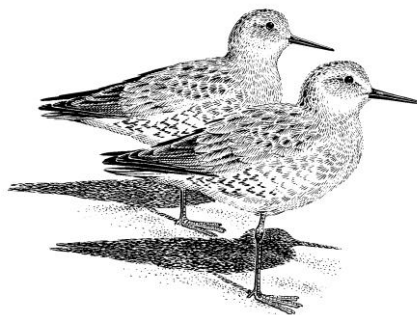




Duddon Estuary
European marine site

**English Nature's advice given under
Regulation 33(2) of the Conservation
(Natural Habitats &c.) Regulations 1994**



Issued 25 May 2001

English Nature's advice for the Duddon Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Preface

This document provides English Nature's advice to other relevant authorities as to (a) the conservation objectives and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for the Duddon Estuary European marine site. This advice is being prepared to fulfil our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

The Duddon Estuary Special Protection Area is a European marine site. European marine sites are defined in the Conservation (Natural Habitats &c.) Regulations 1994 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 Special Areas of Conservation (designated under the Habitats Directive, which support certain natural habitats and species of European importance), and Special Protection Areas (designated under the Birds Directive which support significant numbers of internationally important wild birds). In many instances these designations may coincide and our advice is being prepared to cover both the SAC and SPA interests where this occurs.

This 'Regulation 33 package' is designed to help relevant and competent authorities, who have responsibilities to implement the Habitats Directive, to:

- understand the international nature conservation importance of the site, underlying physical processes and the ecological requirements of the habitats and species involved;
- advise relevant authorities as to the conservation objectives for the site and operations which may cause deterioration or disturbance
- set the standards against which the condition of the site's interest features can be determined and undertake compliance monitoring to establish whether they are in favourable condition; and
- develop, if deemed necessary, a management scheme to ensure that the features of the site are maintained.

In addition, the Regulation 33 package will provide a basis to inform the scope and nature of 'appropriate assessment' required in relation to plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). English Nature will keep this advice under review and may update it every six years or sooner, depending on the changing circumstances of the European marine site. In addition, we 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. If as a result of the UK SPA Network Review (led by JNCC) interest features are added to this European marine site or the site boundaries change, English Nature will amend this advice, as appropriate.

Tim Bines
General Manager
English Nature
25 May 2001

English Nature’s advice for the Duddon Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

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English Nature's advice for the Duddon 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 Habitats¹ and Birds² Directives are international obligations which 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 status³. The Birds Directive protects all wild birds and their habitats within the European Union, and there are special measures for migratory birds and those 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. These sites will form a network of conservation areas across the EU to be known as "Natura 2000". Where SACs or SPAs consist of 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.

Further guidance on European marine sites is contained in the Department of the Environment Transport and Regions/Welsh Office document: *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*.

1.2 English Nature's role

The Conservation (Natural Habitats &c.) Regulations 1994 translate the Habitats Directive into law in Great Britain. It gives English Nature a statutory responsibility to advise relevant authorities as to the conservation objectives for European marine sites in England and to advise 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 sites have been designated. This information will be a key component of any of the management schemes which may be developed for these sites.

This document is English Nature's advice for the Duddon Estuary European marine site issued in fulfilment of Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 (the 'Regulation 33

1 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

2 Council Directive 79/409/EEC on the conservation of wild birds

3 A habitat or species is defined as being at favourable conservation status when its natural range and the area it covers within that range are stable or increasing and the specific structure and functions which are necessary for its long term maintenance and are likely to continue to exist for the foreseeable future.

package'). Copies of key references quoted in this document are held at the English Nature local office, in Kendal.

In addition to providing such advice, the Regulation 33 package informs on the scope and nature of 'appropriate assessment' which the Directive requires to be undertaken for plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). English Nature may also provide more detailed advice to competent and relevant authorities to assess the implications of any such plans or projects.

1.3 The role of relevant authorities

The Conservation (Natural Habitats &c.) Regulations 1994 require all competent authorities to exercise their functions so as to secure compliance with the Habitats Directive. This European marine site is managed through existing SSSI mechanisms under the Wildlife and Countryside Act 1981, as amended 1985. However, relevant authorities may, if deemed necessary, draw up a management scheme under Regulation 34 for the European marine site component of the Duddon Estuary SPA. If such a management scheme is developed, it will provide the framework through which relevant authorities exercise their functions so as to secure compliance with the Habitats Directive and must be based on the advice in this package. Irrespective of this decision, relevant authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site as well as cumulative effects. This may include consideration of features and issues outside the boundary of the European marine site and above the highest astronomical tide.

Relevant authorities should ensure that all plans for the area integrate with any management scheme for the European marine site. Such plans may include shoreline management plans, CHaMPs (Coastal Habitat Management Plans), Local Environment Agency Plans, SSSI management plans, local BAP plans and sustainable development strategies for estuaries. This must occur to ensure that there is only a single management scheme through which all relevant authorities exercise their duties under the Conservation (Natural Habitats &c.) Regulations 1994.

Relevant authorities also need to have regard to changing circumstances of the SPA and may therefore need to modify the way in which they exercise their functions so as to maintain the favourable condition of interest features concerned in the long term. There is no requirement for relevant authorities to take any actions outside their statutory functions.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, English Nature is empowered to use its bylaw-making powers for Marine Nature Reserves (MNR) for use in European marine sites.

1.4 Activity outside the control of relevant authorities

Nothing within this Regulation 33 package will require relevant 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 causes⁴. This also applies if the changes, although causing deterioration or disturbance to the interest features, are the result of human or natural events outside their control. Having issued Regulation 33 advice for European marine sites, English Nature will work with relevant authorities and others to agree, within a defined time frame, a protocol for evaluating all observed changes to baselines and to develop an understanding of natural change and provide further guidance as appropriate and possible.

⁴ Determination of what constitutes natural change will be based on the best available information and scientific opinion at the time.

On the Duddon Estuary European marine site a management group has already been set up and should be used to alert all relevant authorities to such issues so that they may be assessed and any appropriate measures taken. This does not, however, preclude relevant authorities from taking action to prevent deterioration to the interest features, for example by introducing or promoting codes of practice through the Management Group.

1.5 Responsibilities under other conservation designations

In addition to its SPA status, parts of the Duddon Estuary are also designated and subject to agreements under other conservation legislation (e.g. SSSIs notified under the Wildlife and Countryside Act 1981 as amended 1985). The obligations of relevant authorities and other organisations under such designations are not affected by the advice contained in this document.

1.6 Role of conservation objectives

Section 4 of this document sets out the conservation objectives for the Duddon Estuary European marine site. They are the starting point from which management schemes and monitoring programmes may be developed as they provide the basis for determining what is currently or may cause a significant effect, and for informing on the scope of appropriate assessments of plans or projects. The conservation objectives set out what needs to be achieved and thus deliver the aims of the Habitats Directive.

