# RWE Renewables UK Dogger Bank South (West) Limited

# RWE Renewables UK Dogger Bank South (East) Limited

# Dogger Bank South Offshore Wind Farms

**Report to Inform Appropriate Assessment**

**Habitats Regulations Assessment**

**Volume 6**

**Part 4 of 4 – Marine Ornithological Features**

**June 2024**

**Application Reference: 6.1**

**APFP Regulation: 5(2)(g)**

**Revision: 02**

Unrestricted

| | | | |
|---|---|---|---|
| Company: | **RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited** | Asset: | **Development** |
| Project: | **Dogger Bank South Offshore Wind Farms** | Sub Project/Package: | **Consents** |
| Document Title or Description: | Report to Inform Appropriate Assessment<br>Habitats Regulations Assessment – Part 4 of 4 - Marine Ornithological Features | | |
| Document Number: | 004300178-01 | Contractor Reference Number: | PC2340-RHD-ZZ-ZZ-RP-Z-0137 |



| Rev No. | Date | Status/Reason for Issue | Author | Checked by | Approved by |
|---|---|---|---|---|---|
| 01 | February 2024 | Draft for PINS / TCE Submission | RHDHV | RWE | RWE |
| 02 | June 2024 | Final for DCO Application | RHDHV | RWE | RWE |

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## Glossary

| Term | Definition |
|---|---|
| Array Areas | The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables will be located. The Array Areas do not include the Offshore Export Cable Corridor or the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area. |
| Array cables | Offshore cables which link the wind turbines to the Offshore Converter Platform(s). |
| Collision | The act or process of colliding (crashing) between two moving objects. |
| Collision Risk Model (CRM) | Quantitative means to estimate the number of predicted collisions between seabirds recorded in the Array Areas and rotating wind turbines. |
| Concurrent Scenario | A potential construction scenario for the Projects where DBS East and DBS West are both constructed at the same time. |
| Cumulative effects | The combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource. |
| Cumulative Effects Assessment (CEA) | The assessment of the combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource. |
| Cumulative impact | The combined impact of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource. |
| Development Consent Order (DCO) | An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP). |
| Development Scenario | Description of how the DBS East and/or DBS West Projects would be constructed either in-isolation, sequentially or concurrently. |
| Dogger Bank South (DBS) Offshore Wind Farms | The collective name for the two Projects, DBS East and DBS West. |

| Term | Definition |
|---|---|
| Effect | Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the value, or sensitivity, of the receptor or resource in accordance with defined significance criteria. |
| Electrical Switching Platform (ESP) | The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area. |
| Environmental Impact Assessment (EIA) | A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES). |
| Environmental Statement (ES) | A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations. |
| Evidence Plan Process (EPP) | A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics. |
| Expert Topic Group (ETG) | A forum for targeted engagement with regulators and interested stakeholders through the EPP. |
| Export Cable Platform Search Area | The Export Cable Platform Search Area is located mid-way along the Offshore Export Cable Corridor and is the area of search for the Electrical Switching Platform (ESP). |
| Habitats Regulations | Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017. |
| Habitats Regulations Assessment (HRA) | The process that determines whether or not a plan or project many have an adverse effect on the integrity of a European Site or European Offshore Marine Site. |

| Term | Definition |
|---|---|
| Impact | Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise. |
| In Isolation Scenario | A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation. |
| Inter-Platform Cable Corridor | The area where Inter-Platform Cables would route between platforms within the DBS East and DBS West Array Areas, should both Projects be constructed. |
| Inter-Platform Cables | Buried offshore cables which link offshore platforms. |
| Intertidal | Area on a shore that lies between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS). |
| Landfall | The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water. |
| Mean Sea Level | The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events. |
| National Site Network | The National Site Network comprises National Site Network sites (formerly referred to as European) in the UK that already existed (i.e., were established under the Nature Directives) on 31 December 2020 (or proposed to the EC before that date) and any new sites designated under the Habitats Regulations under an amended designation process. |
| National Site Network sites | Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017. |

| Term | Definition |
|---|---|
| Offshore Development Area | The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones. |
| Offshore Export Cable Corridor | This is the area which will contain the Offshore Export Cables (and potentially the ESP) between the offshore substation / converter platforms and Transition Joint Bays at the landfall. |
| Offshore Export Cables | The cables which would bring electricity from the offshore platforms to the Transition Joint Bays (TJBs). |
| Projects Design (or Rochdale) Envelope | A concept that ensures the EIA is based on assessing the realistic worst-case scenario where flexibility or a range of options is sought as part of the consent application. |
| Sequential Scenario | A potential construction scenario for the Projects where DBS East and DBS West are constructed with a lag between the commencement of construction activities. Either Project could be built first. |
| Special Protection Area (SPA) | Strictly protected sites designated pursuant to Article 4 of the Birds Directive (via the Habitats Regulations) for species listed on Annex I of the Directive and for regularly occurring migratory species |
| The Applicants | The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake). |
| The Projects | DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms). |
| Wind turbine | Power generating device that is driven by the kinetic energy of the wind. |

## Acronyms

| Term | Definition |
|---|---|
| AEoI | Adverse Effect on [Site] Integrity |
| CGR | Counterfactuals of Growth Rate |
| CRM | Collision Risk Modelling |
| DBS | Dogger Bank South |
| DCO | Development Consent Order |
| EIA | Environmental Impact Assessment |
| ES | Environmental Statement |
| ESP | Electrical Switching Platform |
| FFC | Flamborough and Filey Coast |
| HVAC | High Voltage Alternating Current |
| HVDC | High Voltage Direct Current |
| MCA | Maximum Curvature Analysis |
| PCH | Potential Collision Height |
| PVA | Population Viability Analyses |
| RIAA | Report to Inform Appropriate Assessment |
| SPA | Special Protection Area |

# 9 Sites Designated for Marine Ornithological Features

## 9.1 Approach to Assessment

1. The assessment of predicted impacts from the Projects alone on the qualifying features of Special Protection Areas (SPAs) draws on the impact assessment completed for the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**). Species assessed for impacts are those which were recorded during baseline aerial surveys and which are considered to be at potential risk either due to their abundance, potential sensitivity to wind farm impacts or due to biological characteristics which make them potentially susceptible (e.g. the species commonly flies at rotor heights).

2. Estimates of predicted collisions and predicted displacement impacts from the Environmental Impact Assessment were used as the basis for the assessment of impacts on the qualifying feature of SPAs in this report. These were then apportioned to demographic unit (i.e. breeding adult population size) and appropriate SPA as described in section 9.1.5.

3. Impacts from the different pathways, seasons and other reasonably foreseeable plans and projects were collated to provide a single, reasonable worst case, predicted impact. Where this impact was of a sufficiently high level (e.g. the increase in background mortality was estimated to be >1%), Population Viability Analyses (PVA) was undertaken to understand in more detail the potential impact on the population of the relevant SPA qualifying feature.

4. If the increase in background mortality for a particular feature was less than 1% then it has been concluded there is no risk of an Adverse Effect on Site Integrity (AEoI). Where the increase was greater than 1% and a PVA has been used, the counterfactual metrics (of population growth rate and population size) have been considered with respect to population trends (where available) to determine whether the effect on the feature population could result in an AEoI. Both forms of assessment (the 1% mortality test and PVA) have been conducted for Project alone, and in-combination effects (with other reasonably foreseeable plans and projects).

5. The assessment of potential impacts used in this report follows Natural England (Parker *et al*. 2022) guidance and specific advice provided though consultation on the Project.

### 9.1.1 Collision risk

6. Collision risk modelling (CRM) results from the EIA were used to inform the Report to Inform Appropriate Assessment (RIAA), these results have been used to produce predictions of mortality for key seabird species at risk of collision across biological seasons and annually (refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12), Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)**).

7. The assessment is based on collision risk predictions obtained using the Band CRM Option 2. This option uses generic estimates of flight height for each species based on the percentage of birds flying at Potential Collision Height (PCH) derived from data from a number of offshore array areas, presented in Johnston *et al*. (2014).

8. As with the EIA, the assessment was based on the results from outputs of the stochastic Band model (Band, 2012; Caneco *et al*. 2022), incorporating uncertainty in flight densities, flight height, bird dimensions (wingspan, body length, flight speed), avoidance rates and nocturnal activity. Input parameters used for the CRM were those advised by Natural England (**Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)**); and proportions at collision height (based on the generic dataset in Johnston *et al*. 2014).

9. For all species scoped into the EIA, the worst-case collision risk design was identified as being the 200 small wind turbines (100 in each of DBS East and DBS West) scenario (see turbine parameter set 1, **Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)** and section 2.1.2 of this report for further details regarding wind turbine parameters and definitions). This turbine scenario was also used for the RIAA.

10. The predicted collisions per season in relation to worst case design scenario for each species that were qualifying features of SPAs requiring assessment are summarised in **Table 9-1**.

*Table 9-1 Total Seasonal Collision Risk Estimates for the Worst Case Scenario Wind Turbine (the 200 Small wind turbines scenario) for all birds. Values are the Mean Number of Predicted Collisions and 95% Confidence Intervals Derived From 5,000 stochastic simulations.*

| Species | Array | Breeding season | Autumn migration | Non-breeding/ Winter | Spring Migration | Annual |
|---|---|---|---|---|---|---|
| Gannet | East | 3.44 (0.76-7.78) | 1.61 (0.34-3.81) | 0 (0-0) | 0.11 (0-0.55) | 5.16 (1.15-11.44) |
| | West | 4.81 (1.02-11.39) | 2.11 (0.31-5.92) | 0 (0-0) | 0.14 (0-0.63) | 7.06 (1.37-17.77) |
| | East+West | 8.25 (2.71-16.09) | 3.72 (1.12-8.13) | 0 (0-0) | 0.25 (0-0.88) | 12.22 (3.97-24.48) |
| Great black-backed gull | East | 0.92 (0-4.42) | 0.33 (0-2.05) | 2.76 (0-7.66) | 2.43 (0-7.35) | 3.68 (0.58-9.83) |
| | West | 0 (0-0) | 0.82 (0-3.81) | 1.16 (0-4.92) | 0.34 (0-1.99) | 1.16 (0-4.92) |
| | East+West | 0.92 (0-4.42) | 1.15 (0-4.43) | 3.92 (0-9.76) | 2.77 (0-7.95) | 4.84 (0.74-11.5) |
| Herring gull | East | 0 (0-0) | 0.29 (0-1.79) | 0.57 (0-2.08) | 0.28 (0-1.78) | 0.57 (0-2.08) |
| | West | 0.76 (0-2.62) | 0.55 (0-2.72) | 0.85 (0-2.81) | 0.3 (0-1.82) | 1.61 (0-4.22) |
| | East+West | 0.76 (0-2.62) | 0.84 (0-3.26) | 1.42 (0-3.78) | 0.58 (0-2.43) | 2.18 (0-5.18) |
| Kittiwake | East | 83.31 (42.28-168.51) | 41.39 (14.65-82.93) | 0 (0-0) | 14.59 (6.83-28.02) | 139.3 (66.87-261.27) |
| | West | 107.83 (36.94-280.76) | 37.92 (9.54-81.91) | 0 (0-0) | 14.88 (7.07-26.47) | 160.64 (55.88-372.05) |
| | East+West | 191.14 (96.22-378.38) | 79.32 (30.47-143.14) | 0 (0-0) | 29.48 (16.89-47.35) | 299.94 (150.92-540.51) |
| Lesser black-backed gull | East | 0.93 (0-3.82) | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0.93 (0-3.82) |
| | West | 0.28 (0-1.7) | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0.28 (0-1.7) |
| | East+West | 1.21 (0-4.37) | 0 (0-0) | 0 (0-0) | 0 (0-0) | 1.21 (0-4.37) |

### 9.1.2 Displacement

11. The recommended SNCB (2022) matrix approach was used to calculate the predicted number of birds that would be killed as a result of being displaced from DBS East and DBS West and a suitable buffer area around it. The buffer area can vary between species: for divers, the assessment used all data recorded within the 4km buffer, for all other species the assessment used all data recorded within the 2km buffer.

12. It is important to note that the seasonal total for the sum of DBS East and DBS West may not be the sum of the seasonal peak on each individual site since the peak may have occurred in different months within any given season. The combined (DBS East + DBS West) seasonal peak was estimated as the highest of the summed monthly values (e.g. the highest breeding season value might have been recorded in May on DBS East and July in DBS West, but the highest sum across both sites could have been recorded in June). Using the approach avoids double counting.

13. The matrix approach uses the range of predicted losses, in association with the scientific evidence available from post-construction monitoring studies, to quantify the level of displacement and the potential losses as a consequence of the Projects. These losses are then placed in the context of the relevant population (e.g. SPA or BDMPS) to determine the magnitude of impact.

14. The matrix approach was used in the EIA to provide an estimate of the total impact on birds of all ages occurring within the Projects and 2 km buffer (4km for divers; **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12), Volume 7, Appendix 12-12 – Displacement matrices for upper/lower 95% confidence interval abundance estimates (application ref: 7.12.12.12)**). Predicted impacts on relevant species at risk of displacement that were recorded in DBS East and DBS West (plus 2km buffer) during baseline surveys are summarised in **Table 9-2** and for operational impacts in **Table 9-3**.

15. Construction displacement impacts resulting from construction vessels plus 50% installed turbines (i.e. the worst case scenario) has been assessed in the RIAA. Additional breakdown of construction displacement impacts from construction vessels or 50% installed turbines has been presented in **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**.

*Table 9-2 Construction Seasonal Displacement Mortality in the Array Areas (construction vessels plus 50% installed turbines). Impact for birds of all ages. Values are the Maximum displacement mortality in the Project and 2km buffer and evidence based rates for auks (from MacArthur Green 2019).*

| Species | Array | Breeding season | Autumn migration | Non-breeding/ Winter | Spring Migration | Annual |
|---|---|---|---|---|---|---|
| Gannet (80% displaced + 1% mortality) | East | 3.56 | 3.57 | - | 0.56 | 7.69 |
| | West | 3.58 | 3.58 | - | 0.56 | 8.22 |
| | East+West | 6.64 | 7.65 | - | 0.62 | 14.41 |
| Guillemot (70% displaced + 10% mortality) | East | 382.7 | - | 532.3 | - | 915 |
| | West | 371.3 | - | 528.2 | - | 899.5 |
| | East+West | 653 | - | 888.5 | - | 1541 |
| Guillemot (50% displaced + 1% mortality) | East | 27.3 | - | 38.0 | - | 65.4 |
| | West | 26.5 | - | 37.7 | - | 64.3 |
| | East+West | 46.6 | - | 63.5 | - | 110.1 |
| Puffin (70% displaced + 10% mortality) | East | 2.5 | - | 7.8 | - | 10.3 |
| | West | 4.8 | - | 8.4 | - | 12.7 |
| | East+West | 6.3 | - | 15.7 | - | 22 |
| Puffin (50% displaced + 1% mortality) | East | 0.2 | - | 0.6 | - | 0.7 |
| | West | 0.3 | - | 0.6 | - | 0.9 |
| | East+West | 0.5 | - | 1.1 | - | 1.6 |
| Razorbill (70% displaced + 10% mortality) | East | 23.6 | 198.6 | 142.9 | 152 | 517.1 |
| | West | 96.5 | 206.5 | 40.5 | 188.3 | 531.5 |
| | East+West | 119.6 | 292.6 | 187.9 | 279.3 | 878.6 |
| Razorbill (50% displaced + 1% mortality) | East | 1.7 | 14.2 | 10.2 | 10.9 | 36.9 |
| | West | 6.9 | 14.8 | 2.9 | 13.5 | 38.0 |
| | East+West | 8.5 | 20.9 | 13.4 | 20.0 | 62.8 |

*Table 9-3 Operation Seasonal Displacement in the Array Areas. Impact for birds of all ages. Values are the Maximum displacement mortality in the Project and 2km buffer and evidence based rates for auks (from MacArthur Green 2019).*

| Species | Array | Breeding season | Autumn migration | Non-breeding/ Winter | Spring Migration | Annual |
|---|---|---|---|---|---|---|
| Gannet (80% displaced + 1% mortality) | East | 6 | 6 | - | 1 | 13 |
| | West | 6 | 6 | - | 1 | 14 |
| | East+West | 11 | 13 | - | 1 | 24 |
| Guillemot (70% displaced + 10% mortality) | East | 632 | - | 879 | - | 1,511 |
| | West | 615 | - | 875 | - | 1,490 |
| | East+West | 1045 | - | 1410 | - | 2,454 |
| Guillemot (50% displaced + 1% mortality) | East | 45.1 | - | 62.8 | - | 107.9 |
| | West | 43.9 | - | 62.5 | - | 106.4 |
| | East+West | 74.6 | - | 100.7 | - | 175.3 |
| Puffin (70% displaced + 10% mortality) | East | 4 | - | 13 | - | 17 |
| | West | 8 | - | 14 | - | 21 |
| | East+West | 10 | - | 26 | - | 36 |
| Puffin (50% displaced + 1% mortality) | East | 0.3 | - | 0.9 | - | 1.2 |
| | West | 0.6 | - | 1.0 | - | 1.5 |
| | East+West | 0.7 | - | 1.9 | - | 2.6 |
| Razorbill (70% displaced + 10% mortality) | East | 39 | 328 | 236 | 251 | 845 |
| | West | 160 | 342 | 67 | 312 | 881 |
| | East+West | 198 | 445 | 312 | 441 | 1,395 |
| Razorbill (50% displaced + 1% mortality) | East | 2.8 | 23.4 | 16.9 | 17.9 | 60.4 |
| | West | 11.4 | 24.4 | 4.8 | 22.3 | 62.9 |
| | East+West | 14.1 | 31.8 | 22.3 | 31.5 | 99.6 |

#### 9.1.2.1 Barrier effects

16. The small risk of impact to migrating birds resulting from flying around rather than through, the array area of an offshore windfarm is considered a potential barrier effect. The assessment on direct disturbance and displacement effects is based on the SNCB (Parker *et al*. 2022) Advice Note which in turn is based on the work of Furness *et al*. (2013) and Bradbury *et al*. (2014). Displacement is defined as 'a reduced number of birds occurring within or immediately adjacent to an offshore windfarm' (Furness *et al*., 2013) and involves birds present in the air and on the water (Parker *et al*. 2022). Birds that do not intend to utilise a windfarm area but would have previously flown through the area on the way to a feeding, resting or nesting area, and which either stop short or detour around a development, are subject to barrier effects (Parker *et al*. 2022). For the purposes of assessment of displacement for resident birds, it is usually not possible to distinguish between displacement and barrier effects - for example to define where individual birds may have intended to travel to, or beyond an offshore windfarm, even when tracking data are available. Therefore, in this assessment the effects of displacement and barrier effects on the key resident species are considered together.

