

# DOGGER BANK D WIND FARM

## Preliminary Environmental Information Report

Volume 2

Appendix 13.4 Offshore Displacement Analysis Report

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APPENDIX 13.4 OFFSHORE DISPLACEMENT ANALYSIS REPORT

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## 1. Introduction

### 1.1 Project Background

SSE Renewables and Equinor ('the Applicant') is proposing to develop the Dogger Bank D Offshore Wind Farm (DBD OWF) as a proposed optimisation to the Dogger Bank C (DBC) OWF that is currently in construction. . DBD is located approximately 210km offshore from the north-east coast of England at its closest point, with the array covering an area of approximately 262km<sup>2</sup>. The Array Area plus the relevant asymmetrical 2km and asymmetrical 4km buffer covering an area of approximately 370km<sup>2</sup> and 488km<sup>2</sup>, respectively (see **Section 2.1** for further detail regarding the asymmetrical buffers). DBD will comprise both offshore and onshore infrastructure, including an offshore generating station (wind farm Array Area), export cables to landfall, and an onshore substation for connection to the electricity transmission network (please see **Volume 1, Chapter 4 Project Description** for full details on the Project Design).

APEM Ltd (hereafter APEM) was commissioned by the Applicant to undertake a study of offshore ornithology features that characterise the area that may be influenced by DBD. A separate report (**Appendix 13.2 Offshore Ornithology Baseline Characterisation Report**) provides the findings from offshore ornithology data to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from DBD. This technical annex has been produced to support **Volume 1, Chapter 13 Offshore and Intertidal Ornithology**.

### 1.2 Array Area Displacement Analysis

The presence of Wind Turbine Generators (WTGs) has the potential to disturb and displace seabirds that would normally use the area of sea within and around the proposed DBD array. WTGs can also create barriers for seabirds, potentially changing original flight paths to less energy efficient paths. For the purposes of assessment, it is usually not possible to distinguish between displacement and barrier effects and so they are both encapsulated within displacement analyses as recommended by Natural England (Parker *et al.* 2022; SNCBs, 2022). This in effect represents indirect habitat loss, potentially reducing the area available for those seabirds sensitive to disturbance to forage, loaf and/ or moult in the way that they are currently able to within and around DBD. There is also the potential for the construction and decommissioning of wind turbines, substations and cable laying to disturb and displace seabirds, though the nature of such potential impacts is more restricted spatially and temporally by virtue of the nature of those phases of the development.

Following a review of the 24 months of site-specific Digital Aerial Survey (DAS) data, and consultation with Natural England via the Expert Topic Group (ETG) meetings, six seabird species have been considered for displacement analysis within the DBD Array Area (see Natural England's comment on displacement analysis from ETG2 Meeting 2 in **Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**). These are:

- Guillemot (*Uria aalge*);
- Razorbill (*Alca torda*);
- Puffin (*Fratercula arctica*);
- Great northern diver (*Gavia immer*);
- White-billed diver (*Gavia adamsii*); and
- Gannet (*Morus bassanus*).

### 1.3 Export Cable Corridor Displacement Analysis

The laying of the export cable between the Array Area and the cable landfall area for DBD has the potential for construction activities associated with export cable laying, namely the presence of the cable laying vessel(s), to lead to disturbance and displacement of more sensitive species surrounding the cable laying vessel and out to differing buffers surrounding the vessels dependent upon the species present.

The nearshore section of the DBD offshore Export Cable Corridor (ECC) intersects the northern most point of the Greater Wash SPA. Red-throated diver (*Gavia stellata*) is a designated feature (non-breeding season) of the Greater Wash SPA that has a high classification in terms of sensitivity to disturbance and displacement to offshore windfarms and their associated activities (Bradbury *et al.* (2014); SNCBs, 2022). As such red-throated diver have been considered for displacement analysis associated with the ECC works but are not considered for the displacement analysis associated with the Array Area due to the negligible numbers recorded so far from shore. In addition to red-throated diver, the Greater Wash SPA has other designated features including common scoter (*Melanitta nigra*), little gull (*Hydrocoloeus minutus*), common tern (*Sterna hirundo*), little tern (*Sternula albifrons*) and sandwich tern (*Sterna sandvicensis*). The tern species have low sensitivity to disturbance from vessels and so were screened out (Fleissbach *et al.*, 2019). This was agreed at scoping (see Natural England's Scoping Opinion comments on tern species in **Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**). Little gull and common scoter were not considered further as there was no overlap between the species distribution within the SPA and the ECC (Lawson *et al.*, 2016).

## 2. Methods

### 2.1 Buffers for Displacement

#### *Array Area*

The assessment of disturbance and displacement effects from DBD is found within **Chapter 13 Offshore and Intertidal Ornithology**. The scale of the potential displacement applied in this report follows guidance in the literature (SNCBs, 2022; Parker *et al.* 2022). As recommended, this report presents displacement matrices for the key receptors identified; guillemot, razorbill, puffin and gannet within the DBD Array Area plus a 2km asymmetrical buffer, and great northern diver and white-billed diver within the DBD Array Area plus a 4km asymmetrical buffer (SNCBs, 2022; Parker *et al.* 2022).

The Array Area of Dogger Bank C (DBC), which is currently in the pre-construction phase, directly abuts the DBD Array Area. An appropriate method is therefore required to reduce double counting of potential displacement effects from both projects. A previously implemented solution agreed by SNCBs (including Natural England), is to assess against an asymmetrical buffer for abutting projects, as recently implemented for Rampion 2 (WSP, 2024) and Awel Y Mor (RWE, 2022). Although DBC is still at the pre-construction phase, the project will be fully operational before the proposed commissioning timeframe for DBD, therefore enacting a potential displacement effect before DBD is fully commissioned. Therefore, prior to DBD being commissioned, the ‘populations’ of birds using the DBC Array Area (and arguably extending into the adjacent parts of the DBD Array Area as well) will have been subjected to displacement effects already, and the bird densities within the DBC array will already equate to those which occur within the array of an operational OWF. Birds which remain within the DBC Array Area at the point of DBD operation are likely to have either habituated to or tolerate the presence of WTGs making them less likely to be displaced by the operation of DBD, following the conclusions drawn for Rampion 2 and Awel Y Mor. In addition, DAS data for DBD was collected prior to the construction of DBC and so estimates are more conservative than if birds had already been displaced. The DBC Array Area has therefore been excluded from the buffer zones used in calculating the abundance estimates on which the displacement assessment relies, meaning an asymmetrical buffer has been used for assessment (**Figure 2-1**).

It should be noted that the level of effect concluded for DBC (and retained with the current cumulative assessment) was originally based on the predicted abundance within the former Dogger Bank Teesside A site, which covered the entire DBC and DBD Array Area. Therefore, when assessing both projects cumulatively there is still a significant degree of precaution factored into any potential cumulative effect from both projects.

