Liverpool Bay CCS Ltd

HYNET CARBON DIOXIDE TRANSPORTATION AND STORAGE PROJECT TO OFFSHORE

Environmental Statement
Volume 3, appendix K2: Offshore Ornithology Displacement Technical Report

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Offshore Ornithology Displacement Technical Report

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Glossary

Term	Meaning
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons. Separate bio-seasons are recognised in this technical report in order to establish the level of importance any seabird species has within the study area during any particular period of time.
Disturbance sensitivity	Disturbance by wind farm structures, ship and helicopter traffic factor used scores from 1 (limited escape behaviour and a very short flight distance when approached), to 5 (strong escape behaviour, at a large response distance).
Habitat specialisation	The habitat specialisation factor represents the range of habitats species are able to use and whether they use these as specialists or generalists. This score classifies species into categories from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).
Negligible magnitude	Very slight change from the size or extent of distribution of the relevant biogeographic population.
Ornithology	Ornithology is a branch of zoology that concerns the study of birds.
Significant effect	The significance of an effect is determined by considering the overall importance of the receptor and the magnitude of the effect using a matrix-based approach and applying professional judgement as to whether the integrity of a Special Protection Area (SPA) feature will be affected.
Statutory Nature Conservation Bodies (SNCBs)	Comprised of Joint Nature Conservation Committee (JNCC), Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage, these agencies provide advice in relation to nature conservation to government.

Acronyms

Acronym	Description
AON	Apparently Occupied Nest
BDMPS	Biologically Defined Minimum Population Scale
CEA	Cumulative Effects Assessment
IBMs	Individual Based Models
JNCC	Joint Nature Conservation Committee
LCI/UCI	Lower/Upper Confidence Interval
SNCBs	Statutory Nature Conservation Bodies
SMP	Seabird Monitoring Programme
SPA	Special Protection Area

Units

Unit	Description
%	Percent
km	Kilometres

Contents

Tables

Figures

1 OFFSHORE ORNITHOLOGY DISPLACEMENT TECHNICAL REPORT

1.1 Introduction

1.1.1 Background to displacement impacts

Seabirds have been shown to be attracted to large offshore structures such as hydrocarbon drilling and production platforms. Causes for this attraction include structure and perching opportunities (Tasker *et al.*, 1986), concentration of prey (Tasker *et al.*, 1986; Wolfson *et al.*, 1979), shelter from predators (Jones, 1980; Tasker *et al.*, 1986), oceanographic processes (Fedoryako, 1982) and due to disorientation by and attraction to light sources (Deakin *et al.*, 2022; Russell, 2005; Montevecchi, 2006).

Platform structures concentrate both seabirds and their prey in their immediate surroundings. Offshore structures such as oil platforms create artificial reefs and augment levels of benthic flora and fauna, zooplankton and fish (Carlisle *et al.*, 1964; Klima and Wickham, 1971; Shinn, 1974; Duffy, 1975; Sonnier *et al.*, 1976; Ortego, 1978; Wolfson *et al.*, 1979; Baird, 1990). With this attraction however, offshore platforms can have both direct and indirect impacts on seabird species, with mortalities of birds being documented by lighthouses, ceilometers, communication towers, office buildings, navigational lights, and oil platforms.

Direct effects on birds can be lethal, through mortality associated with collision with infrastructure and disorientation from artificial light sources, causing birds to become lost and exhausted (Ronconi *et al.*, 2015). Even when collisions are avoided, birds can be displaced due to habitat loss, noise and disturbance from construction and maintenance activities, with displaced seabirds moving into areas already occupied by other seabirds, facing higher intra/interspecific competition due to a higher density of individuals competing for the same resource (Ronconi *et al.*, 2015). Alternatively, displaced seabirds may be forced to move into areas of lower quality (e.g. areas of lower prey availability). Such disturbance and resulting displacement could ultimately affect their demographic fitness (i.e. survival rates and breeding productivity) as well as potentially impacting on other birds in areas that displaced birds move to.

Displacement can be temporary and reversible (for example stopping once construction is complete, allowing birds to go back to using the areas as before), or it can reduce over time as birds habituate to the presence of an operational structure. Or it may be permanent, with birds never returning to the area previously occupied. Displacement sensitivity can also vary significantly between seabird species, with some species exhibiting higher sensitivity, experiencing reduced reproductive success and survival rates when displaced from their preferred nesting or foraging areas compared to others. In contrast, other species can display greater adaptability and resilience to displacement, potentially finding suitable alternative habitats or adjusting their behaviour and foraging patterns accordingly (Bradbury *et al.*, 2014).

Individuals and bird communities can also be affected indirectly, via changes to the local marine community; not only in terms of potential changes in marine prey density and availability (Russell, 2005), but also through, increased exposure to predators attracted by concentrations of avian prey (Russell, 2005).

There is however a lack of empirical evidence on the consequence of displacement of seabirds, in terms of both their survival and productivity. While the potential for offshore activities, such as oil platforms, to displace seabirds from their natural habitats is acknowledged, limited scientific research or guidance has been produced on how to assess the level of such displacement from offshore platforms and how these impacts affect surrounding populations. When assessing potential displacement resulting from offshore structures, it may therefore be valuable to leverage existing assessment processes utilised by the offshore wind industry.

Furness *et al.* (2013) defines displacement as '*a reduced number of birds occurring within or immediately adjacent to an offshore wind farm*', involving birds present in the air and on the water (SNCBs, 2022). Birds that do not intend to utilise an offshore wind farm, but would have previously flown through the area, and which either stop short or detour around a development, are subject to barrier effects (SNCBs, 2022). For the purposes of assessment, it is usually not possible to distinguish between displacement and barrier effects (e.g. to determine if individual birds may have intended to travel to, or beyond an offshore wind farm, even when tracking data are available). Vessel and helicopter traffic associated with the construction of offshore infrastructure also have the potential to cause temporary disturbance to sensitive species, with some species avoiding the area altogether, potentially resulting in a loss of optimal rafting, foraging and moulting habitat.

The Statutory Nature Conservation Bodies (SNCBs) have produced guidelines to assess seabird displacement associated with offshore wind farms (SNCB, 2022). The guidelines promote the use of a displacement matrix approach (i.e. representing proportions of seabirds potentially displaced/dying as a result of offshore wind farm development).

The assessment of seabird displacement for the Eni Development Project makes use of the SNCB Matrix table approach, recognizing that the findings presented in this report may be overestimated. By utilising the framework provided by the SNCB, this assessment comprehensively evaluates the potential effects of displacement on seabird populations from the Eni Development Project.

1.1.2 Project description

As part of the Eni Development, the existing offshore natural gas import pipeline from Point of Ayr (PoA) Gas Terminal will be re-purposed to become a CO_2 export pipeline and will transport the CO_2 to a newly constructed Douglas CCS platform. From the new Douglas CCS platform and new pipeline connections, CO_2 will be transported along re-purposed existing natural gas pipelines to the Hamilton Main platform for injection into the Hamilton Main reservoir, to the Hamilton North platform for injection into the Hamilton North reservoir, and to the Lennox platform for injection into the Lennox reservoir.

The Proposed Development will also require new electrical and fibre optic transmission infrastructure seawards of MHWS, connecting the PoA Terminal to the offshore infrastructures.

The Proposed Development therefore will include:

- Installation of a new Douglas CCS platform to replace the existing Douglas Process platform to receive CO2 from the onshore PoA Terminal and distribute CO2 to the Hamilton Main, Hamilton North, and Lennox wellhead platforms and when necessary, provide heating to the CO2 stream. Installation of the new Douglas CCS platform will include up to eight driven piles.
- Installation of new sections of pipeline to connect the new Douglas CCS platform and the existing subsea natural gas pipelines.
- Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms to receive and inject CO2 into the depleted hydrocarbon reservoirs.
- Repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO2 service.
- Development of the Hamilton Main, Hamilton North and Lennox reservoirs for CO2 storage through the drilling and re-completion of injection wells by side-tracking existing production wells. This includes drilling and recompletion operations, all of which will be within the existing footprint (template) of each platform.
- Implementation of a programme of Monitoring, Measurement and Verification (MMV) activities. This includes the drilling of two new monitoring wells, one at Hamilton North and one at Hamilton Main. Additional monitoring wells will be created from the recompletion of existing wells within the existing footprint (template) of each platform: one monitoring well created by side-tracking an existing well in Lennox; and two sentinel wells, one in Hamilton North and one in Lennox.
- Installation of two submarine 33 kilovolt (kV) power cables, with integrated fibre-optic cable connections (35 kilometres (km) from PoA Terminal onshore to the modified Douglas platform, including within the intertidal/foreshore area up to MHWS, within Welsh waters only).

- Installation of new submarine 33 kV power cables with integrated fibre-optic connecting the modified Douglas platform with the Hamilton Main (12 km; 33 kV), Hamilton North (15 km; 33 kV) and Lennox (35 km; 33 kV) platforms.
- Installation of concrete mattresses and external cable protection, at crossings of existing cables, and in areas where cable burial is not deemed feasible, or as a remedial secondary protection measure if the target cable depth of lowering cannot be achieved.

With the construction and installation of the above proposed works, birds that are present within the offshore environment where these works are proposed to take place will be potentially affected by the construction, operation and decommissioning of the Proposed Development.

Depending on the species and its respectable foraging range from nearby colonies, birds may be impacted by the proposed development in in a variety of ways:

- Installation of new power cables and cable protection;
  - Construction activities associated with cable laying may lead to disturbance and displacement of species within the area of cable laying and potentially within close proximity to the cable laying vessles (up to 4 km depending on the species).
- Construction of the new Douglas platform, Installation of the new sections of pipeline to connect the new Douglas CCS platform and the existing subsea natural gas pipelines, Installation of new topsides on the Hamilton Main, Hamilton North, and Lennox wellhead platforms to receive and inject CO_2 into the depleted hydrocarbon reservoirs, Repurposing of the existing subsea natural gas pipelines for their change of use from hydrocarbon to CO_2 service, Development of the Hamilton Main, Hamilton North and Lennox reservoirs for CO_2 storage, drilling of monitoring wells.
  - Construction noise associated with the installation of new infrastructure and the refurbishment of existing infrastructure may cause birds to temporarily vacate the area (up to 2 km), reducing the amount of functional habitat available for foraging, resting and other activities.
- Operation and maintanence of the new Douglas platform; and
  - Loss of foraging grounds due to new platform, with the presence of the platform itself potentially disturbing and displacing species within the direct facinity of the platform and potentially within the surrounding area (up to 2 km).

As the Hamilton Main, Hamilton North and Lennox platforms are already in place and do not need to be reconstructed, it is likely that birds have already become accustomed to their presence and any past effects of displacement has likely been accounted for in the baseline assessment. A displacement assessment is therefore not required.

1.2 Aim of report

This report presents the method and results of the Matrix table approach to seabird displacement assessment resulting from the Eni Development Project during the construction, operations and maintenance, and decommissioning phases. The report considered the most sensitive species found within the impacted area; utilising densities sourced from baseline data sources (see volume 3, appendix K1: Offshore Ornithology Baseline Technical Report).

1.3 Study area

The Offshore Ornithology Study Area is defined as the area encompassing the Proposed Development area, which includes the offshore structures, offshore cables and subsea cables (including intertidal habitats up to Mean High Water Spring (MHWS)), plus an additional 10 km buffer, or up to MLWS where this is less than 10 km (Figure 1.1). The designated offshore ornithology study area was used to help identify potential species that utilise the site and therefore may be affected by displacement.

