Deep Green Holyhead Deep Project Phase I (0.5 MW)

Offshore Habitats Regulations Assessment (HRA) Report

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1 INTRODUCTION

1.1 Introduction

This document presents the findings from the Habitat Regulations Assessment (HRA) for Phase I of the Minesto Deep Green (DG) Holyhead Deep Project. Where appropriate it draws on the following:

> The Crown Estate (2014). Wave and tidal further leasing plan HRA: summary report for Holyhead Deep project site (and supporting documentation); and

> NRW Tidal stream energy checklist – west of Holy Island, Anglesey.

1.2 Habitats Regulations Assessment (HRA)

The Habitats Directive affords protection to European sites designated under the Habitats Directive (Special Areas of Conservation (SACs)) and the Birds Directive (Special Protection Areas (SPAs)), collectively referred to as Natura 2000 or European sites. Under Article 6(3) of the Habitats Directive (EC Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna) any plan or project which is not directly connected with or necessary to the management of a European site but would be likely to have a significant effect on such as site, either individually or in-combination with other plans and projects, shall be subject to an Appropriate Assessment of its implications for the European site in view of the site's conservation objectives.

The Habitats Directive applies the precautionary principle to these sites and projects can only be permitted when it is ascertained that there will be no adverse effect on the integrity of the site(s) in question. Where adverse effects are identified a project may only be permitted in the absence of alternative solutions if there is an Imperative Reason of Overriding Public Interest (IROPI) for the project to go head. Where this is the case, Member States are required to take all compensatory measures necessary to ensure that the overall coherence of the Natura 2000 network is protected.

The Habitats Directive is transposed in England and Wales by the Conservation (Natural Habitats &c.) Regulations 1994 which covers onshore areas and territorial waters (out to 12 nm).In accordance with these Regulations, the effects of a project on the integrity of a European site are assessed and evaluated as part of the HRA process. The approach for carrying out an HRA of the DG Holyhead Deep Project is described in Section 2.

It should be noted that the possible SACs and potential SPAs, which underwent consultation in early 2016, have been considered in the HRA.

1.3 Project background and overview

Minesto is a marine energy technology company that has developed a unique, award winning technology for cost effective electricity generation from tidal and ocean currents known as Deep Green. The unusual design of Deep Green enables cost effective operation in low velocity deep water sites. Minesto intends to develop the DG Holyhead Deep Project off the west coast of Anglesey, Wales (Figure 1.1).

Phase I of the DG Holyhead Deep Project will consist of a single 0.5 MW fully submerged tidal energy power plant, known as a Deep Green Utility (DGU) unit. The DGU generates energy by using water current flow to move an underwater kite with a small turbine attached to its underside. The kite will operate in mid-water and be fixed to the seabed by a tether, which also transmits electricity generated by the device. The electricity will then be transmitted directly to a meter located on an on-site barge, so the output of the device can be monitored and optimised. The single device and associated infrastructure, will be tested for a period of up to 5 years. This first device will ultimately be the first device of a future grid connected array (which will be subject to a separate application including ES and HRA report).

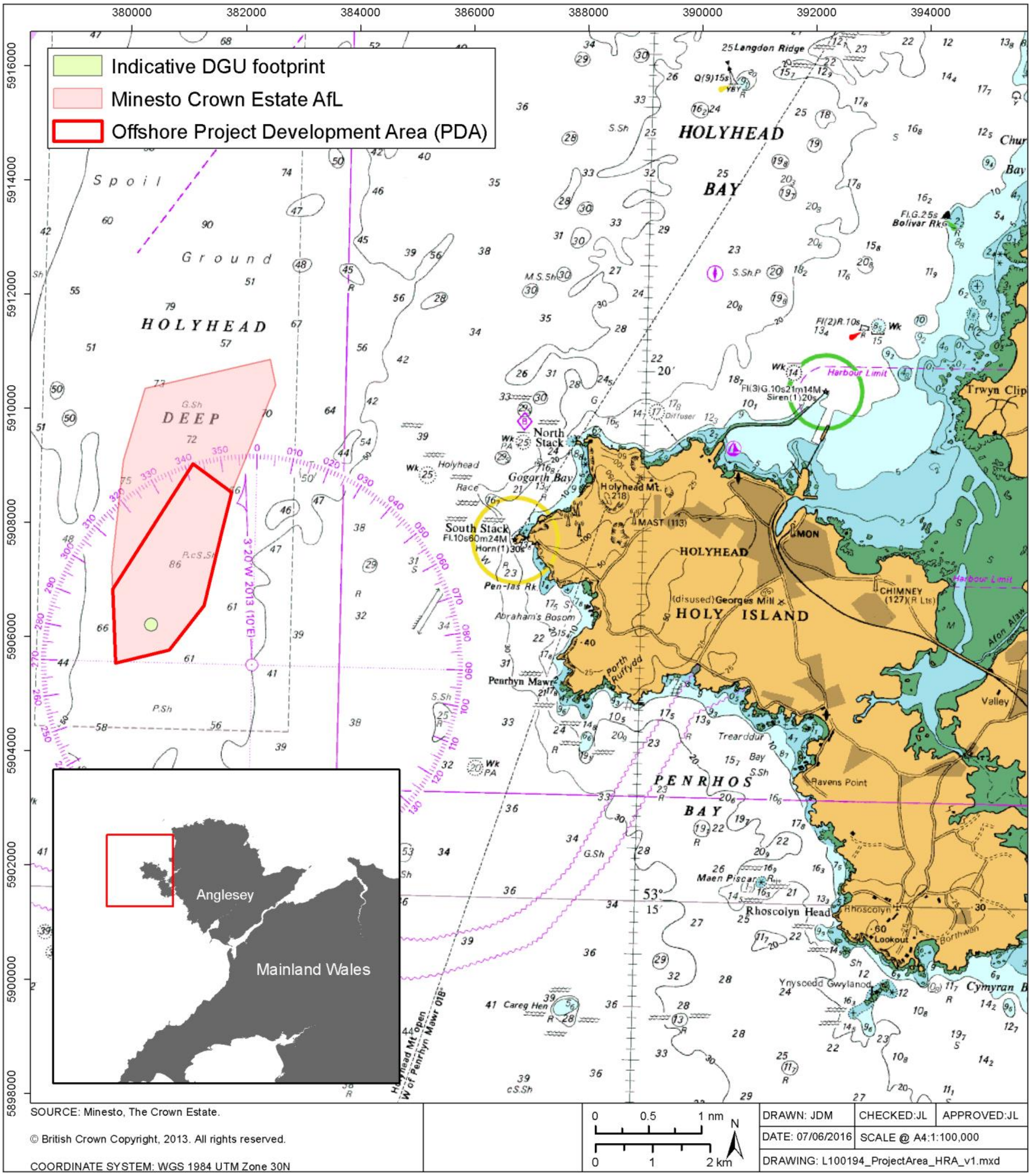

Figure 1.1 Project area

2 APPROACH TO HRA

2.1 Overview of approach to HRA

Having determined that the Project is not directly connected with, or necessary for the management of a European site for nature conservation, it is necessary to carry out screening to identify whether there is potential for the Project to have a Likely Significant Effect (LSE) on a Natura site (SAC or SPA including draft, candidate and proposed/possible sites). For those sites where it cannot be concluded that there will be no LSE, an Appropriate Assessment is required.

The proposed approach to the HRA for the DG Holyhead Deep Project is described below, and illustrated in Figure 2.1. It is in line with Article 6 of the Habitats Directive, HRA Case Law and best practice guidance.

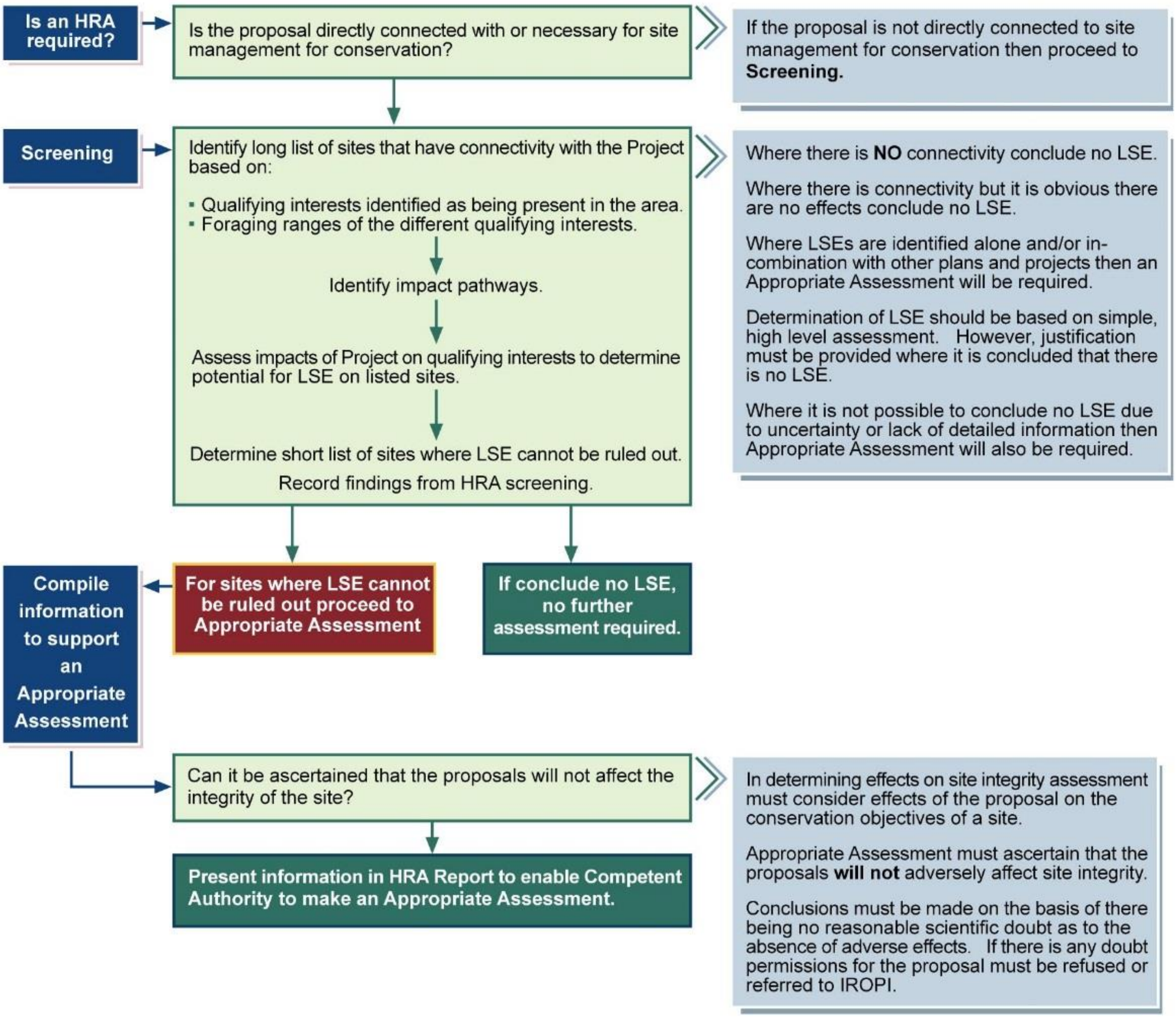

Figure 2.1 Approach to HRA

2.2 HRA screening

The main objective of HRA screening is to conclude whether there will or will not be LSEs on a European site. The assessment of LSE is based on a coarse, high level filtering of qualifying interests and associated European sites based on:

> Evidence that qualifying interest(s) are present in the Project area/zone of impact associated with the Project and likely use of the area e.g. foraging / breeding;

> Whether there is connectivity between the Project and the qualifying interests of a European site based on:
  - Foraging distances from breeding colonies (seabirds) (e.g. Thaxter *et al*., 2012);
  - Proximity to foraging and breeding sites (marine mammals and fish);
  - Migration routes (migratory wildfowl, marine mammals and fish);
  - Influence of tidal flow/sediment dynamics on benthic/intertidal Annex I habitats;
  - Indirect connectivity with other qualifying interests (e.g. fresh-water pearl mussel due to life cycle ecology of salmonids);

> The range of impacts that the Project could have on qualifying interest(s) of a site (impact pathways); and

> Whether that qualifying interest(s) would, by virtue of its behavioural and foraging characteristics, be affected by a particular impact (species sensitivity).

Where potential impacts on a qualifying interest are identified, further evaluation is undertaken to determine whether or not the Project (alone or in-combination with other Projects) will or will not have LSEs on the site taking into account appropriate mitigation (conclusion of LSE or no LSE). Where it is obvious that there is no connectivity or impact pathway between the Project and a site, it should be concluded that there is no LSE. No LSE should also be concluded for trivial effects (minor effects on qualifying interests that will not have a significant effect on a site) despite there being connectivity providing there is sufficient evidence to support this conclusion.

HRA screening has been informed by available information from the relevant impact assessment studies to determine with certainty whether the Project is likely to have a significant effect on a European site, or not. This approach ensures that sites and qualifying interests where significant effects are not likely to occur (conclusion no LSE) are screened out of the HRA process, thereby reducing the total number of sites identified as requiring an Appropriate Assessment. The result of this is that the Appropriate Assessment focuses specifically on those sites where LSE cannot be ruled out, rather than a long list of sites where LSE may or may not occur.

2.3 Appropriate Assessment

For sites where it cannot be concluded that there is no LSE an Appropriate Assessment is required to ascertain whether the Project will have an adverse effect on the integrity of a European site in view of the sites conservation objectives.

It is the responsibility of the developer to provide sufficient information, as part of the HRA process, to enable the Competent Authority to carry out an Appropriate Assessment of the Project. In this case the Competent Authority is Natural Resources Wales (NRW) with regards to the Marine Licence application.

For all sites and associated qualifying interests where LSEs cannot be rules out, necessary information required to inform an Appropriate Assessment (provided in this HRA Report) includes:

> Details on the sites Conservation Objectives;

> The current condition status of the sites qualifying interests e.g. Favourable Conservation Status;

> Site specific (e.g. SAC and SPA) and regional population estimates for specific qualifying interests;

> Assessment of potential impacts on qualifying interests – this is a detailed assessment of impacts based on information from the Environmental Impact Assessment (EIA);

- Importance of the Project area (and zone of impact) for the relevant qualifying interest based on seasonal abundance / density estimates in context of site and regional populations (e.g. % of site / regional population present in Project area); and
- Where relevant, information on demographic parameters for specific qualifying interests.

2.3.1 Assessment of population level impacts

To determine whether there would be an adverse effect on the integrity of a Natura site it is necessary to determine whether the Project will affect the viability of the site population (for the specific qualifying interest where LSE cannot be ruled out). Impacts on a site population may also need to be considered in the context of the wider regional population of a species.

For the viability of an SAC or SPA population to be significantly affected, the Project would normally have to cause a change to the population's productivity or mortality rates. Typically these parameters would need to change by at least 1% of their baseline rate for the change to be considered significant.

2.3.2 Assessment of in-combination and cumulative effects

The assessment of effect of the Project on site integrity is also considered with respect to other plans and projects. The plans and projects considered as part of the HRA are the same as those considered for the EIA to ensure consistency across both processes (Chapter 8 of the ES). The location of these projects are shown in Figure 2.2. Key renewables projects included:

Wave and tidal

- West Anglesey Demonstration Zone (1.2 km)
- Minesto Phase II (0 km)
- Skerries (18 km)
- Ramsey Sound (160 km)
- South Pembrokeshire Demonstration Zone (200 km)
- St David's Head (158 km)
- Strangford Lough (Minesto 1) (130 km)
- Strangford Lough (SeaGen) (128 km)
- Mull of Galloway (146 km)
- North Devon Demonstration Zone (233 km)

Offshore wind

- Oriel Wind Farm (105 km)
- Dublin Array (73 km)
- Codling Bank and Codling Bank II (68 km)
- North Hoyle (88 km)
- Rhyl Flats (73 km)
- Burbo Bank and Burbo Bank Extension (107 km)
- Gwynt y Môr (74 km)
- Arklow Bank Phases 1 and 2 (84 km)
- Solway Firth / Robin Rigg (East and West) (172 km)
- Walney 1, 2 and Walney Extension (112 km)
- Barrow (123 km)
- Ormonde (123 km)
- West of Duddon Sands (111 km)

2.4 HRA Report

This report includes results from both HRA screening and information required to inform the Appropriate Assessment for the offshore components of Phase I of the DG Holyhead Deep Project. This HRA report has been prepared for submission to NRW alongside the DG Holyhead Deep Project ES. Where appropriate, references are made to specific data and evidence presented in the ES and other supporting reports.

2.5 Types of European site included in the HRA based on qualifying features

Based on the information presented in the EIA Scoping Report, the proposed HRA approach document (Xodus, 2015a) and the DG Holyhead Deep Offshore Project ES, the types of sites shown in Table 2.1 have been considered in this HRA.

Table 2.1 Types of sites considered within this HRA document

Designation	Qualifying interest(s) (type)
Special Protection Areas (SPAs) including potential SPAs (pSPAs)*	Seabirds
Special Areas of Conservation (SACs) including possible SACs (pSACs)	Marine mammals Migratory fish
* Where SPA boundaries are contiguous with the boundary of a Ramsar site, potential effects on these sites will be assessed as part of the assessment of effects on the SPA. A separate assessment of effects on Ramsar sites has not been included in this report as these sites are designated under different legislation and are not subject to HRA under the Habitat Regulations.	

2.6 Scoped out European sites

The benthic desk study carried out as part of the Project (Xodus, 2014a) confirmed that although there are some areas of Annex I habitat within the Project area, there are no SACs designated for either benthic or intertidal habitats either within or adjacent to the Project area or within the wider study area for benthic ecology. It has therefore been determined that, on the basis there is no connectivity between the Project and SACs designated for benthic (or intertidal) habitats and therefore these sites do not require any further consideration as part of the HRA.