### *Export Cable Corridor*

A review of seabird displacement responses to the presence of vessels undertaken by Fleissbach *et al.* (2019) suggests a maximum escape distance (the distance in which birds will flee an area if disturbance occurs) for red-throated divers of 1,187m. Considering this escape distance, the consideration of a 2km buffer around the ECC provides for significant level of precaution within the assessment. The assessment of red-throated diver within the ECC is based only on the area of overlap with the Greater Wash SPA, due to the limited potential for any significant number of red-throated diver to be present within the remaining ECC based on their habitat preferences (**Figure 2-2**).

A worst-case number of construction vessels, at nine vessels at any one time, is considered for the Project. This would include one cable installation vessel, one trenching vessel, one rock placement vessel, two Horizontal Directional Drilling (HDD) prep vessels, two Crew Transfer Vessels (CTV) and two guard vessels. These vessels, rather than occupying the entire area of overlap, will likely be clustered into construction teams at any one time. Therefore, the area of ECC and buffer included in this assessment is considered to be highly precautionary.

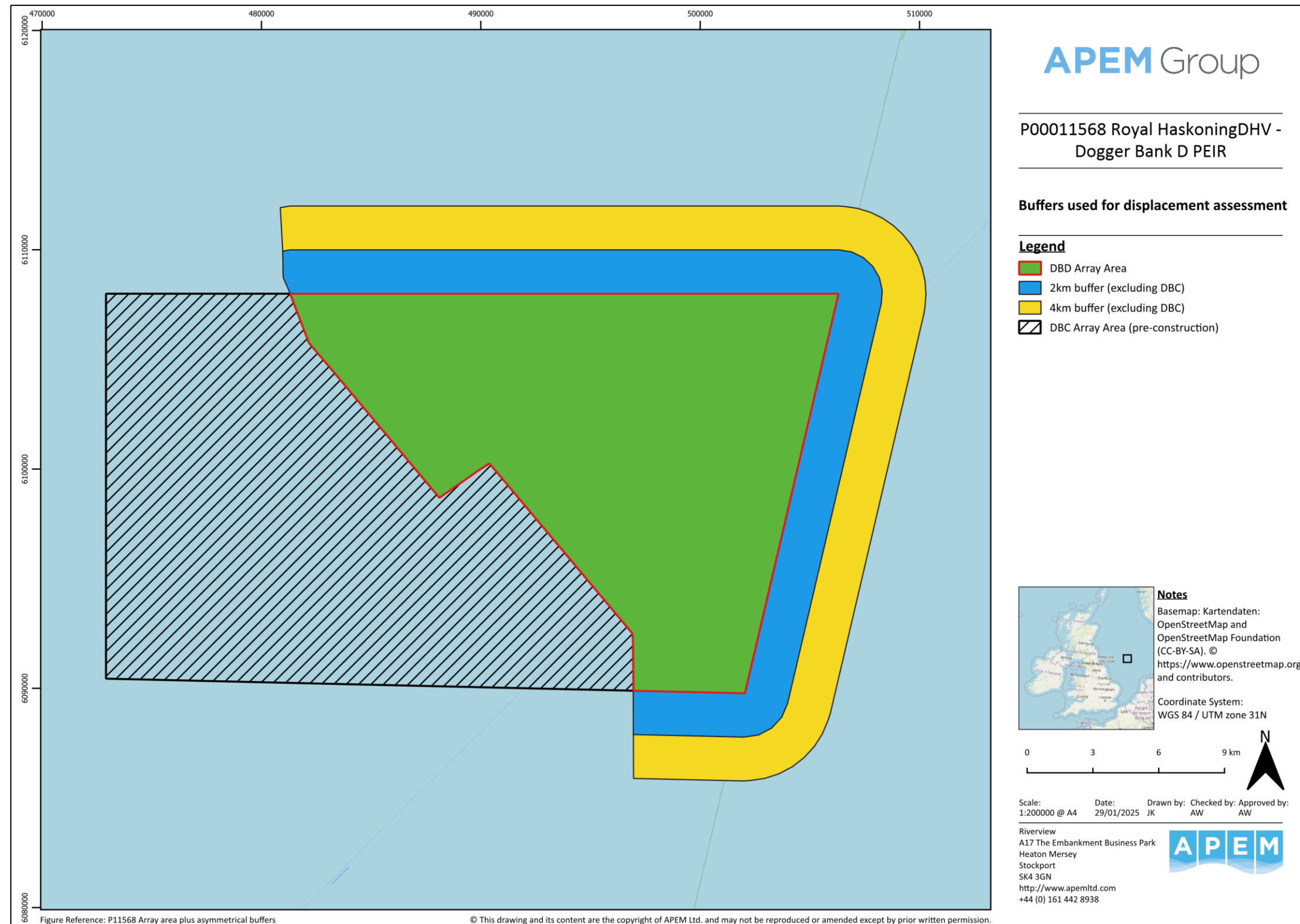


Figure 2-1 Buffers used for displacement assessment avoiding overlap with DBC Array Area



