterock. Little depth of water is required and insulating suits enable enthusiasts to sail throughout the year when weather permits. Jet skiing has developed on a small scale on the Lough notably at Whiterock.

Although generally a benign activity, boating may result in a number of potentially harmful impacts on the Lough and its wildlife. It may cause physical disturbance to the seabed and shore, particularly at moorings and where slipways and jetties are built. It is often difficult to maintain water quality at anchorage's and harbours. Boating may also cause noise and general disturbance to wildlife, particularly to breeding or over-wintering birds. Fast powered craft including jet-skis tend to be the worst in this regard. Windsurfing during the winter could potentially conflict with wildlife in refuges.

Diving
Strangford Lough is one of the principal areas in Northern Ireland used by recreational divers for training, exploring wrecks and observing marine life. The Lough's sheltered waters are ideal as training areas for novice divers, while also affording some of the most challenging dives to be found in Northern Ireland for the more experienced.

The study of the seabed by divers is in harmony with conservation interests provided no damage is done. Over-collection of marine life could, however, prove damaging to the populations of certain species. The Strangford Lough Regulation of anchoring, mooring and diving byelaws 2012 () prohibit anchoring, mooring or diving within a restricted zone at any time. This byelaw applies to all waters deeper than 10m below chart datum in the restricted zone which is bounded by a Northern Limit and a Southern Limit. Diving for the purposes of monitoring condition and recovery of the designated features within the zone may be permitted by the Department following an assessment of the proposed methodology and qualifications of the Dive Team. Any such Permit will be time bounded and require the production of a detailed survey report.

Horse Riding
Newtownards, Mount Stewart and Ballyhornan are the most popular areas for horse riding on the foreshore. Firm beaches provide uninterrupted gallops for exercising horses.

The areas most sensitive to horse riding are wildlife refuges over the winter months and areas supporting Eelgrass. Birds may not be unduly disturbed by riders hacking across the shore, but are more likely to move where several horses are using the same stretch of shore as a gallop. There is some conflict with displacement of wildfowl from the shore at Castle Espie where there is a bird watching hide. Otherwise there are few significant problems at present.

Wildfowling
There is a very long tradition of wildfowling on Strangford Lough. The five wildfowling clubs around the Lough, (all affiliated to the British Association for Shooting and Conservation), co-ordinate their activities through the Joint Council of Strangford Lough Wildfowling Associations. Wildfowling on the foreshore and on adjacent lands owned or controlled by the National Trust is subject to controls under the Wildlife Scheme. A system of refuges has been established where wildfowling is either banned or restricted to certain times of year and where efforts are being made to minimise all forms of disturbance. Bag returns provide information on the

composition of birds shot and their location. Mallard is the main quarry species, followed by teal.

Wildfowling inevitably causes some disturbance to the birds though this is minimised by the wildfowlers. Participants try to reach their positions unseen, and shoot birds on a flightline, rather than on the feeding grounds. Dogs retrieving birds may cause some disturbance to feeding birds, but with well-trained animals this is minimal.

The revised system of refuges, including time-share zones and shooting regulated zones, has been designed to increase the birds' opportunity to feed and roost undisturbed, so maintaining the Lough’s attraction for them. Work to determine the effectiveness and sustainability of the current refuge system is on-going.

Aircraft
Newtownards Airfield lies adjacent to the SAC/SPA. Light aircraft, gliders and small helicopters use the airfield, mostly for recreation. An annual fund-raising air-show attracts large crowds.

The evidence to date suggests that birds generally become accustomed to the movements of light aircraft. Microlites and helicopters cause greater disturbance.

Education and Research
The Lough provides a natural laboratory for carrying out marine biological and oceanographic research and this is evident from the number and diversity of research projects that it supports. Strangford Lough is much used for field studies at all levels of education, with many school groups visiting the interpretative centres which have been established around the Lough. In addition, residential centres bring Primary and Secondary school parties to the Lough for study and training.

Generally speaking these activities have little lasting impact on the Lough’s ecology. There is, however, a risk of disturbance from large parties repeatedly using sensitive areas. Repeated collecting at favoured sites may also lead to local depletion of species in that area.

ACTION: The increasing recreational pressure needs to be continuously monitored and assessed for any possible adverse impacts on the loughs SAC/ASSI habitats and associated species. Recreational pressure also needs to be considered in appropriate assessments when assessing the possible adverse impacts of proposed recreational developments, on or around the lough.

Operations Affecting Water Quality
Anthropogenic inputs entering Strangford Lough include those from sewage out-falls, watercourses, recreational and commercial craft and associated facilities, and the open sea. They include nutrients from effluent discharges, organic wastes and fertiliser run-off; some particulate material including bacteria; small amounts of petroleum and oils; some metal ions and other more complex chemicals derived from industrial processes; fuel additives, pesticides, anti-fouling paints, slip-way treatments etc.; and plastic and other floating waste. Some fly-tipping of refuse

onto the shore also takes place, which may result in chemicals leaching into the Lough.

Sewage effluent is discharged directly into Strangford Lough from eight main outfalls. In addition, treated sewage effluent from a number of neighbouring settlements is discharged into the Quoile system. Slurry, silage effluent, effluent from septic tanks and leachate from landfill sites may enter the rivers and some of the smaller streams, particularly the Quoile. A certain amount of agricultural run-off enters the Lough directly from adjacent fields, or indirectly via watercourses.

Effluent discharged from in-board toilets on boats may cause localised pollution.

Water quality in the Lough is generally good, although there be locally significant effects from discharges of storm water and sewage from peripheral housing areas. High nutrient levels from sewage outfalls can adversely modify the local biota though such inputs may increase productivity and carrying capacity. Some forms of wildlife thrive in nutrient enriched areas but nutrient overload can also lead to some species having a blanketing effect on the habitat. Enrichment tends to result in an increase in the abundance of a few tolerant species such as ragworms and in the growth of green algae.

Nutrification may be having a detrimental effect particularly at the northern end of the Lough. Increases in the suspension of organic or inorganic material in the water column increases turbidity and reduces light levels, which along with changes in sedimentation may be affecting the growth of eelgrass.

The potential exists for any spillage from shipping in the Irish Sea to enter the Lough system. The scale of impact would depend on the amount of spill, its location and type of oil etc.

ACTION: The ongoing water quality monitoring of the lough should identify any potential water quality problems. In the case of accidental oil spills from shipping in the Irish Sea, there needs to be an up to date Oil Spill Contingency Plan, in place, to deal with such an eventuality.

Commercial Fisheries Impacts

Commercial Fishing

Fishing on a commercial scale can affect the seabed in a variety of ways. Several studies of the impact of fishing operations on the seabed were undertaken during the 1990s. These studies concluded that only those areas where fishing boats could not easily gain access remained unmodified. Following concerns about a serious decline in the biogenic reef (*Modiolus modiolus*) in Strangford Lough, Queen's University Belfast were commissioned by EHS to undertake a wide ranging investigation into the probable causes of this decline. The final report (Strangford Lough Ecological Change Investigation) identified trawling and dredging for scallop species as the main cause for the demise of the *Modiolus* biogenic reef structure. Subsequently, DARD Fisheries Division introduced the Strangford Lough

(Prohibition of Fishing for Shellfish) Regulations (Northern Ireland) 2001 which prohibits the use of mobile fishing gear within the Lough.

In 2008, DOE and DARD developed a comprehensive restoration plan for the *Modiolus* biogenic reef, which was submitted to and accepted by the European Commission. This included surveying the extent and condition of the remaining biogenic reef, identification of sites in good condition, investigation of practical methodologies and introducing total protection measures where required. The Restoration plan was modified and resubmitted to the European Commission in October 2012. As part of the restoration plan DARD brought forward proposals to prohibit, through regulations, fishing in two areas of Strangford Lough, known to contain *Modiolus* biogenic reef. These regulations (The Strangford Lough (Sea Fishing Exclusion Zones) Regulations (Northern Ireland) 2012) came into operation in January 2013 and prohibit all fishing within two zones at a depth of 10m or more below chart datum.

Potting takes place mainly in the Narrows and the periphery of the Lough. There is pot fishing of Dublin Bay Prawns and more recently of Shore Crabs, Velvet Swimming Crabs, Common Whelks and Lobsters are also taken. Fishing effort can disturb sediment and over-fishing of some species might affect the conservation interests.

Harvesting of Wild Shellfish

Though economically viable beds of the Native Oyster were worked out in the 19th century, other shellfish are still gathered. Cockles are gathered by hand raking the sediment. While the collection of Common Mussels and Winkles for personal use is unlikely to have a significant impact on the designated features of the Lough, there has been an increase in unregulated shellfish harvesting by large groups or 'gangs'. Some commercial harvesting may be sustainable but large-scale harvesting may be detrimental. Mechanical harvesting of cockles for example would be very likely to severely damage other fauna and flora that live in the mudflats. Eelgrass may be physically damaged and harvesting may interfere with birdlife such as oystercatchers, for which cockles are a major food source.

People on the shore engaged in such activities may reduce bird feeding times and increase their energy requirements as they fly to other areas. Common and Grey seals hauled out onto rocks within the intertidal area may also be disturbed by people harvesting wild shellfish.

Seaweed Harvesting

Historically in Strangford Lough seaweeds have been both harvested and cultured. Drift wrack and kelp (brown seaweeds) were used on the land as fertiliser. Up to the Second World War seaweed - in particular the Knotted Wrack - was extensively cut for fertiliser and for burning to produce a powder used in glass-making. At certain sites, for example around Greyabbey, large boulders were placed on sandy areas of shore for seaweeds to attach and create a crop of material.

The red algae known as Dulse is also a traditional crop, being cut from the stipes of kelp, on which it grows particularly in the Narrows, then dried for human consumption.

Were extensive commercial exploitation of seaweed to take place in Strangford Lough the loss in ecological terms would be likely to be on a significant scale. Research has indicated that large scale commercial harvesting would probably alter populations over a wider area with consequent decline in larval supply, increase in sediment mobility and loss of organic maternal from the inshore system.

There is interest in the cultivation of seaweed in Strangford Lough which may have implications for the features.

Bait Digging
Bait digging has traditionally taken place on a small scale in many places around the Lough and today digging for Lugworm and Ragworm is commonplace at Island Hill. Small-scale bait digging by anglers for individual use may be insignificant in its effect in many situations but if undertaken in sensitive habitats, at certain times of the year or on a commercial scale, it may be incompatible with the aims of nature conservation. It may damage eelgrass beds and large numbers of bait diggers are likely to cause disturbance to waterfowl. Raking or digging for burrowing invertebrates buries oxygen-rich surface sediments often killing the animals they contain.

Aquaculture
There has been a steady growth in interest in shellfish cultivation in Strangford Lough in recent years. Some 350 hectares of seabed and intertidal area within the Lough are now subject to shellfish culture licences. A number of different techniques are used for growing oysters, mussels, clams and scallops. Oyster farming is the most economically important fishery in the Lough with an annual turnover in excess of that from commercial fishing. Both Native Oyster and Pacific Oyster are cultivated in the Lough; these are grown in mesh sacks on trestles at low water and finished on ground mats.

Shellfish culture is generally regarded as an activity that has relatively low negative impact on the environment. A high standard of water quality is required and no chemicals or antibiotics are used in shellfish production. It can, however, cause loss or modification of habitat, disruption of sediment movement, and disturbance to wildlife. Care has to be taken to avoid the accidental introductions of other species with commercial shellfish. Imports of juvenile shellfish for cultivation are therefore routinely inspected by the Department.

The impact of areas set aside for the shellfish cultivation on bird feeding is generally limited. Sown areas cover only a small proportion of the foreshore and are usually well spaced. Harvesting and net cleaning occurs only during periods of spring tides. However, harvesting does occur during the winter months when bird feeding may be at its most intense. The cumulative impacts of shellfish cultivation on all designated features should be considered, in particular with each new application.

Caged fin-fish farming is presently considered to be an inappropriate practice in Strangford Lough for various environmental reasons including risks to native marine life from waste products and parasite treatments, incompatibility with predator species and its impact on maintaining visual amenity.

ACTION: Commercial fisheries operations need to be constantly monitored and reviewed to assess the sustainability of the operations to prevent any adverse impacts on the loughs water-quality and foodchain ecology.

Wildlife watching trips

Wildlife watching trips (boat and land based) have the potential to cause disturbance to species if operators are not appropriately trained in how to approach species while minimising potential disturbance. In addition, damage to sensitive habitats may occur through lack of knowledge of their location. Various wildlife training courses are available which teach best practice when dealing with wildlife.

Nitrogen Deposition

Excess nitrogen deposition can favour the growth of competitive plants and lead to changes in ecosystem structure or function and to a reduction in biodiversity. National scale studies show the potential adverse effects of excess nitrogen on natural and semi-natural habitats to be widespread across the UK. Lower and upper critical loads have been calculated for Strangford Lough SAC.

Large Shallow Inlets and Bays - Designated feature/feature habitat not sensitive to eutrophication.

Reefs - Designated feature/feature habitat not sensitive to eutrophication.

Annual Vegetation of Drift Lines - Designated feature/feature habitat not sensitive to eutrophication.

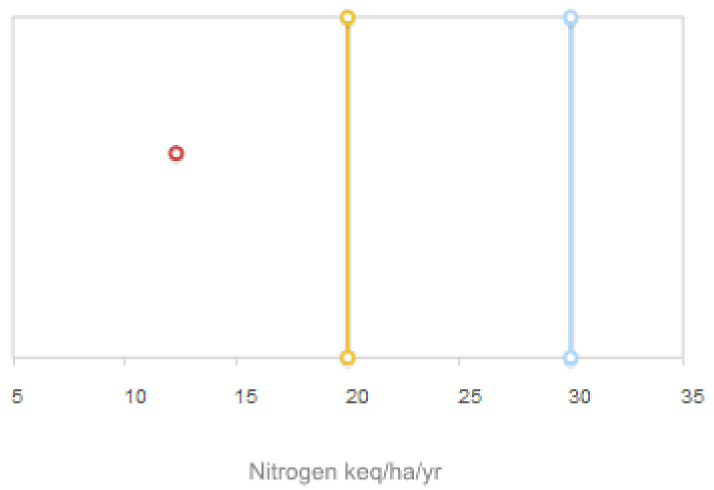
Feature: Coastal lagoons

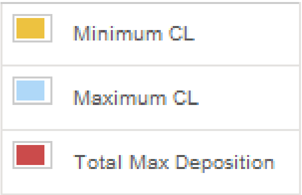
Critical Load Class: Pioneer, low-mid, mid-upper saltmarshes

Critical Loads (kg N/ha/yr): 20-30

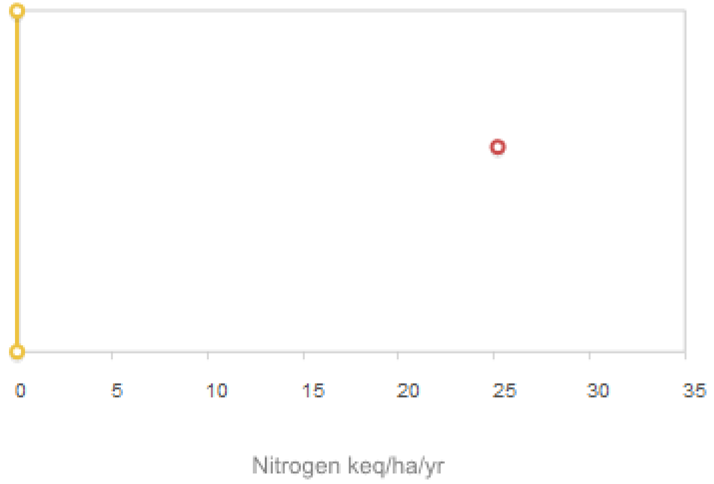
Nitrogen Deposition (kg N/ha/yr):

Maximum: 12.3 Minimum: 6.6 Average: 8.8

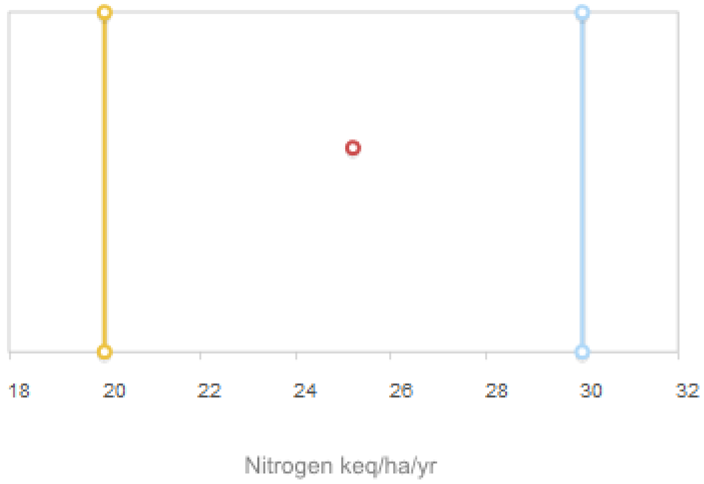


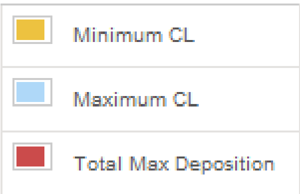


Feature: Mudflats and sandflats not covered by seawater at low tide
Critical Load Class: No comparable habitat with established critical load estimate available
Critical Loads (kg N/ha/yr): no critical loads available for this feature
Nitrogen Deposition (kg N/ha/yr):
Maximum: 25.2 Minimum: 14.3 Average: 18



Feature: Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
Critical Load Class: Pioneer, low-mid, mid-upper saltmarshes
Critical Loads (kg N/ha/yr): 20-30
Nitrogen Deposition (kg N/ha/yr):
Maximum: 25.2 Minimum: 14.3 Average: 18





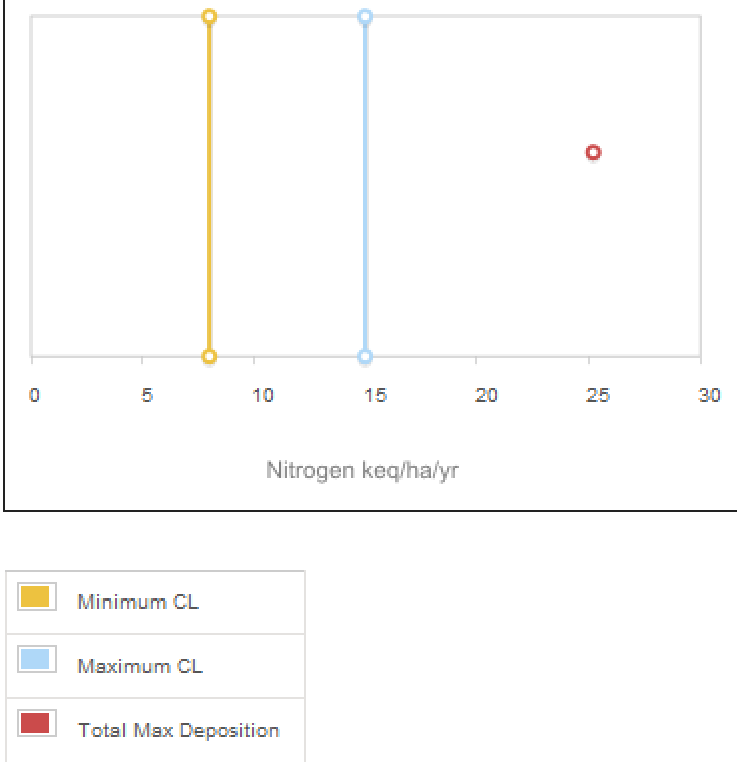
Feature: Perennial vegetation of stony banks

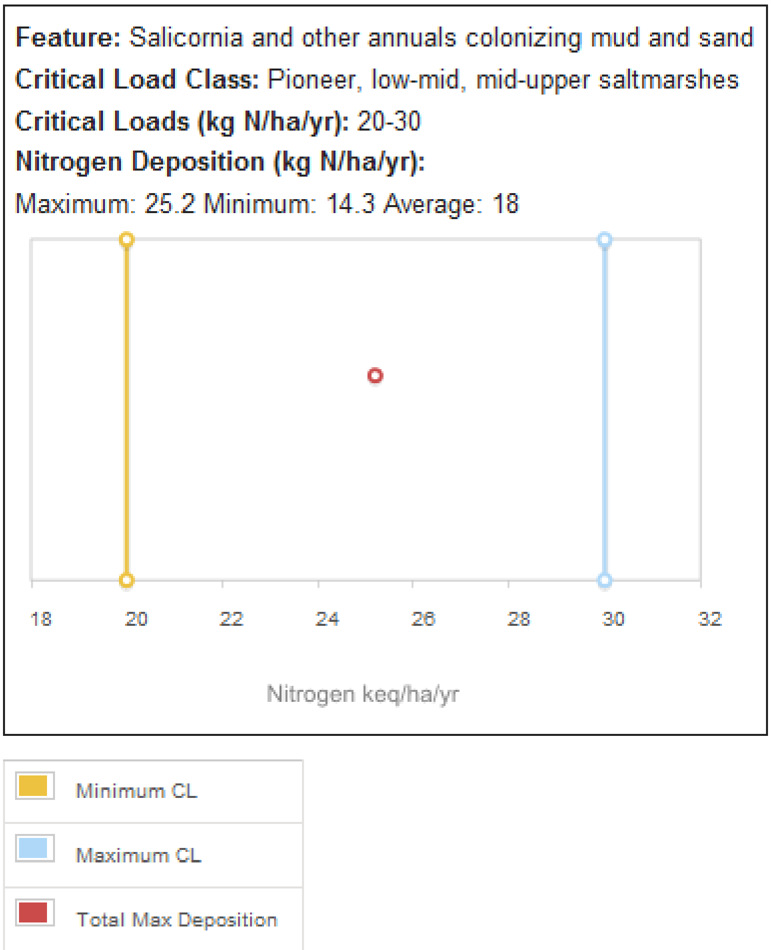
Critical Load Class: Coastal stable dune grasslands

Critical Loads (kg N/ha/yr): 8-15

Nitrogen Deposition (kg N/ha/yr):

Maximum: 25.2 Minimum: 14.3 Average: 18





(Source: Air Pollution Information System (APIS) website- www.apis.ac.uk)

ACTION: Seek to maintain or where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant critical load.

Changes to surrounding land use
Any changes in local land-use e.g. agricultural intensification, drainage works and development) may be detrimental to the SAC.

ACTION: Reduce the risk of surrounding agricultural intensification by encouraging the adjacent owner/occupiers to enter into agri-environment schemes. Use Habitats Regulations Assessments (HRAs), through the planning process, to minimise any development risks adjacent to the SAC.

Climate Change
Northern Ireland faces changes to its climate over the next century. Indications are that we will face hotter, drier summers, warmer winters and more frequent extreme weather events. The Northern Ireland Climate Change Adaptation Programme was published in January 2014. This contains the Northern Ireland Executive's response to the risks and opportunities identified in the Climate Change Risk Assessment for Northern Ireland (published January 2012) as part of the overall UK Climate Change Risk Assessment. The Adaptation Programme provides the strategic objectives in relation to adaptation to climate change, the

proposals and policies by which each department will meet these objectives and the timescales associated with the proposals and policies identified in the period up to 2019.

ACTION: When developing SAC management plans, the likely future impacts of climate change should be considered.

11. MONITORING

The SACs are surveyed using two forms of monitoring:

Site Integrity Monitoring (SIM) is carried out to ensure compliance with the ASSI/ SAC conservation objectives. The most likely processes of change will either be picked up by SIM (e.g. dumping, burning, turf cutting, grazing etc.) or will be comparatively slow (e.g. gradual degradation of the habitat). In addition, potentially damaging activities may be picked up through the active marine ranger programme or by members of the public raising concerns with the Department. These reports are followed up through consultation with the relevant competent authorities.

Site Condition Assessment of the designated features is carried out on a rolling 6 year basis to pick up subtle changes in the condition of the feature and to ensure that the conservation objectives are being met.

The method for Site Condition Assessment was agreed by the relevant JNCC-led Lead Co-ordination Network although the methodology has been modified to reflect individual site attributes in Northern Ireland. For marine features, condition assessments include a variety of techniques such as diving, remote cameras, sediment sampling and acoustic seabed mapping. Marine mammal monitoring programmes also contribute.

11.1 MONITORING SUMMARY

1. Monitor the integrity of the site (SIM or Compliance Monitoring)
This SIM should be carried out at least once every year.

2. Monitor the condition of the site (Condition Assessment)
Monitor the key attributes for each of the SAC selection features. This will detect if the features are in favourable condition or not. See Annex I.

The favourable condition table provided in Annex I is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring condition of the site and its features. It does <u>not by itself</u> provide a comprehensive basis on which to assess plans and projects, but it does provide a basis to inform the scope and nature of any Habitats Regulations Assessment (HRA) that may be needed. It should be noted that completion of a HRA is a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

12. REFERENCES

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ANNEX I

The marine Annex I habitats are very broadly defined habitats that are often represented by large and complex sites. To effectively describe, monitor and manage such complex features, it has been necessary to divide some of them into smaller units called *sub-features*. Sub-features are distinctive biological communities (e.g. eelgrass beds, maerl beds, horse-mussel reefs), or particular structural or geographical elements of the feature. Due to the broad nature of marine Annex I features, it has often proved helpful, both in the development of conservation objectives, and of monitoring programs, to separate the feature into a number of constituent sub-features, and then to identify attributes and targets for the sub-features. The use of sub-features has been found to be particularly helpful for those marine Annex I features that represent whole physiographic units , and permits a level of flexibility in the application of the UK's Common Standards Monitoring which has been found necessary when applying the standards at the site level.

Feature 1 (SAC) - Large shallow inlet and bay (Status A)

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
	Extent	Area (ha) of the large shallow inlet and bay, measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	
	Water clarity	Light attenuation measured on a monthly basis from March to September.	Seasonal light attenuation should not deviate from the baseline, subject to natural change.	The extent and diversity of plant and algal communities is affected by water clarity. Clarity is reduced through increases in the suspension of organic or inorganic material in the water column.

	Water salinity & temperature	Salinity and water temperature measured on a monthly basis.	Temperature & salinity should not deviate significantly from the long-term trends, subject to natural change.	Temperature and salinity are characteristics of the overall hydrography of the area, thus the overall functioning of the Lough.
	Nutrient status	Phytoplankton concentration in summer measured annually.	No significant increase in phytoplankton concentration from the established baseline, subject to natural change.	Nutrient enrichment stimulating excessive growth of phytoplankton is a common factor contributing to a reduction in water clarity. Single species-dominated phytoplankton blooms can also be harmful.

Feature 1 (SAC) - Large shallow inlet and bay (Status A) – continued.

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
Subtidal Sand and Gravel Communities Subtidal Fine Sand and Mud Communities	Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of selected biotopes at selected sites measured once during the reporting cycle	Results should not deviate significantly from the established baseline, subject to natural change.	Changes in extent and distribution may indicate long term changes in the physical conditions at the site. Previously, AFBI was involved in a range of mapping exercises (ROXANN) to produce habitat maps, however, the complex heterogeneity of Strangford Lough seabed has rendered this maps of limited use. In 2015 AFBI produced a comprehensive bathymetric and habitat map (https://www.afbini.gov.uk/sites/afbini.gov.uk/files/publications/strangford_lough.pdf) and the Department is engaged in follow-up monitoring in ground truthing to further refine the precision of this map.
	Species composition of selected biotopes at monitoring sites.	Species composition of selected biotopes measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities. A list of selected indicator species identified by both spyball and diving surveys will be utilised to determine the achievement of the conservation objectives throught presence/absence at monitoring sites .

NOTE: As they are all part of the single system, the condition of other features which occur within a large shallow inlet and bay will also contribute to the overall assessment of the large shallow inlet and bay

Feature 2 (SAC) – Coastal Lagoons (Status B)

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
Tide-swept communities (The Dorn Sill)	Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of selected biotopes at selected sites measured once during the reporting cycle	Results should not deviate significantly from the established baseline, subject to natural change.	Baseline survey was carried out as part of the Northern Ireland Littoral Survey between 1984 and 1987 by Heriot-Watt University. Changes in extent and distribution may indicate long term changes in the physical conditions at the site
	Species composition of selected biotopes at monitoring sites.	Presence and abundance of composite species, measured during summer, once per reporting cycle.	Presence and abundance of composite species should not deviate significantly from an established baseline, subject to natural change.	Tide-swept communities are characteristic of inlet lagoons and are therefore integral to the structure and function of such lagoons. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.
	Extent	Area (ha) measured once per reporting cycle.	No decrease in extent from an established baseline, subject to natural change.	Use of aerial photographs and subsequent ground truthing to determine this.

Feature 3 (SAC) - Mudflats and sandflats not covered by sea water at low tide (Status B)

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
	Morphological naturalness (extent, mobility and substrate)	Ensure that any loss in extent and change in system dynamics is only due to natural processes	No human induced developments impacting on the natural system.	This habitat occupies a naturally dynamic position in coastal systems. Provided that no human developments result in direct loss of habitat, or change the site dynamics, then the attribute should be deemed to be in favourable condition. Substrate supply and distribution should be regulated by natural coastal processes. Aerial photos can be used to monitor natural movement of channels and any encroachment from unregulated planning.
Intertidal Sand and Gravel Communities Intertidal Fine Sand and Mud Communities	Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of selected biotopes at selected sites measured once during the reporting cycle	Results should not deviate significantly from the established baseline, subject to natural change.	Baseline survey was carried out as part of the Northern Ireland Littoral Survey between 1984 and 1987 by Heriot-Watt University. Changes in extent and distribution may indicate long term changes in the physical conditions at the site
	Species composition of selected biotopes at monitoring sites.	Species composition of selected biotopes measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.

Zostera Spp Beds (*Z noltii, Z. angustifolia Z. marina*)	Distribution of *Zostera* beds.	Distribution of *Zostera* beds, measured during autumn once during the reporting cycle.	Distribution should not deviate significantly from the established baseline, subject to natural change.	The distribution of the beds is of key importance to their conservation condition. It is important that any consideration of *Zostera* within the context of these conservation objectives fits with the UK Biodiversity Action Plan for Seagrass Beds. A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data. The Department is currently gathering data on the distribution, extent and quality of subtidal *Zostera marina* beds (at present these are located at Ballyhenry and Strangford Harbour, but others may be found through subtidal survey).
	Extent.	Area (ha) of *Zostera* spp. Beds	Extent should not deviate significantly from the established baseline, subject to natural change.	A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data.

Feature 3 (SAC) - Mudflats and sandflats not covered by sea water at low tide (Status B) – continued.

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
Zostera Spp Beds (*Z noltii, Z. angustifolia Z. marina*)	Taxonomic composition	Presence of selected taxa	Taxonomic species should not deviate significantly from the established baseline, subject to natural change.	A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data.
	Density	Measuring *Zostera* shoot density	Target: Average shoot density should not deviate significantly from the long term average.	An early indicator of seagrass under stress is a reduction in the number of plants and loss of plants on the lower shore. This will probably concentrate only on *Z. angustifolia* which, being a larger plant, is found at lower densities than *Z. noltii*.

Feature 4 (SAC) - Reefs (Status B)

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
Subtidal Rock and Boulder Communities Subtidal Rocky Reef Communities Intertidal Rock and Boulder Communities	Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of the selected biotopes at selected sites measured once during the reporting cycle.	Results should not deviate significantly from the established baseline, subject to natural change	AFBI was involved in a range of mapping exercises (ROXANN) to produce habitat maps, however, the complex heterogeneity of Strangford Lough seabed has rendered these maps of limited use. In 2015 AFBI produced a comprehensive bathymetric and habitat map (https://www.afbini.gov.uk/sites/afbini.gov.uk/files/publications/strangford_lough.pdf) and the Department is engaged in follow-up monitoring in ground truthing to further refine the precision of this map. For intertidal rock and boulder communities, baseline surveys were carried out as part of the Northern Ireland Littoral Survey between 1984 and 1987 by Heriot-Watt University. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
	Species composition of selected biotopes at monitoring sites	Species composition of the selected biotopes measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.

Feature 4 (SAC) - Reefs (Status B) - continued

SUB-FEATURE	ATTRIBUTE	MEASURE	TARGETS	COMMENTS
Modiolus modiolus Beds	Distribution of *Modiolus* beds.	Distribution of *Modiolus modiolus* biotope SCR.ModCVar and biotopes with *Modiolus /Ophiothrix* measured once during the reporting cycle.	*Modiolus* beds (SCR.ModCVar) and other biotopes should be present in those areas of the Lough where they historically occurred.	The *Modiolus beds* are currently in unfavourable condition and are subject to a restoration plan which has been agreed with the EU Commission and all relevant stakeholders. It has been agreed that no direct intervention (by way of transplants etc.) will be conducted, instead favouring a natural resettlement of the feature, facilitated by enhanced fishery management plans. Periodic monitoring for indicators of natural restoration will be conducted by the Department and others but natural restoration is likely to take decades.
	Extent and percentage cover of *Modiolus* beds.	Extent and percentage cover occupied by *Modiolus* beds i.e biotope SCR.Mod.Cvar and biotopes with *Modiolus/ Ophiothrix* measured once during the reporting cycle.	This target will reflect the potential for natural recovery of *Modiolus modiolus* beds in areas where it has been impacted. Lower limit: No decrease in extent or percentage cover from established baseline, subject to natural change.	It will be important to ensure that the beds do not become further reduced or fragmented even if the distribution does not change significantly. A considerable amount of data has recently been collated and is being updated regarding this attribute. Periodic monitoring for indicators of natural restoration will be conducted by the Department and others but natural restoration is likely to take decades.

	Species index of *Modiolus* beds.	The diversity (number of species and their abundance) of the mussel beds is a key measure of its health.	Species index of the *Modiolus modiolus* beds should not deviate from the established baseline, subject to natural change.	*Modiolus* beds are a habitat for many other species. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.