### 9.1.3 Indirect effects through effects on habitats and prey species

17. Indirect disturbance and displacement of birds may occur during the construction stage if there are impacts on prey species and the habitats of prey species. These indirect effects include those resulting from the production of underwater noise (e.g. during piling), temporary habitat loss and disturbance (e.g. during preparation of the seabed for foundations and cable installation) that may alter the behaviour or availability of bird prey species.

18. With regard to changes to the seabed and to suspended sediment levels, **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** and **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)** of the ES discuss the nature of any change and impacts on the seabed and benthic habitats. The impact on benthic habitats was predicted to be minor adverse due to the limited spatial extent (i.e. restricted to discrete areas within the Projects), the relatively short-term duration (as it is limited to the duration of construction activities), intermittent and with high reversibility nature of the effect. The consequent indirect impact is considered to be minor, and this is also likely to be the case for species such as herring, sprat and sandeel which are the main prey items of seabirds such as gannet and auks. As outlined in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sandeel and herring are potentially vulnerable to seabed disturbance and increases in local suspended sediments as these species are demersal spawners with specific habitat requirements. However, considering the temporary, intermittent, and localised nature of this impact, it is considered to be a minor adverse effect.

19. Therefore, since these effects were ruled out as sources of potential impacts on seabirds at the EIA scale the same conclusion has been reached for designated sites and it is concluded there are no risks of AEoI for any SPA.

### 9.1.4 Seasonal definitions

20. Impacts have been assessed in relation to relevant biological seasons, as defined by Furness (2015). Seasonal definitions for impacted species identified in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**) are presented in **Table 9-4.**

21. The seasonal definitions in Furness (2015) include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). However, as a precautionary assumption, the full breeding season has been applied, with the adjacent non-breeding months reduced to remove overlaps (i.e. if March was identified as a spring migration month and also a breeding season month, it was assigned only to the latter).

*Table 9-4 Species Specific Seasonal Definitions and Biologically Defined Minimum Population Sizes (In Brackets) Have Been Taken from Furness (2015). Shaded Cells Indicate the Appropriate Non-Breeding Season Periods Used in the Assessment for Each Species.*

| Species | Breeding | Migration-free breeding | Migration - autumn | Winter | Migration - spring | Non-breeding |
|---|---|---|---|---|---|---|
| Gannet | Mar-Sep | Apr-Aug | Sep-Nov (456,298) | - | Dec-Mar (248,385) | Sep-Mar |
| Puffin | Apr-Aug (868,689) | May-Jun | Jul-Aug | Sep-Feb | Mar-Apr | Mid-Aug-Mar (231,957) |
| Razorbill | Apr-Jul | Apr-Jun | Aug-Oct (591,874) | Nov-Dec (218,622) | Jan-Mar (591,874) | - |
| Guillemot | Mar-Jul (2,045,078) | Mar-Jun | Jul-Oct | Nov | Dec-Feb | Aug-Feb (1,617,306) |
| Kittiwake | Mar-Aug (839,456) | May-Jul | Aug-Dec (829,937) | - | Jan-Apr (627,816) | - |
| Lesser black-backed gull | Apr-Aug | May-Jul | Aug-Oct (209,007) | Nov-Feb (39,314) | Mar-Apr (197,483) | - |
| Herring gull | Mar-Aug | May-Jul | Aug-Nov | Dec | Jan-Apr | Sep-Feb (466,511) |
| Great black-backed gull | Mar-Aug | May-Jul | Aug-Nov | Dec | Jan-Apr | Sep-Mar (91,399) |

### 9.1.5 Apportioning of predicted impacts to SPAs

22. Predicted impacts on birds of all ages within the Projects (and a 2km buffer for displacement impacts) were calculated in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

23. The first stage in the RIAA was to adjust the displacement and collision risk impacts predicted in the EIA (**Table 9-1, Table 9-2 and Table 9-3**) to account for the proportion of impacts on adults only.

24. To calculate the adult proportion for each species screened into assessment, demographic rates were taken from Horswill and Robinson (2015) and entered into a matrix population model. This was used to calculate the expected stable proportions in each age class (note, to obtain robust stable age class distributions for less well studied species such as divers it was necessary to adjust the rates in order to obtain a stable population size). Each age class survival rate was multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate for all ages. Taking this value from 1 gives the average mortality rate. The demographic rates and the age class proportions, and average mortality rates calculated from them are presented in **Table 9-5**. For SPAs with breeding season connectivity to the Projects, as well as the demographic rate based estimate of the adult proportion outlined above, a precautionary '100% adult' apportioning was applied. This followed advice from Natural England (at the ETG of 6th February 2024) that, in the absence of evidence to the contrary, this was their preferred option (note Natural England also advised consideration of age ratios derived from observations of plumage features in the survey data, however this is approach is quite limited for most species as it is not feasible to reliably distinguish most sub-adult age classes birds from adults).

*Table 9-5 Average Mortality Across All Age Classes. Average Mortality Calculated Using Age Specific Demographic Rates and Age Class Proportions*

| Species | Parameter | Survival (age class) | | | | | | Productivity | Adult mortality | Average mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-10-1 | 1-2 | 2-3 | 3-4 | 4-5 | Adult | | | |
| Gannet | Demo-graphic rate | 0.424 | 0.829 | 0.891 | 0.895 | - | 0.912 | 0.7 | 0.088 | 0.191 |
| | Population age ratio | 0.191 | 0.081 | 0.067 | 0.06 | - | 0.6 | - | | |
| Guillemot | Demo-graphic rate | 0.56 | 0.792 | 0.917 | 0.939 | 0.939 | 0.939 | 0.672 | 0.061 | 0.14 |
| | Population age ratio | 0.168 | 0.091 | 0.069 | 0.062 | 0.056 | 0.552 | - | | |
| Razorbill | Demo-graphic rate | 0.63 | 0.63 | 0.895 | 0.895 | - | 0.895 | 0.57 | 0.105 | 0.174 |
| | Population age ratio | 0.159 | 0.102 | 0.065 | 0.059 | - | 0.613 | - | | |
| Puffin | Demo-graphic rate | 0.709 | 0.709 | 0.709 | 0.760 | 0.805 | 0.906 | 0.617 | 0.094 | 0.176 |
| | Population age ratio | 0.156 | 0.113 | 0.082 | 0.060 | 0.047 | 0.543 | - | | |
| Kittiwake | Demo-graphic rate | 0.79 | 0.854 | 0.854 | 0.854 | | 0.854 | 0.69 | 0.146 | 0.156 |

| Species | Parameter | Survival (age class) | | | | | | Productivity | Adult mortality | Average mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-10-1 | 1-2 | 2-3 | 3-4 | 4-5 | Adult | | | |
| | Population age ratio | 0.155 | 0.123 | 0.105 | 0.089 | | 0.53 | - | | |
| Great black-backed gull[1] | Demo-graphic rate | 0.815 | 0.815 | 0.815 | 0.815 | | 0.885 | 0.53 | 0.115 | 0.144 |
| | Population age ratio | 0.137 | 0.112 | 0.093 | 0.076 | | 0.581 | - | | |

*1 – Great black-backed gull survival rates were taken from EATL (2016) which provided compelling reasons for the representativeness of these rates rather than those in Horswill and Robinson (2015).*

25. These predicted impacts were apportioned to individual SPAs so that the total effect of the Projects alone and in-combination could be assessed for each SPA qualifying feature for which LSE could not be rule out.

26. In the breeding season apportioning was based on hypothetical connectivity between the Project (and buffer) based on existing information on species specific foraging ranges (Woodward *et al*. 2019) as recommended by Natural England (Parker *et al*. 2022) guidance. The NatureScot distance-decay approach was used, which considers relative population sizes, distances and areas of sea to estimate colony proportions as follows:

*Colony i weight = (Colony Population i / Sum of Candidate Populations i-n) x (Sum of Candidate Colony i-n Distances$^2$ / Colony i Distance$^2$) x (1/Colony i Sea Proportion / Sum of 1/Colony i-n Sea Proportions)*

27. Where *i* indicates values for the focal colony from a sample of values for *n* candidate colonies (i.e. those within foraging range).

28. The apportioning of impacts to each designated site was calculated for each qualifying feature by dividing the impact (number of collisions and/or displacement mortality) calculated at the national level in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**) by the proportion of the national population that were members of the designated site population at citation. Designated site populations were obtained from the SPA citation, or the Ramsar site population if the SPA citation did not include a population estimate (although in some cases more recent colony counts are available, it is important that all counts used in the apportioning calculation are contemporaneous; assuming the relative population sizes for all colonies are comparable this has no effect on the estimated SPA proportions). It should also be noted that, in practice, as very few SPAs were within foraging range of the Projects, this calculation had little bearing on the assessment.

29. During the nonbreeding season the proportion of the relevant BDMPS represented by the SPA population in question was used on the assumption that individuals from all candidate SPAs are equally likely to be present throughout the defined BDMPS region.

30. For the non-breeding period, the relevant population sizes for Biologically Defined Minimum Population Scales (BDMPS) were taken from Furness (2015, Appendix A) for each SPA.

31. SPA populations and apportioning percentages are summarised in **Table 9-6** and **Table 9-7**. For species with breeding season connectivity limited to only one SPA it has been assumed that all individuals present in the breeding season originate from that SPA.

*Table 9-6 Breeding season apportioning for kittiwake SPAs.*

| SPA | Most recent count (AON) | Year of most recent count | Minimum distance from to DBS (km) | Marine proportion of foraging range | Apportioned estimate |
|---|---|---|---|---|---|
| Flamborough and Filey Coast | 44574 | 2022 | 125.29 | 0.74 | 0.952 |
| Farne Island | 4402 | 2019 | 247.02 | 0.69 | 0.026 |
| St Abbs Head to Fast Castle | 5150 | 2018-2021 | 290.36 | 0.68 | 0.022 |

*Table 9-7 Breeding season apportioning for puffin SPAs.*

| SPA | Most recent count (AOB) | Year of most recent count | Minimum distance from to DBS (km) | Marine proportion of foraging range | Apportioned estimate |
|---|---|---|---|---|---|
| Flamborough and Filey Coast | 4929 | 2022 | 103.08 | 0.70 | 0.27 |
| Farne Island | 43752 | 2019 | 247.02 | 0.66 | 0.44 |
| Coquet | 25029 | 2019 | 229.60 | 0.65 | 0.29 |

## 9.2 Consultation

32. Consultation with regard to offshore ornithology has been undertaken in line with the general process described in section 2 (see Part 1 of the RIAA). The key elements to date have included scoping and the HRA screening.

33. The feedback received throughout this process has been considered in preparing the offshore ornithology sections of the RIAA. Stakeholder comments relevant to the RIAA are included in **Table 9-8**.

*Table 9-8 Consultation Responses Relevant to Marine Ornithological Features*

| Comment | Project Response |
|---|---|
| **Responses to Draft HRA Screening Report** | |
| **Natural England, 20/02/2023** | |
| <u>Sites designated for marine ornithological features (Section 4.4)</u><br>Whilst Natural England are content with the sites screened in and out of the HRA assessment we would like to see more consideration of seabird features outside the breeding season.<br><br>Distant SPAs screened in should not be limited to those determined solely by the breeding season/foraging ranges of their ornithological features, but also account for the potential for the project to interact with birds from much more distant SPAs during the migration and non-breeding seasons. Furness (2015) provides information for many species of seabird on the suite of colonies that may have connectivity with the southern North Sea outside the breeding season. Natural England recommend that impacts on breeding seabird features outside the breeding season be considered and that details of how they are considered be clearly presented. | We welcome Natural England's confirmation of the sites screened in and out.<br><br>Further details regarding SPA's screened in for assessment following the publication of the HRA Screening Report are detailed in section 5.4.4 of this report. |
| Natural England would also like to see greater clarity on which SPA features have been screened in for which SPAs. Both Table 4-10 and 4-11 could be made clearer if the 'species/feature' column listed individual features. | Further detail regarding which SPA features have been screened in for which SPAs are provided throughout this report. |

| Comment | Project Response |
|---|---|
| No information has been provided on which impact pathways the relevant SPA features are being screened in for, Natural England therefore cannot comment on this at this stage. Likewise, no detail has been provided on seasonal definitions for different features. | Details of the impact pathways assessed for each SPA feature are provided in section 9.1 of this report. |
| **Responses to Final HRA Screening Report** | |
| **Natural England, 17/07/2023** | |
| We do not agree with the Applicant's approach of only screening in SPAs within mean max foraging range +1s.d. for potential effects on non-breeding seabirds.<br>We advise that the screening process be revised, considering the information presented in Furness (2015) on potential connectivity of seabird features of SPAs outside the breeding season. | Further SPAs that are potentially connected with the Projects during the non-breeding season (Furness, 2015), but are beyond mean maximum + 1SD foraging range for designated seabirds to the Projects have now been screened in for further assessment, see section 5.4.4 for further details. |
| Section 4.4.4.2. Table 4-10, Table 4-11<br>Non-breeding and migratory seabirds:<br>Natural England do not agree with the Applicant's approach of only screening in SPAs within mean max foraging range +1s.d. for potential effects on non-breeding seabirds. SPAs screened in should not be limited to those determined solely by the breeding season/foraging ranges of their ornithological features, | Further SPAs that are potentially connected with the Projects during the non-breeding season (Furness, 2015), but are beyond mean maximum + 1SD foraging range for designated seabirds to the Projects have now been screened in for further assessment, see section 5.4.4 for further details. |

| Comment | Project Response |
|---|---|
| but also account for the potential for the projects to interact with birds from much more distant SPAs during the migration and non-breeding seasons.<br><br>Furness (2015) provides information for many of the relevant seabird species on the suite of SPAs with potential connectivity to the relevant area outside of the breeding season. This information should be considered when screening in SPAs for impacts on seabird species outside of the breeding season.<br><br>Natural England advise that the screening process be revised, taking into account the information presented in Furness (2015) on potential connectivity of seabird features of SPAs outside the breeding season. | |
| Section 4.4.4.4, Table 4-10, Table 4-11<br><br>Transboundary considerations: Natural England does not agree with screening out non-UK SPAs that are within foraging range (mean max + 1sd) for breeding features or that might have connectivity with features during the non-breeding season (see comment above re information in Furness 2015). Non-UK SPAs should be treated the same as for UK SPAs and screened in for assessment where appropriate.<br><br>Natural England advise that the screening process be revised to include all SPAs that are within foraging range (mean max + 1sd) for breeding features. | Further details on transboundary considerations are provided in section 5.4.3 of this report. |
| Table 4-10, Table 4-11<br><br>FFC SPA: "There is potential for disturbance to breeding cormorant, shag and herring gull from operation & maintenance vessels." | The operational displacement assessment encompasses potential displacement due to both the presence of turbines and also O&M vessels. Any |

| Comment | Project Response |
|---|---|
| Natural England notes that disturbance from operation & maintenance vessels may also affect guillemot, razorbill, and puffin, and advises that these species be screened in for assessment of impacts from operation and maintenance vehicles.<br><br>Please include consideration of disturbance impacts from operation & maintenance vessels to FFC guillemot, razorbill, and puffin. | additional effects due to birds avoiding vessels outside the wind farm would be small and short-lived, with birds rapidly relocating following vessel passage. Against the baseline of vessel traffic in the region the additional O&M vessel movements will make an insignificant contribution to this potential source of disturbance. |
| Table 1-1<br><br>Natural England note that no detail has been provided on the impact pathways to be considered for each SPA feature, but note that it is stated that this information will be provided in the RIAA.<br><br>Please provide details of the impact pathways to be assessed for each SPA feature in the RIAA, as stated. | Details of the impact pathways assessed for each SPA feature are provided in section 9.1 of this report. |

## 9.3 Assessment of Potential Effects

34. The assessment of potential effects at each SPA are presented in sections 9.4 to 9.25.

### 9.3.1 Embedded Mitigation

35. Certain measures have been adopted as part of the Project development process in order to reduce the potential for impacts to the environment, as presented in **Table 9-9**. These have been accounted for in the assessment presented below. General mitigation measures, which would apply to all parts of the Project, are set out first. Thereafter mitigation measures that would apply specifically to offshore ornithology issues associated with the OAA and offshore export cable corridor, are described separately.