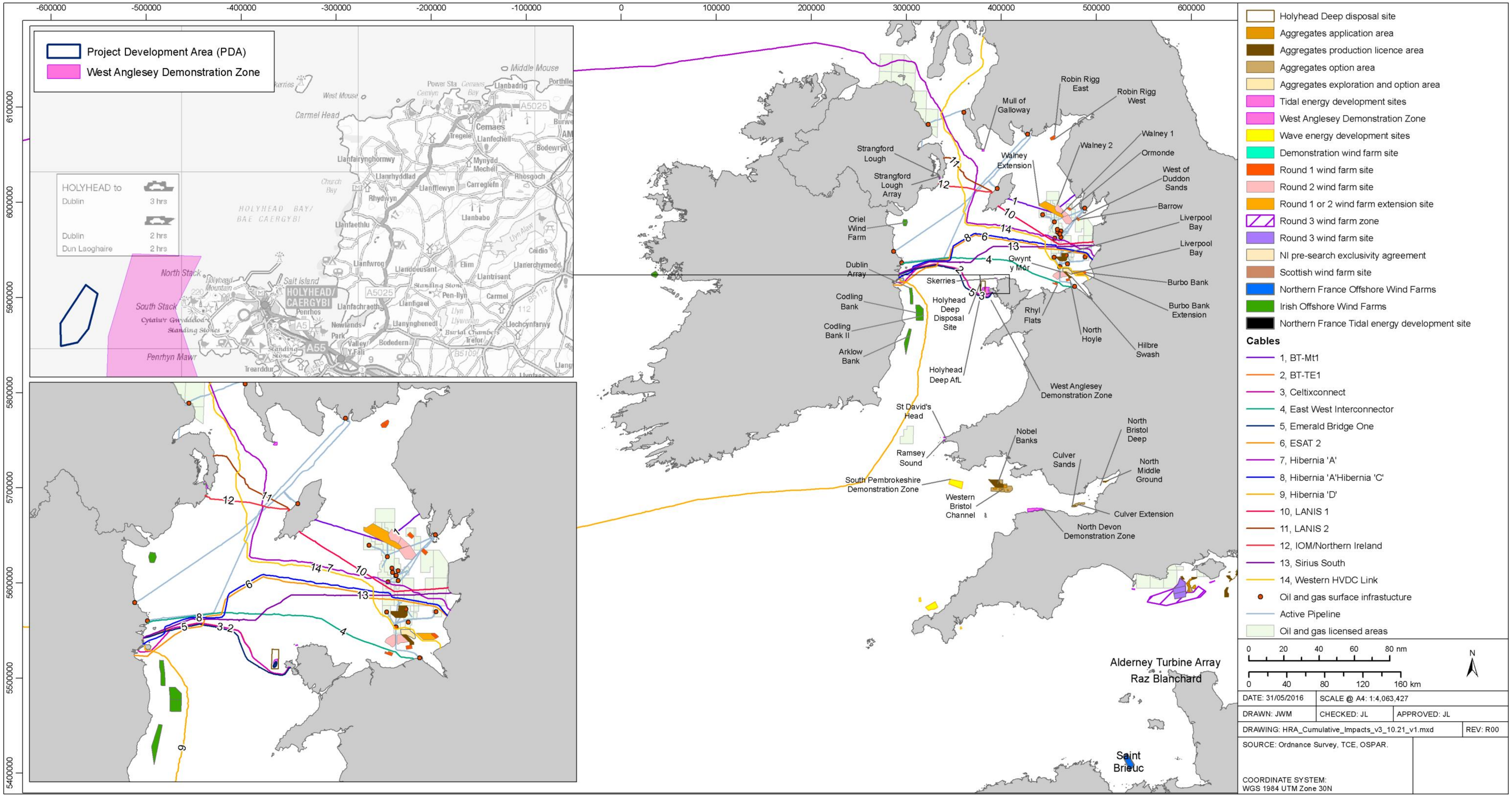

Figure 2.2 Projects considered when making selection for cumulative impact assessment within the HRA

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2.7 Relevant specialist studies carried out to inform the EIA

2.7.1 Baseline characterisation

Both the ornithology and marine mammal impact assessments involved an extensive review and collation of key data. Technical baseline summary reports (Xodus, 2014b, NRP, 2016) were prepared to inform the impact assessments. Summaries of these baseline reports are included in the relevant chapters of the ES.

2.7.2 Impact assessment

As part of the EIA, the assessment of potential impacts on birds and marine mammals was informed by encounter rate and collision risk modelling respectively.

The potential risk of collision between the DGU unit and marine mammals was assessed using a fully simulated collision risk model (CRM) developed by the Sea Mammal Research Unit (SMRU). The CRM applied to this Project was based on a redeveloped version of an earlier model developed by SMRU for the 1:4 scale version of the DGU unit deployed in Strangford Lough. The redeveloped CRM framework makes use of real DGU movement data collected by Minesto under different tidal conditions in order to understand the potential for marine mammal encounter at various states of the tide and therefore operation of the DGU. Further information on the results from the CRM framework are provided in the CRM report (SMRU Consulting, 2015) and in Chapter 11 of the ES.

Encounter Rate Modelling (ERM) in order to assess potential impacts on birds was carried out by Natural Research (Projects) Ltd (NRP). This modelling made use of an ERM method developed by SRSL (Wilson *et al*., 2007) and further elaborated by Band (EMEC, 2014). ERM estimates the number of encounter events per unit time per device based on the relative velocities (i.e., closing velocity) of the device components and a swimming animal, and their sizes and density. Modelling was undertaken for the two DGU Units deployment modes, namely ‘normal’ mode (seabed mounted) and ‘upside down’ mode (barge mounted). The aim of the modelling was to predict the annual number of encounters between adult birds of diving species and the moving parts of the DGU unit for the breeding and non-breeding season. An unusual aspect of the DGU unit device is that it comprises several distinct moving components of different size and shapes, one of which is a long tether fixed either to the seabed or to a floating barge. Since the ERM assumes a simple shape for the collision surface of the device, separate models were developed for each major component part (tether, kite struts and turbine) and the collision rates for the separate components were summed to give the rate for a single DGU unit. Further information on the results of the ERM are provided in the ERM report (NRP, 2016) and in Chapter 12 of the ES.

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3 SPAS – ORNITHOLOGY

3.1 Introduction

This section presents results from HRA screening, and subsequent information required to inform an Appropriate Assessment, with respect to SPAs that could potentially be impacted by the Project. Both HRA screening and the provision of data to inform an Appropriate Assessment has been informed by information presented in findings from the ornithological desk study presented in Offshore Ornithological Baseline Report (Xodus, 2014b), the collision risk modelling study (NRP, 2016) and results from the ornithological impact assessment presented in Chapter 12 of the ES.

SPAs are designated for the protection of rare, threatened or vulnerable bird species listed in Annex I of the Birds Directive, and also for regularly occurring migratory species. In terms of identifying SPAs that are capable of being affected by the offshore components of the Project, this assessment focuses specifically on SPAs where seabirds are the qualifying interest, on the basis that there is potential for these birds to use the waters in and around the Project area for foraging or other activities. Given that non-seabird species e.g. wetland birds of international importance (passage or wintering wildfowl, waders or waterfowl which forage in intertidal and coastal habitat such as coastal lagoons, saltmarsh, mudflats, sandflats and shallow inshore coastal waters) are highly unlikely to be present in the offshore Project area, the potential for these species to be impacted by the Project is limited. It has therefore been determined that these species, and all SPAs designated specifically for these species e.g. Liverpool Bay SPA do not require any further consideration as part of the HRA.

Similarly, sea ducks (e.g. common scoter, common goldeneye, common eider and greater scaup), divers (red throated diver) and grebes (Slavonian grebe) have also been identified as not requiring consideration as part of this HRA on the basis that, although they forage at sea, their habitat is generally restricted to shallow (up to 20 m depth) coastal waters e.g. sea lochs, sheltered coastlines, large bays and estuaries where they forage on molluscs, crustaceans, aquatic insects and worms (Birdlife International, 2015; Natural England, 2012; COWRIE, 2002). Given that the offshore Project area lies approximately 6.5 km off Holy Island and is located in a large depression in the seabed known as the Holyhead Deep, where depths range from approximately 50 to 96 m, the potential for sea ducks to be present or forage in the offshore Project area is very limited. The potential for impacts on these species, and therefore any SPAs where these species are a qualifying interest where the PDA is within the foraging ranges for these species, is negligible.

The Holy Island Coast SPA, which is designated for chough, has also been screened out of the HRA for this Project. This is on the basis that, whilst the species is of high local importance, occupies coastal habitats and breeds in coastal locations e.g. nests on cliffs and in caves, it forages onshore on insects and larvae and therefore will not be present in the offshore Project area and will not be impacted by the offshore components of the Project. Potential impacts on chough and the Holy Island Coast SPA will be considered as part of the HRA to support the separate application for a future array of devices, including onshore grid connection.

Information presented in this chapter includes:

> List of seabird SPAs (including pSPAs) requiring consideration as part of the HRA based on qualifying interests of the site and connectivity to the PDA;

> Determination of Likely Significant Effects (LSE) for the long list of sites based on potential impacts of DGU unit on a sites qualifying interests and species sensitivity;

> Final list of SPAs where LSE cannot be ruled out; and

> Information to inform an Appropriate Assessment for SPAs where LSE could not be ruled out.

3.2 Baseline desk study

As discussed in Chapter 12 of the ES: Ornithology, given the very small offshore Project area and the deployment of only a single DGU unit, the approach taken to the collation of baseline data for the EIA and HRA was to undertake a detailed ornithological desk based study utilising a number of sources of existing data available for the Project and surrounding area. This includes data from previous surveys undertaken as part of the nearby Skerries project, surveys for the Irish Sea offshore wind zone, together with data on regional distributions, abundances and trends acquired from various sources including European Seabirds at Sea (ESAS) data (JNCC, 2014), Wildlife and Wetlands Trust (WWT) aerial bird survey data 2007/2008 (WWT, 2009), JNCC Seabird Colony Register (JNCC, 2014b), RSPB data records for South Stack, RSPB FAME (Future of the Atlantic Marine Environment) and STAR (Seabirds Tracking and Research) Projects and National Parks and Wildlife Service (NPWS) (Ireland) Protected Sites Database.

3.3 HRA Screening - species and SPA identification

In order to determine which SPAs require consideration as part of the HRA, it is necessary to identify which seabird species are most likely to be present in the Project area. Having identified which species are most likely to be present in the Project area, it is then necessary to determine whether the Project area lies within the foraging range distance of birds from SPAs where that species is a qualifying interest. Table 3.1 below lists the most commonly occurring seabird species in Welsh waters (WAG, 2011), the mean maximum and maximum foraging ranges for each species (based on Thaxter *et al.,* 2012) during breeding and SPAs where the listed species is a qualifying interest that are located within the mean maximum foraging range from the Project area.

It should be noted the species listed in Table 3.1 are breeding seabirds only. While it is acknowledged that seabirds may also be present in the Project area during the non-breeding period it is very difficult to apportion these birds to specific SPAs, as discussed in the MacArthur Green (2014) report on defining biological appropriate, species-specific, geographic non-breeding season population's estimates for seabirds. The MacArthur Green report used existing data and literature in order to determine biologically defined minimum population scales (BDMPS) for key seabird species. For many seabirds, once breeding is complete, individuals are no longer restricted to foraging within certain distances (foraging ranges) from their breeding colony as there is no longer any requirement to return to their eggs / chicks. For a number of key species there is strong evidence that once birds leave the breeding colony they become widely dispersed over large distances, often intermingling with birds from other breeding colonies (same species) and in some cases birds that have migrated to UK waters for the winter from overseas breeding colonies (MacArthur Green, 2014). Consequently, given that individuals from an SPA population become so widely dispersed the potential for the Project to impacts any of these birds during this period becomes significantly diluted as it is not possible to know which SPA birds present on the site actually belong to. Potential impacts on birds during the non-breeding season therefore are expected to be negligible and not significant and not considered further in this HRA.

Table 3.1 Seabird species in Welsh waters and associated SPAs requiring consideration in the HRA

Species	Relative population abundance in Welsh waters Note 1	MMFR (km) Note 2	MaxFR (km)	Relevant SPAs	Species requiring consideration in HRA?
Arctic skua	-	62.5	75	Project lies beyond foraging range of birds from SPAs where this species is a QI	No
Arctic tern	Low	24.2	30	Ynys Feurig, Cemlyn Bay and The Skerries SPA Anglesey Terns pSPA	Yes
Atlantic puffin	Low	105.4	200	Ireland's Eye SPA Lambay Island SPA Skokholm and Skomer SPA* Skomer, Skokholm and the seas off Pembrokeshire pSPA*	Yes
Black-legged kittiwake	Low	60	120	Howth Head Coast SPA* Ireland's Eye SPA* Lambay Island SPA* Wicklow Head SPA*	Yes
Common guillemot	Low	84.2	135	Ireland's Eye SPA Lambay Island SPA	Yes
Common tern	Medium	15.2	30	Ynys Feurig, Cemlyn Bay and The Skerries SPA Anglesey Terns pSPA	Yes

Species	Relative population abundance in Welsh waters[Note 1]	MMFR (km)[Note 2]	MaxFR (km)	Relevant SPAs	Species requiring consideration in HRA?
European shag	Low	14.5	17	Project lies beyond foraging range of birds from SPAs where this species is a QI	No
European Storm-petrel	Low	Unknown	>65	Skokholm and Skomer SPA* Skomer, Skokholm and the seas off Pembrokeshire pSPA*	Yes
Great black-backed gull	-	Unknown	Unknown	Project lies beyond foraging range of birds from SPAs where this species is a QI	Yes
Great cormorant	High	25	35	Project lies beyond foraging range of birds from SPAs where this species is a QI	No
Great skua	-	10.9	219	Project lies beyond foraging range of birds from SPAs where this species is a QI	No
Herring gull	Medium	61.1	92	Ireland's Eye SPA* Lambay Island SPA* Skerries Islands SPA*	Yes
Lesser black-backed gull	High	141	181	Lambay Island SPA, Ribble and Alt Estuaries SPA, Morecambe Bay SPA, Skokholm and Skomer SPA Skomer, Skokholm and the seas off Pembrokeshire potential SPA, Morecambe Bay and Duddon Estuary pSPA	Yes
Little tern	Low	6.3	11	Project lies beyond foraging range of birds from SPAs where this species is a QI	No
Manx shearwater	High	18.3	330	Aberdaron Coast and Bardsey Island SPA Lambay Island SPA* Skokholm and Skomer SPA* Skomer, Skokholm and the seas off Pembrokeshire potential SPA, East Coast (Northern Ireland) Marine pSPA*	Yes
Northern fulmar	Low	400	580	Lambay Island SPA Rathlin Island SPA	Yes
Northern gannet	High	229.4	590	Grassholm SPA Saltee Island SPA Ailsa Craig SPA	Yes
Razorbill	Medium	48.5	95	Ireland's Eye SPA* Lambay Island SPA*	Yes
Red-throated diver	Unknown	9	9	Project lies beyond foraging range of birds from SPAs where this species is a QI e.g. Northern Cardigan Bay pSPA	
Roseate tern	Low	16.6	30	Ynys Feurig, Cemlyn Bay and The Skerries SPA Anglesey Terns potential SPA	Yes
Sandwich tern	Low	49	54	Ynys Feurig, Cemlyn Bay and The Skerries SPA Anglesey Terns pSPA	Yes

Note[1] based on information from the Welsh Assembly Government report on the underwater ecology of diving seabirds in Welsh waters (WAG, 2011).

Note[2] Mean Maximum Foraging Ranges for breeding seabirds based on Thaxter *et al.,* 2012.

* Project area lies beyond the Mean Max Foraging Range (MMFR) but is within the Maximum Foraging Range (MaxFR) from SPAs where the listed species is a qualifying interest.

3.3.1 Long list of sites requiring consideration as part of the HRA

Based on the outcome of species and site identification, Table 3.2 lists all SPAs that have been identified as requiring consideration as part of the HRA. The location of these sites are shown in Figure 3.1.

Table 3.2 SPAs to be considered as part of the HRA

SPA	Distance from Project area	Qualifying interest*
Anglesey Terns pSPA	0 km	Possible new marine SPA in seas around Anglesey for Arctic, common, Sandwich and roseate terns
Skomer, Skokholm and the seas off Pembrokeshire pSPA	180 km	Possible new marine SPA off south west coast of Pembrokeshire identified for Manx shearwater** and Atlantic puffin** during breeding season
Ynys Feurig, Cemlyn Bay and The Skerries SPA	16 km	Arctic tern, common tern, Sandwich tern, roseate tern
Aberdaron Coast and Bardsey Island SPA	53 km	Manx shearwater
Ribble and Alt Estuaries SPA	135 km	Lesser Black-backed Gull during breeding season and a seabird assemblage of international importance.
Howth Head Coast SPA	84 km	Kittiwake**
Ireland's Eye SPA	85 km	Herring gull** Kittiwake** Common guillemot Razorbill**
Skerries Islands (Ireland) SPA	90 km	Herring gull
Lambay Island SPA	83 km	Northern fulmar Lesser black-backed gull Herring gull** Kittiwake** Common guillemot Razorbill** Atlantic puffin
Rathlin Island SPA	240 km	A seabird assemblage of international importance (due to large distance from Project, only relevant species is northern fulmar).
Skokholm and Skomer SPA	180 km	European storm petrel** Lesser black-backed gull** Manx shearwater** Atlantic puffin**
Wicklow Head SPA	90 km	Kittiwake**
Grassholm SPA	180 km	Northern gannet
Saltee Islands SPA	175 km	Northern gannet Northern fulmar** Atlantic puffin** Lesser black-backed gull**
Ailsa Craig	220 km	Northern gannet

SPA	Distance from Project area	Qualifying interest*
East Coast (Northern Ireland) Marine pSPA	117 km	Manx shearwater**
Morecambe Bay and Duddon Estuary pSPA	126.5 km	Lesser black-backed gull
Morecambe Bay SPA	132.5 km	Lesser black-backed gull

* Some sites are designated for more species. However, only those species (qualifying interests) that have foraging ranges (Mean Max Foraging Range (MMFR) and Max Foraging Range (MaxFR)) that potentially extend as far as the Project area are listed in the table.

** Site beyond MMFR but within MaxFR for qualifying interest.

3.3.2 Potential impacts on seabirds

Based on findings from impact assessment (Chapter 12 of the ES) the key potential impacts of the Project on seabirds include:

> Collision risk between DGU unit and diving seabirds;

> Disturbance from vessels and other operations;

> Displacement from presence of barge;

> Pollution from accidental events;

> Indirect effects from changes in habitat and prey; and

> Cumulative and in-combination impacts.

Displacement of seabirds to any appreciable extent is only plausible in response to the presence of vessels and other structures that are at or extend above the sea surface. The only such Project structure will be the barge that will be moored in the Project area for up to five years. Such structures are likely to be visually detected by flying birds or birds on the sea surface at distances of up to at least 1 km away, and thus could potentially cause displacement from relatively large areas of seas and thereby effectively reduce access to foraging habitat. It is not considered plausible that diving birds could show a displacement response to sub-surface Project structures of a magnitude that could compromise SPA integrity, such as the DGU unit. This is because the visual cues alerting diving birds to the proximity of sub-surface structures would be effective only at distances up to a few tens of metres, at most, due to the underwater low visibility and hence any displacement would be limited to a very small spatial scale.

3.3.3 Sensitivity to impacts

Different species of seabird vary in terms of their sensitivity to the impacts listed above and therefore their potential to be impacted by the Project. Therefore not all qualifying interests of the SPAs listed in Table 3.1 and shown in Figure 3.1 will be affected by the Project. Consequently these species can be screened out of the HRA on the basis that there is no impact pathway. Similarly if any of the qualifying interests of the SPAs listed in Table 3.1 are known not to use the Project area (or potential impact zone associated with the Project) or it is considered highly unlikely for them to use the Project area (or Project impact zone), then these species can also be screened out of the HRA on the basis that there is no connectivity).

The review of the sensitivity of species to potential impacts is based on the sensitivity index developed by Furness *et al.,* (2012) which ranks species according to their sensitivity to tidal devices. Although the sensitivity index was originally developed for tidal projects in Scottish Waters, it is directly applicable to projects located elsewhere in UK waters where the same species are present and therefore potentially at risk of being impacted by the Project.