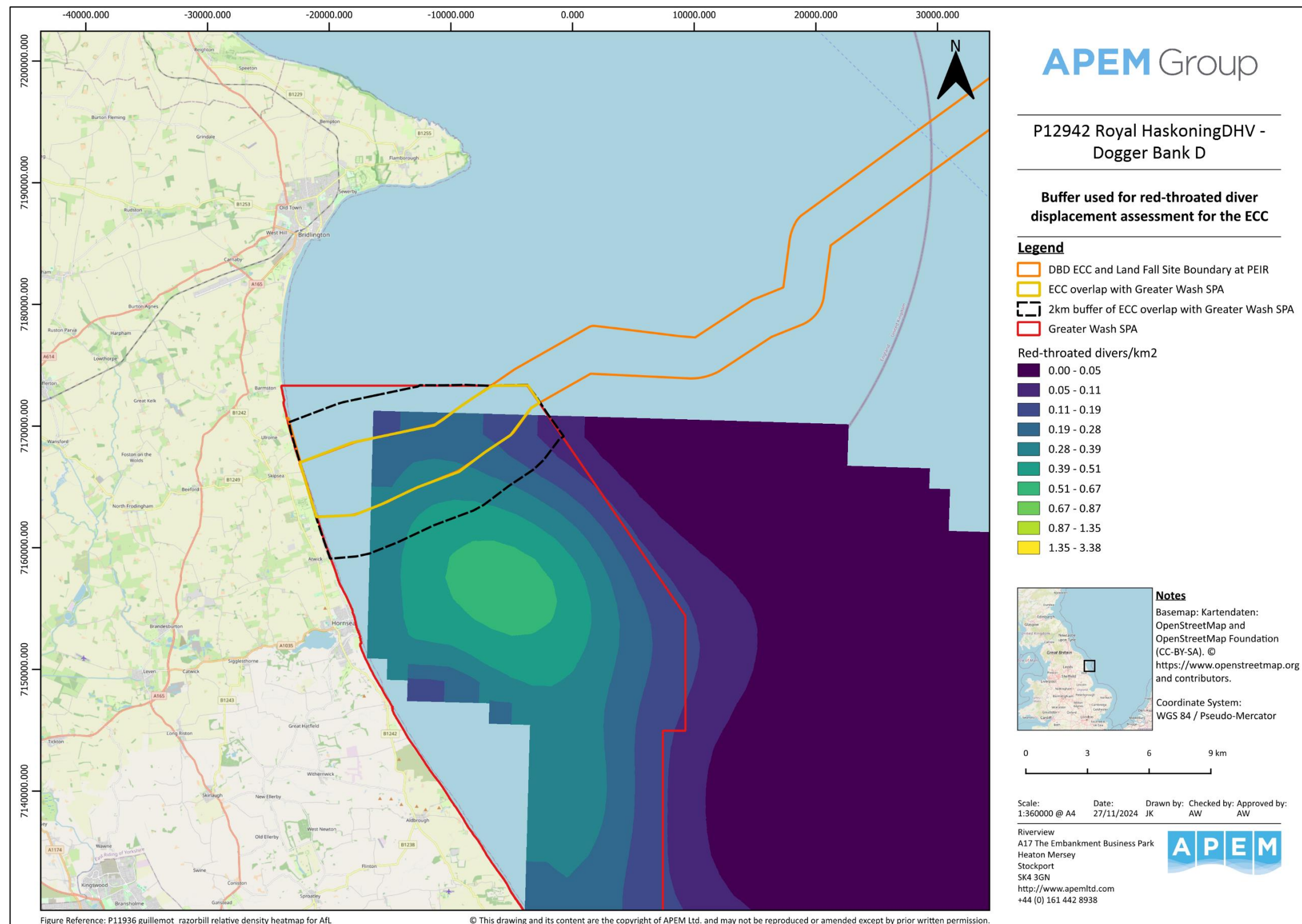


Figure 2-2 Buffer defining the area used for the displacement assessment of red-throated diver for the ECC in relation to the Greater Wash SPA and red-throated diver densities (as estimated in Lawson *et al.* 2016)

## 2.2 Data sources for displacement matrices

The data contributing to the displacement assessment for the Array Area are taken from the 24 months of DAS across the DBD Array Area plus buffers, covering October 2021 to September 2023, inclusive. Full details of the site-specific surveys can be found in the **Appendix 13.2 Offshore Ornithology Baseline Characterisation report**. The abundance data used to estimate displacement effects are inclusive of apportionment of unidentified species-groups (**Appendix 13.2 Offshore Ornithology Baseline Characterisation report**) and corrections for availability bias using available literature for guillemot, razorbill and puffin. Although diver species require corrections for availability bias, there is currently no data that is recommended by Natural England and so no corrections have been applied.

The data contributing to the displacement assessment for the ECC are extracted from the red-throated diver distributional data presented in Lawson *et al.* (2016).

Displacement matrices for the DBD Array Area and associated buffers are presented for each of the six species (guillemot, razorbill, puffin, great northern diver, white-billed diver and gannet) separately for each bio-season (**Table 2-1**). For all six species, the displacement analysis is based on the abundance of 'all individuals' (i.e. both flying and 'sitting', including birds observed diving, landing and taking off). All behaviours have been included within displacement analysis as recommended within Natural England's best practice guidance (Parker *et al.* 2022). This is because Natural England currently consider there is insufficient evidence to quantitatively separate and individually assess displacement impacts and barrier effects, for species sensitive to such effects. All behaviours are therefore included within displacement impacts to account for impacts from both displacement and potential barrier effects (Parker *et al.* 2022).

Displacement matrices for red-throated diver, based on the mean and maximum density estimates within the ECC plus 2km buffer overlap area with the Greater Wash SPA boundary, are also presented for the wintering/ non-breeding bio-season in **Section 3.7**.

## 2.3 Data limitations

### Array Area

The data within this annex for all six species are reliant upon site-specific high-resolution DAS undertaken across the DBD survey area. A detailed description of the survey area and DAS methodology can be found in the **Appendix 13.2 Offshore Ornithology Baseline Characterisation report**. These data are considered to be the most reliable source for characterising the baseline environment for offshore ornithology. However, exactly how these data are used to characterise the abundances for each species within individual bio-seasons (as described in **Section 2.4**) is subject to interpretation, given variation in migratory movements between species and between years, the age classification of birds within each bio-season, potential connectivity to breeding colonies and other factors. The approach taken

to baseline characterisation to inform displacement assessments conforms with SNCB guidance on displacement analysis (SNBC, 2022).

### *Export Cable Corridor*

The data used to estimate the abundance of red-throated diver (Lawson *et al.* 2016) within the ECC and associated buffer was collected between 2002 and 2008 and therefore there is uncertainty regarding the representativeness of this dataset capturing the population in its current state (see Natural England's comments on assessment of the ECC from ETG2 Meeting 1 in **Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**). However, on review of all publicly available information and in discussion with Natural England through the ETG process, this was considered the most appropriate available dataset to inform impact assessments at the time of drafting.

## **2.4 Presentation of displacement by bio-seasons**

Bio-seasons are based on those defined by Furness (2015) and as recommended within the Natural England and NRW interim guidance on demographic rates note (Natural England & NRW, 2024). The bio-seasons used for each species and the constituent months are presented in **Table 2-1**. The bio-seasons presented within **Table 2-1** are consistent with those presented within Tables 7-19 of the Project's Scoping Report (Royal HaskoningDHV, 2023), which Natural England agreed as appropriate for EIA assessment for DBD as confirmed in their Scoping Opinion Response (PINS, 2024). A full overview of the bio-seasons used in impact assessment for each species is provided in **Appendix 13.2 Offshore Ornithology Baseline Characterisation, Section 2.3.2**.

For gannet both the migration-free breeding and full breeding bio-season are considered for displacement analysis within this report. When the full breeding bio-season (March – September) is considered, the months of overlap in the non-breeding bio-seasons are reduced accordingly to avoid any double counting of effects between seasons. Therefore, the return migration bio-season would be December to February and the post-breeding migration bio-season October to November.

For white-billed diver, great northern diver bio-seasons, as presented in Furness (2015), were used as a proxy. Based on the review of Trektellen (Trektellen, 2025) and Bird Guides (Bird Guides, 2025) records, the use of great northern diver bio-season as a proxy for white-billed diver bio-seasons is conservative. White-billed divers are in high numbers in Norway in May with very few sightings in June and no records in July. North Sea entry for the species commences in October.

In order to provide a visual approach to presenting data on the species considered for disturbance and displacement, a colour-coding system has been applied in the tables to represent different bio-seasons. Each species has its own set of months defining each bio-season; the number of bio-seasons also varies between species. The colours used to define the bio-seasons are presented in **Table 2-1**.