1.7 Role of advice on operations

The advice on operations set out in Section 6 provides the basis for discussion about 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. It is given on the basis of the working assumption that sites were in favourable condition at the time they were identified. In the 2000-2006 reporting period an assessment of the condition of the site will be made to support this assumption, and ensure that favourable condition is being maintained. The advice should also be used to identify the extent to which existing measures of control, management and use are, or can be made, consistent with the conservation objectives and thereby focus the attention of relevant authorities and surveillance to areas that may need management measures.

This operations advice may need to be supplemented through further discussions with any management and advisory groups for the European marine site.

2. Qualifying species within the SPA under the EU Birds Directive

The boundary of the Duddon Estuary Special Protection Area (SPA) is shown in Appendix I.

The Duddon Estuary SPA qualifies under Article 4.1 of the EU Birds Directive by supporting:

- Internationally important populations of regularly occurring Annex 1 species.

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

- Internationally important populations of regularly occurring migratory species; and
- An internationally important assemblage of waterfowl.

The Duddon Estuary SPA citation was written in March 1998 and classified as an SPA in August 1998 and it is that citation on which this advice is based. The Duddon Estuary was also listed in October 1993 as a Ramsar site under the Ramsar convention for its internationally important wetland status.

3. Interest features of the European marine site

The Duddon Estuary SPA includes both marine areas (ie. land covered continuously or intermittently by tidal waters) and land which is not subject to tidal influence. The marine part of the SPA is termed a European marine site. The extent of the Duddon Estuary European marine site is illustrated in Appendix I. 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.

Where SPA qualifying species occur within the European marine site they are referred to as interest features. Sub-features (habitats) have also been identified to highlight the ecologically important components of the European marine site for each interest feature. The interest features and sub-features for the Duddon Estuary European marine site are described below and the sub-features are mapped at Appendix II to show their distribution and extent.

3.1 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.

English Nature's conservation objectives at a site level focus on maintaining the condition of the habitats used by the qualifying species. Habitat condition will be delivered through appropriate site management including the avoidance of damaging disturbance. In reporting on Favourable Conservation Status, account will need to be taken both of habitat condition and the status of the birds on the SPA.

Accordingly, English Nature 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 Commission.

English Nature's advice focuses on the qualifying species for which the Duddon Estuary SPA was originally classified despite the fact that numbers and species composition may have changed on the site since that time. Such population and species composition changes are being documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes required in SPA citations. Depending on the review and decisions from DETR, English Nature may reissue this advice.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions are taken to avoid significant disturbance to the species for which the site was designated. Such disturbance may include alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table underpinning the conservation objectives for the SPA. In this context, five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

Attention is, however, also directed to the inclusion of disturbance in the advice on operations provided in section 6. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

3.2 Reductions in organic inputs

Under the Urban Waste Water Treatment (UWWT) Directive all coastal discharges above a certain volume (15, 000 population equivalent) must have secondary treatment installed by the end of 2000, with smaller discharges receiving appropriate treatment by 2005. Secondary treatment of sewage will significantly reduce organic loading and to a lesser extent reduce concentrations of dissolved 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 bird populations. On the other hand, where bird populations are currently adversely affected by eutrophication, cleaner discharges may contribute to improving site condition.

English Nature supports the cleaning up of coastal discharges. On balance, the overall ecological benefits of cleaner discharges are likely, in general, to outweigh any subsequent local decline in bird numbers, although there is presently insufficient knowledge to accurately predict the effects in general or for individual SPA sites. Consequently, English Nature, with input from the Countryside Council for Wales and the Environment Agency, is commissioning a related research project to study the relationship between birds and organic nutrient levels, the overall effects on the ecosystem and thereby the effects of the clean-up programme under the UWWT and Bathing Water Directives.

Under the Habitats Regulations, 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.

3.3 General description

In recognition that bird populations may change as a reflection of national or international trends or events, this advice on the bird interests of the European marine site focuses on the condition of the habitats necessary to support the bird populations. Sub-features are identified which describe the key habitats within the European marine site necessary to support the birds that qualify within the SPA. Detailed information and targets for habitat condition are listed in the favourable condition table in Section 5. 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 English Nature, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

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 them differently. The important bird populations of this site require these habitats for feeding and roosting. The most important factors related to this are:

- Extent and distribution of suitable feeding and roosting habitat (e.g. saltmarsh, mudflats);
- Sufficient prey availability (e.g. small fish, crustaceans and worms);
- Minimal levels of disturbance consistent with maintaining conditions for birds feeding and roosting;
- Absence of obstructions to viewlines;
- Vegetation characteristics.

The Duddon Estuary supports a wide variety of habitats. At its mouth there are extensive highly mobile sand flats which get progressively muddier with increasing distance up the estuary. The middle and upper reaches of the estuary are flanked by saltmarsh, and above high water on both the north and south sides of the estuary mouth extensive sand dune systems support a wide range of community types, providing a habitat

for rare and uncommon plants and nationally rare invertebrate species. The site is notable for an internationally important population of sandwich terns (*Sterna sandvicensis*) as well as being used by internationally significant numbers of migratory birds and waterfowl that overwinter within the estuary. Previous land use activities have created artificial habitats for wildlife, such as slagheaps near Askam Pier, and a fresh water lagoon at Hodbarrow.

3.4 Internationally important populations of the regularly occurring Annex 1 bird species

The species listed in Annex 1 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 1 are in danger of extinction, or are rare or vulnerable. Annex 1 species that regularly occur at levels over 1% of the national population meet the SPA qualifying criteria. The Duddon Estuary supports internationally important populations of sandwich tern (*Sterna sandvicensis*), a species listed on Annex 1 that meet the qualifying criteria by being rare and/or vulnerable.

Relevant authorities need also to have regard to adjacent European interests (i.e. those occurring above the highest astronomical tide), as they might be affected by activities taking place within, or adjacent to the European marine site. Objectives to maintain this aspect of bird interest in favourable condition are found within English Nature's conservation objectives for the Duddon Estuary SSSI within the SPA boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994.

Two such features occurring within the Duddon Estuary are listed below:

Coastal lagoon - Hodbarrow Lagoon is one of the largest coastal open water bodies in North West England. It is a slightly brackish lagoon due to seepage through the outer wall. Hodbarrow Lagoon is one of the main nesting and breeding areas for sandwich terns within the Duddon Estuary.

Slag bank - Areas of slag bank are also important breeding and nesting areas for sandwich terns in the Duddon Estuary. The main concentrations of these are around Millom and Askam.

3.4.1 Key sub-features

Shallow Coastal waters - Sandwich terns feed on marine fish, particularly sandeels and spratt. The shallow coastal waters provide an important feeding habitat. Food availability is essential for maintaining the population of sandwich terns in this SPA.

