Carlingford Lough Special Protection Area

(Site Code 4078)

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Conservation Objectives Supporting Document

VERSION 1

National Parks & Wildlife Service

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SUMMARY

This document presents conservation objectives for the Special Conservation Interests of Carlingford Lough Special Protection Area, designated under Directive 2009/147/EC on the conservation of wild birds (Birds Directive).

Part One presents an introduction to the Special Protection Area (SPA) designation process and to the site designated as Carlingford Lough Special Protection Area, as well as introducing the concept of conservation objectives and their formulation.

Part Two provides site designation information for Carlingford Lough SPA and Part Three presents the conservation objectives for this site.

Part Four reviews the conservation condition of the site Special Conservation Interest (SCI) species including analysis of wintering (non-breeding) population trends, assignment of site conservation condition, and examination of site trends in light of all-Ireland and international status and trends. Importantly, this section states the current conservation condition of SCI species.

Part Five provides supporting information that will assist the interpretation of the site-specific conservation objectives. This section includes a review of the ecological characteristics of the SCI species and examines waterbird distribution recorded during the winter season of 2010/11 (after Martin, 2011), drawing also on data from NPWS monitoring programmes (e.g. benthic surveys) and the Irish Wetland Bird Survey (I-WeBS). Part Five concludes with information on activities and events that occur in and around the site which may interact with waterbirds during the non-breeding season and includes a review of activities that were recorded to cause disturbance to non-breeding waterbirds during the 2010/11 survey period.

PART ONE – INTRODUCTION

1.1 Introduction to the designation of Special Protection Areas

The over-arching framework for the conservation of wild birds within Ireland and across Europe is provided by Directive 2009/147/EC on the conservation of wild birds (the codified version of Council Directive 79/409/EEC as amended) (Birds Directive). Together with the EU Habitats Directive (Council Directive 92/43/EEC), these legislative measures provide for wild bird protection via a network of protected sites across Europe known as Natura 2000 sites, of which the overriding conservation objective is the maintenance (or restoration) of 'favourable conservation status' of habitats and species.

Under Article 4 of Directive 2009/147/EC, Ireland, along with other Member States, is required to classify the most suitable territories in number and size as Special Protection Areas (SPAs) for the conservation of certain wild bird species, which are:

- species listed in Annex I of the directive
- regularly occurring migratory species

Also under Article 4, Member States are required to pay particular attention to the protection of wetlands, especially those of international importance.

The National Parks & Wildlife Service (NPWS), part of the Department of the Arts, Heritage and the Gaeltacht, is responsible for the selection and designation of SPAs in the Republic of Ireland. NPWS has developed a set of criteria, incorporating information relating to the selection of wetland sites developed under the Ramsar Convention, which are used to identify and designate SPAs. Sites that meet any of the following criteria may be selected as SPAs:

- A site regularly supporting 20,000 waterbirds or 10,000 pairs of seabirds;
- A site regularly supporting 1% or more of the all-Ireland population of an Annex I species;
- A site regularly supporting 1% or more of the biogeographical population of a migratory species;
- A site that is one of the 'n' most suitable sites in Ireland for an Annex I species or a migratory species (where 'n' is a variable which is related to the proportion of the total biogeographic population of a species held by Ireland).

The biogeographic population estimates and the recommended 1% thresholds for wildfowl and waders are taken from Wetlands International (Wetlands International, 2002); thresholds reflecting the baseline data period used. The all-Ireland populations for the majority of wintering waterbirds are taken from Crowe et al. (2008).

Site specific information relevant to the selection and designation of a SPA is collated from a range of sources including the Irish Wetland Bird Survey (I-WeBS), The Wetland Bird Survey (WeBS) in Northern Ireland, species specific reports and a wide range of scientific publications, reports and other surveys. If, following collation of all the available scientific data, a site meets the relevant criteria for designation and is selected as an SPA, a list of species for which the site is nationally and internationally important is compiled. These species are known as **Special Conservation Interests** and may be one of the following:

- An Annex I species that occurs at the site in numbers that exceed the all-Ireland 1% population threshold;
- A migratory species that occurs at the site in numbers that exceed the biogeographic 1% population threshold (referred to as a species that occurs in numbers of 'international importance');
- A migratory species that occurs at the site in numbers that exceed the all-Ireland 1% threshold (referred to as a species that occurs in numbers of 'all-Ireland importance');

- A species for which the site is considered to be one of the *'n'* most suitable sites in Ireland for the conservation of that species (where *n* is a variable that is related to the proportion of the total biogeographic population held by Ireland).

The wetlands of northwest Europe are a vital resource for millions of northern and boreal nesting waterbird species that overwinter on these wetlands or visit them when migrating further south. To acknowledge the importance of Ireland's wetlands to wintering waterbirds the term Wetland & Waterbirds can be included as a Special Conservation Interest for a Special Protection Area that has been designated for wintering waterbirds, and is or contains a wetland site of significant importance to one or more of the species of Special Conservation Interest.

1.2 Introduction to Carlingford Lough Special Protection Area

Carlingford Lough is a 15km long and narrow sea inlet that is also the estuary of the Newry River (Crowe, 2005). A glacial fjord, the lough is flanked by glacial moraines and mountains - the Mourne Mountains to the north and Carlingford Mountain to the south-west. The lough straddles the border between Northern Ireland (County Down) and the Republic of Ireland (County Louth).

The Lough is generally shallow with the average depth between 2 and 10 m, although the narrow channels that run along the centre of the Lough may be as deep as 25 m (Taylor et al. 1999).

The underlying rock of the wider site is mainly carboniferous limestone and this appears at times in the form of bedrock shore or reefs. Granite boulders are occasionally found as are sand/gravel banks and intertidal mudflats (NPWS, 2002). At the mouth of the lough are several small rock and shingle islands which are of importance for breeding terns.

The site designated as Carlingford Lough SPA (Site Code 4078) comprises a section of the southern side of the lough between Carlingford Harbour and Ballagan Point. The predominant habitats within the SPA are intertidal sand and mud flats. This SPA is of special conservation interest for non-breeding (over-wintering) Light-bellied Brent Goose (*Branta bernicla hrota*).

More extensive mudflats occur along the northern shore of the lough and together with saltmarsh these are included in the 827ha area designated as a SPA in the United Kingdom (site code UK9020161). The qualifying species for this SPA are Common Tern (*Sterna hirundo*) and Sandwich Tern (*Sterna sandvicensis*) as breeding species, and Light-bellied Brent Goose as a non-breeding (over-wintering) species (see www.jncc.defra.gov.uk for details).

The Site Synopsis for Carlingford Lough SPA 4078 and a map showing the SPA boundary are given in Appendix 1.

1.3 Introduction to Conservation Objectives

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is being maintained in a satisfactory condition, and that this status is likely to continue into the future. Definitions as per the EU Habitats Directive are given in Box 1.

Box 1

Favourable Conservation Status as defined by Articles 1 (e) and 1(i) of the Habitats Directive

The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:

- *its natural range and areas it covers within that range are stable or increasing; and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and*
- *the conservation status of its typical species is favourable'.*

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

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

Site-specific conservation objectives define the desired condition or range of conditions that a habitat or species should be in, in order for these selected features within the site to be judged as favourable. At site level, this state is termed 'favourable conservation condition.' Site conservation objectives also contribute to the achievement of the wider goal of biodiversity conservation at other geographic scales, and to the achievement of favourable conservation status at national level and across the Natura 2000 network[1].

Where relevant, conservation objectives are defined for attributes[2] relating to bird species populations, and for attributes related to the maintenance and protection of habitats that support them. These attributes are:

- Population trend;
- Population distribution;
- Habitat range and area (extent).

Further guidance is given in Section 3.1 (Conservation Objectives for the Special Conservation Interests of Carlingford Lough Special Protection Area).

[1] Note that the terms 'conservation condition' and 'conservation status' are used to distinguish between site and the national level objectives respectively.

[2]Attribute can be defined as: 'a characteristic of a habitat, biotope, community or population of a species which most economically provides an indication of the condition of the interest feature to which it applies' (JNCC, 1998).

PART TWO – SITE DESIGNATION INFORMATION

2.1 Special Conservation Interests of Carlingford Lough Special Protection Area

The **Special Conservation Interest Species** for Carlingford Lough SPA is listed below and summarised in Table 2.1. This table also shows the importance of Carlingford Lough for the SCI species, relative to the importance of other sites within Ireland and within the Border region.

The Special Conservation Interests listed for Carlingford Lough SPA are as follows:-

1. During winter the site regularly supports 1% or more of the biogeographic population of Light-bellied Brent Geese (*Branta bernicla hrota*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 253 individuals.

2. The wetland habitats contained within Carlingford Lough SPA are identified of conservation importance for non-breeding (wintering) migratory waterbirds. Therefore the wetland habitats are considered to be an additional Special Conservation Interest.

Table 2.1 Designation Summary: species listed for Carlingford Lough Special Protection Area, plus site importance at national and regional scale

Special Conservation Interests	Annex I species	Baseline Population[a]	Population status at baseline	National Importance Rank[1]	Regional Importance Rank[2]	County Importance Rank[3]
Light-bellied Brent Goose (*Branta bernicla hrota*)		253	International Importance	17	3	1
Other conservation designations associated with the site[b]	**SAC**	**RAMSAR SITE**	**IMPORTANT BIRD AREA (IBA)**	**WILDFOWL SANCTUARY**	**OTHER**	**OTHER**
	SAC 002306	Yes	Yes		pNHA	Various – related to Northern Ireland e.g. UK SPA (site code UK9020161); RSPB reserve.

[a] Baseline data are the 5-year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS). Population assessment is based on the 1% threshold detailed in Crowe et al. (2008).
[b] Note that other designations associated with Carlingford Lough may relate to different areas and/or areas outside SPA 4078.
[1]National importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites in Ireland.
[2]Regional importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites within the Border region.
[3]County importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites within County Louth.

PART THREE – CONSERVATION OBJECTIVES FOR CARLINGFORD LOUGH SPA

3.1 Conservation Objectives for the Special Conservation Interests of Carlingford Lough SPA

The overarching Conservation Objective for Carlingford Lough Special Protection Area is to ensure that waterbird populations and their wetland habitats are maintained at, or restored to, favourable conservation condition. This includes, as an integral part, the need to avoid deterioration of habitats and significant disturbance; thereby ensuring the persistence of site integrity.

The site should contribute to the maintenance and improvement where necessary, of the overall favourable status of the national resource of waterbird species, and continuation of their long-term survival across their natural range.

Conservation Objectives for Carlingford Lough Special Protection Area, based on the principles of favourable conservation status, are described below and summarised in Table 3.1. Note that these objectives should be read and interpreted in the context of information and advice provided in additional sections of this report.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Carlingford Lough SPA.*

This objective is defined by the following attributes and targets:-

- To be favourable, the long term **population trend** for the waterbird Special Conservation Interest species should be stable or increasing.[3] Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis.[4]

- To be favourable, there should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest, other than that occurring from natural patterns of variation.[5]

Factors that can adversely effect the achievement of Objective 1 include:

- ❖ Habitat modification: activities that modify discrete areas or the overall habitat(s) within the SPA in terms of how the listed species uses the site (e.g. as a feeding resource) could result in the displacement of the species from areas within the SPA and/or a reduction in numbers (for further discussion on this topic please refer to Section 5.4).

- ❖ Disturbance: anthropogenic disturbance that occurs in or near the site and is either singular or cumulative in nature could result in the displacement of the listed waterbird species from areas within the SPA, and/or a reduction in numbers (for further discussion on this topic please refer to Section 5.4).

[3] Note that 'population' refers to site population (numbers wintering at the site) rather than the species biogeographic population.

[4] Population trend analysis is presented in Section 4.

[5] Waterbird distribution from surveys undertaken in 2010/11 (Martin, 2011) is examined in Section 5.

- ❖ Ex-situ factors: the listed waterbird species may at times use habitats situated within the immediate hinterland of the SPA or in areas ecologically connected to it. Significant habitat change or increased levels of disturbance within these areas could result in the displacement of the listed waterbird species from areas within the SPA, and/or a reduction in numbers (for further information on this topic please refer to Section 5.2).