*Table 9-9 Embedded Mitigation Measures*

| Parameter | Embedded Mitigation Measures | Where commitment is secured? |
|---|---|---|
| Site Selection | The Crown Estate conducted a detailed site selection exercise, considering a range of sensitivities which included ornithological impacts. The Projects' Array Areas are located at least 100km from the nearest seabird breeding colony at Flamborough and Filey Coast Special Protection Area (FFC SPA) and as such connectivity for most species will be relatively low. The Array Areas have been refined following review of site-specific survey information. | **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** |
| Wind turbine design | There would be a minimum blade tip clearance (air draft height) of at least 34m above MSL.<br>Project parameters would be secured within **Volume 3, Draft DCO (application ref: 3.1)**. | Deemed Marine Licence (DML) 1 & 2 - Condition 2 |
| Vessel traffic | Potential impacts on red throated diver in the Greater Wash SPA during construction, operation and maintenance works will be mitigated through measures such as:<br>• Selecting routes that avoid known aggregations of birds;<br>• Restricting vessel movements to existing navigation routes (where the densities of red-throated divers are typically relatively low); | Pollution Environmental Management Plan (PEMP)<br>DML 1 & 2 - Conditions 15 & 21<br>DML 3 & 4-Conditions 13 & 19 |

| Parameter | Embedded Mitigation Measures | Where commitment is secured? |
|---|---|---|
| | • Maintaining direct transit routes (to minimise transit distances through areas used by red-throated diver);<br>• Considering the potential for crew transfer vessels to travel in convoy en route to the wind farm sites and seeking to do so where it is considered practicable;<br>• Avoidance of over-revving of engines (to minimise noise disturbance); and<br>• Briefing of vessel crew on the purpose and implications of these vessel management practices (through, for example, tool-box talks).<br>These measures are set out in **Volume 8, Outline Project Environmental Management Plan (application ref: 8.21).** | DML 5 - Conditions 11 & 15 |

## 9.3.2 Realistic Worst Case Scenario

### 9.3.2.1 General Approach

36. The realistic worst case design parameters for likely significant effects scoped into the RIAA for the Offshore Ornithology assessment are summarised in **Table 9-10**. These are based on the project parameters described in the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)**, which provides further details regarding specific activities and their durations.

*Table 9-10 Realistic Worst Case Design Parameters for Offshore Ornithology*

| | Parameter | | | |
|---|---|---|---|---|
| | **DBS East or DBS West in isolation** | **DBS West and DBS East concurrently** | **DBS West and DBS East sequentially** | **Notes and rationale** |
| **Construction** | | | | |
| Array areas | Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 100 in either DBS East or DBS West)<br>3 piling vessels operating at same time | Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 200 across the two Projects)<br>3 piling vessels operating at same time | Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 200 across the two Projects)<br>3 piling vessels operating at same time | Assumed a 2km buffer around each construction location. |
| Offshore Export Cable Corridor | Two cables, assume each laid independently. Assessment has been based on a 2km buffer around each independently operating cable laying vessel.<br>Pin piling / monopiling for one Electrical Switching Platform (ESP) along the Offshore Export Cable Corridor. | Four cables– assume each laid independently. Assessment will be based on a 2km buffer around each independently operating cable laying vessel.<br>Pin piling / monopiling for one ESP along the Offshore Export Cable Corridor. | Four cables– assume each laid independently. Assessment will be based on a 2km buffer around each independently operating cable laying vessel.<br>Pin piling / monopiling for one ESP along the Offshore Export Cable Corridor. | |

| | Parameter | | | |
|---|---|---|---|---|
| | **DBS East or DBS West in isolation** | **DBS West and DBS East concurrently** | **DBS West and DBS East sequentially** | **Notes and rationale** |
| **Operation** | | | | |
| Array areas | 100 smaller wind turbines in either DBS East or DBS West | 200 smaller wind turbines (100 in DBS East and 100 in DBS West) for the same operational period i.e. 30 years. | 200 smaller wind turbines (100 in DBS East and 100 in DBS West) for the overlapping operational period i.e. 32 years. | Larger number of smaller wind turbines gives highest collision risk |
| | Complete development of areas within the Array Area boundaries assessed. | Complete development of areas within the Array Area boundaries assessed. | Complete development of areas within the Array Area boundaries assessed. | Greatest area from which birds could be displaced |
| **Decommissioning** | | | | |
| No final decision regarding the final decommissioning policy for the offshore project infrastructure including landfall, has yet been made. It is also recognised that legislation and industry best practice change over time. It is likely that offshore project infrastructure will be removed above the seabed and reused or recycled where practicable. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase. A decommissioning plan for the offshore works would be submitted prior to any decommissioning commencing. | | | | |

#### 9.3.2.2 Development Scenarios

37. Following Statutory Consultation High Voltage Alternating Current (HVAC) technology (previously assessed in PEIR) was removed from the Projects' Design Envelope (see ES **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** for further information). As a result, only High Voltage Direct Current (HVDC) technology has been taken forward for assessment purposes. This assessment considers the following development scenarios:

- Either DBS East or DBS West is built In Isolation (the In Isolation Scenario);
- DBS East and DBS West are developed concurrently (the Concurrent Scenario); or
- Both DBS East and DBS West are developed sequentially (the Sequential Scenario).

38. An In Isolation scenario has been assessed on the basis that theoretically one Project could be taken forward without the other being built out. If an In Isolation project is taken forward, either DBS East or DBS West may be constructed. As such the offshore assessment considers both DBS East and DBS West in isolation.

39. In order to ensure that a robust assessment has been undertaken, all development scenarios and options have been considered to ensure the realistic worst case scenario for each topic has been assessed. Further details are provided in ES **Volume 7, Chapter 5 Project Description (application ref: 7.5).**

40. The three development scenarios to be considered for assessment purposes are outlined in **Table 9-11.**

*Table 9-11 Development Scenarios and Construction Durations*

| Development scenario | Description | Overall Construction Duration (Years) | Maximum construction Duration Offshore (Years) | Maximum construction Duration Onshore (Years) |
|---|---|---|---|---|
| In Isolation | Either DBS East or DBS West is built In Isolation | Five | Five | Four |
| Sequential | DBS East and DBS West are both built Sequentially, either Project could commence construction first with staggered / overlapping construction | Seven | A five year period of construction for each project with a lag of up to two years in the start of construction of the second project (excluding landfall duct installation) – reflecting the maximum duration of effects of seven years. | Construction works (i.e. onshore cable civil works, including duct installation) to be completed for both Projects simultaneously in the first four years, with additional works at the Landfall Zone, Onshore Substation Zone and cable joint bays in the following two years. Maximum duration of effects of six years. |
| Concurrent | DBS East and DBS West are both built Concurrent reflecting the maximum peak effects | Five | Five | Four |

41. The In Isolation, Concurrent and Sequential Development Scenarios all allow for flexibility to build out either or both Projects using a phased approach offshore. Under a phased approach the maximum timescales for individual elements of the construction are assessed.

#### 9.3.2.3 Operation Scenarios

42. Operation scenarios are described in detail in the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. The assessment considers the following scenarios:

- Only DBS East in operation;
- Only DBS West in operation; and
- The two projects operating concurrently, with a lag of two years between each Project commencing operation.

43. If the Projects are built out using a phased approach, there would also be a phased approach to starting the operational stage. The worst case scenario for the operational phases for the Projects have been assessed. See the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)** for further information on phasing scenarios for the Projects.

44. The operational lifetime of each Project is expected to be 30 years.

#### 9.3.2.4 Decommissioning Scenarios

45. Decommissioning scenarios are described in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Programme prior to construction, however for the purpose of this assessment it is assumed that decommissioning of the Projects could be conducted separately, or at the same time.

## 9.4 Greater Wash SPA

### 9.4.1 Site Description

46. The Greater Wash SPA is a marine SPA located in the southern North Sea. The SPA boundary encompasses offshore areas identified as containing high densities of the qualifying bird species (Natural England and JNCC, 2016). The offshore export cable corridor crosses the Greater Wash SPA prior to making landfall.

47. To the north, off the Holderness coast in Yorkshire, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. Offshore, soft sediments dominate, with extensive areas of subtidal sandbanks off The Wash as well as north and east Norfolk coasts. Closer inshore at The Wash and north Norfolk coast, sediments comprise a mosaic of sand, muddy sand, mixed sediments and coarse sediments, as well as occasional Annex I reefs. The area off the Suffolk coast continues the mosaic habitats mostly dominated by soft sediment.

48. The landward boundary of the SPA covers the coastline from Bridlington Bay in the north (at the village of Barmston), to the existing boundary of the Outer Thames Estuary SPA in the south. Across the mouth of the Humber Estuary, the boundary abuts the boundary of the Humber Estuary SPA, except where neither the little tern foraging zone nor the red-throated diver Maximum Curvature Analysis (MCA) density threshold reaches the SPA. The landward boundary abuts the seaward boundary of The Wash SPA except where the former overlaps the latter to encompass habitats used by breeding Sandwich tern.

### 9.4.1.1 Qualifying Features

49. The qualifying features of this SPA screened into the assessment are listed in **Table 4-7** (see Part 1 of this report). These are non-breeding red-throated diver and common scoter.

### 9.4.1.2 Conservation Objectives

50. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features.
- The structure and function of the habitats of the qualifying features.
- The supporting processes on which the habitats of the qualifying features rely.
- The populations of each of the qualifying features.
- The distribution of qualifying features within the site.

## 9.4.2 Assessment: Offshore Export Cable Corridor

### 9.4.2.1 Red-throated diver

51. Red-throated diver has been screened into the assessment to assess impacts from disturbance / displacement from construction activity in the Offshore Export Cable Corridor and increased vessel activity during the construction and operation phase.

#### *9.4.2.1.1 Status*

52. At citation, the population of red-throated diver was 1,407 non-breeding individuals (Natural England, 2018a). This was calculated using a five year peak mean population estimate derived from distance-corrected visual aerial surveys of the Greater Wash in 2002/03, 2004/05, 2005/06, 2006/07 and 2007/08.

53. The annual baseline mortality of this population, assuming that the published all age class mortality rate of 22.8% applies (Horswill and Robinson 2015), is 321 birds.

#### *9.4.2.1.2 Connectivity to the Projects*

54. The export cable route will pass through the northern most end of the Greater Wash SPA, therefore the presence of vessels undertaking the installation of the export cable could result in the direct disturbance and displacement of red-throated diver.

#### *9.4.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

##### *9.4.2.1.3.1 Potential Effects During Construction: Direct Disturbance and Displacement from Export Cable construction vessels*

###### *9.4.2.1.3.1.1 DBS East or DBS West in Isolation*

55. The region of the SPA which the export cable route crosses had low densities of red-throated diver recorded, and the nearshore sections were not identified as within the species' distribution (Natural England and JNCC 2016). The peak density of red-throated diver within the overlap of the cable route and the SPA was 0.5 birds/km$^2$.

56. The magnitude of disturbance to red-throated diver from construction vessels has been estimated on a worst case basis. This assumes that there would be 100% displacement of birds within a 2km buffer surrounding the source, in this case around a maximum of two cable laying vessels (one main cable vessel and one support vessel). This approach is the same as that applied for this potential impact in other wind farm applications (e.g. East Anglia TWO (SPR, 2019). This 100% displacement from vessels is consistent with Garthe and Hüppop (2004) and Schwemmer *et al*. (2011) since they suggested that all red-throated divers present fly away from approaching vessels at a distance of often more than 1km.

57. The worst case area from which birds could be displaced was defined as a circle with a 2km radius around each cable laying vessel, which is 25.2km$^2$ (2 x 12.6km$^2$). If 100% displacement is assumed to occur within this area, then at a peak density of 0.5 birds/km$^2$, a peak of 13 divers could be displaced at any given time. This would lead to a 0.7% increase in diver density in the remaining areas of the SPA assuming that displaced birds all remain within the SPA. As the vessels move it is assumed that displaced birds return and therefore any individual will be subjected to a brief period of impact. Consequently, for the purposes of this assessment it has been assumed that the estimated number displaced at any one time represents the total number displaced over the course of a single winter (i.e. rather than many individuals for a short duration each, the same individuals for the duration of a single winter).

58. Definitive mortality rates associated with displacement for red-throated divers, or for any other seabird species, are not known and precautionary estimates have to be used. There is no evidence that birds displaced from wind farms suffer any mortality as a consequence of displacement; any mortality due to displacement would be most likely a result of increased density in areas outside the affected area, resulting in increased competition for food where density was elevated (Dierschke *et al*., 2017). Such impacts are most likely to be negligible, and below levels that could be quantified, as the available evidence suggests that red-throated divers are unlikely to be affected by density-dependent competition for resources during the nonbreeding period (Dierschke *et al*., 2017).

59. Impacts of displacement are also likely to be context-dependent. In years when food supply has been severely depleted, as for example by unsustainably high fishing mortality of sandeel stocks as has occurred several times in recent decades (ICES, 2013), displacement of sandeel-dependent seabirds from optimal habitat may increase mortality. In years when food supply is good, displacement is unlikely to have any negative effect on seabird populations. Red-throated divers may feed on sandeels, but take a wide diversity of small fish prey, so would be buffered to an extent from fluctuations in abundance of individual fish species. It is not possible for the Projects to predict future fishing effort.

60. For recent wind farm assessments Natural England has advised that an unconfirmed 10% mortality rate should be used for birds displaced by cable laying vessels. This magnitude of impact is not supported in the literature and equates to more than half the natural adult annual mortality (16%) from a single occasion of disturbance (as described above). Furthermore, given the high levels of background shipping within the species' wintering range (the southern North Sea) and the undoubtably high rate of interaction with existing vessel traffic, it seems highly improbable that such a large effect would occur.

61. Indeed, disturbance from vessels in the southern North Sea must have been ongoing for decades since there are designated shipping lanes located throughout the areas where this species is present. With this in mind, additional mortality of 10% of the population due to single instances of vessel disturbance during the course of the winter, as proposed by Natural England, would reduce the population of 1,407 (i.e. the Greater Wash SPA population) to fewer than 100 within 10 years (alternatively the SPA population would need to have been 16 times larger 10 years prior to the SPA designation surveys in order to have been reduced to 1,407). Neither of these scenarios is supported by the evidence.

62. A review of available evidence for red-throated diver displacement was submitted for the Norfolk Vanguard assessment (MacArthur Green 2019a) and this concluded that there would be little or no effect of displacement on diver survival. Consequently, a maximum, and hence precautionary, displacement caused mortality rate of 1% was identified as appropriate for this assessment.

63. At this level of additional mortality, only a maximum of 0.1 individuals would be expected to die across the entire winter period (September to April) as a result of any potential displacement effects from the offshore cable installation activities, which would be restricted to a maximum of one nonbreeding seasons. This highly precautionary assessment will have no discernible effect on the Greater Wash SPA red-throated diver population, and therefore will not adversely affect the integrity of the Greater Wash SPA.

###### *9.4.2.1.3.1.2 DBS East and West Together*

64. If both wind farms are constructed the potential effect on red-throated diver within the overlap of the export cable route and the Greater Wash SPA will be the same as that described for DBS East or DBS West in isolation, but over a period of two nonbreeding seasons rather than one. This would not materially change the conclusions for one project in isolation and therefore it is concluded that predicted red-throated diver mortality due to construction phase displacement within the export cable corridor of DBS East and DBS West together would not adversely affect the integrity of the Greater Wash SPA.

##### *9.4.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement from maintenance vessel activity.*

###### *9.4.2.1.3.2.1 DBS East or DBS West in Isolation*

65. The Operations and Maintenance port has not been determined, however this may be located such that vessels accessing the Array area will need to cross the Greater Wash SPA. Therefore, it is appropriate to assess the potential effects on red-throated diver of additional vessel movements.

66. It is estimated that as a worst case up to five vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port and while steaming through the SPA would be subject to best practice guidance on minimising disturbance to red-throated divers (see section 9.3.1). Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

###### *9.4.2.1.3.2.2 DBS East and West Together*

67. The Operations and Maintenance port has not been determined, however this may be located such that vessels accessing the Array Areas will need to cross the Greater Wash SPA. Therefore it is appropriate to assess the potential effects on red-throated diver of additional vessel movements.

68. It is estimated that as a worst case up to nine vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port, and while steaming through the SPA would be subject to best practice guidance on minimising disturbance to red-throated divers (as has been agreed with Natural England for previous projects). Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

###### *9.4.2.1.4 Summary*

69. It is concluded that any potential effects on red-throated diver due to construction of the export cable through the Greater Wash SPA for either DBS East or DBS West in isolation or for both together would not adversely affect the integrity of the Greater Wash SPA.

70. It is concluded that any potential effects on red-throated diver due to disturbance from operational and maintenance vessels for either DBS East or DBS West in isolation or for both together, and on the assumption that these vessels would need to cross the SPA (noting that the Operations and Maintenance Port has not yet been finalised) would not adversely affect the integrity of the Greater Wash SPA.

###### *9.4.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

71. Given the extremely low mortality predicted for construction (a maximum of 0.1 mortalities per year during construction), and the commitment to adopt best practice management for project vessels crossing the SPA (including travelling within existing shipping lanes where possible) there is no risk that the Projects will make any material contribution to impacts on red-throated diver in the Greater Wash SPA and therefore **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West alone and in-combination with other projects**.

#### 9.4.2.2 Common scoter

###### *9.4.2.2.1 Status*

72. At citation, the population of common scoter was 3,449 non-breeding individuals (Natural England, 2018a). This was calculated using a five year peak mean population estimate derived from distance-corrected visual aerial surveys of the Greater Wash in 2002/03 to 2007/08.

#### 9.4.2.3 Connectivity to the Projects

73. The export cable route will pass through the northern most end of the Greater Wash SPA, therefore the presence of vessels undertaking the installation of the export cable could result in the direct disturbance and displacement of common scoter.

##### *9.4.2.3.1 Assessment of Potential Effects of the Projects alone and Together*

###### *9.4.2.3.1.1 Potential Effects During Construction: Direct Disturbance and Displacement from Export Cable construction vessels*

74. Although common scoter are a designated feature of the Greater Wash SPA, and the export cable will be installed through the northern most tip of the SPA, it is clear from the data used for the SPA's designation (Natural England and JNCC, 2016) that this species was present in, at most, very low numbers in this part of the SPA. Indeed, the only identified higher density areas were in The Wash itself off the east coast of Norfolk. Therefore, it can be concluded that the risk of an adverse effect on the SPA as a result of disturbance to common scoter is extremely low and can be ruled out.

75. This conclusion applies to all development scenarios.

###### *9.4.2.3.1.2 Potential Effects During Operation: Disturbance and Displacement from maintenance vessel activity.*

###### *9.4.2.3.1.2.1 DBS East or DBS West in Isolation and DBS East and West Together*

76. The Operations and Maintenance port has not been finalised, however this may be located such that vessels accessing the Array area will need to cross the Greater Wash SPA. Therefore, it is appropriate to assess the potential effects on common scoter of additional vessel movements.