3.5 Internationally important populations of regularly occurring migratory bird species

Several of the species included in the wintering waterfowl assemblage also occur in internationally important numbers, and thus qualify for SPA status in their own right. These species are listed in Table 1. As all these internationally important populations are included within the wintering waterfowl assemblage, and depend on the same marine habitats, they have been included in the conservation objective for the assemblage.

3.5.1 Key sub-features

The key sub-features for the internationally important populations of regularly occurring migratory bird species are as for the wintering waterfowl assemblage (given at 3.6.1)

3.6 An internationally important assemblage of waterfowl

The Duddon Estuary is one of the most important estuaries in the UK for wintering waterfowl, regularly supporting over 20,000 birds (Cranswick *et al.*, 1992). During severe winter weather the Duddon Estuary assumes even greater national and international importance as waterfowl arrive from other areas further inland, attracted by the mild conditions and the abundant food resource.

Coastal lagoon communities - Hodbarrow lagoon is an important area for the migratory bird species and the important assemblage of waterfowl. The lagoon contains soft sediments which can support tassel weeds and charophytes as well as filamentous green and brown algae that provide an important feeding habitat for waterfowl. As this lagoon is located above the highest astronomical tide level, it is not included as a key sub-features for the European marine site.

3.6.1 Key sub-features

Intertidal mudflat and sandflat communities in the Duddon Estuary support high densities of invertebrates which are important as food for waterfowl. The high biomass of invertebrates includes species such as the Baltic tellin (*Macoma balthica*), cockles (*Cerastoderma edule*), mud snails (*Hydrobia ulvae*), marine worms such as lugworms (*Arenicola marina*) and crustaceans such as *Corophium volutator*. In general more sheltered areas with a relatively high silt content support a richer biomass than more exposed areas. These habitats are particularly favoured by knot (*Calidris canutus islandica*).

Intertidal and subtidal boulder and cobble skear communities - Boulder & cobble skears provide a hard substrate for a different range of prey species including dense beds of mussels. These areas are very important feeding habitats, particularly for knot. The skear areas are also important as mid tide roosting sites for redshank (*Tringa totanus*).

Saltmarsh communities - Saltmarsh on the site provides important feeding and roosting areas for pintail (*Anas acuta*) and redshank. The characteristic short sward height resulting from grazing pressure makes the saltmarsh an important habitat for roosting and feeding birds. On high spring tides thousands of wading birds concentrate on roost sites on the upper levels of the saltmarsh.

4. Conservation objectives for SPA interest features

Under Regulation 33(2)(a) of The Conservation (Natural Habitats &c.) Regulations 1994, English Nature has a duty to advise other relevant authorities as to the conservation objectives for the European site. The conservation objectives for the Duddon Estuary European marine site interest features are provided below and should be read in the context of other advice given in this package, particularly:

- the attached maps showing the extent of the sub-features (Appendices I & II);
- summary information on the interest of each of the features; and
- the favourable condition table, providing information on how to recognise favourable condition for the feature and which will act as a basis for the development of a monitoring programme.

4.1 The conservation objective for the internationally important populations of the regularly occurring Annex 1 bird species

Subject to natural change, maintain in favourable condition⁵ the habitats for the internationally important populations of the regularly occurring Annex 1 bird species, under the Birds Directive, in particular:

- **Shallow coastal waters**

Numbers of bird species using these habitats are given in Table 1

4.2 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain in favourable condition⁵ the habitats for the internationally important populations of regularly occurring migratory bird species, under the Birds Directive, in particular:

- **Intertidal mudflat and sandflat communities**
- **Intertidal and subtidal boulder & cobble skear communities**
- **Saltmarsh communities**

Numbers of bird species using these habitats are given in Table 1

4.3 The conservation objective for the internationally important assemblage of waterfowl

⁵ For a detailed definition of how to recognise favourable condition see Table 2 (Section 5)

Subject to natural change, maintain in favourable condition ⁵ the habitats for the internationally important assemblage of waterfowl under the Birds Directive, in particular:

- **Intertidal mudflat and sandflat communities**
- **Intertidal and subtidal boulder & cobble skear communities**
- **Saltmarsh communities**

Numbers of bird species using these habitats are given in Table 1

Note: These SPA conservation objectives focus on habitat condition in recognition that bird populations may change as a reflection of national or international trends or events. Annual counts for qualifying species will be used by English Nature, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

⁵

For a detailed definition of how to recognise favourable condition see Table 2 (Section 5)

Table 1 Information on populations of bird species qualifying under the Birds Directive using the Duddon Estuary European marine site at the time the SPA was classified.

Internationally important populations of regularly occurring Annex 1 species.

Species	Population (5 yr mean)*
Sandwich tern (<i>Sterna sandvicensis</i>)	210 pairs 1.5% Great Britain (1988 - 1992)

Unit of population size - P - pairs breeding
 Bird number from: JNCC, Seabirds and Cetaceans Branch, Aberdeen & Birds in Cumbria (1987 to 1991)

Internationally important populations of regularly occurring migratory bird species.⁶

Species	Population (5 yr peak mean for 1992/93 - 1996/97)*
Pintail (<i>Anas acuta</i>)	1,273 birds 1.8 % North West Europe
Knot (<i>Calidris canutus islandica</i>)	3,603 birds 2.3% East Atlantic Flyway
Redshank (<i>Tringa totanus</i>)	1,517 birds 1.0% East Atlantic Flyway

Unit of Population size: I - individual birds wintering
 Bird number from: Cranswick, P.A., Kirby, J.S. & Waters, R.J. (1992) The Wetland Bird Survey 1991 - 1992. Wildfowl and wader counts BTO/WWT/RSPB/JNCC

An internationally important assemblage of waterfowl.

Importance	Population (5 yr peak mean for 1992/94 - 1996/97)*
The Duddon Estuary supports large populations of wintering waterfowl.	31,505 birds wintering

Bird number from: Cranswick, P.A., Kirby, J.S. & Waters, R.J. (1992) The Wetland Bird Survey 1991 - 1992. Wildfowl and wader counts BTO/WWT/RSPB/JNCC

* SPA citation (1998) held on Register of European marine sites for Great Britain.

5. Favourable condition table

The favourable condition table is supplied as an integral part of English Nature's Regulation 33 advice

⁶ The Duddon Estuary is regularly used by 1% or more of the biogeographical population of a regularly occurring species (other than those listed on annex 1) in any season (Cranswick *et al.*, 1992).

package. It is intended to supplement the conservation objectives only in relation to management of activities and requirements on monitoring the condition of the site and its features. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under Regulations 20 and 48-50, but it does provide a basis to inform the scope and nature of any 'appropriate assessment' that may be needed. It should be noted that appropriate assessments are, by contrast, a separate activity to condition monitoring, requiring consideration of issues specific to individual plans or projects. English Nature 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.