Objective 2: *To maintain the favourable conservation condition of the wetland habitat at Carlingford Lough SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.*

This objective is defined by the following attributes and targets:-

- To be favourable, the permanent **area** occupied by the wetland habitat should be stable and not significantly less than the area of **595 ha**, other than that occurring from natural patterns of variation.

The boundary of Carlingford Lough SPA was defined to include the primary wetland habitats of this site. Objective 2 seeks to maintain the permanent extent of these wetland habitats, which constitute an important resource for regularly-occurring migratory waterbirds. The wetland habitats can be categorised into three broad types: subtidal; intertidal; and supratidal. Over time and through natural variation these subcomponents of the overall wetland complex may vary due to factors such as changing rates of sedimentation, erosion etc. Waterbird species may use more than one of the habitat types for different reasons (behaviours) throughout the tidal cycle.

Subtidal areas refer to those areas contained within the SPA that lie below the mean low water mark and are predominantly covered by marine water. Tidal rivers, creeks and channels are included in this category. For Carlingford Lough SPA this broad category is estimated to be **304 ha**. Subtidal areas are continuously available for benthic and surface feeding ducks (e.g. Shelduck, Shoveler) and for the listed species Light-bellied Brent Geese. Various waterbirds roost in subtidal areas.

The intertidal area is defined, in this context, as the area contained between the mean high water mark and the mean low water mark. For Carlingford Lough SPA this is estimated to be **282 ha**. When exposed or partially exposed by the tide, intertidal habitats provide important foraging areas for many species of waterbirds, especially wading birds, as well as providing roosting/loafing[6] areas. When the intertidal area is inundated by the tide it becomes available for benthic and surface feeding ducks, geese and piscivorous/other waterbirds. During this tidal state this area can be used by various waterbirds as a loafing/roosting resource.

The supratidal category refers to areas that are not frequently inundated by the tide (i.e. occurring above the mean high watermark) but contain shoreline and coastal habitats and can be regarded as an integral part of the shoreline. For Carlingford Lough SPA this is estimated to be **9 ha**. Supratidal areas are used by the listed species Light-bellied Brent Geese and a range of other waterbird species as a roosting resource as well as providing feeding opportunities.

The maintenance of the 'quality' of wetland habitat lies outside the scope of Objective 2. However, for the species of Special Conservation Interest, the scope of Objective 1 covers the need to maintain, or improve where appropriate, the different properties of the wetland habitats contained within the SPA.

[6] Loafing can be described as any behaviour not connected with breeding or feeding, and includes preening and resting.

Table 3.1 Conservation Objectives for the waterbird Special Conservation Interests of Carlingford Lough SPA.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Carlingford Lough SPA, which is defined by the following list of attributes and targets:*				
Parameter	**Attribute**	**Measure**	**Target**	**Notes**
Population	Population trend	Percentage change as per population trend assessment using waterbird count data.	The long term population trend should be stable or increasing	Waterbird population trends are presented in Part Four of this document.
Range	Distribution	Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys.	There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation.	Waterbird distribution is reviewed in Part Five of this document.
Objective 2: *To maintain the favourable conservation condition of the wetland habitat at Carlingford Lough SPA as a resource for the regularly-occurring migratory waterbirds that utilise it. This is defined by the following attributes and targets:*				
Parameter	**Attribute**	**Measure**	**Target**	**Notes**
Area	Wetland habitat	Area (ha)	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 595 ha, other than that occurring from natural patterns of variation.	The wetland habitat area was estimated as 595 ha using OSI data and relevant orthophotographs.

PART FOUR – REVIEW OF THE CONSERVATION CONDITION OF WATERBIRD SPECIAL CONSERVATION INTERESTS

4.1 Population data for waterbird SCI species of Carlingford Lough SPA

Wintering waterbirds have been surveyed at Carlingford Lough as part of the Irish Wetland Bird Survey (I-WeBS) and its UK counterpart, the Wetland Bird Survey (WeBS) since 1994/95 and 1998/99 respectively. The lough is divided into a number of count subsites and two subsites correspond closely, but not exactly, to the area designated as Carlingford Lough (SPA 4078): (1) Carlingford to Greenore; and (2) Greenore to Ballagan Point.

The SCI species Light-bellied Brent Goose is counted as part of I-WeBS but is also the subject of an additional species-specific survey at this site. Further information about this survey, I-WeBS and other waterbird surveys is given in Appendix 2.

Note that an area along the northern shore of Carlingford Lough (centred upon Mill Bay) is designated as a SPA under UK jurisdiction (Carlingford Lough SPA Site Code UK9020161) (refer to www.jncc.defra.gov.uk for more details). Light-bellied Brent Goose is a qualifying species for this SPA.

Table 4.1 presents summary population[7] data for Light-bellied Brent Goose; these data are relevant to SPA 4078. Where possible annual maxima were identified and used to calculate the five-year mean peak number. However WeBS and I-WeBS surveys have been undertaken irregularly since 2002/03, so recent data differ in their calculations and relate to different time periods for the two subsites.

I-WeBS data were kindly provided by BirdWatch Ireland; a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service. WeBS data were supplied by the Wetland Bird Survey (WeBS), a partnership between the British Trust for Ornithology, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee (the latter on behalf of the Council for Nature Conservation and the Countryside, the Countryside Council for Wales, Natural England and Scottish Natural Heritage) in association with the Wildfowl and Wetlands Trust.

Table 4.1 Population data for the waterbird Special Conservation Interest Species of Carlingford Lough SPA – Light-bellied Brent Goose

Site Special Conservation Interest Species:	Light-bellied Brent Goose
Baseline data period (I-WeBS)	
Carlingford Lough SPA (4078) Baseline period (1995/96 – 1999/00) – Mean peak number	253 (i)
Subsite - Carlingford to Greenore Baseline period (1995/96 – 1999/00) – Mean peak number	135
Subsite - Greenore to Ballagan Point Baseline period (1995/96 – 1999/00) – Mean peak number	167
Recent data period (WeBS)	
Subsite - Carlingford to Greenore (2009/10 - 2010/11) - Peak count winter (spring)	45 (145)
Subsite - Greenore to Ballagan Point (2006/07 – 2010/11) - Mean peak number *(peak number)	32 (93)

(i) denotes numbers of international importance; note that thresholds differ for the baseline and recent time periods used (refer to Wetlands International, 2002 and Wetlands International, 2012 respectively). * refers to the three-year peak mean from the period 2006/07 – 2010/11 (counts from 2008/09 and 2009/09 missing).

[7] Note that 'population' refers to site population (numbers wintering at the site) rather than a species' biogeographic population.

4.2 Waterbird population trends for Carlingford Lough SPA

The calculation and assessment of waterbird population trends at Irish coastal SPA sites follows the UK Wetland Bird Survey 'Alerts System' which provides a standardised technique for monitoring changes in the numbers of non-breeding waterbirds over a range of spatial scales and time periods (Appendix 3). Because of incomplete coverage during I-WeBS, the population trend for Light-bellied Goose at Carlingford Lough has been based directly on that calculated for the UK Wetland Bird Survey 'Alerts System' (Cook et al. 2013). The calculations are based on total site data, a larger area than designated as Carlingford Lough SPA (4078), but this is deemed appropriate as the same flock of Brent Geese utilises both the southern shore and other areas within the wider site.

Short, medium and long-term trends for the data period 1998/99 to 2009/10[8] are shown in Table 4.2. The values represent the percentage change in index (population) values across the specified time period. Positive values equate to increases in population size while negative values reflect a decrease in population size.

Table 4.2 Site Population Trend for Light-bellied Brent Goose at Carlingford Lough (after Cook et al. 2013)

Site Special Conservation Interests (SCIs)	Short-term % change[1]	Medium-term % change[2]	Long-term % change[3]
Light-bellied Brent Goose	- 2	+ 12	- 1

[1]Short-term (five-year);
[2]Medium-term (ten-years);
[3]Long-term (up to 25 years).

Waterbirds are relatively long-lived birds and changes in population size can take several years to become evident. The short-term trend can be useful to assess whether species numbers at the site are remaining stable, showing increase or signs of recovery, or are continuing to decline. For example, although a species' long-term trend may be negative, the short-term trend could be positive if numbers have increased during the recent five year period being assessed. Importantly, the short-term trend may detect more rapidly where a species population is beginning to decline.

4.3 Carlingford Lough SPA – site conservation condition of waterbird SCI species

Conservation condition of waterbird species at coastal SPA sites is determined using the long-term site population trend and is assigned using the following criteria:

Favourable population = population is stable/increasing.

Intermediate (unfavourable) = Population decline in the range 1.0 – 24.9%.

Unfavourable population = populations that have declined between 25.0 – 49.9% from the baseline reference value.

Highly Unfavourable population = populations that have declined > 50.0% from the baseline reference value.

[8] *first winter 1998/99; reference winter 2009/10;

The threshold levels of >25.0% and >50.0% follows standard convention used for waterbirds (e.g. Lynas et al. 2007; Leech et al. 2002). The 'Intermediate' range (1.0% - 24.9% decline) allows for natural fluctuations and represents a range within which relatively small population declines have the potential to be reversible and less likely to influence conservation status in the long-term (Leech et al. 2002). Declines of more than 25.0% are deemed of greater ecological significance for the long-term.

With regards the waterbird species of Special Conservation Interest listed for Carlingford Lough SPA, and based on the long-term population trend for the site, it has been determined that Light-bellied Brent Goose is in **Intermediate Unfavourable Conservation Condition** (Table 4.3).

Table 4.3 SCI species of Carlingford Lough SPA – Current Site Conservation Condition

Special Conservation Interests	BoCCI Category[a]	Site Population Trend[b]	Site Conservation Condition	Current all-Ireland Trend[c]	Current International Trend[d]
Light-bellied Brent Goose	Amber	- 1	Intermediate Unfavourable	+ 62.3	Increase

[a]After Lynas *et al.* (2007); [b] Site population trend; see Table 4.2; [c]all-Ireland trend calculated for period 1994/95 to 2008/09 (I-WeBS); [d]international trend after Wetland International (2012).

PART FIVE – SUPPORTING INFORMATION

5.1 Introduction

Part Five of this report is based around the need to review, collate and disseminate site-specific information relating to the Special Conservation Interests of Carlingford Lough SPA.

Section 5.2 provides selected ecological summary information for the non-breeding waterbirds of the site. Section 5.3 presents results from a waterbird survey undertaken during the winter season 2010/11. Finally, Section 5.4 provides summary information on the activities and events that occur in and around Carlingford Lough that may either act upon the habitats within the site, or may interact with waterbirds using the site.

The information provided is intended to:-

- provide information to assist the interpretation and understanding of the site-specific conservation objectives;
- facilitate the identification of conservation priorities and direct site management measures;
- inform the scope and nature of Appropriate Assessments in applying the provisions of Article 6 of the Habitats Directive.

Note however, that the information does not aim to provide a comprehensive assessment on which to assess plans and projects as required under the Habitats Directive, but rather should inform the scope of these assessments and help direct where further detailed examinations are required. The information presented in this report was compiled in March 2013.

5.2 Waterbird species – Ecological characteristics, requirements and specialities – summary information

Waterbirds, defined as ‘*’birds that are ecologically dependent on wetlands”* (Ramsar Convention, 1971), are a diverse group that includes divers, grebes, swans, geese and ducks, gulls, terns and wading birds.

As described in Section 1.1, the wetland habitats contained within this SPA are considered to be a Special Conservation Interest in their own right. The wetland habitat is an important resource for listed SCI species and for other waterbird species included in the total waterbird assemblage. These species may include those that utilise the site during passage, those that are present in months of the year outside of the non-breeding season[9] or species that use the site at certain times only (e.g. as a cold weather refuge). Regularly-occurring non-breeding waterbirds within Ireland are listed in Appendix 4 along with their Latin names and waterbird species codes.