77. It is estimated that as a worst case up to five vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port and while steaming through the SPA would be subject to best practice guidance on minimising disturbance to red-throated divers (as per previous projects: need to include details of this), and this would also reduce the risk of disturbance to other species including common scoter. Furthermore, common scoter were primarily recorded in the region of The Wash, which is not located between the Array Areas and any Ports under consideration. Therefore, the likelihood of encountering any concentrations of common scoter is extremely low.

78. Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

*9.4.2.3.2 Summary*

79. It is concluded that any potential effects on common scoter due to construction of the export cable through the Greater Wash SPA for either DBS East or DBS West in isolation or for both together would not adversely affect the integrity of the Greater Wash SPA.

80. It is concluded that any potential effects on common scoter due to disturbance from operational and maintenance vessels for either DBS East or DBS West in isolation or for both together, and on the assumption that these vessels would need to cross the SPA (noting that the Operations and Maintenance Port has not yet been finalised) would not adversely affect the integrity of the Greater Wash SPA.

*9.4.2.3.3 Assessment of potential effects of the Projects in combination with other plans and projects*

81. Given the near absence of common scoter in the cable construction corridor and hence negligible to zero mortality predicted for construction, and the commitment to adopt best practice management for project vessels crossing the SPA (including travelling within existing shipping lanes where possible) there is no risk that the project will make any material contribution to impacts on common scoter in the Greater Wash SPA and therefore **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West alone and in-combination with other projects**.

## 9.5 Flamborough and Filey Coast SPA

### 9.5.1 Site Description

82. The Flamborough and Filey Coast SPA was designated in 2018. It is a geographical extension to the former Flamborough Head and Bempton Cliffs SPA, which was designated in 1993 (Natural England, 2018b).

83. The SPA is located on the Yorkshire coast between Bridlington and Scarborough, and is composed of two sections. The northern section runs from Cunstone Nab to Filey Brigg, and the southern section from Speeton, around Flamborough Head, to South Landing. The seaward boundary extends 2km offshore and applies to both sections of the SPA.

84. The predominantly chalk cliffs of Flamborough Head rise to 135m and have been eroded into a series of bays, arches, pinnacles and gullies. The cliffs from Filey Brigg to Cunstone Nab are formed from various sedimentary rocks including shales and sandstones. The adjacent sea out to 2km off Flamborough Head as well as Filey Brigg to Cunstone Nab is characterised by reefs supporting kelp forest communities in the shallow subtidal, and faunal turf communities in deeper water. The southern side of Filey Brigg shelves off gently from the rocks to the sandy bottom of Filey Bay. This site does not support any priority habitats or species (Natural England, 2018b).

85. The coastal areas of the SPA cover cliffs supporting internationally important breeding populations of seabirds, the marine extension includes areas close to the colony used by seabirds for maintenance behaviours (loafing, preening etc).

#### 9.5.1.1 Qualifying Features and Condition Assessment

86. The qualifying features of the Flamborough and Filey Coast SPA screened into the assessment are listed in **Table 4-7**. These are breeding gannet, kittiwake and guillemot, razorbill and one named component of the breeding seabird assemblage (puffin).

#### 9.5.1.2 Conservation Objectives

87. The site's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

88. Of relevance to the requirement to maintain the supporting habitats for qualifying features, in January 2024 Defra announced that the UK government had decided to prohibit the fishing of sandeels within English waters of ICES Area 4 (North Sea) effective from 26$^{th}$ March 2024 (Defra, 2024). This measure will go a considerable way towards ensuring greater resilience for species which rely upon sandeels, which in particular includes the seabird qualifying features from Flamborough and Filey Coast SPA assessed in this section.

### 9.5.2 Assessment: Array Areas

#### 9.5.2.1 Gannet

89. Gannet has been screened in to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

##### *9.5.2.1.1 Status*

90. Gannet is listed as a designated species of the Flamborough and Filey Coast SPA.

91. The SPA breeding population at classification was cited as 8,469 pairs or 16,938 breeding adults, for the period 2008 to 2012 (Natural England, 2018b). The most recent count is 15,223 apparently occupied nests, or 30,446 breeding adults in 2023 (Butcher *et al*. 2023), however the closest to the period when the surveys were conducted was 13,125 in 2022 (Clarkson *et al*. 2022). The baseline mortality of this population is 2,310 breeding adult birds per year based on the published adult mortality rate of 8.8% (Horswill and Robinson, 2015).

92. Supplementary advice on the conservation objectives were added for qualifying features of the Flamborough and Filey Coast SPA in 2020 (Natural England, 2020). For gannet, these are:

- Maintain the size of the breeding population at a level which is above 8,469 pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent;
- Maintain safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;

- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. herring, mackerel, sprat, sandeel – see section 9.5.1.2) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

###### *9.5.2.1.2 Connectivity to the Projects*

93. DBS East and DBS West are at least 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding gannet from the Flamborough and Filey Coast SPA.

94. Although the gannets which breed at the Bass Rock, part of the Forth Islands SPA, are also within this mean maximum foraging distance (c. minimum of 290km to the Projects), Wakefield *et al*. (2013) found very little overlap in colony foraging areas, so connectivity with that SPA is considered very unlikely during the breeding season. Therefore, a precautionary assumption has been made that all of the gannets recorded at the Projects during the breeding season could be breeding adult birds from the Flamborough and Filey Coast SPA.

95. Outside the breeding season, breeding gannets, including those from the Flamborough and Filey Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they range more widely and mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March; Furness, 2015).

96. During the autumn migration and spring migration seasons it is estimated that 4.8% and 6.2% of birds respectively present in the Project Array Areas are breeding adults from the Flamborough and Filey Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.5.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.5.2.1.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

97. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-12**.

98. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-12**).

*Table 9-12 Summary of gannet density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm during construction has been estimated as 30%-40%, half the operational rates. Note that breeding season impacts have been estimated assuming 60% of birds present were adults (demographic) and also 100% (shaded cells).*

| Site | Season | Peak no. (mean) | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | Wind farm construction displacement mortality to SPA | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 60-1 | 80-1 | 30-1 | 40-1 | | | | 30-1 & vessel | 40-1 & vessel |
| DBS East | Breeding | 754.9 | 100 | 60 | 452.9 | 2.72 | 3.62 | 1.36 | 1.81 | 1.48 | 0.56 | 0.36 | 1.72 | 2.17 |
| | | | | 100 | 754.9 | 4.53 | 6.04 | 2.26 | 3.02 | | | 0.56 | 2.83 | 3.58 |
| | Autumn | 776.1 | 4.8 | 100 | 37.2 | 0.22 | 0.30 | 0.11 | 0.15 | 1.52 | 0.57 | 0.03 | 0.14 | 0.18 |
| | Spring | 75.1 | 6.2 | 100 | 4.6 | 0.03 | 0.04 | 0.01 | 0.02 | 0.15 | 0.06 | 0.006 | 0.02 | 0.03 |
| | Annual (60% adult & 100% adult) | | | | 494.7 | 2.97 | 3.96 | 1.48 | 1.98 | | 1.19 | 0.40 | 1.88 | 2.38 |
| | | | | | 796.7 | 4.78 | 6.38 | 2.38 | 3.19 | | | 0.60 | 2.99 | 3.79 |
| DBS West | Breeding | 805.3 | 100 | 60 | 483.2 | 2.90 | 3.87 | 1.45 | 1.93 | 1.55 | 0.58 | 0.36 | 1.81 | 2.29 |
| | | | | 100 | 805.3 | 4.83 | 6.44 | 2.42 | 3.22 | | | 0.58 | 2.77 | 3.57 |
| | Autumn | 797.5 | 4.8 | 100 | 38.3 | 0.23 | 0.31 | 0.11 | 0.15 | 1.54 | 0.58 | 0.03 | 0.14 | 0.18 |
| | Spring | 86.2 | 6.2 | 100 | 5.3 | 0.03 | 0.04 | 0.02 | 0.02 | 0.17 | 0.06 | 0.006 | 0.03 | 0.03 |
| | Annual (60% adult & 100% adult) | | | | 526.8 | 3.16 | 4.22 | 1.58 | 2.1 | | 1.22 | 0.40 | 1.98 | 2.50 |
| | | | | | 848.9 | 5.09 | 6.79 | 2.55 | 3.39 | | | 0.62 | 2.94 | 3.78 |
| DBS East + DBS West | Breeding | 1560.2 | 100 | 60 | 936.1 | 5.62 | 7.49 | 2.81 | 3.74 | - | 1.14 | 0.72 | 3.53 | 4.46 |
| | | | | 100 | 1560.2 | 9.36 | 12.48 | 4.68 | 6.24 | | | 1.14 | 5.03 | 6.59 |
| | Autumn | 1573.6 | 4.8 | 100 | 75.5 | 0.45 | 0.61 | 0.22 | 0.3 | - | 1.15 | 0.06 | 0.28 | 0.36 |
| | Spring | 161.3 | 6.2 | 100 | 9.9 | 0.06 | 0.08 | 0.03 | 0.04 | - | 0.12 | 0.012 | 0.05 | 0.06 |
| | Annual (60% adult & 100% adult) | | | | 1021.5 | 6.13 | 8.18 | 3.06 | 4.08 | | | 0.79 | 3.86 | 4.88 |
| | | | | | 1645.6 | 9.87 | 13.17 | 4.93 | 6.58 | | | 1.21 | 5.36 | 7.01 |

*9.5.2.1.3.1.1 DBS East in Isolation*

99. The wind farm construction displacement from DBS East in the breeding, autumn and spring seasons were up to 1.8 (60% adults) and 3.0 (100% adults), 0.1 and 0, respectively (**Table 9-12**). Displacement mortalities due to construction vessels were 0.36 (60% adults) and 0.56 (100% adults), 0.03 and <0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 2.1 (60% adults) and 3.6 (100% adults), 0.18 and 0.03 birds during the breeding, autumn and spring.

100. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 2.4 to 3.8 birds per annum. These result in a predicted change in adult mortality rate of 0.1% to 0.16% which are below the 1% threshold for detectability and therefore no further assessment is required.

*9.5.2.1.3.1.2 DBS West in Isolation*

101. The wind farm construction displacement from DBS West in the breeding, autumn and spring seasons were up to 1.9 (60% adults) and 3.2 (100% adults), 0.1 and 0, respectively (**Table 9-12**). Displacement mortalities due to construction vessels were 0.36 (60% adults) and 0.58 (100% adults), 0.03 and <0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 2.3 (60% adults) and 3.6 (100% adults), 0.18 and 0.03 birds during the breeding, autumn and spring.

102. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 2.5 to 3.8 birds per annum. These result in a predicted change in adult mortality rate of 0.1% to 0.16% which are below the 1% threshold for detectability and therefore no further assessment is required.

###### *9.5.2.1.3.1.3 DBS East and West Together*

103. The wind farm construction displacement from DBS East and DBS West in the breeding, autumn and spring seasons were up to 3.7 (60% adults) and 6.2 (100% adults), 0.3 and 0.04, respectively. Displacement mortalities due to construction vessels were 0.72 (60% adults) and 1.14 (100% adults), 0.06 and 0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 4.4 (60% adults) and 6.6 (100% adults), 0.36 and 0.05 birds during the breeding, autumn and spring.

104. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 4.8 to 7.0 birds per annum. These result in a predicted change in adult mortality rate of 0.21% to 0.30% which are below the 1% threshold for detectability and therefore no further assessment is required.

##### *9.5.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.5.2.1.3.2.1 DBS East in Isolation*

105. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding, autumn and spring seasons were up to 3.6 (60% adults) and 6.0 (100% adults), 0.3 and 0.04, respectively (**Table 9-12**).

106. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 3.96 to 6.3 birds per annum. These result in a predicted change in adult mortality rate of 0.17% to 0.27% which are below the 1% threshold for detectability and therefore no further assessment is required.

###### *9.5.2.1.3.2.2 DBS West in Isolation*

107. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding, autumn and spring seasons were up to 3.9 (60% adults) and 6.4 (100% adults), 0.3 and 0.04, respectively (**Table 9-12**).

108. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 4.2 to 6.7 birds per annum. These result in a predicted change in adult mortality rate of 0.18% to 0.29% which are below the 1% threshold for detectability and therefore no further assessment is required.

#### *9.5.2.1.3.2.3 DBS East and West Together*

109. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding, autumn and spring seasons were up to 7.5 (60% adults) and 12.5 (100% adults), 0.6 and 0.08, respectively (**Table 9-12**).

110. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,310 (26,250 x 0.088). The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 8.2 to 13.2 birds per annum. These result in a predicted change in adult mortality rate of 0.35% to 0.57% which are below the 1% threshold for detectability and therefore no further assessment was required (**Table 9-14).**

### *9.5.2.1.3.3 Potential Effects During Operation: Collision Risk*

*Table 9-13 Summary of gannet total collisions and apportioned to the Flamborough and Filey Coast SPA. Note that breeding season impacts have been estimated assuming 60% of birds present were adults (demographic) and also 100% (shaded cells).*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 0.7 | 3.4 | 7.8 | 100 | 60 | 0.44 | 2.04 | 4.68 |
| | | | | | | 100 | 0.74 | 3.40 | 7.80 |
| | Autumn | 0.3 | 1.6 | 3.8 | 4.8 | 100 | 0.02 | 0.08 | 0.18 |
| | Spring | 0.0 | 0.1 | 0.6 | 6.2 | 100 | 0.00 | 0.01 | 0.03 |
| | Annual | 1.1 | 5.1 | 12.2 | - | 60 | 0.46 | 2.12 | 4.90 |
| | | | | | | 100 | 0.76 | 3.48 | 8.02 |

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS West | Breeding | 1.0 | 4.8 | 11.4 | 100 | 60 | 0.60 | 2.89 | 6.84 |
| | | | | | | 100 | 1.00 | 4.81 | 11.40 |
| | Autumn | 0.3 | 2.1 | 5.9 | 4.8 | 100 | 0.01 | 0.10 | 0.28 |
| | Spring | 0.0 | 0.1 | 0.6 | 6.2 | 100 | 0.00 | 0.01 | 0.04 |
| | Annual | 1.3 | 7.1 | 17.9 | - | 60 | 0.61 | 3.00 | 7.16 |
| | | | | | | 100 | 1.01 | 4.92 | 11.72 |
| DBS East + DBS West | Breeding | 2.7 | 8.2 | 16.1 | 100 | 60 | 1.63 | 4.93 | 9.66 |
| | | | | | | 100 | 2.71 | 8.21 | 16.10 |
| | Autumn | 1.1 | 3.7 | 8.1 | 4.8 | 100 | 0.05 | 0.18 | 0.39 |
| | Spring | 0.0 | 0.2 | 0.9 | 6.2 | 100 | 0.00 | 0.01 | 0.05 |
| | Annual | 3.8 | 12.2 | 25.1 | - | 60 | 1.68 | 5.12 | 10.10 |
| | | | | | | 100 | 2.76 | 8.40 | 16.54 |

*9.5.2.1.3.3.1 DBS East in Isolation*

111. Based on adult gannet proportions of 60% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding gannet population is 2.0 (0.4 to 4.7 at 60% adults) and 3.4 (0.7 to 7.8 at 100% adults) birds in the breeding season, 0.08 (0.02 to 0.18) birds during autumn migration and 0.01 (0 to 0.03) birds during spring migration (**Table 9-13**).

112. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding gannet population is 2.1 (0.5 to 4.9) to 3.5 (0.8 to 8.0) birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which are below the 1% threshold for detectability and therefore no further assessment was required.

*9.5.2.1.3.3.2 DBS West in Isolation*

113. Based on adult gannet proportions of 60% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding gannet population is 2.9 (0.6 to 6.8 at 60% adults) and 4.8 (1.0 to 11.4 at 100% adults) birds in the breeding season, 0.10 (0.01 to 0.28) birds during autumn migration and 0.01 (0 to 0.04) birds during spring migration (**Table 9-13**).

114. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 3.0 (0.61 to 7.2) to 4.9 (1.0 to 11.7) birds per annum. These result in a predicted change in adult mortality rate of 0.13% to 0.21% which are below the 1% threshold for detectability and therefore no further assessment was required.

*9.5.2.1.3.3.3 DBS East and West Together*

115. Based on an adult gannet proportions of 60% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East and DBS West alone on the breeding gannet population is 4.9 (1.6 to 9.7 at 60% adults) and 8.2 (2.7 to 16.1 at 100% adults) birds in the breeding season, 0.18 (0.05 to 0.39) birds during autumn migration and 0.01 (0 to 0.05) birds during spring migration (**Table 9-13**).

116. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 5.1 (1.7 to 10.1) to 8.4 (2.8 to 16.5) birds per annum. These result in a predicted change in adult mortality rate of 0.22% to 0.36% which are below the 1% threshold for detectability and therefore no further assessment was required (**Table 9-14**).

##### 9.5.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk

###### 9.5.2.1.3.4.1 DBS East in Isolation

117. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS East alone is up to 7.0 (3.6 + 3.4) birds in the breeding season, 1.9 (0.3 + 1.6) birds during autumn migration and 0.14 (0.04 + 0.1) birds during spring migration.

118. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding gannet population is 9.0 birds per annum. This results in a predicted change in adult mortality rate of 0.39% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.5.2.1.3.4.2 DBS West in Isolation

119. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS West alone is 11.2 (6.4 + 4.8) birds in the breeding season, 2.4 (0.3 + 2.1) birds during autumn migration and 0.14 (0.04 + 0.1) birds during spring migration.

120. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 13.7 birds per annum. This results in a predicted change in adult mortality rate of 0.59% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.5.2.1.3.4.3 DBS East and West Together

121. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS East and DBS West together is 20.7 (12.5 + 8.2) birds in the breeding season, 0.97 (0.6 + 0.37) birds during autumn migration and 0.28 (0.08 + 0.2) birds during spring migration.

122. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 21.9 birds per annum. This results in a predicted change in adult mortality rate of 0.9% which is below the 1% threshold for detectability and therefore no further assessment was required (**Table 9-14**).