The favourable condition table is the principle source of information that English Nature will use to assess the condition of an interest feature and as such comprises indicators of condition. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying habitats to be able to define measures and associated targets for all attributes to be assessed in condition monitoring. Assessments as to whether individual interest features are in favourable condition will be made against these targets. In European marine sites we know less about habitat condition and find it difficult to specify favourable condition. Individual sites within a single marine habitat category are also all very different, further hampering the identification of generic indicators of condition. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on the existing conditions, which may need to be established through baseline surveys in many cases.

The assumption that existing interest features on European marine sites are in favourable condition will be tested in the 2000 - 2006 reporting period and the results subsequently fed back into our advice and site management. Where there is more than one year's observations on the condition of marine habitats, all available information will need to be used to set the site within long-term trends in order to form a view on favourable condition. Where it may become clear that certain attributes are a cause for concern, and if detailed studies prove this correct, restorative management actions will need to be taken to return the interest feature from unfavourable to favourable condition. It is the intention of English Nature to provide quantification of targets in the favourable condition table during the 2000 - 2006 reporting period.

This advice also provides the basis for discussions with management and advisory groups, and as such the attributes and associated measures and targets may be modified over time. 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. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site. To meet UK agreed common standards, English Nature will be committed to reporting on each of the attributes subsequently listed in the final version of the table, although the information to be used may be collected by other organisations through agreements.

The 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. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. English Nature will be responsible for collating the information required to assess condition and will form a judgement on the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

Box 1	Glossary of terms used in the favourable condition table
Interest feature	The habitat or species for which the site has been selected.
Sub-feature	An ecologically important sub-division of the interest feature.
Attribute	Selected characteristic of an interest feature/sub-feature which provides an indication of the condition of the feature to which it applies.
Measure	What will be measured in terms of the units of measurement, arithmetic nature and frequency at which the measurement is taken. This measure will be attained using a range of methods from broad scale to more specific across the site.
Target	This defines the desired condition of an attribute, taking into account fluctuations due to natural change. Changes that are significantly different from the target will serve as a trigger mechanism through which some further investigation or remedial action is taken.
Comments	The rationale for selection of the attribute.

Table 2 Favourable Condition Table for the Duddon Estuary European marine site
Numbers of bird species using these habitats are given in Table 1

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 populations of regularly occurring Annex 1 bird species	Shallow coastal waters	Disturbance	Reduction or displacement of birds.	No significant reduction in numbers or displacement from an established baseline ⁷ , subject to natural change.	For feeding sandwich terns.
		Extent and distribution of habitat	Area (ha) measured once during reporting cycle.	No decrease in extent from an established baseline ⁷ , subject to natural change.	Shallow coastal waters provide important feeding habitat for sandwich terns.
		Food availability	Presence and abundance of fish, measured periodically, frequency to be determined.	Presence and abundance of prey species should not deviate significantly from an established baseline ⁷ , subject to natural change.	Sandeel and sprats of 5-13cm are important for sandwich terns.

FEATURE	SUB-FEATURE	ATTRIBUTE	MEASURE	TARGET	COMMENTS
<p>Internationally important assemblage of waterfowl including internationally important populations of regularly occurring migratory species</p>	<p>Intertidal mudflats and sandflats, Intertidal and subtidal boulder & cobble skears, Saltmarsh.</p>	<p>Disturbance in feeding and roosting areas</p>	<p>Reduction in or displacement of birds measured using 5 year peak mean information on populations.</p>	<p>No significant reduction in numbers or displacement of birds from an established baseline⁷, subject to natural change.</p>	<p>Excessive disturbance 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.</p>
		<p>Extent and distribution of habitat</p>	<p>Area (ha) measured once during reporting cycle.</p>	<p>No decrease in extent from an established baseline⁷, subject to natural change.</p>	<p>These habitats provide important roosting and feeding areas for the migratory species. 1997 aerial photographs can be used to determine the baseline for the extent of saltmarsh.</p>
		<p>Absence of obstruction to viewlines</p>	<p>Openness of terrain unrestricted by obstructions, measured periodically, frequency to be determined.</p>	<p>No increase in obstruction to existing viewlines, subject to natural change.</p>	<p>Waterfowl require unrestricted views >200m to allow early detection of predators when feeding and roosting.</p>

FEATURE	SUB-FEATURE	ATTRIBUTE	MEASURE	TARGET	COMMENTS
		Food availability	Presence and abundance of surface and sub-surface invertebrates, measured periodically, frequency to be determined.	Presence and abundance of prey species should not deviate significantly from an established baseline ⁷ , subject to natural change.	<i>Hydrobia</i> is important for pintail. <i>Macoma</i> , <i>Mytilus/ Cerastoderma spat</i> , and <i>Hydrobia</i> are important for knot. <i>Hydrobia</i> , <i>Macoma</i> , <i>Corophium</i> and <i>Nereis</i> are important for redshank.
		Vegetation characteristics	Open, short vegetation or bare ground predominating in areas used for roosting measured periodically, frequency to be determined.	Vegetation height throughout areas used for roosting should not deviate from an established baseline ⁷ , subject to natural change.	Vegetation of <10cm is required at roost sites by knot and redshank.

⁷ Baselines to be determined during the first reporting cycle.

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 Duddon Estuary and may well be missed by routine monitoring.

6. Advice on operations

English Nature has 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 English Nature has developed this advice is given in section 6.2, and on how it may be reviewed and updated in the future, in Section 6.4.

The advice is provided in summary form in Table 3 and Section 6.5 and with more detail in Table 4 and Section 6.8, including advice in relation to specific interest features and their sub-features.

6.1 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 Duddon Estuary European marine site. The advice is linked to the conservation objectives for interest features and will help provide the basis for detailed discussions within the management group to formulate and agree a management scheme to agreed time scales 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.

6.2 Methods for assessment

To develop this advice on operations English Nature has 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 English Nature 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.

All the scores of relative sensitivity, exposure and vulnerability are 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).

6.2.1 Sensitivity assessment

The sensitivity assessment used is an assessment of the relative sensitivity of the interest features or the component sub-features of the Duddon 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). The sensitivity has been assessed in relation to the use of habitats by birds. As an example, 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 Duddon Estuary European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SAC LIFE project (Davison & Hughes 1998; Elliott *et al* 1998), the Countryside Council for Wales Science Report (Holt *et al*, 1995) and the Marine Habitats Reviews (Jones *et al*, 2000.).

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 have commissioned the Marine Biological Association of the UK, through its Marine *Life* Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice, over the next three years, and available to all over the World Wide Web (www.marlin.ac.uk).

6.2.2 Exposure assessment

This has been undertaken for the Duddon 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. This has been greatly assisted by informal discussions with relevant authorities and interest groups. The exposure has been assessed in relation to the use of habitats by birds. As an example, wintering birds' feeding and roosting grounds may be considered moderately exposed to toxic contamination from synthetic compounds due to the locations and intensity of discharges into an area.