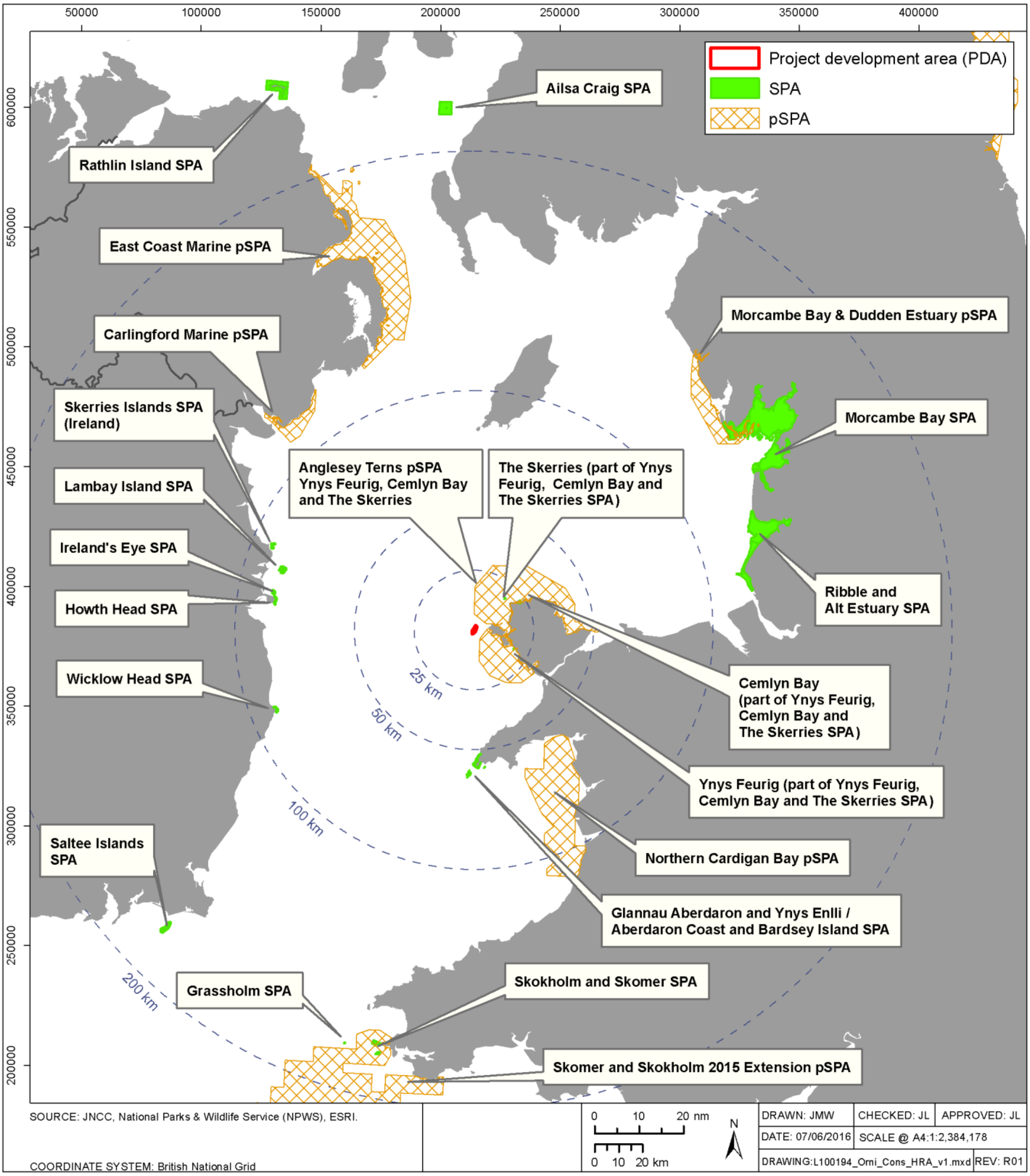

Figure 3.1 Location of SPAs considered as part of the HRA

The species rankings are based on overall scores of sensitivity taking into account a range of sensitivity factors which are evaluated against a scale of 1 to 5, where 5 is a strong negative impact (Furness *et al.,* 2012). The sensitivity factors include consideration of: drowning risk; mean and maximum diving depth; benthic foraging; use of tidal races for foraging; feeding range; disturbance of ship traffic; and habitat specialisation. Although other factors such as impacts of anti-fouling paints on structures or chemical spillages associated with the structures, were considered not to represent a significant threat to seabirds (Furness *et al.,* 2012), guidance from Wiens *et al.,* (1995) suggested that certain species e.g. common guillemot, razorbill, Atlantic puffin and Northern gannet are highly sensitive surface pollutants. The overall sensitivity index scores range from 0 to 25. These spread of scores is divided into five descriptor categories: which range from: very low sensitivity at 1 or less than 1 through to very high sensitivity between 10 and 25 (Furness *et al.,* 2012). The overall sensitivity scores for species that use the Project area are presented in Table 3.3.

Table 3.3 Sensitivity to impacts from tidal devices (Furness *et al.,* 2012)

Species	Sensitivity index	Sensitivity descriptor on 5-point scale
Artic tern	1.9	2: low
Atlantic puffin	3.8	3: moderate
Black-legged kittiwake	0.9	1: very low
Common guillemot	9.0	4: high
European storm petrel	0.5	1: very low
Herring gull	0.8	1: very low
Lesser black-backed gull	0.7	1: very low
Manx shearwater	1.5	2: low
Northern gannet	1.4	2: low
Northern fulmar	0.5	1: very low
Razorbill	9.6	4: high
Roseate tern	1.0	2: low
Sandwich tern	1.1	2: low

3.3.4 Key species requiring consideration with regard to HRA

The assessment of Likely Significant Effects (LSEs) considers both the importance of the Project area for specific qualifying interests in context of the regional population for that species and the sensitivity of each qualifying interest to the impacts listed above. As identified in Table 3.3, and drawing on results from the impact assessment (Chapter 12 of the ES: Ornithology), it can be concluded that there are three species that could potentially be impacted by the Project:

- Razorbill;
- Common guillemot; and
- Atlantic puffin.

3.3.5 Assessment of Likely Significant Effects (LSE)

The assessment of LSE focuses on those sites where the three species identified above as having greatest potential to be impacted by the Project. For SPAs that are not designated for those species, there is considered to be no route for the Project to impact the site and thus no LSE can be concluded for those sites. This is summarised in Table 3.4.

Table 3.4 Screening of SPAs by species

SPA	Distance from Project area	Is the site designated for one of the three sensitive species (common guillemot, razorbill, Atlantic puffin)	Assessment of LSE
Anglesey Terns pSPA	0 km	No	Potential impacts on qualifying interest associated with these sites are highly unlikely on the basis that all qualifying interests are considered to have low or very low sensitivity to impacts from tidal devices. Although the Ribble and Alt Estuaries SPA also supports seabird assemblages of international importance under Article 2 of the Birds Directive, species listed do not include any of the three sensitive species (guillemot, razorbill or puffin) **Conclusion = No LSE**
Ynys Feurig, Cemlyn Bay and The Skerries SPA	16 km	No	
Aberdaron Coast and Bardsey Island SPA	53 km	No	
Ribble and Alt Estuaries SPA	135 km	No	
Howth Head Coast SPA	84 km	No	
Ireland’s Eye SPA	85 km	Common guillemot (MMFR = 84.2 km, MaxFR = 135 km) Razorbill* (MMFR = 48.5 km, MaxFR = 90 km)	Potential impacts on common guillemot cannot be ruled out on the basis that this species potentially has very high sensitivity to tidal devices and therefore could potentially be impacted by the DGU unit. **Conclusion = LSE cannot be ruled out for common guillemot** Although this site is beyond the MMFR for razorbill (48.5 km) it is within the MaxFR for this species (90 km). Therefore, although connectivity with this site will be weak due to distance, given that razorbill has been identified as potentially having very high sensitivity to collision risk, it is concluded that it is not possible to rule out LSE for this site at this stage (screening) due to potential impacts on razorbill. **Conclusion = LSE cannot be ruled out for razorbill**
Lambay Island SPA	83 km	Common guillemot (MMFR = 84.2 km, MaxFR = 135 km) Razorbill* (MMFR = 48.5 km, MaxFR = 90 km) Atlantic puffin (MMFR = 105.4 km, MaxFR = 200 km)	Potential impacts on common guillemot and Atlantic puffin cannot be ruled out on the basis that common guillemot have very high sensitivity to tidal devices and Atlantic puffin potentially have high sensitivity to tidal devices and therefore could potentially be impacted by the DGU unit. **Conclusion = LSE cannot be ruled out for common guillemot and Atlantic puffin** Although this site is beyond the MMFR for razorbill (48.5 km) it is within the MaxFR for this species (90 km). Therefore, although connectivity with this site will be weak due to distance, given that razorbill has been identified as potentially having very high sensitivity to collision risk, it is concluded that it is not possible to rule out LSE for this site at this stage (screening) due to potential impacts on razorbill. **Conclusion = LSE cannot be ruled out for razorbill**

SPA	Distance from Project area	Is the site designated for one of the three sensitive species (common guillemot, razorbill, Atlantic puffin)	Assessment of LSE
Rathlin Island SPA	240 km	Common guillemot (MMFR = 84.2 km, MaxFR = 135 km) Razorbill* (MMFR = 48.5 km, MaxFR = 90 km)	Rathlin Island qualifies under Article 4.2 of the Birds Directive for a seabird assemblage of international importance. Potential impacts on species within this assemblage are highly unlikely on the basis that the distance is greater than the MMFR of all species listed, except northern fulmar, which is rated as having potentially has very low sensitivity to tidal devices. Therefore, the potential for this species to be impacted by the DGU unit is negligible. **Conclusion = No LSE**
Skokholm and Skomer SPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	Although these sites are beyond the MMFR for Atlantic puffin (105.4 km) they are within the MaxFR for this species. Therefore, although connectivity with the sites will be weak due to distance, given that Atlantic puffin has been identified as potentially having high sensitivity to collision risk, it is concluded that it is not possible to rule out LSE for this site at this stage (screening) due to potential impacts on Atlantic puffin. **Conclusion = LSE cannot be ruled out for Atlantic puffin**
Skomer, Skokholm and the seas off Pembrokeshire pSPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	
Wicklow Head SPA	90 km	No	Potential impacts on qualifying interest associated with these sites are highly unlikely on the basis that kittiwake have very low sensitivity to tidal devices therefore the potential for this species to be impacted by the DGU unit is negligible. **Conclusion = No LSE**
Grassholm SPA	180 km	No	Although gannet is a diving bird, they are considered to have low sensitivity to potential impacts from tidal devices (Furness *et al.,* 2012). The results from the CRM carried out to inform the impact assessment also concluded very low risk of collision for gannet (NRP, 2016). Potential impacts on gannet populations associated with these sites are therefore unlikely on the basis that potential impacts on gannet from the DGU unit is assessed as low and not significant. See Chapter 12 of the ES: Ornithology for more information to support these conclusions. **Conclusion = No LSE**
Saltee Islands SPA	175 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	As with Skokholm and Skomer this site is also beyond the MMFR for Atlantic puffin (105.4 km) but within the MaxFR for this species. Therefore, although connectivity with this site will be weak due to distance, given that Atlantic puffin has been identified as potentially having high sensitivity to collision risk, it is concluded that it is not possible to rule out LSE for this site at this stage (screening) due to potential impacts on Atlantic puffin. **Conclusion = LSE cannot be ruled out for Atlantic puffin**

SPA	Distance from Project area	Is the site designated for one of the three sensitive species (common guillemot, razorbill, Atlantic puffin)	Assessment of LSE
Ailsa Craig SPA	220 km	No	Although gannet is a diving bird, they are considered to have low sensitivity to potential impacts from tidal devices (Furness *et al.*, 2012). The results from the CRM carried out to inform the impact assessment also concluded very low risk of collision for gannet (NRP, 2016). Potential impacts on gannet populations associated with these sites are therefore unlikely on the basis that potential impacts on gannet from the DGU unit is assessed as low and not significant. See Chapter 12 of the ES: Ornithology for more information to support these conclusions. **Conclusion = No LSE**
Morecambe Bay and Duddon Estuary pSPA	126.5 km	No	Potential impacts on qualifying interest associated with these sites are highly unlikely on the basis that lesser black-backed gull have very low sensitivity to tidal devices therefore the potential for this species to be impacted by the DGU unit is negligible. **Conclusion = No LSE**
Morecambe Bay SPA	132.5 km	No	
* Site beyond Mean Max Foraging Range (MMFR) but within Mean Foraging Range (MaxFR) for qualifying interest			

3.3.6 Conclusion from the assessment of LSE

Based on these results from Table 3.4 it is concluded that the only SPAs where LSEs cannot be ruled out summarised in Table 3.5.

Table 3.5 Conclusion from assessment of LSE

SPA	Distance from Project area	Qualifying interest	Reason LSE cannot be ruled out
Ireland's Eye SPA	85 km	Common guillemot (MMFR = 84.2 km, MaxFR = 135 km) Razorbill (MMFR = 48.5 km, MaxFR = 90 km)	The Project area is within the MMFR for one or more qualifying species from these sites, these species are known to be present in the Project area and are diving birds that could potentially be affected as a result of collision with the DGU unit during foraging or due to displacement from foraging grounds due to presence of DGU unit. Therefore, LSE cannot be ruled out at screening.
Lambay Island SPA	83 km	Common guillemot (MMFR = 84.2 km, MaxFR = 135 km) Razorbill (MMFR = 48.5 km, MaxFR = 90 km) Atlantic puffin (MMFR = 105.4 km, MaxFR = 200 km)	
Skokholm and Skomer SPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	
Skomer, Skokholm and the seas off Pembrokeshire pSPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	

SPA	Distance from Project area	Qualifying interest	Reason LSE cannot be ruled out
Saltee Islands SPA	175 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	

3.4 Information to inform and Appropriate Assessment

The purpose of an Appropriate Assessment is to determine whether the Project could have an adverse effect on the integrity of an SPA when tested against the stated conservation objectives of the SPA. These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2010 (the "Habitats Regulations") and Article 6(3) of the Habitats Directive.

The conservation objectives must be considered when a Competent Authority is required to make a 'Habitats Regulations Assessment' including an Appropriate Assessment, under the relevant parts of this legislation. Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving the aims of the Wild Birds Directive with regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'qualifying interest'), and subject to natural change.

In undertaking an Appropriate Assessment for the SPA qualifying interest where the potential for LSE has not been ruled out, it is considered that information on the following topics are relevant and should therefore be taken into account:

> The condition of the qualifying interest, i.e. the current conservation status of qualifying feature;

> Connectivity between the qualifying interest (in this case the population of individuals forming a SPA qualifying feature) and the Project area;

> The importance of the area potentially affected by the Project for supporting the qualifying interest (i.e. an SPA population);

> The sensitivity of the qualifying interest to the effects predicted to arise from the Project; and

> Any other aspect of the ecology of the qualifying interest that is relevant to evaluating the likely impacts to it from the development.

Information on connectivity between the qualifying interest and the Project area, importance of the Project area for the qualifying interest and sensitivity of the qualifying interest to the listed impacts was taken into account in determining LSEs. The assessment of impacts on qualifying interests presented below is based results from the ornithological impact assessment carried out as part of the Project EIA (presented in Chapter 12 of the ES: Ornithology).

3.4.1 Site (and relevant qualifying interests) details

Table 3.6 provides information on the site (SPA) and regional populations for SPAs and associated qualifying interests requiring further assessment as part of the HRA. All sites requiring further assessment as part of the HRA were in either Ireland or Wales.

Table 3.6 Population data for sites requiring further assessment

SPA	Distance from Project area	Qualifying interest requiring further assessment	Population (SPA) (based on Seabird 2000 count)	Population (Regional)* (based on Seabird 2000 count)
Ireland's Eye SPA	85 km	Common guillemot (MMFR = 84.2 km)	2,948 (individual birds at colony)	96,669

SPA	Distance from Project area	Qualifying interest requiring further assessment	Population (SPA) (based on Seabird 2000 count)	Population (Regional)* (based on Seabird 2000 count)
		Razorbill (MMFR = 48.5 km, MaxFR = 90 km)	522 (individual birds at colony)	9,244
Lambay Island SPA	83 km	Common guillemot (MMFR = 84.2 km)	59,824 (individual birds at colony)	96,669
		Atlantic puffin (MMFR = 105.4 km)	530 adults based on 265 Apparently Occupied Burrows (AOBs) – assuming a single breeding pair per AOB	12,504
		Razorbill (MMFR = 48.5 km, MaxFR = 90 km)	4,337 (individual birds at colony)	9,361
Skokholm and Skomer SPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	9,131 (breeding pairs)	12,504
Skomer, Skokholm and the seas off Pembrokeshire pSPA	180 km			
Saltee Islands SPA	175 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	1,822 (breeding pairs)	12,504
* Regional populations are based on the total population from all colonies located within the MaxFR for each species.				

3.4.2 SPA Conservation Objectives

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and SACs and SPAs are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network (NPWS, 2015). SPAs are strictly protected sites classified in accordance with Article 4 of the EC Birds Directive, which came into force in April 1979. They are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species, designed to maintain or restore the favourable conservation status of their features through the implementation of specific conservation objectives. Conservation objectives for the SPAs listed in Table 3.6, which are located in Ireland and Wales, are described below.

3.4.2.1 SPAs in Ireland

The following sets out the key conservation objectives for the Irish SPAs listed in Table 3.6 (Ireland's Eye, Lambay Island and Saltee Islands), which are based on information presented by the National Parks and Wildlife Service (NPWS), the statutory body responsible for the designation and management of European sites (SPAs and SACs) in Ireland.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites (NPWS, 2015).

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level[1].

- Favourable conservation status of a habitat is achieved when:
  - Its natural range, and area it covers within that range, are stable or increasing;
  - The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
  - The conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

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

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests[2] for the specified SPA.

While this objective applies to all species listed as Special Conservation Interests, this HRA is only focusing on common guillemot, Atlantic puffin and razorbill as these are the only Special Conservation Interest species for which LSE cannot be ruled out.

3.4.2.2 SPAs in Wales

Although there are a range of SPAs protecting seabird species in Wales, this HRA focusses on Atlantic puffin as this is the only SPA qualifying feature species for which LSE cannot be ruled out. The only two sites potentially affected are Skomer and Skokholm SPA and Skomer, Skokholm and the seas off Pembrokeshire pSPA.

The conservation objectives (sourced from NRW, 2015) for Atlantic puffin for Skomer and Skokholm SPA are as follows:

- To achieve favourable conservation status, satisfying all of the following conditions:
  - During the breeding season the population of puffins will be at least 9,500 pairs within the SPA, (this represents at least 1.1% of the current breeding population);
  - Breeding success will be 0.7 chicks/pair; and
  - The factors affecting the feature are under control.

The Skomer, Skokholm and the seas off Pembrokeshire potential SPA is being proposed as a further marine extension to the existing Skokholm and Skomer SPA, which was first designated (or ‘classified’) in 1982, and subsequently extended in 2014 to include some adjacent marine areas. The draft conservation objectives for Atlantic puffin (sourced from NRW, 2015) afforded protection by this this potential SPA are broadly in line with those described above, and are as follows:

- **The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term** - the breeding population of Atlantic puffin should be stable or increasing with an aim of 9,500 individuals being achieved.

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[1] It is noted that the Conservation Objectives provided are based on the Irish Government’s interpretation of the Habitats Directive and Conservation Objectives which may be different to the UK Government’s interpretation. However, the general overarching objective to maintain sites and species at a favourable conservation status are consistent with UK objectives.

[2] Equivalent to UK qualifying interests.

> **The distribution of the population should be being maintained, or where appropriate increasing** - the distribution of this species within the site should not be constrained by anthropogenic factors. There should be no contraction of the distribution of nesting sites as a result of anthropogenic factors.

> **There should be sufficient habitat, of sufficient quality, to support the population in the long term** - the breeding and foraging habitat of this species should be stable or increasing in terms of its area, and its quality should remain unaffected by anthropogenic factors.

> **Factors affecting the population or its habitat should be under appropriate control** - there should be no mammalian land predators present in the SPA, and control measures should be in place to ensure that accidental introduction does not take place. Access beyond designated footpaths, should be under appropriate control.

3.4.3 Identification of impacts requiring further information to inform an Appropriate Assessment

Table 3.7 below identifies which of the key potential impacts on birds have the potential to have a significant effect on the breeding populations of common guillemot, Atlantic puffin or razorbill at the identified SPAs, and therefore require more detailed information to be provided to inform an Appropriate Assessment.