##### *9.5.2.1.4 Summary of DBS alone*

123. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-14**).

124. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

*Table 9-14 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Gannet** | | |
|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | |
| Displacement mortality (40% + 1%) | | Mean |
| Breeding season (60-100% adults) | | 4.46-6.59 |
| Autumn | | 0.36 |
| Spring | | 0.05 |
| Annual | | 4.88-7.0 |
| Effect | Reference population | 26,250 |
| | Increase in background mortality (%) | 0.21-0.30 |
| **Potential Effects During Operation: Disturbance and Displacement** | | |
| Displacement mortality (80% + 1%) | | Mean |
| Breeding season (60-100% adults) | | 7.5-12.5 |
| Autumn | | 0.61 |
| Spring | | 0.08 |
| Annual | | 8.18-13.2 |
| Effect | Reference population | 26,250 |

| Gannet | | | | |
|---|---|---|---|---|
| | Increase in background mortality (%) | 0.35-0.57 | | |
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season (60-100% adults) | | 1.6-2.7 | 4.9-8.2 | 9.7-16.1 |
| Autumn | | 0.05 | 0.18 | 0.39 |
| Spring | | 0.00 | 0.01 | 0.05 |
| Annual | | 1.68-2.76 | 5.12-8.4 | 10.1-16.5 |
| Effect | Reference population | 26,250 | | |
| | Increase in background mortality (%) | 0.01-0.12 | 0.2-0.36 | 0.43-0.7 |
| **Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk** | | | | |
| Combined Displacement and Collision mortality | | Mean | | |
| Breeding season | | 12.4-20.7 | | |
| Autumn | | 0.79 | | |
| Spring | | 0.10 | | |
| Annual | | 13.3-21.6 | | |
| Effect | Reference population | 26,250 | | |
| | Increase in background mortality (%) | 0.58-0.94 | | |

##### *9.5.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

###### *9.5.2.1.5.1 Potential Effects During Operation: Disturbance and Displacement*

125. Seasonal and annual abundance estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-15**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

126. The estimated total number of gannets at risk of displacement from all OWFs within the UK North Sea BDMPS combined is 59,359 of which 10,243 to 10,867 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-15**). Using displacement rates of 60% to 80% and a maximum mortality rate of 1% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between 61 to 87.

127. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual in-combination mortality on the breeding gannet population would result in a predicted change in adult mortality rate of between 2.6% and 3.7%. These are above the 1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further. The results of the PVA are considered below (paragraph 133).

*Table 9-15 Total in-combination gannet abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.*

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 1 | Beatrice | 151 | 0 | 0 | 0 | 0 | 0 | 151 | 0 |
| 1 | Beatrice Demonstrator | - | - | - | - | - | - | - | - |
| 1 | Blyth Demonstration Project | - | - | - | - | - | - | - | - |
| 1 | Dudgeon | 53 | 53 | 25 | 1.2 | 11 | 0.7 | 89 | 54.9 |
| 1 | East Anglia ONE | 161 | 161 | 3638 | 174.6 | 76 | 4.7 | 3875 | 340.3 |
| 1 | European Offshore Wind Deployment Centre | 35 | 0 | 5 | 0.2 | 0 | 0 | 40 | 0.2 |
| 1 | Galloper | 360 | 0 | 907 | 43.5 | 276 | 17.1 | 1543 | 60.6 |
| 1 | Greater Gabbard | 252 | 0 | 69 | 3.3 | 105 | 6.5 | 426 | 9.8 |
| 1 | Gunfleet Sands | 0 | 0 | 12 | 0.6 | 9 | 0.6 | 21 | 1.2 |
| 1 | Hornsea Project One | 671 | 671 | 694 | 33.3 | 250 | 15.5 | 1615 | 719.8 |
| 1 | Humber Gateway | - | - | - | - | - | - | - | - |
| 1 | Hywind | 10 | 0 | 0 | 0 | 4 | 0.2 | 14 | 0.2 |
| 1 | Kentish Flats | - | - | - | - | - | - | - | - |
| 1 | Kentish Flats Extension | 0 | 0 | 13 | 0.6 | 0 | 0 | 13 | 0.6 |
| 1 | Kincardine | 120 | 0 | 0 | 0 | 0 | 0 | 120 | 0 |
| 1 | Lincs | - | - | - | - | - | - | - | - |
| 1 | London Array | - | - | - | - | - | - | - | - |
| 1 | Race Bank | 92 | 92 | 32 | 1.5 | 29 | 1.8 | 153 | 95.3 |
| 1 | Rampion | 0 | 0 | 590 | 28.3 | 0 | 0 | 590 | 28.3 |
| 1 | Scroby Sands | - | - | - | - | - | - | - | - |
| 1 | Sheringham Shoal | 47 | 47 | 31 | 1.5 | 2 | 0.1 | 80 | 48.6 |
| 1 | Teesside | 1 | 0.5 | 0 | 0 | 0 | 0 | 1 | 0.5 |
| 1 | Thanet | - | - | - | - | - | - | - | - |
| 1 | Westermost Rough | - | - | - | - | - | - | - | - |
| 2 | Triton Knoll | 211 | 211 | 15 | 0.7 | 24 | 1.5 | 250 | 213.2 |
| 3 | Dogger Bank Creyke Beck Projects A and B | 1155 | 577.5 | 2048 | 98.3 | 394 | 24.4 | 3597 | 700.2 |
| 3 | Dogger Bank Teesside Projects A and B | 2250 | 1125 | 887 | 42.6 | 464 | 28.8 | 3601 | 1196.4 |
| 3 | East Anglia ONE North | 149 | 149 | 468 | 22.5 | 44 | 2.7 | 661 | 174.2 |
| 3 | East Anglia THREE | 412 | 412 | 1269 | 60.9 | 524 | 32.5 | 2205 | 505.4 |
| 3 | East Anglia TWO | 192 | 192 | 891 | 42.8 | 192 | 11.9 | 1275 | 246.7 |
| 3 | Firth of Forth Alpha and Bravo | 2956 | 0 | 664 | 31.9 | 332 | 20.6 | 3952 | 52.5 |
| 3 | Hornsea Project Three | 1333 | 844 | 984 | 47 | 524 | 32.5 | 2841 | 924 |
| 3 | Hornsea Project Two | 457 | 457 | 1140 | 54.7 | 124 | 7.7 | 1721 | 519.4 |
| 3 | Inch Cape | 2398 | 0 | 703 | 33.7 | 212 | 13.1 | 3313 | 46.8 |
| 3 | Methil | 23 | 0 | 0 | 0 | 0 | 0 | 23 | 0 |
| 3 | Moray Firth (EDA) | 564 | 0 | 292 | 14 | 27 | 1.7 | 883 | 15.7 |
| 3 | Moray West | 2827 | 0 | 439 | 21.1 | 144 | 8.9 | 3410 | 30 |

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 3 | Neart na Gaoithe | 1987 | 0 | 552 | 26.5 | 281 | 17.4 | 2820 | 43.9 |
| 3 | Norfolk Boreas | 1229 | 1229 | 1723 | 82.7 | 526 | 32.6 | 3478 | 1344.3 |
| 3 | Norfolk Vanguard | 271 | 271 | 2453 | 117.7 | 437 | 27.1 | 3161 | 415.8 |
| 3 | Hornsea Project Four | 976 | 883.1 | 790 | 38.3 | 401 | 25 | 2167 | 946.4 |
| 4 | Rampion 2 | 111 | 0 | 102 | 4.9 | 123 | 7.6 | 336 | 12.5 |
| 4 | DEP | 417 | 319.8 | 343 | 16.5 | 47 | 2.9 | 807 | 339.2 |
| 4 | SEP | 23 | 17.6 | 295 | 14.1 | 11 | 0.7 | 328 | 32.4 |
| 4 | Berwick Bank | 4735 | 61 | 1500 | 30 | 269 | 11 | 6504 | 102 |
| **Total without DBS** | | **26629** | **7773.5** | **23574** | **1089.5** | **5862** | **357.83** | **56064** | **9221.3** |
| 5 | DBS East | 755 | 452.9 | 776 | 37.6 | 75 | 4.7 | 1606 | 495 |
| 5 | DBS West | 805 | 483.2 | 798 | 38.7 | 86 | 5.4 | 1689 | 527 |
| 5a | DBS East+West (60% adults in breeding season) | 1560 | 936 | 1574 | 76 | 161 | 10 | 3295 | 1022 |
| 5b | DBS East+West (100% adults in breeding season) | | 1560 | | | | | | 1646 |
| **5a Total (all projects)** | | **28189** | **8710** | **25148** | **1165** | **6023** | **368** | **59359** | **10243** |
| **5b Total (all projects)** | | | **9334** | | | | | | **10867** |

*9.5.2.1.5.2 Potential Effects During Operation: Collision Risk*

128. Seasonal and annual collision mortality estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-16**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

129. The estimated total number of gannets at risk of collision from all OWFs within the UK North Sea BDMPS combined is 665 of which between 73 and 76.4 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-16**).

130. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual in-combination collision mortality would result in a predicted change in adult mortality rate of 3.1% to 3.3%. These are above the 1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further. The results of the PVA are considered below (paragraph 133).

*Table 9-16 Total in-combination gannet collision risk at North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population. Collisions adjusted to 99.2% micro-avoidance and 70% macro-avoidance.*

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 1 | Beatrice | 8.2 | 0 | 10.6 | 0.5 | 2.1 | 0.1 | 20.9 | 0.6 |
| 1 | Beatrice Demonstrator | 0.2 | 0 | 0.3 | 0 | 0.2 | 0 | 0.7 | 0 |
| 1 | Blyth Demonstration Project | 0.8 | 0 | 0.5 | 0 | 0.6 | 0 | 1.8 | 0.1 |
| 1 | Dudgeon | 4.9 | 4.9 | 8.5 | 0.4 | 4.2 | 0.3 | 17.5 | 5.5 |
| 1 | East Anglia ONE | 0.7 | 0.7 | 28.6 | 1.4 | 1.4 | 0.1 | 30.8 | 2.2 |
| 1 | European Offshore Wind Deployment Centre | 0.9 | 0 | 1.1 | 0.1 | 0 | 0 | 2 | 0.1 |
| 1 | Galloper | 3.9 | 0 | 6.7 | 0.3 | 2.7 | 0.2 | 13.4 | 0.5 |
| 1 | Greater Gabbard | 3.1 | 0 | 1.9 | 0.1 | 1 | 0.1 | 6 | 0.2 |
| 1 | Gunfleet Sands | - | - | - | - | - | - | - | - |
| 1 | Hornsea Project One | 2.5 | 2.5 | 7 | 0.3 | 4.9 | 0.3 | 14.4 | 3.1 |
| 1 | Humber Gateway | 0.4 | 0.4 | 0.2 | 0 | 0.3 | 0 | 1 | 0.4 |
| 1 | Hywind | 1.2 | 0 | 0.2 | 0 | 0.2 | 0 | 1.6 | 0 |
| 1 | Kentish Flats | 0.3 | 0 | 0.2 | 0 | 0.2 | 0 | 0.7 | 0 |
| 1 | Kentish Flats Extension | - | - | - | - | - | - | - | - |
| 1 | Kincardine | 0.7 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 |
| 1 | Lincs | 0.5 | 0.5 | 0.3 | 0 | 0.4 | 0 | 1.1 | 0.5 |
| 1 | London Array | 0.5 | 0 | 0.3 | 0 | 0.4 | 0 | 1.2 | 0 |
| 1 | Lynn and Inner Dowsing | 0.1 | 0.1 | 0 | 0 | 0.1 | 0 | 0.2 | 0.1 |
| 1 | Race Bank | 7.4 | 7.4 | 2.6 | 0.1 | 0.9 | 0.1 | 10.8 | 7.5 |
| 1 | Rampion | 7.9 | 0 | 13.9 | 0.7 | 0.5 | 0 | 22.2 | 0.7 |
| 1 | Scroby Sands | - | - | - | - | - | - | - | - |
| 1 | Sheringham Shoal | 3.1 | 3.1 | 0.8 | 0 | 0 | 0 | 3.8 | 3.1 |
| 1 | Teesside | 1.1 | 0.5 | 0.4 | 0 | 0 | 0 | 1.5 | 0.5 |
| 1 | Thanet | 0.2 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 |
| 1 | Westermost Rough | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 |
| 2 | Triton Knoll | 5.8 | 5.8 | 14 | 0.7 | 6.6 | 0.4 | 26.4 | 6.9 |
| 3 | Dogger Bank Creyke Beck Projects A and B | 17.7 | 8.9 | 18.2 | 0.9 | 11.9 | 0.7 | 47.8 | 10.5 |
| 3 | Dogger Bank Teesside Projects A and B | 3.2 | 1.6 | 2.2 | 0.1 | 2.4 | 0.1 | 7.8 | 1.9 |
| 3 | East Anglia THREE | 1.3 | 1.3 | 7.3 | 0.3 | 2.1 | 0.1 | 10.7 | 1.8 |
| 3 | Firth of Forth Alpha and Bravo | 174.7 | 0 | 10.8 | 0.5 | 14.4 | 0.9 | 199.8 | 1.4 |
| 3 | Hornsea Project Three | 2.2 | 1.3 | 1.1 | 0 | 0.9 | 0 | 4.1 | 1.5 |
| 3 | Hornsea Project Two | 1.5 | 1.5 | 3.1 | 0.1 | 1.3 | 0.1 | 5.9 | 1.7 |
| 3 | Inch Cape | 73.5 | 0 | 6.4 | 0.3 | 1.1 | 0.1 | 81 | 0.4 |
| 3 | Methil | 1.8 | 0 | 0 | 0 | 0 | 0 | 1.8 | 0 |
| 3 | Moray Firth (EDA) | 17.6 | 0 | 7.7 | 0.4 | 1.9 | 0.1 | 27.3 | 0.5 |
| 3 | Moray West | 2.2 | 0 | 0.4 | 0 | 0.2 | 0 | 2.8 | 0 |
| 3 | Neart na Gaoithe | 31.2 | 0 | 10.3 | 0.5 | 5 | 0.3 | 46.5 | 0.8 |
| 3 | Norfolk Boreas | 3.1 | 3.1 | 2.8 | 0.1 | 0.9 | 0.1 | 6.7 | 3.3 |
| 3 | Norfolk Vanguard | 1.8 | 1.8 | 4.1 | 0.2 | 1.2 | 0.1 | 7 | 2.1 |

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 3 | East Anglia TWO | 2.7 | 2.7 | 5 | 0.2 | 0.9 | 0 | 8.6 | 3 |
| 3 | East Anglia ONE North | 2.7 | 2.7 | 2.4 | 0.1 | 0.2 | 0 | 5.3 | 2.8 |
| 3 | Hornsea Project Four | 3.4 | 3.1 | 1.1 | 0.1 | 0.3 | 0 | 4.9 | 3.2 |
| 4 | Rampion 2 | 2.9 | 0 | 1.4 | 0.1 | 0.6 | 0.0 | 4.9 | 0.1 |
| 4 | DEP | 0.4 | 0.3 | 0.5 | 0 | 0 | 0 | 0.9 | 0.3 |
| 4 | SEP | 0 | 0 | 0.1 | 0 | 0 | 0 | 0.2 | 0 |
| 4 | Berwick Bank | 30 | 0.4 | 3 | 0.1 | 0.4 | 0 | 33.4 | 0.4 |
| **Total before DBS** | | **428.3** | **54.6** | **186.0** | **8.6** | **72.4** | **4.2** | **686.0** | **67.7** |
| 5 | DBS East | 3.5 | 2.1 | 1.6 | 0.1 | 0.1 | 0.0 | 5.3 | 2.2 |
| 5 | DBS West | 4.9 | 2.9 | 2.1 | 0.1 | 0.1 | 0.0 | 7.1 | 3.0 |
| 5a | DBS East+West (60% adults in breeding season) | 8.2 | 5.0 | 3.7 | 0.2 | 0.2 | 0.0 | 12.4 | 5.1 |
| 5b | DBS East+West (100% adults in breeding season) | | 8.2 | | | | | | 8.4 |
| **5a Total (all projects)** | | **407** | **59** | **187** | **9** | **72** | **4** | **665** | **73** |
| **5b Total (all projects)** | | | **63.4** | | | | | | **76.4** |

##### *9.5.2.1.5.3 Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

131. The annual displacement and collision mortality estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-15** and **Table 9-16**. The estimated total number of breeding adult gannets from Flamborough and Filey Coast SPA at risk of both displacement and collision mortality from all OWFs within the UK North Sea BDMPS combined is 134 to 162.

132. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,310 (26,250 x 0.088) adults per annum. The predicted annual in-combination displacement and collision mortality would result in a predicted change in adult mortality rate of 5.8% to 7.0%. These are above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further. The results of the PVA are considered below (paragraph 133).

##### *9.5.2.1.5.4 Population Viability Analysis Results for gannet*

133. The Natural England commissioned Population Viability Analysis (PVA) tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA ResultsAnnex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-17**.

*Table 9-17 PVA results for in-combination impacts on FFC SPA gannet after 30 years.*

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination displacement lower (60% x 1%) | 61 | 0. 0023238 | 0.9983 (0.9976-0.9991) | 0.9492 (0.9265-0.9723) |
| In-combination displacement lower (80% x 1%) | 87 | 0.0033143 | 0.9976 (0.9968-0.9984) | 0.9285 (0.9063-0.9509) |
| In-combination collisions | 76 | 0.0029105 | 0.9979 (0.9971-0.9987) | 0.9369 (0.9153-0.9597) |

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination displacement lower (60% x 1%) + collisions | 137 | 0.0052190 | 0.9962 (0.9955-0.9970) | 0.8897 (0.8685-0.9113) |
| In-combination displacement lower (80% x 1%) + collisions | 163 | 0.0062095 | 0.9955 (0.9947-0.9963) | 0.8702 (0.8492-0.8916) |

134. After a period of 30 years, in-combination displacement reduced the population growth rate by up to 0.24% (0.9976), in-combination collision risk reduced the population growth rate by up to 0.21% (0.9979), and displacement and collisions combined reduced the population growth rate by up to 0.45% (0.9955).