6.2.3 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 provided in Appendix I.

6.3 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 in England 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 English Nature.

Sensitivity and vulnerability have been assessed in relation to the use of habitats by birds.

These broad categories provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Tables 3 & 4 provides relevant authorities with a context against which to consider an assessment of ‘significant effect’ for any plans or projects which 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 English Nature formally over individual plans and projects where required to do so under the Regulations.

6.4 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 English Nature knows about current activities and patterns of usage at the Duddon Estuary European marine site. English Nature expects that the information on current activities and patterns of usage (which was used to derive table 4) will be supplemented as part of the process of developing the management of the site, and through further discussion with the relevant authorities. The option of zoning this information may be appropriate. 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 (Table 5) 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.

6.5 Summary of advice on operations

6.5.1 Internationally important populations of regularly occurring Annex 1 species

In pursuit of the conservation objective for “habitats supporting internationally important populations of regularly occurring Annex 1 species” (Section 4.1), the relevant and competent authorities for the Duddon Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration of the habitats of species, or significant disturbance to habitats or species for which the site has been selected, through any of the following:

- Physical loss resulting from removal of habitats
- Toxic contamination caused by the introduction of synthetic compounds
- Toxic contamination caused by the introduction of non-synthetic compounds
- Non toxic contamination caused by changes in nutrient loading
- Non toxic contamination caused by changes in organic loading
- Biological disturbance resulting from the introduction of microbial pathogens
- Biological disturbance resulting from selective extraction of species

6.5.2 An international assemblage of waterfowl, including internationally important populations of regularly occurring migratory species

In pursuit of the conservation objective for “habitats supporting an international assemblage of waterfowl, including internationally important populations of regularly occurring migratory species” (Section 4.2 & 4.3), the relevant and competent authorities for the Duddon Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration of the habitats of species, or significant disturbance to habitats or species for which the site has been selected, through any of the following:

- Physical loss resulting from removal of habitats
- Physical damage resulting from abrasion of habitats
- Non-physical noise disturbance
- Non-physical visual disturbance
- Toxic contamination caused by the introduction of synthetic compounds
- Toxic contamination caused by the introduction of non-synthetic compounds
- Non-toxic contamination caused by changes in nutrient loading
- Non-toxic contamination caused by changes in organic loading
- Biological disturbance resulting from the introduction of microbial pathogens
- Biological disturbance resulting from the selective extraction of species

6.6 Plans and Projects

Under Regulation 48(1), an appropriate assessment must be undertaken 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.

English Nature’s ‘Habitats Regulations Guidance Note 1: The Appropriate Assessment (Regulation 48)’, is at Appendix III for information.

Tables 3 and 4 provide relevant 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 relevant authorities to formally consult English Nature over individual plans and projects where required under the Regulations.

6.7 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 were being 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. This will have implications for discharge and other consents, which will need to be reviewed in light of these objectives and may mean that lower targets for background levels of contaminants etc. will need to be set.

Table 3 Summary of operations which may cause deterioration or disturbance to the Duddon Estuary European marine site interest features at current levels of use⁸

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 ✓ indicate those features that are considered to be highly or moderately vulnerable to the effects of the operations.

Standard list of categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring Annex 1 birds	Internationally important populations of regularly occurring migratory species
Physical loss Removal (e.g. harvesting, coastal development) Smothering (e.g. by artificial structures, disposal of dredge spoil)	✓	✓
Physical damage Siltation (e.g. run-off, channel dredging, outfalls) Abrasion (e.g. boating, anchoring, trampling) Selective extraction (e.g. aggregate dredging)		✓
Non-physical disturbance Noise (e.g. boat activity) Visual (e.g. recreational activity)		✓ ✓
Toxic contamination Introduction of synthetic compounds (e.g. pesticides, TBT, PCBs) Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons) Introduction of radionuclides	✓ ✓	✓ ✓
Non-toxic contamination Changes in nutrient loading (e.g. agricultural run-off, outfalls) Changes in organic loading (e.g. mariculture, outfalls) Changes in thermal regime (e.g. power stations) Changes in turbidity (e.g. run-off, dredging) Changes in salinity (e.g. water abstraction, outfalls)	✓ ✓	✓ ✓

Standard list of categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring Annex 1 birds	Internationally important populations of regularly occurring migratory species
Biological disturbance Introduction of microbial pathogens Introduction of non-native species & translocation Selective extraction of species (e.g. bait digging, commercial & recreational fishing)	<p style="text-align: center;">✓</p> <p style="text-align: center;">✓</p>	<p style="text-align: center;">✓</p> <p style="text-align: center;">✓</p>

⁸This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at March 2001). 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. This is shown in the sensitivity and vulnerability matrices at Table 4. 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 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 English Nature 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 March 2001). 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 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.

6.8 Interest feature and sub-feature specific advice on operations

This section provides information to help relate general advice to each of the specific interest features of the Duddon Estuary European marine site.

This advice relates to the vulnerability of the interest features and sub-features of the Duddon Estuary European marine site as summarised in Table 3 and set out in more detail in Table 4. An explanation of the sensitivity of the interest features or sub-features 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 European marine site's interest features, as set out in Section 3, to be made.

6.8.1 Internationally important populations of regularly occurring Annex 1 species

Physical loss

Removal

Sandwich terns (*Sterna sandvicensis*) are highly sensitive to the loss through removal of any important feeding habitats on which they depend. In the case of the Duddon Estuary European marine site, they are primarily dependant on shallow coastal water.

Loss of shallow coastal waters through changes in sea defence structures would result in a reduction in important feeding habitat which supports sand eels, spratt and other species on which feeding birds depend.

Removal of feeding habitat through coastal protection works may also lead to changes in coastal processes, for example, increased wave exposure and changes in subtidal channels. This can exacerbate habitat loss and can change the nature of existing sediments, thus further influencing changes in feeding areas.

Due to their high sensitivity and current, low, level of exposure, shallow coastal waters are moderately vulnerable to removal.

Non-toxic contamination

Changes in nutrient and organic loading

Changes in nutrient and organic loading can have a variety of effects upon the habitats within the Duddon Estuary that support Annex 1 species. The most notable habitats are the intertidal mud & sand flats and the intertidal and subtidal boulder & cobble skear communities. Nutrient and organic loading can affect bird feeding habitats either positively by increasing food availability or negatively by altering species composition to less favourable prey species.

Organic or nutrient loading can reduce the availability of food for birds by increasing growth of algal mats in the intertidal area. Algal blooms can reduce the surrounding water quality by causing the removal of oxygen as the bloom decomposes or occasionally by the release of toxins. Such deterioration in water quality can impact on marine communities and cause a reduction in food availability. Algal blooms also cause a reduction in water clarity, thereby reducing the visibility of prey items for sandwich tern.