Table 3.7 Identification of impacts requiring more detailed assessment

Impact	Description	Potential for significant effect on breeding population of common guillemot, Atlantic puffin or razorbill	Is further assessment required?
Collision risk between DGU unit and diving seabirds	Potential for diving birds to be at risk of collision with submerged DGU unit. Where collision results in loss / mortality of individual birds, potential impacts on an SPA will depend on what proportion (%) of the SPA population (for specific species) would be lost as a result of collision with DGU unit.	Common guillemot and razorbill are identified as potentially having very high sensitivity to collision with tidal devices, and Atlantic puffin potentially has high sensitivity to collision with tidal devices. Further information is therefore required to determine the potential for any adverse effects on either of the SPA breeding populations.	Yes
Disturbance from vessels and other operations	Potential for disturbance due to increased boat traffic / presence and vessel noise. Disturbance can affect forging behaviour which could have an adverse effect on SPA population if disturbance occurs during breeding when foraging success is critical	It is highly unlikely that impacts on common guillemot, Atlantic puffin or razorbill due to disturbance caused by vessel presence / noise are will have a significant effect on the breeding populations of any of the listed SPAs as the expected level of disturbance will be very low given the small scale of the Project, low number of vessels that are expected to be involved in installation and operations and maintenance activities (these are not expected to vary much from current vessel presence in the Project area) and short duration of the installation period.	No

Impact	Description	Potential for significant effect on breeding population of common guillemot, Atlantic puffin or razorbill	Is further assessment required?
Displacement due to presence of barge	Presence of the barge has the potential to displace seabirds from a small area of foraging habitat. The barge may also cause flying birds transiting through an area to change their course as they deviate round them.	Common guillemot, Atlantic puffin and razorbill are considered by Furness *et al.*, (2012) to have low or very low sensitivity to displacement. Results from the EIA concluded that, at worst, displacement would affect 0.01% of the regional population of common guillemot, 0.05% of the regional population of Atlantic puffin and 0.2%of the regional population of razorbill. Given that the birds from the potentially affected SPAs are predicted to make up only a small proportion of the birds using the Project area, this effect will be negligible for SPA populations of all three species.	No
Underwater displacement from DGU unit and tether	The presence of the DGU unit could affect foraging success of diving or pursuit feeding birds by displacing birds from a small area	Common guillemot, Atlantic puffin and razorbill have low to very low sensitivity to adverse effects from displacement. Therefore, although the physical presence of DGU unit and associated infrastructure potential could affect their ability to forage effectively in the area, due to the scale of the Project, at a worst case, less than 0.2% of the regional population for all three species would be affected which in terms of a loss of foraging area would be negligible and not significant.	No
Pollution from accidental events	There is potential for pollution to have both direct and indirect effect on birds. Accidental release of oil from vessels and other fluids from the DGUs could affect birds directly either though getting caught on feathers affecting waterproofing or ingestion which can cause poisoning. Pollution incidents can also have effects on bird prey species (fish).	Due to the small scale of the Project, low number of vessels involved in installation and operations and maintenance, and short duration of Project installation, pollution incidents are highly unlikely to occur. If a pollution incident does occur appropriate response mechanisms will be in place to ensure impacts on all seabirds are minimised. Although common guillemot, Atlantic puffin and razorbill are considered to be highly sensitive to pollution, significant impacts on SPA populations due to pollution incidents are highly unlikely and not significant.	No
Indirect effects from changes in habitat and prey	Installation of the DGU unit could affect benthic habitats and seabird prey species through direct habitat loss, smothering and turbidity changes.	The EIA assessed potential impacts on prey species (Chapter 13: Fisheries and Chapter 10: Benthic Ecology) to be negligible. Potential impacts on birds as a result of changes to prey species are therefore also assessed as negligible and not significant.	No

3.4.4 Assigning birds in the offshore Project area to breeding colonies

Apportionment is used to assign predicted effects of the Project to individual seabird colonies, some of which are SPA colonies. This allows a reasonable estimate to be made of the likely impact on an individual SPA population. Rarely is it reasonable to assume for the purpose of an assessment that all the impacts from a project (e.g. the DG

Holyhead Deep Project) will fall on a single SPA only. Assuming that all of an impact affects the SPA under consideration is likely to overestimate the magnitude of the impact, and could result in a false conclusion that the development is not acceptable or requires onerous mitigation.

Scottish Natural Heritage (SNH) has produced draft guidance (SNH, 2014) on how to apportion impacts across multiple seabird breeding colonies. This guidance has been followed to estimate the magnitude of colony-specific effects for all colonies of common guillemot, Atlantic puffin and razorbill that lie within the maximum foraging range distance from the Project area.

Common guillemot

Although common guillemot is the most numerous of species examined and occurs commonly throughout the year in the vicinity of the Project area, there are no SPAs where this species is a qualifying feature within the mean max foraging range distance. The colony apportioning undertaken for common guillemot is based on all breeding colonies within the maximum foraging range distance (135 km) from the Project area These results are presented in Table 3.8.

Table 3.8 shows that of the common guillemots potentially affected by the Project, approximately 40.4% are likely to be from the Lambay Island SPA and about 1.4% from the Ireland's Eye SPA.

Table 3.8 Estimated proportion of common guillemots using the Project area during the breeding season to originate from each colony within the MaxFR distance of 135 km (Thaxter *et al.,* 2012)

County	Breeding colony	Seabird 2000 count (birds)*	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Dublin	**Lambay Island (SPA)*** **	60,754	84.0	0.012	723.3	40.4%
Gwynedd	South Stack	3,889	7.2	0.139	540.7	30.2%
Gwynedd	Carreg y Llam (SSSI)	7,980	42.2	0.024	189.1	10.6%
Gwynedd	Middle Mouse	2,464	29.2	0.034	84.4	4.7%
Gwynedd	Puffin Island	2,799	59.5	0.017	47.0	2.6%
Dyfed	New Quay to Lochtyn	5,012	125.0	0.008	40.1	2.2%
Gwynedd	Trwyn Cilan	2,100	71.8	0.014	29.2	1.6%
Dublin	**Ireland's Eye (SPA)*** **	2,191	85.0	0.012	25.8	1.4%
Isle of Man	Port - St Mary - Sound	2,139	86.2	0.012	24.8	1.4%
Isle of Man	Glen Maye - Peel	1,515	101.9	0.010	14.9	0.8%
Gwynedd	St Tudwal	962	77.8	0.013	12.4	0.7%
Dublin	Howth Head	892	84.0	0.012	10.6	0.6%
Gwynedd	Bardsey Island & Ynysoedd Gwylan	573	60.0	0.017	9.6	0.5%
Gwynedd	Great Orme (SSSI)	622	69.4	0.014	9.0	0.5%
Gwynedd	Little Orme	444	74.6	0.013	6.0	0.3%
Isle of Man	Calf of Man	416	85.1	0.012	4.9	0.3%
Wicklow	Wicklow Head	420	88.6	0.011	4.7	0.3%

County	Breeding colony	Seabird 2000 count (birds)*	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Isle of Man	Ramsey - Port Mooar	409	116.3	0.009	3.5	0.2%
Wicklow	Bray Head	286	86.2	0.012	3.3	0.2%
Dyfed	Newport to Poppit	419	134.0	0.007	3.1	0.2%
Dyfed	Llangrannog to Penpeles	270	128.0	0.008	2.1	0.1%
Isle of Man	Bradda - Fleshwick	57	89.7	0.011	0.6	0.04%
Isle of Man	Sound - Port Erin	30	87.3	0.011	0.3	0.02%
Gwynedd	Penymynydd	15	71.4	0.014	0.2	0.01%
Gwynedd	Mean Du	11	54.5	0.018	0.2	0.01%

* The estimates are based on the inverse of distance to colonies and Seabird 2000 colony counts, as recommended by SNH.
** The two SPAs where common guillemot is a qualifying interest are shown in bold.
*** Distance from colonies is based on flight over sea not direct over land.

Atlantic puffin

Apportionment for Atlantic puffin was first undertaken for all breeding colonies lying within the Maximum Foraging Range (MaxFR) distance (200 km, Thaxter *et al.,* 2012) from the Project area i.e. the same approach used for common guillemot. The results of this are presented in Table 3.9. For this scenario the SNH method predicts that a high proportion of Atlantic puffin using the Project area in the breeding season are likely to originate from large colonies located between the MMFR distance (105 km) and the MaxFR distance (200 km), in particular the large SPA colonies of Skomer (43.0% of birds) and Skokholm (12.2%) and Great Saltee (9.1%). The analysis present in Table 3.9 predicts that only 3.3% of the puffins using the Project area are from Lambay Island SPA.

Table 3.9 Estimated proportion of Atlantic puffin using the Project area during the breeding season to originate from each colony within the MaxFR distance of 200 km (Thaxter *et al.,* 2012).

County	Breeding colony*	Seabird 2000 count (pairs)	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Dyfed	**Skomer Island (part of Skomer and Skokholm SPA)****	7,076	176.3	0.006	40.1	43.0%
Gwynedd	Bardsey Island & Ynysoedd Gwylan	1,053	56.7	0.018	18.6	19.9%
Dyfed	**Skokholm Island (part of Skomer and Skokholm SPA)****	2,055	180.3	0.006	11.4	12.2%
Wexford	**Great Saltee (part of Saltee Islands SPA)****	1,522	180.0	0.006	8.5	9.1%
Gwynedd	South Stack	60	7.2	0.139	8.3	8.9%
Dublin	**Lambay Island SPA****	261	84.0	0.012	3.1	3.3%
Wexford	Little Saltee	300	177.0	0.006	1.7	1.8%
Isle of Man	Port - St Mary - Sound	29	86.2	0.012	0.3	0.4%

County	Breeding colony*	Seabird 2000 count (pairs)	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Gwynedd	Puffin Island	19	59.5	0.017	0.3	0.3%
Isle of Man	Ramsey - Port Mooar	37	116.3	0.009	0.3	0.3%
Isle of Man	Glen Maye - Peel	19	101.9	0.010	0.2	0.2%
Dyfed	North Bishop	27	159.9	0.006	0.2	0.2%
Antrim	Gobbins	28	179.0	0.006	0.2	0.2%
Cumbria	St Bees Head	9	155.9	0.006	0.1	0.1%
Dublin	**Ireland's Eye SPA****	4	85.0	0.012	0.0	0.1%
Dublin	Howth Head	2	84.0	0.012	0.0	0.0%
Stewartry	Meikle Ross	3	170.4	0.006	0.0	0.0%

* Estimates are based on the inverse of distance to colonies and Seabird 2000 colony counts, as recommended by SNH.
** The SPAs where Atlantic puffin is a qualifying interest are shown in bold.
*** Distance from colonies is based on flight over sea not direct over land.

It is possible that apportionment based on all colonies within the MaxFR might underestimate the importance of the Project area to Atlantic puffins from colonies lying within the MMFR distance. Therefore, the apportionment exercise has been repeated taking into account only those colonies that lie within the MMFR distance. The results of this alternative apportioning analysis are presented in Table 3.10. This makes a large difference to the apportionment predictions (but not the final conclusions). This analysis predicts that Lambay SPA birds will account for 10% of the Atlantic puffin using the Project area.

Table 3.10 Estimated proportion of Atlantic puffin using the Project area during the breeding season to originate from each colony within the MMFR distance of 104.5 km (Thaxter *et al.,* 2012).

County	Breeding colony*	Seabird 2000 count (pairs)	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Gwynedd	South Stack	60	7.2	0.139	8.3	27.0%
Gwynedd	Bardsey Island & Ynysoedd Gwylan	1,053	56.7	0.018	18.6	60.1%
Gwynedd	Puffin Island	19	59.5	0.017	0.3	1.0%
Dublin	Howth Head	2	84.0	0.012	0.0	0.1%
Dublin	**Lambay Island SPA****	261	84.0	0.012	3.1	10.0%
Dublin	**Ireland's Eye SPA****	4	85.0	0.012	0.0	0.2%
Isle of Man	Port - St Mary - Sound	29	86.2	0.012	0.3	1.1%
Isle of Man	Glen Maye - Peel	19	101.9	0.010	0.2	0.6%

* Estimates are based on the inverse of distance to colonies and Seabird 2000 colony counts, as recommended by SNH.
** The SPAs where Atlantic puffin is a qualifying interest are shown in bold.
*** Distance from colonies is based on flight over sea not direct over land.

Razorbill

Apportionment for razorbill is summarised in Table 3.11. This shows that, of the razorbills that may be affected by the Project, approximately 22.6% are likely to be from Lambay Island SPA and about 2.7% from Ireland's Eye SPA.

Table 3.11 provides an overview of the estimated change to the annual adult mortality rate of razorbill at these two SPAs. The total estimated collisions (2.23 per year for a 90% avoidance rate, as estimated in NRP (2016) were attributed to individual SPAs using the percentages calculated in Table 3.11. These %s applied in this way are likely to be conservative as they have been applied to the mortality for the whole year. In reality, all the birds from the colonies considered are likely to winter to the south of the Irish Sea (Wareham *et al.,* 2002) and therefore it is unlikely that birds from these SPA colonies would be exposed to a collision risk from the Minesto project during non-breeding months.

At both the SPAs considered, the predicted increase in annual adult mortality rate of the breeding razorbill qualifying feature does not exceed or even approach a 1% change to the assumed baseline rate of 10.5% (Horswill & Robinson, 2015). Note, the reason why both SPAs are predicted to experience the same mortality rate change is because they just so happen to be at almost identical distances from the Project area.

Table 3.11 The estimated proportion of razorbills using the Project area during the breeding season to originate from each colony within the MaxFR distance of 95 km (Thaxter *et al.,* 2012).

County	Breeding colony*	Seabird 2000 count (birds)	SPA to Project area distance (km)***	1/distance	1/distance x count	Estimated % of birds in Project area from colony
Gwynedd	South Stack	806	7.2	0.139	112.1	49.1%
Dublin	**Lambay Island (SPA)****	4,337	84.0	0.012	51.6	22.6%
Gwynedd	Bardsey Island	786	60.0	0.017	13.1	5.7%
Gwynedd	Carreg y Llam (SSSI)	445	42.2	0.024	10.5	4.6%
Dublin	**Ireland's Eye (SPA)****	522	85.0	0.012	6.1	2.7%
Isle of Man	Port - St Mary - Sound	424	86.2	0.012	4.9	2.2%
Isle of Man	Calf of Man	362	85.1	0.012	4.3	1.9%
Dublin	Howth Head	316	84.0	0.012	3.8	1.6%
Gwynedd	Middle Mouse	90	29.2	0.034	3.1	1.4%
Gwynedd	Great Orme (SSSI)	196	69.4	0.014	2.8	1.2%
Gwynedd	Puffin Island & Bwrdd Arthur	156	59.5	0.017	2.6	1.1%
Wicklow	Wicklow Head	186	88.6	0.011	2.1	0.9%
Gwynedd	Ynysoedd Gwylan	121	61.9	0.016	2.0	0.9%
Gwynedd	St Tudwal islands &Ebolion	140	77.8	0.013	1.8	0.8%
Gwynedd	Carmel Head South	28	19.0	0.053	1.5	0.6%
Gwynedd	Mean Du & Braich Anelog	71	54.5	0.018	1.3	0.6%
Isle of Man	Port Soderick - Port Grenaugh	108	92.7	0.011	1.2	0.5%
Isle of Man	Sound - Port Erin	73	87.3	0.011	0.8	0.4%
Gwynedd	Trwyn Cilan	59	71.8	0.014	0.8	0.4%
Gwynedd	Little Orme	47	74.6	0.013	0.6	0.3%
Isle of Man	Bradda - Fleshwick	44	89.7	0.011	0.5	0.2%
Isle of Man	Fleshwick - Stroin Voigh - Niarbyl	19	92.0	0.011	0.2	0.09%
Isle of Man	Doughlas - Port Soderick	17	95.7	0.010	0.2	0.08%
Gwynedd	Penymynydd	8	71.4	0.014	0.1	0.05%

* Estimates are based on the inverse of distance to colonies and Seabird 2000 colony counts, as recommended by SNH.
** The SPAs where razorbill is a qualifying interest are shown in bold.
*** Distance from colonies is based on flight over sea not direct over land.

3.4.5 Information to support an assessment of effects on SPAs

As discussed in section 3.4.3, potential impacts on common guillemot and razorbill populations of the Lambay Island and Ireland's Eye SPAs, and the Atlantic puffin populations of the Lambay Island, Skokholm and Skomer and Saltee Islands SPAs are limited to potential collision risk between the DGU device and diving seabirds.

The following section provides more detailed information on the potential effect of these impacts on the common guillemot, Atlantic puffin and razorbill populations breeding at these SPAs.

3.4.6 Collision risk between DGU device and diving seabirds

Tidal stream devices and other tidal devices pose a theoretical risk to some diving bird species (McCluskie *et al*., 2012; Furness *et al*., 2012; Welsh Assembly Government, 2011). The risk is theoretical because any effect has yet to be empirically demonstrated. Furthermore there is uncertainty as to whether: animals of relatively small size such as diving seabirds would be struck by the moving parts of tidal device or would be swept past the while entrained within the tidal stream; and whether, were birds to be struck, the strike force would result in a trauma sufficient to cause injury or death (Wilson *et al*., 2007). For the purposes of impact assessment it is cautiously assumed that the DGU unit does pose a collision risk to diving birds and that the strike force could be sufficient to cause mortality (or serious injury), and therefore this subject merits detailed evaluation.

A review of the various modelling methods against the design of Minesto device, concluded that the Encounter Rate Modelling (ERM) is suitable for examining collision risk from the Minesto device as the nature of the device is compatible with the model assumptions and this was endorsed by NRW through consultation (13th May 2015). The ERM method was developed by SRSL (Wilson *et al*., 2007) and further elaborated by Band (EMEC, 2014; Band, 2014). ERM estimates the number of encounter events per unit time per device based on the relative velocities (i.e., closing velocity) of the device components and a swimming animal, and their sizes and density.

The ERM modelling undertaken is reported in detail in the supporting technical report (NRP, 2016). Modelling was undertaken for the two DGU unit deployment modes, namely ‘normal’ mode (seabed mounted) and ‘upside down’ mode (barge mounted). The aim of the modelling was to predict the annual number of encounters between adult birds and the moving parts of the DGU unit for the breeding and non-breeding season.

An unusual aspect of the DGU unit device is that it comprises several distinct moving components of different size and shapes, one of which is a long tether fixed either to the seabed or to a floating barge. The ERM assumes a simple shape for the collision surface of the device and therefore is not suited to modelling the DGU unit device as a whole. This problem was overcome by undertaking separate models for each major component part (tether, kite and turbine) and summing the collision rates for the separate components to give the rate for a single DGU unit.

Encounter risk is assumed to scale in direct proportion to a species mean at-sea surface density (birds/km^2). Therefore, to keep the models simple, ERM was undertaken for an surface density of one bird/km^2 and then the output later scaled to give results for six indicative density values (0.5, 1, 2, 4, 8 and 16 birds/km^2) covering the range of at-sea densities of interest (see NRP (2016) Tables 11 to 14).

There are several uncertainties that affect the accuracy of the model predictions, but by choosing conservative parameter values (i.e., those that err on the side of caution) it is considered that the outputs are likely to overestimate rather than underestimate the number of harmful collisions. Nevertheless, an obvious criticism of the ERM is that it has not been empirically validated for diving birds. This will not be possible until tidal devices are operated and there are appropriate monitoring data that measure if, and how many, collision fatalities actually occur (this is an industry wide issue, not only specific to this Project).

Although not part of ERM *per se*, the greatest uncertainty in terms of practical application of the model outputs is the total lack of information on the effectiveness of avoidance and evasion behaviour by diving birds (and all other taxa) and the consequences to individual birds of a collision event. In the absence of any specific guidance for Wales, collision estimates are presented for 50%, 90%, 95%, 98% and 99% avoidance rates, the range considered appropriate for presenting and assessing diving bird collision predictions for tidal stream arrays in Scotland (SNH, 2015). These values are considered to be reasonable and reflect the general view of many biologists working in the field that the actual number of harmful collisions will be substantially lower than the predicted number of encounters (EIMR Conference collision workshop, 2nd May 2014). The potential effect that the predicted collision mortality would have on the baseline adult mortality rate of the receptor populations is examined to establish the impact magnitude (Table 3.12) (note, the change in the far right column of the table is expressed as the percentage change to the baseline annual percentage mortality, and not absolute change, e.g. a 1% increase to a baseline mortality rate of 10.0% would change the mortality rate to 10.1%).