**Table 2-1: Bio-season colour coding**

Bio-season	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver*	Gannet**
Return Migration (Green)	N/A	Jan - Mar	N/A	N/A	N/A	Dec - Mar
Migration-free Breeding (Purple)	N/A	N/A	N/A	N/A	N/A	Apr - Aug
Post-breeding Migration (Orange)	N/A	Aug - Oct	N/A	N/A	N/A	Sept - Nov
Migration-free Winter (Grey/Blue)	N/A	Nov - Dec	N/A	N/A	N/A	N/A
Breeding (Pink)	Mar - Jul	Apr - Jul	Apr - Jul	Jun - Aug	Jun - Aug	Mar - Sep
Non-breeding (Yellow)	Aug - Feb	N/A	Aug - Mar	Sep - May	Sep - May	N/A

Table Note: \*For white-billed diver, the bio-seasons for great northern diver have been used as a proxy.

\*\*For gannet both the migration-free breeding and full breeding bio-season are presented. When the full breeding bio-season is considered, the constituent months of the non-breeding bio-seasons have been adjusted accordingly to avoid overlapping of constituent months.

## 2.5 Bio-season mean peak abundances

### *Array Area*

As per Statutory Nature Conservation Bodies (SNCBs) displacement guidance (SNCBs, 2022), displacement assessments are based on bio-season mean peak abundances. The bio-season mean peak abundance is calculated as the highest recorded monthly abundance within each bio-season for each survey year averaged across the two years' of data. It should be noted that calculating bio-season abundance in such a way is highly precautionary, as it is highly unlikely that the abundance within a given bio-season remains at such consistently high abundance across the entire season, especially when considering the non-breeding bio-season (which, for certain of the species, may be characterised by temporary peaks associated with passage movements or moulting flocks). An example of this can be seen in razorbill recorded in the DBD Array Area plus 2km buffer. In April 2023 an abundance of 1,378 was recorded, much higher than other abundances within the breeding season for razorbill across both survey years. The highest abundance recorded in the previous year's breeding season was 96 individuals with a range throughout the season of 23. For the 2023 breeding season, the range including the high abundance would be 1,378 compared to 10 without, an abundance range much closer to that recorded for the previous year. Therefore, carrying through the count of 1,378 individuals as part of the mean peak calculation over inflates the

number of razorbills consistently present in the Array Area plus 2km buffer for DBD for an entire season.

The calculated bio-season mean peak abundances are presented in **Table 2-2** for the appropriate displacement effect areas recommended within the joint SNCBs Interim Displacement Advice Note (SNCBs, 2022). As per the joint SNCB Interim Displacement Advice Note (SNCBs, 2022), the full dataset of abundance estimates is provided in the **Appendix 13.2 Offshore Ornithology Baseline Characterisation report**, from which mean peak abundances have been derived. In addition, a clear methodology of the mean peak abundance calculation is provided in the Offshore and Intertidal Baseline Characterisation Report. The upper and lower 95% confidence limits for mean peak abundances are provided in **Appendix 2**.

**Table 2-2 Bio-season mean peak abundances in the DBD Array Area and DBD Array Area plus corresponding buffers (all behaviours)**

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Return Migration	DBD Array Area	N/A	957	N/A	N/A	N/A	63	61
	DBD Array Area plus 2km buffer	N/A	1,461	N/A	N/A	N/A	90	85
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Breeding	DBD Array Area	N/A	N/A	N/A	N/A	N/A	153	N/A
	DBD Array Area plus 2km buffer	N/A	N/A	N/A	N/A	N/A	211	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Post-breeding Migration	DBD Array Area	N/A	179	N/A	N/A	N/A	600	600
	DBD Array Area plus 2km buffer	N/A	282	N/A	N/A	N/A	813	813
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Winter	DBD Array Area	N/A	439	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 2km buffer	N/A	588	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Breeding	DBD Array Area	5,391	526	83	0	0	N/A	176
	DBD Array Area plus 2km buffer	6,872	749	111	N/A	N/A	N/A	217
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	0	0	N/A	N/A
Non-breeding	DBD Array Area	4,479	N/A	18	33	8	N/A	N/A
	DBD Array Area plus 2km buffer	7,406	N/A	24	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	53	14	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Annual total	DBD Array Area	9,870	2,101	101	33	8	815	836
	DBD Array Area plus 2km buffer	14,277	3,079	134	N/A	N/A	1,113	1,114
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	53	14	N/A	N/A

### *Export Cable Corridor*

GIS shapefiles of the Lawson *et al* (2016) density data for red-throated diver within Greater Wash SPA provide point counts in a grid layout spaced 1km apart. In order to calculate the mean density in the area of overlap with the ECC, all points within this overlap and their corresponding densities were averaged. All 51 density values are provided in **Appendix 1**. The Lawson *et al* (2016) data does not cover the entire area of overlap between the ECC and Greater Wash SPA boundary (see **Figure 2-2**). Mean density has been assumed for these data absent overlap areas to ensure a precautionary approach.

The mean density of red-throated diver surveyed in the Greater Wash with overlap to the DBD ECC plus 2km buffer is 0.25 birds per km<sup>2</sup>, whilst the maximum density 0.45 birds per km<sup>2</sup>. When applying a 2km buffer around the area of overlap between the DBD ECC and the Greater Wash SPA, the total area is 74.3km<sup>2</sup>. Therefore, the abundance estimate of red-throated diver at risk of displacement effects at any one time within the ECC is a mean of 19 (18.9) and a maximum of 33 (33.4) individuals during the wintering/ non-breeding bio-season. Displacement matrices for the ECC and buffer overlap for the mean and maximum abundance estimates are provided in **Table 3-25** and **Table 3-26**, respectively.

### 3. Results

#### *Array Area*

Displacement matrices are presented below for each of the six species. These include matrices for each bio-season as well as the annual total for each species. Each matrix uses the mean peak abundance estimates for each species in each bio-season to show the potential number of individuals subject to mortality if between 0 – 100% displacement and 0 – 100% mortality was to occur. Further increments of displacement rates and mortality rates are presented, providing a complete range of scenarios, which can be used to estimate number of individuals that potentially subject to mortality at varying rates. Additionally, colour coding has been provided to visually present both the Applicant's and SNCB (Natural England) preferred displacement and mortality rates for assessment. Corresponding literature sources used to inform likely displacement and consequent mortality rates are provided within **Volume 1, Chapter 13 Offshore and Intertidal Ornithology**.