At present in the Duddon Estuary, the main sources of point source contamination enter these habitats through diffuse agricultural sources and point source discharges from sewage treatment works most notably at the towns of Millom and Askam in Furness. Crude sewage also enters the estuary through discharges at Broughton in Furness and Barrow in Furness.

As mentioned previously (Section 3.2) the Urban Waste Water Treatment Directive and Bathing Water Directive are focussing on installing appropriate treatment to reduce the concentration of dissolved nutrients. The effect of this upon the Annex 1 species, and the European marine site in general is currently being researched.

Given the current, medium level of exposure, these particular sub-features are moderately vulnerable to changes in nutrient and organic loading.

Toxic contamination

Introduction of synthetic and non-synthetic compounds

Sandwich terns are sensitive to the introduction of synthetic and non-synthetic compounds due to the accumulation of toxins through the food chain or through direct contact with toxic substances when feeding. Their ability to feed can also be affected by changes in the palatability and abundance of prey items caused by toxic contamination.

The lethal effects of this contamination depend on the type and concentration of the toxic compound. Sub-lethal levels of exposure may affect bird's reproductive physiology, genetics and general health, which may ultimately reduce their fitness for survival. Industrial and domestic effluent discharges contain contaminants which build up in the food chain and may have toxic effects on sandwich terns and their prey; sandeels, spratt etc.

In the Duddon Estuary at present, there are a number of industrial effluent disposal sites, namely a paper mill and ship building works at Barrow in Furness, and other industry at Askam in Furness and Millom. Discharges from these sites are covered by Environment Agency discharge consents.

The past industrial history of the Duddon Estuary has left a legacy of industrial waste including large slag heaps at Barrow, Askam and Millom. The extent, location, contents and stability of other past industrial waste sites is less well known e.g waste disposal on North Walney. The impact on the bird populations of the estuary of leachate from past industrial sites and the reworking of existing sediments is unknown. Disturbance of anoxic sediments through activities such as commercial baitdigging can result in "hot spots" for heavy metals such as cadmium and lead.

Due to the current exposure levels and the sensitivity rating, sandwich terns are moderately vulnerable to the effects of toxic contamination.

Biological disturbance

Introduction of microbial pathogens

Microbial pathogens can enter the Duddon Estuary via sewage discharges as mentioned previously. The main sewage outfall points can be found at Millom, Askam in Furness and Broughton in Furness.

Microbial pathogens can enter the food chain of sandwich terns via the sandeels and sprat on which the birds feed in the shallow coastal waters of the Duddon Estuary

With the introduction of secondary or appropriate sewage treatment work in the estuary, the level of input of microbial pathogens is likely to be reduced. As mentioned in Section 3.2 however, this relationship is currently being researched.

At present however, microbial pathogens within the estuary are deemed to be of high exposure, and thus sub-features are experiencing moderate vulnerability

Selective extraction of species

Sandwich terns are sensitive to selective extraction of species. This can include selective extraction of species for which the site has been selected or which form important food sources for the Annex 1 birds, for example, over fishing and bait digging. Selective extraction may reduce the suitability of the habitat to feeding by sandwich terns. The intertidal food web is very complex and many communities interdepend on each other for their healthy functioning.

At the present level of exposure, mainly caused by the seasonal fishing activities carried out throughout the estuary, sandwich terns are deemed to be moderately vulnerable to the effects of selective extraction of species.

6.8.2 An internationally important assemblage of waterfowl including internationally important populations of regularly occurring migratory species.

Physical loss

Removal

Internationally important bird species such as knot, pintail and redshank are highly sensitive to removal of important feeding and roosting habitat such as intertidal mud and sand flats, intertidal and subtidal boulder & cobble skears and saltmarshes. The physical loss of intertidal habitats may be caused directly through change of land use (e.g. land claim or harvesting) or indirectly as a consequence of changes to sedimentation processes (e.g. coastal defence or construction activities). The effects of a possible rise in sea level resulting in coastal squeeze may also result in the removal of intertidal habitats.

Loss of intertidal sediment habitat could reduce the supply of marine invertebrates upon which many waders depend as an important source of food and may reduce the availability of roosting areas. Loss by removal of intertidal habitats may also lead to changes in coastal processes. For example, increased wave exposure can exacerbate habitat loss and change the nature of existing sediments, thus further influencing changes in feeding and roosting areas.

Waterfowl and migratory species in the Duddon Estuary are highly sensitive to the effects of habitat removal. This activity has been assigned a moderate exposure rating based on the current level of operations. These two ratings result in the internationally important assemblage of waterfowl (including internationally important populations of regularly occurring migratory species) being awarded a high vulnerability rating to physical loss.

Physical damage

Abrasion

Intertidal and subtidal boulder & cobble skears and saltmarsh communities within the Duddon Estuary that support waterfowl and migratory species, are moderately sensitive to physical damage by abrasion, which can reduce their suitability as feeding and roosting areas. Damage to intertidal and subtidal boulder & cobble skears can be caused by the use and landing of 4WD vehicles and boats which can disturb the form and integrity of the features. Damage to saltmarsh is mainly caused by grazing animals and recreational users. Damage by abrasion can reduce the suitability of these areas as feeding and roosting habitats.

Knot, for example, are particularly dependant on the boulder & cobble skewer habitat for feeding. Any activity that reduces the area and integrity of this habitat may have detrimental consequences on the suitability of the site.

Current levels of exposure to abrasion can be regarded as medium, which results in the previously mentioned habitats being moderately vulnerable to the effects of abrasion.

Non-physical disturbance

Noise and visual disturbance

Waterfowl are highly sensitive to noise and visual disturbance by human activities when they are feeding or roosting. Examples of such disturbance include construction work, rambling, watersports and bait digging. They are particularly sensitive to disturbance in the winter months when cold temperatures and increased energy requirements are combined with short daylight hours available for feeding. Continued disturbance may force birds to change feeding and roosting sites which often results in increased energy use and reduced intake rates. If birds are continually disturbed from feeding or roosting sites, the resulting effect may be the long term loss of available habitat.

Bird's ability to change feeding areas is also dependant on the availability of alternative suitable feeding sites nearby. Such sites may already support a capacity level of feeding birds. The arrival of new birds may result in competition for prime feeding sites, with some individuals forced onto less favourable sites. Birds forced onto poor feeding areas may not maintain sufficient fat reserves for survival.

During winter high spring tides, birds are pushed high up the shore to small roost areas, which are left uncovered by the tide. They can easily be disturbed at these areas, and if forced to fly off will waste their limited energy reserves.

In the Duddon Estuary, the main sites vulnerable to disturbance are those most popular with users, namely the important redshank feeding areas around Askam Pier and the high tide roosts located along the Cumbrian Coastal Way. This level of physical disturbance has been assessed as being a medium exposure activity. This coupled with high sensitivity to disturbance results in the migratory species and waterfowl assemblage being awarded a high vulnerability rating.