As outlined in section 1.1.2, displacement was assessed on the installation of new power cables and cable protection, construction of the new Douglas platform and associated construction activities and on the operation and maintenance of the new Douglas platform. For the purposes of displacement assessment therefore, peak densities of seabirds were identified within the;

- the Area of Project Physical Work plus 2 km buffer which overlaps with the Liverpool Bay/Bae Lerpwl SPA and the Area of Project Physical Work plus 4 km buffer which overlaps with the Liverpool Bay/Bae Lerpwl SPA work if appropriate for the species (Figure 1.1);
- Area of Project Physical Work plus a 2 km buffer (Figure 1.1); and
- the Douglas platform plus 2 km buffer (Figure 1.1).

The overlap between the Area of Project Physical Works plus a 2 km and 4 km buffer and the Liverpool Bay/Bae Lerpwl SPA is 237.28 km^2 and 458.08 km^2. The total area of the Liverpool Bay/Bae Lerpwl SPA is 2,528 km^2, which equates to an overlap of 9.38% and 18.12% respectively.

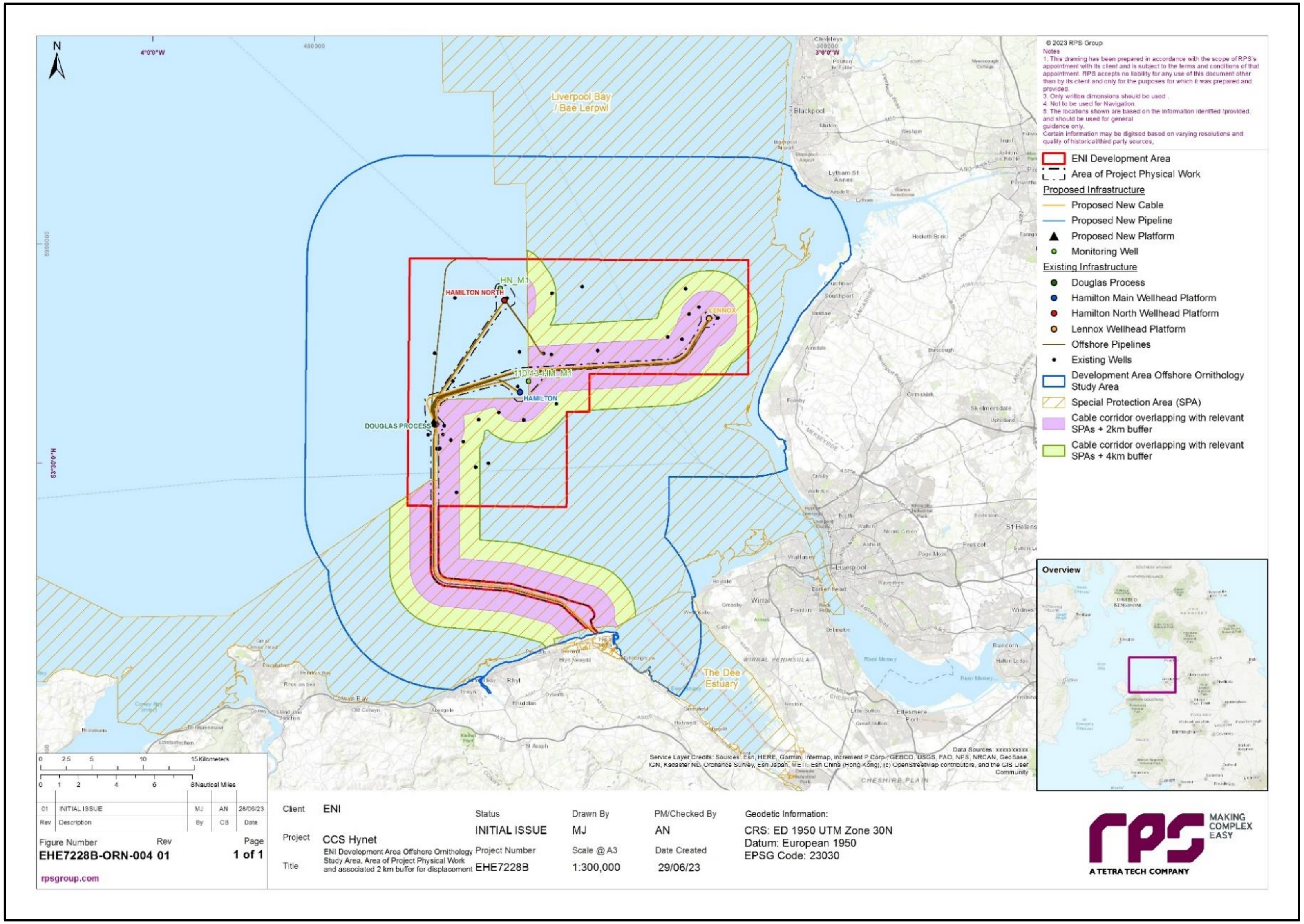

Figure 1.1: Proposed Development Area, Offshore Ornithology Study Area, Area Of Project Physical Work And Associated 2 Km And 4 km Buffers For Displacement With Overlap With Liverpool Bay/Bae Lerpwl SPA

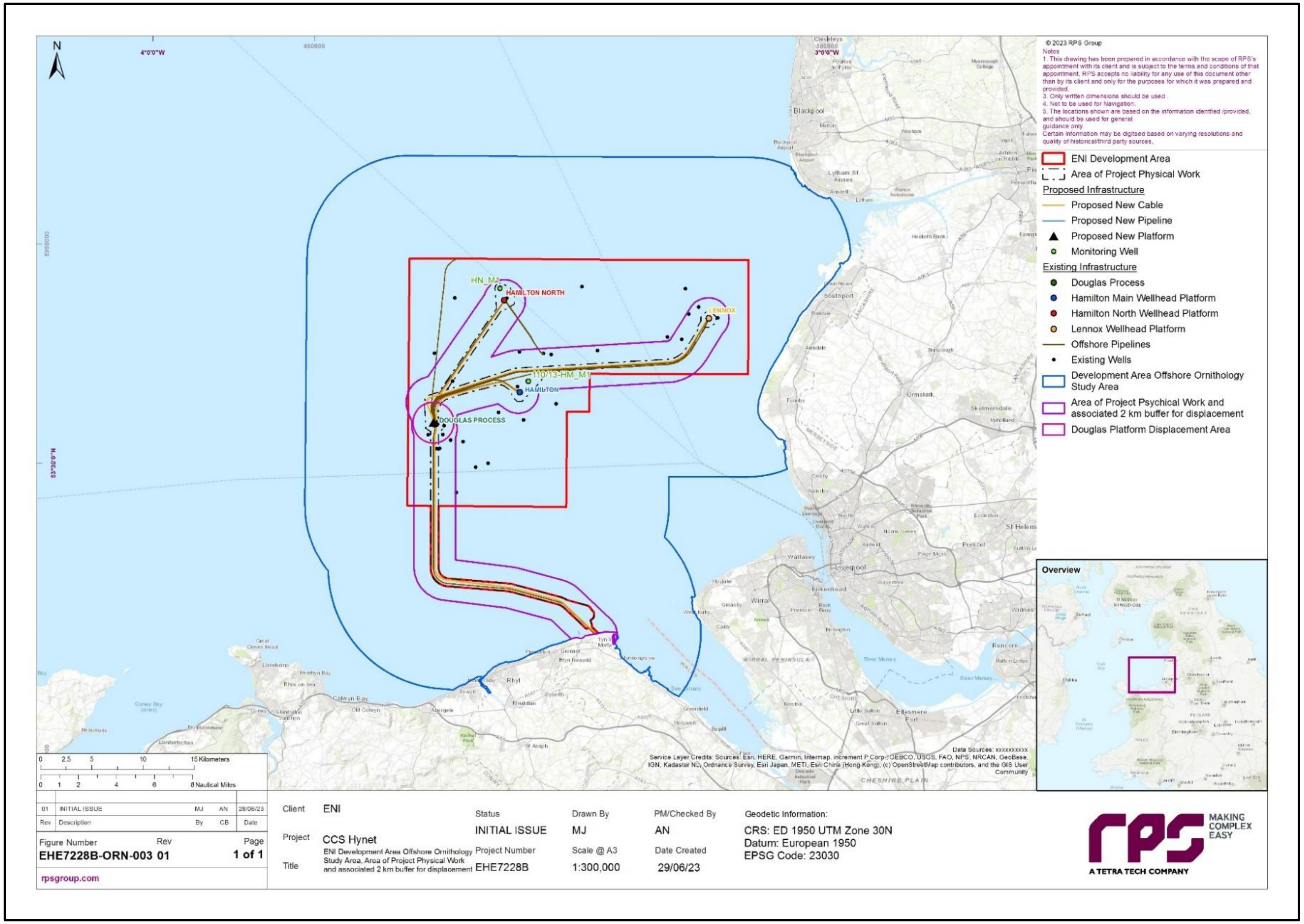

Figure 1.2: Proposed Development Area, Offshore Ornithology Study Area, Area Of Project Physical Work And Associated 2 Km Buffer For Displacement

1.4 Methodology

As sensitivity to displacement differs considerably between seabird species, species were screened and progressed for the Matrix table approach using '*Disturbance Sensitivity*' and '*Habitat Specialization*' scores from Bradbury *et al*. (2014) (expanded from Furness *et al*., 2013) as recommended by the Joint SNCB Interim Displacement Advice Note (SNCB, 2022), alongside the relative abundance within the Proposed Development area. In addition, uncertainty level associated with these scores were taken from Wade *et al.* (2016), with uncertainty levels defined by Wade *et al.* (2016) based on the quantity and quality of available data informing the respective vulnerability score. These uncertainty levels are considered as part of the process to identify sensitive species for inclusion in displacement analyses. The assessment is based on the mean seasonal peak number of seabirds in the Area of Project Physical Works with the appropriate buffer zone, as recommended by the SNCB (2022).

Finally, as there is no recommendation or guidance on what displacement and mortality rates to use for each sensitive species, displacement matrices are shown in full, with potential rates chosen based on literature (Bradbury *et al*., 2014) with displaced population assessed against the relevant regional population during each bio-season.

1.4.1 Screening species for displacement assessment

Seabird species that qualify under the sensitivity assessment and are present within one of the study areas were progressed to the Matrix table stage. Those sensitive species that are potentially affected by displacement are those:

- known to be vulnerable to displacement impacts (based on Bradbury *et al*., 2014; Wade *et al.*, 2016) and;
- where the population of the species observed within the Proposed Development Areais considered to be of importance (i.e. high abundance recorded within the Offshore Ornithology Study Area and/or are a feature of an SPA within that species mean-max foraging range).

Table 1.1 identifies potential species (ordered by taxonomic grouping and then by most abundant species within each grouping) that could be considered for displacement based on the above criteria.

Table 1.1: Identification Of Sensitive Species For Which Analysis Of Displacement For The Proposed Development Area May Be Required.