### 3.1 Guillemot displacement matrices

**Table 3-1 Guillemot breeding displacement matrix (March - July) based on an abundance of 6,872 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	3	3	7	14	21	27	34	41	48	55	62	69
10	0	7	14	21	27	34	69	137	206	275	344	412	481	550	618	687
20	0	14	27	41	55	69	137	275	412	550	687	825	962	1,099	1,237	1,374
30	0	21	41	62	82	103	206	412	618	825	1,031	1,237	1,443	1,649	1,855	2,061
40	0	27	55	82	110	137	275	550	825	1,099	1,374	1,649	1,924	2,199	2,474	2,749
50	0	34	69	103	137	172	344	687	1,031	1,374	1,718	2,061	2,405	2,749	3,092	3,436
60	0	41	82	124	165	206	412	825	1,237	1,649	2,061	2,474	2,886	3,298	3,711	4,123
70	0	48	96	144	192	241	481	962	1,443	1,924	2,405	2,886	3,367	3,848	4,329	4,810
80	0	55	110	165	220	275	550	1,099	1,649	2,199	2,749	3,298	3,848	4,398	4,947	5,497
90	0	62	124	186	247	309	618	1,237	1,855	2,474	3,092	3,711	4,329	4,947	5,566	6,184
100	0	69	137	206	275	344	687	1,374	2,061	2,749	3,436	4,123	4,810	5,497	6,184	6,872

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-2 Guillemot non-breeding displacement matrix (August - February) based on an abundance of 7,406 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	3	4	7	15	22	30	37	44	52	59	67	74
10	0	7	15	22	30	37	74	148	222	296	370	444	518	592	666	741
20	0	15	30	44	59	74	148	296	444	592	741	889	1,037	1,185	1,333	1,481
30	0	22	44	67	89	111	222	444	666	889	1,111	1,333	1,555	1,777	1,999	2,222
40	0	30	59	89	118	148	296	592	889	1,185	1,481	1,777	2,074	2,370	2,666	2,962
50	0	37	74	111	148	185	370	741	1,111	1,481	1,851	2,222	2,592	2,962	3,332	3,703
60	0	44	89	133	178	222	444	889	1,333	1,777	2,222	2,666	3,110	3,555	3,999	4,443
70	0	52	104	156	207	259	518	1,037	1,555	2,074	2,592	3,110	3,629	4,147	4,665	5,184
80	0	59	118	178	237	296	592	1,185	1,777	2,370	2,962	3,555	4,147	4,740	5,332	5,924
90	0	67	133	200	267	333	666	1,333	1,999	2,666	3,332	3,999	4,665	5,332	5,998	6,665
100	0	74	148	222	296	370	741	1,481	2,222	2,962	3,703	4,443	5,184	5,924	6,665	7,406

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-3 Guillemot annual displacement matrix based on an abundance of 14,277 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	3	4	6	7	14	29	43	57	71	86	100	114	128	143
10	0	14	29	43	57	71	143	286	428	571	714	857	999	1,142	1,285	1,428
20	0	29	57	86	114	143	286	571	857	1,142	1,428	1,713	1,999	2,284	2,570	2,855
30	0	43	86	128	171	214	428	857	1,285	1,713	2,142	2,570	2,998	3,426	3,855	4,283
40	0	57	114	171	228	286	571	1,142	1,713	2,284	2,855	3,426	3,998	4,569	5,140	5,711
50	0	71	143	214	286	357	714	1,428	2,142	2,855	3,569	4,283	4,997	5,711	6,425	7,139
60	0	86	171	257	343	428	857	1,713	2,570	3,426	4,283	5,140	5,996	6,853	7,710	8,566
70	0	100	200	300	400	500	999	1,999	2,998	3,998	4,997	5,996	6,996	7,995	8,995	9,994
80	0	114	228	343	457	571	1,142	2,284	3,426	4,569	5,711	6,853	7,995	9,137	10,279	11,422
90	0	128	257	385	514	642	1,285	2,570	3,855	5,140	6,425	7,710	8,995	10,279	11,564	12,849
100	0	143	286	428	571	714	1,428	2,855	4,283	5,711	7,139	8,566	9,994	11,422	12,849	14,277

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

### 3.2 Razorbill displacement matrices

**Table 3-4 Razorbill return migration displacement matrix (January - March) based on an abundance of 1,461 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	1	1	3	4	6	7	9	10	12	13	15
10	0	1	3	4	6	7	15	29	44	58	73	88	102	117	131	146
20	0	3	6	9	12	15	29	58	88	117	146	175	205	234	263	292
30	0	4	9	13	18	22	44	88	131	175	219	263	307	351	394	438
40	0	6	12	18	23	29	58	117	175	234	292	351	409	468	526	584
50	0	7	15	22	29	37	73	146	219	292	365	438	511	584	657	731
60	0	9	18	26	35	44	88	175	263	351	438	526	614	701	789	877
70	0	10	20	31	41	51	102	205	307	409	511	614	716	818	920	1,023
80	0	12	23	35	47	58	117	234	351	468	584	701	818	935	1,052	1,169
90	0	13	26	39	53	66	131	263	394	526	657	789	920	1,052	1,183	1,315
100	0	15	29	44	58	73	146	292	438	584	731	877	1,023	1,169	1,315	1,461

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-5 Razorbill breeding displacement matrix (April - July) based on an abundance of 749 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	2	3	4	4	5	6	7	7
10	0	1	1	2	3	4	7	15	22	30	37	45	52	60	67	75
20	0	1	3	4	6	7	15	30	45	60	75	90	105	120	135	150
30	0	2	4	7	9	11	22	45	67	90	112	135	157	180	202	225
40	0	3	6	9	12	15	30	60	90	120	150	180	210	240	270	300
50	0	4	7	11	15	19	37	75	112	150	187	225	262	300	337	375
60	0	4	9	13	18	22	45	90	135	180	225	270	315	360	404	449
70	0	5	10	16	21	26	52	105	157	210	262	315	367	419	472	524
80	0	6	12	18	24	30	60	120	180	240	300	360	419	479	539	599
90	0	7	13	20	27	34	67	135	202	270	337	404	472	539	607	674
100	0	7	15	22	30	37	75	150	225	300	375	449	524	599	674	749

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-6 Razorbill post-breeding migration displacement matrix (August - October) based on an abundance of 282 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3
10	0	0	1	1	1	1	3	6	8	11	14	17	20	23	25	28
20	0	1	1	2	2	3	6	11	17	23	28	34	39	45	51	56
30	0	1	2	3	3	4	8	17	25	34	42	51	59	68	76	85
40	0	1	2	3	5	6	11	23	34	45	56	68	79	90	102	113
50	0	1	3	4	6	7	14	28	42	56	71	85	99	113	127	141
60	0	2	3	5	7	8	17	34	51	68	85	102	118	135	152	169
70	0	2	4	6	8	10	20	39	59	79	99	118	138	158	178	197
80	0	2	5	7	9	11	23	45	68	90	113	135	158	180	203	226
90	0	3	5	8	10	13	25	51	76	102	127	152	178	203	228	254
100	0	3	6	8	11	14	28	56	85	113	141	169	197	226	254	282

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-7 Razorbill migration-free winter displacement matrix (November - December) based on an abundance of 588 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	2	2	3	4	4	5	5	6
10	0	1	1	2	2	3	6	12	18	24	29	35	41	47	53	59
20	0	1	2	4	5	6	12	24	35	47	59	71	82	94	106	118
30	0	2	4	5	7	9	18	35	53	71	88	106	123	141	159	176
40	0	2	5	7	9	12	24	47	71	94	118	141	165	188	212	235
50	0	3	6	9	12	15	29	59	88	118	147	176	206	235	265	294
60	0	4	7	11	14	18	35	71	106	141	176	212	247	282	318	353
70	0	4	8	12	16	21	41	82	123	165	206	247	288	329	370	412
80	0	5	9	14	19	24	47	94	141	188	235	282	329	376	423	470
90	0	5	11	16	21	26	53	106	159	212	265	318	370	423	476	529
100	0	6	12	18	24	29	59	118	176	235	294	353	412	470	529	588