Toxic contamination

Introduction of synthetic and non-synthetic compounds

The regularly occurring migratory species and the waterfowl assemblage are sensitive to the introduction of synthetic and non-synthetic compounds due to the accumulation of toxins through the food chain or through direct contact with toxic substances when feeding. Their ability to feed can also be affected by changes in the palatability of prey items caused by toxic contamination.

The lethal effects of this contamination depend on the type and concentration of the toxic compound. Sub-lethal levels of exposure may affect the functioning of organisms such as reproduction physiology, genetics and general health that will ultimately reduce fitness for survival.

Industrial and domestic effluent discharges contain contaminants that build up in the food chain and may have toxic effects on pintail, knot and their prey.

In the Duddon Estuary at present, there are a number of industrial effluent disposal sites, namely a paper mill and ship building works at Barrow in Furness, and other industry at Askam in Furness and Millom. Discharges from these sites are covered by Environment Agency discharge consents.

The past industrial history of the Duddon Estuary has left a legacy of industrial waste including large slag heaps at Barrow, Askam and Millom. The extent location, contents and stability of other past industrial waste sites is less well known e.g. industrial waste disposal on North Walney. The impact on the bird populations of the estuary of leachate from past industrial sites and the reworking of existing sediments is unknown. Disturbance of anoxic sediments through activities such as commercial baitdigging can result in "hot spots" for heavy metals such as cadmium and lead.

Due to the current exposure levels and the sensitivity rating, the migratory species and waterfowl assemblage are moderately vulnerable to the effects of toxic contamination.

Non toxic contamination

Changes in nutrient and organic loading

Changes in nutrient and organic loading can have a variety of effects upon the habitats within the Duddon Estuary which support waterfowl and migratory species. The most notable habitats are the intertidal mud & sand flats and the intertidal and subtidal boulder & cobble skewer communities. Nutrient and organic loading can affect bird feeding habitats either positively by increasing food availability or negatively by altering species composition to less favourable prey species.

Organic or nutrient loading can reduce the availability of food for birds by increasing growth of algal mats in the intertidal area. Algal blooms can reduce the surrounding water quality by causing the removal of oxygen as the bloom decomposes or occasionally by the release of toxins. Such a deterioration in water quality can impact on marine communities and cause a reduction in food availability. Algal blooms also cause a reduction in water clarity, thereby reducing the visibility of prey items for pintail, knot and redshank.

At present in the Duddon Estuary, the main sources of point source contamination enter these habitats through diffuse agricultural sources and point source discharges from sewage treatment works most notably at the towns of Millom and Askam in Furness. Crude sewage also enters the estuary through discharges at Broughton in Furness and Barrow in Furness.

As mentioned previously (Section 3.2) the Urban Waste Water Treatment Directive and Bathing Water Directive are focussing on installing appropriate treatment to reduce the concentration of dissolved nutrients. The effect of this upon the internationally important species, and the European marine site in general is currently being researched.

Given the current, medium level of exposure, these particular sub-features are moderately vulnerable to changes in nutrient and organic loading.

Biological disturbance

Introduction of microbial pathogens

Microbial pathogens can enter the Duddon Estuary via sewage discharges and can affect all sub-features of the migratory species and waders and wildfowl. As has been mentioned in the previous section, the main sewage outfall points can be found at Millom, Askam in Furness and Broughton in Furness.

Shellfish are particularly vulnerable to microbial pathogens that can enter the food chain of particular birds, for example knot, which are specialist feeders of such prey species.

With the introduction of secondary or appropriate sewage treatment work in the estuary, the level of input of microbial pathogens is likely to be reduced. As mentioned in Section 3.2 however, this relationship is currently being researched.

At present however, microbial pathogens within the estuary are deemed to be of high exposure, and thus sub-features are experiencing moderate vulnerability.

Selective extraction of species

Migratory species and the waterfowl assemblage are moderately sensitive to the effects of selective extraction of species. This can include selective extraction of species for which the site has been selected or which form important food sources for the migratory species and waterfowl. The intertidal sediment food web is very complex and many communities are interdependent on each other for their healthy functioning. Selective extraction of elements of the ecosystem, for example extensive removal of prey species such as lugworms and ragworms through commercial bait-digging activities may reduce the suitability of the habitat to feeding. The current extent of commercial bait digging on the Duddon estuary is unknown.

Where bird species feed on less optimal habitats they will use greater energy to find a smaller amount of food. This is likely to have a particularly severe effect on the knot population which roost and feed in large numbers. A reduction in food availability in the Duddon Estuary is likely to have an enormous impact both on the general health of individuals and the suitability of the site.

At present in the Duddon Estuary, migratory bird species and the waterfowl assemblage are moderately exposed to these activities. As a result, particular sub-features have been awarded a moderate vulnerability score.

Table 4. Assessment of the relative exposure of interest features and sub-features of The Duddon Estuary European marine site to different categories of operations based on current level of activities (March 2001)

Key: High= High exposure (3) Med = Medium exposure (2) Low= Low exposure (1) None= No exposure (0)

Categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring bird species listed on Annex 1 of the Birds Directive.	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	<i>Shallow coastal waters</i>	<i>Intertidal mudflat and sandflat communities</i>	<i>Intertidal and subtidal boulder & cobble skears communities</i>	<i>Saltmarsh communities</i>
Physical loss				
Removal (e.g. harvesting, land claim, construction)	Low	Med	Med	Med
Smothering (e.g. by artificial structures, disposal of dredge spoil)	Low	Low	Low	Low
Physical damage				
Siltation (e.g. run-off, dredging, outfalls)	Med	Med	Med	Low

Categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring bird species listed on Annex 1 of the Birds Directive.	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	<i>Shallow coastal waters</i>	<i>Intertidal mudflat and sandflat communities</i>	<i>Intertidal and subtidal boulder & cobble skears communities</i>	<i>Saltmarsh communities</i>
Abrasion (e.g. boating, anchoring, trampling).	Low	Med	Med	Med
Selective extraction (e.g. aggregate dredging).	Low	Low	Low	Med
Non-physical disturbance				
Noise (e.g. boat activity)	Med	Med	Med	Med
Visual (e.g. recreational activity)	Med	Med	Med	Med
Toxic contamination				
Introduction of synthetic compounds (e.g. Pesticides, antifoulants, PCBs)	Med	Med	Med	Med

Categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring bird species listed on Annex 1 of the Birds Directive.	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	<i>Shallow coastal waters</i>	<i>Intertidal mudflat and sandflat communities</i>	<i>Intertidal and subtidal boulder & cobble shears communities</i>	<i>Saltmarsh communities</i>
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	Med	Med	Med	Med
Introduction of radionuclides	Med	Med	Med	Med
Non-toxic contamination				
Changes in nutrient loading (e.g. agricultural run-off, outfalls)	Med	Med	Med	Med
Changes in organic loading (e.g. mariculture, outfalls)	Med	Med	Med	Med
Changes in thermal regime (e.g. outfalls, power stations)	Low	Low	Low	Low
Changes in salinity (e.g. water abstraction, outfalls)	Low	Low	Low	Low