Feature 5 (SAC) - Annual vegetation of drift lines (Status C)

* = primary attribute. One failure among primary attribute = unfavourable condition

Attribute	Targets	Method of Assessment	Comments
* Morphological naturalness (extent, mobility and substrate)	No human induced developments impacting on the natural system.		This community occupies a naturally dynamic position in coastal systems. Provided that no human developments result in direct loss of habitat or of areas with the potential to develop this habitat, or change the site dynamics, then the attribute should be deemed to be in favourable condition. Both inorganic and organic substrates are important precursors to development of annual vegetation of drift lines. Substrate supply should be regulated by natural coastal processes.
* Characteristic species	Maintain the presence and broad distribution of stands of *Honckenya peploides – Cakile maritima* SD2 community and the SD3 *Matricaria maritima - Galium aparine* community together with other local variants across the feature. Assessments will need to be made during late summer(July/August)		These communities are found in a narrow strip at the extreme high water mark. Changes in the frequency and abundance of these species should be expected to occur seasonally as a result of storm events, but the communities are also sensitive to disturbance by human activities. Some communities on coarse substrates do not match well with SD 2 but are important as regional variants. Such communities are dominated by *Beta* and *Atriplex* spp. and show affinities to MC 6 *Atriplex hastata-Beta vulgaris* ssp *maritima* Sea-bird cliff community.
Disturbance	No increase in area where vegetation colonisation/recolonisation is prevented by human activity		To be assessed once per reporting cycle in late summer (July/August)
Rare and notable species	To maintain the presence of notable species at localities with historical records.		Check historical records to determine applicability

Feature 6 (SAC) - Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (Status C)

* = primary attribute. One failure among primary attribute = unfavourable condition

Attribute	Target	Method of assessment	Comments
* Area of saltmarsh	Subject to natural processes, maintain the overall extent of saltmarsh vegetation.	Visual estimate in 2 x 2 m plots and across the extent of the saltmarsh using a combination of aerial photographs and SIM. The area should be measured once per reporting cycle (6 years) during the summer months of June, July, August or early September.	Judgements in changes to extent/area will have to take particular care to distinguish changes as a result of natural erosion vs. anthropogenic actions.
* Mobility	No increase in either the linear extent or the area constrained by introduced structures or landforms.	Visual inspection of aerial photographs, SIM and Condition assessment structured walk. Check for any new physical structures that may impact on this community.	Introduction of physical constraints would reduce the extent of this community and affect its structure.
Physical structure: creeks and pans	Realignment of creeks absent or rare. No further anthropogenic alteration of creek patterns or loss of pans compared to an established baseline.	Visual inspection of aerial photographs, SIM and Condition assessment structured walk. Check for man-made influences on creeks and pans.	Creeks and pans vary in size and density. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network.

* Saltmarsh community diversity	Maintain presence of saltmarsh communities SM10, SM13, SM16, SM18, SM19, SM20 and SM28 as established at baseline survey.	Visual estimate in 2x2m plots.	
*Presence of associated semi-natural habitats	Maintain other saltmarsh communities and transitions to freshwater/flush and grassland - e.g. some of the samples to contain open SM8 communities with *Salicornia*; S21 communities with *Scirpus maritimus*; and S4d communities with *Phragmites*	Visual estimate in 2x2 m plots	*Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types. Where they occur with saltmarsh communities, their presence should be recorded.
* Maintain frequency of positive indicators for low-level marsh (SM10)	At least 5 of the indicator species listed below at least occasional, of which 3 are at least frequent throughout the sward: *Suaeda maritima, Salicornia* agg., *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima Armeria maritima.* At least occasional is equivalent to greater than	Visual estimate in 2x2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities. **Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types/ ASSI selection features.

	21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.		
* Sward Height (SM10)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 12 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for low-level marsh (SM13a, b, c and d)	At least 5 of the indicator species listed below at least occasional, of which 3 are at least frequent throughout the sward: *Suaeda maritima, Salicornia* agg., *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima, Armeria maritima.* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities. **Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types/ ASSI selection features..

	41% occurrence in recorded plot.		
* Sward Height (SM13a, b, c and d)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 15 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for middle marsh communities (SM16b, c, d and e)	At least 6 of the indicator species listed below at least occasional, of which 4 are at least frequent throughout the sward: *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima Armeria maritima, Festuca rubra, Juncus gerardii, Agrostis stolonifera, Trifolium repens, Leontodon autumnalis, Carex flacca* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities. **Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types/ ASSI selection features.

* Sward Height (SM16b, c, d and e)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 20 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for upper marsh communities (e.g.SM18a, SM19 and SM20 and SM28)	At least 6 of the indicator species listed below at least occasional, of which 4 are at least frequent throughout the sward: *Juncus maritimus, Agrostis stolonifera, Festuca rubra*, *Glaux maritima*, *Juncus gerardii, Triglochin maritima, Plantago maritima, Armeria maritima, Aster tripolium, Elymus repens, Atriplex prostrata, Potentilla anserina, Phragmites australis, Blysmus rufus, Eleocharis uniglumis* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities.
Sward Height (Upper marsh communities)	Maintain mean sward height less than 1m.	Visual estimate in 2x2 m plots	Measure during summer (July/August/early September)

			As upper saltmarsh communities are tall, often mono-dominant stands of vegetation, the height of the vegetation is not critical.
* Frequency and/or % cover of *Spartina* encroachment into the saltmarsh communities (% Cover)	*Spartina* be should be recorded as absent or rare across the saltmarsh communities. Mean cover should be less than 2 %. No more than rare is equivalent to less than 20% occurrence in recorded plots	Visual estimate within a 10x10 m radius of monitoring plots <u>and</u> across the feature using a combination of aerial photographs and Condition Assessment structured walk.	*Spartina* is extremely invasive across all saltmarsh communities and its occurrence should be carefully recoded to ensure that it does not pose a threat to these valuable communities.
* Frequency and % cover of negative indicators excluding *Spartina* (DAFOR and % cover)	Negative indicators no more than occasional across the saltmarsh communities Mean cover should be less than 2 %. No more than occasional is equivalent to less than 40% occurrence in recoded 2x2m plots.	Visual estimate in 2x2 m plots	
* Frequency and % cover of scrub/tree encroachment into transitional communities (DAFOR and % cover)	Scrub encroachment no more than occasional in transitional communities. Mean cover should be less than 5 %.	Visual estimate within a 10x10 m radius of monitoring plots <u>and</u> across the feature using a combination of aerial photographs and	

	No more than occasional is equivalent to less than 40% occurrence in recoded 10x10m plots.	Condition Assessment structured walk.	
* Cover of litter/thatch accumulation (% cover)	Less than 25% mean cover. Lower thresholds may be appropriate for short SM 10 communities.	Visual estimate in 2x2m plots.	More than 25% litter cover indicates insufficient removal of biomass by grazing, particularly in middle and upper saltmarsh communities such as SM13 and SM16. A lower threshold for thatch should be set - perhaps 10% For SM10 communities (to be determined).
* % cover of bare ground	Bare areas resulting from trampling by stock or human activity (vehicle use, etc.) should account for less than 10 % of the extent of all communities with the exception of SM 10.	Visual estimate in 2x2m plots <u>and</u> across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Saltmarsh can be severely affected by persistent heavy trampling Note: UK CSM suggests 25% upper limit for poaching – a lower limit is recommended for SM13 and SM16 at most saltmarsh areas in N. Ireland.
Lack of disturbance	There should be no management activities leading to erosion.	Visual estimate in 2x2m plots <u>and</u> across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Saltmarsh can be severely affected by persistent heavy trampling Lower marsh communities naturally have higher cover of bare ground than middle and upper marsh communities.
Lack of pollution	No evidence of oil or other forms of pollution	Visual estimate in 2x2m plots <u>and</u> across the extent of the saltmarsh using a combination of aerial photographs, SIM and	

		Condition Assessment structured walk.	
Saltmarsh hydrology	Artificial drainage channels adversely affecting hydrology are absent or rare,	Visual estimate across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	
* Maintain distinctive elements at current extent/levels and/or in current locations	Maintain distinctive elements at current extent/levels and/or in current locations (e.g. maintain existing populations of notable species, important structural attributes or notable transitions between habitats)	Visual estimate in 2x2 m plots and across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk. Check for presence of species/structural attributes, and/or transitions.	This attribute is intended to cover any site-specific aspects of this habitat feature which are not adequately covered by the previous attributes.

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 7 (SAC) - Perennial vegetation of stony banks (Status C)

* = primary attribute. One failure among primary attribute = unfavourable condition

Attribute	Target	Method of assessment	Comments
* Extent	Subject to natural processes, maintain the overall extent of the vegetation at 1.92 ha. Gransha Point - 1.02 ha Mid Island (at least partially on shingle) – 0.9 ha	Visual estimate in 2 x 2m plots and across the extent of the community using SIM and aerial photos. Measured once per reporting cycle.	Although the habitat on Strangford Lough (and at Ballyquintin Point in particular) is comparatively stable, there may be some natural variation as a result of dynamic coastal processes at Gransha Point, which appears to be active in places.
* Physical structure: functionality and sediment supply	No increase in either the linear extent or the area constrained by introduced structures or landforms.	Visual inspection of aerial photographs, SIM and Condition Assessment structured walk.	Potentially relevant to Gransha Point.
Sward Height	Sward height should be between 5-15 cm over at least 75% of the sample plots within grassland habitats	Visual estimate in 2x2m plots.	Grassland makes up the bulk of the community at Gransha Point; requires sufficient (but not excessive) grazing to maintain it.
Litter	Average litter cover (i.e. dense thatch-like material in a more or less continuous layer) should be less than 10 %. May be distributed either in patches or in one larger	Visual estimate in 2x2m plots.	Excessive build-up of litter indicates inadequate grazing levels.

	area within grassland areas.		
Bare ground	Bare areas resulting from disturbance should account for less than 10 % of the extent of any of the habitat No management activities leading to erosion.	Visual estimate in 2x2m plots.	Note that some parts of the site are naturally bare, with only a rudimentary cover of lichens over the stable cobbles.
* Zonation of vegetation	The current range of NVC communities and their approximate distribution should be maintained – i.e. shingle banks (SD2, SD3), saltmarsh (SM9, SM10, SM13, SM14, SM16 and SM28), grasslands (SD8, MC8, MC9, MG1, MG11 and MG12) and scrub (W23,W24). In particular, there should be no loss in extent of the more species-rich communities.	Visual estimate in 2x2m plots.	Ballyquintin Point has a mosaic of different habitats and vegetation types. Gransha Point is much more limited in communities present on shingle – essentially saltmarsh, strandline and grassland. Note: 1. Gransha Point was mapped as SD8 (NI Coastal Survey), but perhaps should more accurately be described as MC8/9 2. only a limited range of these communities are actually **perennial** vegetation on shingle
* Presence of positive indicator species in the dry grassland plots	Frequency of community character species. At least four of the following at least frequent and four at least occasional throughout the sward:	Visual estimate in 2x2m plots.	

	Agrostis spp., Aira spp., Armeria maritima, Carex panicea, Centaurea nigra, Cladonia spp., Danthonia decumbens, Festuca rubra, Galium saxatile, Galium verum, Hypochaeris radicata, Jasione montana, Koeleria macrantha, Lotus corniculatus, Molinia caerulea, Plantago lanceolata, Polypodium agg., Potentilla erecta, Rumex acetosella, Scilla verna, Sedum spp., Succisa pratensis, Thymus praecox		
Agricultural weed species :	No more than one negative species should more than frequent; or singly or together contribute more than 5% cover: - *Cirsium arvense, Cirsium vulgare, Senecio jacobaea, Urtica dioica, Arrhenatherum elatius*	Visual estimate in 2x2m plots.	
Bracken	Less than 5% *Pteridium aquilinum* over the area as whole	Visual estimate in 2x2m plots and across the extent of the feature using Condition Assessment structured walk.	
Indicators of Improvement	Mean cover values from the sample plots for eutrophic broad-leaved grasses (i.e.	Visual estimate in 2x2m plots.	

	Lolium perenne, Holcus lanatus, Dactylis glomerata.) should be less than 10% cover		
Trees/shrubs	Trees and/or shrubs no more than occasional on W-Walk, with seedlings rare or absent Less than 10 % tree or shrub cover (over the area as a whole)	Visual estimate in 2x2m plots <u>and</u> across the extent of the feature using Condition Assessment structured walk.	
Presence of Dung	Dung no more than occasional (as recorded in monitoring plots)	Visual estimate in 2x2m plots.	
Presence of Tracks	Tracks no more than occasional (over the total area)	Visual estimate across the extent of the feature using Condition Assessment structured walk.	
Stock Feeding	No evidence of stock feeding (over the total area)	Visual estimate across the extent of the feature using Condition Assessment structured walk.	
Stone Removal	No evidence of stone removal (over the total area)	Visual estimate across the extent of the feature using Condition Assessment structured walk.	

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

NOTE: “Perennial vegetation of stony banks” occurs on Strangford Lough at two discrete and rather different locations. Gransha Point is still an active shingle bank, and the importance of ensuring that active processes are maintained is one of the fundamental aims here. In contrast, Ballyquintin Point is no longer an active system, so coastal processes are not particularly relevant, except for occasional storm events which may cause some erosion.

The “habitat” at both sites is actually a complex of many different habitats, and the main aim is to maintain the full range of communities represented at both sites. Particular issues of note are grazing levels (leading to scrub encroachment over more valuable grassland communities) and enrichment.

Feature 8 (SAC) - *Salicornia* and other annuals colonising mud and sand (Status C)

* = primary attribute. One failure among primary attribute = unfavourable condition

Attribute	Target	Method of assessment	Comments
* Extent	Subject to natural processes, maintain the overall extent of the vegetation.	Visual estimate in 2 x 2 m plots and across the extent of the community using SIM. Aerial photographs can be useful if taken at the appropriate scale and time of year. Measured once per reporting cycle, preferably during the summer months of July or August	These communities are important precursors to more stable vegetation of low to mid marsh. Communities may be dynamic in their distribution and are linked with the physical processes operating on the site - e.g., topography, creek patterns, sea-level rise etc.
* Mobility/Coastal Processes	No increase in either the linear extent or the area constrained by introduced structures or landforms.	Visual inspection of aerial photographs, SIM and Condition assessment structured walk. Check for any new physical structures that	Colonisation of mud and sand by saltmarsh plants will only occur if adequate sediment is accreting - this is influenced by extent of fronting mudflat which can dissipate wave energy and affect availability of suspended sediment. Introduced structures could interfere with these processes.

		may impact on this community. Aerial photographs are particularly valuable for this, if available.	
* Vegetation composition	Maintain extent and species composition of low-level marsh communities *Salicornia* and *Suaeda* (SM8 and SM9) – At least 1 of the species below recorded as frequent and at least a further 2 as occasional or rare: *Salicornia* agg., *Suaeda maritima,* *Zostera* spp., *Ruppia* spp., *Puccinellia maritima,* *Aster tripolium,* *Spergularia media,* *Limonium humile,* *Cochlearia officinalis* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.	Visual estimate in 2x2m plots.	

* Frequency and/or % cover of *Spartina* encroachment into the *Salicornia* communities	*Spartina* be should be recorded as absent or rare in *Salicornia* communities. Mean cover should be less than 2 %. No more than rare is equivalent to less than 20% occurrence in recoded plots	Visual estimate within a 10x10 m radius of monitoring plots <u>and</u> across the feature using a combination of aerial photographs and Condition Assessment structured walk.	*Spartina* often invades these lower marsh communities and its spread needs to be controlled.
* Vegetation Structure	Area and thickness of algal mats should not deviate significantly from an established baseline, subject to natural change	Area and thickness of algal mat, measured during summer periodically (frequency to be determined).	Algal mats are often associated with the pioneer saltmarsh communities, and are important primary producers. However, they can be affected by changes to water quality – nutrient enrichment/eutrophication may lead to expansion and smothering of vegetation. On the other hand, pollution can cause a decline, leading to destabilisation of sediment surfaces and initiate erosion. An increase in algal cover can also indicate a decline in grazing invertebrates.
* % cover of bare ground	Bare areas resulting from trampling by stock or human activity (vehicle use, etc.) should account for less than 10 % of the extent of the habitat	Visual estimate in 2x2m plots and across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Lower marsh communities naturally have higher cover of bare ground than middle and upper marsh communities. *Salicornia* communities on mud and sand can be severely affected by persistent heavy trampling
Lack of disturbance	There should be no management activities leading to erosion.	Visual estimate in 2x2m plots <u>and</u> across the extent	

		of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	
Lack of pollution	No evidence of oil or other forms of pollution	Visual estimate in 2x2m plots <u>and</u> across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Check for direct and indirect evidence of pollution.

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 9 (SAC) - *Phoca vitulina* Harbour (Common) Seal (Status C)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

ATTRIBUTE	MEASURE	TARGETS	COMMENTS
*Population	Number of Habour Seals counted during the autumn moult period.	Maintain a population of at least 210 Harbour Seals.	The minimum population declared at the time of designation was 210. The target should be calculated as a mean maximum count over the 6 year rolling cycle. When monitoring Harbour Seal numbers, ideally 2 counts would be performed during the moult season and 2 counts would be performed during the pupping season each year to give a reasonable estimate of the population. The population within this area could be influenced by factors including population trends within the wider Irish Sea, food availability and disturbance. Strangford Lough data to be considered in the context of both long-term trends and existing seal numbers in Co. Down, all Ireland, UK and North East Atlantic.
Number of Pups	Percentage of pups in relation to number of seals counted in the moult period.	Maintain a pup percentage of at least 25%.	
*Haul-outs	Integrity of haul-outs.	Maintain integrity of traditional haul-outs.	Changes to traditional haul-outs should only be through natural processes e.g. coastal erosion/deposition.
Disturbance	Disturbance events	Contain disturbance events to a level which do not significantly impact the population.	Disturbance can result in injury to pups, separation of pups from their mothers and reduced opportunities to feed and rest. Disturbance events reported previously within this SAC include recreational activities on the shore and on water. Deliberate disturbance by boating activities has also been reported. Incidents reported to DAERA should be logged and investigated where practicable.

Appendix V Murlough SAC

MURLOUGH SAC

UK0016612

CONSERVATION OBJECTIVES

Document Details

Title	*Murlough SAC Conservation Objectives*
Prepared By	*R. McKeown*
Approved By	*P. Corbett*
Date Effective From	*24/3/2017*
Version Number	*V4*
Next Review Date	Nov 2020
Contact	cdp@daera-ni.gov.uk

Revision History:

Version	Date	Summary of Changes	Initials
V1	June 2013	Internal working document	PC
V2	January 2015	Complete review	RMK
V3	March 2017	Review marine features	LP
V4	November 2018	Review seal targets	LP

1. INTRODUCTION

EU Member States have a clear responsibility under the Habitats and Birds Directives[1] to ensure that all habitats and species of Community Interest are maintained or restored to Favourable Conservation Status (FCS). Natura 2000 sites have a crucial role to play in achieving this overall objective since they are the most important core sites for these species and habitats. Each site must therefore be managed in a way that ensures it contributes as effectively as possible to helping the species and habitats for which it has been designated reach a favourable conservation status within the EU.

To ensure that each Natura 2000 site contributes fully to reaching this overall target of FCS, it is important to set clear conservation objectives for each individual site. These should define the desired state, within that particular site, of each of the species and habitat types for which the site was designated.

Once a site has been included in the Natura 2000 network, Member States are required to implement, on each site, the necessary conservation measures which correspond to the ecological requirements of the protected habitat types and species of Community Interest present, according to Article 6.1 of the Habitats Directive. They must also prevent any damaging activities that could significantly disturb those species and habitats (Article 6.2) and to protect the site from new potentially damaging plans and projects likely to have a significant effect on a Natura 2000 site (Article 6.3, 6.4).

Conservation measures can include both site-specific measures (i.e. management actions and/or management restrictions) and horizontal measures that apply to many Natura 2000 sites over a larger area (e.g. measures to reduce nitrate pollution or to regulate hunting or resource use).

In Northern Ireland, Natura 2000 sites are usually underpinned by the designation of an Area of Special Scientific Interest (ASSI) under the Environment (NI) Order 2002 (as amended).

2. ROLE OF CONSERVATION OBJECTIVES

Conservation Objectives have a role in

- Conservation Planning and Management – guide management of sites, to maintain or restore the habitats and species in favourable condition

- Assessing Plans and Projects, as required under Article 6(3) of the Habitats Directive - Habitats Regulations Assessments (HRA) are required

[1] 92/43/EEC and 2009/147/EC (codified version of Directive 79/409/EEC as amended)

to assess proposed plans and projects in light of the site's conservation objectives.

- Monitoring and Reporting – Provide the basis for assessing the condition of a feature, the factors that affect it and the actions required.

3. DEFINITION OF FAVOURABLE CONSERVATION STATUS

Favourable Conservation Status is defined in Articles 1(e) and 1(i) of the Habitats Directive:

The conservation status of a natural habitat is the sum of the influences acting on it 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. The conservation status of a natural habitat will be taken as favourable when:

- Its natural range and 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
- The conservation status of its typical species is favourable as defined in Article 1(i).

For species, favourable conservation status is defined in Article 1(i) as when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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 population on a long term basis.

3.1 DEFINITION OF FAVOURABLE CONDITION

Favourable Condition is defined as "**the target condition for an interest feature in terms of the abundance, distribution and/or quality of that feature within the site**".

The standards for favourable condition (Common Standards) have been developed by JNCC and are applied throughout the UK. Achieving Favourable

Condition on individual sites will make an important contribution to achieving Favourable Conservation Status across the Natura 2000 network.

4. SITE INFORMATION

COUNTY: DOWN

GRID REFERENCE: J 410360

AREA: 11902.03 ha

5. SUMMARY SITE DESCRIPTION

The site adjoins Dundrum Bay and includes the shallow waters of the Bay itself, of importance as the largest area of shallow sub-littoral sandbanks in Northern Ireland. The inter-tidal sands and muds are also extensive, and the beach area at Ballykinler is important as a haul-out for Common Seal. The terrestrial element comprises the major dune systems of Murlough and Ballykinler, together with the relatively intact low dunes and ridges within Royal County Down golf club. These host a range of dune communities, but most important, are the dune heath and grey dune grasslands.

The site is particularly important for the population of Marsh Fritillary butterfly. The Inner Bay supports limited saltmarsh. The site is of international importance for earth science with contemporary coastal processes, including a classic ridge and runnel beach form, and associated dune forms, together with features important to understanding post-glacial sea-level history including the important underlying gravel series. The dunes host important fossil soil horizons with associated archaeological artefacts.

Further details of the site are available on the DAERA website (https://www.daera-ni.gov.uk/publications/reasons-designation-special-area-conservation-murlough).

5.1 BOUNDARY RATIONALE

The seaward boundary includes Outer Dundrum Bay, its line being determined by the main area of sublittoral sandbanks. The landward boundary includes all undeveloped beach area between Newcastle harbour and the western end of Tyrella Beach (this being the presumed active coastal unit associated with the selected dune complexes), the main dune system at Murlough, including the Royal County Down golf course, and at Ballykinler. The boundary in Inner Dundrum Bay includes all inter-tidal habitat, together with all substantive units of adjoining semi-natural habitat.

6. SAC SELECTION FEATURES

Feature type	Feature	Global Status	Size/ extent/ pop.
Habitat	Atlantic decalcified fixed dunes (Calluno-Ulicetea)	A	93 ha*
Habitat	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	C	8.5 ha
Habitat	Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)	C	0.2 ha
Habitat	Embryonic shifting dunes	C	2.0 ha
Habitat	Fixed dunes with herbaceous vegetation (grey dunes)	B	127.0 ha
Habitat	Mudflats and sandflats not covered by seawater at low tide	C	785.0 ha
Habitat	Sandbanks which are slightly covered by sea water all the time	C	10000.0 ha
Habitat	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	C	4.5 ha
Species	Marsh Fritillary *Euphydryas aurinia*	B	
Species	Harbour (Common) Seal *Phoca vitulina*	C	106 individuals

Table 1. List of SAC selection features. Those with global status A-C will be referred to in Annex I.

The global status is an expert judgement of the overall value of the site for the conservation of the relevant Annex I habitat. Sites have been graded A, B or C - in the UK these gradings have been interpreted as follows:

A - Sites holding outstanding examples of the habitat in a European context.

B - Sites holding excellent stands of the habitat, significantly above the threshold for SSSI/ASSI notification but of somewhat lower value than grade A sites.

C - Examples of the habitat which are of at least national interest (i.e. usually above the thresholdfor SSSI/ASSI notification on terrestrial sites) but not significantly above this. These habitats are not the primary reason for SACs being selected.

D - Habitat present but not of sufficient extent or quality to merit listing as SAC feature.

There is therefore a distinction between the principal features for which sites have been selected (those graded A or B) and those which are only of secondary interest (those graded C). This is a useful distinction but it is important to note that all three grades are qualifying SAC interest features.

Click here to go to the Natura 2000 Standard Data Form for Murlough SAC.

6.1 ASSI SELECTION FEATURES

Murlough ASSI

Feature Type	Feature	Size/ extent/ pop~
Habitat	Coastal Sand Dunes	226.7 ha
Habitat	Coastal Saltmarsh	8.5 ha
Habitat	Mudflats	785 ha
Species	Marsh Fritillary	
Species	Harbour (Common) Seal	
Species	Higher Plant Assemblage	
Species	Wintering waterfowl assemblage	
Species	Invertebrate assemblage	
Earth science	Contemporary coastal processes – Recent dune systems together with the associated fossil soil horizons and sub-fossil dune series.	
Earth science	Holocene sea-level history – buried and semi-buried components within dune system	

Table 2. List of ASSI features.

7. CONSERVATION OBJECTIVES

The ***Conservation Objective*** for this site is:

To maintain (or restore where appropriate) the

- **Atlantic decalcified fixed dunes (Calluno-Ulicetea)**
- **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)**
- **Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)**
- **Embryonic shifting dunes**
- **Fixed dunes with herbaceous vegetation (grey dunes)**

- **Mudflats and sandflats not covered by seawater at low tide**
- **Sandbanks which are slightly covered by sea water all the time**
- **Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)**
- **Marsh Fritillary *Euphydryas aurinia***
- **Harbour (Common) Seal *Phoca vitulina***

to favourable condition.
Maintain implies that the feature is in favourable condition and will, subject to natural change, remain at its condition at designation. Restore implies that the feature is degraded to some degree and that activities will have to be managed to reduce or eliminate negative impact(s). Restoration in the marine environment can refer to natural recovery through the removal of unsustainable physical, chemical and biological pressures, as well as intervention.

For each SAC feature, there are a number of component objectives which are outlined in the table below. These include a series of attributes, measures and targets which form the basis of *Condition Assessment*. The results of this will determine whether the feature is in favourable condition or not. The feature attributes and measures are found in the attached annex.

8. SAC SELECTION FEATURE OBJECTIVE REQUIREMENTS

Feature	Global Status	Component Objective
Atlantic decalcified fixed dunes (Calluno-Ulicetea)	A	Maintain and if feasible, expand the extent of existing decalcified fixed dune, H 11 and H10. Increase permitted into areas of rank dune grassland, NOT into spp-rich short turf (Grey Dune SD8).
		Maintain and enhance structural and species diversity within the H11 and H10 communities including the presence of notable species.
		Seek nature conservation management over suitable areas immediately outside the SAC where there is possibility of restoring decalcified fixed dune
		Maintain the diversity and quality of habitats associated with the decalcified fixed dunes, e.g. neutral grasslands, scrub, especially where these exhibit natural transition to decalcified fixed dune vegetation.
Atlantic salt	C	Maintain or extend, as appropriate, the area

meadows (*Glauco-Puccinellietalia maritimae*)		of saltmarsh, subject to natural processes
		Maintain or enhance, as appropriate, the composition of the saltmarsh communities
		Maintain transitions between saltmarsh communities and to other adjoining habitats
		Permit the continued operation of formative and controlling natural processes acting on the saltmarsh communities
Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)	C	Maintain and expand the extent of existing Fixed dunes with *Salix repens.* Increase permitted into areas of rank dune grassland, NOT into spp-rich short turf (Grey Dune SD8).
		Maintain and enhance species diversity within the SD16 community including the presence of notable species.
		Seek nature conservation management over suitable areas immediately outside the SAC where there is possibility of restoring fixed dune with *Salix repens*
Embryonic shifting dunes	C	Maintain or enhance the extent of embryonic shifting dunes subject to natural processes
		Allow the natural processes which determine the development and extent of embryonic shifting dunes to operate appropriately
Fixed dunes with herbaceous vegetation (grey dunes)	B	Maintain and expand the extent of existing species-rich fixed dune, SD8.
		Maintain and enhance species diversity within the SD8 community including the presence of notable species.
		Seek nature conservation management over suitable areas immediately outside the SAC where there is possibility of restoring fixed dune
		Maintain the diversity and quality of habitats associated with the fixed dunes, e.g. neutral grasslands, scrub, especially where these exhibit natural transitions to fixed dune vegetation.
Mudflats and sandflats not covered by seawater at low tide	C	Maintain the extent of mudflats and sandflats not covered by sea water at low tide
		Allow the natural processes which determine the development, structure and extent of mudflats and sandflats not covered by sea water at low tide, to operate appropriately

		Maintain and enhance, as appropriate, the species diversity within this habitat.
Sandbanks which are slightly covered by sea water all the time	C	Allow the natural processes which determine the development, structure and extent of sandbanks which are slightly covered by sea water all the time, to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this habitat.
		Maintain the extent and volume of sandbanks which are slightly covered by sea water all the time, subject to natural processes.
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	C	Maintain and enhance the extent of white dunes subject to natural processes
		Allow the natural processes which determine the development and extent of white dunes to operate appropriately
		Maintain and enhance, as appropriate, the species diversity within this community
Marsh Fritillary *Euphydryas aurinia*	B	Maintain (and if feasible enhance) population numbers and distribution.
		Maintain (and if feasible enhance) the extent and quality of suitable Marsh Fritillary breeding habitat, particularly suitable rosettes of the larval food plant *Succisa pratensis*
Harbour (Common) Seal *Phoca vitulina*	C	Maintain (and if feasible enhance) population numbers and distribution of Harbour (Common) Seal.
		Maintain and enhance, as appropriate, physical features used by Harbour (Common) Seals within the site

9. ASSI FEATURE OBJECTIVE REQUIREMENTS

Feature	**Component Objective**
Coastal Sand Dunes	See SAC Selection Feature Objective Requirements table.
Coastal Saltmarsh	See SAC Selection Feature Objective Requirements table.
Mudflats	See SAC Selection Feature Objective Requirements table.
Sandbanks	See SAC Selection Feature Objective Requirements

	table.
Marsh Fritillary *Euphydryas aurinia*	See SAC Selection Feature Objective Requirements table.
Harbour (Common) Seal *Phoca vitulina*	See SAC Selection Feature Objective Requirements table.
Higher Plant Assemblage	To maintain (and if feasible enhance) the populations of notable species, including their abundance and distribution: i.e. *Carlina vulgaris, Echium vulgare, Juncus subnodulosus, Teesdalia nudicaulis, Erigeron acer, Filigo minima* and the bryophytes *Rhodobryum roseum* and *Racomitrium canescens*.
Wintering waterfowl assemblage	To be finalised.
Invertebrate assemblage	Maintain or enhance, as appropriate, the invertebrate population together with their habitat requirements.
Contemporary coastal processes – Recent dune systems together with the associated fossil soil horizons and sub-fossil dune series.	Permit the continued operation of formative and controlling natural processes acting on the dune systems. Maintain natural site morphology subject to natural processes. Maintain the potential for access to fossil soil horizons and sub-fossil dune series.
Holocene sea-level history – buried and semi-buried components within dune system	Maintain the potential for access to buried and semi-buried components necessary for the demonstration of sea-level history as related to this site.

10. MANAGEMENT CONSIDERATIONS

Ownership

Considerable portions of the site are owned by the National Trust and managed as a NNR (Murlough). Ministry of Defence own and actively use much of the Ballykinler area but have a broadly favourable attitude to site conservation objectives. Royal County Down golf club own much of the western portion of the Murlough dune complex; again, they have a broadly favourable attitude to site conservation objectives.

11. MAIN THREATS, PRESSURES AND ACTIVITIES WITH IMPACTS ON THE SITE

Both on-site and off-site activities can potentially affect SAC/ASSI features. The list below is not exhaustive, but deals with the most likely factors that are either affecting Murlough, or could affect it in the future. Although **Atlantic decalcified**

fixed dunes (Calluno-Ulicetea), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*), Embryonic shifting dunes, Fixed dunes with herbaceous vegetation (grey dunes), Mudflats and sandflats not covered by seawater at low tide, Sandbanks which are slightly covered by sea water all the time, Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), Marsh Fritillary *Euphydryas aurinia* and Common Seal *Phoca vitulina* are the qualifying SAC features, factors affecting ASSI features are also considered.

NOTE - Carrying out <u>any</u> of the Notifiable Operations listed in the ASSI schedule could affect the site.

Grazing
In common with many dune grasslands in the UK, parts of the Murlough system suffer from under-grazing. In the absence of livestock, a healthy rabbit population can generally maintain short, species-rich swards and sufficient open ground for important communities of annual plants and invertebrates. However, populations are prone to very wide fluctuations, and once the sward becomes too rank, they are generally ineffective at reversing the trend, even if populations recover. Increased rankness leads to the loss of less competitive species and eventual colonisation by bracken and scrub – over much of the Murlough system Gorse *Ulex europaeus* is the main species.

The problem of increasing rankness may be even more severe in dune slacks and hollows, where under-grazing exacerbates a natural tendency towards drying out as plant litter accumulates progressively over time. Hydrological changes – a lowering of the underlying water table – will accelerate this process (note – only applicable at Ballykinler). In such cases, the only effective methods of managing the site are the manual removal of scrub and the introduction of livestock grazing. Further hydrological management may be required for dune slacks – for example, re-configuring dune profiles.

On the National Trust land at Murlough, a new grazing regime has been established using rare breeds (Dexter cattle – now replaced by Galloway cattle - and Exmoor ponies). The effectiveness of this regime will be formally determined through condition assessment and adjusted as required, but early indications suggest that the livestock are successful in reducing the rank growth. This has been combined with a programme of bracken and scrub control (part of HLF grant-aided “Tomorrow’s Heathland Heritage” programme). Again, early indications suggest that the work is improving the condition of the dunes.

To ensure optimum conditions for Marsh Fritillary, a series of grazing exclosures have been established in areas where breeding takes place; however, these should not be allowed to become too rank.

Management of the other major part of the dune complex at Ballykinler is more problematical; here, the rabbit population is relatively low and much of the grey dune habitat is becoming rank. The difficulty is introducing a regime of livestock grazing in an area that is used so intensively for military training.

ACTION: Continue to work with MOD and National Trust staff at Murlough as partners to:

a. **explore the possibility of extending current livestock grazing over the bulk of the dune system**
b. **develop a scrub and bracken management plan for the whole site**
c. **investigate options for maintaining (and restoring where feasible) dune slack communities at Ballykinler.**

Sea Buckthorn

Sea-buckthorn is an alien species that can spread widely in dune systems and cause radical changes to the composition of the vegetation, and the underlying soils. The species is widespread in places at Murlough, both within NT and MOD land (especially in the dunes around Murlough House and on the opposite bank of the channel at Ballykinler). A programme of control should be implemented.

ACTION: Review the need for a Sea Buckthorn control programme with National Trust and MOD.

Military Use

Military use has the potential to cause substantial impacts on the dune system. The current management committee and agreed management plan provide a framework for resolving issues.

ACTION: Continue to liaise with M.O.D. and other stakeholders

Disruption to natural sediment regime

Like most dune systems, Murlough is a highly dynamic system that needs sensitive management. Construction on the shore – including rock armouring and other coastal defence works – are likely to have “knock-on” impacts throughout the system, potentially leading to coastal erosion and loss of intertidal and adjacent coastal habitats.

Natural sand loss from the western end of the beach fronting Newcastle is probably an ongoing system response to hard engineering activities foreshortening the beach profile. Ongoing retreat of the dune front is most noticeable east of the Slieve Donard Hotel. This has resulted in the golf club getting approval for installation of hard engineering coastal protection structures, which generally have the effect of reducing or stopping the interchange of sediment between the beach and dune components of the system, and to exacerbate erosion further down ‘drift’.