Species	Observed within Offshore Ornithology Study Area	Vulnerability to displacement impacts	Displacement sensitivity uncertainty level	SPA Qualifying Feature (within range of Eni Development Area)
Northern fulmar	Yes – peak average density of 0.274 birds per km^2	Very Low	Moderate	Yes
Manx Shearwater	Yes – peak average density of 0.062 birds per km^2	Very Low	High	Yes
European storm petrel	Yes – peak density of 0.003 birds per km^2	Very Low	High	Yes
Common gull	Yes – peak density of 2.01 birds per km^2	Low	Moderate	No
Lesser black-backed gull	Yes – peak density of 0.903 birds per km^2	Low	Low	Yes
Herring gull	Yes – peak density of 0.894 birds per km^2	Low	Low	No

Species	Observed within Offshore Ornithology Study Area	Vulnerability to displacement impacts	Displacement sensitivity uncertainty level	SPA Qualifying Feature (within range of Eni Development Area)
Little gull	Yes – peak density of 0.773 birds per km^2	Very Low	Moderate	Yes
Black-legged kittiwake	Yes – peak average density of 0.409 birds per km^2	Low	Low	No
Black-headed gull	Yes – peak density of 0.334 birds per km^2	Low	Low	No
Great black-backed gull	Yes – peak density of 0.151 birds per km^2	Low	Low	No
Sandwich tern	Yes – peak density of 0.583 birds per km^2	Low	Moderate	Yes
Little tern	Yes	Low	High	Yes
Common tern	Yes	Low	Low	Yes
Arctic tern	No	Low	Moderate	No
Great cormorant	Yes – peak density of 7.703 birds per km^2	High	Low	Yes
European Shag	Yes – peak density of 0.725 birds per km^2	Moderate	Low	No
Northern gannet	Yes – peak density of 0.163 birds per km^2	Low	Low	Yes
Common Scoter	Yes – peak density of 311.46 birds per km^2	Very High	Low	Yes
Red-throated diver	Yes – peak density of 0.821 birds per km^2	Very High	Low	Yes
Great skua	No	Very Low	High	No
Arctic skua	No	Very Low	High	No
Common guillemot	Yes – peak average density of 1.024 birds per km^2	Moderate	Very low	No
Atlantic puffin	Yes – peak average density of 0.022 birds per km^2	Low	Low	No
Razorbill	Yes – peak average density of 0.186 birds per km^2	Moderate	Very low	No
Black guillemot	No	Moderate	Low	No

The effects from disturbance and displacement is expected to be spatially limited to the Area of Project Physical Work and close vicinity (up to 2 km for most species, with displacement up to 4 km considered for divers and seaducks due to being the most sensitive species groups to disturbance from noise, boat and helicopter traffic).

Gull species with the exception of black-legged kittiwakes are considered relatively insensitive to displacement effects, while the effects of displacement are likely to be minimal for species which have particularly large foraging ranges such as northern gannet, northern fulmar and Manx shearwater (irrespective of their sensitivity to the effect), because the resultant habitat loss represents a small proportion of the total available habitat. However, emerging advise suggests (Natural England, 2022) that the large distances over which northern gannet and Manx shearwater may be displaced, together with the increasing number of offshore structures (with implications for in-combination effects), means that there is potential for adverse impacts to be felt by these populations due to displacement. Arctic tern, common tern and sandwich tern are considered relatively insensitive to anthropogenic disturbance when foraging and commuting in the marine environment, but evidence relating to the sensitivity of these species to displacement effects is sparse (Furness *et al*., 2013, Dierschke *et al.*, 2016).

Auk species, including Atlantic puffin, common guillemot, and razorbill, are known to be highly sensitive to displacement (SNCB, 2022). Auk species rely on specific habitat characteristics, such as steep cliffs or rocky ledges, for nesting and rearing chicks, with displacement to unsuitable or unfamiliar locations disrupting their breeding behaviours, which in turn can lead to decreased breeding success, abandonment of eggs or chicks, and increased vulnerability to predation (Dierschke *et al.*, 2016). In terms of auk displacement in relation to the Area of Project Physical Works and that the project falls outside mean-max foraging distance for these species, there is not considered to be any displacement risk.

Migratory waterbird species (such as red-throated diver and common scoter) would not be significantly affected when passing through (or over) the platform structures within the Proposed Development Area on migration (as they are not expected to forage or rest in the marine environment around the platform structures within the Eni Development Area). However, as the offshore cable passes through part of the Liverpool Bay/Bae Lerpwl SPA and the Dee Estuary SPA, and as these species are highly sensitive to vessels (Wade *et al.,* 2016) there is the potential for impacts to occur during the construction phase (during operation, the offshore cable is an immobile structure on the seabed with minimal maintenance activity involving vessel activity).

Based on the above information, the following species (Table 1.2) were taken forward to the displacement assessment.

Table 1.2: Identification Of Species Taken Forward To The Displacement Assessment

Species	Displacement analysis required (yes/no)
Northern fulmar	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, moderate uncertainty level associated with displacement vulnerability score
Manx Shearwater	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, high uncertainty level associated with displacement vulnerability score
European storm petrel	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, high uncertainty level associated with displacement vulnerability score
Common gull	No – Low vulnerability to displacement, not a qualifying feature of nearby SPA within foraging range
Lesser black-backed gull	No – Low vulnerability to displacement, low uncertainty level associated with displacement vulnerability score
Herring gull	No – Low vulnerability to displacement, low uncertainty level associated with displacement vulnerability score, not a qualifying feature of nearby SPA within foraging range
Little gull	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, moderate uncertainty level associated with displacement vulnerability score
Black-legged kittiwake	No – Low vulnerability to displacement, low uncertainty level associated with displacement vulnerability score, not a qualifying feature of nearby SPA within foraging range
Black-headed gull	No – Low vulnerability to displacement, low uncertainty level associated with displacement vulnerability score, not a qualifying feature of nearby SPA within foraging range
Great black-backed gull	No – Low vulnerability to displacement, low uncertainty level associated with displacement vulnerability score, not a qualifying feature of nearby SPA within foraging range

Species	Displacement analysis required (yes/no)
Sandwich tern	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, moderate uncertainty level associated with displacement vulnerability score
Little tern	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, high uncertainty level associated with displacement vulnerability score
Common tern	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range
Arctic tern	No – Species not recorded within development area, low vulnerability to displacement, not a qualifying feature of nearby SPA within foraging range
Great cormorant	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, high vulnerability to displacement, low uncertainty level associated with displacement vulnerability score
European Shag	No – Low uncertainty level associated with displacement vulnerability score, not a qualifying feature of nearby SPA within foraging range
Northern gannet	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range
Common Scoter	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, very high vulnerability to displacement, low uncertainty level associated with displacement vulnerability score
Red-throated diver	Yes – Species recorded within development area, qualifying feature of nearby SPA within foraging range, very high vulnerability to displacement, low uncertainty level associated with displacement vulnerability score
Great skua	No – Species not recorded within development area, very low vulnerability to displacement, not a qualifying feature of nearby SPA within foraging range
Arctic skua	No – Species not recorded within development area, very low vulnerability to displacement, not a qualifying feature of nearby SPA within foraging range
Common guillemot	No – Not a qualifying feature of nearby SPA within foraging range
Atlantic puffin	No – Not a qualifying feature of nearby SPA within foraging range
Razorbill	No – Not a qualifying feature of nearby SPA within foraging range
Black guillemot	No – Not a qualifying feature of nearby SPA within foraging range

Out of the species recorded within the Eni Offshore Ornithology Study Area, impacts caused by the Douglas platform during its operational phase, as well as the effects of construction and decommissioning phase are considered for species such as sandwich tern, Manx shearwater, northern gannet, northern fulmar and European storm-petrel (Table 1.3). Additionally, the displacement caused by the installation of the cable during construction and decommissioning phases has been considered for the common scoter, red-throated diver and little gull, little tern and common tern (Table 1.3).

Table 1.3: Phases of The Development For Which Displacement Assessment Is Required For Each Species

Species	Cable corridor displacement assessment	Area of Project Physical works displacement assessment	Douglas platform displacement assessment
Northern fulmar	No – assessment not required due to being assessed in Area of Project Physical Works displacement assessment	Yes – species foraging range overlaps with Area of Project Physical Works	Yes – species foraging range overlaps with the Douglas platform
Manx shearwater	No – assessment not required due to being assessed in Area of Project Physical Works displacement assessment	Yes – species foraging range overlaps with Area of Project Physical Works	Yes – species foraging range overlaps with the Douglas platform
European storm-petrel	No – assessment not required due to being assessed in Area of Project Physical Works displacement assessment	Yes – species foraging range overlaps with Area of Project Physical Works	Yes – species foraging range overlaps with the Douglas platform
Little gull	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform
Sandwich tern	No – assessment not required due to being assessed in Area of Project Physical Works displacement assessment	Yes – species foraging range overlaps with Area of Project Physical Works	Yes – species foraging range overlaps with the Douglas platform
Little tern	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform
Common tern	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform
Common scoter	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform
Red-throated diver	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform
Northern gannet	No – assessment not required due to being assessed in Area of Project Physical Works displacement assessment	Yes – species foraging range overlaps with Area of Project Physical Works	Yes – species foraging range overlaps with the Douglas platform
Great cormorant	Yes – cable corridor overlaps with species foraging range	No – assessment not required due to being assessed in the cable corridor displacement assessment	No - species foraging range does not overlap with the Douglas platform

1.4.2 Seasonality

The seasonal split in Bradbury *et al*. (2014) differed to the approach that was followed for generating densities from the Waggitt *et al*. (2020) data. Bradbury *et al*. (2014) split seasons into summer and winter, while the Waggitt *et al*. (2020) data used the breeding and non-breeding periods from Furness (2015) which different depending on species (Table 1.4). Bio-seasons used within the displacement assessment were defined according to the breeding, non-breeding and migratory periods (autumn and spring migration) based on Furness (2015) (Table 1.5).

Table 1.4: Seasonal Definitions As The Basis For Assessment

	Waggitt *et al*., 2020		Bradbury *et al*., 2014	
Species	**Breeding season**	**Non-breeding season**	**Summer**	**Winter**
Little tern	n/a	n/a	April to September	October to March
Common tern	n/a	n/a	April to September	October to March
Sandwich tern	n/a	n/a	April to September	October to March
Manx shearwater	April to August	September to March	n/a	n/a
Northern gannet	March to September	October to February	n/a	n/a
Northern fulmar	January to August	September to December	n/a	n/a
European storm-petrel	March to October	November to February	n/a	n/a
Common scoter	n/a	n/a	April to September	October to March
Red-throated diver	n/a	n/a	April to September	October to March
Little gull	n/a	n/a	April to September	October to March
Cormorant	n/a	n/a	April to September	October to March

Table 1.5: Seasonal Definitions As The Basis For Assessment (Based On Furness, 2015)

Species	Return migration	Migration free Breeding season	Post-breeding season	Migration free Non-breeding season
Little tern	April to May	June	July to September	October to March
Common tern	April to May	June to July	August to September	October to March
Sandwich tern	April to May	June	July to September	October to March
Manx shearwater	March to May	June to July	August to October	November to February
Northern gannet	December to March	April to August	September to November	N/A
Northern fulmar	December to March	April to August	September to October	November
European storm-petrel	March to June	July to October	November to February	N/A
Common scoter	N/A	May to August	N/A	September to April
Red-throated diver	February to April	May to August	September to November	December to January
Little gull	N/A	April to July	N/A	August to March
Cormorant	February to April	May to July	August to October	November to January

1.4.3 Abundance estimates

As per the joint SNCB interim guidance (SCNBs, 2022), assessment of displacement impacts were conducted on the mean seasonal peak population estimates, calculated as the peak count for each species in each appropriate bio-season. Densities were extracted from Bradbury *et al.* (2014) and Waggitt *et al.* (2020) depending on species (Table 1.6). For both little tern and common tern, the data presented within Bradbury *et al.* (2014), indicated zero birds present within all study areas, however as both species have known colonies within connectivity of the Proposed Development, and are named as features of both the Liverpool Bay SPA and the Dee Estuary SPA, they are taken through on a qualitative assessment.