As a cross-border site, wintering waterbirds have been surveyed at Carlingford Lough as part of the Irish Wetland Bird Survey (I-WeBS) and its UK counterpart, the Wetland Bird Survey (WeBS) since 1994/95 and 1998/99 respectively. The lough is divided into a number of count subsites and two subsites correspond closely, but not exactly to the area designated as Carlingford Lough (4078): (1) Carlingford to Greenore; and (2) Greenore to Ballagan Point.

During the I-WeBS period 1995/96 to 1999/00, and excluding the SCI species Light-bellied Brent Goose, a total of 23 waterbird species occurred in the subsite Carlingford to Greenore on a regular basis (recorded in at least three of the five years). 17 species occurred regularly

[9] Non-breeding season is defined as September – March inclusive

within the subsite Greenore to Ballagan Point during the five-year period 1996/97 – 2000/01 (no count in 1995/96). These species and their five-year mean peak number are shown in Table 5.1a (data kindly provided by the I-WeBS Office, BirdWatch Ireland). These species represent eight waterbird families: *Podicipedidae* (grebes), *Anatidae* (swans, geese and ducks), *Haematopodidae* (oystercatchers), *Charadriidae* (plovers and lapwings), *Scolopacidae* (sandpipers and allies) and *Laridae* (gulls and terns) plus *Phalacrocoracidae* (Cormorants) and *Ardeidae* (Herons).

Table 5.1a Regularly-occurring non SCI waterbird species that occurred in the subsites Carlingford to Greenore (1995/96 – 1999/00) and Greenore to Ballagan Point (1996/97 – 2000/01).

Species	Carlingford to Greenore Mean peak 1995/06 to 1999/00	Greenore to Ballagan Point Mean peak 1996/97 – 2000/01
Wigeon (*Anas penelope*)	107	
Teal (*Anas crecca*)	5	
Mallard (*Anas platyrhynchos*)	20	
Goldeneye (*Bucephala clangula*)	8	
Red-breasted Merganser (*Mergus serrator*)	6	7
Great Crested Grebe (*Podiceps cristatus*)	12	
Cormorant (*Phalacrocorax carbo*)	81	195
Grey Heron (*Ardea cinerea*)	8	4
Oystercatcher (*Haematopus ostralegus*)	188	187
Ringed Plover (*Charadrius hiaticula*)	64	7
Golden Plover (*Pluvialis apricaria*)	184	
Grey Plover (*Pluvialis squatarola*)	4	11
Lapwing (*Vanellus vanellus*)	82	68
Dunlin (*Calidris alpina*)	211	424
Bar-tailed Godwit (*Limosa lapponica*)	20	24
Curlew (*Numenius arquata*)	100	68
Greenshank (*Tringa nebularia*)	5	
Redshank (*Tringa totanus*)	94	49
Turnstone (*Arenaria interpres*)	14	24
Black-headed Gull (*Chroicocephalus ridibundus*)	162	304
Common Gull (*Larus canus*)	147	91
Herring Gull (*Larus argentatus*)	23	98
Great Black-backed Gull (*Larus marinus*)	8	11
Sandwich Tern (*Sterna sandvicensis*)		2

Grey shading denotes an Annex I species.

WeBS and I-WeBS surveys have been irregular at Carlingford Lough since 2002/03, so Table 5.1b shows recent data for the species listed in Table 5.1a, in terms of the peak count recorded during either of the winter seasons 2009/10 or 2010/11 (Carlingford to Greenore) or the mean peak count (2006/07 – 2010/11) for Greenore to Ballagan Point (data kindly provided by the WeBS Office, British Trust for Ornithology).

Table 5.1b Regularly-occurring non SCI waterbird species in the subsites Carlingford to Greenore and Greenore to Ballagan Point - data from the 2010/11 season (WeBS)

Species	Carlingford to Greenore Peak Count 2009/10 or 2010/11[1]	Greenore to Ballagan Point Mean Peak 2006/07 – 2010/11[2]
Wigeon (*Anas penelope*)	120	
Teal (*Anas crecca*)	50	
Mallard (*Anas platyrhynchos*)		
Goldeneye (*Bucephala clangula*)		
Red-breasted Merganser (*Melanitta nigra*)		2
Great Crested Grebe (*Podiceps cristatus*)		
Cormorant (*Phalacrocorax carbo*)	20	22
Grey Heron (*Ardea cinerea*)	6	2
Oystercatcher (*Haematopus ostralegus*)	50	211
Ringed Plover (*Charadrius hiaticula*)	2	25
Golden Plover (*Pluvialis apricaria*)		
Grey Plover (*Pluvialis squatarola*)		2
Lapwing (*Vanellus vanellus*)	45	104
Dunlin (*Calidris alpina*)	150	186
Bar-tailed Godwit (*Limosa lapponica*)	15	17
Curlew (*Numenius arquata*)	40	49
Greenshank (*Tringa nebularia*)	7	
Redshank (*Tringa totanus*)	122	97
Turnstone (*Arenaria interpres*)	30	55
Black-headed Gull (*Chroicocephalus ridibundus*)	65	85*
Common Gull (*Larus canus*)	100	60*
Herring Gull (*Larus argentatus*)	14	38*
Great Black-backed Gull (*Larus marinus*)	1	12*

Grey shading denotes an Annex I species.
[1]the peak count from either 2009/10 or 2010/11; [2] the three-year peak mean from the period 2006/07 – 2010/11 (counts from 2008/09 and 2009/09 missing), *except gulls where the data refer to the peak count from 2010/11.

Although waterbirds may be linked by their dependence on water, different species vary considerably in aspects of their ecology due to many evolutionary adaptations and specialisations to their wetland habitats. Different species or groups of species may therefore utilise wetland habitats in very different ways which relates to how species are distributed across a site as a whole.

Table 5.2 provides selected ecological information for the SCI species of Carlingford Lough SPA. Information is provided for the following categories[10]:-

- waterbird family (group);
- winter distribution – species distribution range during winter (based on the period 2001/02 – 2008/09 (after Boland & Crowe, 2012);
- trophic (foraging) guild (after Weller, 1999; see Appendix 5);
- food/prey requirements;
- principal supporting habitat within the site;
- ability to utilise other/alternative habitat in/around the site;
- site fidelity (species 'faithfulness' to wintering sites).

[10] Notes to aid the understanding of categories and codes used in Table 5.2 are provided in the table sub text.

It should be borne in mind that a single wetland site is unlikely to meet all of the ecological requirements of a diverse assemblage of waterbirds (Ma et al. 2010). Although some waterbird species will be faithful to specific habitats within the SPA, many will at times also use habitats situated within the immediate hinterland of the site or in areas ecologically connected to the SPA. These areas may be used as alternative high tide roosts, as a foraging resource or, be simply flown over, either on migration or on a more frequent basis throughout the non-breeding season as waterbirds move between different areas used (e.g. commuting corridors between feeding and roosting areas).

Reliance on alternative habitats will vary from site to site, and between species. Use of alternative habitats is also likely to vary through time, from seasonally through to daily, and different habitats may be used by day and night (Shepherd et al. 2003). Different waterbirds may utilise wetland habitats in different ways. For example, while the majority of wading birds forage across exposed tidal flats, species such as Lapwing and Golden Plover are considered to be 'terrestrial waders' typically foraging across grassland and using tidal flats primarily for roosting. When tidal flats are covered at high water, intertidally-foraging waterbirds are excluded and many species then move to nearby fields to feed. Terrestrial foraging is also important when environmental factors (e.g. low temperature) reduce the profitability of intertidal foraging (e.g. Zwarts & Wanink, 1993). Some waterbird species are simply generalists, and make use of a range of habitats, for example the Black-tailed Godwit that forages across intertidal mudflats and grassland habitats. Other waterbird species such as Greenland White-fronted Goose or Bewick's Swan are herbivores and are reliant on terrestrial areas, often outside of the SPA boundary, and use the wetland site primarily for roosting. Some species switch their habitat preference as food supplies become depleted; an example being Light-bellied Brent Geese that exploit grasslands increasingly when intertidal seagrass and algae become depleted.

The topic of alternative habitat use is also applicable to benthic-foraging seaducks and divers whose foraging distribution is highly influenced by water depth and tidal conditions. Many of these species however (e.g. Great Northern Diver, Common Scoter) exhibit a widespread coastal distribution during winter utilising shallow nearshore waters to a greater degree at certain times (e.g. storms, driving onshore winds).

Thus the area designated as a SPA can represent a variable portion of the overall range of the listed waterbird species. To this end, data on waterbird use of areas adjacent to or ecologically connected to the SPA are often collected. Indeed for some species a mix of site-related and wider countryside measures are needed to ensure their effective conservation management (Kushlan, 2006). Furthermore, it is recommended that assessments that are examining factors that have the potential to affect the achievement of the site's conservation objectives should also consider the use of these '*ex-situ'* habitats, and their significance to the listed bird species.

Table 5.2 Waterbirds – Ecological characteristics, requirements & specialities

	Family (group)	Winter distribution[A]	Trophic Guild[B]	Food/Prey Requirements[C]	Principal supporting habitat within site[D]	Ability to utilise other/alternative habitats[E]	Site Fidelity[F]
Light-bellied Brent Goose *Branta bernicla hrota*	Anatidae (geese)	Localised	1, 5	Highly specialised	Intertidal mud and sand flats, *Zostera* beds	2	High

[A] Winter distribution: Very widespread (>300 sites); Widespread (200 – 300 sites); Intermediate (100 – 200 sites); Localised (50-100 sites); Highly restricted (<50 sites) (based on Boland & Crowe, 2012).
[B] Waterbird foraging guilds. 1 = Surface swimmer, 2 = water column diver (shallow), 3 = water column diver (deeper), 4/5 = intertidal walker (out of water), 6 = intertidal walker (in water), 7 = terrestrial walker. Further details are given within Appendix 5.
[C] Food/prey requirements - species with a wide prey/food range; species with a narrower prey range (e.g. species that forage upon a few species/taxa only), and species with highly specialised foraging requirements (e.g. piscivores).
[D] Principal supporting habitat present within Carlingford Lough. This is the main habitat used when foraging.
[E] Ability to utilise alternative habitats refers to the species ability to utilise other habitats adjacent to the site. 1 = wide-ranging species with requirement to utilise the site as and when required; 2 = reliant on site but highly likely to utilise alternative habitats at certain times (e.g. high tide); 3 = considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
[F] Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High (based on published literature).

5.3 Carlingford Lough – waterbird surveys 2010/11

5.3.1 Introduction

Data presented within this section are based on the results of survey work undertaken at Carlingford Lough during the period October 2010 to April 2011 (Martin, 2011). Waterbirds were counted within two survey zones: Zone 1 (Ballagan to Greenore) and Zone 2 (Greenore to Carlingford). Note that the survey zone boundaries are not coincident with the SPA boundary.

While the surveys included all waterbird species, special attention was focused on the numbers, distribution, behaviour and movements of Light-bellied Brent Goose, hereafter called 'Brent Goose.'

5.3.2 Intertidal habitats of the study area

Zone 1 is composed of a shingle bank plus an extensive area of mudflats that is exposed at low tide. Most of the lower shore is used for aquaculture, the cultivation of Oysters (*Crassostrea gigas*).

The benthic community is described as 'sandy mud to mixed sediment with *Tharyx* sp.' (NPWS, 2012). The sediment ranges from sandy mud to mixed sediments and mud and fine sand account for between 53.8% and 98.3% of the sediment. The distinguishing fauna of this community complex are the polychaetes *Tharyx* sp., *Nephtys hombergii, Scoloplos armiger* and *Notomastus latericeus,* the crustaceans *Corophium volutator* and *Crangon crangon* and the bivalve *Scrobicularia plana* (NPWS, 2012).

On the lower shore in the south of Zone 1 is a sandy community with polychaetes. This complex is distinguished by the polychaetes *Capitella capitata*, *Arenicola marina* and *Polydora cornuta* while other polychaetes include *Eteone longa, Nephtys cirrosa, Galathowenia oculata, Owenia fusiformis, Pygospio elegans* and *Lanice conchilega*.