Substantial erosion of the dune front is ongoing over the length of the National Trust ownership – no management response is anticipated. Historically emplaced railway sleepers near the dune foot fronting the golf course have been recently

renewed. In general, the Newcastle - Murlough beach/dune system is undergoing erosion while the Ballykinler side is stable or actively accreting.
ACTION: Liaise with Council, MOD, NT, Golf Course and others as appropriate.

Recreational Impact
Trampling through dunes can have a destabilising effect, with particular impacts on foredunes and shifting white dunes. Severe cases can result in blow-outs. Less intensive trampling can affect plant communities through the loss of species sensitive to trampling.

In the Murlough system, recreational impacts are clearly more pronounced on the NT land, where public access is permitted. However, NT has a proactive management strategy for dealing with visitors, which includes fencing the most sensitive areas, and the use of boardwalks where access to the beach is concentrated. As a result, recreational pressure does not currently appear to be a major issue on this part of the system.

At Ballykinler, the dunes represent an important amenity area for military personnel, and recreation tends to be concentrated in the more accessible parts (e.g. to the east).

At Royal County Down, golf course management is important for the condition of the grey dunes and especially dune heaths. Gorse removal offers the opportunity to extend the area of more desirable communities.
ACTION: Liaise with NT, MOD and Golf Course as appropriate.

Nitrogen Deposition
Excess nitrogen deposition can favour the growth of competitive plants and lead to changes in ecosystem structure or function and to a reduction in biodiversity. National scale studies show the potential adverse effects of excess nitrogen on natural and semi-natural habitats to be widespread across the UK. Lower and upper critical loads have been calculated for Murlough SAC.

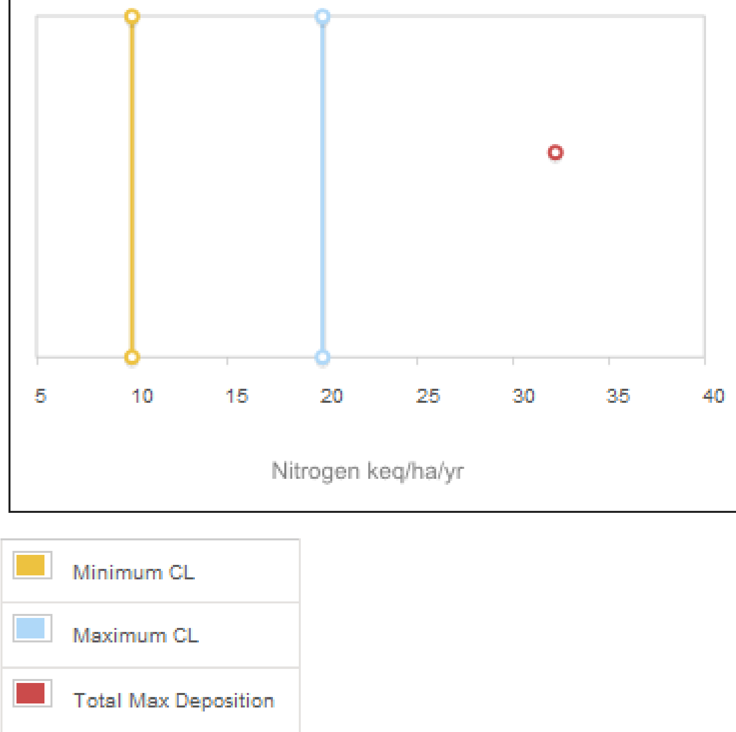
Feature: Atlantic decalcified fixed dunes (Calluno-Ulicetea)

Critical Load Class: Coastal dune heaths

Critical Loads (kg N/ha/yr): 10-20

Nitrogen Deposition (kg N/ha/yr):

Maximum: 32.2 Minimum: 14.3 Average: 12.6



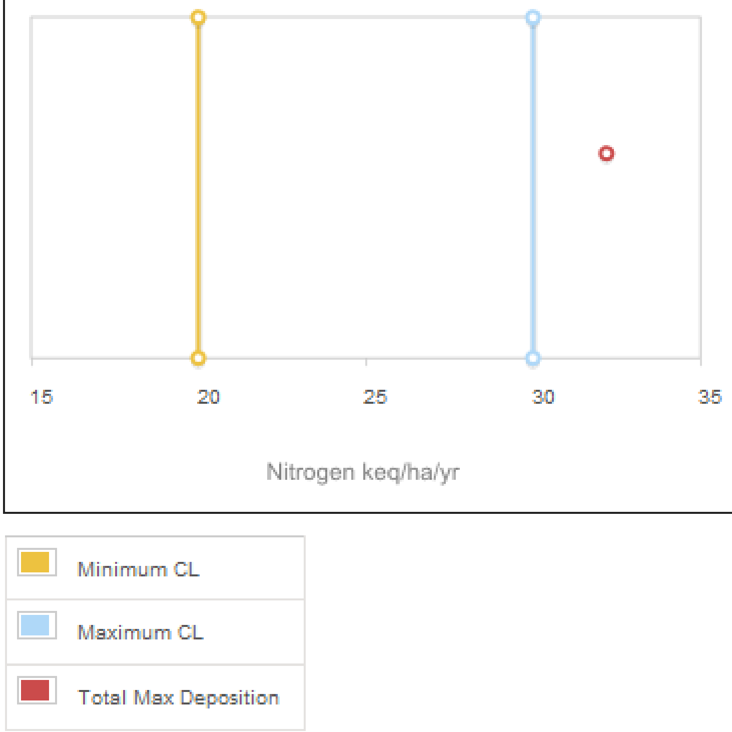
Feature: Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

Critical Load Class: Pioneer, low-mid, mid-upper saltmarshes

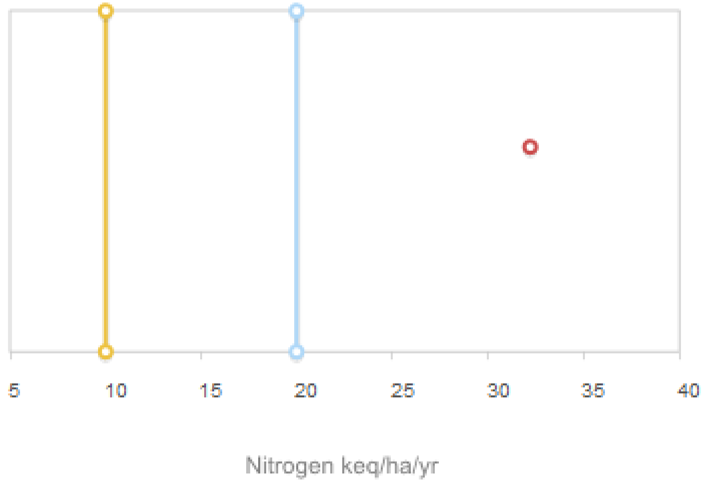
Critical Loads (kg N/ha/yr): 20-30

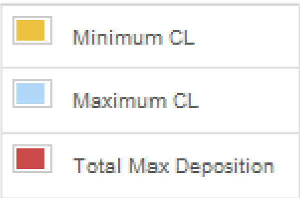
Nitrogen Deposition (kg N/ha/yr):

Maximum: 32.2 Minimum: 14.3 Average: 12.6

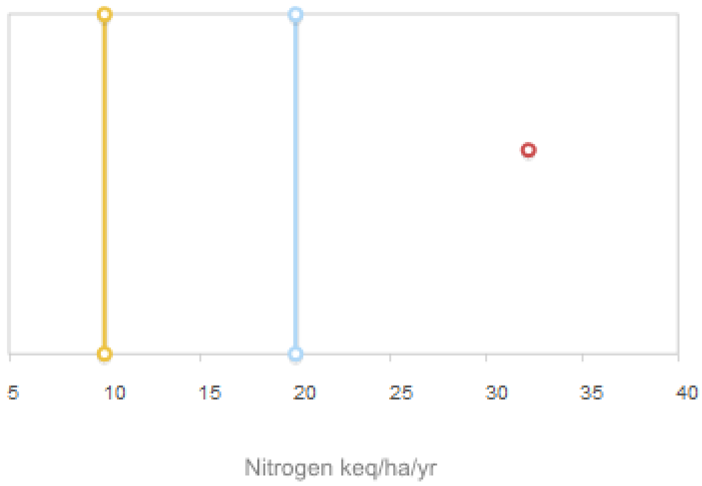


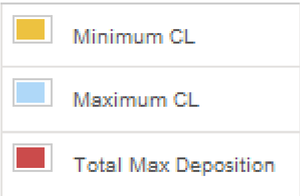
Feature: Dunes with Salix repens ssp argentea (Salicion arenariae)
Critical Load Class: Moist to wet dune slacks
Critical Loads (kg N/ha/yr): 10-20
Nitrogen Deposition (kg N/ha/yr):
Maximum: 32.2 Minimum: 14.3 Average: 12.6



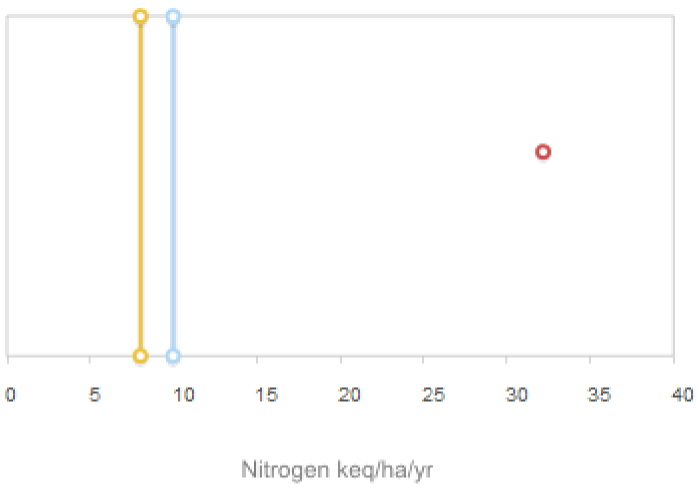


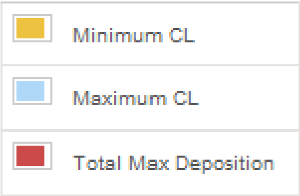
Feature: Embryonic shifting dunes
Critical Load Class: Shifting coastal dunes
Critical Loads (kg N/ha/yr): 10-20
Nitrogen Deposition (kg N/ha/yr):
Maximum: 32.2 Minimum: 14.3 Average: 12.6





Feature: Fixed coastal dunes with herbaceous vegetation ("grey dunes")
Critical Load Class: Coastal stable dune grasslands - acid type
Critical Loads (kg N/ha/yr): 8-10
Nitrogen Deposition (kg N/ha/yr):
Maximum: 32.2 Minimum: 14.3 Average: 12.6





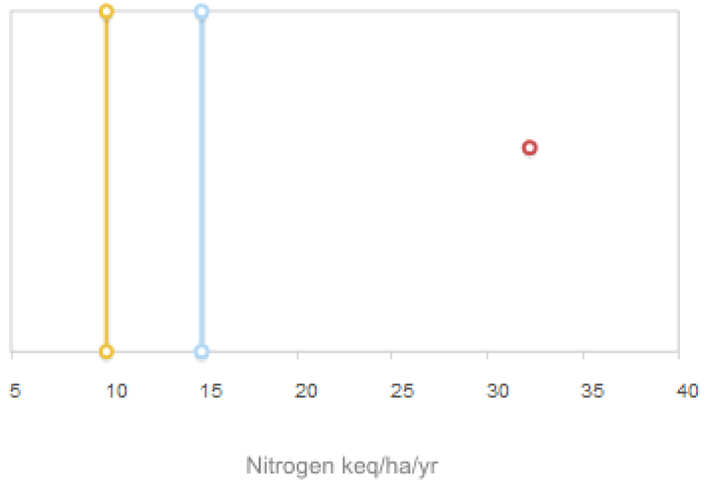
Feature: Fixed coastal dunes with herbaceous vegetation ("grey dunes")

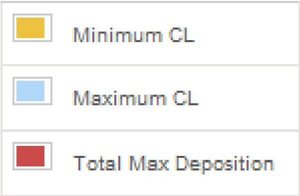
Critical Load Class: Coastal stable dune grasslands - calcareous type

Critical Loads (kg N/ha/yr): 10-15

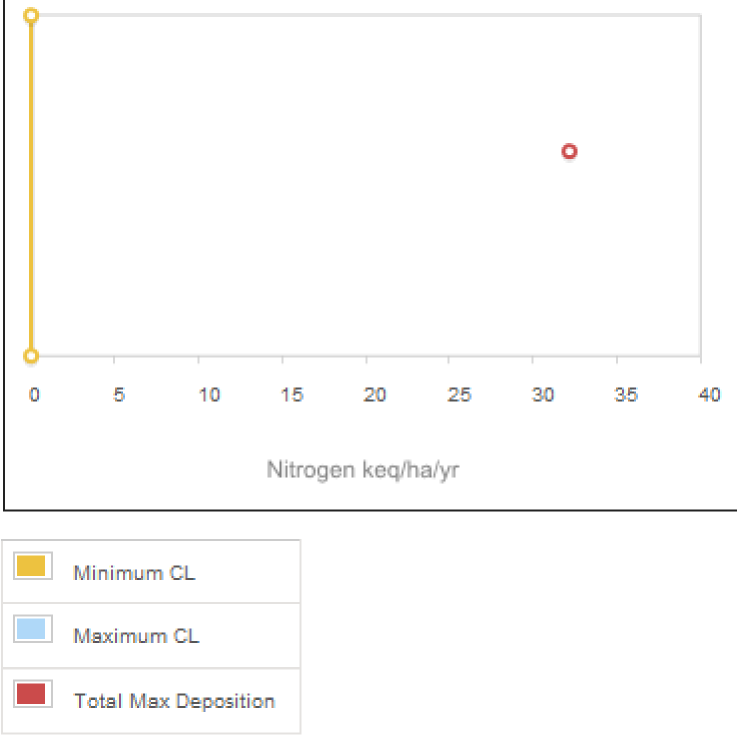
Nitrogen Deposition (kg N/ha/yr):

Maximum: 32.2 Minimum: 14.3 Average: 12.6





Feature: Mudflats and sandflats not covered by seawater at low tide
Critical Load Class: No comparable habitat with established critical load estimate available
Critical Loads (kg N/ha/yr): no critical loads available for this feature
Nitrogen Deposition (kg N/ha/yr):
Maximum: 32.2 Minimum: 14.3 Average: 12.6



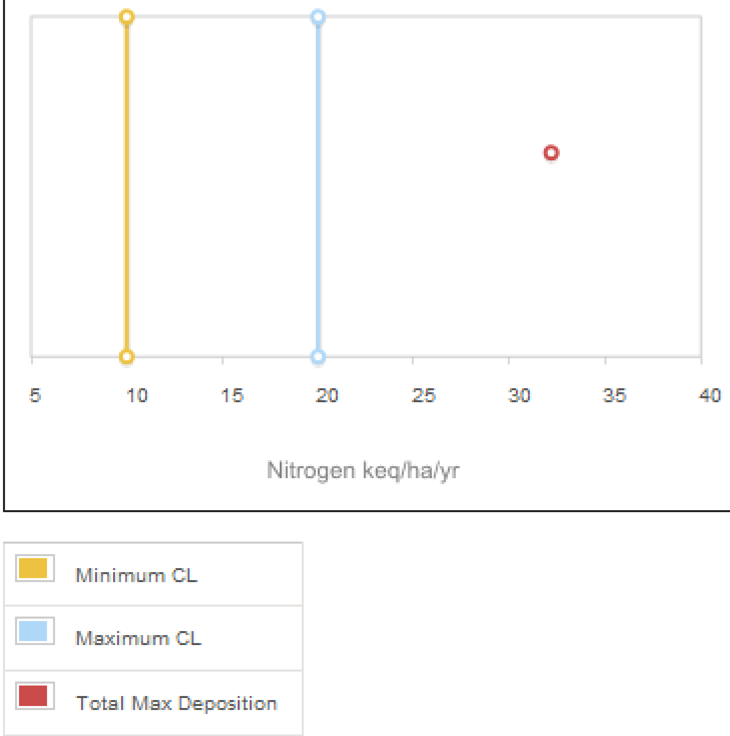
Feature: Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")

Critical Load Class: Shifting coastal dunes

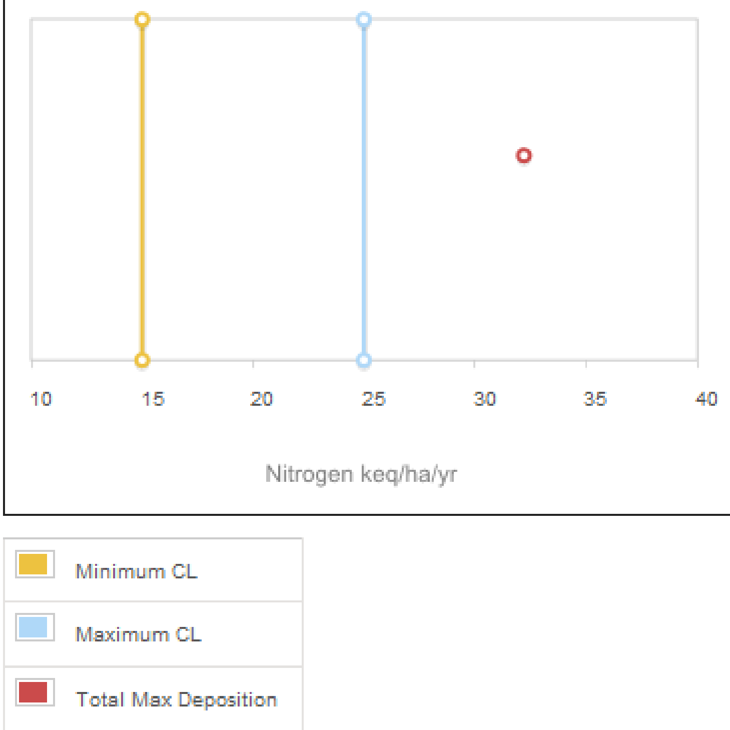
Critical Loads (kg N/ha/yr): 10-20

Nitrogen Deposition (kg N/ha/yr):

Maximum: 32.2 Minimum: 14.3 Average: 12.6



Feature: Euphydryas (Eurodryas, Hypodryas) aurinia - Marsh fritillary butterfly
Critical Load Class: Sub-atlantic semi-dry calcareous grassland
Critical Loads (kg N/ha/yr): 15-25
Nitrogen Deposition (kg N/ha/yr):
Maximum: 32.2 Minimum: 14.3 Average: 12.6



(Source: Air Pollution Information System (APIS) website- www.apis.ac.uk)

ACTION: Seek to maintain or where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant critical load.

Changes to surrounding land use
Any changes in local land-use e.g. agricultural intensification, drainage works, and coastal development) may be detrimental to the SAC.
Action: Reduce the risk of surrounding agricultural intensification by encouraging the adjacent owner/occupiers to enter into agri-environment schemes. Use Habitats Regulations Assessments (HRAs), through the planning process, to minimise any development risks adjacent to the SAC.

Climate Change
Northern Ireland faces changes to its climate over the next century. Indications are that we will face hotter, drier summers, warmer winters and more frequent extreme weather events. The Northern Ireland Climate Change Adaptation Programme was published in January 2014. This contains the Northern Ireland Executive's response to the risks and opportunities identified in the Climate

Change Risk Assessment for Northern Ireland (published January 2012) as part of the overall UK Climate Change Risk Assessment. The Adaptation Programme provides the strategic objectives in relation to adaptation to climate change, the proposals and policies by which each department will meet these objectives and the timescales associated with the proposals and policies identified in the period up to 2019.
ACTION: When developing SAC management plans, the likely future impacts of climate change should be considered and appropriate changes made.

12. MONITORING

The SACs are surveyed using two forms of monitoring:

Site Integrity Monitoring (SIM) is carried out to ensure compliance with the ASSI/ SAC Schedule. The most likely processes of change will either be picked up by SIM (e.g. dumping, burning, turf cutting, grazing etc.) or will be comparatively slow (e.g. gradual degradation of the habitat). In addition, potentially damaging activities may be picked up through the active marine ranger programme or by members of the public raising concerns with the Department. These reports are followed up through consultation with the relevant competent authorities.

Site Condition Assessment of the designated features is carried out on a rolling 6 year basis to pick up subtle changes in the condition of the feature and to ensure that the conservation objectives are being met.

The method for Site Condition Assessment was agreed by the relevant JNCC-led Lead Co-ordination Network although the methodology has been modified to reflect individual site attributes in Northern Ireland. For marine features, condition assessments include a variety of techniques such as diving, remote cameras, sediment sampling and acoustic seabed mapping. Marine mammal monitoring programmes also contribute.

12.1 MONITORING SUMMARY

1. *Monitor the integrity of the site (SIM or Compliance Monitoring)*
Complete boundary survey to ensure integrity of site and that any fencing is still intact. Ensure that no sand extraction, dumping or dune damage has occurred within the SAC boundary. This SIM should be carried out at least once a year.

2. Monitor the condition of the site (Condition Assessment)
Monitor the key attributes for each of the SAC selection features. This will detect if the features are in favourable condition or not. See Annex I.

The favourable condition table provided in Annex I is intended to supplement the conservation objectives only in relation to management of established and ongoing activities and future reporting requirements on monitoring condition of the site and its features. It does not by itself provide a comprehensive basis on which to assess plans and projects, but it does provide a basis to inform the scope and nature of any Habitats Regulations Assessment (HRA) that may be needed. It should be noted that completion of a HRA is a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects.

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ANNEX I
Feature 1 (SAC) – Atlantic decalcified fixed dunes (Calluno-Ulicetea) (Status A)

(* = primary attribute. One failure among primary attributes = unfavourable condition)

Attribute	Targets/Limits	Method of Assessment	Comments
* Area (ha)	Maintain the extent of dune heath community.	Visual estimate in 2x2 plots and across the site using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Any loss of the current intact area is unacceptable. The fixed dune communities include H11 *Calluna vulgaris – Carex arenaria* heath (only H11a *Erica cinerea* subcommunity and H11c species-poor subcommunity present in NI) and H10 *Calluna vulgaris – Erica cinerea* heath.
Extent and distribution of dune heath vegetation communities	Maintain extent and distribution of dune heath communities/sub-communities: Both variants of H11a: H11a(i) – grassy on slopes H11a(ii) – lichen rich in hollows And non-coastal dry heath: H10x – species-poor variant	Visual estimate in 2x2 m plots.	
* Area of mosaic communities and associated habitats	Maintain associated mosaic communities and habitats.	Visual estimate across the SAC using a combination of aerial photographs,	Repeat monitoring using condition assessment, SIM, and aerial photographs should indicate whether mosaics and associated habitats have changed or been lost.

		SIM and Condition Assessment structured walk.	
Vegetation height	Average vegetation height should be 20-50cm cm. Where H11a (II) lichen community occurs this should be assessed separately and be between 5-20cm.	Visual estimate in 2x2 m plots.	
Dwarf-shrub cover (%)	Dwarf-shrub cover should be maintained between 25-90%. Both *Calluna vulgaris* and *Erica cinerea* should be frequent.	Visual estimate in 2x2m plots	
Bare ground (%)	Bare ground or sand (not rock) extent, noticable without disturbing the vegetation < 5%	Visual estimate in 2x2m plots	
Bryophyte cover (%)	Bryophytes should have a minimum cover of 33% over at least 66% of the site.	Visual estimate in 2x2m plots	
Lichen cover (%)	Lichens should have a minimum cover of 33% over at least 66% of the site.	Visual estimate in 2x2m plots	
Graminoid cover (excluding *Ammophila*) (%)	Graminoid cover (excluding Ammophila) should be less than 40%.	Visual estimate in 2x2m plots	

* Frequency of community character species	At least 3 of the following at least frequent, with at least two also frequent from either list A or List B throughout the sward: *Erica cinerea, Dicranum scoparium, Lotus corniculatus, Luzula campestris* Frequency of the following species on slopes: List A *Calluna vulgaris, Pleurozium schreberi, Teucrium scorodonia* Frequency of the following species in hollows: List B *Cladonia* spp*, Hypochaeris radicata*	Visual estimate in 2x2m plots	
* Frequency of negative indicators	Any one of the following more than frequent throughout the sward: *Cirsium arvense, Cirsium vulgare, Lolium perenne, Senecio jacobaea, Urtica dioica, Arrhenatherum elatius*	Visual estimate in 2x2m plots	

Pteridium cover (%)	Mean cover should be less than 15%	Visual estimate in 2x2m plots	
* Frequency and % cover of scrub/tree encroachment. (DAFOR and % cover)	Scrub/tree encroachment should be no more than occasional. Mean cover should be less than 5%.	Visual estimate within a 10x10 m radius of plots.	
* Management – Grazing (DAFOR)	Signs of grazing (poaching/dung) should be no more than occasional.	Visual estimate in 2x2 m plots.	
Management – Disturbance (DAFOR)	Tracks/disturbed ground should not be recorded as frequent in more than 25% of plots over the whole area.	Visual estimate in 2x2 m plots.	
* Presence of rare or scarce species specific to the site.	Locally distinctive species recorded for the site should be at least present along the length of the Condition Assessment structured walk.	Name the species at least present along the length of the Condition Assessment structured walk.	If these species are not recorded on any one visit, it does not automatically make the site unfavourable.

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
>60%=Constant

Feature 2 (SAC) – Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (Status C)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

Attribute	Target	Method of assessment	Comments
* Area of saltmarsh	Subject to natural processes, maintain the overall extent of saltmarsh vegetation.	Visual estimate in 2 x 2 m plots and across the extent of the saltmarsh using a combination of aerial photographs and SIM. The area should be measured once per reporting cycle (6 years) during the summer months of June, July, August or early September.	Judgements in changes to extent/area will have to take particular care to distinguish changes as a result of natural erosion vs. anthropogenic actions.
* Mobility	No increase in either the linear extent or the area constrained by introduced structures or landforms.	Visual inspection of aerial photographs, SIM and Condition assessment structured walk. Check for any new physical structures that may impact on this community.	Introduction of physical constraints would reduce the extent of this community and affect its structure.

Physical structure: creeks and pans	Realignment of creeks absent or rare. No further anthropogenic alteration of creek patterns or loss of pans compared to an established baseline.	Visual inspection of aerial photographs, SIM and Condition assessment structured walk. Check for man-made influences on creeks and pans.	Creeks and pans vary in size and density. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network.
* Saltmarsh community diversity	Maintain presence of saltmarsh communities SM10, SM13, SM16, SM18, SM19, SM20 and SM28 as established at baseline survey.	Visual estimate in 2x2m plots.	
*Presence of associated semi-natural habitats	Maintain other saltmarsh communities and transitions to freshwater/flush and grassland - e.g. some of the samples to contain open SM8 communities with *Salicornia*; S21 communities with *Scirpus maritimus*; and S4d communities with *Phragmites*	Visual estimate in 2x2 m plots	*Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types. Where they occur with saltmarsh communities, their presence should be recorded.
* Maintain frequency of positive indicators for low-level marsh (SM10)	At least 5 of the indicator species listed below at least occasional, of which 3 are at least frequent throughout the	Visual estimate in 2x2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities.

	sward: *Suaeda maritima, Salicornia* agg., *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima Armeria maritime* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.		**Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types/ ASSI selection features.
* Sward Height (SM10)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 12 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for low-level marsh (SM13a, b, c and d)	At least 5 of the indicator species listed below at least occasional, of which 3 are at least frequent throughout the sward: *Suaeda maritima, Salicornia*	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities. **Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are

	agg., *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima Armeria maritime.* At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.		included within other Annex 1 habitat types/ ASSI selection features..
* Sward Height (SM13a, b, c and d)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 15 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for middle marsh communities (SM16b, c, d and e)	At least 6 of the indicator species listed below at least occasional, of which 4 are at least frequent throughout the sward: *Puccinellia maritima, Aster tripolium, Limonium humile, Glaux maritima, Cochlearia officinalis, Plantago maritima, Triglochin maritima Armeria maritima, Festuca rubra,*	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities. **Note:** *Zostera* and *Ruppia* beds (SM1 and SM2) and stands of *Salicornia* and *Suaeda* (SM8 and SM9) are included within other Annex 1 habitat types/ ASSI selection features.

	Juncus gerardii, Agrostis stolonifera, Trifolium repens, Leontodon autumnalis, Carex flacca At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41%		
* Sward Height (SM16b, c, d and e)	Maintain short sward in areas of species-rich vegetation. Maintain mean sward height at less than 20 cm.	Visual estimate in 2 x 2 m plots	Measure during summer (July/August/early September)
* Maintain frequency of positive indicators for upper marsh communities (e.g.SM18a, SM19 and SM20 and SM28)	At least 6 of the indicator species listed below at least occasional, of which 4 are at least frequent throughout the sward: *Juncus maritimus, Agrostis stolonifera, Festuca rubra*, *Glaux maritima*, *Juncus gerardii, Triglochin maritima, Plantago maritima, Armeria maritima, Aster tripolium, Elymus repens, Atriplex*	Visual estimate in 2 x 2 m plots	Ensure species-poor/rank communities/sub-communities do not increase at the expense of other sub-communities.

	prostrata, Potentilla anserina, Phragmites australis, Blysmus rufus, Eleocharis uniglumis At least occasional is equivalent to greater than 21% occurrence in recorded plots. At least frequent is equivalent to greater than 41% occurrence in recorded plot.		
Sward Height (Upper marsh communities)	Maintain mean sward height less than 1m.	Visual estimate in 2x2 m plots	Measure during summer (July/August/early September) As upper saltmarsh communities are tall, often mono-dominant stands of vegetation, the height of the vegetation is not critical.
* Frequency and/or % cover of *Spartina* encroachment into the saltmarsh communities (% Cover)	*Spartina* be should be recorded as absent or rare across the saltmarsh communities. Mean cover should be less than 2 %. No more than rare is equivalent to less than 20% occurrence in recoded plots	Visual estimate within a 10x10 m radius of monitoring plots <u>and</u> across the feature using a combination of aerial photographs and Condition Assessment structured walk.	*Spartina* is extremely invasive across all saltmarsh communities and its occurrence should be carefully recoded to ensure that it does not pose a threat to these valuable communities.

* Frequency and % cover of negative indicators excluding *Spartina* (DAFOR and % cover)	Negative indicators no more than occasional across the saltmarsh communities Mean cover should be less than 2 %. No more than occasional is equivalent to less than 40% occurrence in recoded 2x2m plots.	Visual estimate in 2x2 m plots	
* Frequency and % cover of scrub/tree encroachment into transitional communities (DAFOR and % cover)	Scrub encroachment no more than occasional in transitional communities. Mean cover should be less than 5 %. No more than occasional is equivalent to less than 40% occurrence in recoded 10x10m plots.	Visual estimate within a 10x10 m radius of monitoring plots <u>and</u> across the feature using a combination of aerial photographs and Condition Assessment structured walk.	
* Cover of litter/thatch accumulation (% cover)	Less than 25% mean cover. Lower thresholds may be appropriate for short SM 10 communities.	Visual estimate in 2x2m plots.	More than 25% litter cover indicates insufficient removal of biomass by grazing, particularly in middle and upper saltmarsh communities such as SM13 and SM16. A lower threshold for thatch should be set - perhaps 10%

			For SM10 communities (to be determined).
* % cover of bare ground	Bare areas resulting from trampling by stock or human activity (vehicle use, etc.) should account for less than 10 % of the extent of all communities with the exception of SM 10.	Visual estimate in 2x2m plots and across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Saltmarsh can be severely affected by persistent heavy trampling Note: UK CSM suggests 25% upper limit for poaching – a lower limit is recommended for SM13 and SM16 at most saltmarsh areas in N. Ireland.
Lack of disturbance	There should be no management activities leading to erosion.	Visual estimate in 2x2m plots and across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Saltmarsh can be severely affected by persistent heavy trampling Lower marsh communities naturally have higher cover of bare ground than middle and upper marsh communities.
Lack of pollution	No evidence of oil or other forms of pollution	Visual estimate in 2x2m plots and across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	

Saltmarsh hydrology	Artificial drainage channels adversely affecting hydrology are absent or rare,	Visual estimate across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk.	
* Maintain distinctive elements at current extent/levels and/or in current locations	Maintain distinctive elements at current extent/levels and/or in current locations (e.g. maintain existing populations of notable species, important structural attributes or notable transitions between habitats)	Visual estimate in 2x2 m plots <u>and</u> across the extent of the saltmarsh using a combination of aerial photographs, SIM and Condition Assessment structured walk. Check for presence of species/structural attributes, and/or transitions.	This attribute is intended to cover any site-specific aspects of this habitat feature which are not adequately covered by the previous attributes.

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 3 (SAC) – Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*) (Status C)

(* = primary attribute. One failure among primary attributes = unfavourable condition)

Attribute	Targets/Limits	Method of Assessment	Comments
* Area (ha)	Maintain the extent of *Salix* dune slack community.	Visual estimate in 2x2 plots and across the site using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Any loss of the current intact area is unacceptable. The Salix dune slack community includes SD16 *Salix repens – Holcus lanatus* dune-slack community (with *Salix repens* dominant).
* Area of mosaic communities and associated habitats	Maintain associated mosaic communities and habitats.	Visual estimate across the SAC using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Repeat monitoring using condition assessment, SIM, and aerial photographs should indicate whether mosaics and associated habitats have changed or been lost.
Height and frequency of *Salix repens*	Average height of *Salix repens* should be 5–30cm. *Salix repens* should be at least	Visual estimate in 2x2 m plots.	Low bushy *Salix* should be maintained in association with open patches of shorter dune communities.

	frequent.		
Litter (%)	Litter in a more or less continuous layer, distributed either in patches or in one larger area should not cover > 50% of the area.	Visual estimate in 2x2m plots	
Bare ground (%)	Bare ground or sand (not rock) extent, noticable without disturbing the vegetation < 10%	Visual estimate in 2x2m plots	
* Frequency of community character species	At least two of the following at least frequent and two at least occasional throughout the sward: *Salix repens,* *Festuca rubra,* *Carex flacca,* *Carex arenaria,* *Ononis repens,* *Lotus corniculatus,* *Pilosella officinarum*	Visual estimate in 2x2m plots	At least frequent is equivalent to greater than 41% occurrence in recorded plots. At least occasional is equivalent to greater than 21% occurrence in recorded plots.
* Frequency of negative indicators	Any one of the following more than frequent throughout the sward: *Cirsium arvense, Cirsium vulgare, Cirsium palustre, Lolium perenne, Senecio jacobaea, Urtica dioica, Pteridium aquilinum, Arrhenatherum elatius, Rubus fruticosus.*	Visual estimate in 2x2m plots	

*Frequency and % cover of scrub/tree encroachment (excluding *Salix repens*) (DAFOR and % cover)	Scrub/tree encroachment (excluding *Salix repens*) should be no more than occasional. Mean cover should be less than 5%.	Visual estimate within a 10x10 m radius of plots.	If scrub/tree species are more than occasional throughout the sward but less than 5% cover they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.
* Presence of rare or scarce species specific to the site.	Locally distinctive species recorded for the site should be at least present along the length of the Condition Assessment structured walk. If these species are not recorded on any one visit, it does not automatically make the site unfavourable.	Name the species at least present along the length of the Condition Assessment structured walk.	