For common scoter and red-throated diver, HiDef Aerial Surveying Limited (2023) data was used (see ,Volume 3, appendix K1) whereby an aerial survey regime was conducted to inform a condition assessment of these features of the Liverpool Bay SPA. This survey regime was focussed on common scoter and red-throated diver as species typically found inshore and did not capture sufficient data for a robust assessment to be carried out on pelagic species using the wider Liverpool Bay area. In addition the densities of great cormorant and little gull were mapped in volume 3, appendix K1 and it was concluded that the nature of the HiDef surveys did not capture enough data to fully inform displacement assessment. Therefore, the HiDef Aerial Surveying Limited (2023) data source was only used to derive abundance estimates of red-throated diver and common scoter. A four-year mean peak density and abundance estimate was derived from a subset of the data intersecting with the cable corridor area plus 4km buffer (55% coverage) to give mean peak abundance estimates for the wintering bio-season for both species, and the return migration bio-season for red-throated diver only (Table 1.7). Mean peak densities from HiDef (2023) data for common scoter (non-breeding) and red-throated diver (return migration and non-breeding) were taken from the mean peak abundance divided by the intersection area and are presented in Table 1.6. The four-year mean peak abundance was used in displacement analysis as a more accurate measure of the number of birds with the potential to be displaced as density is not uniform throughout the surveyed area and these species are found in higher densities closer to the shore.

Waggitt *et al.* (2020) data was provided on a month-by-month basis (unlike Bradbury *et al.* (2014) that provided data by season) and so, density layers had to first be combined by season and averaged using the computer software QGIS and the '*r.series*' function within the GRASS plugin. Peak abundances estimated across the Eni Development site and associated buffers (2 km and 4 km) were then calculated for each species. In accordance with SNCB (2022), displacement was estimated as affecting seabirds present both in flight and sitting on the water (whether foraging or loafing).

Table 1.6: Peak Abundances (Birds Per km^2) For Use In The Assessment For Each Bio-Season

Species	Cable corridor overlapping with relevant SPAs + 2 km buffer peak abundance	Cable corridor overlapping with relevant SPAs + 4 km buffer peak abundance	Area of Project Physical Works + 2 km buffer peak abundance	Douglas Platform + 2 km buffer peak abundance
Little tern				
Return migration	No birds recorded	N/A	No birds recorded	No birds recorded
Breeding	No birds recorded	N/A	No birds recorded	No birds recorded
Post-breeding migration	No birds recorded	N/A	No birds recorded	No birds recorded
Non-breeding	N/A	N/A	N/A	N/A
Common tern				
Return migration	No birds recorded	N/A	No birds recorded	No birds recorded
Breeding	No birds recorded	N/A	No birds recorded	No birds recorded
Post-breeding migration	No birds recorded	N/A	No birds recorded	No birds recorded

Species	Cable corridor overlapping with relevant SPAs + 2 km buffer peak abundance	Cable corridor overlapping with relevant SPAs + 4 km buffer peak abundance	Area of Project Physical Works + 2 km buffer peak abundance	Douglas Platform + 2 km buffer peak abundance
Non-breeding	N/A	N/A	N/A	N/A
Sandwich tern				
Return migration	N/A	N/A	38.5	No birds recorded
Breeding	N/A	N/A	38.5	No birds recorded
Post-breeding migration	N/A	N/A	38.5	No birds recorded
Non-breeding	N/A	N/A	N/A	N/A
Manx shearwater				
Return migration	N/A	N/A	0.5	0.5
Breeding	N/A	N/A	4.4	4.3
Post-breeding migration	N/A	N/A	0.5	0.5
Non-breeding	N/A	N/A	N/A	N/A
Northern gannet				
Return migration	N/A	N/A	10.5	9.2
Breeding	N/A	N/A	15.7	13.8
Post-breeding migration	N/A	N/A	10.5	9.2
Northern fulmar				
Return migration	N/A	N/A	21.8	17.6
Breeding	N/A	N/A	23.6	19.0
Post-breeding migration	N/A	N/A	21.8	17.6
Non-breeding	N/A	N/A	N/A	N/A
European storm-petrel				
Return migration	N/A	N/A	No birds recorded	No birds recorded
Breeding	N/A	N/A	0.1	0.1
Post-breeding migration	N/A	N/A	No birds recorded	No birds recorded
Common scoter				
Breeding	N/A	No birds recorded	N/A	N/A
Non-breeding	N/A	93.0*	N/A	N/A
Red-throated diver				
Return migration	N/A	1.1*	N/A	N/A
Breeding	N/A	0.1	N/A	N/A
Post-breeding migration	N/A	0.8	N/A	N/A
Non-breeding	N/A	1.0*	N/A	N/A
Little gull				
Breeding	No birds recorded	N/A	N/A	N/A
Non-breeding	0.3	N/A	N/A	N/A
Great cormorant				

Species	Cable corridor overlapping with relevant SPAs + 2 km buffer peak abundance	Cable corridor overlapping with relevant SPAs + 4 km buffer peak abundance	Area of Project Physical Works + 2 km buffer peak abundance	Douglas Platform + 2 km buffer peak abundance
Return migration	N/A	N/A	N/A	N/A
Breeding	1.6	N/A	N/A	N/A
Post-breeding migration	N/A	N/A	N/A	N/A
Non-breeding	1.2	N/A	N/A	N/A

*Common scoter (non-breeding) and red-throated diver (return migration and non-breeding) density estimate taken from mean peak abundance derived from HiDef (2023) survey area intersecting with cable corridor +4 km buffer.

Table 1.7: Four-year Peak Abundance of Common Scoter and Red-throated Diver Within the Cable Corridor +4 km, Derived From HiDef (2023) Dataset

Species	Four-year mean peak abundance within cable corridor + 4 km buffer
Common scoter	
Non-breeding	33,079
Red-throated diver	
Return migration	407
Non-breeding	344

1.4.4 Regional populations

Breeding population sizes are based on colony counts from the Seabird Monitoring Programme (SMP) online database (https://app.bto.org/seabirds/public/index.jsp) for all colonies within mean-maximum foraging range of each respective species (Woodward *et al*., 2019). One Apparently Occupied Nest (AON) was assumed to equal two breeding seabirds.

All breeding sites (including Special Protection Area (SPA) and non-SPA sites) within the species-specific foraging ranges from the Area of Project Physical Works were identified. The location of the breeding sites were sourced from data.gov.uk (Seabird Nesting Counts (British Isles)). The latest colony counts were sourced from the SMP online database. In the SMP online database, the 'Master Site' can be made up of several sites along the coastline. Where '*Master Site*' in the SMP were made up of several nesting sites (i.e. sub-colonies), a centroid was generated for each '*Master Site*' to calculate the distance to the Eni Development Area.

During the breeding season, in addition to seabirds associated with breeding colonies, there will be immature seabirds, juvenile seabirds and *'sabbatical*' seabirds (mature seabirds not breeding in a given year) present within the region. Population counts therefore must be adjusted to account for these seabirds. It was assumed that all immature seabirds in the Biologically Defined Minimum Population Scales (BDMPS) population in the bio-season immediately before the breeding season (usually the return migration bio-season) return to breeding colonies. The total regional population within the breeding season is therefore the sum of breeding adults associated with nearby colonies plus the proportion of immature seabirds from the BDMPS return migration population. This is shown in Table 1.8.

Table 1.8: Calculation Of Regional Population During The Breeding/Summer Season

Species	Breeding/Summer population within mean-max foraging range (JNCC, 2023)	BDMPS return migration population (Furness, 2015)	Proportion of juvenile and immature (Furness, 2015)	Juvenile and immature individuals	Total regional breeding /summer population
Little tern	324	1,602	0.261	418	742
Common tern	766	64,659	0.401	25,941	26,707
Sandwich tern	N/A	10,761	0.386	4,159	4,159
Manx shearwater	246,664	1,580,895	0.456	720,888	967,552
Northern gannet	153,370	661,888	0.447	295,863	449,233
Northern fulmar	25,844	828,194	0.383	317,198	343,042
European storm-petrel	492	838,500	0.213	178,601	179,093
Red-throated diver	N/A	4,373	0.425	1,859	1,859
Cormorant	294	9,602	0.539	5,177	5,471

In the non-breeding season, seabirds are not constrained by colony location and can, depending on individual species, range widely within UK seas and beyond. Furness (2015) also provides population estimates for each species in each non-breeding bio-season in each BDMPS region. The zone of influence for seabird species where an assessment in the non-breeding season and migratory periods is deemed to be required is based on the '*UK Western Waters*' populations defined by Furness (2015). In the absence of BDMPS population estimates in Furness (2015), a regional non-breeding population estimate for common scoter within the wider Liverpool Bay SPA is derived from a four-year peak population estimate in HiDef Aerial Surveying Limited (2023). Lawson *et al.* (2016) provides updated non-breeding population estimates for little gull within Liverpool Bay.

All population estimates based on bio-season are provided in Table 1.9. Colour-coding has been used to define the main bio-seasons presented in Table 1.9.

Table 1.9: Bio-Season Population Sizes Used Within The Assessment

Species	Return migration	Breeding	Post-breeding migration	Non-breeding
Little tern	1,602	742	1,602	N/A
Common tern	64,659	26,707	64,659	N/A
Sandwich tern	10,761	4,159	10,761	N/A
Manx shearwater	1,580,895	967,552	1,580,895	N/A
Northern gannet	661,888	449,233	545,954	N/A
Northern fulmar	828,194	343,042	828,194	N/A
European storm-petrel	838,500	179,093	838,500	N/A
Common scoter	N/A	N/A	N/A	141,801
Red-throated diver*	4,373	1,859	4,373	1,657

Species	Return migration	Breeding	Post-breeding migration	Non-breeding
Little gull	N/A	N/A	N/A	319
Cormorant	N/A	5,471	N/A	9,602

* UK Western waters plus Channel in migratory bio-seasons; NW England and Wales in winter bio-season

1.4.5 Background mortality rates

The displacement assessment assumes that all age classes are at risk of the possible impacts of the proposed development equally and as such the baseline mortality rate is a weighted average based on all age classes. Demographic rates for each species from Horswill and Robinson (2015) were entered into a matrix population model. The national-average productivity figure was used from Horswill and Robinson (2015). No information on European storm-petrel was available in Horswill and Robinson (2015) and so Deakin *et al*. (2022) was consulted. Productivity values were used to calculate the expected proportions in each age class. Each age class survival rate was multiplied by its proportion and the total for all ages summed to give the average survival rate for all ages. The average mortality rate was subsequently calculated by subtracting the survival rate from 1. The demographic rates and the age class proportions, and average mortality rates calculated from them are presented in Table 1.10.