135. After a period of 30 years, in-combination displacement reduced the population compared to the baseline size by up to 7.1% (0.9285), in-combination collision risk reduced the population size by up to 6.3% (0.9369), and displacement and collisions combined reduced the population compared to the baseline size by up to 13.0% (0.8702).

136. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

137. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the gannet PVA, with a baseline annual average growth rate of 1.7% and a maximum impacted growth rate of 1.25%. These result in median populations after 30 years of over 43,000 and 38,000 for baseline and maximum impact respectively. It is clear therefore that the 10% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still grown considerably from the starting size of 26,250 (which has in fact already been exceeded, with the most recent population estimate of 30,446 in 2023).

138. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example, the CPS after 10 years was 0.9499 (a 5% difference to the baseline) which increased to 0.8702 (13%) after 30 years, while the CPGR after 10 years was almost exactly the same (0.9953) as that after 30 years (0.9955). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

139. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the gannet population at Flamborough and Filey Coast SPA has grown at an average rate of 2.9% per year between 2012 (11,061 AON) and 2023 (15,223 AON). The maximum CPGR was 0.45% which if realised would only reduce the annual growth rate to 2.45%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

140. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts:

- The use of mean peak abundance estimates in the displacement assessment is likely to result in unrealistically high predictions about displaced effects, especially when combined across wind farms;
- The assumption of a 1% mortality rate for displaced birds is not based on any scientific evidence and is highly likely to be an overestimate;
- Most of the impact estimates for other wind farms are based on their consented designs, not the actual built designs, which will over-estimate collision risks;
- The lack of density dependence in the PVA means the CPS values in particular present overly pessimistic outcomes which are very unlikely to occur; and

- The PVA are run as closed populations, with no immigration or emigration, while it is well known that seabird populations operate as metapopulations with considerable levels of exchange. The interconnections in seabird populations will confer a large degree of resilience which is absent from the assessment.

141. Therefore, in conclusion, the combined displacement and collision impacts for gannet predicted at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

### 9.5.2.2 Kittiwake

142. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

#### *9.5.2.2.1 Status*

143. Kittiwake is listed as a designated species of the Flamborough and Filey Coast SPA.

144. The SPA breeding population at classification was cited as 44,520 pairs or 89,040 breeding adults, for the period 2008 to 2011 (Natural England, 2018b). Clarkson *et al*. (2022) reported the 2022 population was 44,574 apparently occupied nests (AON), or 89,148 breeding adults, while Burnell *et al*. (2023) reported a small increase to 45,504 AON, 91,008 individuals. The baseline mortality of this population using the most recent figure is 13,287 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015).

145. Supplementary advice on the conservation objectives were added for qualifying features of the Flamborough and Filey Coast SPA in 2020 (Natural England, 2020). For kittiwake, these are:

- Restore the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent;
- Restore safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;

- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Restore the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;
- Restore the distribution, abundance and availability of key food and prey items (e.g. sandeel, sprat, cod, squid, shrimps) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

##### *9.5.2.2.2 Connectivity to the Projects*

146. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the Flamborough and Filey Coast SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA (based on the most recent count of 91,008 breeding adults) is calculated as 92% (**Table 9-6)**.

147. Outside the breeding season breeding kittiwakes, including those from the Flamborough and Filey Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

148. During the autumn migration and spring migration seasons, 60% of the Flamborough and Filey Coast SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 5.4% and 7.2% of birds respectively present in the Project array areas are breeding adults from the Flamborough and Filey Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.5.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.5.2.2.3.1 Potential Effects During Operation: Collision risk*

*Table 9-18 Summary of kittiwake total collisions and apportioned to the Flamborough and Filey Coast SPA. Note that breeding season impacts have been estimated assuming 53% of birds present were adults (demographic) and also 100% (shaded cells).*

| **Site** | **Season** | **Collision mortality** | | | **SPA %** | **Adult %** | **Collisions apportioned to SPA** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Lower 95% c.i.** | **Mean** | **Upper 95% c.i.** | | | **Lower 95% c.i.** | **Mean** | **Upper 95% c.i.** |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 92 | 53 | 20.63 | 40.62 | 82.16 |
| | | | | | | 100 | 38.92 | 76.64 | 155.02 |
| | Autumn | 14.6 | 41.4 | 82.9 | 5.4 | 100 | 0.79 | 2.24 | 4.48 |
| | Spring | 6.8 | 14.6 | 28.0 | 7.2 | 100 | 0.49 | 1.05 | 2.02 |
| | Annual (53% adults) | 66.9 | 139.3 | 261.3 | - | - | 21.90 | 43.90 | 88.65 |
| | Annual (100% adults) | | | | | | 40.19 | 79.92 | 161.51 |

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS West | Breed-ing | 36.9 | 107.8 | 280.8 | 92 | 53 | 17.99 | 52.56 | 136.92 |
| | | | | | | 100 | 33.95 | 99.18 | 258.34 |
| | Autumn | 9.5 | 37.9 | 81.9 | 5.4 | 100 | 0.51 | 2.05 | 4.42 |
| | Spring | 7.1 | 14.9 | 26.5 | 7.2 | 100 | 0.51 | 1.07 | 1.91 |
| | Annual (53% adults) | 55.9 | 160.6 | 327.0 | - | - | 19.02 | 55.68 | 143.25 |
| | Annual (100% adults) | | | | | | 34.97 | 102.3 | 264.67 |
| DBS East + DBS West | Breed-ing | 96.2 | 191.1 | 378.4 | 92 | 53 | 46.91 | 93.18 | 184.51 |
| | | | | | | 100 | 88.50 | 175.8 | 348.13 |
| | Autumn | 30.5 | 79.3 | 143.1 | 5.4 | 100 | 1.65 | 4.28 | 7.73 |
| | Spring | 16.9 | 29.5 | 47.3 | 7.2 | 100 | 1.22 | 2.12 | 3.41 |
| | Annual (53% adults) | 150.9 | 299.9 | 540.5 | - | - | 49.77 | 99.59 | 195.64 |
| | Annual (100% adults) | | | | | | 91.37 | 182.2 | 359.26 |

###### *9.5.2.2.3.1.1 DBS East in Isolation*

149. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (92%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is 40.6 (20.6 to 82.2 at 53% adults) and 76.6 (38.9 to 155.0 at 100% adults) birds in the breeding season, 2.2 (0.8 to 4.5) birds during autumn migration and 1.0 (0.5 to 2.0) birds during spring migration (**Table 9-18**).

150. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,287 (91,008 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is 43.9 (21.9 to 88.6) to 79.9 (40.2 to 161.5) birds per annum. These result in a predicted change in adult mortality rate of 0.33% to 0.6% which are below the 1% threshold for detectability and therefore no further assessment was required.

*9.5.2.2.3.1.2 DBS West in Isolation*

151. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (92%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is 52.6 (18.0 to 136.9 at 53% adults) and 99.2 (33.9 to 258.3 at 100% adults) birds in the breeding season, 2.0 (0.5 to 4.4) birds during autumn migration and 1.1 (0.5 to 1.9) birds during spring migration (**Table 9-18**).

152. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,287 (91,008 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population are 55.7 (19.0 to 143.2) to 102.3 (34.9 to 264.7) birds per annum. These result in a predicted change in adult mortality rate of 0.42% to 0.77% which are below the 1% threshold for detectability and therefore no further assessment was required.

*9.5.2.2.3.1.3 DBS East and DBS West Together*

153. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (92%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is 93.2 (46.9 to 184.5 at 53% adults) and 175.8 (88.5 to 348.1 at 100% adults) birds in the breeding season, 4.3 (1.6 to 7.7) birds during autumn migration and 2.1 (1.2 to 3.4) birds during spring migration (**Table 9-18**).

154. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,287 (91,008 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects alone on the breeding kittiwake population is 99.6 (49.8 to 195.6) to 182.2 (91.4 to 359.3) birds per annum. These result in predicted changes in adult mortality rate of 0.75% to 1.37% which at the upper end of the range exceeds the 1% threshold for detectability. Further consideration of kittiwake impacts using PVA is provided in the in-combination section below (paragraph 159).

##### *9.5.2.2.4 Summary of DBS alone*

155. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-19**).

*Table 9-19 Summary of predicted Kittiwake collision mortality from the Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season (53-100% adults) | | 46.9-88.5 | 93.2-175.8 | 184.5-348.1 |
| Autumn | | 1.6 | 4.3 | 7.7 |
| Spring | | 1.2 | 2.1 | 3.4 |
| Annual | | 49.8-91.4 | 99.6-182.2 | 195.6-359.3 |
| Effect | Reference population | | | 91,008 |
| | Increase in background mortality (%) | 0.4-0.7 | 0.75-1.37 | 1.5-2.7 |

##### *9.5.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

###### *9.5.2.2.5.1 Potential Effects During Operation: Collision Risk*

156. Seasonal and annual collision mortality estimates of kittiwake, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-20**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

157. The estimated total number of kittiwakes at risk of collision from all OWFs within the UK North Sea BDMPS combined is 3,995 of which between 351 and 434 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-20**).

158. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,287 (91,008 x 0.146) adults per annum. The predicted annual in-combination collision mortality would result in a predicted change in adult mortality rate of 2.6 – 3.3%. This is above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further.

*Table 9-20 Total in-combination kittiwake collision risk at North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.*

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 1 | Beatrice | 68.9 | 0 | 7.8 | 0.4 | 28.9 | 2.1 | 105.6 | 2.5 |
| 1 | Beatrice Demonstrator | 0 | 0 | 2.1 | 0.1 | 1.7 | 0.1 | 3.8 | 0.2 |
| 1 | Blyth Demonstration Project | 1.2 | 0 | 1.7 | 0.1 | 1 | 0.1 | 3.9 | 0.1 |
| 1 | Dudgeon | - | - | - | - | - | - | - | - |
| 1 | East Anglia ONE | 1.3 | 0 | 116.7 | 6.3 | 34 | 2.5 | 152 | 8.7 |
| 1 | European Offshore Wind Deployment Centre | 8.6 | 0 | 4.2 | 0.2 | 0.8 | 0.1 | 13.6 | 0.3 |
| 1 | Galloper | 4.6 | 0 | 20.2 | 1.1 | 23.1 | 1.7 | 47.9 | 2.8 |
| 1 | Greater Gabbard | 0.8 | 0 | 10.9 | 0.6 | 8.3 | 0.6 | 20 | 1.2 |
| 1 | Gunfleet Sands | - | - | - | - | - | - | - | - |
| 1 | Hornsea Project One | 32 | 26.5 | 40.7 | 2.2 | 15.2 | 1.1 | 87.9 | 29.8 |
| 1 | Humber Gateway | 1.4 | 1.4 | 2.3 | 0.1 | 1.4 | 0.1 | 5.1 | 1.6 |
| 1 | Hywind | 12.1 | 0 | 0.7 | 0.1 | 0.7 | 0.1 | 13.3 | 0.1 |
| 1 | Kentish Flats | 0 | 0 | 0.7 | 0.1 | 0.5 | 0.1 | 1.2 | 0.1 |
| 1 | Kentish Flats Extension | 0 | 0 | 0 | 0 | 2.7 | 0.2 | 2.7 | 0.2 |
| 1 | Kincardine | 16 | 0 | 6.5 | 0.4 | 0.7 | 0.1 | 23.3 | 0.4 |
| 1 | Lincs | 0.5 | 0.5 | 0.9 | 0.1 | 0.5 | 0.1 | 1.9 | 0.6 |
| 1 | London Array | 1 | 0 | 1.7 | 0.1 | 1.3 | 0.1 | 4 | 0.2 |
| 1 | Lynn and Inner Dowsing | - | - | - | - | - | - | - | - |
| 1 | Race Bank | 1.4 | 1.4 | 17.4 | 0.9 | 4.1 | 0.3 | 22.8 | 2.6 |
| 1 | Rampion | 39.6 | 0 | 27.2 | 1.5 | 21.6 | 1.5 | 88.4 | 3.1 |
| 1 | Scroby Sands | - | - | - | - | - | - | - | - |
| 1 | Sheringham Shoal | - | - | - | - | - | - | - | - |
| 1 | Teesside | 27.9 | 0 | 17.5 | 0.9 | 1.8 | 0.1 | 47.2 | 1.1 |
| 1 | Thanet | 0.1 | 0 | 0.4 | 0 | 0.3 | 0 | 0.8 | 0.1 |
| 1 | Westermost Rough | 0.1 | 0.1 | 0.1 | 0 | 0.1 | 0 | 0.4 | 0.1 |
| 2 | Triton Knoll | 17.9 | 17.9 | 101.1 | 5.5 | 33 | 2.4 | 152 | 25.7 |
| 3 | Dogger Bank Creyke Beck Projects A and B | 209.9 | 40.6 | 98.2 | 5.3 | 214.8 | 15.5 | 522.9 | 61.3 |
| 3 | Dogger Bank Teesside Projects A and B | 99.6 | 19.2 | 66 | 3.6 | 157.7 | 11.3 | 323.3 | 34.1 |
| 3 | East Anglia THREE | 4.4 | 0 | 50.2 | 2.7 | 27.3 | 2 | 82 | 4.7 |
| 3 | Firth of Forth Alpha and Bravo | 111.3 | 0 | 227.7 | 12.3 | 180.1 | 12.9 | 519.1 | 25.2 |
| 3 | Hornsea Project Three | 56 | 0 | 27.6 | 0 | 5.8 | 0 | 89.5 | 0* |
| 3 | Hornsea Project Two | 11.6 | 9.7 | 6.5 | 0.4 | 2.2 | 0.1 | 20.4 | 10.2 |
| 3 | Inch Cape | 9.5 | 0 | 163.5 | 8.8 | 46.2 | 3.3 | 219.2 | 12.1 |
| 3 | Methil | 0.4 | 0 | 0 | 0 | 0 | 0 | 0.4 | 0 |
| 3 | Moray Firth (EDA) | 31.7 | 0 | 1.5 | 0.1 | 14 | 1 | 47.2 | 1.1 |
| 3 | Moray West | 57.5 | 0 | 17.5 | 0.9 | 5.1 | 0.4 | 80 | 1.3 |
| 3 | Neart na Gaoithe | 23.9 | 0 | 40.8 | 2.2 | 3.2 | 0.2 | 67.9 | 2.5 |
| 3 | Norfolk Boreas | 9.7 | 0 | 23.4 | 0 | 8.7 | 0 | 41.8 | 0* |
| 3 | Norfolk Vanguard | 15.9 | 0 | 11.9 | 0 | 14 | 0 | 41.8 | 0* |
| 3 | East Anglia TWO | 29.4 | 0 | 5.9 | 0 | 2.5 | 0 | 37.8 | 0* |

| Tier | Wind Farm | Breeding | | Autumn | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 3 | East Anglia ONE North | 21.5 | 0 | 3.9 | 0 | 5.4 | 0 | 30.8 | 0* |
| 3 | Hornsea Project Four | 54.2 | 51.2 | 10.1 | 0.5 | 3.3 | 0.2 | 67.6 | 0* |
| 4 | Rampion 2 | 1.3 | 0 | 1.2 | 0.1 | 5.3 | 0.4 | 7.7 | 0.4 |
| 4 | DEP | 6.6 | 5.6 | 3.4 | 0.2 | 0.9 | 0.1 | 10.9 | 0* |
| 4 | SEP | 0.6 | 0.5 | 0.9 | 0 | 0 | 0 | 1.5 | 0* |
| 4 | Berwick Bank | 426 | 0.4 | 155 | 7 | 104 | 10 | 685 | 17.4 |
| **Total before DBS** | | **1416.4** | **175** | **1296** | **64.8** | **982.2** | **70.8** | **3694.6** | **251.8** |
| 5 | DBS East | 83 | 40.1 | 41 | 2.2 | 15 | 1.1 | 139 | 43 |
| 5 | DBS West | 108 | 51.8 | 38 | 2.0 | 15 | 1.1 | 161 | 55 |
| 5a | DBS East+West (53% adults in breeding season) | 191 | 93 | 79 | 4 | 29 | 2 | 300 | 99 |
| 5b | DBS East+West (100% adults in breeding season) | | 176 | | | | | | 182 |
| **5a Total (all projects)** | | **1607** | **268** | **1375** | **69** | **1012** | **73** | **3995** | **351** |
| **5b Total (all projects)** | | | **351** | | | | | | **434** |

** Note projects for which compensation is required have been given an annual apportioned mortality of 0.*

##### *9.5.2.2.5.2 Population Viability Analysis Results for kittiwake*

159. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-21**.

*Table 9-21 PVA results for in-combination impacts on FFC SPA kittiwake after 30 years.*

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination collisions (assuming 53% adult proportion from DBS) | 351 | 0.0038568 | 0.9974 (0.9969-0.9979) | 0.9231 (0.9082-0.9377) |
| In-combination collisions (assuming 100% adult proportion from DBS) | 434 | 0.0047688 | 0.9968 (0.9963-0.9973) | 0.9057 (0.8913-0.9202) |

160. After a period of 30 years, in-combination collision risk reduced the population growth rate by up to 0.32% (0.9968) and reduced the population size compared to the baseline size by up to 9.4% (0.9057).

161. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

162. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the kittiwake PVA, with a baseline annual average growth rate of 2.1% and a maximum impacted growth rate of 1.8%. These result in median populations after 30 years of over 180,000 and 165,000 for baseline and maximum impact respectively. It is clear therefore that the 9.9% 'reduction' in population size suggested by the CPS is in fact a population which has simply not grown as quickly, but has still doubled from the starting size of over 91,000.

163. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example the CPS after 10 years was 0.9642 (3.6%) which increased to 0.9057 (9.4% after 30 years, while the CPGR after 10 years was almost exactly the same (0.9967) as that after 30 years (0.9968). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

164. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, since 2000 the kittiwake population at Flamborough and Filey Coast SPA has grown at an average rate of 2.5% per year. The maximum CPGR was 0.32% which if realised would only reduce the annual growth rate to 2.2%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

165. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above (paragraph 140).