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-8 Razorbill annual displacement matrix based on an abundance of 3,079 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	2	3	6	9	12	15	18	22	25	28	31
10	0	3	6	9	12	15	31	62	92	123	154	185	216	246	277	308
20	0	6	12	18	25	31	62	123	185	246	308	369	431	493	554	616
30	0	9	18	28	37	46	92	185	277	369	462	554	647	739	831	924
40	0	12	25	37	49	62	123	246	369	493	616	739	862	985	1,108	1,232
50	0	15	31	46	62	77	154	308	462	616	770	924	1,078	1,232	1,386	1,540
60	0	18	37	55	74	92	185	369	554	739	924	1,108	1,293	1,478	1,663	1,847
70	0	22	43	65	86	108	216	431	647	862	1,078	1,293	1,509	1,724	1,940	2,155
80	0	25	49	74	99	123	246	493	739	985	1,232	1,478	1,724	1,971	2,217	2,463
90	0	28	55	83	111	139	277	554	831	1,108	1,386	1,663	1,940	2,217	2,494	2,771
100	0	31	62	92	123	154	308	616	924	1,232	1,540	1,847	2,155	2,463	2,771	3,079

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.



### 3.3 Puffin displacement matrices

**Table 3-9 Puffin breeding displacement matrix (April - July) based on an abundance of 111 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
20	0	0	0	1	1	1	2	4	7	9	11	13	16	18	20	22
30	0	0	1	1	1	2	3	7	10	13	17	20	23	27	30	33
40	0	0	1	1	2	2	4	9	13	18	22	27	31	36	40	44
50	0	1	1	2	2	3	6	11	17	22	28	33	39	44	50	56
60	0	1	1	2	3	3	7	13	20	27	33	40	47	53	60	67
70	0	1	2	2	3	4	8	16	23	31	39	47	54	62	70	78
80	0	1	2	3	4	4	9	18	27	36	44	53	62	71	80	89
90	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
100	0	1	2	3	4	6	11	22	33	44	56	67	78	89	100	111

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-10 Puffin non-breeding displacement matrix (August - March) based on an abundance of 24 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5
20	0	0	0	0	0	0	1	2	3	4	5	6	7	8	8	9
30	0	0	0	0	1	1	1	3	4	6	7	8	10	11	13	14
40	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
50	0	0	0	0	0	1	1	2	4	5	6	7	8	10	11	12
60	0	0	0	0	1	1	1	3	4	6	7	9	10	12	13	14
70	0	0	0	1	1	1	2	3	5	7	8	10	12	13	15	17
80	0	0	0	1	1	1	2	4	6	8	10	12	13	15	17	19
90	0	0	0	1	1	1	2	4	6	9	11	13	15	17	19	22
100	0	0	0	1	1	1	2	5	7	10	12	14	17	19	22	24

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-11 Puffin annual displacement matrix based on an abundance of 134 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
10	0	0	0	0	1	1	1	3	4	5	7	8	9	11	12	13
20	0	0	1	1	1	1	3	5	8	11	13	16	19	21	24	27
30	0	0	1	1	2	2	4	8	12	16	20	24	28	32	36	40
40	0	1	1	2	2	3	5	11	16	21	27	32	38	43	48	54
50	0	1	1	2	3	3	7	13	20	27	34	40	47	54	60	67
60	0	1	2	2	3	4	8	16	24	32	40	48	56	64	72	80
70	0	1	2	3	4	5	9	19	28	38	47	56	66	75	84	94
80	0	1	2	3	4	5	11	21	32	43	54	64	75	86	96	107
90	0	1	2	4	5	6	12	24	36	48	60	72	84	96	109	121
100	0	1	3	4	5	7	13	27	40	54	67	80	94	107	121	134

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (30% - 70% displacement and 1% - 10% mortality). Cells highlighted purple provide the Applicant's preferred range for displacement and mortality rates (up to 50% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

### 3.4 Great northern diver displacement matrices

**Table 3-12 Great northern diver non-breeding displacement matrix (September - May) based on an abundance of 53 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
10	0	0	0	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	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	1	1	1	2	4	6	8	11	13	15	17	19	21
50	0	0	1	1	1	1	3	5	8	11	13	16	19	21	24	27
60	0	0	1	1	1	2	3	6	10	13	16	19	22	25	29	32
70	0	0	1	1	1	2	4	7	11	15	19	22	26	30	33	37
80	0	0	1	1	2	2	4	8	13	17	21	25	30	34	38	42
90	0	0	1	1	2	2	5	10	14	19	24	29	33	38	43	48
100	0	1	1	2	2	3	5	11	16	21	27	32	37	42	48	53

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-13 Great northern diver breeding displacement matrix (June - August) based on an abundance of 0 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	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	0	0	0
30	0	0	0	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	0	0	0
50	0	0	0	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	0	0	0
70	0	0	0	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	0	0	0
90	0	0	0	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	0	0	0

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-14 Great northern diver annual displacement matrix based on an abundance of 53 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
10	0	0	0	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	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	1	1	1	2	4	6	8	11	13	15	17	19	21
50	0	0	1	1	1	1	3	5	8	11	13	16	19	21	24	27
60	0	0	1	1	1	2	3	6	10	13	16	19	22	25	29	32
70	0	0	1	1	1	2	4	7	11	15	19	22	26	30	33	37
80	0	0	1	1	2	2	4	8	13	17	21	25	30	34	38	42
90	0	0	1	1	2	2	5	10	14	19	24	29	33	38	43	48
100	0	1	1	2	2	3	5	11	16	21	27	32	37	42	48	53

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

### 3.5 White-billed diver displacement matrices

**Table 3-15 White-billed diver non-breeding displacement matrix (September - May) based on an abundance of 14 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	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	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5	6
50	0	0	0	0	0	0	1	1	2	3	4	4	5	6	6	7
60	0	0	0	0	0	0	1	2	3	3	4	5	6	7	8	8
70	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
80	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
90	0	0	0	0	1	1	1	3	4	5	6	8	9	10	11	13
100	0	0	0	0	1	1	1	3	4	6	7	8	10	11	13	14

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-16 White-billed diver breeding displacement matrix (June - August) based on an abundance of 0 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	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	0	0	0
30	0	0	0	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	0	0	0
50	0	0	0	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	0	0	0
70	0	0	0	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	0	0	0
90	0	0	0	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	0	0	0

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.