Vegetation comprises various brown fucoid seaweed, red seaweed and green algae, as well as vegetation typical of shingle banks. Two small streams flow into this zone and support algal growth. Further growth of algae is widespread across the survey zone with a layer of filamentous *Ulva* spp. (formerly *Enteromorpha* spp.)[11] occurring along the base of the shingle bank, and observed growing between and upon the aquaculture trestles. *Zostera noltii* does not occur in this zone.

From approximately mid-tide, the whole intertidal area is covered and the only high tide roost opportunity is the shingle bank along the shore. At very low tides several islands become exposed offshore.

The southern part of the SPA (between the boundary of Zone 1 and Ballagan Point) is composed of rock which supports various seaweeds. Zone 1 is significantly more exposed than Zone 2, particularly with southerly or easterly winds.

Zone 2 is a significantly more diverse area than Zone 1. Habitats include shingle shore, mudflats, rocky outcrops and islands at high tide, plus upper saltmarsh, three significant streams, a tidal inlet and adjacent brackish ponds. As with Zone 1, it also includes an extensive aquaculture area.

[11] Hayden et al. (2003), using genetic information, reassigned the genus *Enteromorpha* to the genus *Ulva.*

The benthic community is described as 'sandy mud to mixed sediment with *Tharyx* sp.' (NPWS, 2012). The sediment of this community ranges from sandy mud to mixed sediments and mud and fine sand account for between 53.8% and 98.3%. The proportion of coarse material increases toward Greenore Point. The distinguishing fauna of this community complex are the polychaetes *Tharyx* sp., *Nephtys hombergii, Scoloplos armiger* and *Notomastus latericeus,* the crustaceans *Corophium volutator* and *Crangon crangon* and the bivalve *Scrobicularia plana* (NPWS, 2012).

A *Zostera noltii* dominated-community is recorded at three locations between Shilties Lough and Greenore. It occurs most extensively south of Shilties Lough (NPWS, 2012). Natural mussel beds of the species *Mytilus edulis* occur along the shore. While providing a direct source of food for Oystercatchers, these mussel beds may indirectly provide food for Light-bellied Brent Geese, in that the beds, acting as a hard surface, provide attachment for green macroalgae such as *Ulva* spp.

Extensive amounts of green algae are found, especially along the outlet of a brackish pond and at the outlet from Shilties Lough, a sea inlet fed by a stream. Green algae (*Ulva* spp.) were noted growing in extensive patches throughout the zone, with the wider 'sea lettuce' form in the rockier and more sheltered areas, and the filamentous form upon the sandflats. A greater area was occupied by green algae in Zone 2 than in Zone 1 during the survey period (November 2010).

Zone 2 is less exposed than Zone 1 due to its aspect and because of a more gradual foreshore gradient. Of further note is that the intertidal area of Zone 2 is exposed for a significantly longer period than that in Zone 1.

5.3.3 Survey methods

One coordinated count of the two survey zones was undertaken each month during the period October 2010 to April 2011. Four fieldworkers made observations from four positions and recorded the number of birds in each zone, movements of birds between zones and bird behaviour.

In addition, monthly counts were also made by one fieldworker that moved between subdivisions of Zone 1 (subdivisions related to a separate project and not reported here). Complete counts were also made of Zones 1 and 2. Because of movements and travel time between Zones in contrast to co-ordinated counts where fieldworkers remained stationary, these counts are necessarily assumed to be less accurate due to the potential for bird movements/re-distribution during the counting periods.

Overall the site was surveyed at approximate two week intervals during the survey period; amounting to 400 survey hours in total. In all cases, counts were undertaken at hourly intervals between dawn and dusk.

5.3.4 Waterbird data analyses

Summary count data are presented. Although the survey period covered October 2010 to April 2011, the majority of data analyses were undertaken for the core wintering period October 2010 – February 2011 inclusive.

Peak counts are presented for waterbird species that contributed to the waterbird assemblage at the site. For Brent Geese, monthly peak counts per zone are presented which relates to the peak number within a zone during any one of the hourly counts. Monthly 'site' peak counts are the peak numbers counted within both Zones 1 and 2 during the same 60-minute count period.

Frequency of occurrence was calculated as the proportion of the total number of counts within which Brent Geese were present.

Distributional patterns were investigated by comparing numbers of Brent Geese across four tidal stages as follows:

Tide 1: Initial tidal ebb (3 hours after HT);

Tide 2: tidal ebb approaching and including low water (3 hours prior LT);

Tide 3: initial tidal inflow (3 hours after LT);

Tide 4: tidal inflow approaching high water (3 hours prior HT).

Notes on data interpretation and methodological limitations

It is important to consider that distribution data and patterns reported refer to a single season of surveys. Although important patterns of distribution will emerge, these distributions should not be considered absolute; waterbirds by their nature are highly mobile and various factors including tide (e.g. spring/neap), temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, could lead to patterns that may change in different months and years. In particular, the winter season of 2010/11 was notable for a relatively unusual cold spell (Met Éireann, 2010a, b, 2011) with December being the coldest on Irish record (Met Éireann, 2010b).

The distribution of Brent Geese in the study area has been observed to be influenced by the distribution and abundance of green macroalgae (B. Martin *pers. comm.).* As macroalgal growth can vary from year to year due to a number of environmental factors, and is often transient in nature; the distribution of Brent Geese may therefore also vary both within and between seasons.

5.3.5 Summary Results – waterbird assemblage

During the 2010/11 survey period a total of 32 waterbird species were recorded within Zone 1 and a total of 33 species within Zone 2 (October 2010 – April 2011). During the core winter period (Oct – February), 32 species were recorded across both zones collectively.

Peak species richness (Oct – Feb) was relatively similar for the two zones although Zone 2 recorded slightly more species in four out of the five months (Table 5.3).

Table 5.3 Peak species richness by zone

Month	Zone 1	Zone 2
October 2010	15	19
November 2010	18	21
December 2010	19	18
January 2011	17	21
February 2011	19	22

Peak counts per zone are shown in Table 5.4. One species (Light-bellied Brent Goose) occurred in numbers of international importance and one species (Redshank) occurred in numbers of all-Ireland importance (Table 5.4).

Table 5.4 Peak waterbirds counts recorded for Zone 1 and 2 during the period October 2010 – February 2011, and month in which peak occurred

Species	Zone 1	Zone 2
Whooper Swan *Cygnus cygnus*	8 (Oct)	3 (Nov)
Light-bellied Brent Goose *Branta bernicla hrota*	346 (Feb)	412[a] (Dec)
Shelduck *Tadorna tadorna*	1 (Nov)	7 (Feb)
Wigeon *Anas penelope*	2 (Oct)	180 (Dec)
Teal *Anas crecca*	22 (Jan)	60 (Jan)
Mallard *Anas platyrhynchos*	62 (Nov)	61 (Jan)
Scaup *Aythya marila*	3 (Feb)	0
Red-breasted Merganser *Mergus serrator*	14 (Oct)	12 (Feb)
Great Northern Diver *Gavia immer*	9 (Nov)	0
Great Crested Grebe *Podiceps cristatus*	5 (Nov)	3 (Oct, Nov, Jan)
Cormorant *Phalacrocorax carbo*	42 (Nov)	28 (Oct)
Shag *Phalacrocorax aristotelis*	2 (Nov, Dec, Feb)	13 (Jan)
Grey Heron *Ardea cinerea*	7 (Oct)	5 (Jan)
Little Egret *Egretta garzetta*	6 (Nov)	35 (Oct)
Oystercatcher *Haematopus ostralegus*	132 (Jan)	193 (Jan)
Ringed Plover *Charadrius hiaticula*	27 (Dec)	73 (Nov)
Golden Plover *Pluvialis apricaria*	4 (Dec)	60 (Oct)
Grey Plover *Pluvialis squatarola*	6 (Dec)	2 (Nov)
Lapwing *vanellus vanellus*	146 (Dec)	100 (Feb)
Knot *Calidris canutus*	7 (Dec)	26 (Oct)
Dunlin *Calidris alpina*	249 (Jan)	300 (Feb)
Black-tailed Godwit *Limosa limosa*	15 (Nov)	7 (Feb)
Bar-tailed Godwit *Limosa lapponica*	32 (Dec)	66 (Dec)
Curlew *Numenius arquata*	87 (Jan)	110 (Jan)
Greenshank *Tringa nebularia*	3 (Nov)	32 (Feb)
Redshank *Tringa totanus*	177 (Jan)	410[b] (Feb)
Turnstone *Arenaria interpres*	79 (Dec)	54 (Feb)
Black-headed Gull *Chroicocephalus ridibundus*	202 (Jan)	520 (Feb)
Common Gull *Larus canus*	249 (Oct)	270 (Oc)
Herring Gull *Larus argentatus*	50 (Oct)	60 (Oct)
Great Black-backed Gull *Larus marinus*	38 (Nov)	7 (Nov, Feb)

[a]exceeds international threshold of 400 after Wetlands International (2012).
[b]exceeds all-Ireland threshold of 310 after Crowe et al. (2008).

5.3.6 Summary Results – Light-bellied Brent Goose

Migratory Light-bellied Brent Geese (hereafter called 'Brent Geese') that winter within Ireland belong to the East Canadian High Arctic population. Almost all of this population spends winter within Ireland.

Brent Geese begin to arrive in Ireland in late August when almost three-quarters of the biogeographic population congregate at Strangford Lough in Northern Ireland before dispersing to other sites (Robinson et al. 2004).

Brent Geese are grazers and are known for their preference for foraging in intertidal areas with the Eelgrass *Zostera* sp. (Robinson et al. 2004). Where this food source is absent or becomes depleted, the birds feed upon algae species, saltmarsh plants and may also undertake terrestrial grazing.

In Carlingford Lough a cohort of Brent Geese are known to commute from saltmarsh in Dundalk Bay[12] (North and South Bull as well as Lurgangreen/Mooretown) to Carlingford Lough, which constitutes a round trip of 36 km. Another cohort may be seen moving between Mill Bay and Eelgrass beds in Zone 2 of Carlingford Lough (B. Martin *pers. obs*). Movements of geese between Dundalk Bay and Carlingford Lough are primarily at dawn and dusk, but may also occur in response to tidal state. During their commute, the geese do not fly over land, but rather tack along the coast, even though this extends the commute considerably (B. Martin *pers. obs.).*

(i) Numbers

Both survey zones supported good numbers of the Special Conservation Interest species Light-bellied Brent Geese. Zone 2 supported peak numbers of international importance in December 2010, while the site (zones 1 and 2 combined) supported peak numbers that exceeded the threshold of international importance in three survey months (Table 5.5).

Table 5.5 Peak zone counts and the peak site count*

Month	Zone 1	Zone 2	Site*
October 2010	126	92	218
November 2010	109	317	411**
December 2010	275	412**	687**
January 2011	177	132	271
February 2011	346	176	522**
March 2011	438**	282	572**

*numbers in Zone 1 and Zone 2 combined within any one 60-minute period.
**exceeds international threshold of 400 after Wetlands International (2012).

(ii) Distribution

The frequency with which Light-bellied Brent Geese occurred within the count zones was markedly different (Table 5.6) with Zone 2 supporting individuals in nearly all hourly count sessions in contrast to Zone 1 that held the species for roughly half of the survey period. This is largely because the tidal flats in Zone 2 are exposed for longer than in Zone 1. Some foraging opportunities are apparent in Zone 2 even at high tide while from about mid-tide onwards suitable habitat in Zone 1 is covered to such an extent that foraging habitat is unavailable. The geese moved regularly between zones.

Zone 1
Larger numbers of Brent Geese were observed in Zone 1 at the end of the season, likely due to the new growth of *Ulva* spp. that occurred in association with streams (south end of Zone 1). Geese arriving from Dundalk Bay after dawn were observed to stop in Zone 1 if the tide was suitable.

At low tide, geese in Zone 1 were observed to spread out throughout the aquaculture area availing of algae that grows between the trestles. On very low tides the geese would spread out along the tide edge feeding on exposed or free-floating algae. As the tide rose the geese

[12] Dundalk Bay SPA (site code 0004026)

would either depart the area for Zone 2 or move up the shore to feed on a thin band of green algae running along the base of the shingle bank.