While actual rates of behavioural avoidance and evasion and mortality/injury are unknown, model outputs adjusted by an avoidance rate are considered useful in terms of giving a first order and, most likely, cautious estimate of the absolute magnitude of the potential collision risk. In light of the uncertainty about actual avoidance rates, a relatively low avoidance of 90% was used for assessment purposes. However, using a higher avoidance rate would lead to a corresponding reduction in the assumed collision mortality. For example, increasing the avoidance rate to 95% would result in a reduction by a half in the collision mortality predicted using a 90% rate.

The worst case collision scenario is assessed. For common guillemot the worst case scenario (based on collision risk modelling output) is the DGU unit operated in normal mode, for Atlantic puffin and razorbill the worst case scenario (based on collision risk modelling output) the DGU unit operated in upside-down mode.

Table 3.12 Summary of ERM results for worst case scenarios and effect of collision mortality on adult mortality rate assessed for a 90% avoidance rate (figures from NRP, 2016)

Species	Worst case scenario DGU operation mode	Assumed mean surface density (birds per km^2)	Predicted encounters per year (no avoidance)	Predicted adults deaths per year for given avoidance rate (A.R.)					% change to adult mortality rate for 90% A.R.
				50%	90%	95%	98%	99%	
Common guillemot	Normal	4	158.9	79.5	15.9	7.9	3.2	1.6	0.12%
Atlantic puffin	Upside down	0.5	1.4	0.7	0.1	0.07	0.03	0.01	<0.1%
Razorbill	Upside down	1	16.3	8.1	1.6	0.8	0.3	0.2	0.39%

Furness *et al*., (2012) considers common guillemot and razorbill to have very high sensitivity (score 5) and Atlantic puffin as having high sensitivity (score 4) to underwater collision effects from tidal devices. However, the receptor populations of all three species are considered to have low vulnerability to this impact as they are likely to have some tolerance to modest additional adult mortality given that the regional breeding populations for each species are large and have shown generally increasing population trends in recent decades (JNCC, 2014).

The ERM concluded, that of all three species, common guillemot is most likely to be involved in collisions with the DGU unit, while collisions involving Atlantic puffin are extremely unlikely to occur.

3.4.6.1 Potential impacts on SPA populations

Common guillemot

Table 3.13 provides an overview of the estimated change to the annual adult mortality rate of common guillemot at the Lambay Island and Ireland's Eye SPAs. The total estimated collisions (average 15.9 per year for a 90% avoidance rate, as estimated in NRP, 2016) were attributed to individual SPAs using the percentages calculated in Table 3.8. These percentages applied in this way are likely to be conservative as they have been applied to the mortality for the whole year. In reality, because of the extensive movements by birds and mixing of populations that occur outside the breeding season (Wareham *et al.,* 2002), the frequency of SPA birds among those affected during non-breeding months is likely to be lower than during the breeding season.

At both the SPAs considered, the predicted increase in annual adult mortality rate of the breeding common guillemot qualifying feature does not exceed or even approach a 1% change to the assumed baseline rate of 6.1% (Horswill & Robinson, 2015). The potential for any adverse effects on the populations of common guillemot at either site would therefore be negligible. Note, the reason why both SPAs are predicted to experience the same mortality rate change is because they just happen to be at almost identical distances from the Project area.

Table 3.13 Common guillemot collision risk estimates for individual SPAs and the predicted impact on the annual adult mortality rate

SPA	Seabird 2000 colony count (breeding adults)*	Estimated average collisions p.a. at 90% avoidance (NRP, 2016)	Proportion of birds using Project area originating from SPA	Collisions attributed to SPA population	Additional mortality p.a. (%)	Change to baseline adult mortality rate of 6.1%**
Lambay Island SPA	81,410	15.9	40.4%	6.4	0.01%	0.13%
Ireland's Eye SPA	2,936		1.4%	0.2	0.01%	0.13%

* Seabird 2000 count adjusted by colony attendance rate (count x 1.34) (Mitchell *et al.,* 2004)
** Horswill & Robinson, 2015

Atlantic puffin

Table 3.14 provides an overview of the estimated change to the annual adult mortality rate of Atlantic puffin the four SPAs considered. The total estimated collisions (average 0.14 per year for a 90% avoidance rate, as estimated in NRP, 2016) were attributed to individual SPAs using the percentages calculated in Table 3.9 and 3.10. These percentages applied in this way are likely to be conservative as they have been applied to the mortality for the whole year. In reality, because of the extensive movements by birds and mixing of populations that occur outside the breeding season (Wareham et al., 2002), the frequency of SPA birds among those affected during non-breeding months is likely to be lower than during the breeding season.

The predicted increase in annual adult mortality rate of the breeding Atlantic puffin qualifying feature does not exceed or even approach a 1% change to the assumed baseline rate of 9.4% (Horswill & Robinson, 2015). The potential for any adverse effects on the populations of Atlantic puffin at any of the three sites would therefore be negligible.

Table 3.14 Atlantic puffin collision risk estimates for individual SPAs and the predicted impact on the annual adult mortality rate

SPA	Seabird 2000 colony count (breeding adults)*	Estimated collisions p.a. at 90% avoidance (NRP, 2016)	Proportion of birds using Project area originating from SPA	Apportioning method (see text for details)	Collisions attributed to SPA population	Additional mortality p.a. (%)	Change to baseline adult mortality rate of 9.4%**
Skomer and Skokholm SPA	18,262	0.14	55.2%	MaxFR (Table 3.9)	0.08	0.0004%	0.005%
Skomer, Skokholm and the seas off Pembrokeshire pSPA***							
Saltee Islands SPA	3,044		9.1%	MaxFR (Table 3.9)	0.01	0.0004%	0.004%
Lambay Island SPA	522		10.0%	MMFR (Table 3.10)	0.01	0.003%	0.03%

* Seabird 2000 Apparently Occupied Burrows/pairs count multiplied by two (Mitchell *et al.,* 2004)
** Horswill & Robinson, 2015
*** Assumed that the potential SPA is designed to protect the same population as the existing Skomer and Skokholm SPA, albeit over a larger area.

Razorbill

Table 3.15 provides an overview of the estimated change to the annual adult mortality rate of razorbill the two SPAs considered. The total estimated collisions (average 1.63 per year for a 90% avoidance rate, as estimated in NRP, 2016) were attributed to individual SPAs using the percentages calculated in Table 3.11. These percentages applied in this way are likely to be conservative as they have been applied to the mortality for the whole year. In reality, because of the extensive movements by birds and mixing of populations that occur outside the breeding season (Wareham et al., 2002), the frequency of SPA birds among those affected during non-breeding months is likely to be lower than during the breeding season.

At both the SPAs considered, the predicted increase in annual adult mortality rate of the breeding razorbill qualifying feature does not exceed or even approach a 1% change to the assumed baseline rate of 10.5% (Horswill & Robinson, 2015). The potential for any adverse effects on the populations of razorbill at either site would therefore be negligible. Note, the reason why both SPAs are predicted to experience the same mortality rate change is because they happen to be at almost identical distances from the Project area.

Table 3.15 Razorbill collision risk estimates for individual SPAs and the predicted impact on the annual adult mortality rate

SPA	Seabird 2000 colony count (breeding adults)*	Estimated collisions p.a. at 90% avoidance (NRP, 2016)	Proportion of birds using Project area originating from SPA	Collisions attributed to SPA population	Additional mortality p.a. (%)	Change to baseline adult mortality rate of 10.5%**
Lambay Island SPA	5,812	1.63	22.6%	0.37	0.006%	0.06%
Ireland's Eye SPA	699		2.7%	0.04	0.006%	0.06%
* Seabird 2000 count adjusted by colony attendance rate (count x 1.34) (Mitchell *et al.,* 2004) ** Horswill & Robinson, 2015						

3.4.7 Conclusion of assessment of potential impacts with regard to site integrity

Based on the results from the assessment of potential impacts on SPA populations discussed in section 3.4.7.1 above, it can be concluded that there would be no impact on populations of common guillemot, Atlantic puffin and razorbill associated with the SPAs listed in Table 3.16 below as a result of potential collision with the DGU unit.

Table 3.16 Summary of findings from the assessment of potential impacts from collision risk with DGU unit on identified SPAs

SPA	Distance from Project area	Qualifying interest	Impact assessment
Ireland's Eye SPA	85 km	Common guillemot (MMFR = 84.2 km)	Predicted increase in annual adult mortality rate of breeding guillemot = 0.13%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 6.1%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
		Razorbill (MMFR = 48.5 km, MaxFR = 90 km)	Predicted increase in annual adult mortality rate of breeding razorbill = 0.06%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 10.5%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
Lambay Island SPA	83 km	Common guillemot (MMFR = 84.2 km)	Predicted increase in annual adult mortality rate of breeding guillemot = 0.13%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 6.1% the potential for adverse effects on the population of common guillemot at this SPA is negligible.

SPA	Distance from Project area	Qualifying interest	Impact assessment
		Atlantic puffin (MMFR = 105.4 km)	Predicted increase in annual adult mortality rate of breeding puffin = 0.03%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 9.4%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
		Razorbill (MMFR = 48.5 km, MaxFR = 90 km)	Predicted increase in annual adult mortality rate of breeding razorbill = 0.06%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 10.5%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
Skokholm and Skomer SPA	180 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	Predicted increase in annual adult mortality rate of breeding puffin = 0.005%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 9.4%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
Saltee Islands SPA	175 km	Atlantic puffin* (MMFR = 105.4 km, MaxFR = 200 km)	Predicted increase in annual adult mortality rate of breeding puffin = 0.004%. Given that this does not exceed, or even approach, the 1% change to the assumed baseline rate of 9.4%** the potential for adverse effects on the population of common guillemot at this SPA is negligible.
* Regional populations are based on the total population from all colonies located within the MaxFR for each species. ** Horswill & Robinson, 2015			

4 SACS – MARINE MAMMALS

4.1 Introduction

This section presents results from HRA screening, and subsequent information required to inform an Appropriate Assessment, with respect to SACs designated for marine mammals (cetaceans and pinnipeds). Both HRA screening and the provision of data to inform an Appropriate Assessment has been informed by information presented in Collision Risk Simulation Modelling study (SRMU Consulting, 2015), Underwater Noise Modelling study (Xodus, 2015b) and results from the marine mammal impact assessment presented in Chapter 11 of the ES: Marine Mammals.

Special Areas of Conservation (SACs) are designated for the protection and conservation of habitats and species listed in Annexes I and II of the EC Habitats Directive (as amended). The requirements of the Habitats Directive are transposed into national law through the Conservation of Habitats and Species Regulations 2010. Under these regulations, which apply to territorial waters out to 12 nautical miles (nm) (22 km), two native species of cetacean (bottlenose dolphin *Tursiops truncatus* and harbour porpoise *Phocoena phocoena*) and two native species of seal (grey *Halichoerus grypus* and harbour *Phoca vitulina*) are listed as Annex II species. Thus these species are featured on Schedule 2 of the Habitat Regulations as requiring protection though the designation of SACs.

This section includes the following information:

> Description of marine mammals recorded in the Project area;

> Long list of SACs (including pSACs) where marine mammals recorded in the Project area are qualifying interests;

> Determination of LSE on a long list of SACs based on potential impacts of the offshore Project on qualifying interests of a site;

> Final list of SACs where LSE cannot be ruled out; and

> Further information to support an Appropriate Assessment for sites where it may be required.

4.2 Baseline desk study

Due to the extremely high levels of mobility associated with marine mammals, in order to predict potential impacts on marine mammal it is necessary to understand both the local and regional distribution and abundance of certain species in relation to the offshore Project area. For this Project it was identified that substantial amounts of baseline data already exist for the Project area. Therefore, given the small scale of the Project (a single 0.5 MW DGU unit) and the proposals to undertake collision risk modelling to inform the impact assessment, through consultation with NRW it was agreed that dedicated site-specific surveys would not be required to inform the impact assessment. However, a thorough desk based study would be required based on a review of the following key data sources:

> Sustainable Expansion of the Applied Coastal and Marine Sectors (SEACAMS) vessel-based visual and acoustic marine mammal surveys off west Anglesey, incorporating the DG Holyhead Deep site (SEACAMS, 2015);

> Studies of marine mammal in Welsh high tidal waters (including visual and acoustic survey data and satellite tagging of grey seals) commissioned by the Welsh Assembly Government (Thompson, 2012; Gordon *et al.,* 2011) (Figure 4.1);

> A three year study of harbour porpoise distribution around the north coast of Anglesey (Shucksmith *et al.,* 2009) (Figure 4.1);

> Aerial surveys of UK marine mammals commissioned by the Department of Energy and Climate Change (DECC, 2009a);

- Surveys of the Irish Sea Zone conducted by The Crown Estate (TCE) and additional site surveys conducted by The Celtic Array[3] (The Celtic Array, 2014);
- Small Cetacean Abundance in the North Sea and Adjacent waters (SCANS) II data (Hammond *et al.,* 2013) – this data was obtained in 2005 via shipboard and aerial surveys of the North Sea and European Atlantic continental shelf waters, using line transect sampling methods. Subsequently, density surface modelling was used to generate broad scale predictions of distribution and abundance;
- The Welsh Cetacean Atlas, including sightings data from Countryside Council for Wales (CCW), Joint Nature Conservation Committee (JNCC), European Seabirds at Sea (ESAS), WDC (Whale and Dolphin Conservation) and Marine Awareness North Wales (Baines & Evans, 2012);
- Department of Energy and Climate Change (DECC) commissioned seal telemetry studies in north Wales (Hammond *et al.,* 2005a);
- CCW/NRW seal monitoring data (e.g. Westcott & Stringell, 2004; Stringell *et al.,* 2013);
- Scientific Advice on Matters Related to the Management of Seal Populations reports (SCOS, 2014);
- Online biological databases including National Biodiversity Network, Shark trust and TURTLE annual reports; and
- Relevant Seawatch Foundation publications.

The spatial coverage (in relation to the study area) of the key studies used to inform this baseline is displayed in Figure 4.1. Results from this desk study are discussed in Chapter 11: Marine Mammals of the ES and summarised in Section 4.3 below.

[3] A 50/50 joint venture between Centrica Renewable Energy Ltd and DONG Energy Ltd.

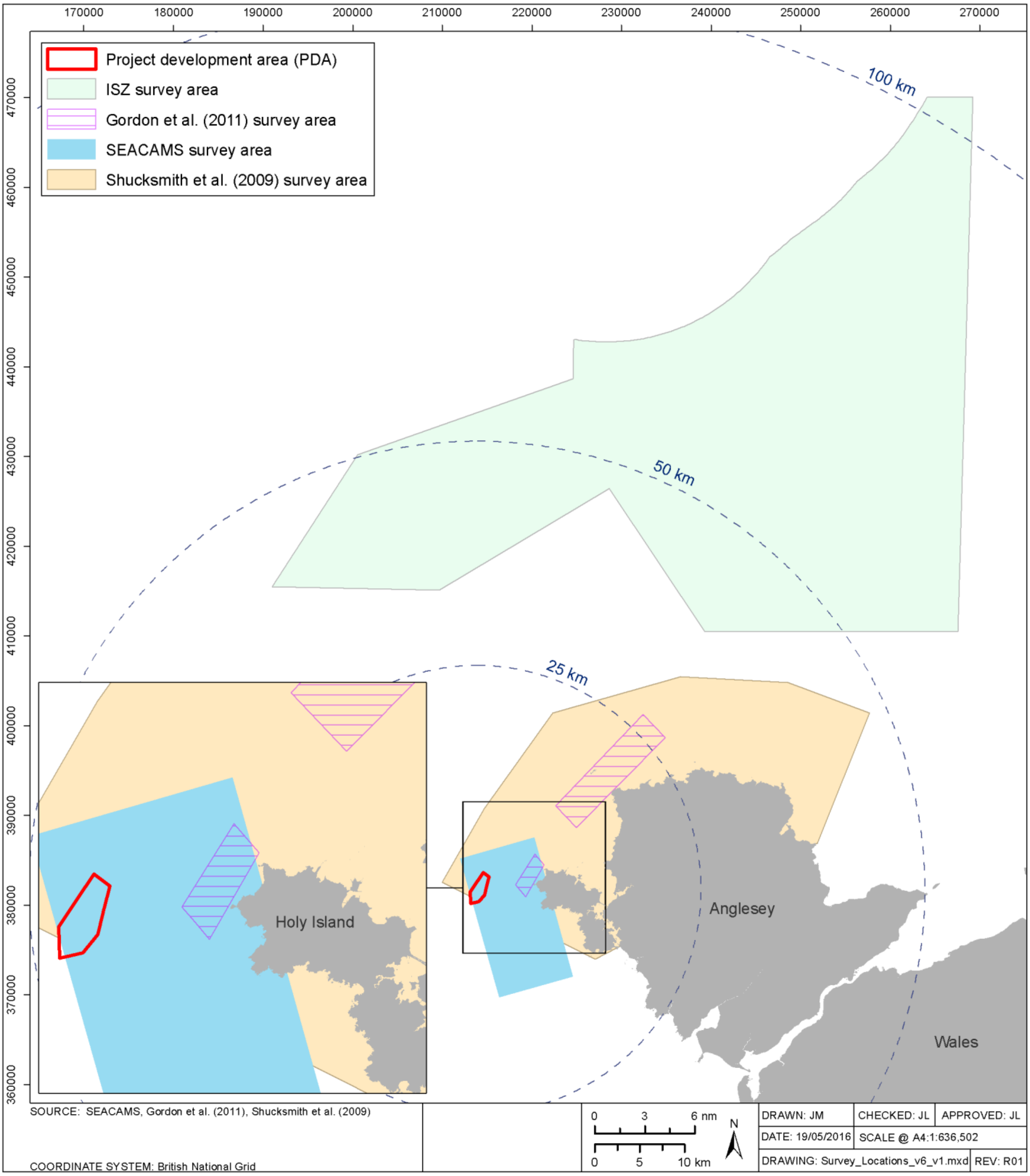

Figure 4.1 Spatial coverage of the key survey work in relation to the DG Holyhead Deep site

4.3 HRA Screening - species and SAC identification

A summary of the key findings from the desk study in terms of the key species in the Project area and estimates of their population is provided in Table 4.1.

Table 4.1 Marine mammal species summary

Species	Local population estimate	Local density estimate	Management Unit	Likely presence at DG Holyhead Deep Project	Identified as key species for HRA?
Harbour porpoise	North coast of Anglesey: 309 individuals (Shucksmith *et al*., 2009)	North coast of Anglesey: 0.63 individuals km^{-2} (Shucksmith *et al*., 2009); 0.56 individuals km^{-2} (Gordon *et al*., 2011)	104,965 individuals (95% CI: 56,774 – 193,065)	Likely	Yes
Bottlenose dolphin	Cardigan Bay population, some of which may visit the site: 213 individuals (Baines *et al*., 2002) – 235 individuals (Hammond *et al*., 2013)	SCANS-II Irish Sea: 0.0052 individuals km^{-2} (Hammond *et al*., 2013)	397 individuals (95% CI: 362 – 414)	Possible	Yes
Common dolphin	SCANS-II Irish Sea: 366 (based on aerial surveys only) (Hammond *et al*., 2013)	SCANS-II Irish Sea: 0.008 individuals km^{-2} (based on aerial surveys only) (Hammond *et al*., 2013)	56,556 individuals (95% CI: 33,014-96,920)	Possible	No – not a qualifying interest of a SAC
Risso's dolphin	Data shows few if any animals			Possible	No – not a qualifying interest of a SAC
Minke whale	Irish sea: 1,070 individuals, mostly summer visitors (Baines & Evans, 2012)	Locally: < 0.001 counts per 10 km (Baines & Evans, 2012). SCANS-II Irish Sea: 0.024 individuals km^{-2} (Hammond *et al*., 2013)	23,528 individuals (95% CI: 13,989 – 39,572)	Possible	No – not a qualifying interest of a SAC
Grey seal	242 – 307 individuals in North Wales (Stringell *et al*., 2013)	Maximum of 7.24 animals per 25 km^2 grid squares adjacent to at site (Jones *et al*., 2013).	6,000 individuals based on a pup count of 1,900	Likely	Yes
Harbour seal	5 – 15 individuals across North Wales's coastline (Hammond *et al*., 2005b).	Maximum of 0.0024animals per 25 km^2 grid squares adjacent to at site (Jones *et al*., 2013).	35 individuals	Unlikely	No

As discussed previously, SACs are only designated for marine mammals listed on Annex II of the Habitats Directive. In the UK these include grey and harbour seals, harbour porpoise and bottlenose dolphin. There are a number of SACs located along the Welsh coast, and along and/or off the coasts of Ireland, Northern Ireland, England (west coast) and southwest Scotland, where these species are either a primary reason for the designation of the site or a qualifying feature of the site. Table 4.2 lists the SACs that have been identified as requiring consideration as part of the HRA, on the basis that qualifying interests of these sites could be present in, or transit through the Project area and therefore could be affected by the Project. The location of these sites are shown in Figure 4.2.