Table 1.10: Demographic Rates And Population Age Ratios Calculated From Stable Population Models

Species	Parameter	Age class (years)*						Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	Adult		
Little tern	Survival	0.800	0.800	N/A			0.800	0.518	0.200
	Proportion in population	0.316	0.276				0.408	N/A	N/A
Common tern	Survival	0.441	0.441	0.850	N/A		0.883	0.764	0.268
	Proportion in population	0.235	0.104	0.046			0.615	N/A	N/A
Sandwich tern	Survival	0.358	0.741	0.741	0.741	N/A	0.898	0.702	0.333
	Proportion in population	0.120	0.089	0.066	0.049		0.676	N/A	N/A
Manx shearwater	Survival	0.870	0.870	0.870	0.870	0.870	0.870	0.697	0.131
	Proportion in population	0.150	0.128	0.109	0.092	0.078	0.442	N/A	N/A
Northern gannet	Survival	0.424	0.829	0.891	0.895	0.895	0.919	0.700	0.187
	Proportion in population	0.191	0.081	0.067	0.059	0.053	0.549	N/A	N/A
Northern fulmar	Survival	0.260	No data available				0.936	0.419	0.181
	Proportion in population	0.173					0.827	N/A	N/A
European storm-petrel	Survival	0.880	0.880	0.880	N/A		0.830	0.800	0.142
	Proportion in population	0.209	0.189	0.164			0.641	N/A	N/A
Common scoter	Survival	0.749	0.749	N/A			0.783	0.384	0.238
	Proportion in population	0.352	0.264				0.384	N/A	N/A
	Survival	0.600	0.620				0.840	0.686	0.233

Species	Parameter	Age class (years)*						Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	Adult		
Red-throated diver	Proportion in population	0.196	0.118	N/A			0.686	N/A	N/A
Little gull	Survival	0.410	0.710	0.828	N/A		0.828	0.543	0.157
	Proportion in population	0.186	0.076	0.054			0.488	N/A	N/A
Cormorant	Survival	0.540	0.540	N/A			0.868	1.985	0.330
	Proportion in population	0.393	0.212				0.395	N/A	N/A

* Where age class data equals N/A this is due to the species being fully adult by this age.

1.4.6 Displacement and mortality rates

As the displacement from static offshore structures such as oil platforms will be less than that caused by offshore wind farms, the suggested rates within the SNCB (2022) guidance note cannot be applied as those are the suggested displacement and mortality rates for offshore wind farms. The SNCB (2017) document states that the 'Disturbance Susceptibility' scores from ship and helicopter traffic in Bradbury *et al*. (2014) give a possible indication of the potential displacement levels that may be exhibited by species. Scores were assigned on a scale of 1 to 5 for almost all factors, where 5 was a strong anticipated negative impact. Without any additional evidence it is assumed that the scores give a crude, but useful, approximation of the levels of displacement that may be experienced by seabirds and can be used to inform the most likely range of displacement for a given species(Table 1.11).

Additionally, scores of species-specific 'Habitat Specialisation' by Bradbury *et al.* (2014) have also been used to provide an indication of the relative scale of mortality arising from displacement for each species (Table 1.11). Scores were assigned on a scale of 1 to 5 for almost all factors, where 5 was a strong anticipated negative impact. Species considered less flexible in their habitat use, are likely to be more vulnerable to displacement from favoured habitats and therefore are given a higher possible mortality rate. A high score for specialisation would therefore be expected to indicate a higher level of potential mortality. The SNCBs (2022) guidance document states however that they do not advise a standardised translation of these scores across to mortality percentages within the matrix. Within the note, it is acknowledged that this information is useful, and should be used in conjunction with expert opinion, to aid in selecting the likely range of possible mortality impacts resulting from particular levels of displacement.

It is considered that impacts relating to disturbance from the temporary presence of vessels during cable laying is highly unlikely to lead to impacts greater than those considered for the construction of an offshore structure. Based on this understanding it is considered appropriate that a mortality rate of 0.5 to 1% is used. In addition, the number of birds potentially displaced is calculated based on the potential total area occupied by cable laying vessels at any one time. These rates are still regarded precautionary for assessment of the displacement impacts, further backed up by the fact that cable laying is both temporally and spatially restricted to a very small area of sea at any one time.

Displacement during the construction phase of the offshore structures is considered to be less than that experienced during the operational period. As a conservative approach, displacement caused by the operational phase of the Douglas platform is considered to be 50 to 100% due to permeant loss of foraging area. The possible displacement rates used in this assessment are outlined in Table 1.11**.**

Table 1.11: Displacement And Mortality Rates For Use In The Assessment During Construction And Operational Phase

Species	Disturbance susceptibility to ship and helicopter traffic	Possible displacement rate (%)	Habitat specialisation	Possible mortality rate (%)
Temporary displacement during the construction phase within the Area of Project Physical Work plus a 2 km buffer				
Sandwich tern	2	10 to 30	3	10 to 30
Manx shearwater	1	0 to 10	1	1 to 5
Northern gannet	2	10 to 30	1	1 to 5
Northern fulmar	1	0 to 10	1	1 to 5
European storm-petrel	1	0 to 10	1	1 to 5
Permanent displacement during the operational phase within the Douglas platform plus 2 km buffer				
Sandwich tern	N/A	50 to 100	3	30 to 50
Manx shearwater	N/A	50 to 100	1	1 to 10
Northern gannet	N/A	50 to 100	1	1 to 10
Northern fulmar	N/A	50 to 100	1	1 to 10
European storm-petrel	N/A	50 to 100	1	1 to 10

Following the SNCB (2022) advise, all displacement matrices are presented in full, with displacement and mortality levels presented for the full range of 0 to 100%. For mortality, the assessment is presented at 10% increments, as well as 1% increments from 0 to 5%, with cells highlighted in red to indicate the likely potential ranges within this complete range for each species.

The degree of change predicted to occur at the population level for a species is further explored by comparing the predicted displacement mortality to the relevant 1% threshold of background mortality for each species. As such, each matrix in the following species-specific sections is shaded to indicate where the predicted displacement mortality surpasses the 1% threshold of background mortality of the relevant regional or national population for each species.

1.4.7 Data Limitations

The data within this report for all sensitive species are reliant upon baseline sources of Bradbury *et al.* (2014) and Waggitt *et al.* (2020) and HiDef Aerial Surveying Limited (2023). These data are considered to be the most reliable source for characterising the baseline environment for offshore ornithology. However, using these data to characterise the abundances for each species within individual bio-seasons is subject to interpretation, given variation in migratory movements between species and between years, the age classification of birds within each bio-season, connectivity to breeding colonies and other factors. Similarly, not all species were covered by each source and therefore for the case of little tern and common tern, there is no abundance estimate presented, however it is known that the area is used by both species.

1.5 Results

1.5.1 Displacement from installation of cable

1.5.1.1 Little tern

Little tern is assessed to have a medium sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low (Goodship and Furness, 2022). It has been stated that little terns can be followed at a moderate distance by a small boat without apparently causing significant disturbance (Perrow *et al*., 2011). As no known reported disturbance distance has been stated, a precautionary distance of 50m is considered appropriate for this species. Consequently, the area of impact from a single vessel at any one time could be up to 0.05 km^2. During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 0.6 km^2 could occur. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

According to Bradbury *et al.* (2014), no little terns were observed within the Proposed Development Area (Table 1.10). However, as the Dee Estuary and Liverpool Bay/Bae Lerpwl SPA support breeding little tern, with the coastal waters key foraging grounds for this species, it is appropriate to consider the potential temporary habitat loss due to cable laying activities, with a high percentage of habitat loss likely to cause increased mortality.

As shown in volume 3, appendix K1, the little tern colony at Granant Dunes and at Point of Ayr have a total foraging range area of 73.35 km^2. As stated within volume 3, (appendix K1, part of the Proposed Development Area and Area of Project Physical Works overlaps with the foraging area, with an overlap of 8.6%. In order to incorporate the displacement resulting from cable laying and increased vessel activity, the potential impacts on little terns are taken into account within a radius of 0.6 km^2. As a result, approximately 0.8% of the 73.35 km^2 foraging area is considered to be affected at any one time.

Breeding season

A breeding season abundance of 5.9 little tern could be displaced from within the 0.8% affected area. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.03 to 0.06 little tern being subject to mortality.

The breeding population estimate for little tern in the Liverpool Bay SPA is recorded as 742 individuals (Table 1.9) and, using the average baseline mortality rate of 0.2 (Table 1.10), the natural predicted mortality in the winter bio-season is 148.4 individuals per annum. The addition of 0.03 to 0.06 mortalities would increase the mortality relative to the baseline mortality rate by 0.02 to 0.04%.

In the breeding bio-season and assessed against the little tern population the predicted mortalities did not surpass a 1% baseline mortality threshold.

1.5.1.2 Common Tern

Common tern is assessed to have a medium to high sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low (Goodship and Furness, 2022). Limited research has been dedicated to investigating the impact of vessel disturbances on common terns. However, the few studies that have been carried out indicate that the speed of the vessel has the most influence on the flight behaviour of common terns, rather than the presence of the vessel itself (Rodgers and Schwikert, 2002). Burger (1998) suggests that common tern are disturbed by vessels at a minimum distance of 100 m.

Consequently, the area of impact from a single vessel at any one time could vary up to a maximum distance of 0.1 km^2. During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 1.2 km^2 could occur. However, during construction, vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

According to Bradbury *et al.* (2014), no common tern were observed within the Proposed Development area (Table 1.10). However, as the Dee Estuary and Liverpool Bay/Bae Lerpwl SPA support breeding common tern, with the coastal waters key foraging grounds for this species, it is appropriate to consider the potential temporary habitat loss due to cable laying activities, with a high percentage of habitat loss likely to cause increased mortality.

As shown in volume 3, appendix K1, the common tern colony have a total foraging range of 750.93 km^2. As stated within volume 3, (appendix K1, part of the Proposed Development Area of Project Physical Works overlaps with the foraging area, with an overlap of 2.5%. In order to incorporate the displacement resulting from cable laying and increased vessel activity, the potential impacts on common terns are taken into account within a radius of 1.2 km^2. As a result, approximately 0.16% of the 750.93 km^2 foraging area is considered to be affected.

Breeding season

A breeding season abundance of 42.7 common tern could be displaced from within the 0.16% affected area. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.21 to 0.42 little tern being subject to mortality.

The breeding population estimate for little tern in the Liverpool Bay SPA is recorded as 26,707 individuals (Table 1.9) and, using the average baseline mortality rate of 0.268 (Table 1.10), the natural predicted mortality in the winter bio-season is 7157 individuals per annum. The addition of 0.21 to 0.42 mortalities would increase the mortality relative to the baseline mortality rate by 0.003 to 0.006%.

In the breeding bio-season and assessed against the little tern population the predicted mortalities did not surpass a 1% baseline mortality threshold.

1.5.1.3 Common Scoter

Common scoter are considered to be highly sensitive to disturbance from vessels (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed common scoter as having a relative high sensitivity from disturbance arising from vessels (Garthe and Hüppop 2004, Furness *et al.*, 2013, Fliessbach *et al.*, 2019).

Studies undertaken indicate that common scoter may be displaced by vessel traffic at distances from between 40 m and 3,200 m (Fliessbach et al., 2019). Consequently, the area of impact from a single vessel at any one time could vary from between 0.04 km^2 to 3.2 km^2 (based on the minimum and maximum reported disturbance distances). During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 38.4 km^2 could occur. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

Non-breeding season

A mean peak abundance of 33,080 common scoter were observed within the export cable plus 4 km buffer area, with the potential to be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 165.4 to 330.8 common scoter being subject to mortality.

The four-year mean peak regional non-breeding population estimate for common scoter in the Liverpool Bay SPA is recorded as 141,801 individuals (Table 1.9) and, using the average baseline mortality rate of 0.238 (Table 1.10), the natural predicted mortality in the winter bio-season is 33,749 individuals per annum. The addition of 165.4 to 330.8 mortalities would increase the mortality relative to the baseline mortality rate by 0.49 to 0.98%.

In the non-breeding bio-season and assessed against the common scoter population the predicted mortalities did not surpass a 1% baseline mortality threshold.

1.5.1.4 Red-throated diver

Red-throated diver are recognised to be sensitive to disturbance from vessels (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have assessed red-throated diver as having a relatively very high sensitivity from disturbance arising from vessels (Furness *et al.*, 2013, Fliessbach *et al.*, 2019).