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 4 (SAC) – Embryonic shifting dunes (Status C)

(* = primary attribute. One failure among primary attributes = unfavourable condition)

Attribute	Targets/Limits	Method of Assessment	Comments
*Area (ha)	Presence of embryonic dunes appropriately positioned within the site	Visual estimate in 2x2 plots and across the site using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Ideally there should be a presence of this community but its ephemeral nature makes prediction of presence or position at dune front difficult. Provided that no human developments result in direct loss of habitat or of areas with the potential to develop this habitat, or change the site dynamics, then the attribute should be deemed to be in favourable condition.
* Area of mosaic communities and associated habitats	Maintain associated mosaic communities and habitats.	Visual estimate across the SAC using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Repeat monitoring using condition assessment, SIM, and aerial photographs should indicate whether mosaics and associated habitats have changed or been lost.
* Frequency of community character species	Presence of characterising species, particularly *Elytrigia juncea*, and/or *Leymus arenarius*, with other species such as *Honkenya peploides, Cakile maritima* during the summer months of June, July or August	Visual estimate in 2x2m plots	At least frequent is equivalent to greater than 41% occurrence in recorded plots. At least occasional is equivalent to greater than 21% occurrence in recorded plots.

* Presence of rare or scarce species specific to the site.	Locally distinctive species recorded for the site should be at least present along the length of the Condition Assessment structured walk.	Name the species at least present along the length of the Condition Assessment structured walk.	If these species are not recorded on any one visit, it does not automatically make the site unfavourable.

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 5 (SAC) – Fixed dunes with herbaceous vegetation (grey dunes) (Status B)

(* = primary attribute. One failure among primary attributes = unfavourable condition)

Attribute	Targets/Limits	Method of Assessment	Comments
* Area (ha)	Maintain the extent of fixed dune community.	Visual estimate in 2x2 plots and across the site using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Any loss of the current intact area is unacceptable. The fixed dune communities include SD7 *Ammophila arenaria – Festuca rubra*, SD8 *Festuca rubra – Galium verum*, SD10 *Carex arenaria*, SD19 *Phleum arenarium – Arenaria serpyllifolia*, U4 *Agrostis capillaris – Galium saxatile* and W25.
* Relative % proportion of species-rich short dune vegetation to taller Marram dominated swards	30-70% of sward to comprise species-rich short dune vegetation, between 2-15 cm tall.	.	.
* Area of mosaic communities and associated habitats	Maintain associated mosaic communities and habitats.	Visual estimate across the SAC using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Repeat monitoring using condition assessment, SIM, and aerial photographs should indicate whether mosaics and associated habitats have changed or been lost.
Vegetation height	Average vegetation height should be 2–25cm over the whole grey dune vegetation.	Visual estimate in 2x2m plots.	Outside target indicates insufficient grazing or over-grazing.

Litter (%)	Litter in a more or less continuous layer, distributed either in patches or in one larger area should not cover > 10% of the area.	Visual estimate in 2x2m plots	
Bare ground (%)	Bare ground or sand (not rock) extent, noticable without disturbing the vegetation < 5%	Visual estimate in 2x2m plots	
Grass:herb ratio	40–90% herbs	Visual estimate in 2x2m plots	
* Frequency of community character species	At least four of the following at least frequent and four at least occasional throughout the sward: *Polygala sp,* *Centaurium erythraea,* *Primula vulgaris,* *Euphrasia sp,* *Thymus polytrichus,* *Galium verum,* *Ranunculus bulbosus,* *Linum catharticum,* *Koeleria macrantha,* *Lotus corniculatus,* *Peltigera/Cladonia,* *Scilla verna,* *Viola tricolor,* *Pilosella officinarum,*	Visual estimate in 2x2m plots	

	Veronica officinalis, *Succisa pratensis,* *Orchid sp,* *Anthyllis vulnareria,* *Erodium* spp., *Campanula rotundifolia*, *Erophila verna*, *Hyacinthoides non-scripta*, *Ononis repens*, *Phleum arenarium*, *Polypodium* spp., small *Carex* At least frequent is equivalent to greater than 41% occurrence in recorded plots. At least occasional is equivalent to greater than 21% occurrence in recorded plots.		
* Frequency of negative indicators	Any one of the following more than frequent throughout the sward: *Cirsium arvense, Cirsium vulgare, Lolium perenne, Senecio jacobaea, Urtica dioica, Pteridium aquilinum, Arrhenatherum elatius*	Visual estimate in 2x2m plots	
* Frequency and %	Scrub/tree encroachment	Visual estimate within a	If scrub/tree species are more than occasional

cover of scrub/tree encroachment. (DAFOR and % cover)	should be no more than occasional. Mean cover should be less than 5%.	10x10 m radius of plots.	throughout the sward but less than 5% cover they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.
* Presence of rare or scarce species specific to the site.	Locally distinctive species recorded for the site should be at least present along the length of the Condition Assessment structured walk. If these species are not recorded on any one visit, it does not automatically make the site unfavourable.	Name the species at least present along the length of the Condition Assessment structured walk.	

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 6 (SAC) – Mudflats and sandflats not covered by seawater at low tide (Status C)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

Sub-feature	Attribute	Measure	Targets	Comments
	*Morphological naturalness (extent, mobility and substrate)	Ensure that any loss in extent and change in system dynamics is only due to natural processes	No human induced developments impacting on the natural system.	This habitat occupies a naturally dynamic position in coastal systems. Provided that no human developments result in direct loss of habitat, or change the site dynamics, then the attribute should be deemed to be in favourable condition. Substrate supply and distribution should be regulated by natural coastal processes.
Intertidal Sand and Gravel communities Intertidal Fine Sand and Mud Communities	*Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent of the Sub-Feature.	Presence of the selected biotopes as identified by the NI Littoral survey at selected sites measured once during the reporting cycle	Results should not deviate significantly from the established baseline, subject to natural change.	Baseline survey was carried out as part of the Northern Ireland Littoral Survey between 1984 and 1987 by Heriot-Watt University. Changes in extent and distribution may indicate long term changes in the physical conditions at the site.
	*Species composition of selected biotopes at monitoring sites.	Species composition of the selected biotopes as identified by the NI Littoral survey measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.

Zostera Spp Beds (*Z.noltii*, *Z. angustifolia*, *Z. marina*)	Distribution of *Zostera* beds.	Distribution of *Zostera* beds, measured during autumn once during the reporting cycle.	Distribution should not deviate significantly from the established baseline, subject to natural change.	The distribution of the beds is of key importance to their conservation condition. It is important that any consideration of *Zostera* within the context of these conservation objectives fits with the UK Biodiversity Action Plan for Seagrass Beds. A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data.
	Extent	Area (ha) of *Zostera* spp. Beds	Extent should not deviate significantly from the established baseline, subject to natural change.	A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data.
	Taxonomic composition	Presence of selected taxa	Taxonomic species should not deviate significantly from the established baseline, subject to natural change.	A considerable amount of data has recently been collated regarding this attribute. A target value and consequently limits, will be derived from this data.
	Density	Measuring *Zostera* shoot density	Target: Average shoot density should not deviate significantly from the long term average.	An early indicator of seagrass under stress is a reduction in the number of plants and loss of plants on the lower shore. This will probably concentrate only on *Z. angustifolia* which, being a larger plant, is found at lower densities than *Z. noltii*.

Feature 7 (SAC) – Sandbanks which are slightly covered by sea water all the time (Status C)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

Attribute	Measure	Targets	Comments
*Extent and disturbance	Area (ha) of the subtidal sandbanks to be measured periodically (frequency to be determined).	Ensure that quality and extent of sandbank are not threatened by unsustainable aggregate removal.	Aggregate removal is subject to EIA, HRA and marine license regulations. Therefore, it could only be approved if shown not to impact the conservation objectives of the site.
*Characteristic biotopes at sites chosen so as to provide some indication of the distribution and extent.	Presence of the selected biotopes at selected sites measured once during the reporting cycle.	Results should not deviate significantly from the established baseline, subject to natural change.	Northern Ireland Sublittoral Survey (NISS) carried out the baseline survey during 1980s. This was enhanced by the Inis Hydro project which mapped 182km^2 of the SAC. DOE commissioned AFBI to produce a habitat map of Murlough in 2015. This details biotope complexes down to L4 (https://www.afbini.gov.uk/sites/afbini.gov.uk/files/publications/dundrum_bay.pdf). Changes in extent and distribution may indicate long term changes in the physical conditions at the site.

*Species composition of selected biotopes at monitoring sites	Species composition of the selected biotopes measured once during the reporting cycle.	Composite species of selected biotopes should not deviate significantly from the established baseline, subject to natural change.	Species composition will be used to determine the biotope classification. The species composition of some biotopes may provide further information on changes/trends in these communities. A list of selected indicator species identified by field surveys will be utilised to determine the achievement of the conservation objectives through presence/absence at monitoring sites.

Feature 8 (SAC) – Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (Status C)

(* = primary attribute. One failure among primary attributes = unfavourable condition)

Attribute	**Targets/Limits**	**Method of Assessment**	**Comments**
* Area (ha)	Maintain the extent of white dune community.	Visual estimate in 2x2 plots and across the site using a combination of aerial photographs, SIM and Condition Assessment structured walk.	This community occupies a naturally dynamic position in coastal systems. Provided that no human developments result in direct loss of habitat or of areas with the potential to develop this habitat, or change the site dynamics, then the attribute should be deemed in favourable condition. The white dune community includes SD6 *Ammophila arenaria*.
* Area of mosaic communities and associated habitats	Maintain associated mosaic communities and habitats (bog woodland, fen, etc)	Visual estimate across the SAC using a combination of aerial photographs, SIM and Condition Assessment structured walk.	Repeat monitoring using condition assessment, SIM, and aerial photographs should indicate whether mosaics and associated habitats have changed or been lost.
Bare ground (%)	Bare ground or sand (not rock) extent, should be noticeable without disturbing the vegetation.	Visual estimate in 2x2m plots	

* Frequency of community character species	*Ammophila arenaria* at least frequent and one of the following at least present throughout the sward: *Euphorbia* spp., *Eryngium maritima*, *Leymus arenarius*, *Calystegia soldanela,* *Festuca rubra*, *Sonchus* spp At least frequent is equivalent to greater than 41% occurrence in recorded plots. At least occasional is equivalent to greater than 21% occurrence in recorded plots.	Visual estimate in 2x2m plots	
* Frequency of non-native species	There should be no non-native species recorded within the white dunes.	Visual estimate in 2x2m plots	
*Frequency and % cover of Sea buckthorn encroachment. (DAFOR and % cover)	Sea buckthorn encroachment should be absent. Mean cover should be 0%.	Visual estimate within a 10x10 m radius of plots.	There is a limited range of invasive species that are likely to be able to establish themselves on shifting dunes. Sea buckthorn would probably present the greatest threat.
* Presence of rare or scarce species	Locally distinctive species recorded for the site should be	Name the species at least present	

specific to the site.	at least present along the length of the Condition Assessment structured walk If these species are not recorded on any one visit, it does not automatically make the site unfavourable.	along the length of the Condition Assessment structured walk.	

Frequency -
1-20% = Rare
21-40% = Occasional
41- 60% = Frequent
> 60% = Constant

Feature 9 (SAC) – *Euphydryas aurinia* (Status B)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

Attribute	Measure	Targets	Comments
* Population Size	Number of larval webs present in at least one year in six	At least 150 larval webs should be present in at least one year in six with a minimum of 20 colonies. (unless unfavourable meteorological conditions during the flight period occur more often)	Larval webs are a much more reliable measure of the "health" of the colony than flying adults. National Trust undertakes an annual survey to assess population and distribution. By its nature, this species naturally adopts a dispersed breeding pattern. Murlough is the most important area for this species with Ballykinler having little Succisa or potential habitat. Exclosures have been used at Murlough to reduce the impact of the recently introduced grazing regime.
* Habitat Extent	Extent of suitable grassland	Maintain the extent of suitable grassland – determine area.	Definition of suitable grassland -Stands of grassland where *Succisa pratensis* is present. Vegetation height and extent of Succisa are critical.
	Extent of good marsh fritillary breeding habitat	Maintain the extent of good marsh fritillary breeding habitat.	Definition of good marsh fritillary breeding habitat
* Habitat Mosaic	Extent of other semi-natural habitats	Maintain the extent of other semi-natural habitats which contribute to marsh fritillary breeding success. No loss in extent of other semi-natural habitats	

Feature 10 (SAC) – *Phoca vitulina* (Status B)

(* = primary attribute. One failure among primary attribute = unfavourable condition)

Attribute	Measure	Targets	Comments
*Population	Number of Harbour Seals counted during the autumn moult period.	Maintain a population of at least 106 Harbour Seals.	Using baseline data from 1994-1999 the mean maximum counts for each year within this 6 year period gave a value of 141 individuals. Allowing for a maximum decline of 25% from this baseline value gives a target of 106 individuals. When monitoring Harbour Seal numbers, ideally 2 counts would be performed during the moult season and 2 counts would be performed during the pupping season each year to give a reasonable estimate of the population. The population within this area could be influenced by factors including population trends within the wider Irish Sea, food availability and disturbance. Murlough data should be considered in the context of both long-term trends and existing seal numbers in Co.Down, all Ireland, UK and North East Atlantic.

Pups	Percentage of pups in relation to number of seals counted in the moult period.	Maintain a pup percentage of at least 25%.	
*Haul-outs	Integrity of haul-outs.	Maintain integrity of traditional haul-outs.	Changes to traditional haul-outs should only be through natural processes e.g. coastal erosion/deposition.
Disturbance	Disturbance events.	Contain disturbance events to a level which do not significantly impact the population.	Disturbance can result in injury to pups, separation of pups from their mothers and reduced opportunities to feed and rest. Disturbance events reported previously within this SAC include recreational activities on the shore and on water. Deliberate disturbance by boating activities has also been reported. Incidents reported to DAERA should be logged and investigated where practicable. If the population becomes unfavourable then more monitoring effort may be required to determine disturbance effects.

Appendix W Rockabill to Dalkey Island SAC

ISSN 2009-4086

National Parks and Wildlife Service

Conservation Objectives Series

Rockabill to Dalkey Island SAC 003000

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta

Department of
Arts, Heritage and the Gaeltacht

National Parks and Wildlife Service,
Department of Arts, Heritage and the Gaeltacht,

7 Ely Place, Dublin 2, Ireland.

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E-mail: nature.conservation@ahg.gov.ie

Citation:

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Series Editor: Rebecca Jeffrey
ISSN 2009-4086

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area 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
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

003000	Rockabill to Dalkey Island SAC

1170	Reefs
1351	Harbour porpoise *Phocoena phocoena*

Please note that this SAC overlaps with North Bull Island SPA (004006), Rockabill SPA (004014), Lambay Island SPA (004069), Howth Head Coast SPA (004113), Ireland's Eye SPA (004117) and Dalkey Islands SPA (004172). It is also adjoins Howth Head SAC (000202), Lambay Island SAC (000204) and Ireland's Eye SAC (002193). See map 2. The conservation objectives for this site should be used in conjunction with those for overlapping and adjacent sites as appropriate.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

References

Year :	2010
Title :	Irish sea reef survey project report
Author :	MERC
Series :	Unpublished report to NPWS
Year :	2012
Title :	Intertidal reef survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins
Author :	MERC
Series :	Unpublished report to the Marine Institute and NPWS
Year :	2012
Title :	Subtidal reef survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins
Author :	MERC
Series :	Unpublished report to the Marine Institute and NPWS

NPWS Documents

Year :	2013
Title :	Rockabill to Dalkey Island SAC (site code 3000) Conservation objectives supporting document- marine habitats and species V1
Author :	NPWS
Series :	Conservation objectives supporting document

Spatial data sources

Year :	Interpolated 2013
Title :	2009 and 2010 subtidal and intertidal reef surveys
GIS Operations :	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data. Expert opinion used as necessary to resolve any issues arising
Used For :	Marine community types, 1170 (maps 3 and 4)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined; EU Annex I Saltmarsh and Coastal data erased out if present
Used For :	Marine community types base data (map 4)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	Low Water Mark (LWM) polyline feature class converted into polygon feature class; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1351 (map 5)

1170 Reefs

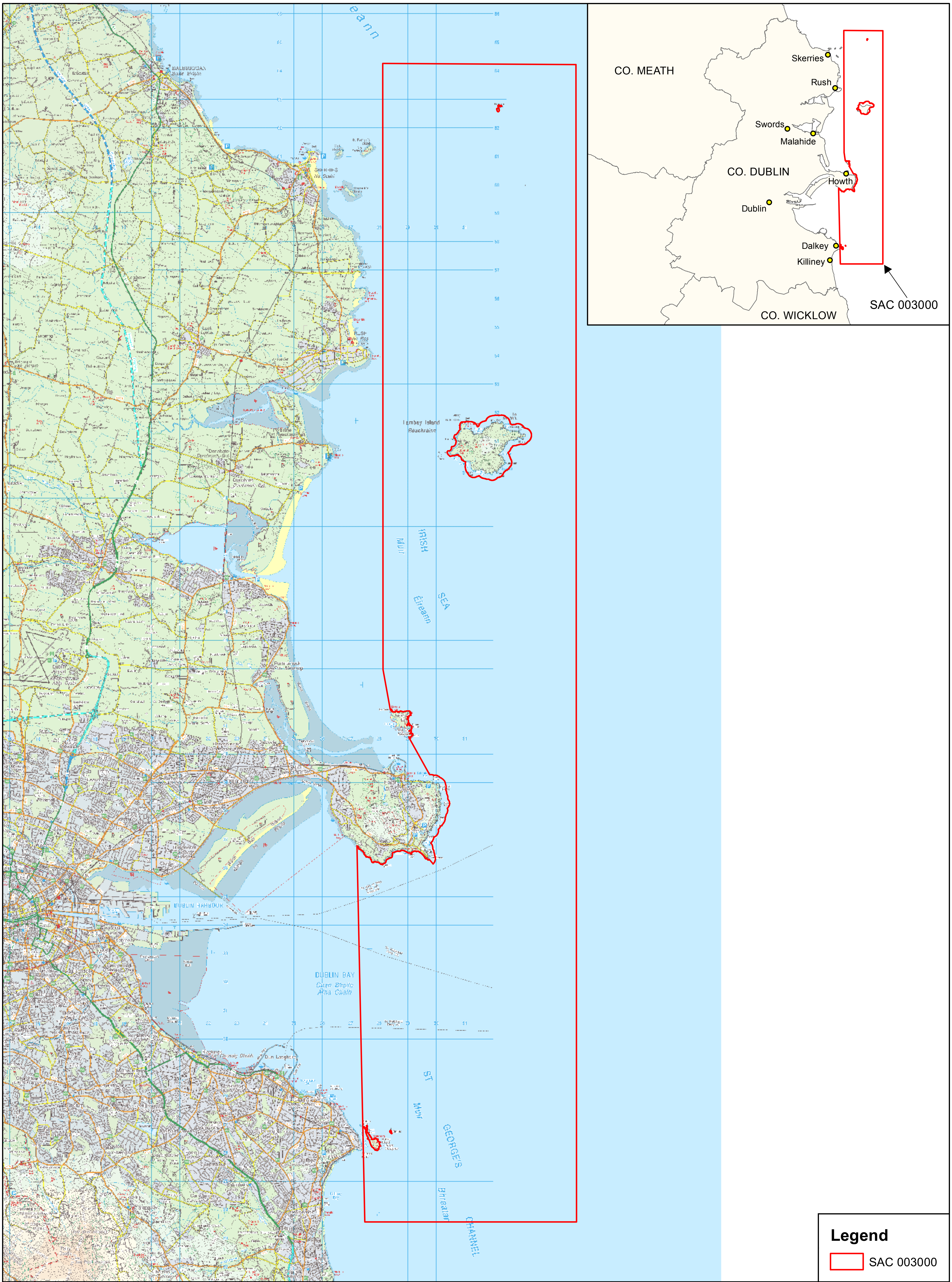
To maintain the favourable conservation condition of Reefs in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent area is stable or increasing, subject to natural processes. See map 3	Habitat area estimated as 182ha using 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a,b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0)
Habitat distribution	Occurrence	Distribution is stable or increasing, subject to natural processes. See map 3	Distribution derived from 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a,b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0). See marine supporting document for further details
Community structure	Biological composition	Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex. See map 4	Reef community mapping based on 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a,b). See marine supporting document for further details

1351 Harbour porpoise *Phocoena phocoena*

To maintain the favourable conservation condition of Harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 5	See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site	See marine supporting document for further details



Legend

SAC 003000

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

MAP 1: ROCKABILL TO DALKEY ISLAND SAC CONSERVATION OBJECTIVES SAC DESIGNATION

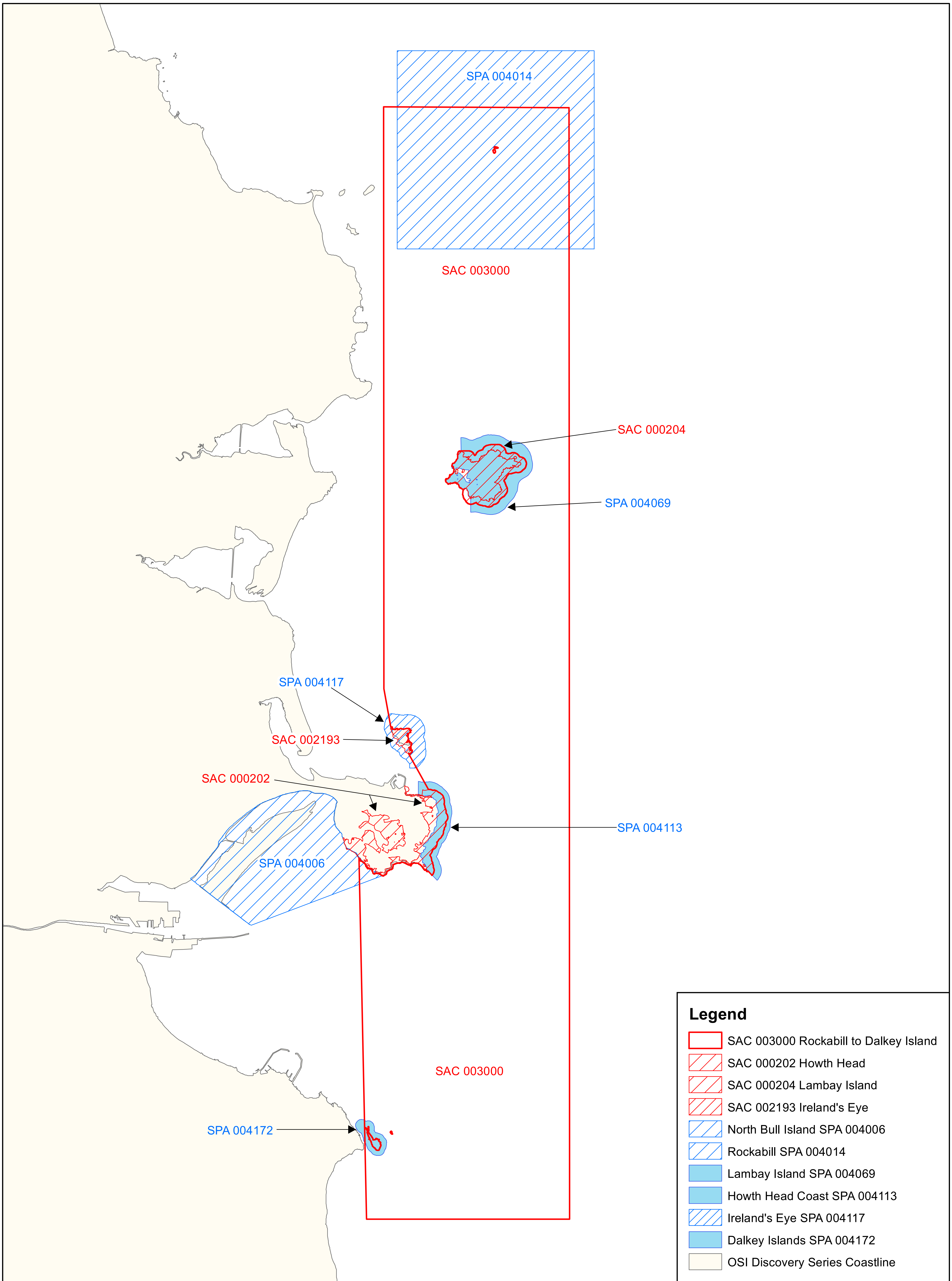
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 003000; version 3

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2013



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MAP 2:
ROCKABILL TO DALKEY ISLAND SAC
CONSERVATION OBJECTIVES
ADJOINING / OVERLAPPING
DESIGNATIONS

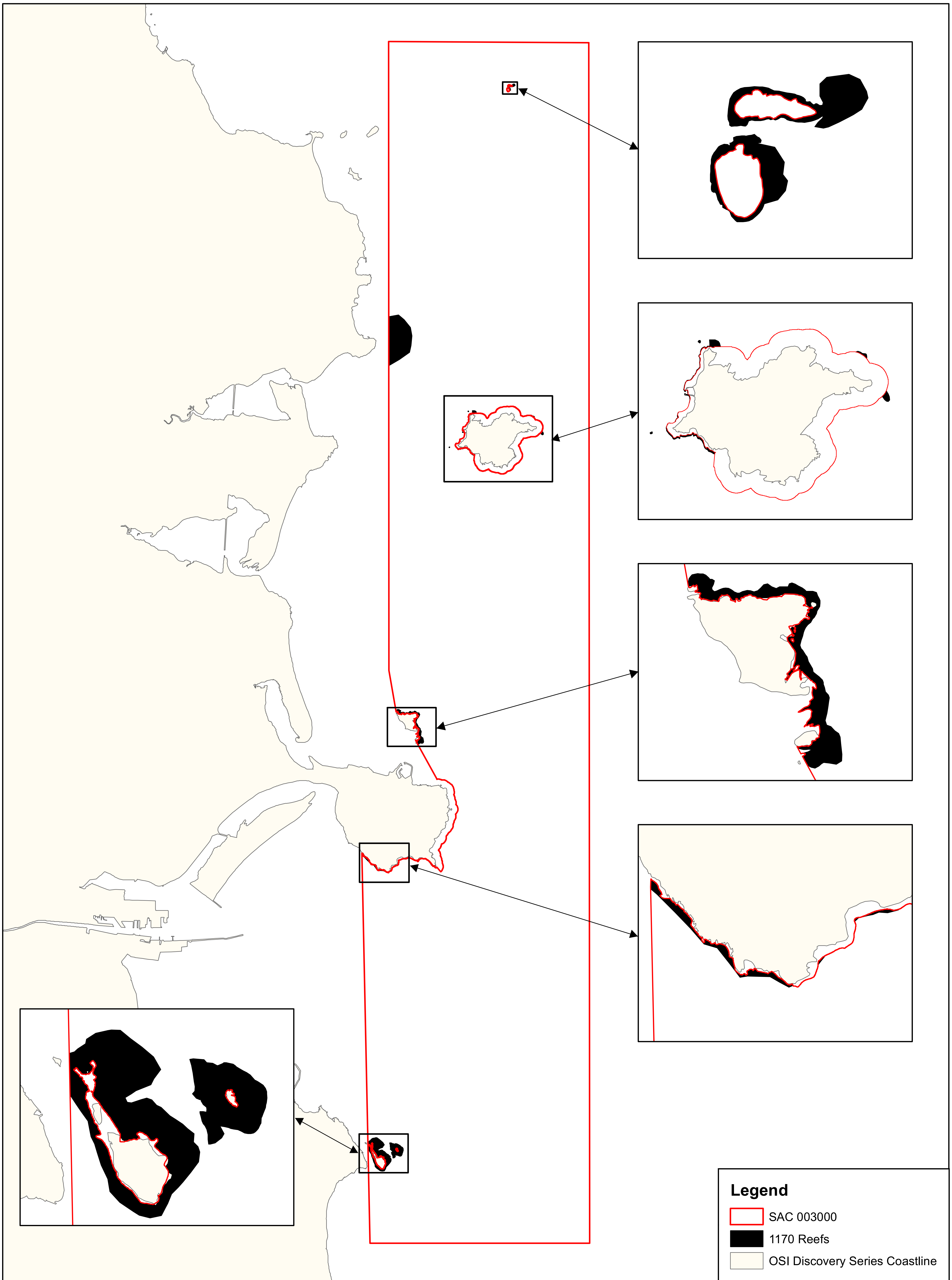
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 000202; version 3, SAC 000204; version 3
SAC 002193;version 3, SAC 003000; version 3
SPA 004006; version 2, SPA 004014; version 2.01
SPA 004069; version 1.01, SPA 004113; version 2
SPA 004117; version 1.02, SPA 004172; version 2

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2013



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Department of
Arts, Heritage and the Gaeltacht

MAP 3:
ROCKABILL TO DALKEY ISLAND SAC
CONSERVATION OBJECTIVES
REEFS

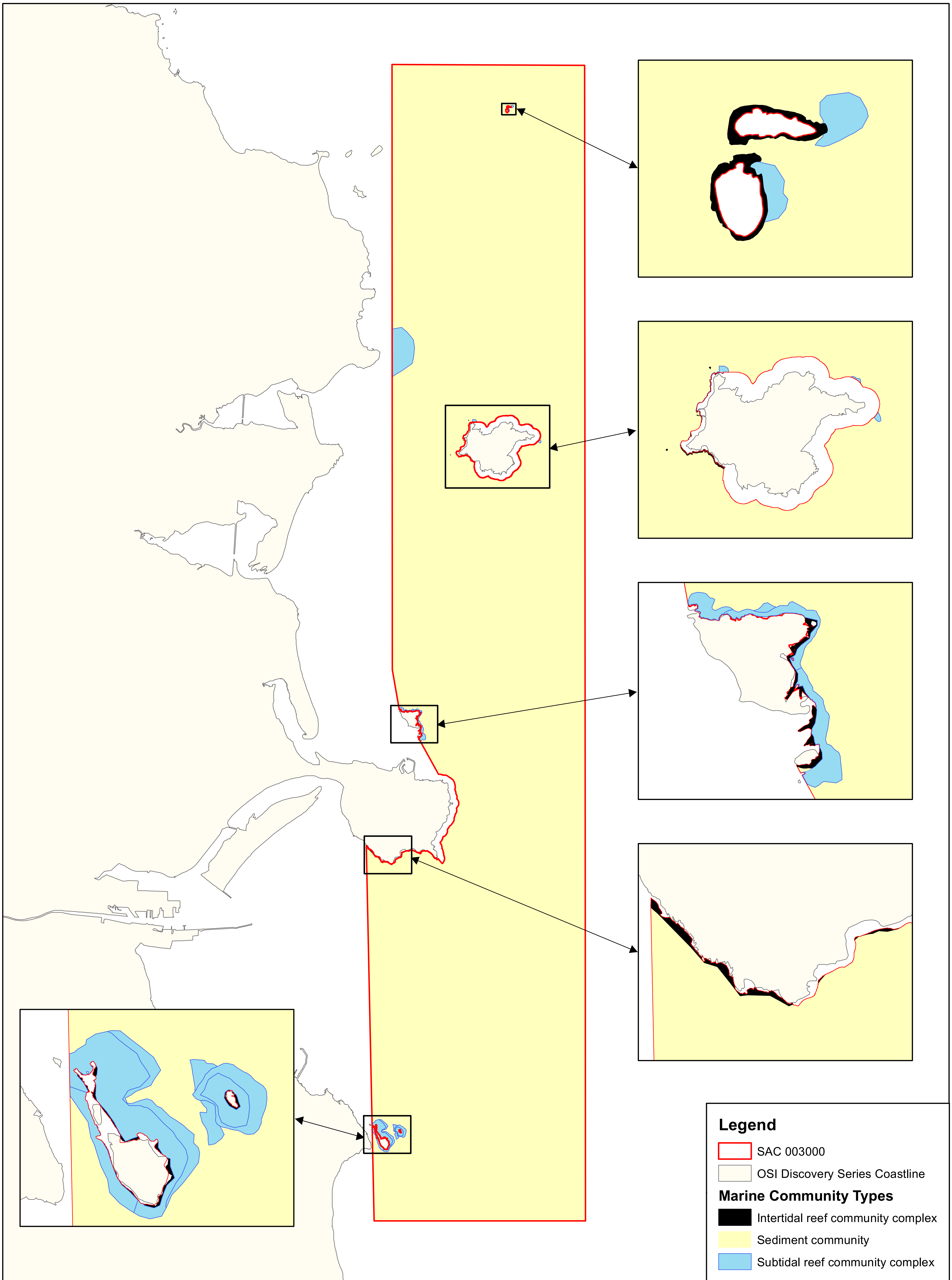
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 003000; version 3

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2013



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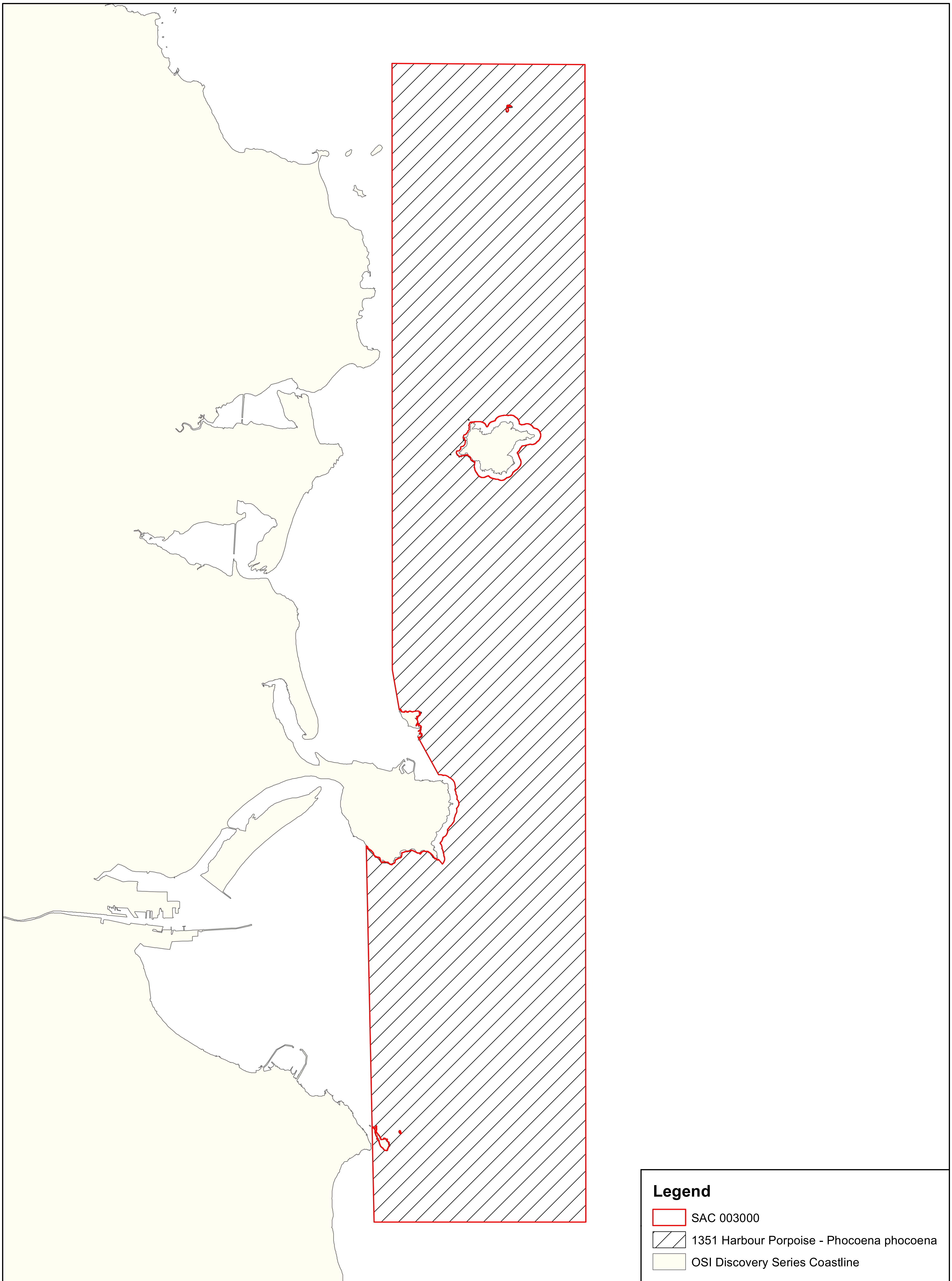
MAP 4: ROCKABILL TO DALKEY ISLAND SAC CONSERVATION OBJECTIVES MARINE COMMUNITY TYPES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 003000; version 3

Map Version 1
Date: May 2013



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MAP 5:
ROCKABILL TO DALKEY ISLAND SAC
CONSERVATION OBJECTIVES
HARBOUR PORPOISE

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 003000; version 3

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2013

Appendix X Roaringwater Bay and Islands SAC

National Parks and Wildlife Service

Conservation Objectives

Roaringwater Bay and Islands SAC 000101

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

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Favourable conservation status of a habitat is achieved when:
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- 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
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

000101 Roaringwater Bay and Islands SAC

QI	Description
1160	Large shallow inlets and bays
1170	Reefs
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
1351	Harbour porpoise *Phocoena phocoena*
1355	Otter *Lutra lutra*
1364	Grey seal *Halichoerus grypus*
4030	European dry heaths
8330	Submerged or partly submerged sea caves

Supporting documents, relevant reports & publications (listed by date)

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

Title: National survey and assessment of the conservation status of Irish sea cliffs

Year: 2011

Author: Barron, S.J.; Delaney, A.; Perrin, P.M.; Martin, J.; O'Neill, F.