Zone 2

During September and October at low tide the geese concentrated on areas of *Zostera noltii.* As the *Zostera* became depleted during November to January, the geese concentrated at locations where macroalgae were available. As the tide rose, the geese continued surface feeding in these areas until the tide became too high, at which point they went to roost on the water.

The overriding distributional pattern observed was for a relatively constant flock of geese to occur in Zone 2, in contrast to Zone 1 where the geese remained only while the intertidal area was exposed.

Table 5.6 Light-bellied Brent Goose – frequency of occurrence in Zone 1 and 2 - monthly

Month	Zone 1* Frequency of occurrence %	Zone 2 Frequency of occurrence %
October 2010	53	100
November 2010	33	100
December 2010	53	100
January 2011	47	91
February 2011	56	100
March 2011	42	100

*as Zone 1 was subdivided into count sectors, this refers to the peak frequency of occurrence recorded, in any of the count sectors.

This pattern was investigated further by comparing the number of geese present in the survey zones across four tidal stages (see 5.3.2 for tidal stages). This shows clearly that in the hours approaching and immediately after low tide, the frequency of occurrence and numbers of Brent Geese within the two zones was comparable, contrasting markedly with the stages prior to and after high water (1 and 4) when Zone 2 was used to a greater degree (Table 5.7).

Table 5.7 Distribution in relation to tidal stage

	Tide Stage 1		Tide Stage 2		Tide Stage 3		Tide Stage 4	
	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
Minimum no. geese	0	55	0	49	0	2	0	0
Maximum no. geese	77	375	346	343	593	412	100	282
Average no. geese	5	136	79	163	123	188	5	113
Frequency of occurrence (%)	16	100	82	100	74	100	8	93

The following distributional summary is after Martin (2011):-

In the morning the geese fly from Dundalk Bay into Carlingford Lough by tacking along the coast, rounding Balaggan point and continuing to feeding areas in the Lough. Apparently depending on the state of the tide, some birds stop before reaching Balaggan Point, others stop in Zone 1, while others continue to Zone 2. Stopping points in Zone 1 were observed to be places where green macroalgae were present such as at the outflow of waterways, but at

times when the intertidal habitat is covered, the geese typically fly directly to Zones 2 or to Mill Bay on the northern shore. The geese feed in the first few hours after arrival.

The geese feed with varying intensity as the day progresses depending on the state of the tide and availability of food. They move around to exploit available food either by feeding on the sandflats, surface feeding (sitting on the water and extending their necks below the water to reach sub-aquatic vegetation swan-like) or by upending completely. On the sandflats where Eelgrass is present, considerable effort is made rooting for rhizomes as the season proceeds.

During the early part of the season (until December) the Brent Geese showed a clear preference for Zone 2 and for areas within it that had Eelgrass. After the end of February the geese did not show a marked preference for either zone, possibly because of the super-abundance of green algae all along the Cooley shore. Note that *Zostera noltii* was recorded from Zone 2 but not from Zone 1.

(iii) Terrestrial foraging (outside the SPA)

During the period December 2010 to late February 2011, a large flock of Brent Geese was observed grazing on agricultural grasses at Lurgangreen in Dundalk Bay; adjacent to roosting areas; and within the Dundalk Bay SPA (Site Code 4026). Similar observations were noted in 2010 (Oscar Merne *pers. comm.).*

Brent Geese were occasionally seen feeding on grass at Greenore Golf Course (two occasions of around 80 birds); green keepers report that this is an occasional occurrence. Brent Geese were also observed feeding in fields around Mill Bay (two occasions involving approximately 110 birds).

(iv) Behaviour

In general, four main seasonally affected foraging behaviours could be discerned:

(1) September – November: Migratory arrival from Iceland primarily and preferentially feeding on *Zostera spp.* with *Ulva* spp. as a second choice.

(2) December to January: Primarily feeding on *Ulva* spp. with agricultural grass as a second choice.

(3) February to March: Almost exclusively feeding *Ulva* spp.

(4) April: Gathering/staging for migration to breeding grounds.

(v) September and April (counts outside of the main survey period)

Counts were undertaken in September 2010 and April 2011 to record periods of arrival and departure. On the 19th September 2010, eight Brent Geese were seen feeding on Eelgrass in Zone 2. This number had increased to 78 geese in the same area on the 22nd September 2010. Of these, six were juveniles, belonging to two families.

April signalled a significant change in Brent behaviour, numbers and distribution. On 7th April 2011, a count that started at 9:00am recorded a total of 922 Brent Geese along the Louth shore, more than any previous count. By 11:37am, on the rising tide, all birds had departed Zone 1 while 145 stayed in Zone 2 through high tide. As the tide dropped in the evening 77 geese arrived from Dundalk Bay. The goose behaviour was notably more agitated than on previous counts, with a large number of movements (in total 37 bird movements between Dundalk Bay, count zones and Carlingford Lough islands). Birds were also observed to be flighty, with much stationary wing-flapping. By 21st April 2011, almost all Brent Geese had

departed with only a few individuals remaining with just six birds in Zone 2 feeding on the emergent Eelgrass.

5.4 Carlingford Lough - Activities and Events

5.4.1 Introduction

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is in a satisfactory condition, and that this status is likely to continue into the future.

At site level, the concept of 'favourable status' is referred to as 'conservation condition.' This can relate to not only species numbers, but importantly, to factors that influence a species abundance and distribution at a site. The identification of activities and events that occur at a designated site is therefore important, as is an assessment of how these might impact upon the waterbird species and their habitats, and thus influence the achievement of favourable condition. Site-based management and the control of factors that impact upon species or habitats of conservation importance are fundamental to the achievement of site conservation objectives.

Section 5.4 provides information on activities and events that occur in and around Carlingford Lough that may either act upon the habitats within the site, or may interact with the Special Conservation Interest species and other waterbirds using the site.

5.4.2 Assessment Methods

Information on 'activities' and 'events' across Carlingford Lough was collected during a desk-top review which included NPWS documents, County Development and other plans (e.g. Louth County Council, 2009, 2009b, 2012), Neagh Bann International River Basin District documents (Neagh Bann IRBD, 2010a,b,c) and other available documents relevant to the ecology of the site. Although information was reviewed in relation to the wider Carlingford Lough, focus was directed on the area between Ballagan Point and Carlingford on the southern shore of the lough i.e. the area designated as SPA 4078.

Records of activities that caused, or had the potential to cause disturbance to waterbirds were collected during waterbird survey work undertaken at Carlingford Lough SPA (4078) during the period October 2010 to April 2011 (Martin, 2011). This information, together with results from a 'site activity questionnaire' provides valuable information on the level of disturbance that can occur at the site.

All data collected were entered into a database but as the dataset will be subject to change over time, the assessment should be viewed as a working and evolving process. The 'activities' and 'events' were categorised using the standard EU list of pressures and threats as used in Article 12 reporting under the EU Bird's Directive. Only factors likely to directly or indirectly affect waterbirds were included but the resulting list is broad and includes built elements (e.g. man-made structures such as roads and bridges that are adjacent to the site), factors associated with pollution (e.g. discharges from waste water treatment plants), various recreational and non-recreational activities as well as biological factors such as the growth of the invasive plant species *Spartina anglica*.

Data are presented as follows:-

Activities and events identified as occurring in and around Carlingford Lough (through either the desk-top review or field survey programme) are listed in relation to the survey zone within which they were observed or are known to occur. The activities/events are classified as follows:

O observed or known to occur within Carlingford Lough;
U known to occur but unknown spatial area hence all potential subsites are included (e.g. fisheries activities);
H historic, known to have occurred in the past.
P potential to occur in the future.

5.4.3 Overview of activities in Carlingford Lough

Activities and events identified to occur in and around Carlingford Lough are shown in Appendix 7, listed for the two survey zones used in the 2010/11 waterbird surveys (Martin, 2011). Activities highlighted in grey are those that have the potential to cause disturbance to waterbirds (see Section 5.4.4). For a map of survey zones, please refer to Appendix 6.

The following pages provide a review of the range of activities and events that occur across Carlingford Lough using the following headings: (1) habitat loss, modification and adjacent landuse; (2) water quality; (3) fisheries and aquaculture; (4) recreational disturbance; and (5) others. Special emphasis is placed on the area of the southern shore that is designated as SPA 4078.

Habitat loss, modification and adjacent landuse

At the head of the lough, the Newry River and the Newry Canal link the lough to the nearby city of Newry; the industrialised head of the lough. There are three small towns on the northern County Down side of the lough, namely Warrenpoint, Rostrevor and Greencastle. On the southern coast are Omeath, Carlingford and Greenore that are backed by the Cooley Mountains, on the Cooley Peninsula.

CORINE land cover data indicate that the land in the immediate vicinity of the lough supports a mixture of forest, rough and improved grazing and small areas of agricultural land (Taylor et al. 1999).

Several wetland sites occur near Greenore, of which one (Mullatee and Greenore) lies adjacent to the SPA and is a modified coastal lagoon located on the landward side of the coastal embankment (Foss et al. 2012).

Near Carlingford, the area to the south of Ghan House contains a mosaic of brackish and freshwater habitats including an artificial freshwater SUDS[13] type pond, a drainage ditch and an ancient drainage channel leading to the harbour, a large sedge swamp and a freshwater stream. Old maps show that this area was in fact an inlet in 1824 but by 1900 it had been infilled and a drainage channel had been put in place. A sluice gate prevents seawater from back flowing into the channel at high tide however the area retains a distinct brackish character. This may be due to underground seepage or occasional backflow from the sluice (Martin, 2009).

Shilties Lough occurs to the south of Carlingford and is an empounded lough that lies between the road (R176) and a disused railway embankment.

[13] sustainable urban drainage system

Industrial activity is minimal along the lough's coastline but there are two commercial freight ports (Greenore and Warrenpoint). There is a lighthouse on Greenore Point that was built in the early 19th century. There is a marina in Carlingford Bay that holds 170 berths for vessels ranging from light speedboats to large cruisers (www.carlingfordmarina.ie).

A ferry once operated between Greenore and Holyhead. A railway line was built in 1873 to serve ferry passengers and ran from Dundalk to Greenore. This railway and the ferry were closed in 1952.

Land claim has occurred at various places across the wider lough.

Water Quality

Carlingford Lough is situated in the Neagh Bann International River Basin District, which is a cross-border river basin district. 2,000 km^2 is in the Republic of Ireland and 6,000 km^2 is in Northern Ireland (Neagh Bann IRBD, 2010).

The contributing catchment is almost 299.9 km^2 in area, the majority of which lies in Northern Ireland (DoEHLG, 2009) Land cover in the catchment is a mix of forest, rough grazing and improved grazing, with small areas of arable land. The principal freshwater input to the lough is the Newry River; other rivers on the northern side of the Lough include the Moygannon, the Rostrevor, the White Water, the Ballincurry and the Ghann.

The water quality of Carlingford Lough has been classified as 'moderate' as per the Neagh Bann International River Basin District Transitional and Coastal Waters Action Programme (Neagh Bann IRBD, 2010b); this substandard classification attributed to high nitrogen levels. The same status is applied by Northern Ireland (NIEA, 2009). Nutrient inputs, wastewater treatment plants (WWTPs) and shellfish dredging are listed as main pressures. Neagh Bann IRBD (2010c) suggests that storm water discharges are a further contributing factor.

A wastewater treatment plant at Carlingford with a design capacity of 1,700 P.E. is currently operating within capacity. It incorporates secondary treatment. Two smaller plants at Greenore and Omeath discharge untreated effluent (DoEHLG, 2009). A review of the numbers of on-site waste water treatment systems (OSWWTS) in the Republic of Ireland section of the shellfish water catchment suggests that the number is much higher than the national average. Many are located in areas of high risk to surface and groundwaters from pathogens and phosphorus and many are located in areas where the likelihood of inadequate percolation of leachate is also high (DoEHLG, 2009).

On the northern shore (Northern Ireland) the main WWTP discharges are located at Newry, Warrenpoint and Cranfield.