Studies undertaken indicate that red-throated diver may be displaced by vessel traffic at distances from between 250 m and 1,700 m and for flocks a median distance of 600 m (Fliessbach *et al.*, 2019). Similar studies have reported up to 5% of individual red-throated divers and 15% of flocks were disturbed by vessels from between 800 and 1,000 m away, with the majority remaining within 600 m of a moving vessel. Up to 67% of all individual red-throated divers were not disturbed (i.e. fly away) until the vessel was within 200 m of them. The study also indicated that flocks of red-throated divers were more sensitive than individuals (Norman and Ellis 2005).

Consequently, the area of impact from a single vessel at any one time therefore could vary from between 0.60 km^2 to 1.70 km^2. During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 20.4 km^2 could occur. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

Return migration

A mean peak abundance of 407.2 red-throated diver was observed within the export cable plus 4 km buffer area in the return migration bio-season, with the potential to be displaced in this zone. When considering a mortality rate of 0.5 to 1.0%, this would result in approximately 2.04 to 4.07 red-throated diver being subject to mortality.

The UK Western Waters plus Channel BDMPS population during the return migration is defined as 4,373 individuals (Table 1.9) and, using the average baseline mortality rate of 0.233 (Table 1.10), the natural predicted mortality in the return migration bio-season is 1,019 individuals per annum. The addition of 2.04 to 4.07 mortalities would increase baseline mortality by 0.2 to 0.4%.

In the return migration bio-season and assessed against the defined red-throated diver population the predicted mortalities did not surpass a 1% baseline mortality threshold.

Breeding season

A peak density 0.099 birds per km^2 was observed for red-throated diver within the export cable plus 4 km buffer area, meaning up to 2.02 birds could be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.010 to 0.020 red-throated diver being subject to mortality.

The regional breeding population during the breeding period is defined as 1,859 individuals (Table 1.9) and, using the average baseline mortality rate of 0.233 (Table 1.10), the natural predicted mortality in the return migration bio-season is 433 individuals per annum. The addition of less than a single mortality would increase baseline mortality by 0.002 to 0.005%.

In the breeding season bio-season and assessed against the defined red-throated diver population the predicted mortalities did not surpass a 1% baseline mortality threshold.

Post-breeding migration

A peak density 0.821 birds per km^2 was observed for red-throated diver within the export cable plus 4 km buffer area, meaning up to 16.75 birds could be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.084 to 0.168 red-throated diver being subject to mortality.

The UK Western Waters plus Channel BDMPS population during the post-breeding migration is defined as 4,373 individuals (Table 1.9) and, using the average baseline mortality rate of 0.233 (Table 1.10), the natural predicted mortality in the post-breeding migration bio-season is 1,019 individuals per annum. The addition of less than a single mortality would increase baseline mortality by 0.008 to 0.016%.

In the post-breeding bio-season and assessed against the defined red-throated diver population the predicted mortalities did not surpass a 1% baseline mortality threshold.

Non-breeding season

A mean peak abundance of 343.9 red-throated diver was observed within the export cable plus 4 km buffer area in the non-breeding bio-season, with the potential to be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 1.72 to 3.44 red-throated diver being subject to mortality.

The NW England and Wales BDMPS population during the non-breeding season is defined as 1,657 individuals (Table 1.9) and, using the average baseline mortality rate of 0.233 (Table 1.10), the natural predicted mortality in the non-breeding bio-season is 386 individuals per annum. The addition of 1.72 to 4.07 mortalities would increase baseline mortality by 0.45 to 0.89%.

In the non-breeding bio-season and assessed against the defined red-throated diver population the predicted mortalities did not surpass a 1% baseline mortality threshold.

1.5.1.5 Little gull

There is little evidence that little gull are sensitive to disturbance and displacement from airborne sound and presence of vessels and infrastructure (Goodship and Furness 2022). Reviews of the sensitivity of different seabird species to disturbance from vessels and helicopter traffic have not assessed little gull although generally gulls are considered not to be sensitive to disturbance or displacement by the physical presence of vessels and that is predicted to be the case for little gull (Furness *et al.*, 2013). Studies on gull species that have been undertaken indicate that gulls may be displaced by vessel traffic at distance from between 250m to 500m (Fliessbach *et al.*, 2019).

Consequently, the area of impact from a single vessel at any one time therefore could vary from between 0.24 km^2 to 0.50 km^2. During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 6 km^2 could occur. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

Non-breeding season

A peak density 0.328 birds per km^2 was observed for little gull within the export cable plus 2 km buffer area, meaning up to 1.97 birds could be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.010 to 0.020 little gull being subject to mortality.

The population during the non-breeding season is defined as 319 individuals (Table 1.9) and, using the average baseline mortality rate of 0.157 (Table 1.10), the natural predicted mortality in the non-breeding bio-season is 50 individuals per annum. The addition of less than a single mortality would increase baseline mortality by 0.020 to 0.040%.

In the breeding bio-season and assessed against the defined little gull population the predicted mortalities did not surpass a 1% baseline mortality threshold.

1.5.1.6 Great cormorant

Great cormorant can vary in their response to the presence of vessels, with reports stating that they typically fly away when the vessel is present, however recent studies indicate that they may be becoming habituated to the presence of vessels, with avoidance less severe than originally thought.

Studies undertaken indicate that great cormorant may be displaced by vessel traffic at distances from between 30 m and 1,500m (Fliessbach *et al.*, 2019). Consequently, the area of impact from a single vessel at any one time could vary from between 0.030 km^2 to 1.5 km^2 (based on the minimum and maximum reported disturbance distances). During construction, there is potential for up to 12 vessels to be present within the area. On this basis a theoretical maximum area of disturbance of up to 18 km^2 could occur. However, during construction vessel activity will be clustered around the area of cable laying and therefore the areas of potential disturbance from each vessel will overlap and the overall area of disturbance will be considerably smaller.

Breeding season

A peak density 1.66 birds per km^2 was observed for great cormorant within the export cable plus 2 km buffer area, meaning up to 29.88 birds could be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.149 to 0.299 great cormorant being subject to mortality.

The population during the non-breeding season is defined as 9,602 individuals (Table 1.9) and, using the average baseline mortality rate of 0.333 (Table 1.10), the natural predicted mortality in the breeding bio-season is 3,197 individuals per annum. The addition of less than a single mortality would increase baseline mortality by 0.004 to 0.008%.

In the non-breeding bio-season and assessed against the defined great cormorant population the predicted mortalities did not surpass a 1% baseline mortality threshold

Non-breeding season

A peak density 1.17 birds per km^2 was observed for great cormorant within the export cable plus 2 km buffer area, meaning up to 21.06 birds could be displaced in this zone. When considering a mortality rate of 0.5 to 1%, this would result in approximately 0.105 to 0.21 great cormorant being subject to mortality.

The population during the non-breeding season is defined as 5,471 individuals (Table 1.9) and, using the average baseline mortality rate of 0.333 (Table 1.10), the natural predicted mortality in the breeding bio-season is 1,82 individuals per annum. The addition of less than a single mortality would increase baseline mortality by 0.02 to 0.04%.

In the non-breeding bio-season and assessed against the defined little gull population the predicted mortalities did not surpass a 1% baseline mortality threshold

1.5.2 Temporary displacement from construction and decommissioning of offshore structures

Disturbance and subsequent displacement of seabirds during the construction phase can also occur due to vessel traffic, construction noise and piling activities occurring within the site. These activities may displace individuals that would normally reside within and around the Area of Project Physical Works.

Decommissioning activities within the Area of Project Physical Works are equal to or less than those carried out during the construction phase. Therefore, for the purpose of this assessment it is assumed that the impacts are likely to be similar.

1.5.2.1 Sandwich tern

For all seasons combined, the annual predicted mortality rate for sandwich tern resulting from displacement during the construction and decommissioning phases was estimated to be between 6 to 30 individuals (Table 1.12). Using the largest BDMPS of 10,761 individuals (Table 1.9) and, using the average baseline mortality rate of 0.333 (Table 1.10), the background predicted mortality across all seasons is 3,583. The addition of 6 to 30 mortalities would increase the baseline mortality rate by 0.167 to 0.837%. Table 1.12 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.13 to Table 1.15.

It is predicted that any disturbance or displacement impacts arising from the construction activities could occur over a relatively wide area but will be temporary, with sandwich tern abundance returning to pre-construction levels once the temporary disturbance caused by the vessels stops. Evidence shows that displacement is temporary and that birds that are displaced will be able to relocate to other locations close by and return shortly after construction activities cease. It is therefore likely the increase in baseline mortality shown in Table 1.12 is overestimated.

Table 1.12: Sandwich Tern Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Construction And Decommissioning

Bio-season	Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of sandwich tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	38.5	10,761	3,583	2 to 10	0.056 to 0.279
Breeding	38.5	4,159	1,385	2 to 10	0.144 to 0.722
Autumn migration	38.5	10,761	3,583	2 to 10	0.056 to 0.279
Annual (BDMPS)	115.5	10,761	3,583	6 to 30	0.167 to 0.837

Table 1.13: Predicted Sandwich Tern Mortality For The Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Construction And Decommissioning)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	1	1	2	2	2	3	3	3	4
	20%	0	0	0	1	2	2	3	4	5	5	6	7	8
	30%	0	0	1	1	2	3	5	6	7	8	9	10	12
	40%	0	0	1	2	3	5	6	8	9	11	12	14	15
	50%	0	0	1	2	4	6	8	10	12	13	15	17	19
	60%	0	0	1	2	5	7	9	12	14	16	18	21	23
	70%	0	1	1	3	5	8	11	13	16	19	22	24	27
	80%	0	1	2	3	6	9	12	15	18	22	25	28	31
	90%	0	1	2	3	7	10	14	17	21	24	28	31	35
	100%	0	1	2	4	8	12	15	19	23	27	31	35	39

Table 1.14: Predicted sandwich tern mortality for the Proposed Development Area and Area of Project Physical Works plus 2 km buffer during the Breeding Season (construction and decommissioning)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	1	1	2	2	2	3	3	3	4
	20%	0	0	0	1	2	2	3	4	5	5	6	7	8
	30%	0	0	1	1	2	3	5	6	7	8	9	10	12
	40%	0	0	1	2	3	5	6	8	9	11	12	14	15
	50%	0	0	1	2	4	6	8	10	12	13	15	17	19
	60%	0	0	1	2	5	7	9	12	14	16	18	21	23
	70%	0	1	1	3	5	8	11	13	16	19	22	24	27
	80%	0	1	2	3	6	9	12	15	18	22	25	28	31
	90%	0	1	2	3	7	10	14	17	21	24	28	31	35
	100%	0	1	2	4	8	12	15	19	23	27	31	35	39

Table 1.15: Predicted Sandwich Tern Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Construction And Decommissioning)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	1	1	2	2	2	3	3	3	4
	20%	0	0	0	1	2	2	3	4	5	5	6	7	8
	30%	0	0	1	1	2	3	5	6	7	8	9	10	12
	40%	0	0	1	2	3	5	6	8	9	11	12	14	15
	50%	0	0	1	2	4	6	8	10	12	13	15	17	19
	60%	0	0	1	2	5	7	9	12	14	16	18	21	23
	70%	0	1	1	3	5	8	11	13	16	19	22	24	27
	80%	0	1	2	3	6	9	12	15	18	22	25	28	31
	90%	0	1	2	3	7	10	14	17	21	24	28	31	35
	100%	0	1	2	4	8	12	15	19	23	27	31	35	39

In all bio-seasons and assessed against the defined sandwich tern populations (10,761 in return migration, 4,159 in the breeding season and 10,761 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during the construction and decommissioning phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.2.2 Manx shearwater

For all seasons combined, the annual predicted mortality rate for Manx shearwater resulting from displacement during the construction and decommissioning phases was estimated to be zero individuals (Table 1.16). Using the largest BDMPS of 1,580,895 individuals (Table 1.9) and, using the average baseline mortality rate of 0.131 (Table 1.10), the background predicted mortality across all seasons is 207,097. The addition of zero mortalities would increase the baseline mortality rate by 0.000%. Table 1.16 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.17 to Table 1.19.