166. Therefore, it is the Applicants' conclusion that the collision impacts predicted at DBS East and DBS West in-combination with other projects, will not adversely affect the integrity of the Flamborough and Filey Coast SPA.

167. Notwithstanding the above conclusion, the Applicants acknowledge that previous decisions on offshore wind farms by the Secretary of State have concluded that an AEoI for kittiwake at the Flamborough and Filey Coast SPA could not be ruled out for in-combination collision risk (e.g. Hornsea 3, Norfolk Vanguard, Norfolk Boreas). The Plan Level HRA conducted by The Crown Estate also concluded that an AEoI could not be ruled out. Given this, it is the Applicants assumption that the Secretary of State will conclude AEoI in this case also. Therefore, the Applicants do not consider it worthwhile to contest this point and on this basis **concede AEoI on the Flamborough and Filey Coast SPA.**

168. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 1 Project Level Kittiwake Compensation Plan (application ref: 6.2.1).**

#### 9.5.2.3 Guillemot

169. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.5.2.3.1 Status*

170. Guillemot is listed as a designated species of the Flamborough and Filey Coast SPA.

171. The SPA breeding population at classification was 41,607 pairs (83,214 breeding adults) for the period 2008 to 2011 (Natural England, 2017b). The most recent published count was of 111,925 individuals in 2023 (Clarkson *et al*. 2023), which once adjusted using standard approaches gives an AON of 74,989 (or 149,978 breeding adults).

172. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For guillemot, these are:

- Maintain the size of the breeding population at a level which is above 41,607 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent;
- Maintain safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as

appropriate) and ensure these measures are not being undermined or compromised;

- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. sandeel, herring, sprat) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

###### *9.5.2.3.2 Connectivity to the Projects*

173. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding guillemot from the Flamborough and Filey Coast SPA. The estimated proportion of the guillemots recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA (based on the most recent count of 149,978 breeding adults) is calculated as 100%.

174. Although Furness (2015) only identified one nonbreeding period for guillemot (August to February), Natural England requested that further consideration be given to the post-breeding months of August and September, during which time the male of each pair accompanies their fledged young as they disperse from the colony. Both are effectively flightless at this time therefore, due to the constraint on how far these birds can travel in August and September, it is likely that most of the birds recorded on the wind farm will originate from Flamborough and Filey Coast SPA. Therefore, in acknowledgement of this, the guillemot breeding season for this SPA has been extended to include August and September, with the attendant 100% apportioning rate. However, it is also appropriate to assume that not all of the birds recorded in these two months are breeding adults since a large proportion will be juveniles. Several factors will contribute to the adult proportion in these two months: only the male of each pair accompanies the juvenile; the females remain at the colony for a few weeks before also dispersing; not all pairs breed successfully; and there will be older sub-adult birds also present. Therefore, taking all these together it has been assumed that up to 70% of birds in August and September could be breeding adults from this SPA. Accordingly, the breeding season peak used in the assessment (here treated as the period from March to September) was the larger value of either the total number recorded in each month between March and July or 70% of the total number recorded in August and September.

175. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (Furness, 2015).

176. During the non-breeding season it is estimated that 4.4% of birds present at the Projects are breeding adults from the Flamborough and Filey Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.5.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

177. The seasonal peak total number of guillemots recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-20**.

178. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, guillemot displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-22**).

*Table 9-22 Summary of guillemot density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 100 | 55.2 | 4984.8 | 15.0 | 24.9 | 348.9 | 7.5 | 12.5 | 174.5 | 17.71 | 6.7 | 3.7 | 11.2 | 16.1 | 178.2 |
| | | | | 100 | 9030.5 | 27.1 | 45.1 | 632.1 | 13.5 | 22.6 | 316.0 | | | 6.7 | 20.2 | 29.3 | 322.7 |
| | Non-breeding | 12551.8 | 4.4 | 100 | 552.3 | 1.7 | 2.8 | 38.7 | 0.8 | 1.4 | 19.3 | 24.62 | 9.3 | 0.4 | 1.2 | 1.8 | 19.7 |
| | Annual | Assuming 55.2% adults in breeding season | | | 5537.1 | 16.7 | 27.7 | 387.6 | 8.3 | 13.9 | 193.8 | - | 16.0 | 4.1 | 12.4 | 17.9 | 197.9 |
| | | Assuming 100% adults in breeding season | | | 9582.8 | 28.8 | 47.9 | 670.8 | 14.3 | 24 | 335.3 | | | 7.1 | 21.4 | 31.1 | 342.4 |
| DBS West | Breeding | 8783.5 | 100 | 55.2 | 4848.5 | 14.5 | 24.2 | 339.4 | 7.3 | 12.1 | 169.7 | 16.92 | 6.4 | 3.5 | 10.8 | 15.6 | 173.2 |
| | | | | 100 | 8783.5 | 26.4 | 43.9 | 614.8 | 13.2 | 22.0 | 307.4 | | | 6.4 | 19.6 | 28.4 | 313.8 |
| | Non-breeding | 12498.4 | 4.4 | 100 | 549.9 | 1.6 | 2.7 | 38.5 | 0.8 | 1.4 | 19.2 | 24.08 | 9.1 | 0.4 | 1.2 | 1.8 | 19.6 |
| | Annual | Assuming 55.2% adults in breeding season | | | 5398.4 | 16.1 | 26.9 | 377.9 | 8.1 | 13.5 | 188.9 | - | 15.5 | 3.9 | 12 | 17.4 | 192.8 |
| | | Assuming 100% adults in breeding season | | | 9333.4 | 28 | 46.6 | 653.3 | 14 | 23.4 | 326.6 | | | 6.8 | 20.8 | 30.2 | 333.4 |
| DBS East + DBS West | Breeding | 14927.7 | 100 | 55.2 | 8240.1 | 24.7 | 41.2 | 576.8 | 12.4 | 20.6 | 288.4 | - | 13.0 | 7.2 | 19.6 | 27.8 | 295.6 |
| | | | | 100 | 14927.7 | 44.8 | 74.6 | 1044.9 | 22.4 | 37.3 | 522.5 | | | 13.0 | 35.4 | 50.3 | 535.5 |
| | Non-breeding | 20136.0 | 4.4 | 100 | 886.0 | 2.7 | 4.4 | 62.0 | 1.3 | 2.2 | 31.0 | - | 18.4 | 0.8 | 2.1 | 3.0 | 31.8 |
| | Annual | Assuming 55.2% adults in breeding season | | | 9126.1 | 27.4 | 45.6 | 638.8 | 13.7 | 22.8 | 319.4 | - | 31.4 | 8 | 21.7 | 30.8 | 327.4 |
| | | Assuming 100% adults in breeding season | | | 15813.7 | 47.5 | 79 | 1106.9 | 23.7 | 39.5 | 553.5 | | | 13.8 | 37.5 | 53.3 | 567.3 |

###### *9.5.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.5.2.3.3.1.1 DBS East in Isolation*

179. The wind farm construction displacement from DBS East in the breeding, and nonbreeding seasons were up to 174.5 (assuming 55.2% adults) or 316 (assuming 100% adults) and 19.3, respectively (**Table 9-22**). Displacement mortalities due to construction vessels were 3.7 (assuming 55.2% adults) or 6.7 (assuming 100% adults) and 0.4 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 178.2 (55.2% adults) or 322.7 (100% adults) and 19.7 birds during the breeding and nonbreeding seasons. The equivalent evidence based mortalities were 16.1 (55.2% adults) or 29.3 (100% adults) and 1.8 respectively.

180. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) construction impacts from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 197.9 (55.2% adults in the breeding season) or 342.4 (assuming 100% adults in the breeding season) birds per annum. This would result in a predicted change in adult mortality rate of 2.16% to 3.7%.

181. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years in areas where there are operational offshore wind farms. But there is no such indication of mortality effects of this magnitude.

182. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (16.1 or 29.3 in the breeding season and 1.8 in the nonbreeding season) would increase the predicted annual mortality by 0.19% to 0.33% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.3.3.1.2 DBS West in Isolation*

183. The wind farm construction displacement from DBS West in the breeding, and nonbreeding seasons were up to 169.7 (assuming 55.2% adults) or 307.4 (assuming 100% adults) and 19.2, respectively (**Table 9-22**). Displacement mortalities due to construction vessels were 3.5 (assuming 55.2% adults) or 6.4 (assuming 100% adults) and 0.4 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 173.2 (55.2% adults) or 313.8 (100% adults) and 19.6 birds during the breeding and nonbreeding seasons. The equivalent evidence based mortalities were 15.6 (55.2% adults) or 28.4 (100% adults) and 1.8 respectively.

184. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) construction impacts from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 192.8 (55.2% adults in the breeding season) or 333.4 (100% adults in the breeding season) birds per annum. These would result in a predicted change in adult mortality rate of 2.1% to 3.6%.

185. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 181). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (15.6 or 28.4 in the breeding season and 1.8 birds in the nonbreeding season) would increase the predicted annual mortality by 0.19% to 0.33% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.3.3.1.3 DBS East and West Together*

186. The wind farm construction displacement from DBS East and DBS West in the breeding and nonbreeding seasons were up to 288.4 (assuming 55.2% adults) or 522.5 (assuming 100% adults) and 31.0, respectively. Displacement mortalities due to construction vessels were 7.2 (55.2% adults) or 13 (100% adults) and 0.8 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 295.6 (55.2% adults) or 535.5 (100% adults) and 31.8 birds during the breeding and nonbreeding seasons.

187. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding guillemot population is 327.4 (55.2% adults) or 567.3 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 3.6% to 6.2%. These are above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate.

188. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (27.8 or 50.3 in the breeding season and 3.0 birds in the nonbreeding season) would increase the predicted annual mortality by 0.33% to 0.58% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

###### *9.5.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.5.2.3.3.2.1 DBS East in Isolation*

189. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 349 (55.2% adults) or 632 (100% adults) and 39, respectively (**Table 9-22**).

190. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding guillemot population is 387.6 (55.2% adults) or 671 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 4.2% to 7.3%. These are above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.

191. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA would be 24.9 (55.2% adults) or 45.1 (100% adults) and 2.8 birds in the breeding and nonbreeding seasons respectively. These would reduce the predicted annual mortality (for 27.7 to 48 birds) to 0.3% to 0.5% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.3.3.2.2 DBS West in Isolation*

192. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 339.4 (55.2% adults) or 614.8 (100% adults) and 38.5, respectively (**Table 9-22**).

193. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding guillemot population is 378 (55.2% adults) or 653 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 4.1% to 7.1%. These are above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.

194. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA would be 24.2 (55.2% adults) or 43.9 (100% adults) and 2.7 birds in the breeding and nonbreeding seasons respectively. These would reduce the predicted annual mortality (for 26.9 to 46.6 birds) to 0.3% to 0.5% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.3.3.2.3 DBS East and West Together*

195. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding and nonbreeding seasons were up to 576.8 (55.2% adults) or 1044.9 (100% adults) and 62, respectively (**Table 9-22**).

196. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding guillemot population is 639 (55.2% adults) or 1107 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 6.9% to 12.1%. These are above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.

197. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b) , the seasonal displacement mortalities apportioned to the FFC SPA would be 41.2 (55.2% adults) or 74.6 (100% adults) and 4.4 birds in the breeding and nonbreeding seasons respectively. These would reduce the predicted annual mortality (for 45.6 to 79 birds) to 0.49% to 0.86% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

#### *9.5.2.3.4 Summary of DBS alone*

198. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-23**).

199. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

*Table 9-23 Summary of predicted guillemot displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season (at 55.2% to 100% adults) | | 295.6 – 535.5 | 27.8 – 50.3 |
| Nonbreeding season | | 31.8 | 3.0 |
| Annual | | 327.4-567.3 | 30.8 – 53.3 |
| Effect | Reference population | 149,978 | |
| | Increase in background mortality (%) | 3.6 – 6.2 | 0.33 – 0.58 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season (at 55.2% to 100% adults) | | 576.8 - 1045 | 41.2 – 74.6 |
| Nonbreeding season | | 62.2 | 4.4 |
| Annual | | 639 - 1107 | 45.6 - 79 |
| Effect | Reference population | 149,978 | |
| | Increase in background mortality (%) | 6.9 – 12.1 | 0.49 – 0.86 |

##### *9.5.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

###### *9.5.2.3.5.1 Potential Effects During Operation: Disturbance and Displacement*

200. Seasonal and annual abundance estimates of guillemots, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-24.** This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

201. The estimated total number of guillemots at risk of displacement from all OWFs within the UK North Sea BDMPS combined is 614,112 of which between 38,809 and 46,789 (not including Hornsea 4 as this project's impacts are subject to compensation) are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-24**). Using displacement rates of 30% to 70% and a mortality rate of 1% to 10% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between 116 and 3,275.

202. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual in-combination mortality on the breeding guillemot population would result in a predicted change in adult mortality rate of between 1.3% and 36%. These are above the 1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further. The results of the PVA are considered below (section 9.5.2.5.3).

*Table 9-24 Total in-combination guillemot abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.*

| Tier | Wind Farm | Breeding | | Nonbreeding | | Annual | |
|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC |
| 1 | Beatrice | 13610 | 0 | 2755 | 121.2 | 16365 | 121.2 |
| 1 | Beatrice Demonstrator | No data | | | | | |
| 1 | Blyth Demonstration Project | 1220 | 0 | 1321 | 58.1 | 2541 | 58.1 |
| 1 | Dudgeon | 334 | 0 | 542 | 23.8 | 876 | 23.8 |
| 1 | East Anglia ONE | 274 | 0 | 640 | 28.2 | 914 | 28.2 |
| 1 | European Offshore Wind Deployment Centre | 547 | 0 | 225 | 9.9 | 772 | 9.9 |
| 1 | Galloper | 305 | 0 | 593 | 26.1 | 898 | 26.1 |
| 1 | Greater Gabbard | 345 | 0 | 548 | 24.1 | 893 | 24.1 |
| 1 | Gunfleet Sands | 0 | 0 | 363 | 16 | 363 | 16 |
| 1 | Hornsea Project One | 9836 | 4554.1 | 8097 | 356.3 | 17933 | 4910.4 |
| 1 | Humber Gateway | 99 | 99 | 138 | 6.1 | 237 | 105.1 |
| 1 | Hywind | 249 | 0 | 2136 | 94 | 2385 | 94 |
| 1 | Kentish Flats | 0 | 0 | 3 | 0.1 | 3 | 0.1 |
| 1 | Kentish Flats Extension | 0 | 0 | 4 | 0.2 | 4 | 0 |
| 1 | Kincardine | 632 | 0 | 0 | 0 | 632 | 35.8 |
| 1 | Lincs & LID | 582 | 0 | 814 | 35.8 | 1396 | 16.6 |
| 1 | London Array | 192 | 0 | 377 | 16.6 | 569 | 31.2 |
| 1 | Race Bank | 361 | 0 | 708 | 31.2 | 1069 | 683.6 |
| 1 | Rampion | 10887 | 0 | 15536 | 683.6 | 26423 | |
| 1 | Scroby Sands | No data | | | | | |
| 1 | Sheringham Shoal | 390 | 0 | 715 | 31.5 | 1105 | 31.5 |
| 1 | Teesside | 267 | 267 | 901 | 39.6 | 1168 | 306.6 |
| 1 | Thanet | 18 | 0 | 124 | 5.5 | 142 | 5.5 |
| 1 | Westermost Rough | 347 | 347 | 486 | 21.4 | 833 | 368.4 |
| 1 | Hornsea Project Two | 7735 | 3581.3 | 13164 | 579.2 | 20899 | 4160.5 |
| 2 | Triton Knoll | 425 | 425 | 746 | 32.8 | 1171 | 457.8 |
| 3 | Dogger Bank Creyke Beck Projects A | 5407 | 1892.5 | 6142 | 270.2 | 11549 | 2162.7 |
| 3 | Dogger Bank Creyke Beck Projects B | 9479 | 3317.7 | 10621 | 467.3 | 20100 | 3785 |
| 3 | Dogger Bank Teesside Projects A | 3283 | 1149.1 | 2268 | 99.8 | 5551 | 1248.9 |
| 3 | Dogger Bank Teesside Projects B | 5211 | 1823.9 | 3701 | 162.8 | 8912 | 1986.7 |
| 3 | East Anglia THREE | 1744 | 0 | 2859 | 125.8 | 4603 | 125.8 |
| 3 | Firth of Forth Alpha | 13606 | 0 | 4688 | 206.3 | 18294 | 206.3 |
| | Firth of Forth Bravo | 11118 | 0 | 4112 | 180.9 | 15230 | 180.9 |
| 3 | Hornsea Project Three | 13374 | 0 | 17772 | 782 | 31146 | 782 |
| 3 | Inch Cape | 4371 | 0 | 3177 | 139.8 | 7548 | 139.8 |
| 3 | Methil | 25 | 0 | 0 | 0 | 25 | 0 |
| 3 | Moray Firth (EDA) | 9820 | 0 | 547 | 24.1 | 10367 | 24.1 |
| 3 | Moray West | 24426 | 0 | 38174 | 1679.7 | 62600 | 1679.7 |
| 3 | Neart na Gaoithe | 1755 | 0 | 3761 | 165.5 | 5516 | 165.5 |
| 3 | Norfolk Boreas | 7767 | 0 | 13777 | 606.2 | 21544 | 606.2 |

| Tier | Wind Farm | Breeding | | Nonbreeding | | Annual | |
|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC |
| 3 | Norfolk Vanguard | 4320 | 0 | 4776 | 210.2 | 9096 | 210.2 |
| 3 | East Anglia ONE North | 4183 | 0 | 1888 | 83.1 | 6071 | 83.1 |
| 3 | East Anglia TWO | 2077 | 0 | 1675 | 73.7 | 3752 | 73.7 |
| 3 | Hornsea Project Four | 15245 | 15245 | 69555 | 3060.4 | 84800 | 0* |
| 4 | DEP | 3839 | 0 | 14887 | 655 | 18726 | 655 |
| 4 | SEP | 1094.5 | 0 | 1085 | 47.7 | 2179 | 47.7 |
| 4 | Rampion 2 | 134 | 0 | 5723 | 251.8 | 5723 | 251.8 |
| 4 | Berwick Bank | 74154 | 0 | 44171 | 1943.5 | 118325 | 1943.5 |
| **Total without DBS** | | 190934 | 32702 | 262124 | 11534 | 452923 | 27873 |
| 5 | DBS East | 9031 | 4984.8 | 12552 | 552.3 | 21582 | 5537 |
| 5 | DBS West | 8784 | 4848.5 | 12498 | 549.9 | 21282 | 5398 |
| 5a | DBS East+West (55.2% adults in breeding season) | 17814 | 9833 | 25050 | 1102 | 42864 | 10936 |
| 5b | DBS East+West (100% adults in breeding season) | | 17814 | | | | 18916 |
| **5a Total (all projects)** | | 282902 | 42535 | 331345 | 14579 | 614112 | 38809 |
| **5b Total (all projects)** | | | 50516 | | | | 46789 |

** Note projects for which compensation is required have been given an annual apportioned mortality of 0*

###### *9.5.2.3.5.2 Population Viability Analysis Results for guillemot*

203. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-25**.