Series: Irish Wildlife Manuals No. 53

Title: Roaringwater Bay and Islands SAC (000101) Conservation objectives supporting document - marine habitats and species [Version 1]

Year: 2011

Author: NPWS

Series: Unpublished Report to NPWS

Title: Roaringwater Bay and Islands SAC (000101) Conservation objectives supporting document - coastal habitats [Version 1]

Year: 2011

Author: NPWS

Series: Unpublished Report to NPWS

Title: Otter tracking study of Roaringwater Bay

Year: 2010

Author: De Jongh, A.; O'Neill, L.

Series: Unpublished Draft Report to NPWS

Title: Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland [Version 1.0]

Year: 2010

Author: Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B.

Series: Irish Wildlife Manuals No. 48

Title: Subtidal benthic surveys (Roaringwater Bay)

Year: 2009

Author: MERC

Series: Unpublished Report to NPWS & MI

Title: Roaringwater Bay baseline intertidal survey

Year: 2009

Author: RPS

Series: Unpublished Report to NPWS

Title: An assessment of the breeding population of grey seals in the Republic of Ireland, 2005

Year: 2008

Author: Ó Cadhla, O.; Strong, D.; O'Keeffe, C.; Coleman, M.; Cronin, M.; Duck, C.; Murray, T.; Dower, P.; Nairn, R.; Murphy, P.; Smiddy, P.; Saich, C.; Lyons, D.; Hiby, L.

Series: Irish Wildlife Manuals No. 34

Title: Survey of sensitive subtidal benthic marine communities

Year: 2007

Author: MERC

Series: Unpublished Report to NPWS

Title: Supporting documentation for the Habitats Directive Conservation Status Assessment - backing documents, Article 17 forms and supporting maps

Year: 2007

Author: NPWS

Series: Unpublished Report to NPWS

Title: Grey seal moult population survey in the Republic of Ireland, 2007

Year: 2007

Author: Ó Cadhla, O.; Strong, D.

Series: Unpublished Report to NPWS & CMRC

Title: Otter Survey of Ireland 2004/2005

Year: 2006

Author: Bailey, M.; Rochford, J.

Series: Irish Wildlife Manuals No. 23

Title: Otters - ecology, behaviour and conservation

Year: 2006

Author: Kruuk, H.

Series: Oxford University Press

Title: Harbour seal population assessment in the Republic of Ireland: August 2003

Year: 2004

Author: Cronin, M.; Duck, C.; Ó Cadhla, O.; Nairn, R.; Strong, D.; O'Keeffe, C.

Series: Irish Wildlife Manuals No. 11

Title: Summary of National Parks & Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003

Year: 2004

Author: Lyons, D.O.

Series: Irish Wildlife Manuals No. 13

Title: Broadscale mapping of candidate marine Special Area of Conservation. Roaringwater Bay and Islands, Co. Cork cSAC (000101)

Year: 2003

Author: SSI; Aquafact

Series: Unpublished Report to NPWS

Title: Diet of Otters *Lutra lutra* on Inishmore, Aran Islands, west coast of Ireland

Year: 1999

Author: Kingston, S.; O'Connell, M.; Fairley, J.S.

Series: Biol & Environ Proc R Ir Acad B 99B:173–182

Title: The BioMar biotope viewer: a guide to marine habitats, fauna and flora in Britain and Ireland

Year: 1997

Author: Picton, B.E.; Costello, M.J.

Series: Trinity College Dublin

Title: The Wild Plants of Sherkin, Cape Clear and adjacent Islands of West Cork

Year: 1996

Author: Akeroyd, J.

Series: Sherkin Island Marine Station

Title: The spatial organization of otters (*Lutra lutra*) in Shetland
Year: 1991
Author: Kruuk, H.; Moorhouse, A.
Series: J. Zool, 224: 41-57

Title: Otter survey of Ireland
Year: 1982
Author: Chapman, P.J.; Chapman, L.L.
Series: Unpublished Report to Vincent Wildlife Trust

Spatial data sources

Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High Water Mark (HWM) polyline feature class converted into polygon feature class; clipped to SAC boundary
Used for:	1160 (map 2)
Year:	Interpolated 2011
Title:	1994 BioMar Survey; 2002 broadscale mapping survey; 2009 subtidal reef survey and intertidal survey
GIS operations:	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data
Used for:	Marine community types, 1170 (maps 3 and 4)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined
Used for:	Marine community types base data (map 4)
Year:	2011
Title:	National survey and assessment of the conservation status of Irish sea cliffs
GIS operations:	Clipped to SAC boundary
Used for:	1230 (map 5)
Year:	Derived 2011
Title:	Coast of Ireland Oblique Imagery Survey 2003
GIS operations:	Point dataset created from visual inspection of survey
Used for:	8330 (map 5)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	Low Water Mark (LWM) polyline feature class converted into polygon feature class; clipped to SAC boundary
Used for:	1351, 1364 (map 6)
Year:	2011
Title:	NPWS rare and threatened species database
GIS operations:	Point dataset created from spatial references in database records
Used for:	1364 (map 6)
Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	Creation of an 80m buffer on the marine side of the high water mark (HWM); creation of a 10m buffer on the terrestrial side of the HWM; combination of 80m and 10m HWM buffer datasets; creation of a 10m buffer on the landward side of the river banks data; creation of a 20m buffer applied to river centerline and stream data; combination of 10m river banks and 20m river and stream centerline buffer datasets; combined river and stream buffer dataset clipped to HWM; combination of HWM buffer dataset with river and stream buffer dataset; overlapping regions investigated and resolved; resulting dataset clipped to SAC boundary
Used for:	1355 (map 7)

1160 Large shallow inlets and bays

To maintain the favourable conservation condition of Large shallow inlets and bays in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 2	Habitat area was estimated using OSI data as 12,809ha. See marine supporting document for further details
Community extent	Hectares	The extent of the *Zostera*-dominated and maërl-dominated communities should be conserved, subject to natural processes. See map 4	Area established from 2002 acoustic mapping and groundtruthing data and 2007 diver observation dropdown camera data. See marine supporting document for further details
Shoot density	Shoots per m^2	The quality of *Zostera*-dominated communities should be conserved, subject to natural processes	Derived from 2007 diver observation dropdown camera data. See marine supporting document for further details
Community structure	Biological composition	The quality of maërl-dominated communities should be conserved, subject to natural processes	Derived from 2002 grab sample data and 2008 diver observation dropdown camera data. See marine supporting document for further details
Community distribution	Hectares	The following communities should be conserved in a natural condition: Muddy sand with bivalves and polychaetes community complex; Mixed sediment community complex; Shallow sand/mud community complex. See map 4	The likely area of sediment communities was derived from a combination of acoustic mapping and grab data obtained in 2002 and 2009

1170 Reefs

To maintain the favourable conservation condition of Reefs in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat distribution	Occurrence	The distribution of reefs should remain stable, subject to natural processes. See map 3 for mapped distribution	Reef mapping based on information from 1994 BioMar Survey (Picton and Costello, 1997); 2002 broadscale mapping survey; 2009 subtidal reef survey (MERC, 2009) and intertidal survey (RPS, 2009). See marine supporting document for further details
Habitat area	Hectares	The permanent habitat area is stable, subject to natural processes. See map 3	The areas generated from the mapped extent is 3497ha. However, this is an under-estimate due to much of the reef habitat comprising vertical or steeply sloping rock. See marine supporting document for further details
Community structure	Biological composition	The following reef community complexes should be maintained in a natural condition: Exposed to moderately exposed intertidal reef; Exposed to moderately exposed subtidal reef below 20m; Sheltered reef. See map 4	Based on information from: 1994 BioMar Survey; 2002 broadscale mapping survey; 2009 subtidal reef survey and intertidal survey. See marine supporting document for further details
Community extent	Hectares	The extent of *Laminaria*-dominated communities should be conserved, subject to natural processes. See map 4	Based on information from: 1994 BioMar Survey; 2002 broadscale mapping survey ; 2009 subtidal reef survey and Intertidal survey. See marine supporting document for further details
Community structure	Biological composition	The biology of *Laminaria*-dominated communities should be conserved, subject to natural processes	Based on information from: 1994 BioMar Survey; 2002 broadscale mapping survey; 2009 subtidal reef survey and intertidal survey. See marine supporting document for further details

1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

To maintain the favourable conservation condition of Vegetated sea cliffs of the Atlantic and Baltic coasts in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat length	Kilometres	Area stable, subject to natural processes, including erosion. Total length of cliff section mapped within SAC: 21.01km. See map 5	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). 19 sub-sites were identified using a combination of aerial photos and the DCENR helicopter viewer. Cliffs are linear features and are therefore measured in kilometres. Length of cliff likely to be underestimated. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5	See coastal habitats supporting document for further details
Physical structure: functionality and hydrological regime	Occurrence of artificial barriers	No alteration to natural functioning of geomorphological and hydrological processes due to artificial structures	Maintaining natural geomorphological processes including natural erosion is important for the health of a vegetated sea cliff. Hydrological processes maintain flushes and in some cases tufa formations that can be associated with sea cliffs. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). See coastal habitats supporting document for further details
Vegetation composition: typical species & sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in the Irish Sea Cliff Survey (Barron et al. 2011)	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). See coastal habitats supporting document for further details
Vegetation composition: bracken and woody species	Percentage	Cover of bracken (*Pteridium aquilinum*) on grassland and/or heath less than 10%. Cover of woody species on grassland and/or heath less than 20%.	Based on data from the Irish Sea Cliff Survey (Barron et al., 2011). See coastal habitats supporting document for further details

1351 Harbour porpoise *Phocoena phocoena*

To maintain the favourable conservation condition of Harbour Porpoise in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 6	See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site	See marine supporting document for further details

1355 Otter *Lutra lutra*

To restore the favourable conservation condition of Otter in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Percentage positive survey sites	No significant decline	Measure based on standard otter survey technique. FCS target, based on 1980/81 survey findings, is 88% in SACs. Current range estimated at 75% (Bailey and Rochford, 2006; Rapid assessment results from Roaringwater Bay)
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 171ha above high water mark (HWM); 3ha along river banks/ around ponds	No field survey. Areas mapped to include 10m terrestrial buffer along shoreline (above HWM and along river banks) identified as critical for otters (NPWS, 2007)
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 1562ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (HWM) (NPWS, 2007; Kruuk, 2006)
Extent of freshwater (river) habitat	Kilometers	No significant decline. Length mapped and calculated as 0.74km	No field survey. River length calculated on the basis that otters will utilise freshwater habitats from estuary to headwaters (Chapman and Chapman, 1982)
Couching sites and holts	Number	No significant decline	Otters need lying up areas throughout their territory where they are secure from disturbance (Kruuk, 2006; Kruuk and Moorhouse, 1991)
Fish biomass available	Kilograms	No significant decline	Broad diet that varies locally and seasonally, but dominated by fish, in particular salmonids, eels and sticklebacks in freshwater (Bailey and Rochford, 2006) and wrasse and rockling in coastal waters (Kingston et al., 1999).
Barriers to connectivity	Number	No significant increase. For guidance, see map 7	Otters will regularly commute across stretches of open water up to 500m. e.g. between the mainland and an island; between two islands; across an estuary (De Jongh and O'Neill, 2010). It is important that such commuting routes are not obstructed

1364 Grey seal *Halichoerus grypus*

To maintain the favourable conservation condition of Grey Seal in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 6	See marine supporting document for further details
Breeding behaviour	Breeding sites	The breeding sites should be maintained in a natural condition. See map 6 for known sites	Attribute and target based on background knowledge of Irish breeding populations, a comprehensive breeding survey in 2005 (Ó Cadhla et al., 2007) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Moulting behaviour	Moult haul-out sites	The moult haul-out sites should be maintained in a natural condition. See map 6 for known sites	Attribute and target based on background knowledge of Irish populations, a national moult survey (Ó Cadhla and Strong, 2007) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Resting behaviour	Resting haul-out sites	The resting haul-out sites should be maintained in a natural condition. See map 6 for known sites	Attribute and target based on review of data from Lyons (2004), Cronin et al. (2004), Ó Cadhla et al. (2007), Ó Cadhla and Strong (2007) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Population composition	Number of cohorts	The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually	Attribute and target based on review of data from Lyons (2004), Ó Cadhla et al. (2007), Ó Cadhla and Strong (2007) and unpublished National Parks and Wildlife Service records. See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site	See marine supporting document for further details

4030 European dry heaths

To maintain the favourable conservation condition of European dry heaths in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat distribution	Occurrence	No decline from current habitat distribution, subject to natural processes	Spatial extent currently unmapped but indicated as occurring in rocky coastal areas and also on the islands especially the larger ones (based on NPWS NHA Survey Site Notes and photographs; Natura 2000 Form Explanatory Notes; Commonage Framework Plans CO8-A2 (2007); CO8-Q1 (2000); CO8-R1 (2000) and on plant records from the NPWS rare and threatened species database (2011).
Habitat area	Hectares	Area stable or increasing, subject to natural processes. Habitat area is not known but estimated as 5% (or 414ha) of the area of the SAC	Based on NPWS NHA Survey Site Notes; Natura 2000 Form Explanatory Notes and Commonage Framework Plans CO8-A2 (2007); CO8-Q1 (2000); CO8-R1 (2000)
Physical structure: outcropping rock	Occurrence	No increase or decrease in outcropping rock or scree, subject to natural processes. (Where rock has been exposed due to human activities, decrease necessary)	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation structure: dwarf shrub indicator species	Pecentage cover	Cover of characteristic dwarf shrub indicator species (heather (*Calluna vulgaris*), bell heather (*Erica cinerea*) and Western gorse (*Ulex gallii*)) at least 25%	Dry heath in this SAC occurs on free-draining nutrient poor soils and on rock outcrop. It is characterised by a mosaic of dwarf shrubs chiefly heather, bell heather and Western gorse and open areas with a characteristic composition of grasses, herbs, bryophytes and lichens. The mosaic patterning of dwarf shrub species interspersed with more open 'grassy' areas are characteristics of the dry heath habitat that need to be maintained in order to conserve the full range of dry heath plants. The species occurring on the site are listed in NPWS NHA Survey Site Notes of 1994. A very brief overview of the principal characteristics of the Dry heath habitat is given in the Site Synopsis on ww.npws.ie. Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation structure: senescent *Calluna vulgaris*	Pecentage cover	Cover of senescent *Calluna vulgaris* less than 50%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation structure: browsing	Percentage cover	Long shoots of palatable dwarf shrubs with signs of browsing collectively less than 33%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al., (2010)

4030 European dry heaths

To maintain the favourable conservation condition of European dry heaths in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Vegetation structure: native trees and shrubs	Pecentage cover	Cover of scattered native trees and shrubs less than 20%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al., (2010)
Vegetation composition: positive indicator species	Number	Number of positive indicator species at least 2 (e.g. heather (*Calluna vulgaris*), bell heather (*Erica cinerea*) and Western gorse (*Ulex gallii*) or other characteristic dry heath grass and herbaceous species for this SAC)	Dry heath in this SAC occurs on free-draining nutrient poor soils and on rock outcrop. It is characterised by a mosaic of dwarf shrubs chiefly heather, bell heather and Western gorse and open areas with a characteristic composition of grasses, herbs, bryophytes and lichens. Based on NPWS NHA Survey Site Notes and Natura 2000 Form Explanatory Notes. Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation composition: positive indicator species	Pecentage cover	Cover of positive indicator species at least 60%. This should include plant species characteristic of dry heath in this SAC including 'southern' plant species	Dry heath in this SAC occurs on free-draining nutrient poor soils and on rock outcrop. It is characterised by a mosaic of dwarf shrubs chiefly heather, bell heather and Western gorse and open areas with a characteristic composition of grasses, herbs, bryophytes and lichens. Based on NPWS NHA Survey Site Notes and Natura 2000 Form Explanatory Notes. Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation composition: bryophyte and non-crustose lichen species	Number	Number of bryophyte or non-crustose lichen species present at least 2	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation composition: bracken	Pecentage cover	Cover of bracken (*Pteridium aquilinum*) less than 10%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation composition: weedy negative indicator species	Pecentage cover	Cover of agricultural weed species (negative indicator species) less than 1%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation composition: non-native species	Pecentage cover	Cover of non-native species less than 1%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)

4030 European dry heaths

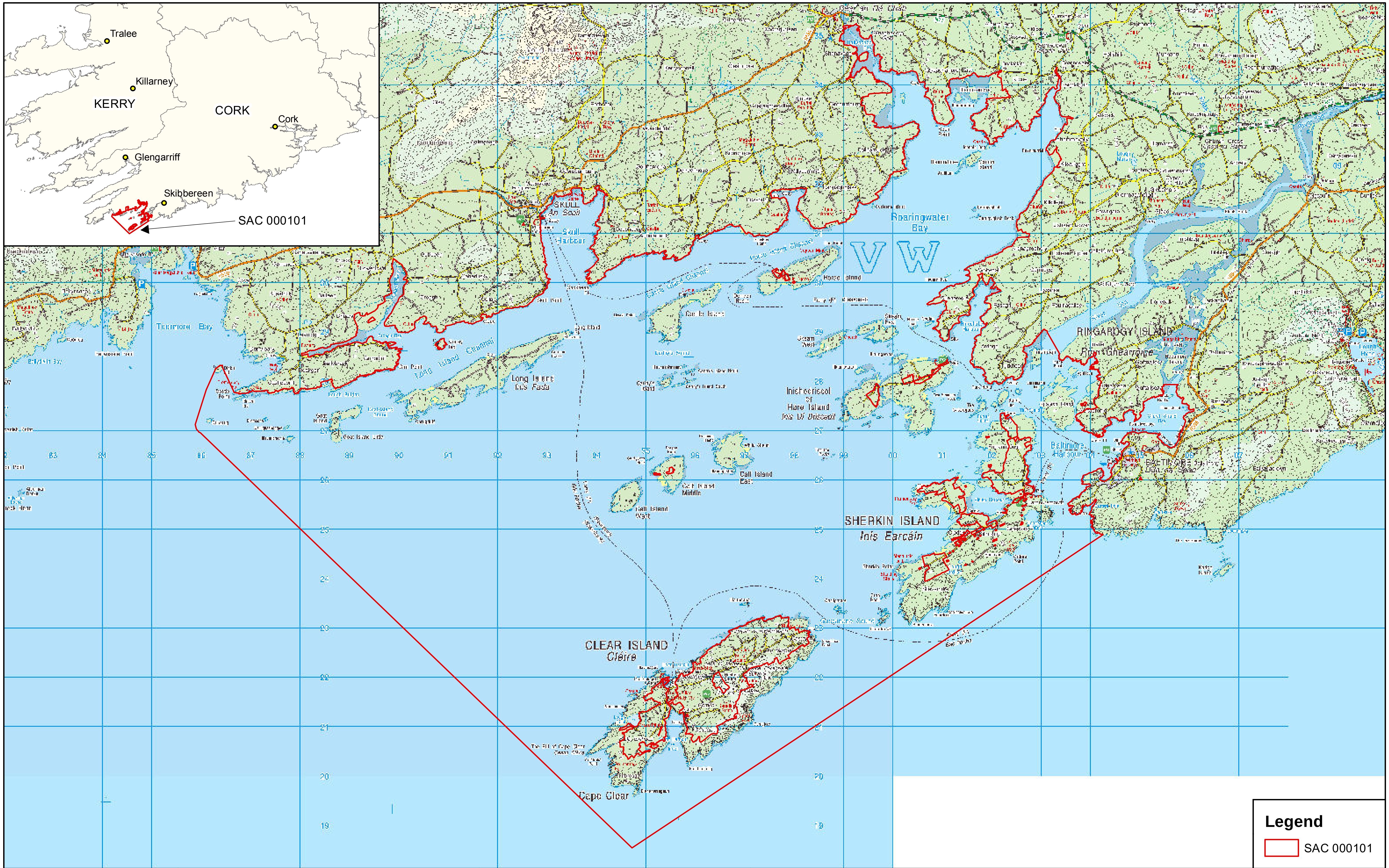
To maintain the favourable conservation condition of European dry heaths in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Vegetation composition: rare/scarce heath species	Location, area and number	No decline in distribution or population sizes of rare/scarce species, including hairy birdsfoot trefoil (*Lotus subbiflorus*), bird's foot (*Ornithopus perpusillus*), spotted rockrose (*Tuberaria guttata*); soft clover (*Trifloium striatum*); pale dog-violet (*Viola lactea*), bird's foot clover (*Trifolium ornithopodioides*), heath pearlwort (*Sagina subulata*)	The floristic composition of dry heath in this SAC is distinguished by 'southern' elements. Records based on: NPWS NHA Survey Site Notes and maps; Natura 2000 Form Explanatory Notes; NPWS rare and threatened species database; Akeroyd (1996)
Vegetation structure: disturbed bare ground	Pecentage cover	Cover of disturbed bare ground less than 10% (but if peat soil less than 5%)	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Vegetation structure: burning	Occurrence	No signs of burning within sensitive areas	Perrin et al. (2010) define sensitive areas

8330 Submerged or partly submerged sea caves

To maintain the favourable conservation condition of Submerged or partly submerged sea caves in Roaringwater Bay and Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Occurrence	The distribution of sea caves occurring in the site should remain stable, subject to natural processes. See map 5 for known caves	Sea cave distribution at this site was derived from an oblique aerial survey and therefore only detects the presence of sea caves visible intertidally in the flight path. See marine supporting document for further details
Community structure	Biological composition	Human activities should occur at levels that do not adversely affect the ecology of sea caves at the site	See marine supporting document for further details



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MAP 1:
ROARINGWATER BAY AND ISLANDS CONSERVATION OBJECTIVES SAC DESIGNATION

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

0 1 2 3 4 km

N

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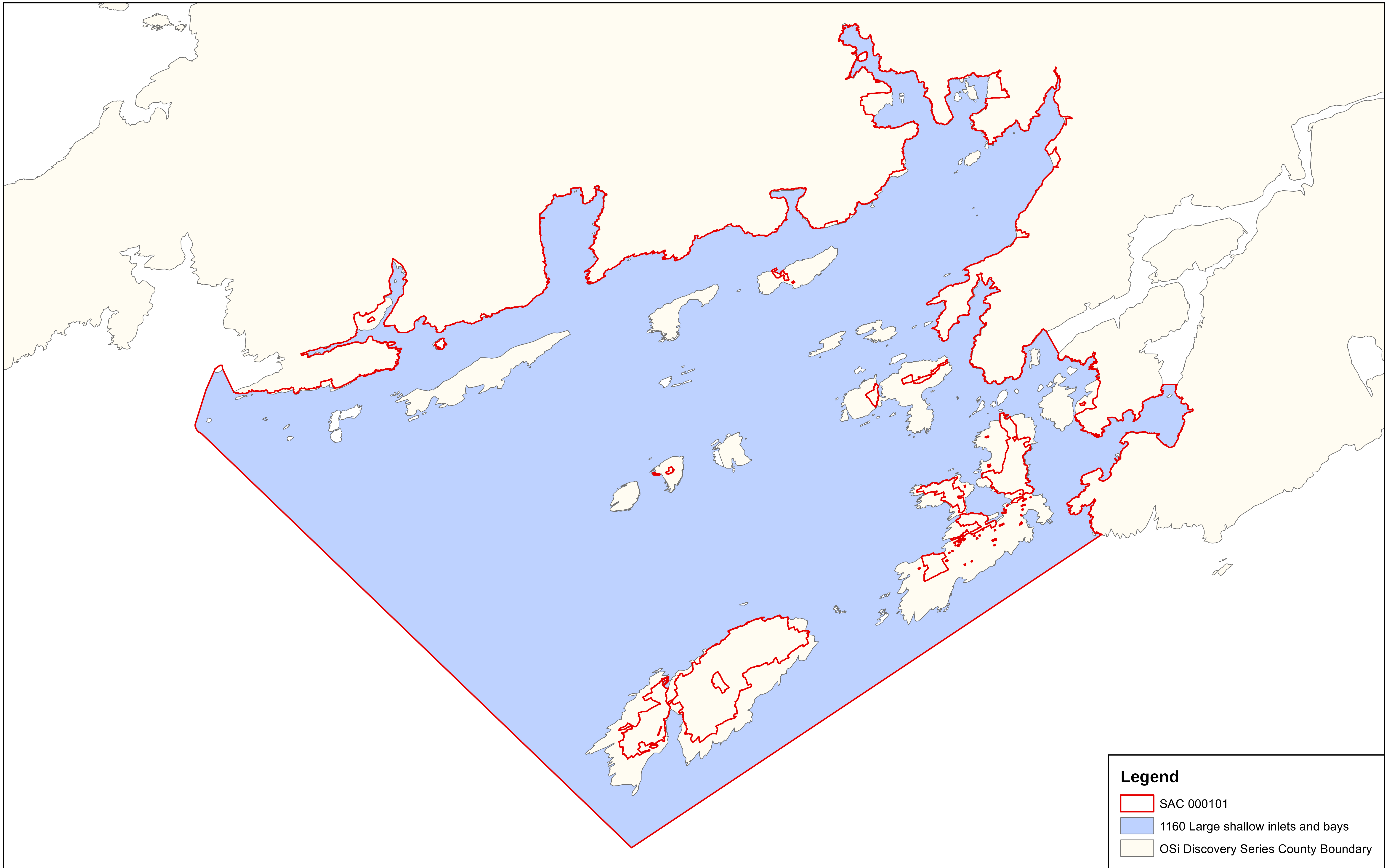
Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)

SITE CODE
SAC 000101
Version 1.06

Map Version 1
Date: March 2011



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MAP 2:
ROARINGWATER BAY AND ISLANDS
CONSERVATION OBJECTIVES
LARGE SHALLOW INLETS AND BAYS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

0 1 2 3 4 km

N

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SITE CODE
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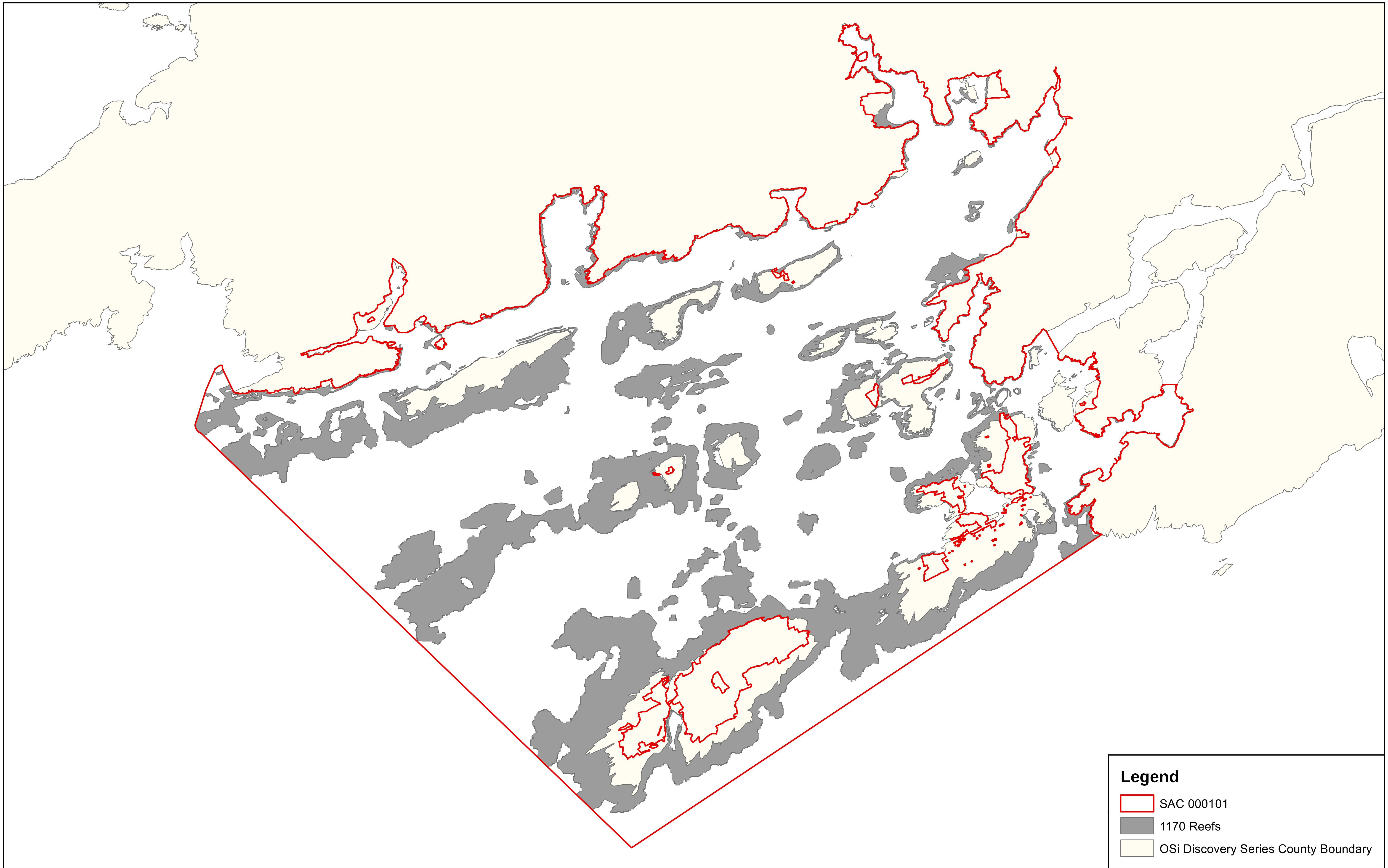
Version 1.06

Map Version 1
Date: April 2011



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MAP 3:
ROARINGWATER BAY AND ISLANDS
CONSERVATION OBJECTIVES
REEFS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