There is one Local Authority licenced (Section 4) discharge (leisure facility) to the lough. There are no IPPC licenced discharges (Neagh Bann IRBD, 2010c).

Recent studies found that Nitrogen is the primary limiting factor for phytoplankton growth in the Lough. Occasionally elevated and sustained levels of chlorophyll in the inner Lough are therefore probably caused by continued inputs of nutrients to this zone. Apart from this factor, there is no other evidence to suggest that the lough is detrimentally affected by anthropogenic discharges or activities and no current signs of eutrophication (Taylor et al. 1999).

While future improvements in WWTP treatment will aim to meet objectives of the Urban Waste Water Treatment Regulations (EU Council Directive 91/271/EEC, as transposed by S.I. No. 254 of 2001 as amended by S.I. 48 of 2010) and the Water Framework Directive (2000/20/EC as transposed by the European Communities (Water Policy) (Amendment) Regulations, 2010)), it should be borne in mind that there may be various consequences for the ecology of the lough, and knock-on effects upon waterbirds. For example, a reduction in

organic and nutrient loading could lead to reduced abundances of benthic invertebrate prey species (e.g. Burton et al. 2002) particularly those invertebrates that thrive (proliferate) in organically-enriched sediments. This could have effects upon the foraging distribution, prey intake rates, and ultimately upon survival and fitness of the waterbird assemblage using the lough.

On the other hand, a reduction in organic loading may benefit the seagrass species *Zostera noltii.* While the effects of changes to nutrient loading are not always clear, it is known that eutrophication may increase the cover of epiphytic algae and prevent photosynthesis of sea grass plants (Burkholder et al. 1992) with detrimental effects upon its production.

Of further relevance is that Light-bellied Brent Geese is likely currently benefiting from nutrient inputs that are 'fuelling' the abundance of green macroalgae such as *Ulva* species. Green macroalgal mats can have both negative and positive effects upon waterbird foraging ecology; some species avoiding them or being negatively affected by lowered invertebrate abundances beneath them (Lewis & Kelly, 2001), while herbivores such as Light-bellied Brent Goose and Wigeon benefit from the algae being a source of food. Ultimately changes in macroalgal abundance as a result of cessation of wastewater discharges could impact upon the foraging distribution of Light-bellied Brent Geese.

Fisheries & aquaculture

The lough supports a wide variety of aquaculture and fishing interests. Productivity appears to be high and historically shellfish growth has always flourished (McGonigle et al. 2012).

An area of 12.2 km^2 of Carlingford Lough is designated as a Shellfish Water under the EU Shellfish Waters Directive[14] (DoEHLG, 2009). This area is located along the southern shore of the lough extending across the designated Special Protection Area. The cultivation of Oysters (*Crassostrea gigas*) and bottom-grown Mussels (*Mytilus edulis*) dominates. Bottom culture is based on the principle of dredging mussel spat (seed) from areas where they have settled in abundance, and their transfer to specifically prepared plots for re-laying at lower densities, allowing for improved growth. Plots or lays are normally 'prepared' in order to allow stabilization of the bottom before seed is laid (McGoningle et al. 2012). The product is harvested through dredging.

Bottom cultivation production in Carlingford has been growing rapidly over the past 10 years (McGoningle et al. 2012). Annual production between 2000 and 2004 averaged 1,840 tonnes of mussels, whereas current production is in the region of 12,000 tonnes (McGoningle et al. 2012).

Annual production between 2000 and 2004 averaged 440 tonnes of oysters (DoEHLG, 2009). These are grown on trestles and Oyster cultivation occurs throughout the area designated as Carlingford Lough SPA (4078).

The Sea Fisheries Protection Authority (SFPA) is responsible for classifying shellfish production areas and the current classification of the Carlingford Lough Bivalve Mollusc Production Area is Class B (Production Area 3) and Class A (Production Area 5), as of 20th July 2012 (www.sfpa.ie). A Class B status requires that shellfish may be placed on the market for human consumption only after treatment in a purification centre or after relaying, so as to meet the health standards for live bivalve molluscs laid down in EC Regulations on food safety[15]; Class A however indicates that no treatment is required.

[14] Originally designated under the European Communities (Quality of Shellfish Waters) Regulations 2004 (SI 200 of 1994).

[15] Criteria for the classification of bivalve mollusc harvesting areas under Regulation (EC) No 854/2004, Regulation (EC) 853/2004 and Regulation (EC) 2073/2005.

Historically, Carlingford Lough was renowned for its herring fishery but the fishery collapsed in the 19th century as numbers of herring dropped dramatically. Similarly, a native oyster fishery (*Ostrea edulis*) collapsed in 1845 due to combined overfishing and exploitation of juveniles for reseeding other areas (Taylor et al. 1999).

Various inshore fishing activities currently occur within or close to the designated SPA. Static fishing gear activity in the area includes widespread line fishing (lines set on the seabed with baited hooks at intervals); the use of pots (baited traps set on the seabed targeting crustaceans) and the use of bottom set gill nets (curtain of netting which allow fish to swim partway through the mesh to become caught with the gills preventing backward movement) (DoEHLG, 2009). Mobile fishing gear activity includes the use of mussel, cockle and scallop dredges. The hand-gathering of molluscs also occurs and is reportedly increasing (B. Martin *pers. obs*) often with associated forms of disturbance e.g. quad bikes.

Sea angling occurs along the shoreline including shore, rock and boat fishing. Carlingford Lough is best known for tope fishing during the summer months. Charter boat services are available from Warrenpoint, Carlingford and Greencastle. The shore around Greenore lighthouse is popular and an array of species can be caught including mackerel, sea trout, pollack, spurdog, ray and dogfish. Bass may also be taken in this area while spinning at Ballaghan Point may produce mackerel, seasonal bass and pollack at high water (www.fishinginireland.info).

Management of fisheries within Carlingford Lough (and Lough Foyle) comes under the auspices of the Lough's Agency. The responsibilities of this agency are set out in North/South Co-operation (Implementation Bodies) (NI) Order 1999, the British-Irish Agreement Act 1999, the Foyle Fisheries Act (NI) 1952 (as amended) and the Foyle Fisheries Act 1952 (as amended) and are as follows:-

- the promotion of development of Lough Foyle and Carlingford Lough for commercial and recreational purposes in respect of marine, fishery and aquaculture matters;
- the management, conservation, protection, improvement and development of the inland fisheries of the Foyle and Carlingford Areas;
- the development and licensing of aquaculture;
- the development of marine tourism.

Recreational disturbance

The coastline of County Louth stretches for more than 120km from the County Down border, through Carlingford Lough as far south as the Boyne Estuary. This coastline is considered of high intrinsic, special amenity and recreational value (Louth County Council, 2009b). Indeed the coastline from Greenore through Carlingford to Omeath is a designated scenic area (Louth County Council, 2009).

Walking is a popular recreational activity and has increased in popularity in recent years. Several walkways come close to the shoreline of Carlingford Lough including the Táin Way, which extends through Carlingford.

Other

A Scoping Study for an Integrated Coastal Zone Management Plan (ICZMP) for the Lough was undertaken in 2007. This study contained a review of the roles of those responsible for the lough, detailed the conflicts and opportunities that may benefit from an ICZM approach and gave recommendations for implementation of an ICZM (Louth County Council, 2009). An ICZMP has been undertaken for the northern side of the lough and it is an action of the County Louth Development Plan (Louth County Council, 2009) to support the preparation and implementation of an ICZM for the southern side.

Carlingford to Greenore (survey Zone 2) is currently being invaded by Common Cord-grass (*Spartina anglica*) which is undermining/smothering the beds of *Zostera noltii* (B. Martin *pers. obs*). However the main pressure upon the seagrass beds noted during summer 2013 was observed to be vehicle tracks.

Wildfowling occurs at the lough, largely centred on Mill Bay on the northern shore. Mourne Game and Wildfowl Club is a local club affiliated to BASC (The British Association for Shooting and Conservation) and aims to:-

- maintain and enhance shooting in the Mill Bay area;
- encourage a high standard, of behaviour and sportsmanship;
- provide refuges for migrant fowl and waders that boost the native population each winter;
- meet head-on any threat to undermine or curtail traditional pursuits.

(http://www.wildfowling.com/mournewa/mgwca.htm)

The winter of 2010/11 was particularly cold, especially December 2010, and in response to the freezing conditions, the Department of the Environment, Heritage and Local Government extended a temporary closure of the hunting season for wild birds (8^{th} – 30^{th} December 2010 inclusive); a similar exclusion period occurred in Northern Ireland.

5.4.4 Review of disturbance during 2010/11 waterbird surveys

Disturbances to birds using the lough, and specifically the survey areas Zone 1 and Zone 2, were monitored throughout the 2010/11 waterbird survey (Martin, 2011).

The main potential sources of disturbance to waterbirds were observed to be: walkers, dog walkers, loose dogs, mussel and periwinkle gatherers, and activities associated with aquaculture production. Oyster cultivation on trestles is dominant in both Zone 1 and Zone 2.

Traffic along both the Carlingford-Mullatee road (R176) and the Ballytransna-Balaggan local road caused a degree of disturbance particularly at high tide. Golfers on the disused railway tee boxes appeared to be tolerated by waterbirds.

Loose and uncontrolled dogs were observed.

Sailing and shipping have the potential to cause disturbance, but marine recreation was minimal during the very cold winter months of 2010/11.

Disturbance from birds of prey was noted and included Buzzard (*Buteo buteo*), Merlin *(Falco columbarius*) and Peregrine Falcon (*Falco peregrinus*).

The area mainly affected by disturbance in Zone 1 was in the north of that zone, while the main area disturbed in Zone 2 was the centre. Zone 1 recorded a minimum of two walkers with dogs but on fine days this could reach up to 14 dog walkers, with loose dogs often directly disturbing birds. In Zone 2, the main disturbing activity was mussel and periwinkle pickers. These sometimes work both during the day and night.

5.4.5 Discussion

This review has highlighted that many ‘activities and events’ occur across the wider lough and the area designated as Carlingford Lough SPA (4078).

Many of the ‘activities’ identified may act so as to modify wetland habitats of the site. While physical loss might be considered more historic in nature (e.g. land claim, the construction of piers, slipways etc.), on-going modifications to intertidal habitats may occur due to changes in natural processes (e.g. sedimentation or erosion rates) as a result of former physical events.

The most obvious on-going activities within the SPA are human-related and attributed to both recreational walking (with/without dogs) and aquaculture. It is clear that both of these activities displace waterbirds. The significance of the impact that results from even a short-term displacement should not be underestimated. In terms of foraging habitat, displacement from feeding opportunities not only reduces a bird's energy intake but also leads to an increase in energy expenditure as a result of the energetic costs of flying to an alternative foraging area. Displacement also has knock-on ecological effects such as increased competition within and/or between different species for a common food source. In areas subject to heavy or on-going disturbance, waterbirds may be disturbed so frequently that their displacement is equivalent to habitat loss. When disturbance effects reduce species fitness[16] (reduced survival or reproductive success) consequences at population level may result.

Whilst the nature and the frequency of disturbance-causing activities are key factors when assessing likely impacts, many aspects of waterbird behaviour and ecology will influence a species response. Waterbird responses are likely to vary with each individual event and to be species-specific. The significance of a disturbance event upon waterbirds will vary according to a range of factors including:-

- Frequency/duration of disturbance event;
- Intensity of activity;
- Response of waterbirds.

and be influenced by:-

- Temporal availability – whether waterbirds have the opportunity to exploit the food resources in a disturbed area at times when the disturbance does not occur;
- Availability of compensatory habitat - whether there is suitable alternative habitat to move to during disturbance events;
- Behavioural changes as a result of a disturbance - e.g. degree of habituation;
- Time available for acclimatisation - whether there is time available for habituation to the disturbance. (there may be a lack of time for waterbirds during the staging period);
- Age - for example when feeding, immature (1st winter birds) may be marginalised by older more dominant flocks so that their access to the optimal prey resources is limited. These individuals may already therefore be under pressure to gain their required daily energy intake before the effects of any disturbance event are taken into account;
- Timing/seasonality - birds may be more vulnerable at certain times e.g. pre- and post-migration, at the end of the winter when food resources are lower;
- Weather - birds are more vulnerable during periods of severe cold weather or strong winds;
- Site fidelity – some species are highly site faithful at site or within-site level and will therefore be affected to a greater degree than species that range more widely;
- Predation and competition – a knock-on effect of disturbance is that waterbirds may move into areas where they are subject to increased competition for prey resources, or increased predation – i.e. the disturbance results in an indirect impact which is an increased predation risk.