Categories of operation which may cause deterioration or disturbance	Internationally important populations of regularly occurring bird species listed on Annex 1 of the Birds Directive.	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	<i>Shallow coastal waters</i>	<i>Intertidal mudflat and sandflat communities</i>	<i>Intertidal and subtidal boulder & cobble shears communities</i>	<i>Saltmarsh communities</i>
Changes in turbidity (e.g. run-off, dredging)	Low	Low	High	Low
Biological disturbance				
Introduction of microbial pathogens	High	High	High	High
Introduction of non-native species & translocation	Low	Low	Low	Low
Selective extraction of species (e.g. bait digging, commercial & recreational fishing)	Med	Med	Med	Low

NB A precautionary score has been given for toxic contamination. It is likely that research identifying the location and nature of these sites will be addressed in the management scheme.

Table 5. Assessment of the relative vulnerability of interest features and sub-features of the Duddon Estuary European marine site to different categories of operations.

Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading. Table also incorporates relative sensitivity scores used in part to derive vulnerability.⁹

Key

	High vulnerability	••••	High sensitivity
	Moderate vulnerability	•••	Moderate sensitivity
		••	Low sensitivity
		•	No detectable sensitivity

Categories of operations which may cause deterioration or disturbance	Internationally important populations of regularly occurring birds listed in Annex 1 of the Birds Directive	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	Shallow coastal waters	Intertidal mudflat and sandflat communities	Intertidal and subtidal boulder & cobble skear communities	Saltmarsh communities
Physical Loss				
Removal (e.g. harvesting, land claim, construction)	••••	••••	••••	••••
Smothering (e.g. artificial structures, disposal of dredge spoil)	••	•••	•••	•••

Categories of operations which may cause deterioration or disturbance	Internationally important populations of regularly occurring birds listed in Annex 1 of the Birds Directive	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	Shallow coastal waters	Intertidal mudflat and sandflat communities	Intertidal and subtidal boulder & cobble skear communities	Saltmarsh communities
Physical damage				
Siltation (e.g. run off, dredging, outfalls)	••	••	••	••
Abrasion (e.g. boating, anchoring, trampling)	••	••	•••	•••
Selective extraction (e.g. aggregate dredging)	••	•••	•••	••
Non-physical disturbance				
Noise (e.g. boat activity)	••	••••	••••	••••
Visual presence (e.g. recreational activity)	••	••••	••••	••••
Toxic contamination				
Introduction of synthetic compounds (e.g. pesticides, TBT, PCBs)	•••	•••	•••	•••

Categories of operations which may cause deterioration or disturbance	Internationally important populations of regularly occurring birds listed in Annex 1 of the Birds Directive	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	Shallow coastal waters	Intertidal mudflat and sandflat communities	Intertidal and subtidal boulder & cobble skear communities	Saltmarsh communities
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	•••	•••	•••	•••
Introduction of radionuclides	••	••	••	••
Non-toxic contamination				
Changes in nutrient loading (e.g. agricultural run-off, outfalls)	•••	•••	•••	••
Changes in organic loading (e.g. mariculture, outfalls)	•••	•••	•••	••
Changes in thermal regime (e.g. outfalls, power stations)	••	•	•	•
Changes in turbidity (e.g. run-off, dredging)	•••	••	•	••
Changes in salinity (e.g. water abstraction, outfalls)	•••	••	••	••

Categories of operations which may cause deterioration or disturbance	Internationally important populations of regularly occurring birds listed in Annex 1 of the Birds Directive	Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory species		
	Shallow coastal waters	Intertidal mudflat and sandflat communities	Intertidal and subtidal boulder & cobble skear communities	Saltmarsh communities
Biological disturbance				
Introduction of microbial pathogens	●●	●●	●●	●●
Introduction of non-native species & translocation	●●	●●●	●●●	●●●
Selective extraction of species (e.g. bait digging, commercial & recreational fishing)	●●●	●●●	●●●	●●●

⁹ English Nature's 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 March 2001), 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 contrast 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.

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8. Glossary

Advisory Group	The body of the representatives from local interests, user groups and conservation groups, formed to advise the management group
Annex 1 Bird species	The species listed in Annex 1 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 1 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.
Annex V	The listing, in the Habitats Directive, of the animal and plant species whose taking in the wild and exploitation may be subject to management measures.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment.
Attribute	Characteristic of an interest feature/sub-feature which provides an indication of the condition of the feature or sub-feature to which it applies.
BAP	Biodiversity Action Plan.
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
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.
Biodiversity	The total variety of life on earth. This includes diversity within species, between species and ecosystems.
Characteristic	Special to, or especially abundant in, a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Circalittoral	The rocky subtidal zone below that which is dominated by algae (Animal dominated subtidal zone).
Community	A group or 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.
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacles, mussels, furoid algae and with red algae often abundant on the lower part.
Epifauna	Benthic animals living on the seabed.
European Marine Site	A European site which 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.
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 EC in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
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.
Habitat	The place in which a plant or animal lives.
Habitats Directive	The abbreviated term of <i>Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora</i> . It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union.
Infauna	Benthic animals which live within the sediment.
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.
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.
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.
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.
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.

Peak mean counts (5 yr)	The Duddon Estuary is broken down into count sectors. Over the winter months WeBs volunteers count all the birds which are visible within each sector. The yearly figures for each species in the Duddon Estuary are then averaged over a five year period to give the 5 yr peak mean count.
Ramsar Site	A site held on the list of wetlands of international importance, especially as habitats for wildfowl, under the Ramsar convention
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.
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.
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 waterfowl based on counts undertaken once per month outside of the breeding season.

Appendix IV Matrix of relative vulnerability

The relative vulnerability of an interest feature or sub-feature is determined by combining the relative sensitivity and exposure assessments according to the table below.

		Relative sensitivity of the interest feature			
		High ●●●●	Moderate ●●●	Low ●●	None detectable ●
Relative exposure of the interest feature	High	High	Moderate	Low	None detectable
	Medium	High	Moderate	Low	None detectable
	Low	Moderate	Moderate	Low	None detectable
	None	None detectable	None detectable	None detectable	None detectable

Categories of relative vulnerability	
High	High
Moderate	Moderate
Low	Low
None detectable	None detectable

Appendix V List of Relevant Authorities

Associated British Ports
Barrow Borough Council
Copeland Borough Council
Cumbria County Council
Environment Agency
Lake District National Park Authority
North West and North Wales Sea Fisheries Committee
South Lakeland District Council
United Utilities