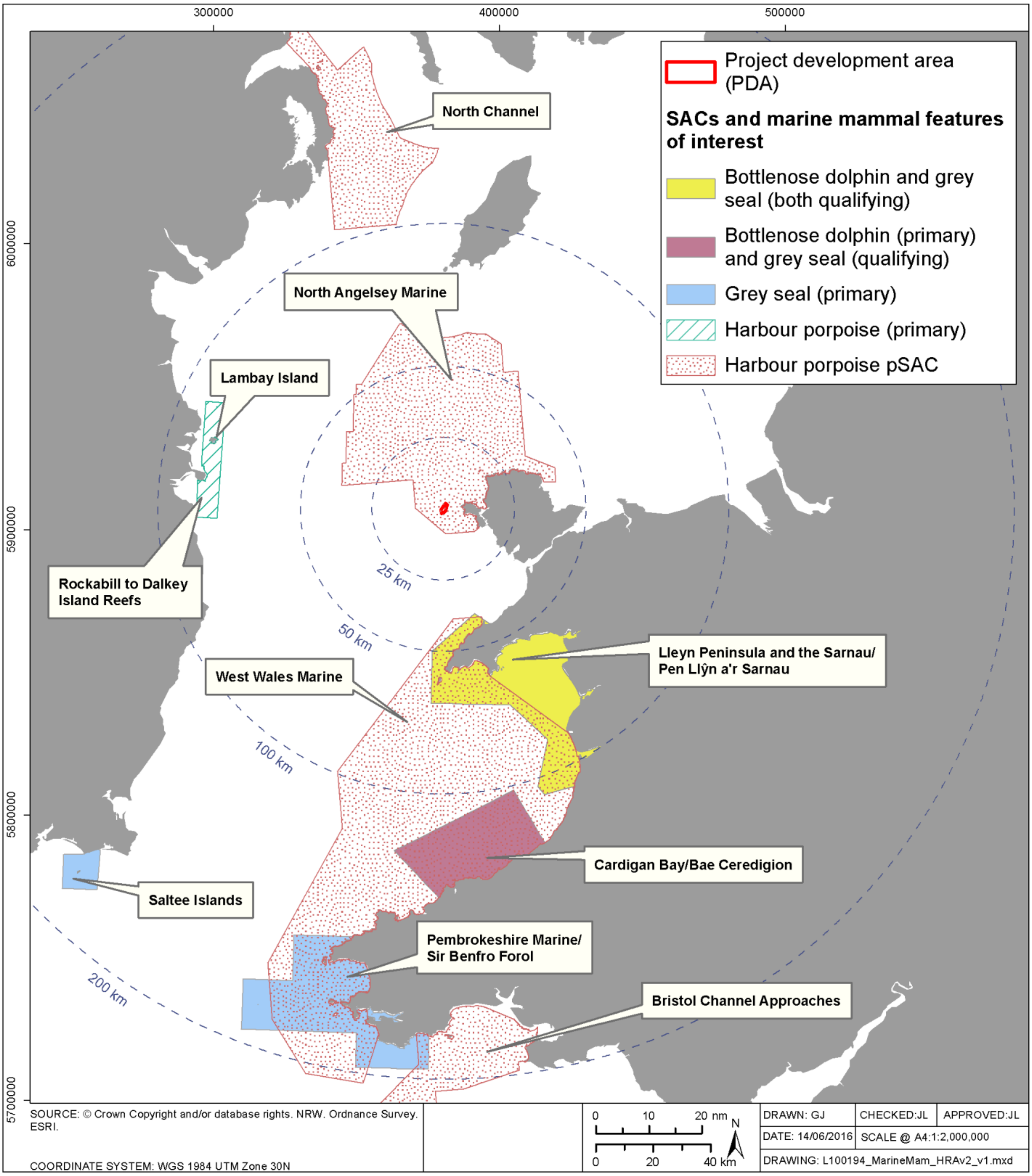

Figure 4.2 Location of marine mammal SACs and pSACs

Table 4.2 Marine mammal SACs requiring consideration as part of the HRA

SAC	Distance from Project site	Qualifying features	Foraging range of qualifying features	Species requiring further consideration as part of HRA?
North Anglesey Marine pSAC	Site inside pSAC	Harbour porpoise	Not defined, but assume movement within Celtic and Irish Seas management unit	Yes
West Wales Marine pSAC	35 km	Harbour porpoise		
Bristol Channel Approaches pSAC	185 km	Harbour porpoise		
North Channel pSAC	130 km	Harbour porpoise		
Lleyn Peninsula and the Sarnau SAC	38 km	Bottlenose dolphin	Not defined for bottlenose dolphins, but assume movement within Irish Sea management unit	Yes
		Grey seal	20 km*	No
Cardigan Bay SAC	100 km	Bottlenose dolphin	Not defined for bottlenose dolphins, but assume movement within Irish Sea management unit.	Yes
		Grey Seal	20 km*	No
Pembrokeshire SAC	156 km	Grey seal	20 km*	No
Lambay Island SAC	85 km	Grey Seal	20 km*	No
Rockabill to Dalkey Island SAC	80 km	Harbour porpoise	Not defined, but assume movement within Celtic and Irish Seas management unit.	Yes
Saltee Islands SAC	174 km	Grey seal	20 km*	No

* Recent advice received from Scottish Natural Heritage (SNH) states that unlike harbour seals, grey seals aggregate to breed on land above the high water mark, returning to the same colonies each year. Mothers generally remain with pups on land for the 3-week lactation before mating / returning to sea. Pups stay on to moult before dispersing. After breeding, most seals then disperse away from the SAC making it very difficult to assign an individual to a particular SAC outwith the breeding season. Grey seal usage of the SAC is therefore very time and space-specific. SNH has therefore advised with regard to Scottish Marine Renewables developments that all grey seal SACs within a 20 km radius are screened into HRAs – although this distance should be used as a guide rather than an absolute cut-off. Sites beyond 20 km from a Project area therefore can be screened out" (SNH, 2015).

Based on information presented in Table 4.2, given that the offshore Project area does not lie within the foraging range of any SACs where grey or harbour seal are a qualifying interest, these species can be screened out of the HRA. The assessment of LSEs therefore is only required to consider potential impacts on SACs where bottlenose dolphin are a qualifying interest of the site and possible SACs identified for harbour porpoise where there is connectivity between the SACs and the Project area based on the location of the sites and behavioural / ecological characteristics of the relevant qualifying interests. This includes consideration of the importance of the Project area for each qualifying interest in context of the regional population for that species.

4.3.1 Potential impacts on bottlenose dolphin and harbour porpoise

The potential impacts of the DGU unit on bottlenose dolphin and harbour porpoise are discussed in Table 4.3 and are based on information from Chapter 11: Marine Mammals of the ES.

Table 4.3 Summary of potential impacts on bottlenose dolphin and harbour porpoise

Impact	Description	Potential impact on SAC qualifying interests (marine mammals)
Increased turbidity	Some marine mammal species make extensive use of visual cues when foraging for prey. Should the proposed operations alter the suspended sediment levels in the water column then foraging ability may be affected.	Cetaceans (harbour porpoise and bottlenose dolphin) are considered to have negligible sensitivity to increased turbidity on the basis that they do not rely extensively on eyesight for hunting and navigation. Due to the small scale of the Project, the volumes of suspended sediment generated during installation (from the potential option to drill the DGU unit foundation structure) are expected to be very small and will be generated over a very short time period. Any suspended sediment will also be rapidly dispersed (due to the high energy environment). Potential impacts on marine mammals are expected to be negligible and not significant.
Noise (from vessels, drilling and operating DGU unit)	There is potential for noise from the Project to cause injury or disturbance to marine mammals, potentially affecting foraging, breeding or migration. Sensitivity to noise differs between species, but all species using the Project area will be sensitive to some degree. Noise can also lead to habitat exclusion or create barriers to movement where noise levels are such that mammals have to avoid an area due to risk of injury or as a result of disturbance.	Results from the Underwater Noise Modelling Study carried out to inform the EIA concluded that there is very limited potential for the Project and associated activities e.g. drilling and vessel presence to cause injury to any species of marine mammal or to result in any significant disturbance due to the highly localised (limited potential zone of impact) and temporary nature of key noise generating activities. Given that noise emissions are very unlikely to lead to any changes in behaviour of marine mammals that are detected above natural variation, it is highly unlikely that there would be any impacts on an SAC population.
Pollution	Given that there will be no discharge to the marine environment from the DGU unit, the main source of potential pollution is as a result of an accidental release of fuel from vessels involved in installation and maintenance activities or the moored barge. Where accidental release of fuel does occur the resulting impacts will depend on the quantity of fuel released, prevailing currents and weather conditions as this will influence whether the fuel is dispersed offshore or carried onshore (beached).	The total oil inventory for a large installation vessel is likely to be in the region of 6 – 8,000,000 litres of marine diesel stored in a number of separate tanks. Based on a worst case scenario, a rupture of a single tank could result in a spill of 600,000 litres. Should a spill occur, cetaceans are considered to be less sensitive to potential impacts than for example seals where beached oil could directly impact haul out sites. Therefore, given spills are extremely unlikely due the low number of vessels expected to be present in the Project area during the project and the short duration of installation activities, the potential for a spill to impact cetaceans at a population level (SAC) are highly unlikely.
Physical interactions with vessels (including corkscrew injuries)	Recent evidence (Scottish Government, 2015 and van Neer *et al*., 2015) has emerged which shows that the corkscrew injuries on juvenile seals have been a result of fatal attacks by adult grey seals, as opposed to ducted propellers. However, it is noted that impacts from vessels cannot totally be ruled out given that previous studies have indicated that ducted propellers could cause such injuries.	In light of this new evidence, potential corkscrew injury impacts resulting from interactions with vessels involved with the Project are considered to be highly unlikely. Therefore, while impacts from vessels cannot totally be ruled out, significant effects on SAC populations of small marine mammals (seals and harbour porpoise) due to corkscrew injuries are unlikely to occur as a result of this Project.

Impact	Description	Potential impact on SAC qualifying interests (marine mammals)
Entanglement	The barge will be moored on site for up to five years using a rope and anchor mooring system comprising 8 anchor lines and surface marker buoys. The anchor lines will be up to 615 m in length and will be connected directly to the barge. As part of the assessment it is necessary to consider the potential for marine mammals to become entangled in the barge mooring system.	No instances of entanglement of marine mammals with mooring systems of marine renewable devices have yet been reported. There is also a lack of entanglement recorded from the use of anchored floating production, storage and offloading (FPSO) vessels in the oil and gas industry. Research (Sparling *et al.,* 2013) indicates that slack lines pose a greater risk for entanglement than taut lines. Entanglement risk is also influenced by other factors such as line thickness, position in water column and materials. With regard to this Project, given that the barge mooring lines will only occupy a small area and will be taut at all times, the potential risk of engagement for all marine mammal species is considered to be extremely low and is highly unlikely and will not result in any significant impacts on SAC populations.
Physical interaction with DGU unit and tether	The risk of collision between the moving DGU unit and its tether and a marine mammal has been identified as one of the key potential impacts associated with Project operation. Where collision does occur this could result in injury or death of the affected individual.	There is potential that injury or death of a marine mammal could, depending on the species impacted and the size and status of the regional population, have an adverse effect on a population of an SAC. Due to the on-going uncertainty regarding the level of impact that may arise as a result of a physical interaction with tidal device, the potential for impacts on SACs where marine mammals are a qualifying interest cannot be discounted at this stage in the HRA process (screening).

4.3.2 Assessment of LSE

Table 4.4 presents the results from the assessment of LSEs on SACs where bottlenose dolphin are a qualifying interest and possible new marine SACs identified for harbour porpoise and is based on the potential impacts discussed in Table 4.3.

Table 4.4 Assessment of LSE for SACs

SAC	Distance from Project area	Qualifying interest requiring consideration for HRA	Is the Project area within the predicted range of the qualifying interest?	Assessment of LSE
North Anglesey Marine pSAC	Project area inside pSAC	Harbour porpoise	Yes	Harbour porpoise are likely to be the most common marine mammal in the Project area. Due to the Project area sitting within the possible SAC, it is not possible to conclude at this stage that there will be no LSE on the population of the pSAC due to collision risk. For other impacts such as increased turbidity, noise, pollution, physical interaction with vessels, entanglement and cumulative effects it is possible to conclude no LSE on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for harbour porpoise and collision risk cannot be ruled out**

SAC	Distance from Project area	Qualifying interest requiring consideration for HRA	Is the Project area within the predicted range of the qualifying interest?	Assessment of LSE
West Wales Marine pSAC	35 km	Harbour porpoise	Yes	Due to the Project area being located approximately 35 km from the possible SAC, it is not possible to conclude at this stage that there will be no LSE on the population of the pSAC due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for harbour porpoise and collision risk cannot be ruled out**
Bristol Channel Approaches pSAC	185 km	Harbour porpoise	Yes	Although the Project area is located approximately 185 km from the possible SAC, it is not possible to conclude at this stage that there will be no LSE on the population of the pSAC due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for harbour porpoise and collision risk cannot be ruled out**
North Channel pSAC	130 km	Harbour porpoise	Yes	Although the Project area is located approximately 130 km from the possible SAC, it is not possible to conclude at this stage that there will be no LSE on the population of the pSAC due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for harbour porpoise and collision risk cannot be ruled out**
Lleyn Peninsula and the Sarnau SAC	38 km	Bottlenose dolphin	Yes	Evidence exists of long distance movement of bottlenose dolphin around the Welsh coast. Since animals from the SAC may pass through the site it is not possible to conclude at this stage that there will be no LSE on the population of the SAC due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on bottlenose dolphins on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for bottlenose dolphin and collision risk cannot be ruled out**

SAC	Distance from Project area	Qualifying interest requiring consideration for HRA	Is the Project area within the predicted range of the qualifying interest?	Assessment of LSE
Cardigan Bay SAC	100 km	Bottlenose dolphin	Yes	Evidence exists of long distance movement of bottlenose dolphin around the Welsh coast. Since animals from the SAC may pass through the site it is not possible to conclude at this stage that there will be no LSE on the population of the SAC due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on bottlenose dolphins on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for bottlenose dolphin and collision risk cannot be ruled out**
Rockabill to Dalkey Island SAC	80 km	Harbour porpoise	Yes	Although the Project area is located approximately 80 km from the SAC, it is not possible to conclude at this stage that there will be no LSE on the SAC population due to collision risk. For other potential impact mechanisms, it is possible to conclude no LSE on the basis of the very limited potential for the impact to occur and the limited change if such impact did occur. **Conclusion = LSE for harbour porpoise and collision risk cannot be ruled out**

4.3.3 Conclusion from the assessment of LSE

Based on the information presented in Table 4.4 it is not possible to screen out at this stage any of the SAC/pSACs identified as requiring consideration as part of the HRA. This is on the basis that it cannot be concluded at this stage that there will be no significant impact on any of the key qualifying interests of the sites identified (harbour porpoise and bottlenose dolphin) as a result of interactions with the DGU unit (collision risk).

All six SAC/pSAC sites are therefore taken through to the next stage of the HRA where more information will be provided on the potential risk of collision with the DGU unit and its tethers. This information will then be provided to the Competent Authority (NRW) to enable them to make an Appropriate Assessment as to whether there is potential for the Project to have an adverse impact on an SAC.

4.4 Information to inform and Appropriate Assessment

As discussed in Section 2.3, the purpose of an Appropriate Assessment is to determine whether the Project could have an adverse effect on the integrity of an SAC based on a judgement against the stated conservation objectives of the SAC.

In undertaking an Appropriate Assessment for the SAC qualifying interest where the potential for LSE has not been ruled out, it is considered that information on the following topics are relevant and should therefore be taken into account:

> The condition of the qualifying interest, i.e. the current conservation status of qualifying feature;

> Connectivity between the qualifying interest (in this case the population of individuals forming a SAC qualifying feature) and the offshore Project area;

> The importance of the area potentially affected by the Project for supporting the qualifying interest (i.e. an SAC population);

> The sensitivity of the qualifying interest to the effects predicted to arise from the Project; and

> Any other aspect of the ecology of the qualifying interest that is relevant to evaluating the likely impacts to it from the Project.

Information on connectivity between the qualifying interest and the offshore Project area, importance of the offshore Project area for the qualifying interest and sensitivity of the qualifying interest to the listed impacts was taken into account in determining LSEs.

4.4.1 Site (and relevant qualifying interests) details

Limited information is available on population counts for individual SACs. Table 4.5 therefore provides information on the local (offshore Project area and surrounding area), regional and Marine Mammal Management Unit (MMMU) populations for the two qualifying interests (bottlenose dolphin and harbour porpoise) of the seven SACs where LSEs could not be ruled out and further assessment is required as part of the HRA.

Table 4.5 Population data for sites requiring further assessment

<table>
<tr><th>SAC</th><th>Distance from Project site</th><th>Qualifying features</th><th>Local population (offshore Project area and surrounding area)</th><th>Regional population estimates</th><th>MMMUs population estimates</th></tr>
<tr><td>North Anglesey Marine pSAC</td><td>Site inside pSAC</td><td rowspan="5">Harbour porpoise</td><td rowspan="5">Shucksmith et al., (2009) survey of North Anglesey (Point Lynas to the west of South Stack = 0.63 individuals km^{-2}

Gordon <i>et al.</i>, (2011) – survey off north west coast of Anglesey (Carmel Head and South Stack – approx. 4.5 km from the DG Holyhead Deep site) = 0.56 individuals km^{-2}</td><td rowspan="5">15,230 individuals Density = 0.36 individuals km-^{2}

Based on population estimates from SCANS-II for Block O (the Irish Sea)</td><td rowspan="5">Irish Sea MMMU = 104,965 (95% CI: 56,774 – 193,065)</td></tr>
<tr><td>West Wales Marine pSAC</td><td>35 km</td></tr>
<tr><td>Bristol Channel Approaches pSAC</td><td>185 km</td></tr>
<tr><td>North Channel pSAC</td><td>130 km</td></tr>
<tr><td>Rockabill to Dalkey Island SAC</td><td>80 km</td></tr>
<tr><td>Lleyn Peninsula and the Sarnau SAC</td><td>38 km</td><td rowspan="2">Bottlenose dolphin</td><td rowspan="2">No density estimate available for Project area or surrounding area</td><td rowspan="2">235 individuals Density = 0.0052 individuals / km^{2}

Based on population estimates from SCANS-II for Block O (the Irish Sea)</td><td rowspan="2">Irish Sea MMMU = 397 (95% CI: 362-414)</td></tr>
<tr><td>Cardigan Bay SAC</td><td>100 km</td></tr>
</table>

4.4.2 SAC Conservation Objectives

As with the population estimates, there is also limited information on Conservation Objectives for the two bottlenose dolphin SACs. The conservations objectives presented below therefore relate specifically to the Irish SAC site (Rockabill to Dalkey Island). Although this site has been identified on the basis that harbour porpoise is a qualifying interest, the conservation objectives are relevant to all marine mammals and therefore are also relevant to the two bottlenose dolphin SACs.