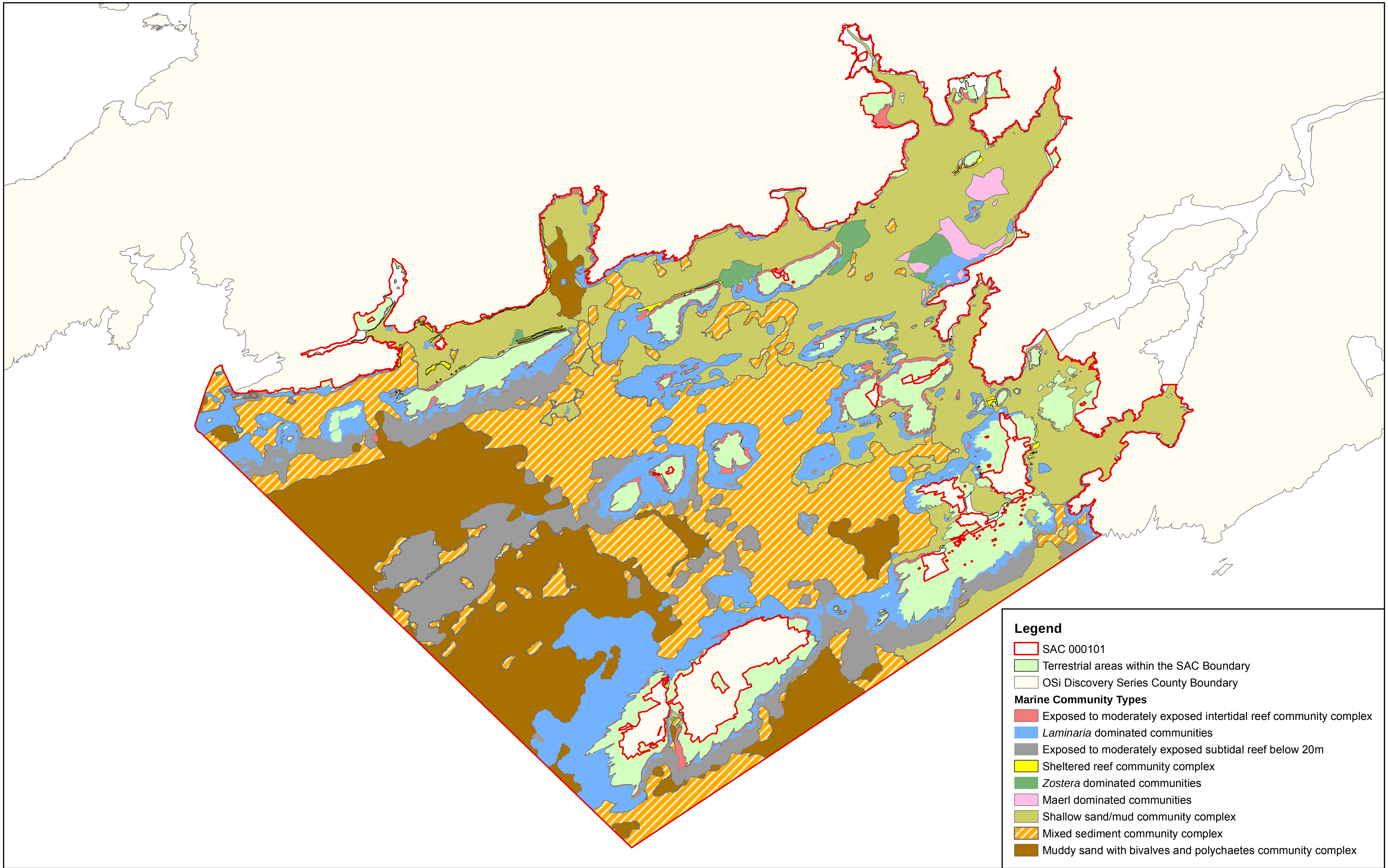
COUNTY CORK

0 1 2 3 4 km

N

SITE CODE
SAC 000101
Version 1.06

Map Version 1
Date: April 2011



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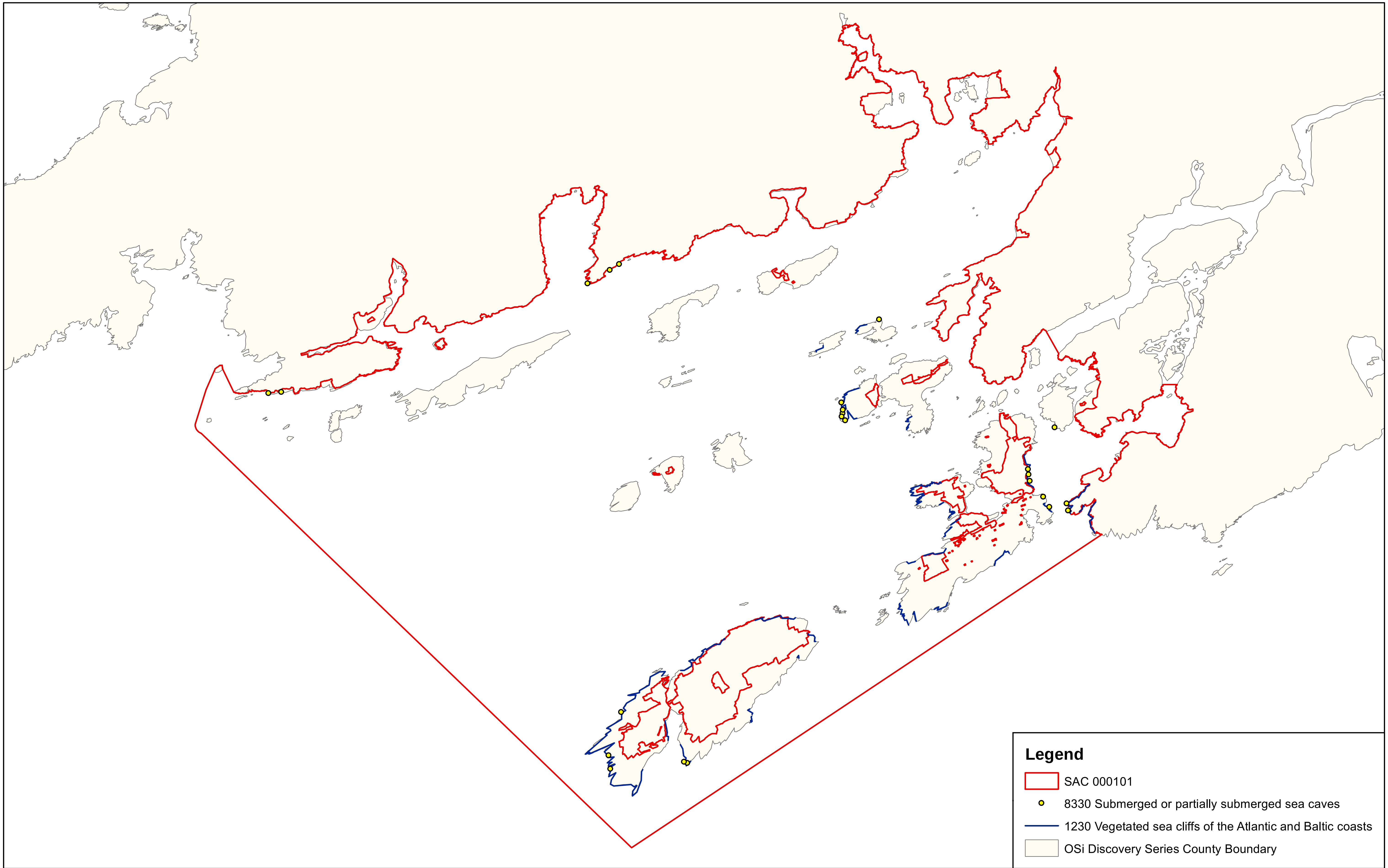
MAP 4: ROARINGWATER BAY AND ISLANDS CONSERVATION OBJECTIVES MARINE COMMUNITY TYPES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

SITE CODE
SAC 000101
Version 1.06

Map Version 1
Date: April 2011



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MAP 5:
ROARINGWATER BAY AND ISLANDS CONSERVATION OBJECTIVES SEA CAVES & VEGETATED SEA CLIFFS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

0 1 2 3 4 km

N

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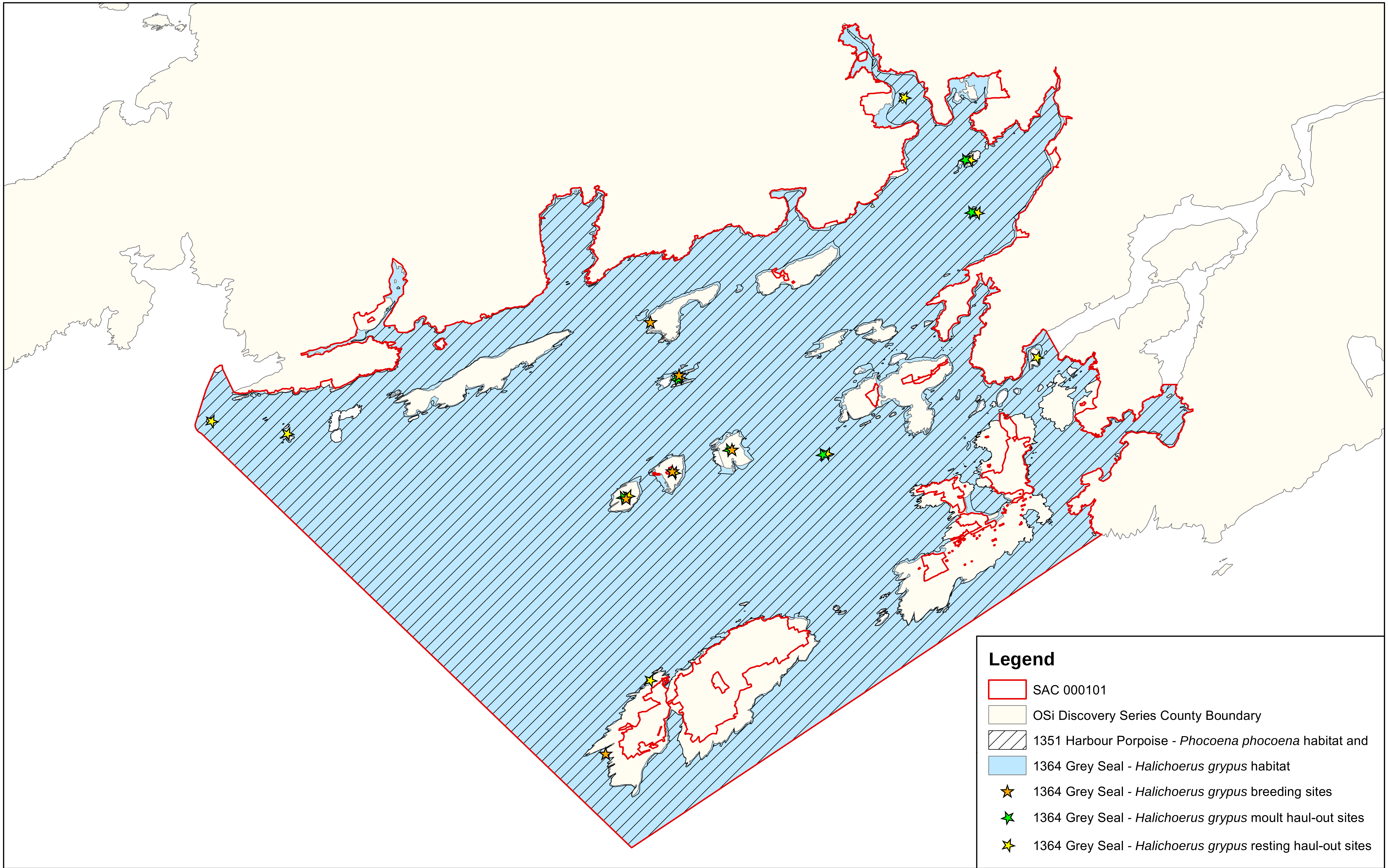
SITE CODE
SAC 000101
Version 1.06

Map Version 1
Date: March 2011



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MAP 6:
ROARINGWATER BAY AND ISLANDS
CONSERVATION OBJECTIVES
HARBOUR PORPOISE AND GREY SEAL

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

0 1 2 3 4 km

N

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Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comhartháithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)

SITE CODE
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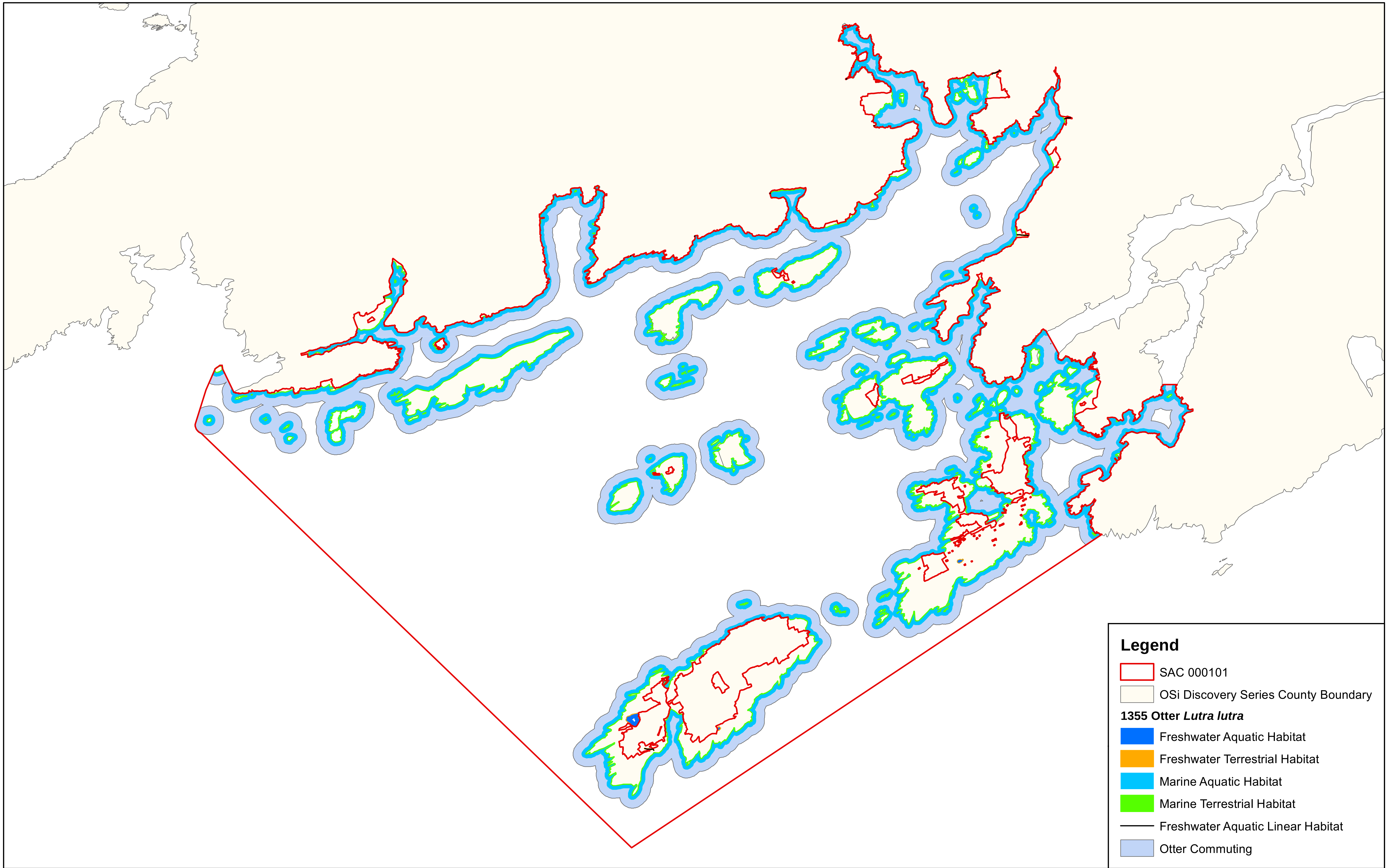
Version 1.06

Map Version 1
Date: March 2011



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MAP 7:
ROARINGWATER BAY AND ISLANDS CONSERVATION OBJECTIVES OTTER

Map to be read in conjunction with the NPWS Conservation Objectives Document.

COUNTY CORK

0 1 2 3 4 km

N

SITE CODE
SAC 000101
Version 1.06

Map Version 1
Date: March 2011

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Appendix Y Blasket Islands SAC

ISSN 2009-4086

National Parks and Wildlife Service

Conservation Objectives Series

Blasket Islands SAC 002172

An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
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National Parks and Wildlife Service,
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ISSN 2009-4086

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area 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
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

002172 Blasket Islands SAC

1170	Reefs
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
1351	Harbour porpoise *Phocoena phocoena*
1364	Grey seal *Halichoerus grypus*
4030	European dry heaths
8330	Submerged or partially submerged sea caves

Please note that this SAC overlaps with Blasket Islands SPA (004008) and Dingle Peninsula SPA (004153). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping sites as appropriate.

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	1988
Title :	The 1988 Blasket Islands expedition
Author :	Brazier, H.; Merne, O.
Series :	Unpublished report by Irish Wildbird Conservancy/Wildlife Service
Year :	2004
Title :	Harbour seal population assessment in the Republic of Ireland: August 2003
Author :	Cronin, M.; Duck, C.; O Cadhla, O.; Nairn, R.; Strong, D.; O'Keeffe, C.
Series :	Irish Wildlife Manual No. 11
Year :	2004
Title :	Summary of National Parks and Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003
Author :	Lyons, D.O.
Series :	Irish Wildlife Manual No. 13
Year :	2004
Title :	Aerial surveying of grey seal breeding colonies on the Blasket Islands, Co. Kerry, the Inishkea Group, Co. Mayo and the Donegal coast during the 2003 breeding season
Author :	Cronin, M.; Ó Cadhla, O.
Series :	Unpublished report to NPWS
Year :	2007
Title :	Abundance estimate and acoustic monitoring of harbour porpoise *Phocoena phocoena* in the Blasket Islands candidate Special Area of Conservation
Author :	Berrow, S.D.; O'Brien, J.; O'Connor, I.; McGrath, D.
Series :	Unpublished report to NPWS
Year :	2007
Title :	Grey seal moult population survey in the Republic of Ireland, 2007
Author :	O Cadhla, O.; Strong, D.
Series :	Unpublished report to NPWS
Year :	2008
Title :	An assessment of the breeding population of grey seals in the Republic of Ireland, 2005
Author :	O Cadhla, O.; Strong, D.; O'Keeffe, C.; Coleman, M.; Cronin, M.; Duck, C.; Murray, T.; Dower, P.; Nairn, R.; Murphy, P.; Smiddy, P.; Saich, C.; Lyons, D.O.; Hiby, L.
Series :	Irish Wildlife Manual No. 34
Year :	2011
Title :	National survey and assessment of the conservation status of Irish sea cliffs
Author :	Barron, S.J.; Delaney, A.; Perrin, P.M.; Martin, J.; O'Neill, F.
Series :	Irish Wildlife Manual No. 53
Year :	2013
Title :	Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012
Author :	Ó Cadhla, O.; Keena, T.; Strong, D.; Duck, C.; Hiby, L.
Series :	Irish Wildlife Manual No. 74
Year :	2013
Title :	An aerial survey of harbour seals in Ireland: part 2: Galway Bay to Carlingford Lough. August-September 2012.
Author :	Duck, C.; Morris, C.
Series :	Unpublished report to NPWS

Year :	2014
Title :	Blasket Islands SAC (site code: 2172) Conservation objectives supporting document- coastal habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2014
Title :	Blaskets Islands SAC (site code: 2172) Conservation objectives supporting document- European dry heaths V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2014
Title :	Blasket Islands SAC (site code: 2172) Conservation objectives supporting document- marine habitats and species V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	in prep.
Title :	Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2
Author :	Perrin, P.M.; Barron, S.J., Roche, J.R.; O'Hanrahan, B.
Series :	Irish Wildlife Manual No. 79

Other References

Year :	1997
Title :	The BioMar biotope viewer: a guide to marine habitats, fauna and flora in Britain and Ireland
Author :	Picton, B.E.; Costello, M.J.
Series :	Environmental Science Unit, Trinity College Dublin
Year :	1998
Title :	Population biology of grey seals (*Halichoerus grypus*, Fabricius 1791) in western Ireland
Author :	Kiely, O.R.M.
Series :	Unpublished PhD thesis, National University of Ireland, University College Cork
Year :	1998
Title :	Grey seal (*Halichoerus grypus*) pup production at the Inishkea island group, Co. Mayo and the Blasket Islands, Co. Kerry
Author :	Kiely, O.; Myers, A.A.
Series :	Biology and Environment: Proc. Royal Ir. Acad. 98B (2): 113-122
Year :	2007
Title :	Aerial surveying of grey seal breeding colonies on the Blasket Islands, Co. Kerry, the Inishkeas group, Co. Mayo and the Donegal coast, Ireland
Author :	Cronin, M.A.; Duck, C.D.; O Cadhla, O.
Series :	J. Nat. Conserv. 15(2): 77-83
Year :	2011
Title :	Reef investigations in Blasket Islands cSAC (site code: IE002172)
Author :	Aquafact
Series :	Unpublished report to the Marine Institute and NPWS

Spatial data sources

Year :	Interpolated 2014
Title :	1996 BioMar Survey; 2010 subtidal reef survey
GIS Operations :	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data. Expert opinion used as necessary to resolve any issues arising
Used For :	1170, marine community types (maps 3 and 4)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined; EU Annex I Saltmarsh and Coastal data erased out if present
Used For :	Marine community types base data (map 4)
Year :	2011
Title :	National Survey and assessment of the conservation status of Irish sea cliffs
GIS Operations :	Clipped to SAC boundary
Used For :	1230 (map 5)
Year :	2014
Title :	Internal NPWS files
GIS Operations :	Digitised using the OSi 1:5000 mapping series and orthophotography as reference datasets. Clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	4030 (map 6)
Year :	Derived 2014
Title :	Coast of Ireland Oblique Imagery Survey 2003
GIS Operations :	Point dataset created from visual inspection of survey
Used For :	8330 (map 7)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	Low Water Mark (LWM) polyline feature class converted into polygon feature class; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1351 (map 8)
Year :	2014
Title :	NPWS rare and threatened species database
GIS Operations :	Dataset created from spatial references in database records. Expert opinion used as necessary to resolve any issues arising
Used For :	1364 (map 9)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	High Water Mark (HWM) polyline feature class converted into polygon feature class; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1364 (map 9)

1170 Reefs

To maintain the favourable conservation condition of Reefs in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3	Habitat area estimated as 4,860ha from a 1996 BioMar survey (Picton and Costello, 1997) and a 2010 subtidal reef survey (Aquafact, 2011)
Distribution	Occurrence	The distribution of reefs remains stable, subject to natural processes. See map 3 for mapped distribution	Based on information from a 1996 BioMar survey (Picton and Costello, 1997) and a 2010 subtidal reef survey (Aquafact, 2011). See marine supporting document for further details
Community structure	Biological composition	Conserve the following community types in a natural condition: Subtidal reef with faunal turf and echinoderms community complex; *Laminaria*-dominated community. See map 4	Reef mapping based on information from a 1996 BioMar survey (Picton and Costello, 1997) and a 2010 subtidal reef survey (Aquafact, 2011). See marine supporting document for further details

1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

To restore the favourable conservation condition of Vegetated sea cliffs of the Atlantic and Baltic coasts in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat length	Kilometres	Area stable, subject to natural processes, including erosion. For sub-sites mapped: Great Blasket - 18.41km; Clogher Head to Slea Head - 7.50km. See map 5	Based on data from the Irish Sea Cliff Survey (ISCS) (Barron et al., 2011). Cliffs are linear features and are therefore measured in kilometres. The length of each cliff was measured (in some cases the cliff was measured in sections) to give a total estimated area of 25.37km. Length of cliff within the SAC likely to be under-estimated. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 5	The ISCS only surveyed and assessed cliffs on the mainland and the Great Blasket Island. However, cliffs are thought to occur on most of the other islands in the SAC. Hard cliffs are the predominant cliff type in this SAC (Browne, 2005; Barron et al., 2011). See coastal habitats supporting document for further details
Physical structure: functionality and hydrological regime	Occurrence of artificial barriers	No alteration to natural functioning of geomorphological and hydrological processes due to artificial structures	Based on data from ISCS (Barron et al., 2011). Maintaining natural geomorphological processes including natural erosion is important for the health of a vegetated sea cliff. Hydrological processes maintain flushes and in some cases tufa formations that can be associated with sea cliffs. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession	Based on data from Barron et al. (2011). At Great Blasket Island, splash, crevice ledge and heath zones were recorded. See coastal habitats supporting document for further details and the conservation objective for European dry heaths (4030)
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	Based on data from Barron et al. (2011). Some non-intensive sheep grazing was noted on Great Blasket Island by the ISCS. See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain range of sub-communities with typical species listed in the Irish Sea Cliff Survey (Barron et al., 2011)	See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Barron et al. (2011). The non-native species, *Hebe* sp., was recorded by the ISCS on Great Blasket Island. See coastal habitats supporting document for further details
Vegetation composition: bracken and woody species	Percentage	Cover of bracken (*Pteridium aquilinum*) on grassland and/or heath less than 10%. Cover of woody species on grassland and/or heath less than 20%	Based on data from Barron et al. (2011). Bracken (*Pteridium aquilinum*) was recorded from the cliffs on Great Blasket Island. See coastal habitats supporting document for further details

4030 European dry heaths

To maintain the favourable conservation condition of European dry heaths in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes. See map 6	Total habitat area is estimated as 306ha based on digitisation of map from Brazier and Merne (1988) and unpublished NPWS files. No recent field survey has occurred. Great Blasket and Inistooskert have the largest proportion of dry heath with limited areas on Inishvickillane and Inishnabro. Dry heath occurs in mosaic with wet heath and blanket bog on Great Blasket and Inishvickillane. See also the conservation objective for Vegetated sea cliffs (1230). See dry heaths supporting document for further details
Habitat distribution	Occurrence	No decline from current habitat distribution, subject to natural processes. See map 6	Dry heath is recorded on Great Blasket, Inishtooskert, Inishvickillane and Inishnabro. The heath in this SAC represents an extremely exposed example at one on the most westerly parts of its Irish and European range. See dry heaths supporting document for further details
Ecosystem function: soil nutrient status	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See dry heaths supporting document for further details
Vegetation structure: dwarf-shrub indicator species	Percentage cover at a representative number of monitoring stops	Cover of dwarf shrub indicator species at least 25%	Attribute and target based on Perrin et al. (in prep.). Ling heather (*Calluna vulgaris*) is dominant but bell heather (*Erica cinerea*) is also a locally important dwarf-shrub component of dry heath in this SAC. See dry heaths supporting document for further details
Vegetation structure: growth phases of ling (*Calluna vulgaris*)	Percentage cover at a representative number of monitoring stops	Senescent proportion of ling (*Calluna vulgaris*) cover less than 50%. Outside boundaries of Sensitive Areas, all growth phases of ling should occur throughout, with at least 10% of cover in mature phase	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation structure: signs of browsing	Percentage cover at a representative number of monitoring stops	Last complete growing season's shoots of ericoids showing signs of browsing collectively less than 33%	Attribute and target based on Perrin et al. (in prep.)
Vegetation structure: native trees and shrubs	Pecentage cover	Cover of scattered native trees and shrubs less than 20%	Attribute and target based on dry heath habitat condition assessment methodology outlined in Perrin et al. (2010)
Physical structure: disturbed bare ground	Percentage cover at a representative number of monitoring stops	Cover of disturbed bare ground less than 5%	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation structure: burning	Occurrence in local vicinity	No signs of burning within sensitive areas	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation composition: positive indicator species	Percentage cover at a representative number of monitoring stops	At least two positive indicator species, as listed in Perrin et al. (in prep), with combined cover of at least 60%	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation composition: bryophyte and non-crustose lichen species	Number at a representative number of monitoring stops	Number of bryophyte or non-crustose lichen species present at least three, excluding *Campylopus* and *Polytrichum* mosses	Attribute and target based on Perrin et al. (in prep.)

Vegetation composition: rare/scarce heath species	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat	See dry heaths supporting document for further details
Vegetation composition: bracken (*Pteridium aquilinum*)	Percentage cover in local vicinity	Cover of bracken (*Pteridium aquilinum*) less than 10%	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation composition: negative indicator species	Pecentage cover at a representative number of monitoring stops	Cover of negative indicator "weed" species collectively less than 1%	Attribute and target based on Perrin et al. (in prep.). See dry heaths supporting document for further details
Vegetation composition: non-native species	Percentage cover in local vicinity	Cover of non-native species less than 1%	Attribute and target based on Perrin et al. (in prep.)
Vegetation composition: soft rush cover	Percentage cover in local vicinity	Cover of soft rush (*Juncus effusus*) less than 10%	Attribute and target based on Perrin et al. (in prep). Dense areas of soft rush (*Juncus effusus*) can indicate disturbance

Conservation Objectives for : Blasket Islands SAC [002172]

8330 Submerged or partially submerged sea caves

To maintain the favourable conservation condition of Submerged or partially submerged sea caves in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Occurrence	The distribution of sea caves occurring in the site should remain stable, subject to natural processes. See map 7 for known caves	Sea cave distribution was derived from an oblique aerial survey and therefore only detects the presence of sea caves visible intertidally in the flight path
Community structure	Biological composition	Human activities should occur at levels that do not adversely affect the ecology of sea caves at the site	See marine supporting document for further details

1351 Harbour porpoise *Phocoena phocoena*

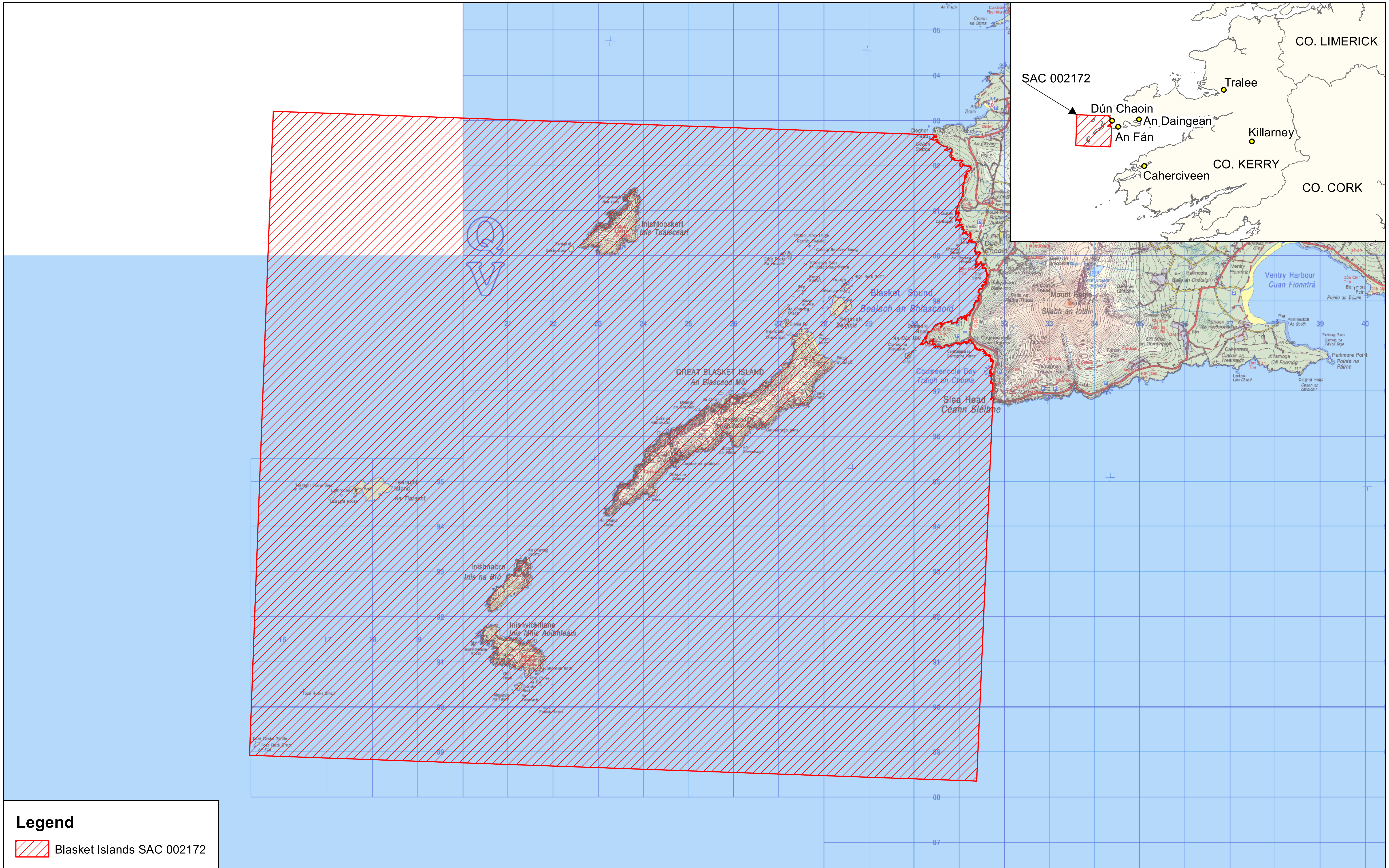
To maintain the favourable conservation condition of Harbour Porpoise in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 8	See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site	See marine supporting document for further details

1364 Grey seal *Halichoerus grypus*

To maintain the favourable conservation condition of Grey Seal in Blasket Islands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 9	See marine supporting document for further details
Breeding behaviour	Breeding sites	Conserve the breeding sites in a natural condition. See map 9 for known sites	Attribute and target based on background knowledge of Irish breeding populations, comprehensive breeding surveys in 1996 (Kiely, 1998; Kiely and Myers, 1998), 2003 (Cronin and Ó Cadhla, 2004; Cronin et al., 2007), and 2005 (Ó Cadhla et al., 2008) and 2011 (Ó Cadhla et al., 2013) and unpublished NPWS records including those reported by Lyons (2004). See marine supporting document for further details
Moulting behaviour	Moult haul-out sites	Conserve the moult haul-out sites in a natural condition. See map 9 for known sites	Attribute and target based on background knowledge of Irish populations, on review of data from Kiely (1998) and Lyons (2004), a national moult survey (Ó Cadhla and Strong, 2007) and unpublished NPWS records. See marine supporting document for further details
Resting behaviour	Resting haul-out sites	Maintain the resting haul-out sites in a natural condition. See map 9 for known sites	Attribute and target based on review of data from Kiely (1998), Lyons (2004), Cronin et al. (2004), Ó Cadhla et al. (2008), Duck and Morris (2013) and unpublished NPWS records. See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site	See marine supporting document for further details



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MAP 1:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

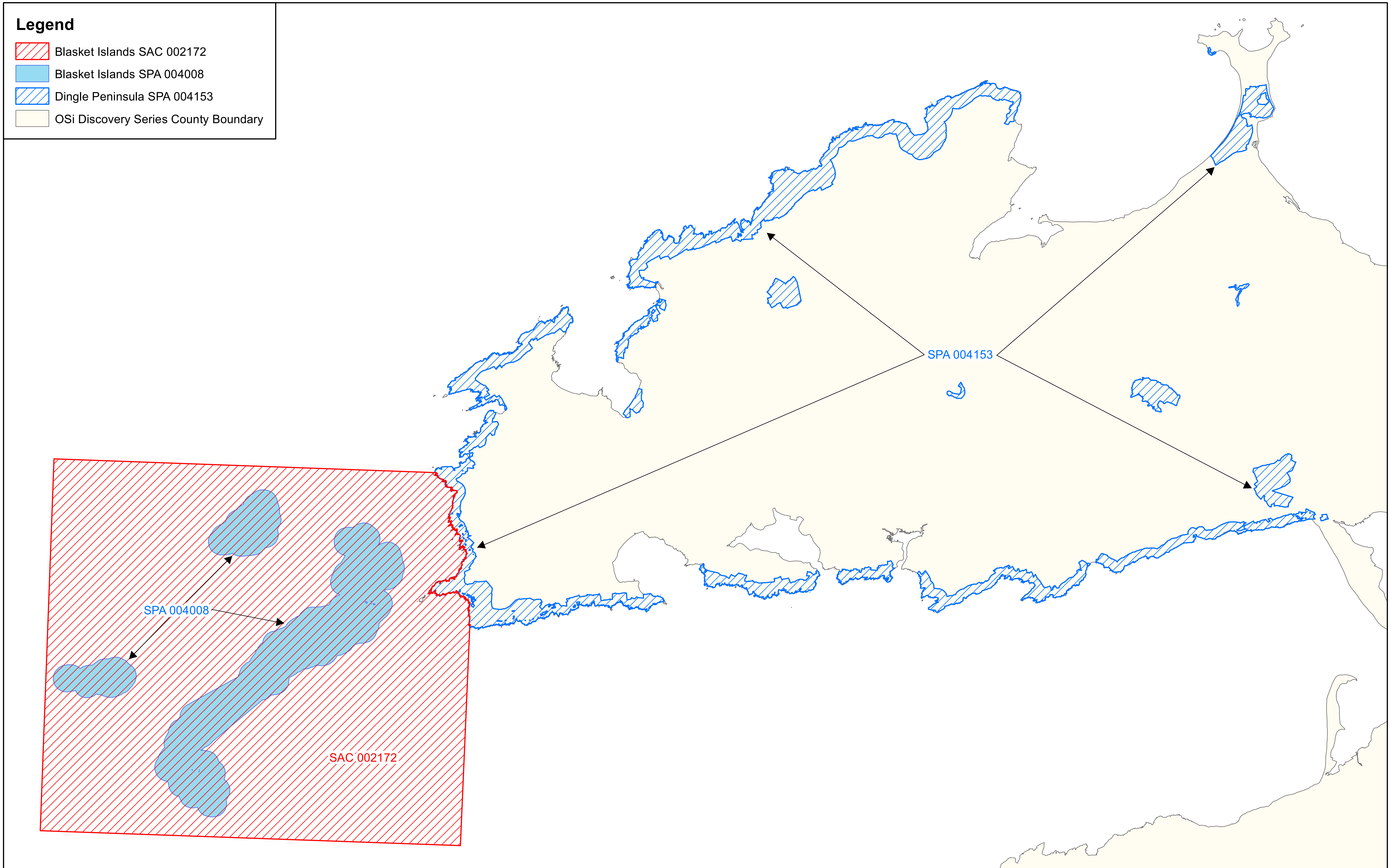
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 1 2 3 4 km

N

Map Version 1
Date: Feb 2014



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MAP 2:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
ADJOINING / OVERLAPPING
DESIGNATIONS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01.
SPA 004008; version 2.01, SPA 004153; version 2.02.
CO. KERRY

0 1 2 3 4 5 km

N

Map Version 1
Date: Feb 2014

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MAP 3:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
REEFS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 1 2 3 4 km

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.

Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe.

N

Map Version 1
Date: Feb 2014

Legend

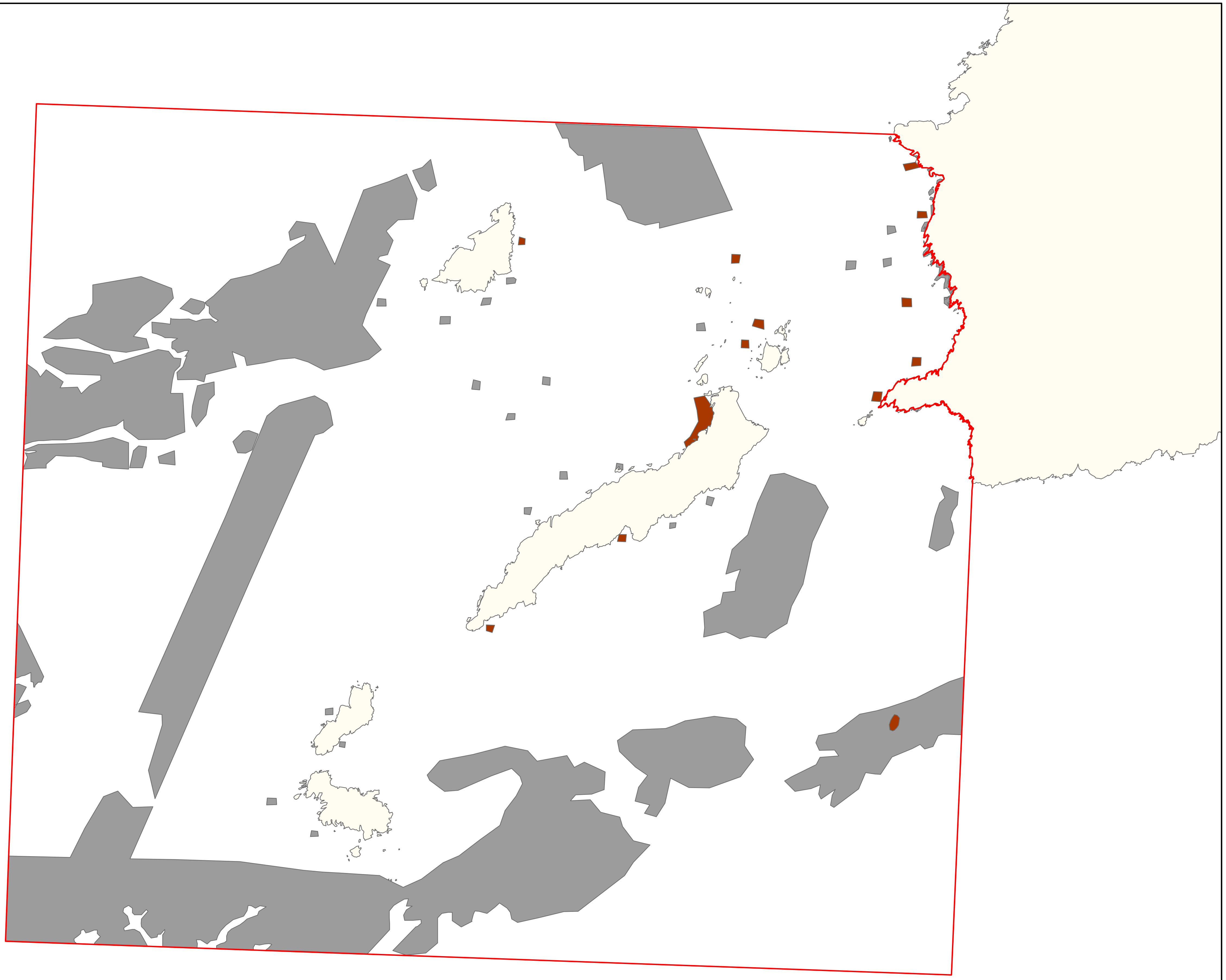
Blasket Islands SAC 002172

OSi Discovery Series County Boundary

Marine Community Types

Laminaria-dominated community

Reef with faunal turf and echinoderms community complex



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MAP 4:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
MARINE COMMUNITY TYPES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

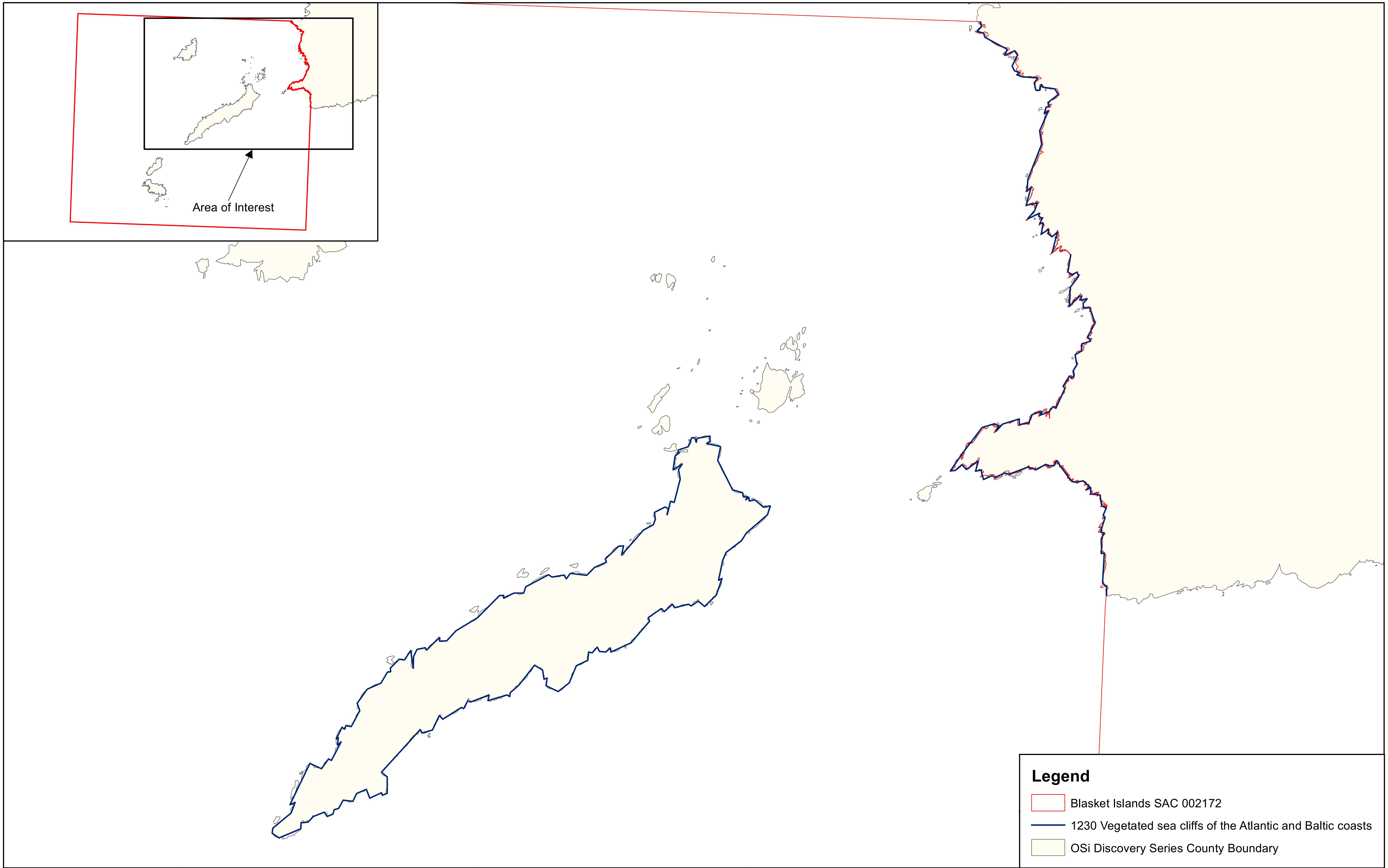
0 1 2 3 4 km

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.

Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe.

N

Map Version 1
Date: Feb 2014



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MAP 5:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
VEGETATED SEA CLIFFS

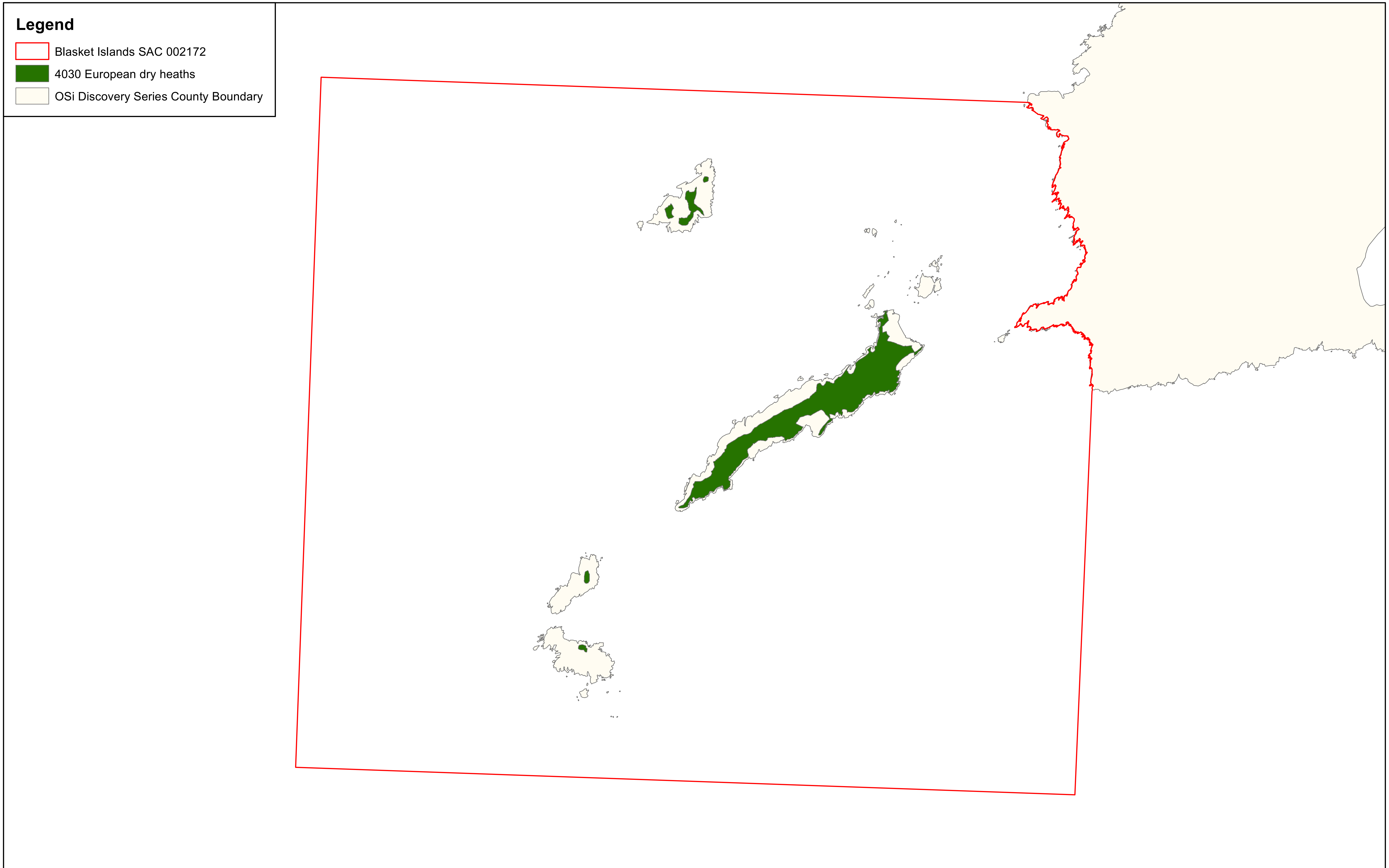
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 0.5 1 1.5 2 km

N

Map Version 1
Date: Feb 2014



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MAP 6:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
EUROPEAN DRY HEATHS

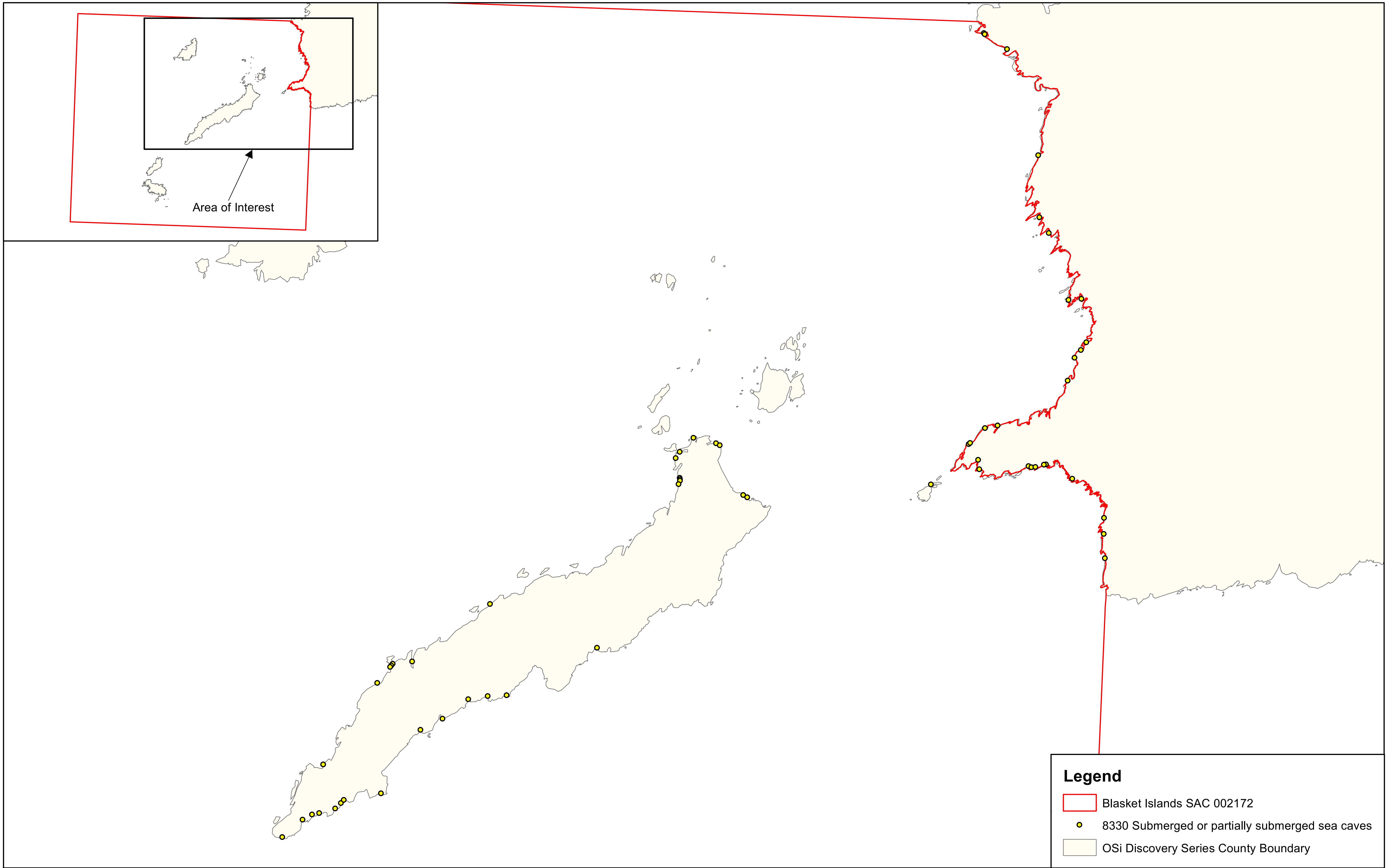
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 1 2 3 4 km

N

Map Version 1
Date: Feb 2014



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MAP 7:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
SEA CAVES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 0.5 1 1.5 2 km

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.
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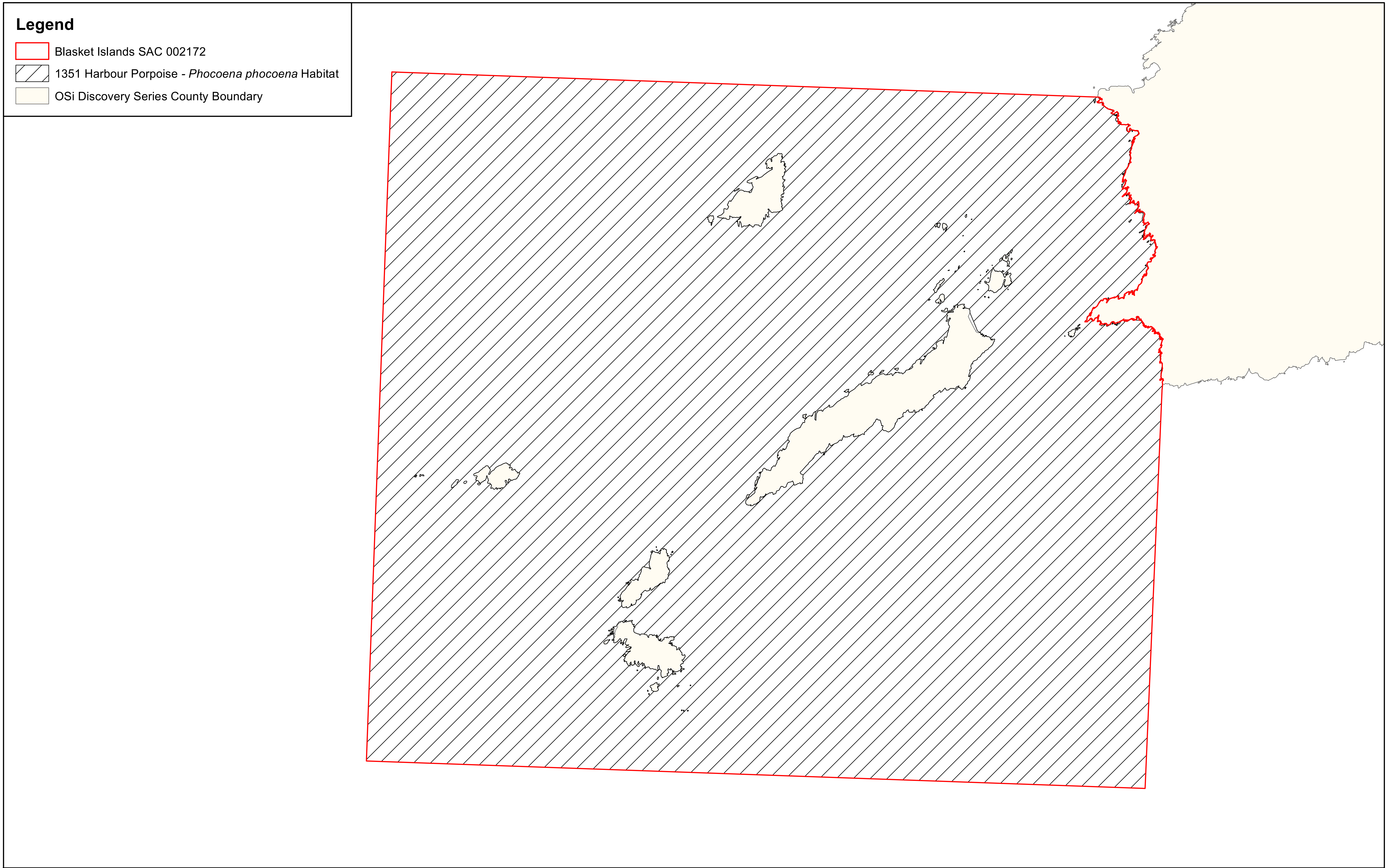
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Suirbhéarachta Ordonáis na hÉireann Ceadúnas Uimh EN 0059214. © Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann

N

Map Version 1
Date: Feb 2014



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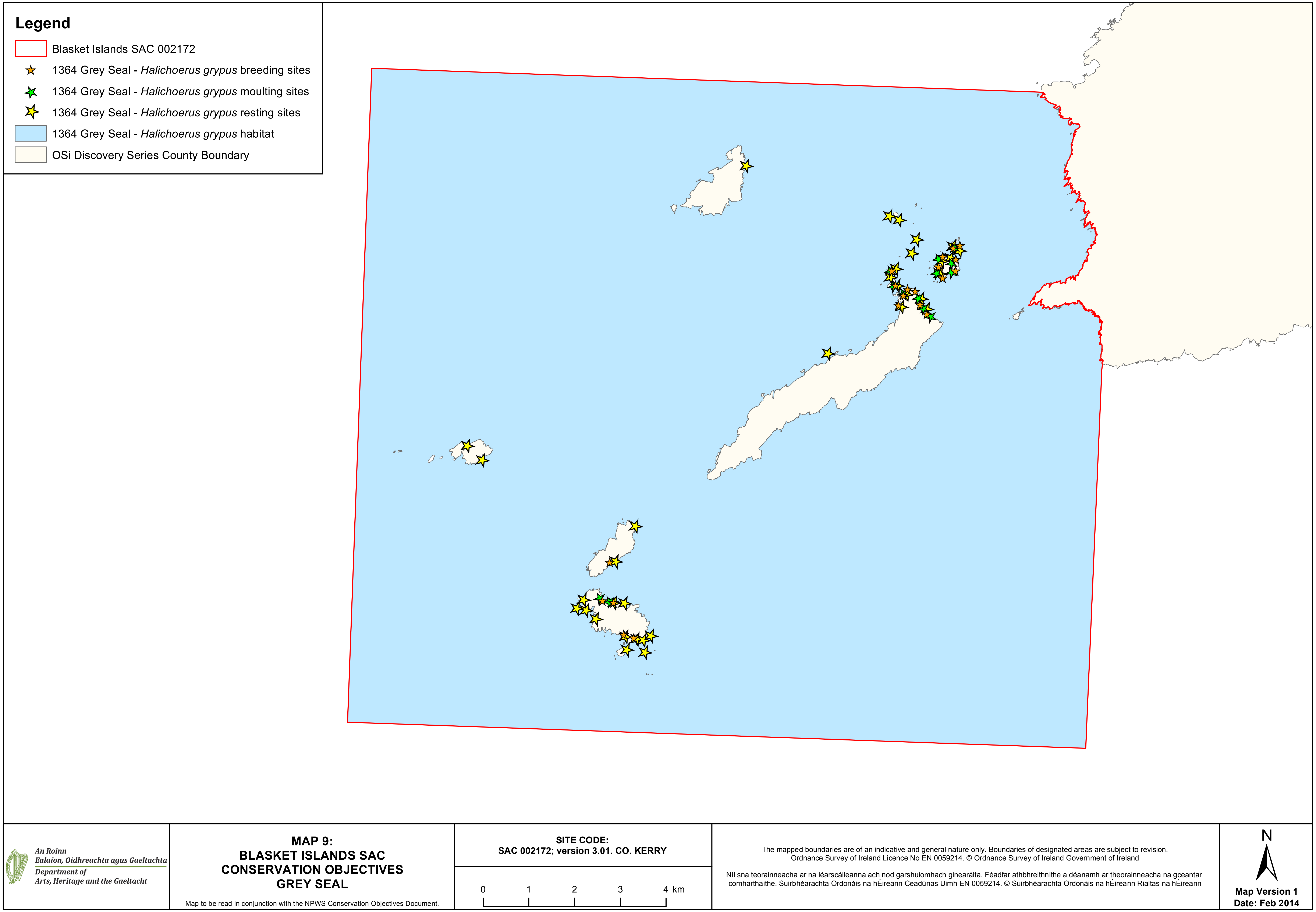
MAP 8:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
HARBOUR PORPOISE

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

0 1 2 3 4 km

Map Version 1
Date: Feb 2014



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MAP 9:
BLASKET ISLANDS SAC
CONSERVATION OBJECTIVES
GREY SEAL

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002172; version 3.01. CO. KERRY

Map Version 1
Date: Feb 2014

Appendix Z Saltee Islands SAC

National Parks and Wildlife Service

Conservation Objectives Series

Saltee Islands SAC 000707
Saltee Islands SPA 004002

An Roinn
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Department of
Arts, Heritage and the Gaeltacht

National Parks and Wildlife Service,
Department of Arts, Heritage and the Gaeltacht,

7 Ely Place, Dublin 2, Ireland.

Web: www.npws.ie
E-mail: natureconservation@environ.ie

Citation:
NPWS (2011) Conservation Objectives: Saltee Islands SAC 000707 and Saltee Islands SPA 004002. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Series Editors: Rebecca Jeffrey & Naomi Kingston
ISSN 2009-4086

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area 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
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, 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.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

000707 Saltee Islands SAC

1140	Mudflats and sandflats not covered by seawater at low tide
1160	Large shallow inlets and bays
1170	Reefs
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
1364	Grey Seal *Halichoerus grypus*
8330	Submerged or partially submerged sea caves

004002 Saltee Islands SPA

A009	Fulmar *Fulmarus glacialis*	breeding
A016	Gannet *Morus bassanus*	breeding
A018	Shag *Phalacrocorax aristotelis*	breeding
A188	Kittiwake *Rissa tridactyla*	breeding
A199	Guillemot *Uria aalge*	breeding
A200	Razorbill *Alca torda*	breeding
A204	Puffin *Fratercula arctica*	breeding

Supporting documents, relevant reports & publications (listed by date)

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

Title: Reef Investigations in Saltee Islands cSAC (Site Code: IE000707), Co. Wexford
Year: 2011
Author: Aquafact
Series: Unpublished Report to NPWS

Title: Subtidal Benthic Investigations in Saltee Islands cSAC (Site Code: IE000707), Co. Wexford
Year: 2011
Author: Aquafact
Series: Unpublished Report to NPWS

Title: BirdLife International Seabird Ecology and Foraging Range Database
Year: 2011
Author: BirdLife International
Series: http://seabird.wikispaces.com

Title: Seabird Monitoring Programme (SMP) Database
Year: 2011
Author: JNCC
Series: http://jncc.defra.gov.uk/smp/Default.aspx

Title: Saltee Islands SAC (000707): Conservation objectives supporting document - marine habitats and species [Version 1]
Year: 2011
Author: NPWS
Series: Unpublished Report to NPWS

Title: Saltee Islands SAC (000707): Conservation objectives supporting document - coastal habitats [Version 1]
Year: 2011
Author: NPWS
Series: Unpublished Report to NPWS

Title: An assessment of the breeding population of grey seals in the Republic of Ireland, 2005
Year: 2008
Author: Ó Cadhla, O.; Strong, D.; O'Keeffe, C.; Coleman, M.; Cronin, M.; Duck, C.; Murray, T.; Dower, P.; Nairn, R.; Murphy, P.; Smiddy, P.; Saich, C.; Lyons, D.; Hiby, L.
Series: Irish Wildlife Manuals No. 34

Title: Grey seal moult population survey in the Republic of Ireland, 2007
Year: 2007
Author: Ó Cadhla, O.; Strong, D.
Series: Unpublished Report to NPWS & CMRC

Title: Marine Natura 2000 recommendations for the extension of existing seabird (colony) special protection areas into the marine environment
Year: 2005
Author: Reid, J.; Webb, A.
Series: JNCC Committee Paper 05P14B

Title: Harbour seal population assessment in the Republic of Ireland: August 2003

Year: 2004

Author: Cronin, M.; Duck, C.; Ó Cadhla, O.; Nairn, R.; Strong, D.; O'Keeffe, C.

Series: Irish Wildlife Manuals No. 11

Title: Summary of National Parks & Wildlife Service surveys for common (harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), 1978 to 2003

Year: 2004

Author: Lyons, D.O.

Series: Irish Wildlife Manuals No. 13

Title: Seabird Populations of Britain and Ireland

Year: 2004

Author: Mitchell, P.I.; Newton, S.F.; Ratcliffe, N.; Dunn, T.E.

Series: Poyser, London

Title: The status of breeding grey seals (*Halichoerus grypus*) on the east and south-east coast of Ireland

Year: 2001

Author: Lidgard, D.C.; Kiely, O.; Rogan, E.; Connolly, N.

Series: Mammalia 65 (3): 283-294

Title: Grey Seals: Status & Monitoring in the Irish & Celtic Seas

Year: 2000

Author: Kiely, O.; Lidgard, D.C.; McKibben, M.; Baines, M.E.; Connolly, N.

Series: Maritime Ireland/Wales INTERREG Report no. 3. Marine Institute

Title: Population biology of grey seals (*Halichoerus grypus* Fabricius 1791) in western Ireland

Year: 1998

Author: Kiely, O.R.M.

Series: Unpublished PhD. Thesis, National University of Ireland, University College Cork

Title: The BioMar biotope viewer: a guide to marine habitats, fauna and flora in Britain and Ireland

Year: 1997

Author: Picton, B.E.; Costello, M.J.

Series: Trinity College Dublin

Title: Seabird monitoring handbook for Britain and Ireland: a compilation of methods for survey and monitoring of breeding seabirds.

Year: 1995

Author: Walsh, P.; Halley, D.J.; Harris, M.P.; del Nevo, A.; Sim, I.M.W.; Tasker, M.L.