**Table 3-17 White-billed diver annual displacement matrix based on an abundance of 14 individuals for DBD Array Area plus 4km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	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	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5	6
50	0	0	0	0	0	0	1	1	2	3	4	4	5	6	6	7
60	0	0	0	0	0	0	1	2	3	3	4	5	6	7	8	8
70	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
80	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
90	0	0	0	0	1	1	1	3	4	5	6	8	9	10	11	13
100	0	0	0	0	1	1	1	3	4	6	7	8	10	11	13	14

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

### 3.6 Gannet displacement matrices

**Table 3-18 Gannet return migration displacement matrix (December - March) based on an abundance of 90 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
10	0	0	0	0	0	0	1	2	3	4	5	5	6	7	8	9
20	0	0	0	1	1	1	2	4	5	7	9	11	13	14	16	18
30	0	0	1	1	1	1	3	5	8	11	14	16	19	22	24	27
40	0	0	1	1	1	2	4	7	11	14	18	22	25	29	32	36
50	0	0	1	1	2	2	5	9	14	18	23	27	32	36	41	45
60	0	1	1	2	2	3	5	11	16	22	27	32	38	43	49	54
70	0	1	1	2	3	3	6	13	19	25	32	38	44	50	57	63
80	0	1	1	2	3	4	7	14	22	29	36	43	50	58	65	72
90	0	1	2	2	3	4	8	16	24	32	41	49	57	65	73	81
100	0	1	2	3	4	5	9	18	27	36	45	54	63	72	81	90

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-19 Gannet return migration displacement matrix (December - February) based on an abundance of 85 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
10	0	0	0	0	0	0	1	2	3	3	4	5	6	7	8	9
20	0	0	0	1	1	1	2	3	5	7	9	10	12	14	15	17
30	0	0	1	1	1	1	3	5	8	10	13	15	18	20	23	26
40	0	0	1	1	1	2	3	7	10	14	17	20	24	27	31	34
50	0	0	1	1	2	2	4	9	13	17	21	26	30	34	38	43
60	0	1	1	2	2	3	5	10	15	20	26	31	36	41	46	51
70	0	1	1	2	2	3	6	12	18	24	30	36	42	48	54	60
80	0	1	1	2	3	3	7	14	20	27	34	41	48	54	61	68
90	0	1	2	2	3	4	8	15	23	31	38	46	54	61	69	77
100	0	1	2	3	3	4	9	17	26	34	43	51	60	68	77	85

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-20 Gannet migration-free breeding displacement matrix (April - August) based on an abundance of 211 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	0	1	1	1	2	4	6	8	11	13	15	17	19	21
20	0	0	1	1	2	2	4	8	13	17	21	25	30	34	38	42
30	0	1	1	2	3	3	6	13	19	25	32	38	44	51	57	63
40	0	1	2	3	3	4	8	17	25	34	42	51	59	68	76	84
50	0	1	2	3	4	5	11	21	32	42	53	63	74	84	95	106
60	0	1	3	4	5	6	13	25	38	51	63	76	89	101	114	127
70	0	1	3	4	6	7	15	30	44	59	74	89	103	118	133	148
80	0	2	3	5	7	8	17	34	51	68	84	101	118	135	152	169
90	0	2	4	6	8	9	19	38	57	76	95	114	133	152	171	190
100	0	2	4	6	8	11	21	42	63	84	106	127	148	169	190	211

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-21 Gannet breeding displacement matrix (March - September) based on an abundance of 217 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	4	7	9	11	13	15	17	20	22
20	0	0	1	1	2	2	4	9	13	17	22	26	30	35	39	43
30	0	1	1	2	3	3	7	13	20	26	33	39	46	52	59	65
40	0	1	2	3	3	4	9	17	26	35	43	52	61	69	78	87
50	0	1	2	3	4	5	11	22	33	43	54	65	76	87	98	109
60	0	1	3	4	5	7	13	26	39	52	65	78	91	104	117	130
70	0	2	3	5	6	8	15	30	46	61	76	91	106	122	137	152
80	0	2	3	5	7	9	17	35	52	69	87	104	122	139	156	174
90	0	2	4	6	8	10	20	39	59	78	98	117	137	156	176	195
100	0	2	4	7	9	11	22	43	65	87	109	130	152	174	195	217

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-22 Gannet post-breeding migration displacement matrix (September – November / October – November) based on an abundance of 813 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	2	2	3	4	5	6	7	7	8
10	0	1	2	2	3	4	8	16	24	33	41	49	57	65	73	81
20	0	2	3	5	7	8	16	33	49	65	81	98	114	130	146	163
30	0	2	5	7	10	12	24	49	73	98	122	146	171	195	220	244
40	0	3	7	10	13	16	33	65	98	130	163	195	228	260	293	325
50	0	4	8	12	16	20	41	81	122	163	203	244	285	325	366	407
60	0	5	10	15	20	24	49	98	146	195	244	293	341	390	439	488
70	0	6	11	17	23	28	57	114	171	228	285	341	398	455	512	569
80	0	7	13	20	26	33	65	130	195	260	325	390	455	520	585	650
90	0	7	15	22	29	37	73	146	220	293	366	439	512	585	659	732
100	0	8	16	24	33	41	81	163	244	325	407	488	569	650	732	813

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-23 Gannet annual displacement matrix (when considering the migration free-breeding bio-season) based on an abundance of 1,113 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
10	0	1	2	3	4	6	11	22	33	45	56	67	78	89	100	111
20	0	2	4	7	9	11	22	45	67	89	111	134	156	178	200	223
30	0	3	7	10	13	17	33	67	100	134	167	200	234	267	301	334
40	0	4	9	13	18	22	45	89	134	178	223	267	312	356	401	445
50	0	6	11	17	22	28	56	111	167	223	278	334	390	445	501	557
60	0	7	13	20	27	33	67	134	200	267	334	401	467	534	601	668
70	0	8	16	23	31	39	78	156	234	312	390	467	545	623	701	779
80	0	9	18	27	36	45	89	178	267	356	445	534	623	712	801	890
90	0	10	20	30	40	50	100	200	301	401	501	601	701	801	902	1,002
100	0	11	22	33	45	56	111	223	334	445	557	668	779	890	1,002	1,113

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-24 Gannet annual displacement matrix (when considering the breeding bio-season) based on an abundance of 1,114 individuals for DBD Array Area plus 2km asymmetrical buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
10	0	1	2	3	4	6	11	22	33	45	56	67	78	89	100	111
20	0	2	4	7	9	11	22	45	67	89	111	134	156	178	201	223
30	0	3	7	10	13	17	33	67	100	134	167	201	234	267	301	334
40	0	4	9	13	18	22	45	89	134	178	223	267	312	356	401	446
50	0	6	11	17	22	28	56	111	167	223	279	334	390	446	501	557
60	0	7	13	20	27	33	67	134	201	267	334	401	468	535	602	668
70	0	8	16	23	31	39	78	156	234	312	390	468	546	624	702	780
80	0	9	18	27	36	45	89	178	267	356	446	535	624	713	802	891
90	0	10	20	30	40	50	100	201	301	401	501	602	702	802	902	1,003
100	0	11	22	33	45	56	111	223	334	446	557	668	780	891	1,003	1,114

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (60% - 80% displacement and 1 - 10% mortality). Cells highlighted purple show the Applicant's preferred range for displacement and mortality rates (60% - 80% displacement and up to 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.