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special

Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network (NPWS, 2015).

The following draft conservation objectives set out for pSACs for harbour porpoise are common across all sites in the UK to ensure coherence across the network:

“To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise.

To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:

1. The species is a viable component of the site.

2. There is no significant disturbance of the species.

3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.”

European and national legislation places a collective obligation member states of the European Union (EU) and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites (NPWS, 2015).

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

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

The favourable conservation status of a species is achieved when:

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

With regard to the North Anglesey Marine, West Wales Marine and Bristol Channel Approaches and North Channel possible SACs, their features (harbour porpoise) are regarded as being in favourable condition, and the aim of designating the sites is to maintain the features so that, subject to natural change, they remain as such.

4.4.3 Species accounts

Detailed species accounts for harbour porpoise and bottlenose dolphin are provided in Chapter 11 of the ES: Marine Mammals. Summaries of each species are provided below:

Bottlenose dolphin

Bottlenose dolphin have a worldwide distribution (Reid *at al.,* 2003) and are distributed throughout UK shelf waters, often close to shore. In the UK, the two largest aggregations of the species are found in the Moray Firth (north-east Scotland) and Cardigan Bay (Wales). They inhabit UK waters throughout the year, but in most coastal areas the greatest numbers are recorded between May and October (Evans *et al*., 2003, Reid *et al.,* 2003). They prey on a wide variety of benthic and pelagic fish species, as well as cephalopods.

At a local level, bottlenose dolphin are regularly observed in the Irish Sea, predominantly in coastal waters between Cardigan Bay and Anglesey (Mackey *et al.,* 2004; Pesante *et al.,* 2008a; Pesante *et al.,* 2008b), with concentrations in south Cardigan Bay, south of the Lleyn Peninsula and to the north and west of Anglesey. Bottlenose dolphin tend to form groups, the size and distribution of which is also observed to vary seasonally with larger groups being formed more in the winter than the summer (Bains and Evans, 2012). The bottlenose dolphin also has an extended breeding season, meaning that calves can often be observed throughout the year.

There is also evidence to suggest that in addition to the Cardigan Bay population there is a second population that moves about the wider Irish Sea and a third population that comprises transient visitors that do not belong to the Irish Sea population (Evans, 2012). There is also evidence from boat surveys that indicates that bottlenose dolphin from the Cardigan Bay population have a wide home range that includes North Wales and Anglesey. At certain times of the year, depending on prey distribution it is thought that individuals from the three different populations converge, resulting in the formation of the larger groups. There is also potential that a proportion of the bottlenose dolphins observed in the vicinity of Holy Island may be part of a wider Cardigan Bay / west Wales population and could therefore be considered to belong to the Cardigan Bay and / or Llyn Peninsula and Sarnau SAC populations.

In comparison to harbour porpoise the abundance of bottlenose dolphins throughout the Irish Sea is very low with sightings from recent surveys (e.g. Celtic Array vessel surveys and Gordon *et al.,* 2011 vessel surveys off the west coast of Anglesey) limited to single figures. Of the 42 marine mammal sightings recorded by SEACAMS (2015) in the west Anglesey area, only one was a bottlenose dolphin. This was outside the DG Holyhead Deep Project area.

Based on the above, it is unlikely that the Project is located in an area of particular importance for bottlenose dolphin. However, the small number of observations to the west of Anglesey demonstrate that their presence cannot be ruled out.

Harbour porpoise

The harbour porpoise is distributed throughout temperate and subarctic waters of the North Pacific and North Atlantic oceans and is the most abundant cetacean to occur in north-west European shelf waters (Evans *et al*., 2003). It is the most frequently-sighted and widely-distributed cetacean species in UK waters, where the highest densities occur along the North Sea coast, around the Northern Isles and the Outer Hebrides, and off Pembrokeshire in Wales (Evans *et al*., 2003; Reid *et al*., 2003; Northridge *et al*., 1995).

Harbour porpoise is a small animal with high metabolic demands. Their diets consists mainly of gadoids and clupeids (small schooling fish). The presence of harbour porpoise in the Irish Sea is most likely driven by the highly suitable foraging and breeding habitat that can be found there (Read, 1999).

Despite being frequently recorded in the Irish Sea and widespread throughout the region, the species is not evenly distributed throughout the Welsh waters region (Northridge *et al*., 1995; Pollock *et al*., 1997; de Boer *et al*., 2002; Baines & Evans, 2012). Instead they tend to occur at a number of localised hotspots including the south-west coast of the Lleyn Peninsula and southern Cardigan Bay. There also appears to be localised hotspots off the north and west coast of Anglesey (Northridge *et al*., 1995; Reid *et al*., 2003; Mackey *et al*., 2004), in particular around Point Lynas and South Stack, including the DG Holyhead Deep site (Baines & Evans, 2012). They are reported to frequently occur near headlands or in sounds between islands (Pierpoint, 2008; Shucksmith *et al*., 2009), where the strong tidal currents, tidal races and eddies provide favourable foraging conditions (Marubini *et al*., 2009). Harbour porpoise are likely to be present at these locations throughout the year, with little seasonal variation. SCANS-II estimated harbour porpoise abundance in Block O (the Irish Sea) to be 15,230, with a density of 0.36 individuals km^{-2} and were recorded in groups which have a mean size of 1.37 individuals (Hammond *et al*., 2013).

Various marine mammal surveys have been undertaken in the Irish Sea and waters off the north and west coasts of Anglesey. These include two dedicated studies of harbour porpoise around the north coast of Anglesey. The first study, which was carried out between 2002 and 2004 by Shucksmith *et al.,* (2009), involved surveying a block of approximately 498 km^2 which extended from the east of Point Lynas to the west of South Stack. The survey involved both visual and acoustic methods to detect animals along 31 transects extending out from shore and resulted in an estimated population density of 0.63 individuals km^{-2} which was considerably higher than the SCANS-II estimate of 0.36 individuals km^{-2} for the Irish Sea region.

The second study was carried out in 2009 by Gordon *et al.,* (2011) who undertook detailed cetacean surveys off the north-west coast of Anglesey at two locations – Carmel Head and South Stack, the latter of which is located approximately 4.5 km from the DG Holyhead Deep site. The surveys used a variety of detection methods including visual surveys, towed hydrophone acoustic surveys, passive acoustic monitoring and visual observations from shore. The resulting density estimates for the two survey areas was calculated to be 0.56 individuals km^{-2}, with densities in the South Stack area decreasing from west to east (lower further offshore) and with distance from the main tidal race.

Of the 42 marine mammal sightings recorded by SEACAMS (2015) in the west Anglesey area, 39 were harbour porpoise. This corresponds to a rate of 1.88 sightings per hour. SEACAMS (2015) report that the spatial distribution of sightings of harbour porpoise appears to be relatively well spread across the survey area. Specifically within the DG Holyhead Deep site, from approximately 26 km of survey effort there was only one recording of harbour porpoise (detected acoustically), although further harbour porpoise sightings have been recorded close to the DG Holyhead Deep site (SEACAMS, 2015).

Considering its status as the most common cetacean in the Irish Sea and considering the results of local surveys, it seems likely that the DG Holyhead Deep Project site is well-used by harbour porpoise, although relative densities suggest the site is not amongst the areas of highest importance in the Irish Sea.

4.4.4 Information to support an assessment of effects on SACs

As discussed in Section 4.3.3 it was not possible to conclude for any of the six SAC sites designated for either bottlenose dolphin or harbour porpoise that there would be no LSE on the integrity of the these sites due to potential risk of collision with the DGU unit and its tether.

The following section therefore provides more detailed information on potential risk of collision on harbour porpoise and bottlenose dolphin. This is based on information presented in Chapter 11: Marine Mammals of the ES.

4.4.4.1 Physical interaction with DGU unit

4.4.4.1.1 Introduction to collision risk

Risk of collision between the moving DGU and its tether and a marine mammal is thought to be a key potential effect of Project operation and it is considered that species of marine mammals that use the Project study area are at some risk of collision impact, which could ultimately result in death or injury. Whilst a distinction can be drawn between species that forage in the water column or at the seabed, they all must return to the surface to breathe and so will transit through the water column to the depths within which the DGU will operate. A number of factors including the visibility, audibility, dimensions and speed of the moving DGU and tether, how important the location is for feeding or breeding and the extent of long range avoidance and close range evasion all interact to determine the likelihood of collision.

Sparling *et al.* (2013) report that there remains uncertainty regarding the level of impacts that may arise from the construction, operation and maintenance stages of single device and array-type tidal projects. This reflects the statements of the Scottish Marine Renewables SEA undertaken in 2007 (Wilson *et al.,* 2007) which identified:

- Collision risks are not well understood for any marine vertebrates (this remains true);
- Man-made collision risks are more diverse and common than generally supposed (e.g. rate of whale–ship strikes);
- Underwater collision risks typically become well studied after they have become a conservation concern;
- Subtleties of gear design (shape, colour etc.) as well as environmental conditions (turbidity, flow rate etc.) can markedly change collision rates;
- Objects in the water column will naturally attract fish and consequently their predators (e.g. marine mammals);
- The proximity and relative orientation to other objects will impact escape options;
- Collision risk will vary with age of the animal, with juveniles potentially at greater risk than adults because of reduced abilities or experience; and

> The potential for animals to escape collisions with marine renewable devices will depend on their body size, social behaviour, foraging tactics, curiosity, habitat use, underwater agility and sensory capabilities.

4.4.4.1.2 Approach to understanding collision risk

Collision risk can be assessed qualitatively by considering the occurrence of animals in the location that devices are to be deployed and the behaviour of those animals. However, in order to make a more quantitative assessment, a collision risk model could be deployed. It has not been possible for this Project, or for any other tidal projects thus far, to develop a full collision risk model because there is not sufficient information on the far-field or near-field behavioural responses of marine mammals to tidal energy devices to enable a robust quantification of potential strike rates (e.g. Thompson *et al*., 2013). However, it has been possible to develop collision risk models based on encounter rates on the basis that collision risk can be thought of as a function of encounter rate. Therefore the probabilities of marine mammal avoidance and evasion and modelling of encounter rates as the basis of collision risk modelling (CRM) was considered an appropriate substitute to inform this EIA. This approach has been followed for other projects, including the MeyGen Tidal Energy Project (MeyGen, 2012), the Skerries Tidal Stream Array EIA (SeaGen, 2011) the Torr Head Tidal Energy project (TVL, 2015) and for the deployment of the Minesto 1:4 scale DGU in Strangford Lough.

SMRU Marine (2014) previously developed a fully simulated collision risk assessment model for a 1:4 scale version of the DGU with respect to harbour seals at the Strangford Lough site. SMRU Consulting (2015) redeveloped the collision risk modelling (CRM) framework for a DGU unit at the Holyhead Deep. The CRM framework makes use of real DGU (kite and tether) movement data collected by Minesto under different tidal conditions[4] (0.50 m/s, 0.80 m/s, 1.10 m/s and 1.66 m/s) to understand the potential for encounter at various states of the tide and hence states of operation of the DGU. The probability of encounter of the device or tether relative to swimming speed of marine mammals and to the anchoring position of the DGU (seabed vs surface) were also considered. For each of the four tidal current speeds, animals were modelled moving with a range of swimming speeds relative to the current. Each set of simulations generated a probability of collision between animals and the kite and tether. Full details of the input parameters and methodology are available in SMRU Consulting (2015).

In order to provide context for the CRM exercise, SMRU Consulting (2015) undertook further work to assess the population level consequences of the range of collision rates predicted by the CRM exercise. This allows an exploration of the level of collision risk that could theoretically occur without a significant impact on marine mammal populations in the long term.

4.4.4.1.3 How species behave around tidal devices

Wilson *et al*. (2007) report that responses to tidal devices are likely to occur on two spatial scales; at long range marine mammals have the option to avoid the area of device placement (i.e. swim around) and at closer range they can evade specific units (i.e. dodge or swerve). Little is known yet about behavioural reactions but detection distances can be determined (Wilson *et al*., 2007). Given the audibility of the operating DGU, it is likely that marine mammals will be able to detect the DGU above background noise, at least in the vicinity of the DGU. Marine mammals are thus likely to be able to recognise the presence of the noise source (the DGU) and will have time on any approach to this noise source to ready an avoidance response.

Where marine mammals do not take avoidance measures at longer ranges, they are likely to come close to the DGU. In terms of reactions on approaching the DGUs, marine mammals ordinarily encounter obstacles in the water column and are clearly adept at dodging or swerving those obstacles, whether they are stationary (such as the seabed) or moving (like predators or vessels). In daytime and clear waters, underwater structures may be visible at ranges of tens of meters and hence give sufficient warning for visual species to exhibit avoidance and evasion if necessary (Wilson *et al*., 2007). Collision risk is expected to be greater for devices deployed in regions of moderate to high turbidity, or if the energy devices increase turbidity, because of reduced visibility (Scottish Executive, 2007), but it is known that the water column in the Project study area does not hold a high sediment content and it is not likely that the device will resuspend any sediment themselves (see ES Chapter 9: Coastal Processes).

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[4] These four tidal conditions were chosen to best represent the distribution of current speeds at the Holyhead Deep. The maximum operational speeds for the DGU (2.2 m/s) was not modelled because it occurs so infrequently.

Some understanding of how marine mammals react around devices may be derived from existing tidal projects; the DGU installed by Minesto in Strangford Lough provides some useful insight. A one in four (1:4) scale version of the DGU was installed in 2013 and remains deployed. A Marine Mammal Observer (MMO) must be present whenever the device is in operation. Sighting data collected by the MMO deployed onboard a test platform prior to operation of the device, and during operation of the device itself, is available between February 2013 and June 2014. During the pre-operational stage, when the device was neither present nor in operation, 55 seals were recorded 50 m or less from the DGU location. When the DGU was present and operating, only 3 seals were recorded 50 m or less from the DGU, representing a decrease of approximately 95%. The closest approach recorded was 50 m, and no incidences of collision were reported with the DGU (although the device did shut down for approaches less than 50 m).

As noted by SCOS (2014), the only other substantial direct information on interactions with tidal devices remains that collected in Strangford Narrows in Northern Ireland where a long term study of seal populations and seal foraging movements has been carried out during the development and deployment stage of the SeaGen device, a large twin rotor tidal turbine (Lonergen *et al*., in review). Data from telemetry and acoustic studies in Strangford Lough suggest that there may be a degree of local avoidance by marine mammals of operating devices, though no reduction in overall seal or harbour porpoise transit rates through the narrows in which the turbine is located (Royal Haskoning, 2011). For example, there was evidence of a redistribution of harbour seals during turbine operation over approximately 250 m around the turbine. Although Royal Haskoning (2011) suggest that this change in distribution is probably of little biological significance, it indicates that harbour seals may well be detecting the presence of the turbine and responding to it to ensure no collision. Royal Haskoning (2011) state that this pattern of avoidance was similar regardless of whether the turbine was operating or not operating, suggesting that it was not a direct result of noise produced by the operating turbine, nor necessarily related to moving turbine rotors, and instead may have been due to the presence of the structure, or, importantly from a collision perspective, a learned 'habit' of avoidance.

Interestingly, monitoring of the SeaGen device showed that seals transited at a relatively higher rate during periods of slack tide. As Royal Haskoning (2011) note, this would clearly have the effect of reducing collision risk if seals were preferentially transiting during periods when the turbine was not operating.

SCOS (2013) report the results of a recent DECC-funded project utilising the SeaGen deployment in Strangford Lough to measure the underwater proximity and frequency of seals around the turbine using active sonar. The results of this showed 109 sonar targets classified as marine mammals (these were likely to be harbour seals) at a detection rate of approximately 5.9 per day. The ranges that marine mammals were detected suggest that animals do move in close proximity to the tidal turbine both when it was operational (minimum range of 9.9 m) and non-operational (minimum range of 8.4 m). Quite clearly animals are approaching tidal devices, including whilst operational, but the results of the carcass recovery, strain gauge and other studies above suggest a near, or complete, absence of collisions between animals and devices. Interestingly, Sparling *et al*. (2013) note that no marine mammals were recorded during video monitoring of the OpenHydro Open Centre Turbine (OCT) device whilst operational at EMEC, although the authors note that the monitoring was not specifically designed to determine the potential for marine mammal interactions.

As part of the deployment of a single Tidal Generation Limited (TGL) tidal device at the Falls of Warness EMEC test site in Orkney, TGL placed strain gauges in the blades of the turbine to monitor impact between objects in the water column and the device, with the main aim being to determine whether marine mammals had made contact with the device (TGL, 2011, in MeyGen, 2012). The monitoring and extensive processing and post-processing analysis of data collected during a nine day monitoring period across a range of tidal states showed no evidence of any marine mammal impact on the blades of the device (TGL, 2011, in MeyGen, 2012). Concurrent with the analysis, there were no reported sightings of injured or dead marine mammals in the locality of the turbine test site (TGL, 2011, in MeyGen, 2012).

What appears evident from the limited data currently available is that animals that are using the water around tidal turbines are likely to encounter those turbines in some form, be that physical encounter or a detection. However, an encounter is not the same as a collision; whilst it could lead to a collision, this would only be possible if the animal in question does not take appropriate avoidance or evasive action. As they are highly mobile underwater, marine mammals have the capacity to avoid and evade marine turbine devices provided they have the ability to detect the objects, perceive them as a threat and then take appropriate action at long or short range (e.g. Gordon *et al*., 2011). Since there is no information on the degree to which marine mammals will actually make appropriate manoeuvres (as highlighted early in the development of tidal energy by Wilson *et al.,* 2007), predicted encounter rates must be very carefully interpreted as a worst case scenario.

4.4.4.1.4 Results from the CRM exercise

In order to provide context for the CRM outputs, SMRU Consulting (2015) assessed the population consequences of a range of collision rates. The approach taken was to first calculate the magnitude of collisions (with both the kite and tether) that would be required to have a 'significant' effect on the population and then work backwards from there to determine the potential for this effect, given current understanding of encounter rates at the Holyhead Deep. Specifically, following calculation of the magnitude of collisions with the kite and tether required for a significant effect, these were multiplied by the calculated collision probability for each species to predict the encounter rate necessary to achieve that magnitude of collisions; these are shown as the 0% evasion line items in Table 4.6. Since it is expected that there would be some degree of avoidance or evasion of devices, a range of probabilities for evasion and avoidance can be considered; these are shown as the 50 to 99% line items in Table 4.6. As seen, passage rate required for significant effects at the population level increases substantially as avoidance and evasion rates increase.

Table 4.6 Passage rate required for significant effects at the population level (this considers both encounter with the kite and with the tether)

Species	Percentage avoidance/evasion	Passage rate (per day) required for significant effects at the population level	
		From	To
Harbour porpoise	0	78	2,191
	50	156	4,382
	75	312	8,764
	95	1,560	43,820
	98	3,900	109,550
	99	7,800	219,100
Bottlenose dolphin	0	0.08	4
	50	0.16	8
	75	0.32	16
	95	1.6	80
	98	4	200
	99	8	400

In order to contextualise the passage rate required for significant effects at the population level, a highly conservative estimate (i.e. highest estimate) of possible site passage rates based on current understanding of the Project area has been calculated. This has been achieved by multiplying the maximum density of animals likely to be within the swept area of the DGU at a single point in time by the maximum number of crossings possible in a 24 hour period, based on the swimming speed of the animal, the distance required to cross the swept area of the DGU and the assumption that as soon as an individual vacates the swept area it is immediately replaced by another. The input data are summarised as follows:

- Project parameters
  - The horizontal swept area of a DGUs has been used as the area through which site passage rate has been calculated. This area represents directly the area of sea within which the potential for collision risk exists (this is the same area that has been considered in the CRM). Passage through any area of sea outwith this area would not result in any risk of collision since animals would not encounter the device. It should be noted that use of this swept area in the calculations represents a

highly conservative approach since the horizontal swept area has been defined as a circle around the device whose radius is the length of the tether, whereas in reality, an operating DGU will occupy a very small proportion of this circle during a given tidal state.