Table 1.16: Manx Shearwater Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Construction And Decommissioning

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	0.5	1,580,895	207,097	0 to 0	0.000 to 0.000
Breeding	4	967,552	126,749	0 to 0	0.000 to 0.000
Autumn migration	0.5	1,580,895	207,097	0 to 0	0.000 to 0.000
Annual (BDMPS)	5	1,580,895	207,097	0 to 0	0.000 to 0.000

Table 1.17: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Construction And Decommissioning)

Return migration	Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)	1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
10%	0	0	0	0	0	0	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0	0	0	0	0	0	0
100%	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 1.18: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Construction And Decommissioning)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	1	1	1	1	1
	30%	0	0	0	0	0	0	1	1	1	1	1	1	1
	40%	0	0	0	0	0	1	1	1	1	1	1	2	2
	50%	0	0	0	0	0	1	1	1	1	2	2	2	2
	60%	0	0	0	0	1	1	1	1	2	2	2	2	3
	70%	0	0	0	0	1	1	1	2	2	2	2	3	3
	80%	0	0	0	0	1	1	1	2	2	2	3	3	4
	90%	0	0	0	0	1	1	2	2	2	3	3	4	4
	100%	0	0	0	0	1	1	2	2	3	3	4	4	4

Table 1.19: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Construction And Decommissioning)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	1

In all bio-seasons and assessed against the defined manx shearwater populations (1,580,895 in return migration, 967,552 in the breeding season and 1,580,895 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during the construction and decommissioning phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.2.3 Northern gannet

For all seasons combined, the annual predicted mortality rate for northern gannet resulting from displacement during the construction and decommissioning phases was estimated to be between zero and one individuals (Table 1.20). Using the largest BDMPS of 661,888 individuals (Table 1.9) and, using the average baseline mortality rate of 0.187 (Table 1.10), the background predicted mortality across all seasons is 123,773. The addition of zero to one mortalities would increase the baseline mortality rate by 0.000 to 0.001%.

Table 1.20 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.21 to Table 1.23.

Table 1.20: Northern Gannet Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Construction And Decommissioning

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	10.5	661,888	123,773	0 to 0	0.000 to 0.000
Breeding	15.7	449,233	84,007	0 to 0	0.000 to 0.000
Autumn migration	10.5	545,954	102,093	0 to 0	0.000 to 0.000
Annual (BDMPS)	36.7	661,888	123,773	0 to 1	0.000 to 0.001

Table 1.21: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Construction And Decommissioning)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	1	1	1	1	1	1
	20%	0	0	0	0	0	1	1	1	1	1	2	2	2
	30%	0	0	0	0	1	1	1	2	2	2	3	3	3
	40%	0	0	0	0	1	1	2	2	3	3	3	4	4
	50%	0	0	0	1	1	2	2	3	3	4	4	5	5
	60%	0	0	0	1	1	2	3	3	4	4	5	6	6
	70%	0	0	0	1	1	2	3	4	4	5	6	7	7
	80%	0	0	0	1	2	3	3	4	5	6	7	8	8
	90%	0	0	0	1	2	3	4	5	6	7	8	9	9
	100%	0	0	1	1	2	3	4	5	6	7	8	9	11

Table 1.22: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Construction And Decommissioning)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	1	1	1	1	1	1	2
	20%	0	0	0	0	1	1	1	2	2	2	3	3	3
	30%	0	0	0	0	1	1	2	2	3	3	4	4	5
	40%	0	0	0	1	1	2	3	3	4	4	5	6	6
	50%	0	0	0	1	2	2	3	4	5	5	6	7	8
	60%	0	0	0	1	2	3	4	5	6	7	8	8	9
	70%	0	0	1	1	2	3	4	5	7	8	9	10	11
	80%	0	0	1	1	3	4	5	6	8	9	10	11	13
	90%	0	0	1	1	3	4	6	7	8	10	11	13	14
	100%	0	0	1	2	3	5	6	8	9	11	13	14	16

Table 1.23: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Construction And Decommissioning)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	1	1	1	1	1	1
	20%	0	0	0	0	0	1	1	1	1	1	2	2	2
	30%	0	0	0	0	1	1	1	2	2	2	3	3	3
	40%	0	0	0	0	1	1	2	2	3	3	3	4	4
	50%	0	0	0	1	1	2	2	3	3	4	4	5	5
	60%	0	0	0	1	1	2	3	3	4	4	5	6	6
	70%	0	0	0	1	1	2	3	4	4	5	6	7	7
	80%	0	0	0	1	2	3	3	4	5	6	7	8	8
	90%	0	0	0	1	2	3	4	5	6	7	8	9	9
	100%	0	0	1	1	2	3	4	5	6	7	8	9	11

In all bio-seasons and assessed against the defined northern gannet populations (661,888 in return migration, 449,233 in the breeding season and 545,954 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during the construction and decommissioning phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.2.4 Northern fulmar

For all seasons combined, the annual predicted mortality rate for northern fulmar resulting from displacement during the construction and decommissioning phases was estimated to be between zero and one individuals (Table 1.24). Using the largest BDMPS of 661,888 individuals (Table 1.9) and, using the average baseline mortality rate of 0.181 (Table 1.10), the background predicted mortality across all seasons is 149,903. The addition of zero to one mortalities would increase the baseline mortality rate by 0.000 to 0.001%. Table 1.24

further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.25 to Table 1.27.

Table 1.24: Northern Gannet Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Construction And Decommissioning

Bio-season	Proposed Development Area and Area of Project Physical Works + 2km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	21.8	828,194	149,903	0	0.000
Breeding	23.6	343,042	62,091	0	0.000
Autumn migration	21.8	828,194	149,903	0	0.000
Annual (BDMPS)	67.2	828,194	149,903	0 to 1	0.000 to 0.001

Table 1.25: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Construction And Decommissioning)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	1	1	1	1	2	2	2	2
	20%	0	0	0	0	1	1	2	2	3	3	3	4	4
	30%	0	0	0	1	1	2	3	3	4	5	5	6	7
	40%	0	0	0	1	2	3	3	4	5	6	7	8	9
	50%	0	0	1	1	2	3	4	5	7	8	9	10	11
	60%	0	0	1	1	3	4	5	7	8	9	10	12	13
	70%	0	0	1	2	3	5	6	8	9	11	12	14	15
	80%	0	0	1	2	3	5	7	9	10	12	14	16	17
	90%	0	0	1	2	4	6	8	10	12	14	16	18	20
	100%	0	0	1	2	4	7	9	11	13	15	17	20	22

Table 1.26: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Construction And Decommissioning)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	1	1	1	1	2	2	2	2
	20%	0	0	0	0	1	1	2	2	3	3	4	4	5
	30%	0	0	0	1	1	2	3	4	4	5	6	6	7
	40%	0	0	0	1	2	3	4	5	6	7	8	8	9
	50%	0	0	1	1	2	4	5	6	7	8	9	11	12
	60%	0	0	1	1	3	4	6	7	8	10	11	13	14
	70%	0	0	1	2	3	5	7	8	10	12	13	15	17
	80%	0	0	1	2	4	6	8	9	11	13	15	17	19
	90%	0	0	1	2	4	6	8	11	13	15	17	19	21
	100%	0	0	1	2	5	7	9	12	14	17	19	21	24

Table 1.27: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Construction And Decommissioning)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	1	1	1	1	2	2	2	2
	20%	0	0	0	0	1	1	2	2	3	3	3	4	4
	30%	0	0	0	1	1	2	3	3	4	5	5	6	7
	40%	0	0	0	1	2	3	3	4	5	6	7	8	9
	50%	0	0	1	1	2	3	4	5	7	8	9	10	11
	60%	0	0	1	1	3	4	5	7	8	9	10	12	13
	70%	0	0	1	2	3	5	6	8	9	11	12	14	15
	80%	0	0	1	2	3	5	7	9	10	12	14	16	17
	90%	0	0	1	2	4	6	8	10	12	14	16	18	20
	100%	0	0	1	2	4	7	9	11	13	15	17	20	22

In all bio-seasons and assessed against the defined northern fulmar populations (828,194 in return migration, 343,042 in the breeding season and 828,194 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during the construction and decommissioning phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.2.5 European Storm-petrel

For all seasons combined, the annual predicted mortality rate for European storm-petrel resulting from displacement during the construction and decommissioning phases was estimated to be between zero individuals (Table 1.28). Using the largest BDMPS of 834,500 individuals (Table 1.9) and, using the average baseline mortality rate of 0.142 (Table 1.10), the background predicted mortality across all seasons is 118,499. The addition of zero mortalities would increase the baseline mortality rate by 0.000%.

Table 1.28 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.29 to Table 1.31.

Table 1.28: European Storm-Petrel Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Construction And Decommissioning

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	0	834,500	118,499	0	0.000
Breeding	0.1	179,093	25,431	0	0.000
Autumn migration	0	834,500	118,499	0	0.000
Annual (BDMPS)	0.1	834,500	118,499	0	0.000

Table 1.29: Predicted European Storm-Petrel Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Construction And Decommissioning)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.30: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Construction And Decommissioning)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.31: Predicted European Storm-Petrel Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Construction And Decommissioning)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

In all bio-seasons and assessed against the defined European storm-petrel populations (838,500 in return migration, 179,093 in the breeding season and 838,500 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during the construction and decommissioning phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.3 Permanent displacement from operation of Douglas platform

Although most studies have documented attraction effects of offshore platforms in both seabirds and landbirds, the presence of platforms can also displace birds from otherwise suitable foraging habitat (Ronconi *et al.*, 2015). In some studies, it has been shown that shearwaters, storm-petrels, and Northern fulmar occurred in lower densities close to offshore platforms compared to regions 10–50 km away from (AMEC, 2011). With the lack of known consequences and rates at which birds avoid offshore structures, it is assumed therefore that for certain species, complete avoidance of the offshore platform occurs.

1.5.3.1 Sandwich tern

For all seasons combined, the annual predicted mortality rate for sandwich tern resulting from displacement during the operation and maintenance phases was estimated to be zero (Table 1.32). Using the largest BDMPS of 10,761 individuals (Table 1.9) and, using the average baseline mortality rate of 0.333 (Table 1.10), the background predicted mortality across all seasons is 3,583. The addition of zero mortalities would increase the baseline mortality rate by 0.000%.

Table 1.32 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.33 to Table 1.35.