## Export Cable Corridor

### 3.7 Red-throated diver displacement matrices

**Table 3-25 Red-throated diver winter season displacement matrix based on a mean abundance of 19 individuals for DBD ECC overlap with Greater Wash SPA plus 2km buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
20	0	0	0	0	0	0	0	1	1	2	2	2	3	3	3	4
30	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6
40	0	0	0	0	0	0	1	2	2	3	4	5	5	6	7	8
50	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
60	0	0	0	0	0	1	1	2	3	5	6	7	8	9	10	11
70	0	0	0	0	1	1	1	3	4	5	7	8	9	11	12	13
80	0	0	0	0	1	1	2	3	5	6	8	9	11	12	14	15
90	0	0	0	1	1	1	2	3	5	7	9	10	12	14	15	17
100	0	0	0	1	1	1	2	4	6	8	10	11	13	15	17	19

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

**Table 3-26 Red-throated diver winter season displacement matrix based on a maximum abundance of 33 individuals for DBD ECC overlap with Greater Wash SPA plus 2km buffer**

Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3
20	0	0	0	0	0	0	1	1	2	3	3	4	5	5	6	7
30	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10
40	0	0	0	0	1	1	1	3	4	5	7	8	9	11	12	13
50	0	0	0	0	1	1	2	3	5	7	8	10	12	13	15	17
60	0	0	0	1	1	1	2	4	6	8	10	12	14	16	18	20
70	0	0	0	1	1	1	2	5	7	9	12	14	16	18	21	23
80	0	0	1	1	1	1	3	5	8	11	13	16	18	21	24	26
90	0	0	1	1	1	1	3	6	9	12	15	18	21	24	27	30
100	0	0	1	1	1	2	3	7	10	13	17	20	23	26	30	33

Table Note: Cells highlighted in orange shows the SNCB preferred range of displacement and mortality (90% - 100% displacement and 1 - 10% mortality). Cells highlighted purple show the upper and lower range of the Applicant's preferred approach for displacement and mortality rates (90% - 100% displacement and up to a 1% mortality). Cells in green highlight area of overlap between the SNCB and Applicant preferred rates.

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## Appendix 1 Red-throated diver densities in area of overlap between ECC and Greater Wash SPA

Point	Density
1	0.093782
2	0.143004
3	0.195336
4	0.239636
5	0.264247
6	0.261916
7	0.234196
8	0.189377
9	0.138859
10	0.192577
11	0.215991
12	0.224147
13	0.216415
14	0.195564
15	0.166398
16	0.134066
17	0.102966
18	0.075635
19	0.053371
20	0.220655
21	0.252824
22	0.270023
23	0.270376
24	0.255103
25	0.228151
26	0.194161
27	0.157838
28	0.122891
29	0.242979
30	0.284514
31	0.312962
32	0.325078
33	0.320424
34	0.300663
35	0.269525
36	0.230998
37	0.261552
38	0.311991
39	0.352185
40	0.378219
41	0.387635

42	0.379894
43	0.356512
44	0.278431
45	0.336287
46	0.387012
47	0.426354
48	0.450832
49	0.293952
50	0.357089
51	0.415325

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## Appendix 2 Means of 95% confidence limits for abundance

The mean of the upper and lower 95% confidence limits for the mean peak abundances presented in **Table 2-2** are presented below for each species. Mean peak abundances are calculated by averaging the highest (peak) monthly value within a bio-season each year (full methods are provided in **Section 2.3.7** of **Appendix 13.2 Offshore Ornithology Baseline Characterisation**). To derive the upper and lower 95% confidence limits for the mean peak abundances, the upper and lower confidence limits for each peak abundance estimate are used.

For example, if in the non-breeding bio-season the peak count was in January of the first year and February of the second year, then the upper and lower confidence limits for those same months were used when calculating the mean. So the upper confidence limits for January and February would be averaged and the lower values would be averaged. This would provide a mean of the upper and lower confidence limit for the mean peak abundance.

Bio-season means of lower 95% confidence limit for abundance in the DBD Array Area and DBD Array Area plus corresponding buffers (all behaviours)

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Return Migration	DBD Array Area	N/A	283	N/A	N/A	N/A	13	12
	DBD Array Area plus 2km buffer	N/A	509	N/A	N/A	N/A	38	32
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Breeding	DBD Array Area	N/A	N/A	N/A	N/A	N/A	30	N/A
	DBD Array Area plus 2km buffer	N/A	N/A	N/A	N/A	N/A	55	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A



Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Post-breeding Migration	DBD Array Area	N/A	66	N/A	N/A	N/A	228	228
	DBD Array Area plus 2km buffer	N/A	113	N/A	N/A	N/A	344	344
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Winter	DBD Array Area	N/A	194	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 2km buffer	N/A	316	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Breeding	DBD Array Area	1,531	235	34	0	0	N/A	35
	DBD Array Area plus 2km buffer	2,851	485	46	N/A	N/A	N/A	63
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	0	0	N/A	N/A
Non-breeding	DBD Array Area	2,977	N/A	4	7	3	N/A	N/A
	DBD Array Area plus 2km buffer	4,873	N/A	5	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	17	3	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Annual total	DBD Array Area	4,508	778	38	7	3	271	275
	DBD Array Area plus 2km buffer	7,724	1,421	50	N/A	N/A	437	438
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	17	3	N/A	N/A

Bio-season means of upper 95% confidence limit for abundance in the DBD Array Area and DBD Array Area plus corresponding buffers (all behaviours)

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Return Migration	DBD Array Area	N/A	1,781	N/A	N/A	N/A	13	12
	DBD Array Area plus 2km buffer	N/A	2,708	N/A	N/A	N/A	38	33
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Breeding	DBD Array Area	N/A	N/A	N/A	N/A	N/A	30	N/A
	DBD Array Area plus 2km buffer	N/A	N/A	N/A	N/A	N/A	55	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Post-breeding Migration	DBD Array Area	N/A	331	N/A	N/A	N/A	228	228
	DBD Array Area plus 2km buffer	N/A	492	N/A	N/A	N/A	344	344
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Migration-free Winter	DBD Array Area	N/A	710	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 2km buffer	N/A	921	N/A	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Breeding	DBD Array Area	11,130	854	146	0	0	N/A	35
	DBD Array Area plus 2km buffer	12,472	1,029	194	N/A	N/A	N/A	63
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	0	0	N/A	N/A
Non-breeding	DBD Array Area	6,117	N/A	39	71	17	N/A	N/A
	DBD Array Area plus 2km buffer	10,151	N/A	48	N/A	N/A	N/A	N/A
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	93	25	N/A	N/A

Bio-season	Mean Peak Abundance							
	Survey Area	Guillemot	Razorbill	Puffin	Great northern diver	White-billed diver	Gannet (migration-free breeding scenario)	Gannet (full breeding season scenario)
Annual total	DBD Array Area	17,247	3,675	185	71	17	1,489	1,544
	DBD Array Area plus 2km buffer	22,622	5,149	242	N/A	N/A	1,909	1,918
	DBD Array Area plus 4km buffer	N/A	N/A	N/A	93	25	N/A	N/A