> Abundance/density
  - As recommended by NRW during consultation, in order to maintain a high level of precaution the starting point for calculating site passage rates for cetaceans has been taken as the upper 95% confidence interval (CI) population estimate for the SCANS-II survey block within which the Project is sited (Block O). Use of the upper 95% CI population estimate instead of the mean population estimate results in a much larger population estimate being considered in the calculations, resulting in a higher predicted density and thus a higher site passage rate. By way of example in these calculations, for harbour a population estimate of 203,500 animals is used (the upper 95% CI value) instead of 15,230 animals (the mean value).
  - As the SCANS-II surveys did not record pinnipeds, the starting point for grey seals is the analogous (i.e. similarly conservative) upper 95% CI at-sea usage density estimates provided by Jones *et al.* (2013).

> Animal movement
  - Site passage rates were calculated by first determining the maximum number of site passages a single animal could make through the swept area of the DGU in one day (since this is the unit used to display the CRM output). This approach assumes that an animal enters the swept area of a single DGU and swims across the diameter of the DGU swept area circle, a distance of 224 m. It was assumed that on leaving the swept area, each animal unit would immediately be replaced by another. For consistency, the average swim speeds used in the CRM were used to calculate the maximum number of possible crossings.

Table 4.7 shows the input data and the estimated worst case (i.e. highest) daily site passage rates in the context of the passage rates required for significant effects at the population level (as detailed in Table 4.6). Considering the information presented earlier in this chapter on avoidance and evasion (Section 4.4.4.1.3), it is likely that avoidance rates will be at the upper end of the scale described in Table 4.6 and Table 4.7). Experience from other tidal project EIA and consultation with regulators and their advisers suggests that 98% avoidance is not unreasonable to assume. Assuming 98% avoidance for the DGU, between 3,900 and 109,550 individual harbour porpoise would be required to pass through the DGU device area on a daily basis for there to be any significant population effects. For bottlenose dolphins, an assumption of 98% avoidance would mean that between 4 and 200 passages of individuals would be required to pass through the DGU device area on a daily basis for there to be any significant population effects. As can be seen for harbour porpoise and bottlenose dolphin, based on the predicted site passage rates through the swept area of the device there is no potential for significant population level assuming the avoidance rate considered most likely (i.e. 98%). This statement holds true even assuming lower levels of avoidance for all species (including assuming no avoidance at all for harbour porpoise and, reflecting the smaller population against which potential impacts are assessed, approximately 84% for bottlenose dolphin).

It is important to additionally consider that the passage rate required for significant effects at the population is based on the probability of collision (with the tether or kite) calculated from four tidal states, all of which would result in the device operating. In reality, it is expected that the tidal conditions will be unsuitable for DGU unit operation for 23% of the tidal cycle (i.e. tidal flow will be below the 0.5 m/s cut-in speed). As such, 23% of passages through the operational area of the device would, instead of encountering an operation device, encounter a device that is static and held close to the seabed. Such a static device would be expected to present no real collision risk and the passage rates required for significant effects at the population level detailed in the paragraphs and tables above will be underestimates of the number of animals that must pass through the site for there to be any potential for significant negative impact at the population level.

Table 4.7 Estimated maximum daily passage rates through the swept area of a single DGU in the context of the passage rates required per day to result in a significant effect at the population level. Green indicates scenarios where there is predicted to be no significant population level effect whilst orange indicates there could potentially be a significant population level effect.

Aspect	Parameter	Species data and results	
		Harbour porpoise	Bottlenose dolphin
Project parameter	Size of horizontal swept area of DGU (km^2) (i.e. the area within which there is a risk of collision with a device, called the 'risk area')	0.1	
Abundance/ density	Size of block O (km^2)	45,417	45,417
	SCANS-II block O abundance (upper 95% CI)	203,500	900
	Density (animals per km^2)	4.481	0.020
	No. of animals in swept area an any time (i.e. the number of animals within the risk area of the DGU at any one time)	0.150	0.001
Animal movement	Animal swim speed (km per hour)	3.96	6.84
	Distance to travel through the risk area of the DGU (m)	224	
	Time to cross the risk area of the DGU (minutes)	3.39	1.96
	Maximum crossings of the risk area for the DGU per day	424.29	732.86
Passage rate predicted for the Project area	Maximum passage rate per day through the risk area of the DGU	63.535	0.485
Comparison of predicted passage rate with CRM passage rates which may result in potentially significant population level impacts	99% avoidance	7,800 – 219,100	8 – 400
	98% avoidance	3,900 – 109,550	4 – 200
	95% avoidance	1,560 – 43,820	1.6 – 80
	75% avoidance	312 – 8,764	0.32 – 16
	50% avoidance	156 – 4,382	0.16 – 80
	0% avoidance	78 – 2,191	0.08 – 4

Of course, these discussions still include the assumption that an encounter with the DGU kite or tether would result in death. Wilson *et al*., (2007) comment that the effects of encounter may range from minor injuries such as abrasions to temporary or permanent debilitation (internal injuries, surface wounds, damage to delicate organs such as eyes) to more significant injuries (major cuts, amputations or internal trauma). Depending on severity and bodily location these injuries may result in recoverable injury, long-term debilitation, delayed or instant mortality (Wilson *et al*., 2007). Injury is likely to be much more common than instant mortality since marine mammals are relatively robust to potential strikes as a result of the thick layer of blubber that protects and defends the vital organs. However evidence from ship strikes suggests that for impacts with large objects, a blubber layer is insufficient to provide complete protection (Laist *et al*., 2001). Sparling *et al*., (2013) cite a US Department of Energy study that modelled the OpenHydro OCT device and predicted that such a device would not exert sufficient force to kill or severely injure an adult killer whale (in part because it does not have the exposed tips commonly present in tidal turbine designs). An assessment of all seal carcasses found in the Strangford Lough has taken place as part of the SeaGen development and in post mortem none have shown signs of interaction with the SeaGen turbine, suggesting an absence of recurring fatal encounters between seals and the tidal turbine (Royal Haskoning, 2011). Thompson *et al*., (2014) report the results of field trials on seal carcasses and tidal turbine interactions, concluding that less than one third of collisions are likely to be fatal.

The encounter rates predicted for harbour porpoise, grey seal and bottlenose dolphins should be viewed in the light of:

> The worst case Project parameters have been used as inputs to the model;

> Monitoring evidence for other devices suggests a high degree of avoidance of tidal devices; and

> The device is likely to be audible above background noise at least in the vicinity of the DGU, increasing the likelihood of early detection by mammals (see below for discussion).

4.4.4.1.5 Conclusion of assessment of potential impacts with regard to site integrity

Based on the findings from the CRM exercise and the impact assessment it was concluded that there would be **no impact** on local or regional populations of harbour porpoise or bottlenose dolphin as a result of potential collision with the DGU unit. This conclusion takes into account a number of factors including species sensitivity and the number of animals that potentially will be present in the Project area.

Table 4.8 Summary of findings from assessment of potential impacts from collision with DGU unit on identified SACs

SAC	Distance from Project site	Qualifying features	Impact assessment – collision risk
North Anglesey Marine pSAC	Site inside possible SAC	Harbour porpoise	The likely number of passages necessary to result in population level effects are much higher than the available baseline data suggest could be achieved in terms of the number of animals expected to be present in the Project area. It can therefore be concluded that there will be no adverse impacts on the conservation objectives or integrity of any of the listed sites.
West Wales Marine pSAC	35 km		
Bristol Channel Approaches pSAC	185 km		
North Channel pSAC	130 km		
Rockabill to Dalkey Island SAC	80 km		
Lleyn Peninsula and the Sarnau SAC	38 km	Bottlenose dolphin	Although the likely number of passages necessary to result in population level effects is much lower for this species than for others, the rate is considered to be higher than the available baseline data suggest could be achieved. Combined with the likely outcome of collisions, there is expected to be no impact at the population level. It can therefore be concluded that there will be no adverse impacts on the conservation objectives or integrity of either of the listed sites.
Cardigan Bay SAC	100 km		

5 SACS – MIGRATORY FISH

5.1 Introduction

The Project area has been identified as not being of high importance for migratory fish and assessment of potential effects on this species was scoped out of the EIA (Minesto, 2013). Nevertheless, there are numerous SACs across the coasts of North, West and South Wales, as well as East Ireland and West England, which require consideration in this HRA because they afford protection one or more of the following species of migratory fish:

> Atlantic salmon *Salmo salar*;

> Sea lamprey *Petromyzon marinus*; and

> River lamprey *Lampetra fluviatilis*.

Atlantic salmon and both species of lamprey are anadromous, meaning they spend the majority of their adult lives in seawater (or estuarine water in the case of river lamprey) but return to freshwater to reproduce. There is limited information available on the at-sea migrations of these species because studies of movements in open water are technically challenging and expensive.

Sea lamprey spawn in gravel beds of freshwater streams and mature in the open sea. Relatively little is known about the precise habitats occupied by adult sea lampreys (Maitland, 2003) as it is uncommon in the UK (DECC, 2009b), but the main population of this species are found in the Bristol Channel and adjacent offshore waters (DECC, 2009b). The rarity of capture in coastal and estuarine waters suggests that marine lampreys are solitary hunters and widely dispersed at sea. Sea lamprey have been caught in shallow waters, as well as at considerable depth (up to 4,099 m) suggesting that they can feed in deeper offshore waters (Haedrich, 1977). Homing behaviour is not apparent in this species. However they are selective in their choice of spawning streams and are thought to favour sites where ammocoete[5] larvae are present due to olfactory cues (OSPAR, 2008). Since relatively little about the offshore distribution of this species is known, their presence in the Project area cannot be ruled out, but it is extremely unlikely that they are present in significant numbers, and even less likely that could be affected by the Project. As such, they have not been considered further in this HRA.

The distribution of adult river lamprey tends to be restricted to the immediate vicinity of their natal rivers, and primarily within estuarine waters. Considering the Project area's fully marine setting and significant distance from the nearest SAC designated for river lamprey (Dee Estuary/ Aber Dyfrdwy SAC – 93 km away), it is extremely unlikely that this species occurs here. Hence, there is extremely limited potential for the Project to affect this species, and they have not been considered further in this HRA.

Atlantic Salmon from SAC rivers in Wales, England and Ireland, (as well as other undesignated/protected rivers), have the potential to pass through the Project area as they migrate north through the Irish Channel to offshore deep water foraging grounds off Greenland. There is also potential for salmon from rivers located in close proximity to the Project area to pass through site as they follow the coast towards open water before heading north (e.g. may swim south initially depending on orientation). Given that Atlantic salmon could potentially pass through the Project area and therefore could be affected by the Project, SACs designated for this species are given further consideration within this HRA report.

5.2 Salmon SACs requiring consideration as part of the HRA

Table 5.1 lists the SACs that have been identified as requiring consideration as part of the HRA. The location of these sites are shown in Figure 5.1.

[5] Lamprey larvae, which spend several years in rivers, where they live burrowed in fine sediment, filter feeding on detritus and microorganisms.

Table 5.1 SACs designated for Atlantic salmon requiring consideration as part of the HRA

SAC	Distance from Project area	Location	Primary reason for selection of site(✓✓), or present as qualifying features but not primary reason for selection of site (✓)
Slaney River Valley SAC	150 km	East coast Ireland	✓
Lower River Suir SAC	187 km	East coast Ireland	✓
River Barrow and River Nore SAC	191 km	East coast Ireland	✓
Blackwater River (Cork/Waterford) SAC	255 km	South east Ireland	✓
Blackwater River (Kerry) SAC	372 km	South coast Ireland	✓
Afon Gwyrfai a Llyn Cwellyn SAC	37 km	North Wales	✓✓
River Dee and Bala Lake / Afon Dyfrdwy a Llyn Tegid SAC	113 km	North Wales	✓✓
Afon Eden – Cors Goch Trawsfynydd SAC	83 km	North Wales	✓
Afon Teifi / River Teifi SAC	132 km	West Wales	✓✓
River Usk / Afon Wysg SAC	231 km	South Wales	✓✓
River Wye / Afon Gwy SAC	236 km	South Wales	✓✓
Dartmoor SAC	300 km	South west England (Devon)	✓
River Camel SAC	290 km	South west England (Cornwall)	✓
River Avon SAC	355 km	South coast England	✓
River Itchen SAC	354 km	South coast England	✓

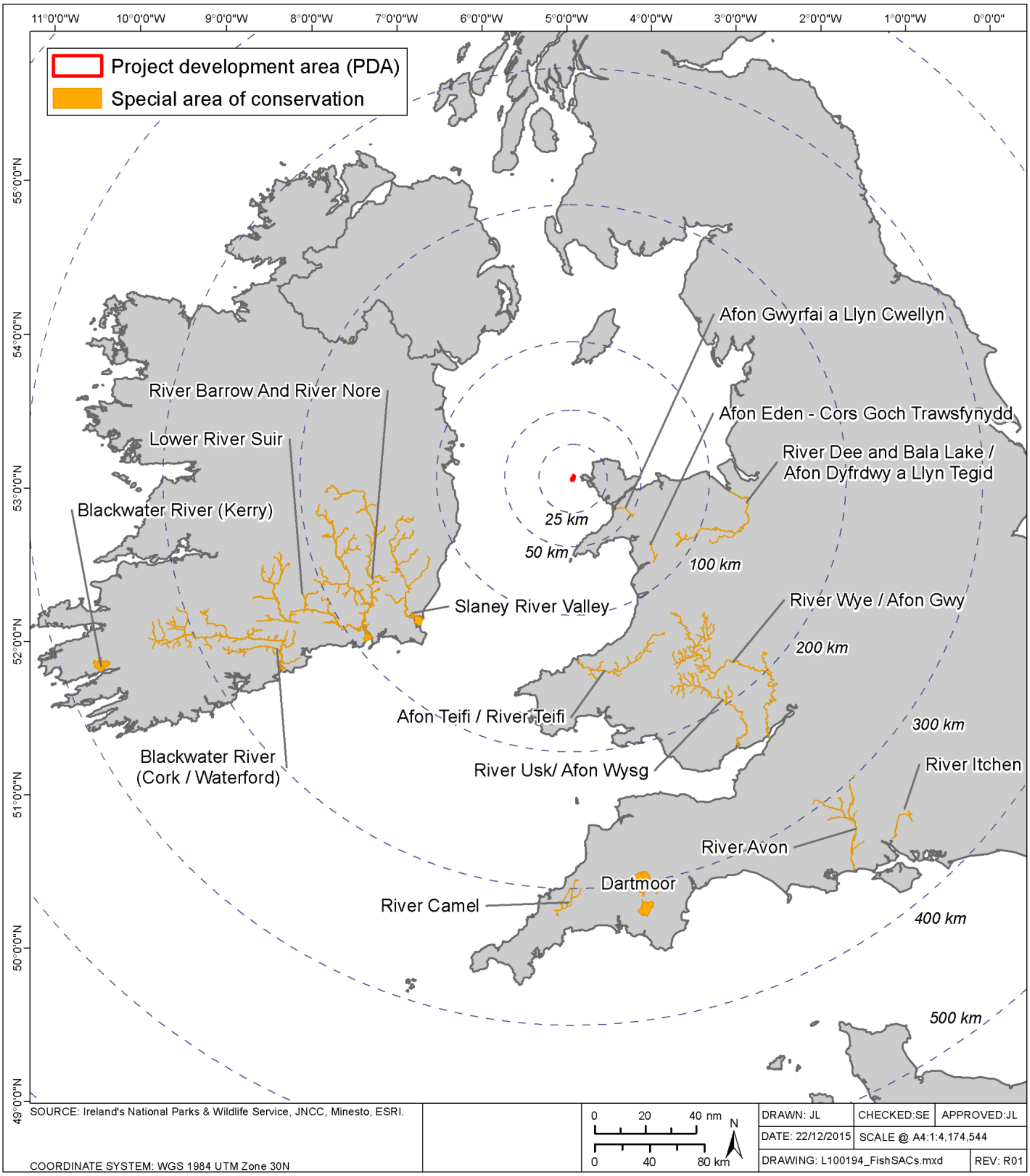

Figure 5.1 Location of Atlantic salmon SACs for consideration

5.3 Potential impacts on Atlantic salmon

The potential impacts of the DGU unit on Atlantic salmon are:

> Increased turbidity;

> Accidental contamination;

> Noise impacts;

> Collision risk;

> Barrier to movement;

> Habitat exclusion; and

> Cumulative and in-combination impacts.

5.4 Assessment of LSE

Table 5.2 presents the results from the assessment of LSE of the Project on SACs where Atlantic salmon is a qualifying interest.

Table 5.2 Assessment of LSE

SAC	LSE Assessment	Justification
Slaney River Valley SAC Lower River Suir SAC River Barrow and River of Nore SAC Blackwater River (Cork/Waterford) SAC Blackwater River (Kerry) SAC Afon Gwyrfai a Llyn Cwellyn SAC River Dee and Bala Lake / Afon Dyfrdwy a Lyyn Tegid SAC Afon Eden – Cors Goch Trawsfynydd SAC Afon Teifi / River Teifi SAC River Usk / Afon Wysg SAC River Wye / Afon Gwy SAC Dartmoor SAC River Camel SAC River Avon SAC River Itchen SAC	No LSE	There will be no significant impacts on Atlantic salmon or Atlantic salmon populations of the listed SACs from increased turbidity or accidental contamination. Due to the highly dynamic environment within the Project area, the limited sediment generated from potential pile drilling or accidentally released pollutants will be rapidly dispersed into surrounding water and is therefore extremely unlikely to affect foraging or migration movements of fish through the area. Underwater noise will not have any significant effects on Atlantic salmon or any SAC populations. Noise modelling (Xodus, 2015b) predicts injury from vessels would be limited to only the largest vessels and only to Atlantic salmon within 10 m of the vessels. For potential drilling during foundation installation, there is no injury zone predicted and for piling the maximum injury range is predicted to be 5 m. No injury is predicted from operation of the DGU unit. Disturbance during installation and drilling/piling is predicted to be limited to 185 m for the largest vessel, with no disturbance predicted during operation of the DGU unit. Results from the encounter modelling carried out previously for similar tidal array projects (e.g. MeyGen Tidal Array; MeyGen, 2012) found that the risk of collision between Atlantic salmon and tidal devices, taking into account a range of avoidance rates and documented evidence on behavioural responses to tidal devices and similar structures, was <1% for all modelled scenarios and concluded that potential impacts on Atlantic salmon and Atlantic salmon SAC populations would be negligible. These conclusions also did not take into account evidence which suggests that smolts swim in surface waters and adult salmon swim in the top 10 m of the water column, which would further reduce the potential for impact with respect to the DGU unit. Atlantic salmon will be able to move up the coastal waters without encountering the DGU unit and will be able to pass between, above and below the kite, should they encounter it. It can therefore be concluded that the potential for salmon to collide with the DGU unit during migration is very low.

SAC	LSE Assessment	Justification
		Salmon are wide ranging species with long migration routes and large foraging areas. The Project area will occupy only approximately 0.034 km^2. Given this small area and given that salmon will still be able to move through the Project area (between, above and under the tidal device), the device is extremely unlikely to lead to habitat exclusion. Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Atlantic salmon.

5.5 Conclusion of LSE

Based on the results of the assessment of LSE given in Section 5.4, it is concluded that the Project will not have any LSE on SACs where Atlantic salmon is a qualifying interest.

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