Table 1.32: Sandwich Tern Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Operation And Maintenance

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	0	10,761	3,583	0	0.000
Breeding	0	4,159	1,385	0	0.000
Autumn migration	0	10,761	3,583	0	0.000
Annual (BDMPS)	0	10,761	3,583	0	0.000

Table 1.33: Predicted Sandwich Tern Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Operation And Maintenance)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.34: Predicted Sandwich Tern Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Operation And Maintenance)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.35: Predicted Sandwich Tern Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Operation And Maintenance)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

In all bio-seasons and assessed against the defined sandwich tern populations (10,761 in return migration, 4,159 in the breeding season and 10,761 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during operation and maintenance phases (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.3.2 Manx shearwater

For all seasons combined, the annual predicted mortality rate for Manx shearwater resulting from displacement during the operation and maintenance was estimated to be zero individuals (Table 1.36). Using the largest BDMPS of 1,580,895 individuals (Table 1.9) and, using the average baseline mortality rate of 0.131 (Table 1.10), the background predicted mortality across all seasons is 207,097. The addition of zero mortalities would increase the baseline mortality rate by 0.000%. Table 1.36 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.37 to Table 1.39.

Table 1.36: Manx Shearwater Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Operation And Maintenance

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	0.5	1,580,895	207,097	0 to 0	0.000 to 0.000
Breeding	4	967,552	126,749	0 to 0	0.000 to 0.000
Autumn migration	0.5	1,580,895	207,097	0 to 0	0.000 to 0.000
Annual (BDMPS)	5	1,580,895	207,097	0 to 0	0.000 to 0.000

Table 1.37: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Operation And Maintenance)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 1.38: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Operation And Maintenance)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	1	1	1	1	1
	30%	0	0	0	0	0	0	1	1	1	1	1	1	1
	40%	0	0	0	0	0	1	1	1	1	1	1	2	2
	50%	0	0	0	0	0	1	1	1	1	2	2	2	2
	60%	0	0	0	0	1	1	1	1	2	2	2	2	3
	70%	0	0	0	0	1	1	1	2	2	2	2	3	3
	80%	0	0	0	0	1	1	1	2	2	2	3	3	4
	90%	0	0	0	0	1	1	2	2	2	3	3	4	4
	100%	0	0	0	0	1	1	2	2	3	3	4	4	4

Table 1.39: Predicted Manx Shearwater Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Operation And Maintenance)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	1

In all bio-seasons and assessed against the defined manx shearwater populations (1,580,895 in return migration, 967,552 in the breeding season and 1,580,895 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during operation and maintenance (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.3.3 Northern gannet

For all seasons combined, the annual predicted mortality rate for northern gannet resulting from displacement during the maintenance and operation phases was estimated to be between zero and three individuals (Table 1.40). Using the largest BDMPS of 661,888 individuals (Table 1.9) and, using the average baseline mortality rate of 0.187 (Table 1.10), the background predicted mortality across all seasons is 123,773. The addition of zero to three mortalities would increase the baseline mortality rate by 0.000 to 0.002%. Table 1.40 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.41 to Table 1.43.

Table 1.40: Northern Gannet Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Operation And Maintenance

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	9.2	661,888	123,773	0 to 1	0.000 to 0.001
Breeding	13.8	449,233	84,007	0 to 1	0.000 to 0.001
Autumn migration	9.2	545,954	102,093	0 to 1	0.000 to 0.001
Annual (BDMPS)	32.2	661,888	123,773	0 to 3	0.000 to 0.002

Table 1.41: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Operation And Maintenance)

Return migration — Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)												
	1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
10%	0	0	0	0	0	0	0	0	1	1	1	1	1
20%	0	0	0	0	0	1	1	1	1	1	1	2	2
30%	0	0	0	0	1	1	1	1	2	2	2	2	3
40%	0	0	0	0	1	1	1	2	2	3	3	3	4
50%	0	0	0	0	1	1	2	2	3	3	4	4	5
60%	0	0	0	1	1	2	2	3	3	4	4	5	6
70%	0	0	0	1	1	2	3	3	4	5	5	6	6
80%	0	0	0	1	1	2	3	4	4	5	6	7	7
90%	0	0	0	1	2	2	3	4	5	6	7	7	8
100%	0	0	0	1	2	3	4	5	6	6	7	8	9

Table 1.42: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Operation And Maintenance)

Breeding season	Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)	1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
10%	0	0	0	0	0	0	1	1	1	1	1	1	1
20%	0	0	0	0	1	1	1	1	2	2	2	2	3
30%	0	0	0	0	1	1	2	2	2	3	3	4	4
40%	0	0	0	1	1	2	2	3	3	4	4	5	6
50%	0	0	0	1	1	2	3	3	4	5	6	6	7
60%	0	0	0	1	2	2	3	4	5	6	7	7	8
70%	0	0	0	1	2	3	4	5	6	7	8	9	10
80%	0	0	1	1	2	3	4	6	7	8	9	10	11
90%	0	0	1	1	2	4	5	6	7	9	10	11	12
100%	0	0	1	1	3	4	6	7	8	10	11	12	14

Table 1.43: Predicted Northern Gannet Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Operation And Maintenance)

Post-breeding migration	Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)	1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
10%	0	0	0	0	0	0	0	0	1	1	1	1	1
20%	0	0	0	0	0	1	1	1	1	1	1	2	2
30%	0	0	0	0	1	1	1	1	2	2	2	2	3
40%	0	0	0	0	1	1	1	2	2	3	3	3	4
50%	0	0	0	0	1	1	2	2	3	3	4	4	5
60%	0	0	0	1	1	2	2	3	3	4	4	5	6
70%	0	0	0	1	1	2	3	3	4	5	5	6	6
80%	0	0	0	1	1	2	3	4	4	5	6	7	7
90%	0	0	0	1	2	2	3	4	5	6	7	7	8
100%	0	0	0	1	2	3	4	5	6	6	7	8	9

In all bio-seasons and assessed against the defined northern gannet populations (661,888 in return migration, 449,233 in the breeding season and 545,954 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during operation and maintenance (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.3.4 Northern fulmar

For all seasons combined, the annual predicted mortality rate for northern fulmar resulting from displacement during the construction and decommissioning phases was estimated to be between zero and five individuals (Table 1.44). Using the largest BDMPS of 661,888 individuals (Table 1.9) and, using the average baseline mortality rate of 0.181 (Table 1.10), the background predicted mortality across all seasons is 149,903. The addition of zero to five mortalities would increase the baseline mortality rate by 0.000 to 0.003%. Table 1.44 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.45 to Table 1.47.

Table 1.44: Northern Gannet Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Operation And Maintenance

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	17.6	828,194	149,903	0 to 2	0.000 to 0.001
Breeding	19.0	343,042	62,091	0 to 2	0.000 to 0.003
Autumn migration	17.6	828,194	149,903	0 to 2	0.000 to 0.001
Annual (BDMPS)	54.2	828,194	149,903	0 to 5	0.000 to 0.003

Table 1.45: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Operation And Maintenance)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	1	1	1	1	1	1	2	2
	20%	0	0	0	0	1	1	1	2	2	2	3	3	4
	30%	0	0	0	1	1	2	2	3	3	4	4	5	5
	40%	0	0	0	1	1	2	3	4	4	5	6	6	7
	50%	0	0	0	1	2	3	4	4	5	6	7	8	9
	60%	0	0	1	1	2	3	4	5	6	7	8	10	11
	70%	0	0	1	1	2	4	5	6	7	9	10	11	12
	80%	0	0	1	1	3	4	6	7	8	10	11	13	14
	90%	0	0	1	2	3	5	6	8	10	11	13	14	16
	100%	0	0	1	2	4	5	7	9	11	12	14	16	18

Table 1.46: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Operation And Maintenance)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	1	1	1	1	1	2	2	2
	20%	0	0	0	0	1	1	2	2	2	3	3	3	4
	30%	0	0	0	1	1	2	2	3	3	4	5	5	6
	40%	0	0	0	1	2	2	3	4	5	5	6	7	8
	50%	0	0	0	1	2	3	4	5	6	7	8	9	10
	60%	0	0	1	1	2	3	5	6	7	8	9	10	11
	70%	0	0	1	1	3	4	5	7	8	9	11	12	13
	80%	0	0	1	2	3	5	6	8	9	11	12	14	15
	90%	0	0	1	2	3	5	7	9	10	12	14	15	17
	100%	0	0	1	2	4	6	8	10	11	13	15	17	19

Table 1.47: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Operation And Maintenance)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Displacement level (% at risk of displacement)	10%	0	0	0	0	0	1	1	1	1	1	1	2	2
	20%	0	0	0	0	1	1	1	2	2	2	3	3	4
	30%	0	0	0	1	1	2	2	3	3	4	4	5	5
	40%	0	0	0	1	1	2	3	4	4	5	6	6	7
	50%	0	0	0	1	2	3	4	4	5	6	7	8	9
	60%	0	0	1	1	2	3	4	5	6	7	8	10	11
	70%	0	0	1	1	2	4	5	6	7	9	10	11	12
	80%	0	0	1	1	3	4	6	7	8	10	11	13	14
	90%	0	0	1	2	3	5	6	8	10	11	13	14	16
	100%	0	0	1	2	4	5	7	9	11	12	14	16	18

In all bio-seasons and assessed against the defined northern fulmar populations (828,194 in return migration, 343,042 in the breeding season and 828,194 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during operation and maintenance (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

1.5.3.5 European Storm-petrel

For all seasons combined, the annual predicted mortality rate for European storm-petrel resulting from displacement during the construction and decommissioning phases was estimated to be between zero individuals (Table 1.48). Using the largest BDMPS of 834,500 individuals (Table 1.9) and, using the average baseline mortality rate of 0.142 (Table 1.10), the background predicted mortality across all seasons is 118,499. The addition of zero mortalities would increase the baseline mortality rate by 0.000%. Table 1.48 further breaks this down into relevant bio-seasons, with displacement matrices presented in Table 1.49 to Table 1.51.

Table 1.48: European Storm-Petrel Bio-Season Displacement Estimates For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Operation And Maintenance

Bio-season	Proposed Development Area and Area of Project Physical Works + 2 km buffer Peak Abundance	Regional Baseline Population		Number of little tern subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration	0	834,500	118,499	0	0.000
Breeding	0.1	179,093	25,431	0	0.000
Autumn migration	0	834,500	118,499	0	0.000
Annual (BDMPS)	0.1	834,500	118,499	0	0.000

Table 1.49: Predicted European Storm-Petrel Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During Spring Migration (Operation And Maintenance)

Return migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.50: Predicted Northern Fulmar Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Breeding Season (Operation And Maintenance)

Breeding season		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.51: Predicted European Storm-Petrel Mortality For The Proposed Development Area And Area Of Project Physical Works Plus 2 km Buffer During The Post-Breeding Migration (Operation And Maintenance)

Post-breeding migration		Mortality level (% of displaced birds at risk of mortality)												
Displacement level (% at risk of displacement)		1%	2%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	10%	0	0	0	0	0	0	0	0	0	0	0	0	0
	20%	0	0	0	0	0	0	0	0	0	0	0	0	0
	30%	0	0	0	0	0	0	0	0	0	0	0	0	0
	40%	0	0	0	0	0	0	0	0	0	0	0	0	0
	50%	0	0	0	0	0	0	0	0	0	0	0	0	0
	60%	0	0	0	0	0	0	0	0	0	0	0	0	0
	70%	0	0	0	0	0	0	0	0	0	0	0	0	0
	80%	0	0	0	0	0	0	0	0	0	0	0	0	0
	90%	0	0	0	0	0	0	0	0	0	0	0	0	0
	100%	0	0	0	0	0	0	0	0	0	0	0	0	0

In all bio-seasons and assessed against the defined European storm-petrel populations (838,500 in return migration, 179,093 in the breeding season and 838,500 individuals in the post-breeding migration respectively) the predicted mortalities did not surpass a 1% baseline mortality threshold during operation and maintenance (highlighted yellow cells within each displacement matrix indicates if mortality exceeds 1%).

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