Knowledge of site activities and events is important when examining waterbird distribution and understanding the many factors that might influence a species' distribution across a site. The above points also highlight the complex nature of waterbird behaviour and species specificity, as well as the need for careful consideration of the impacts of disturbance upon waterbird species when undertaking Appropriate Assessments or other environmental assessments. This review could therefore form the starting point for any future study aiming to quantify the effects of activities/disturbance events across the site, as well as to help

[16] defined as a measure of the relative contribution of an individual to the gene pool of the next generation.

identify the extent to which existing use and management of the site are consistent with the achievement of the conservation objectives described in Part Three of this document.

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APPENDIX 1

SITE NAME: CARLINGFORD LOUGH SPA

SITE CODE: 004078

Carlingford Lough SPA comprises parts of the south side of Carlingford Lough, Co. Louth, between Carlingford Harbour and Ballagan Point. The predominant habitats present are intertidal sand and mud flats

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for Light-bellied Brent Goose. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

In winter the site supports an internationally important population of Light-bellied Brent Goose (253 – all figures are five year mean peaks for the period 1995/96 to1999/2000). A range of other waterfowl species occurs within the site, including Wigeon (107), Oystercatcher (289), Dunlin (392), Bar-tailed Godwit (33), Redshank (108) and Turnstone (29). The intertidal flats provide feeding areas for the wintering birds. The sub-tidal areas outside the SPA support a range of species including Great Crested Grebe, Cormorant and Red-throated Diver.

Carlingford Lough SPA is of international importance for its Light-bellied Brent Goose population. Of note is the occurrence of Bar-tailed Godwit, a species that is listed on Annex I of the E.U. Birds Directive.

14.11.2011


CO. MONAGHAN
Dundalk
Greenore
SPA 004078
CO. LOUTH
CO. MEATH
Drogheda
Carlingford
Cairlinn
Carlingford Point
Harbour
Quay
Midden
Fire Sta
Priory
Sch
Shilties Lough
Liberties Of Carlingford
Perch
Black Rock
Greenore Point
Greenore
An Grianfort
Cliff & Coastal Rescue
Harbour
Breakwater
Railway
Dismantled
R173
R175
R176
Mullatee
Industrial Estate
Boharboy
Milligrange
Holy Well
Ballytrasna
Muchgrange
Ballynamony
Crossanley
Cairn
Bullaun Stone
Reservoir
Grange
Monkslands
Barrow
Rogans Cross
Rath Lower
Maguires Cross
Grange Old
Mucklagh
Mullabane
Ballagan
Ballagan Point
54° 00'
Petestown
Seecrin
Galtrimsland
Ardtully More
Ardtully Beg
Willville
Whitestown
Ballynamony
Ballug Castle
Ballynamaghery
Church
Templetown
Rathcor Lower
12
11
10
09
08
07
06
Legend
SPA 004078
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
CARLINGFORD LOUGH SPA
CONSERVATION OBJECTIVES
SPA DESIGNATION
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
SITE CODE: SPA 004036 version 2.01
0 0.25 0.5 0.75 1 km
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212). Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordanáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 2013

APPENDIX 2

Waterbird data sources

Irish Wetland Bird Survey (I-WeBS)
I-WeBS began in the Republic of Ireland in 1994/95 and aims to monitor wintering (non-breeding) waterbird populations at the wetland sites upon which they rely. Counts are carried out by volunteers and professional staff of the partner organisations across the months September to March of each year. I-WeBS counts take place on a rising tide or close to high tide. For further information please refer to Crowe (2005).

The I-WeBS Programme monitors the larger coastal wetland sites together with inland lakes, turloughs, rivers and callows. However the resulting dataset is incomplete for some waterbird species that utilise other habitats such as non-wetland habitat (e.g. grassland used by many species and particularly foraging geese, and swans), non-estuarine coastline, small and ephemeral wetlands and the open sea; the latter of which is obviously difficult to monitor from land-based surveys (Crowe, 2005).

A number of additional and special surveys are therefore conducted on an annual or regular basis and data collected are, where appropriate, integrated into the I-WeBS database. These surveys include those undertaken for swan and geese species that forage typically during daylight hours across terrestrial habitats (e.g. grassland, arable fields) using coastal wetlands sites at night when they congregate to roost. Some of the additional surveys are carried out at certain times, aimed at providing a better estimate of numbers (e.g. Greylag Geese) and for some species an assessment of breeding success during the previous summer (e.g. Light-bellied Brent Geese). These surveys are introduced briefly below and more information is provided in Crowe (2005).

- Swan Surveys

Coordinated international censuses are carried out of the wintering populations of Whooper Swan (*Cygnus cygnus*) and Bewick's Swan (*Cygnus columbianus bewickii*) at four or five-yearly intervals. The surveys are organised by I-WeBS, the Irish Whooper Swan Study group (IWSSG) and WWT.

- Greenland White-fronted Goose

Greenland White-fronted Geese are concentrated at relatively few sites during winter, many of which are non-wetland habitats. The species is therefore not covered adequately by the I-WeBS programme. The Greenland White-fronted Goose census was initiated in the late 1970's and is carried out by NPWS in Ireland and by JNCC and Scottish Natural Heritage (SNH) in Scotland.

- Greylag Geese

Data for the Icelandic breeding population of Greylag Goose that winters in Ireland are taken from special surveys organised through I-WeBS and undertaken during November each year. The surveys aim to assess the distribution and status of the migratory flocks wintering in Ireland and focus on known feeding areas (grassland & agricultural land). When calculating population estimates of the Icelandic birds, data collected are adjusted to account for feral flocks that also occur within Ireland.

- Barnacle Goose (*Branta leucopsis*)

A wintering population from the northeast Greenland breeding population winters mainly on offshore islands along the west coast of Ireland. An aerial survey is conducted of the principal wintering areas every four to five years.

- Light-bellied Brent Geese

Special autumn surveys of this species have been conducted since 1996 and organised in the Republic of Ireland by the Irish Brent Goose Research Group (IBGRG). The survey is currently conducted on a bi-annual basis during the month of October which coincides with the autumn arrival of the species. Data collected are integrated into the I-WeBS database.

APPENDIX 3

Analysing population trends: a synopsis

Monitoring of non-breeding waterbirds has been undertaken by the Irish Wetland Bird Survey (I-WeBS) and its partner, WeBS in Northern Ireland, since the mid 1990's. For such long-term count data, there is clearly a need to assess long-term trends in a consistent and objective manner (Atkinson et al. 2006).

The first stage in the analytical process involves the use of the Underhill Program (Underhill & Prŷs-Jones, 1994) which models the raw monthly counts using a Generalised Linear Model (GLM). As part of this process, it accounts for changes in numbers at the site and the timing of the count (month, year) while also taking into account completed counts and trends at other sites. When counts at a site are flagged as poor quality (e.g. due to poor visibility) or where there are missing values in a given month, then the modelled values are used. This imputation process is used widely to replace missing data points (e.g. Houlahan et al. 2000; Atkinson et al. 2006; Leech et al. 2002; Gregory et al. 2005; Crowe et al. 2008). The resulting dataset is therefore complete for all months and seasons and comprises a combination of actual count data and imputed count data.

This complete dataset is then modelled using a Generalised Additive Models (GAM) which fits a smoothed curve to the counts. GAMs are non-parametric and flexible extensions of the generalised linear model where the linear predictor of the GLM is replaced by a general additive predictor which allows mean abundance to vary as a smooth function of time. Count data are assumed to follow independent Poisson distribution with 0.3T degrees of freedom (e.g. after Atkinson et al. 2006). The application of GAMs to analyse population trends was applied to UK farmland birds by Fewster et al. (2000) and has since been adopted for modelling waterbird trends elsewhere, for example, the UK WeBS Alert system (Leech et al. 2002; Cook et al. 2013).

Smoothed count data for a site are then indexed to assess population trends over time. An index number can be defined as a measure of population size in one year expressed in relation to the size of the population in another selected year (Leech et al. 2002). Changes in the index numbers can therefore explain the pattern of population change over time (Underhill & Prŷs-Jones, 1994).

Annual indices are calculated separately for each species at a site. For each year included in an analysis, a total is obtained by summing the number of birds present in a predetermined number of months. The final year in the series of totals is then scaled to equal 100 (please see example in table). Index values in any given year therefore represent the number of individuals relative to those present in the final year. As this process is the same across all species and all sites analysed it allows for some useful comparisons.

Count Data	Index
264.41	128.11
262.21	127.04
234.0	113.37
126.0	61.05
197.23	95.56
206.4	100.00

Un-smoothed indices are also calculated and provide a means of examining ('eye-balling') the variation across time and can also be used to provide a measure of the mean annual change over the entire period. However, the GAM extension to the methodology and resultant smoothed indices allows for the calculation of proportional change in population size between one season and another. This latter calculation is used whereby trends are calculated for the 'long-term' 12-year period (1995–2007) and the recent five-year period (2002-2007). The values given represent the percentage change in index (population) values across the specified time period, calculated by subtracting the smoothed index value at the start of the time-frame (1995) from the smoothed index value in the reference year (2007):-

$$\text{Change} = ((I_y - I_x) / I_x) \times 100$$

where I_y is the index from the current year and I_x is the index value at the start of the selected time period (see example below)

The reference year is the penultimate year in the time series because, when smoothing, the GAM takes into account values from both the preceding and following year. The last value in the smoothed dataset (2008) is therefore likely to be the least robust because it has no following year.

The final result is therefore % change in population size across a specified time period. Larger values indicate larger proportional changes in population size; positive values indicating relative increases while negative values indicate relative decreases over the specified time period.

Worked example

Year	Unsmoothed Index	Smoothed Index
1994	0.715	0.753
1995	0.604	0.804
1996	0.739	0.835
1997	0.594	0.826
1998	0.711	0.782
1999	0.745	0.727
2000	0.618	0.691
2001	0.694	0.692
2002	0.300	0.739
2003	0.530	0.827
2004	1.348	0.936
2005	0.836	1.028
2006	0.773	1.069
2007	0.734	1.051
2008	1	1.000

Term	Change
5YR	**+ 42.80**
10YR	**+ 27.24**
ALL YR	**+ 30.72**

Further information on population indexing and trend analysis can be found in various references; for particular reference to waterbirds see Leech et al (2002) and Atkinson et al. (2006). For information on the UK WeBS Alerts system, please see Cook et al. (2013) and http://www.bto.org/webs/alerts.

Limitations

The months chosen for the calculation of population indices aim to reflect the months when the populations at a site are the most stable, excluding months when there may be fluctuations due to passage populations. Despite this, some datasets still present a high degree of variability or fluctuation both within and between years. Because of this, we assess each species separately and take into account where a species shows a history of wide fluctuations between years (within national dataset), or where a species naturally exhibits within-season fluctuations (e.g. species considered to have weak site faithfulness). Where necessary the results of the trend analysis are assigned necessary caution.

A high proportion of imputed counts can limit the effectiveness of the analysis to aid in the interpretation of the dataset. Species for which 50% or more of the monthly count values are imputed are excluded from analysis. But sometimes the calculation of population change may involve a comparison between winters where, at least one has a value based on a high proportion of imputed data. Where data for adjacent winters are relatively complete this is not a serious concern because of the smoothing technique used. However, where data for a number of consecutive winters rely heavily on imputed data then the resulting result is considered less reliable (Thaxter et al. 2010). Where necessary the results of the trend analysis are assigned necessary caution.