Series: JNCC, Peterborough

Spatial data sources

Year:	Interpolated 2011
Title:	1994 BioMar Survey; 2010 subtidal and intertidal surveys
GIS operations:	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data. Expert opinion used as necessary to resolve any issues arising
Used for:	Marine community types, 1140, 1170 (maps 2, 4 and 5)

Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High Water Mark (HWM) polyline feature class converted into polygon feature class; clipped to SAC boundary. Seaward boundary defined by expert judgement
Used for:	1160 (map 3)

Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined
Used for:	Marine community types base data (map 5)

Year:	2011
Title:	Internal NPWS files
GIS operations:	Digitised using the OSi six inch (1:10560) mapping series with reference to draft conservation plan map (2000). Clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used for:	1230 (map 6)

Year:	Derived 2011
Title:	Coast of Ireland Oblique Imagery Survey 2003
GIS operations:	Point dataset created from visual inspection of survey
Used for:	8330 (map 6)

Year:	2011
Title:	NPWS rare and threatened species database
GIS operations:	Dataset created from spatial references in database records. Expert opinion used as necessary to resolve any issues arising
Used for:	1364 (map 7)

Year:	2005
Title:	OSi Discovery series vector data
GIS operations:	High Water Mark (HWM) polyline feature class converted into polygon feature class; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used for:	1364 (map 7)

1140 Mudflats and sandflats not covered by seawater at low tide

To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in the Saltee Islands SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 2	Habitat area was estimated using OSi data as 20ha. See marine supporting document for further details
Community extent	Hectares	The following community should be maintained in a natural condition: Intertidal sand to muddy sand dominated polychaetes community complex. See map 5	Based on information from a intertidal survey (EcoServe, 2011). See marine supporting document for further details

1160 Large shallow inlets and bays

To maintain the favourable conservation condition of Large shallow inlets and bays in the Saltee Islands SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3	Habitat area was estimated using OSi data as 3651ha. See marine supporting document for further details
Community extent	Hectares	The following communities should be maintained in a natural condition: Coarse sediment with *Pomatoceros* spp. and *Pisidia longicornis* community. See map 5	Based on information from 1994 BioMar Survey (Picton and Costello, 1997) and a subtidal survey (Aquafact, 2011). See marine supporting document for further details

1170 Reefs

To maintain the favourable conservation condition of Reefs in the Saltee Islands SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Distribution	Occurrence	The distribution of reefs should remain stable, subject to natural processes. See map 4	Reef mapping based on information from 1994 BioMar Survey (Picton and Costello, 1997), subtidal survey (Aquafact, 2011) and intertidal survey (EcoServe, 2011). See marine supporting document for further details
Habitat area	Hectares	The permanent habitat area is stable, subject to natural processes. See map 4	Habitat area was estimated from the 2010 survey data as 4,595ha. See marine supporting document for further details
Community structure	Biological composition	The following reef community complexes should be maintained in a natural condition: Intertidal reef community complex; and Subtidal reef dominated by echinoderms and sponges community complex. See map 5	Reef mapping based on information from 1994 BioMar Survey (Picton and Costello, 1997), subtidal survey (Aquafact, 2011) and intertidal survey (EcoServe, 2011). See marine supporting document for further details
Community extent	Hectares	The extent of *Laminaria* dominated community should be conserved, subject to natural processes. See map 5	Based on information from 1994 BioMar Survey (Picton and Costello, 1997) and subtidal reef survey (Aquafact, 2011). See marine supporting document for further details
Community structure	Biological composition	The biology of the *Laminaria* dominated community should be conserved, subject to natural processes	Based on information from 1994 BioMar Survey (Picton and Costello, 1997) and subtidal reef survey (Aquafact, 2011). See marine supporting document for further details

1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

To maintain the favourable conservation condition of Vegetated sea cliffs of the Atlantic and Baltic coasts in the Saltee Islands SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Habitat length	Kilometres	Area stable, subject to natural processes, including erosion. For sub-sites mapped: Great Saltee Island - 5.51km and Little Saltee Island - 3.11km. See map 6	Two sub-sites were identified giving a total estimated area of 8.62km within the SAC. Cliffs are linear features and are therefore measured in kilometres. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 6	See coastal habitats supporting document for further details
Physical structure: functionality and hydrological regime	Occurrence of artificial barriers	No alteration to natural functioning of geomorphological and hydrological processes due to artificial structures	Maintaining natural geomorphological processes including natural erosion is important for the health of a vegetated sea cliff. Hydrological processes maintain flushes and in some cases tufa formations that can be associated with sea cliffs, although it is not known if such formations occur on the Saltee Islands. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession	See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimeters	Maintain structural variation within sward	See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in the Irish Sea Cliff Survey (Barron et al., 2011)	See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage	Negative indicator species (including non-natives) to represent less than 5% cover	See coastal habitats supporting document for further details
Vegetation composition: bracken and woody species	Percentage	Cover of bracken (*Pteridium aquilinum*) on grassland less than 10%. Cover of woody species on grassland less than 20%	See coastal habitats supporting document for further details

1364 Grey Seal *Halichoerus grypus*

To maintain the favourable conservation condition of Grey Seal in the Saltee Islands SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use. See map 7	See marine supporting document for further details
Breeding behaviour	Breeding sites	The breeding sites should be maintained in a natural condition. See map 7 for known sites	Attribute and target based on background knowledge of Irish breeding populations; review of data from Kiely et al. (2000); Lidgard et al. (2001); Lyons (2004); a comprehensive breeding survey in 2005 (Ó Cadhla et al., 2007); and unpublished National Parks & Wildlife Service records. See marine supporting document for further details
Moulting behaviour	Moult haul-out sites	The moult haul-out sites should be maintained in a natural condition. See map 7 for known sites	Attribute and target based on background knowledge of Irish populations; research by Kiely et al. (2000); a national moult survey (Ó Cadhla and Strong, 2007); and unpublished National Parks & Wildlife Service records. See marine supporting document for further details
Resting behaviour	Resting haul-out sites	The resting haul-out sites should be maintained in a natural condition. See map 7 for known sites	Attribute and target based on review of data from Kiely (1998); Kiely et al. (2000); Lyons (2004); Cronin et al. (2004); Ó Cadhla et al. (2007); Ó Cadhla and Strong (2007); and unpublished National Parks & Wildlife Service records. See marine supporting document for further details
Population composition	Number of cohorts	The grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually	Attribute and target based on review of data from Kiely (1998), Kiely et al. (2000), Lyons (2004), Ó Cadhla et al. (2007), Ó Cadhla and Strong (2007); and unpublished National Parks & Wildlife Service records. See marine supporting document for further details
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population	See marine supporting document for further details

8330 Submerged or partially submerged sea caves

To maintain the favourable conservation condition of submerged or partly submerged sea caves in the Saltee Islands SAC, which is defined by the following list of attributes and targets subject to natural variation

Attribute	Measure	Target	Notes
Distribution	Occurrence	The distribution of sea caves should remain stable, subject to natural processes. See map 6 for known distribution	Sea cave distribution was derived from an oblique aerial survey and therefore only detects the presence of sea caves visible intertidally in the flight path
Community structure	Biological composition	Human activities should occur at levels that do not adversely affect the ecology of sea caves	

A009 Fulmar *Fulmarus glacialis*

To maintain the favourable conservation condition of Fulmar in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied sites (AOSs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Typically, fulmar nest near the tops of grassy cliffs on relatively wide ledges (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Key prey items: broad diet encompassing fish, zooplankton, squid, offal and fishery discards. Key habitats: relatively clear 'oceanic' water with high salinity, thermally stratified in summer. Shelf breaks, offshore banks, frontal zones, tide and rip currents may also be important. Foraging range: max. 664km, mean max. 311.43km, mean 69.35km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of fulmar performing these behaviours occurred within 2km of the breeding colony (Reid and Webb, 2005). Foraging range: max. 664km, mean max. 311.43km, mean 69.35km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Typically, fulmar nest near the top of grassy cliffs on relatively wide ledges (Mitchell et al., 2004)
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of fulmar performing these behaviours occurred within 2km of the breeding colony (Reid and Webb, 2005)

A016 Gannet *Morus bassanus*

To maintain the favourable conservation condition of Gannet in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Gannetries are conspicuous with high densities of nests built with seaweed, other vegetation and earth stuck together with excreta
Prey biomass available	Kilogrammes	No significant decline	Key prey items: surface schooling fish, fisheries waste; discards important for some colonies and/or in some seasons. Key habitats: Deep-water depressions, tidal mixing fronts, shelf breaks, sandbanks, inshore and coastal waters. Foraging range: max. 640km, mean max. 308.36km, mean 140.09km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of gannet performing these behaviours occurred within 2km of the breeding colony (Reid and Webb, 2005). Foraging range: max. 640km, mean max. 308.36km, mean 140.09km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Gannetries are conspicuous with high densities of nests bulit with seaweed, other vegetation and earth stuck together with excreta. Often 'clubs' of immature and adult plumage non-breeders are discrete from the breeding birds

A016 Gannet *Morus bassanus*

To maintain the favourable conservation condition of Gannet in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of gannet performing these behaviours occurred within 2km of the breeding colony (Reid and Webb, 2005)

A017 Cormorant *Phalacrocorax carbo*

To maintain the favourable conservation condition of Cormorant in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species.
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Cormorant colonies are usually sited on flat or rocky islets or sea stack tops, less often on cliffs (Walsh et al., 1995)
Prey biomass available	Kilogrammes	No significant decline	Key prey items: fish (mostly benthic), some crustaceans. Key habitats: populations use sandy areas, rocky and vegetated substrate. Foraging range: max. 50km, mean max. 31.67km, mean 8.46km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Foraging Range: max. 50km, mean max. 31.67km, mean 8.46km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Cormorant colonies are usually sited on flat or rocky islets or stack stops, less often on cliffs (Walsh et al., 1995)

A018 Shag *Phalacrocorax aristotelis*

To maintain the favourable conservation condition of Shag in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Shags can nest in small groups spread along several kilometres of coastline. In general, colonies are discrete and normally on cliffs/offshore islands (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Key prey items: benthic, demersal and schooling pelagic fish- especially sandeels (Ammodytes spp.). Key habitats: shallow waters, particularly over sand and gravel banks, areas of high tidal flow. Foraging range: max. 20km, mean max. 16.42km, mean 6.53km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Foraging range: max. 20km, mean max. 16.42km, mean 6.53km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Shags can nest in small groups spread along several kilometres of coastline. In general colonies are discrete and normally on cliffs/offshore islands (Mitchell et al., 2004)

A183 Lesser Black-backed Gull *Larus fuscus*

To maintain the favourable conservation condition of Lesser Black-backed Gull in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Lesser black-backed gull nests colonially, often with other gull species on offshore islands and coastal cliffs often within vegetated areas (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Lesser black-backed gulls are surface feeders whose diet includes fish, invertebrates and fishery-related discards. max. foraging range 40km
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Foraging range: max. 40km
Disturbance at the breeding site	Level of impact	No significant increase	Lesser black-backed gull nests colonially, often with other gull species on offshore islands and coastal cliffs often within vegetated areas (Mitchell et al., 2004)

A184 Herring Gull *Larus argentatus*

To maintain the favourable conservation condition of Herring Gull in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Rocky coastline with cliffs, islets and offshore islands, is the preferred breeding habitat (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Primarily a coastal feeder, mainly in the littoral and shallow sub-littoral zones; also targets anthropogenic sources of food in both marine and terrestrial areas. max. foraging range approximately 50km
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Foraging range: max. 50km
Disturbance at the breeding site	Level of impact	No significant increase	Herring gull colonies are usually sited on flat or rocky islets or stack stops, less often on cliffs (Walsh et al., 1995)

A188 Kittiwake *Rissa tridactyla*

To maintain the favourable conservation condition of Kittiwake in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	In general, kittiwake colonies are found on vertical rocky sea cliffs
Prey biomass available	Kilogrammes	No significant decline	Key prey items: small pelagic shoaling fish, marine invertebrates. Key habitats: fronts, tidal upwellings and eddies, offshore sandbanks, areas over rocky seabed. Foraging range: max. 200km, mean max. 65.81km, mean 25.45km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Foraging range: max. 200km, mean max. 65.81km, mean 25.45km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	In general, kittiwake colonies are found on vertical rocky sea cliffs

A199 Guillemot *Uria aalge*

To maintain the favourable conservation condition of Guillemot in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: individual adult	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	In general, guillemot colonies are found on vertical rocky sea cliffs and sea stacks
Prey biomass available	Kilogrammes	No significant decline	Key prey items: schooling pelagic fish, crustaceans. Key habitats: fronts and other ocean features that concentrate prey, offshore sandbanks, areas of sandy sediment. Foraging range: max. 200km, mean max. 60.61km, mean 24.49km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of guillemot performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005). Foraging range: max. 200km, mean max. 60.61km, mean 24.49km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	In general, guillemot colonies are found on vertical rocky sea cliffs and sea stacks
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of guillemot performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005)

A200 Razorbill *Alca torda*

To maintain the favourable conservation condition of Razorbill in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: individual adult	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Razorbill breed mainly on small ledges or in cracks of rocky cliffs and in associated screes, and on boulder fields (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Key prey items: Sandeels (*Ammodytes* spp.), clupeids. Key habitats: shallow waters, sandy seabeds, upwelling areas and tidal fronts. Foraging range: max. 51km, mean max. 31km, mean 10.27km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of razorbill performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005). Foraging range: max. 51km, mean max. 31km, mean 10.27km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Razorbill breed mainly on small ledges or in cracks of rocky cliffs and in associated screes, and on boulder fields (Mitchell et al., 2004)
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of razorbill performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005)

A204 Puffin *Fratercula arctica*

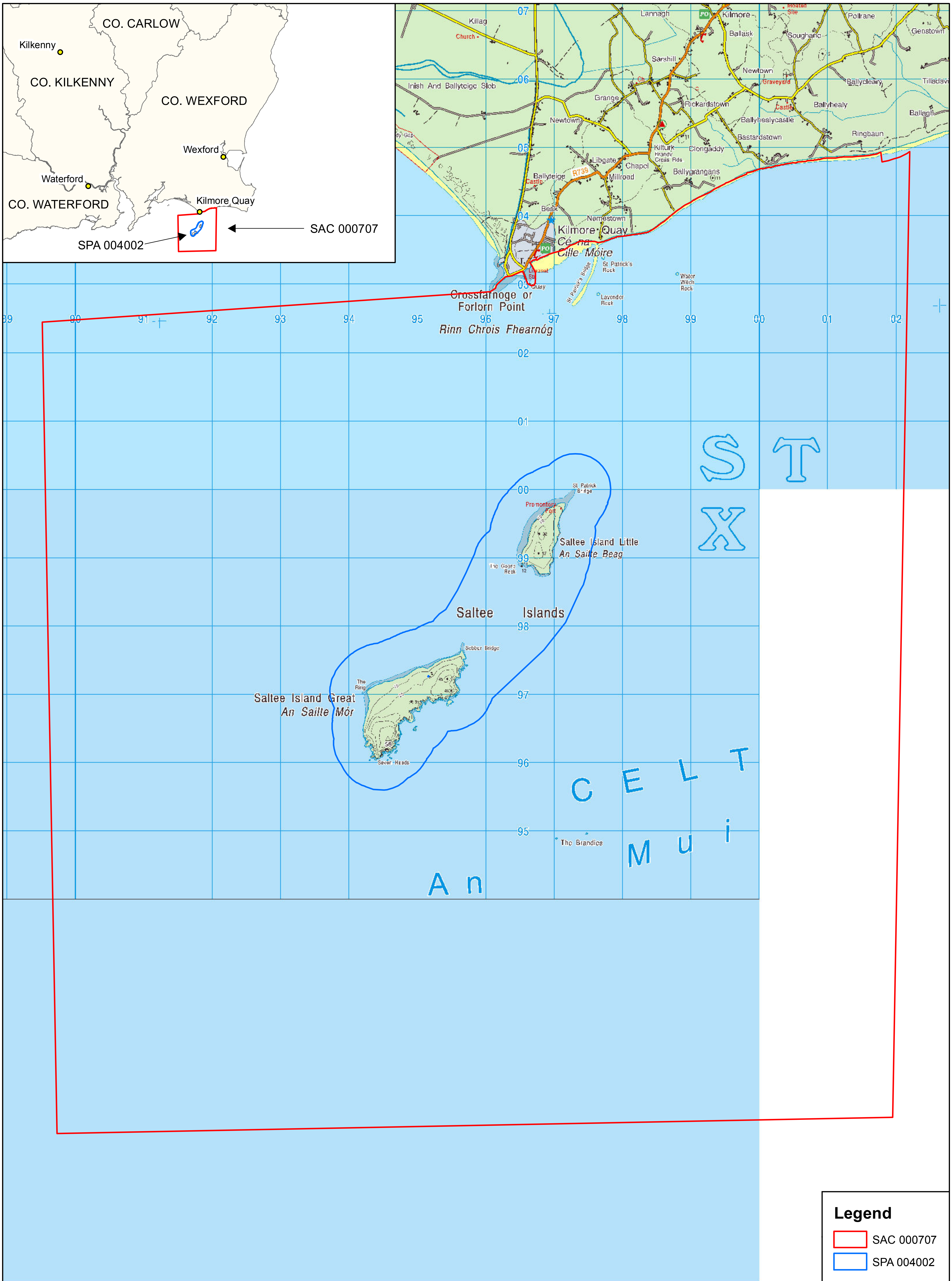
To maintain the favourable conservation condition of Puffin in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Breeding population abundance: apparently occupied burrow (AOB)	Number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). Mitchell et al. (2004) provides summary population information. The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species.
Productivity rate	Mean number	No significant decline	Measure based on standard survey methods (see Walsh et al., 1995). The Seabird Monitoring Programme (SMP) online database (JNCC, 2011) provides population data for this species
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	Highly colonial species with pairs typically nesting underground in burrows dug in the soil of offshore islands. If such habitat is in short supply puffins can nest among boulder screes or at low densities in cracks in sheer cliffs (Mitchell et al., 2004)
Prey biomass available	Kilogrammes	No significant decline	Key prey items: mid-sized schooling mid-water fish, especially sandeels (Ammodytes spp.). Key habitats: shallow waters, tidal fronts. Foraging range: max. 200km, mean max. 62.2km, mean 30.35km (BirdLife International Seabird Database (Birdlife International, 2011))
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of puffin performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005). Foraging range: max. 200km, mean max. 62.2km, mean 30.35km (BirdLife International Seabird Database (Birdlife International, 2011))
Disturbance at the breeding site	Level of impact	No significant increase	Highly colonial species with pairs typically nesting underground in burrows dug in the soil of offshore islands. If such habitat is in short supply Puffins can nest among boulder screes or at low densities in cracks in sheer cliffs (Mitchell et al., 2004)

A204 Puffin *Fratercula arctica*

To maintain the favourable conservation condition of Puffin in the Saltee Islands SPA, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Disturbance at marine areas immediately adjacent to the colony	Level of impact	No significant increase	Seabird species can make extensive use of the marine waters adjacent to their breeding colonies for non site-specific behaviours (e.g. courtship, bathing, preening). Work carried out in the UK found that highest densities of puffin performing these behaviours occurred within 1km of the breeding colony (Reid and Webb, 2005)
Occurrence of mammalian predators	Level of impact	Absent or under control	Puffin and other cavity/burrow nesting seabirds can be particularly susceptible to rat (*Rattus* spp.) predation



MAP 1:
SALTEE ISLANDS CONSERVATION OBJECTIVES SAC & SPA DESIGNATIONS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

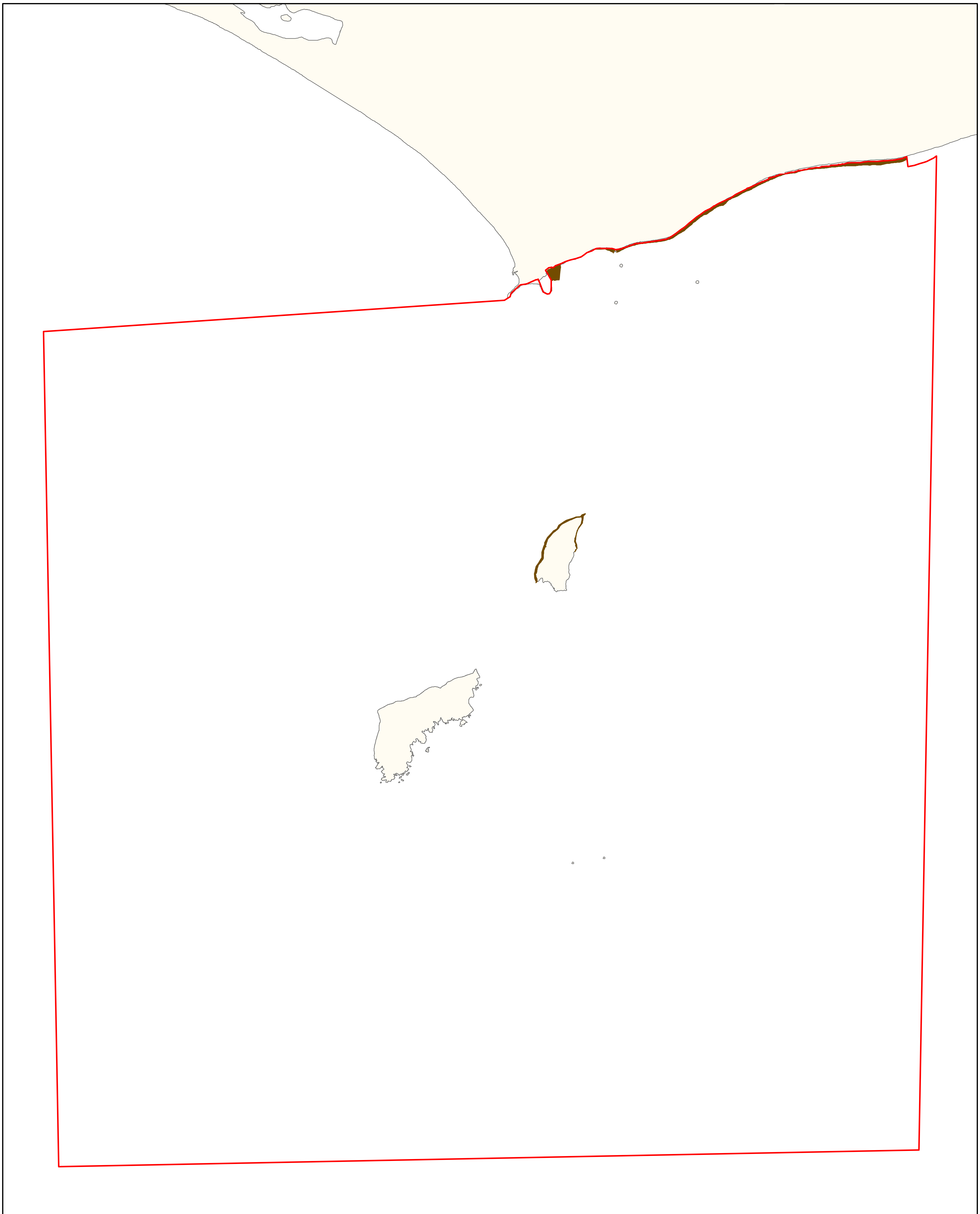
CO. WEXFORD

0 0.5 1 1.5 2 km

N

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)

SITE CODE
SAC 000707
Version 1
SPA 004002
Version 2.01
Map Version 1
Date: August 2011



Legend

- SAC 000707
- 1140 Mudflats and sandflats not covered by sea water at low tide
- OSi Discovery Series Coastal Boundary

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Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

MAP 2:
SALTEE ISLANDS
CONSERVATION OBJECTIVES
MUDFLATS AND SANDFLATS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

CO. WEXFORD

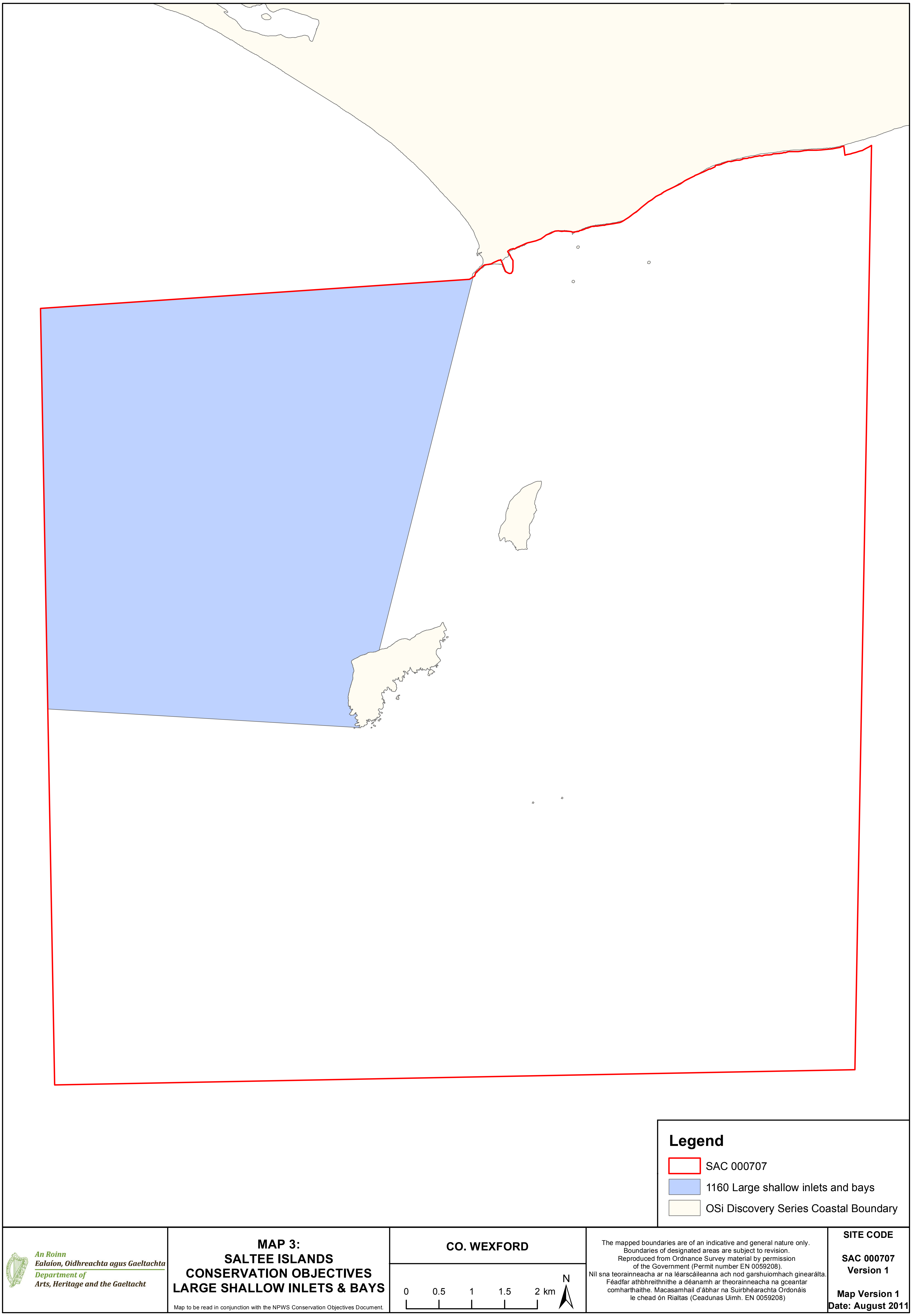
0 0.4 0.8 1.2 1.6 km

N

SITE CODE

SAC 000707
Version 1

Map Version 1
Date: August 2011



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MAP 3:
SALTEE ISLANDS
CONSERVATION OBJECTIVES
LARGE SHALLOW INLETS & BAYS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

CO. WEXFORD

SITE CODE

SAC 000707
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MAP 4:
SALTEE ISLANDS
CONSERVATION OBJECTIVES
REEFS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

CO. WEXFORD

0 0.5 1 1.5 2 km

N

The mapped boundaries are of an indicative and general nature only.
Boundaries of designated areas are subject to revision.
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta.
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar
comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis
le chead ón Rialtas (Ceadunas Uimh. EN 0059208)

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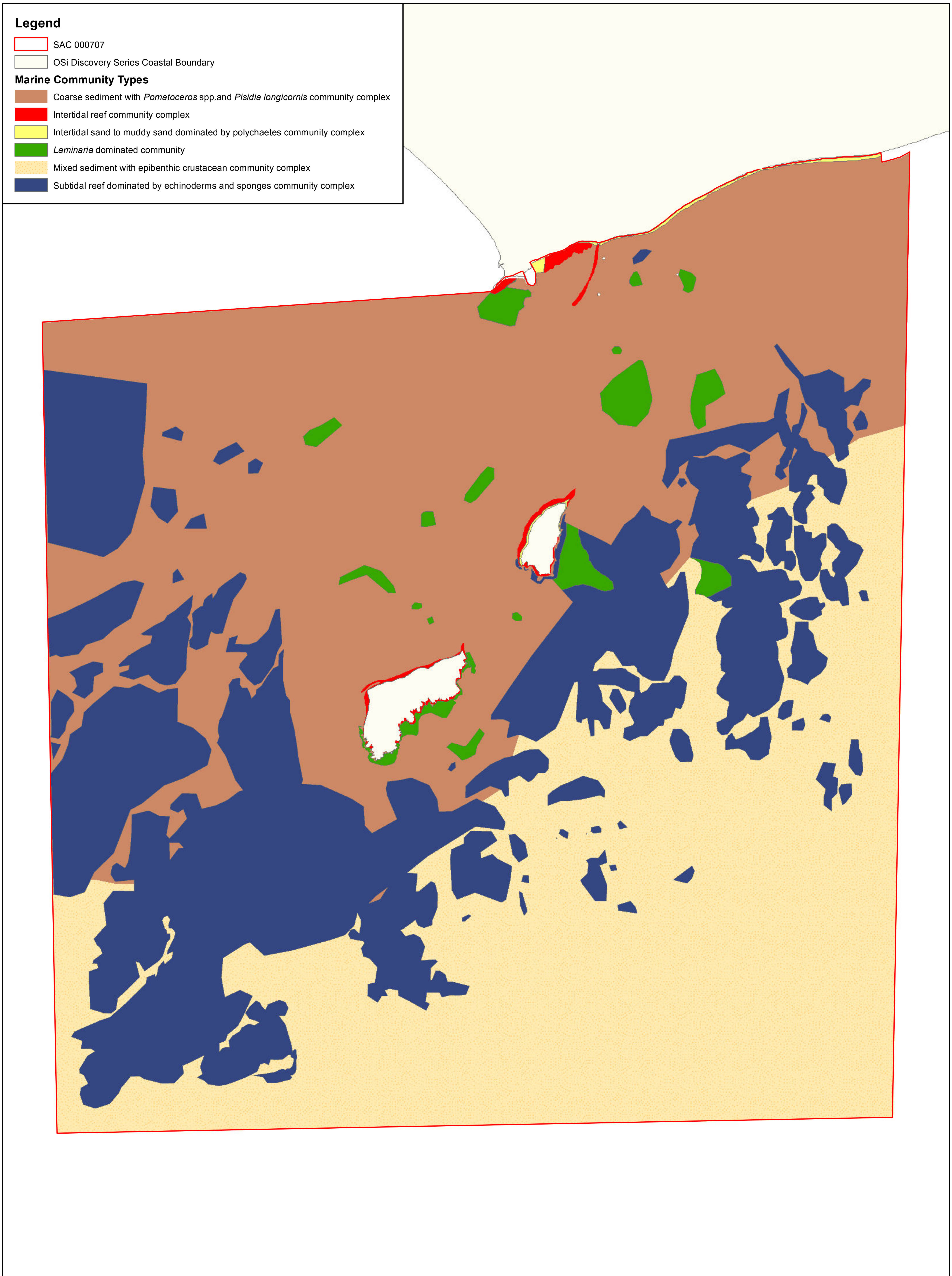

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MAP 5:
SALTEE ISLANDS
CONSERVATION OBJECTIVES
MARINE COMMUNITY TYPES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

CO. WEXFORD

0 0.5 1 1.5 2 km

N

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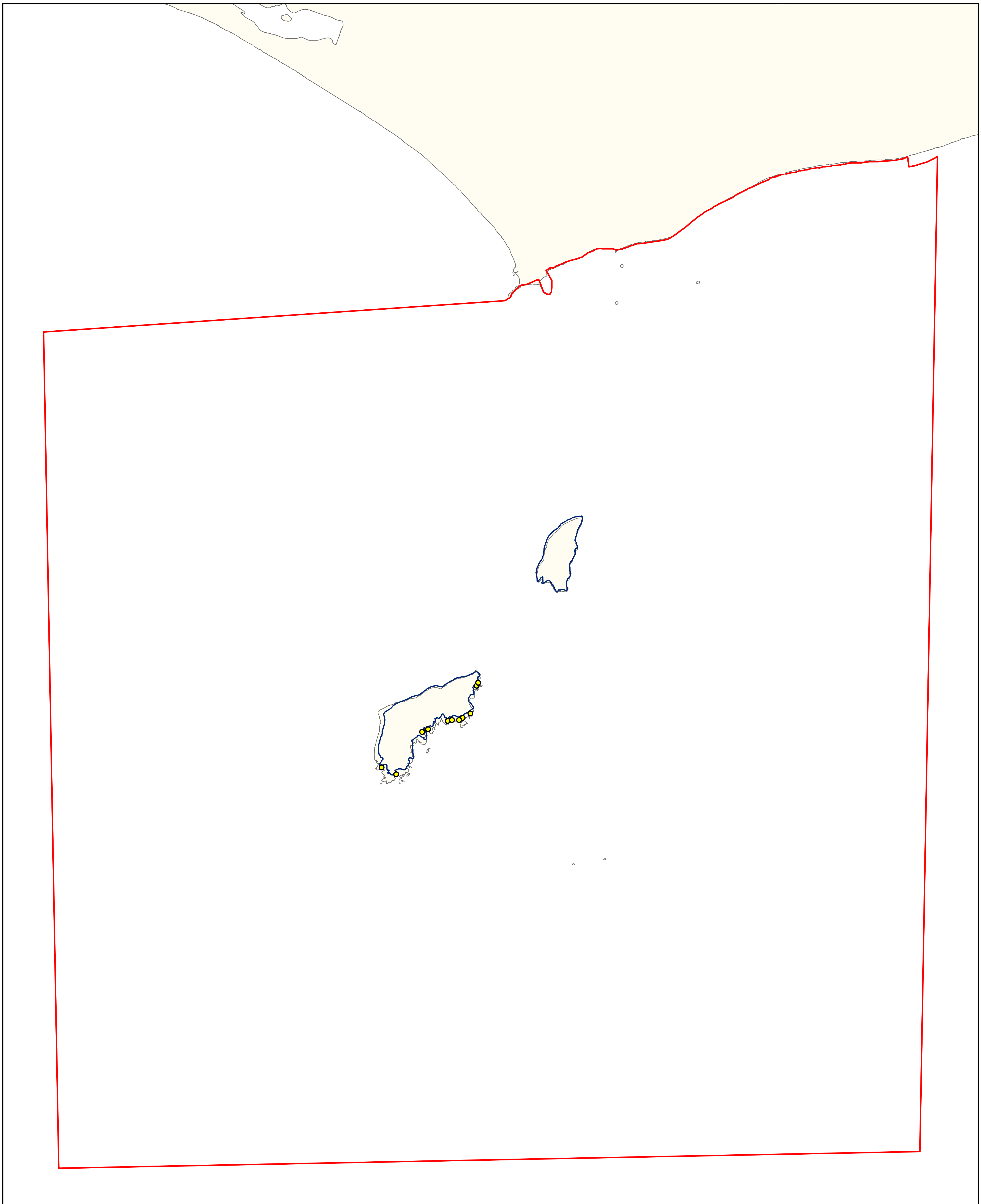

Legend

- SAC 000707
- 1230 Vegetated Sea Cliffs of the Atlantic and Baltic coasts
- 8330 Submerged or partially submerged sea caves
- OSi Discovery Series Coastal Boundary

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MAP 6: SALTEE ISLANDS CONSERVATION OBJECTIVES VEGETATED SEA CLIFFS & SEA CAVES

Map to be read in conjunction with the NPWS Conservation Objectives Document.

CO. WEXFORD

0 0.5 1 1.5 2 km

N

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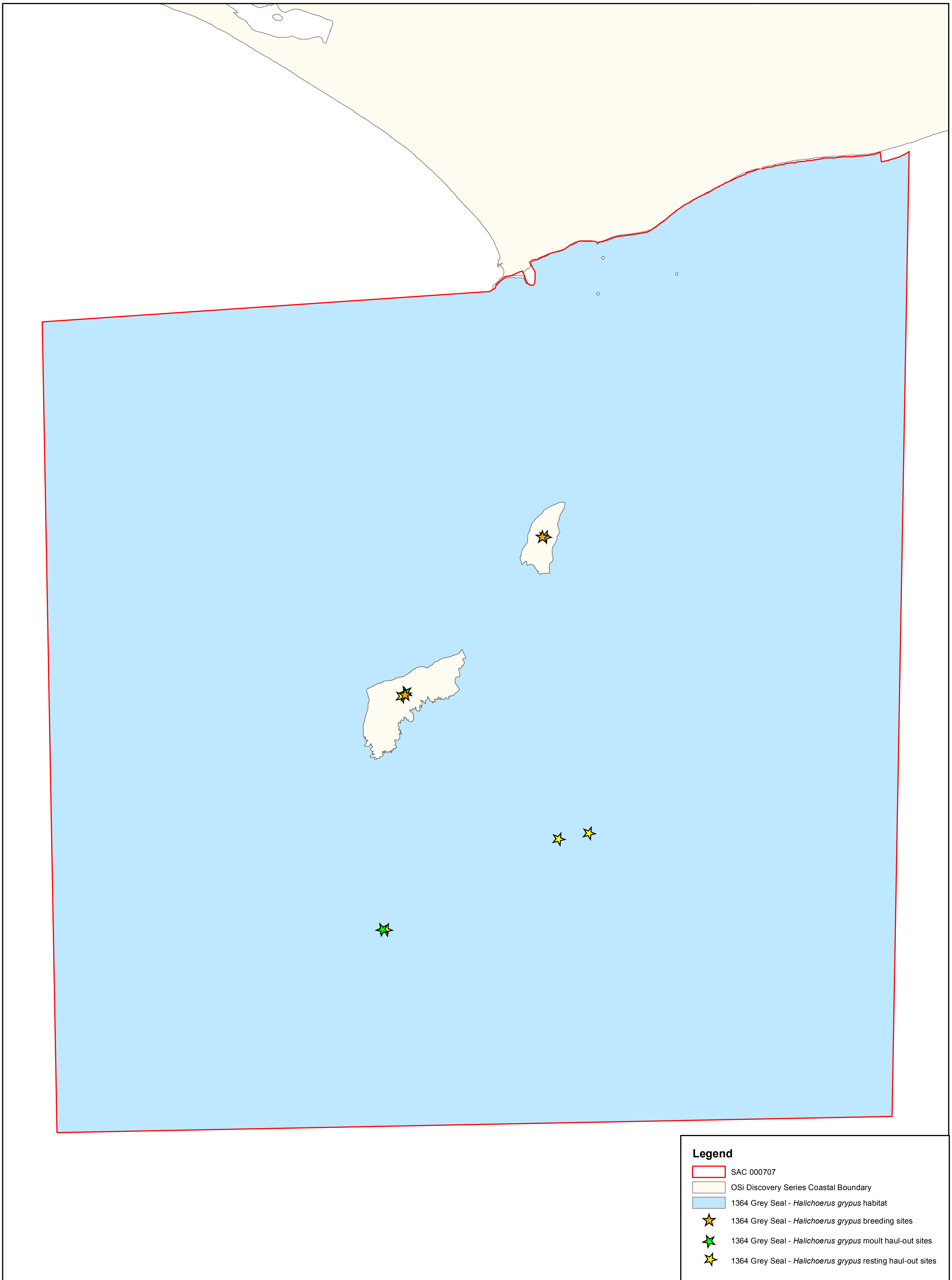

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MAP 7:
SALTEE ISLANDS
CONSERVATION OBJECTIVES
GREY SEAL

Map to be read in conjunction with the NPWS Conservation Objectives Document.

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