Despite the smoothing effects of the GAM analysis, interpretation of population trends may sometimes still be difficult. Therefore we calculate proportional change in the population across differing time periods (e.g. 12-year, 10-year and 5-year periods) to assess more effectively how the population has fared over time.

APPENDIX 4

Waterbird species codes

AE	Arctic Tern	*Sterna paradisaea*
BY	Barnacle Goose	*Branta leucopsis*
BA	Bar-tailed Godwit	*Limosa lapponica*
BE	Bean Goose	*Anser fabalis*
BS	Bewick's Swan	*Cygnus columbianus*
AS	Black Swan	*Cygnus atratus*
BH	Black-headed Gull	*Chroicocephalus ridibundus*
BN	Black-necked Grebe	*Podiceps nigricollis*
BW	Black-tailed Godwit	*Limosa limosa*
BV	Black-throated Diver	*Gavia arctica*
BG	Brent Goose	*Branta bernicla*
CG	Canada Goose	*Branta Canadensis*
CM	Common Gull	*Larus canus*
CS	Common Sandpiper	*Actitis hypoleucos*
CX	Common Scoter	*Melanitta nigra*
CN	Common Tern	*Sterna hirundo*
CO	Coot	*Fulica atra*
CA	Cormorant	*Phalacrocorax carbo*
CU	Curlew	*Numenius arquata*
CV	Curlew Sandpiper	*Calidris ferruginea*
DN	Dunlin	*Calidris alpine*
GA	Gadwall	*Anas strepera*
GP	Golden Plover	*Pluvialis apricaria*
GN	Goldeneye	*Bucephala clangula*
GD	Goosander	*Mergus merganser*
GB	Great Black-backed Gull	*Larus marinus*
GG	Great Crested Grebe	*Podiceps cristatus*
ND	Great Northern Diver	*Gavia immer*
NW	Greenland White-fronted Goose	*Anser albifrons flavirostris*
GK	Greenshank	*Tringa nebularia*
H.	Grey Heron	*Ardea cinerea*
GV	Grey Plover	*Pluvialis squatarola*
GJ	Greylag Goose	*Anser anser*
HG	Herring Gull	*Larus argentatus*
JS	Jack Snipe	*Lymnocryptes minimus*
KF	Kingfisher	*Alcedo atthis*
KN	Knot	*Calidris canutus*
L.	Lapwing	*Vanellus vanellus*
LB	Lesser Black-backed Gull	*Larus fuscus*
PB	Light-bellied Brent Goose	*Branta bernicla hrotra*
ET	Little Egret	*Egretta garzetta*

LG	Little Grebe	*Tachybaptus ruficollis*
AF	Little Tern	*Sterna albifrons*
MA	Mallard	*Anas platyrhynchos*
MU	Mediterranean Gull	*Larus melanocephalus*
MH	Moorhen	*Gallinula chloropus*
MS	Mute Swan	*Cygnus olor*
OC	Oystercatcher	*Haematopus ostralegus*
PG	Pink-footed Goose	*Anser brachyrhynchus*
PT	Pintail	*Anas acuta*
PO	Pochard	*Aythya ferina*
PS	Purple Sandpiper	*Calidris maritime*
RM	Red-breasted Merganser	*Mergus serrator*
RH	Red-throated Diver	*Gavia stellata*
RK	Redshank	*Tringa tetanus*
RP	Ringed Plover	*Charadrius hiaticula*
RU	Ruff	*Philomachus pugnax*
SS	Sanderling	*Calidris alba*
TE	Sandwich Tern	*Sterna sandvicensis*
SP	Scaup	*Aythya marila*
SU	Shelduck	*Tadorna tadorna*
SV	Shoveler	*Anas clypeata*
SY	Smew	*Mergus albellus*
SN	Snipe	*Gallinago gallinago*
NB	Spoonbill	*Platalea leucorodia*
DR	Spotted Redshank	*Tringa erythropus*
T.	Teal	*Anas crecca*
TU	Tufted Duck	*Aythya fuligula*
TT	Turnstone	*Arenaria interpres*
WA	Water Rail	*Rallus aquaticus*
WM	Whimbrel	*Numenius phaeopus*
WG	White-fronted Goose	*Anser albifrons*
WS	Whooper Swan	*Cygnus Cygnus*
WN	Wigeon	*Anas Penelope*
WK	Woodcock	*Scolopax rusticola*

APPENDIX 5

Waterbird foraging guilds (after Weller, 1999)

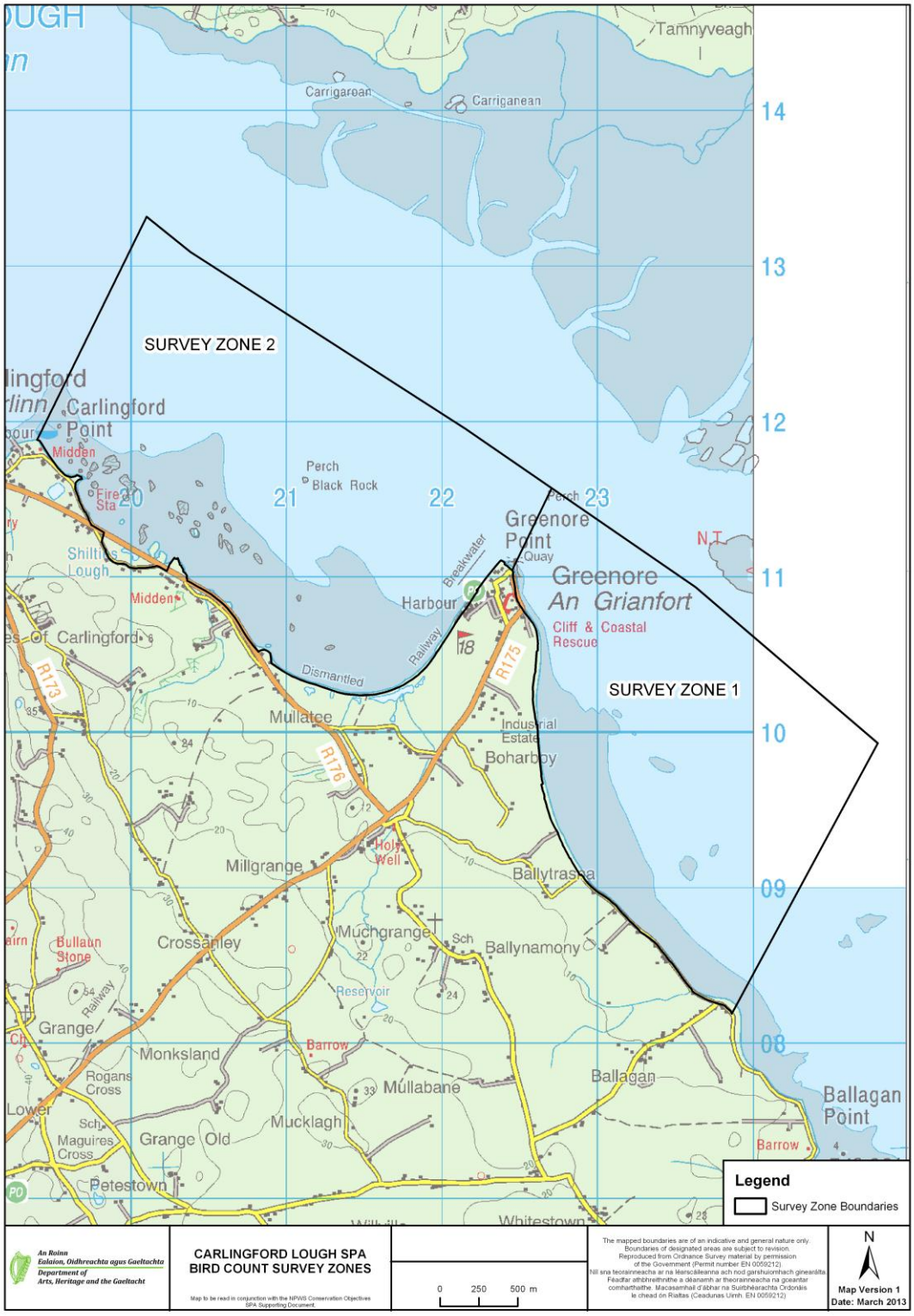
Guild	Foods	Tactics	Examples
(1) Surface swimmer	Invertebrates, vegetation & seeds	Strain/sieve/sweep/dabble/grab/up-ending	'Dabbling ducks'; e.g. Shoveler, Teal, Mallard, Pintail, Wigeon, Gadwall
(2) Water column diver – shallow[a]	Fish & Invertebrates;	Search/grab	'Diving ducks' e.g. Pochard, Tufted Duck, Scaup, Eider,
(3) Water column diver – greater depths	Fish & Invertebrates	Search/grab	Common Scoter, divers, grebes, Cormorant
(4) Intertidal walker, out of water	Invertebrates	Search (probe)/grab	Sandpipers, plovers
(5) Intertidal walker, out of water	Invertebrates, vegetation	Sieve/grab/graze	Shelduck, Avocet, Spoonbill, Wigeon, Light-Bellied Brent Goose,
(6) Intertidal walker, in water	Fish	Search/strike	Grey Heron
	Fish, Invertebrates	Probe, scythe, sweep/grab	Spoonbill, Greenshank
	Fish	Stalk	Little Egret
	Invertebrates	Probe	Several sandpiper species
(7) Terrestrial, walker (e.g. grassland/marsh)	Vegetation (inc. roots, tubers & seeds)	Graze, peck, probe	Many geese species

[a] dives <3m.

Please note that this table refers to generalised foraging strategies and is meant as a guide only. There is a great deal of variation between sites, seasons, tidal states and indeed, individual birds themselves. For example, some waterbird species may deploy several of the methods, e.g. Shelduck may forage by sieving intertidal mud (5) or by up-ending (1) and Pintail, although generally known as a 'dabbling' duck, does occasionally dive for food.

APPENDIX 6

Carlingford Lough – Waterbird Survey 2010/11 – Count Subsites



APPENDIX 7

Carlingford Lough - Activities & Events

Please note that this list is based on the current review process and is not exhaustive.

Legend:	
O	observed or known to occur in or around Carlingford Lough.
U	known to occur but unknown area (subsites)/spatial extent; hence all potential subsites are included (e.g. fisheries activities).
H	historic, known to have occurred in the past.
P	potential to occur in the future.
	Grey highlighting refers to activities that have the potential to cause disturbance to waterbirds.

Activity/Event	Zone 1	Zone 2
1. Coastal protection, sea defences & stabilisation		
1.1 Linear defences		O
1.4 *Spartina* planting/growing		O
2. Barrage schemes/drainage		
2.2 Altered drainage/river channel		O
4. Industrial, port & related development		
4.3 Slipway	O	O
4.4 Pier		O
4.8 Other		O
6. Pollution		
6.1 Domestic & urban waste water		O
6.2 Industrial		O
6.3 Landfill		H
6.4 Agricultural & forestry effluents	O	O
6.7 Solid waste incl. fly-tipping		O
6.8 Others		O
7. Sediment extraction (marine & terrestrial)		
7.1 Channel dredging (maintenance & navigation)	O	
8. Transport & communications		
8.5 Road schemes	O	O
8.7 Shipping channel, shipping lanes	O	O
8.8 Rail lines		H
12. Tourism & recreation		
12.6 Power boating & water-skiing		O
12.7 Jet-skiing		O
12.8 Sailing		O
12.9 Sailboarding & wind-surfing		O
12.10 SCUBA & snorkeling		O
12.11 Canoeing		O
12.13 Rowing		O
12.14 Tourist boat trips		O
12.15 Angling		O
12.16 Other non-commercial fishing		O
12.18 Walking, incl. dog walking		O
12.19 Birdwatching	O	O
12.22 Motorised vehicles		O
12.25 Golf courses		O
14. Bait-collecting		
14.1 Digging for lugworms/ragworms		O
15. Fisheries & Aquaculture		
15.6 Molluscs - hand-gathering		O
15.9 Intertidal aquaculture e.g. trestles		O
16. Agriculture & forestry		
16.13 Land-claim	P	H/P