*Table 9-25 PVA results for in-combination impacts on FFC SPA guillemot after 30 years.*

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination displacement lower (30% x 1%; 55.2% adults from DBS in the breeding season) | 116 | 0.00077344 | 0.9995 (0.9992-0.9997) | 0.9838 (0.9763-0.9914) |
| In-combination displacement lower (30% x 1%; 100% adults from DBS in the breeding season) | 140 | 0.00093347 | 0.9994 (0.9991-0.9996) | 0.9806 (0.9734-0.9878) |
| In-combination displacement Evidence based (50% x 1%; 55.2% adults from DBS in the breeding season) | 194 | 0.00129352 | 0.9991 (0.9989-0.9994) | 0.9732 (0.9660-0.9804) |
| In-combination displacement lower (50% x 1%; 100% adults from DBS in the breeding season) | 234 | 0.00156022 | 0.9989 (0.9987-0.9992) | 0.9678 (0.9609-0.9751) |
| In-combination displacement upper (70% x 10%; 55.2% adults from DBS in the breeding season) | 2717 | 0.01811599 | 0.9878 (0.9874-0.9883) | 0.6842 (0.6747-0.6935) |
| In-combination displacement lower (70% x 10%; 100% adults from DBS in the breeding season) | 3275 | 0.02183654 | 0.9854 (0.9849-0.9858) | 0.6331 (0.6230-6430) |

204. After a period of 30 years, worst case in-combination displacement reduced the population growth rate by up to 1.5% (0.9854) and reduced the population size relative the baseline by up to 37% (0.6331). At the evidence based rates of 50% and 1%, the CPGR and CPS were 0.1% and 3.2% respectively.

205. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the guillemot PVA, with a baseline annual average growth rate of 3.6% and a maximum impact growth rate of 2.1%. These result in median populations after 30 years of over 433,000 and 280,000 for baseline and maximum impact respectively. It is clear therefore that the 41% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still nearly doubled from the starting size of over 150,000.

206. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example at the largest impact the CPS after 10 years was 0.8423 (16%) which decreased to 0.6331 (37%) after 30 years, while the CPGR after 10 years was almost exactly the same 0.9845 (1.55%) as that after 30 years 0.9854 (1.46%). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

207. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the guillemot population at Flamborough and Filey Coast SPA has grown at an average rate of 3.8% per year since 2000. The maximum CPGR was 1.5% which if realised would only reduce the annual growth rate to 2.3%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

208. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above (paragraph 140).

209. Therefore, it is the Applicants' conclusion that the combined displacement and collision impacts predicted at DBS East and DBS West in-combination with other projects, will not adversely affect the integrity of the Flamborough and Filey Coast SPA.

210. Notwithstanding the above conclusion, the Applicant acknowledges that previous decisions on offshore wind farms by the Secretary of State have concluded that an AEoI for guillemot at the Flamborough and Filey Coast SPA could not be ruled out for in-combination displacement risk (e.g. Hornsea 4). Given this, it is the Applicants assumption that the Secretary of State will conclude AEoI in this case also. Therefore, the Applicants do not consider it worthwhile to contest this point and on this basis **concede AEoI on the Flamborough and Filey Coast SPA.**

211. The Applicant has therefore proposed compensation measures for guillemot. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 2 Guillemot and Razorbill Compensation Plan (application ref: 6.2.2).**

### 9.5.2.4 Puffin

212. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.5.2.4.1 Status*

213. Puffin is listed as a named feature of the seabirds assemblage of the Flamborough and Filey Coast SPA.

214. Data from the Seabird Monitoring Programme (2008-2011; Aitken *et al*., 2011) indicated there were 980 pairs breeding adult puffins within the SPA (1,960 individuals), however evidence from pre-breeding rafting counts suggested a higher figure of approximately 2,300 individuals (Babcock *et al*., 2016). Subsequent repeats of this survey recorded around 2,600 individuals in 2017 (Lloyd *et al*., 2019). In 2018, after the reclassification and extension of the site the figure was 4,000 individuals. The most recent SPA estimate, as reported in Burnell *et al*. 2023 is 4,279 AOB.

215. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For the seabird assemblage, of which puffin is a component, these are:

- Maintain the overall abundance of the assemblage at a level which is above 216,730 individuals whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;
- Maintain the species diversity of the bird assemblage;

- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) current extent - (water column; vegetated sea cliffs of the Atlantic and Baltic coast; intertidal rock);
- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period – (vegetated sea cliff and water column);
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels. This target was set using the Environmental Agency 2019 water body classifications data;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

#### *9.5.2.4.2 Connectivity to the Projects*

216. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of puffin is 265.4km (137.1km + 128.3km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Flamborough and Filey Coast SPA. The estimated proportion of the puffin recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA is calculated as 26.7% (**Table 9-7**).

217. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March; (Furness, 2015).

218. During the non-breeding season it is estimated that 0.4% of birds present at the Projects are breeding adults from the Flamborough and Filey Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.5.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

219. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-26.**

220. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-26**).

*Table 9-26 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km2) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.6 | 26.7 | 54.3 | 9.1 | 0.03 | 0.05 | 0.64 | 0.01 | 0.02 | 0.32 | 0.12 | 0.05 | 0.007 | 0.02 | 0.03 | 0.32 |
| | | | | 100 | 16.7 | 0.05 | 0.08 | 1.17 | 0.03 | 0.04 | 0.58 | | | 0.01 | 0.04 | 0.05 | 0.60 |
| | Nonbreeding | 178.7 | 0.4 | 100 | 0.7 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.03 | 0.35 | 0.13 | 0.00 | 0.00 | 0.00 | 0.03 |
| | Annual (54.3% adults) | | | | 9.8 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.3 | - | 0.2 | 0.01 | 0.02 | 0.03 | 0.35 |
| | Annual (100% adults) | | | | 17.4 | 0.1 | 0.1 | 1.2 | 0.0 | 0.0 | 0.6 | | | 0.01 | 0.04 | 0.06 | 0.62 |
| DBS West | Breeding | 109.3 | 26.7 | 54.3 | 15.9 | 0.05 | 0.08 | 1.11 | 0.02 | 0.04 | 0.56 | 0.21 | 0.08 | 0.011 | 0.04 | 0.05 | 0.57 |
| | | | | 100 | 29.2 | 0.09 | 0.15 | 2.04 | 0.04 | 0.07 | 1.02 | | | 0.02 | 0.06 | 0.09 | 1.04 |
| | Nonbreeding | 198.2 | 0.4 | 100 | 0.8 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.03 | 0.38 | 0.14 | 0.001 | 0.002 | 0.003 | 0.03 |
| | Annual (54.3% adults) | | | | 16.6 | 0.0 | 0.1 | 1.17 | 0.0 | 0.0 | 0.6 | - | 0.2 | 0.01 | 0.04 | 0.05 | 0.59 |
| | Annual (100% adults) | | | | 30.0 | 0.1 | 0.1 | 2.10 | 0.0 | 0.1 | 1.0 | | | 0.02 | 0.07 | 0.10 | 1.07 |
| DBS East + DBS West | Breeding | 146.6 | 26.7 | 54.3 | 21.3 | 0.06 | 0.11 | 1.49 | 0.03 | 0.05 | 0.74 | - | 0.12 | 0.018 | 0.05 | 0.07 | 0.76 |
| | | | | 100 | 39.1 | 0.12 | 0.20 | 2.74 | 0.06 | 0.10 | 1.37 | | | 0.03 | 0.09 | 0.13 | 1.40 |
| | Nonbreeding | 372.7 | 0.4 | 100 | 1.5 | 0.00 | 0.01 | 0.10 | 0.00 | 0.00 | 0.05 | - | 0.28 | 0.001 | 0.003 | 0.005 | 0.06 |
| | Annual (54.3% adults) | | | | 22.7 | 0.1 | 0.1 | 1.59 | 0.0 | 0.1 | 0.8 | - | 0.40 | 0.02 | 0.05 | 0.08 | 0.82 |
| | Annual (100% adults) | | | | 40.6 | 0.1 | 0.2 | 2.84 | 0.1 | 0.1 | 1.4 | | | 0.03 | 0.10 | 0.14 | 1.46 |

#### *9.5.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.5.2.4.3.1.1 DBS East in Isolation*

221. The wind farm construction displacement from DBS East in the breeding and nonbreeding seasons were 0.32 (assuming 54.3% adults) or 0.58 (assuming 100% adults) and 0.03 respectively (**Table 9-26**). Displacement mortalities due to construction vessels were 0.007 (at 54.3% adults) or 0.01 (at 100% adults) and 0.001 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.32 (54,3% adults) or 0.6 (100% adults) and 0.03 birds during the breeding and nonbreeding seasons.

222. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.35 to 0.62 birds per annum. These result in a predicted change in adult mortality rate of 0.04% to 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.5.2.4.3.1.2 DBS West in Isolation*

223. The wind farm construction displacement from DBS West in the breeding and nonbreeding seasons were 0.56 (assuming 54.3% adults) or 1.0 (assuming 100% adults) and 0.03 respectively (**Table 9-26**). Displacement mortalities due to construction vessels were 0.011 (54.3% adults) or 0.2 (100% adults) and 0.001 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.57 (54.3% adults) or 1.04 (100% adults) and 0.03 birds during the breeding and nonbreeding seasons.

224. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is 0.6 to 1.1 birds per annum. These result in a predicted change in adult mortality rate of 0.07% to 0.13% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.5.2.4.3.1.3 DBS East and West Together*

225. The wind farm construction displacement from DBS East and DBS West in the breeding and nonbreeding seasons were up to 0.74 (assuming 54.3% adults) or 1.37 (assuming 100% adults) and 0.05, respectively. Displacement mortalities due to construction vessels were 0.018 (54.3% adults) or 0.03 (100% adults) and 0.001 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.76 (54.3% adults) or 1.4 (100% adults) and 0.06 birds during the breeding and nonbreeding seasons.

226. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.82 to 1.46 birds per annum. These result in a predicted change in adult mortality rate of 0.10% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.5.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.5.2.4.3.2.1 DBS East in Isolation*

227. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 0.64 (assuming 54.3% adults) or 1.17 (assuming 100% adults) and 0.05, respectively (**Table 9-26**).

228. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.7 to 1.2 birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.5.2.4.3.2.2 DBS West in Isolation*

229. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 1.1 (assuming 54.3% adults) or 2.0 (assuming 100% adults) and 0.06, respectively (**Table 9-26**).

230. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is 1.17 to 2.1 birds per annum. These result in a predicted change in adult mortality rate of 0.14% to 0.26% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.5.2.4.3.2.3 DBS East and West Together*

231. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 1.5 (assuming 54.3% adults) or 2.7 (assuming 100% adults) and 0.1, respectively (**Table 9-26**).

232. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 804 (8,558 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 1.59 to 2.84 birds per annum. These result in a predicted change in adult mortality rate of 0.2% to 0.35% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.5.2.4.4 Summary*

233. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-27**).

234. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

*Table 9-27 Summary of predicted puffin displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Puffin** | | **Displacement** |
|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | |
| Displacement mortality (@35% x 10%) & Vessel displacement | | Mean |
| Breeding season (54.3% - 100% adults) | | 0.76-1.40 |
| Nonbreeding season | | 0.06 |
| Annual | | 0.82-1.46 |
| Effect | Reference population | 8,558 |
| | Increase in background mortality (%) | 0.1-0.18 |
| **Potential Effects During Operation: Disturbance and Displacement** | | |
| Displacement mortality (@70% x 10%) | | Mean |
| Breeding season (54.3% - 100% adults) | | 1.49-2.74 |
| Nonbreeding season | | 0.11 |
| Annual | | 1.59-2.84 |
| Effect | Reference population | 8,558 |
| | Increase in background mortality (%) | 0.2-0.35 |

##### *9.5.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

235. Given that no measurable increase in the Flamborough and Filey Coast SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only 1.6 to 2.8 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

#### 9.5.2.5 Razorbill

236. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.5.2.5.1 Status*

237. Razorbill is listed as a designated species of the Flamborough and Filey Coast SPA.

238. The SPA breeding population at classification was cited as 10,570 pairs or 21,140 breeding adults, for the period 2008 to 2011 (Natural England, 2018b). The most recent published count was 27,967 pairs or 55,934 individuals in 2017 (JNCC, 2023b). This is used as the reference population for the assessment. The baseline mortality of this population is 5,873 adult birds per year based on this reference population and the published adult mortality rate of 10.5% (Horswill and Robinson, 2015).

239. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For razorbill, these are:

- Maintain the size of the breeding population at a level which is above 10,570 breeding pairs whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent;
- Maintain safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. sandeel, herring, sprat) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;

- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

#### *9.5.2.5.2 Connectivity to the Projects*

240. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding razorbill from the Flamborough and Filey Coast SPA. The estimated proportion of the razorbills recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA (based on the most recent count of 55,967 breeding adults) has been assumed to be 100%.

241. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

242. During the autumn and spring migration Flamborough and Filey Coast SPA breeding adults are estimated to represent 3.4% of the BDMPS population. During the winter season Flamborough and Filey Coast SPA breeding adults are estimated to represent 1% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.5.2.5.3 Assessment of Potential Effects of the Projects alone and Together*

243. The seasonal peak total number of razorbills recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-28.**

244. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, razorbill displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-28**).

*Table 9-28 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km2) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 100 | 61.3 | 340.3 | 1.0 | 1.7 | 23.8 | 0.5 | 0.9 | 11.9 | 1.1 | 0.4 | 0.25 | 0.76 | 1.10 | 12.16 |
| | | | | 100 | 555.1 | 1.7 | 2.8 | 38.9 | 0.8 | 1.4 | 19.4 | | | 0.41 | 1.25 | 1.80 | 19.84 |
| | Autumn | 4685.3 | 3.4 | 100 | 159.3 | 0.5 | 0.8 | 11.2 | 0.2 | 0.4 | 5.6 | 9.2 | 3.5 | 0.12 | 0.36 | 0.52 | 5.69 |
| | Winter | 3376.7 | 1 | 100 | 33.8 | 0.1 | 0.2 | 2.4 | 0.1 | 0.1 | 1.2 | 6.6 | 2.5 | 0.02 | 0.08 | 0.11 | 1.21 |
| | Spring | 3578.5 | 3.4 | 100 | 121.7 | 0.4 | 0.6 | 8.5 | 0.2 | 0.3 | 4.3 | 7.0 | 2.6 | 0.09 | 0.27 | 0.39 | 4.35 |
| | Annual (61.3% adults) | | | | 655.0 | 2.0 | 3.3 | 45.9 | 1.0 | 1.6 | 22.9 | | 9.0 | 0.49 | 1.47 | 2.12 | 23.41 |
| | Annual (100% adults) | | | | 869.8 | 2.6 | 4.3 | 60.9 | 1.3 | 2.2 | 30.4 | | | 0.65 | 1.95 | 2.82 | 31.09 |
| DBS West | Breeding | 2280.6 | 100 | 61.3 | 1398.0 | 4.2 | 7.0 | 97.9 | 2.1 | 3.5 | 48.9 | 4.4 | 1.7 | 1.01 | 3.11 | 4.51 | 49.94 |
| | | | | 100 | 2280.6 | 6.8 | 11.4 | 159.6 | 3.4 | 5.7 | 79.8 | | | 1.66 | 5.08 | 7.36 | 81.48 |
| | Autumn | 4886.9 | 3.4 | 100 | 166.2 | 0.5 | 0.8 | 11.6 | 0.2 | 0.4 | 5.8 | 9.4 | 3.5 | 0.12 | 0.37 | 0.54 | 5.94 |
| | Winter | 5066.2 | 1 | 100 | 50.6 | 0.15 | 0.25 | 3.5 | 0.1 | 0.12 | 1.7 | 9.7 | 3.6 | 0.03 | 0.13 | 0.15 | 1.73 |
| | Spring | 4454.6 | 3.4 | 100 | 151.5 | 0.5 | 0.8 | 10.6 | 0.2 | 0.4 | 5.3 | 8.6 | 3.2 | 0.11 | 0.34 | 0.49 | 5.41 |
| | Annual (61.3% adults) | | | | 1766.3 | 5.35 | 8.85 | 123.6 | 2.6 | 4.42 | 61.7 | | 12.0 | 1.3 | 4.0 | 5.7 | 63.0 |
| | Annual (100% adults) | | | | 2648.9 | 7.95 | 13.25 | 185.3 | 3.9 | 6.62 | 92.6 | | | 1.9 | 5.9 | 8.5 | 94.6 |
| DBS East + DBS West | Breeding | 2826.1 | 100 | 61.3 | 1732.4 | 5.2 | 8.7 | 121.3 | 2.6 | 4.3 | 60.6 | - | 2.1 | 1.27 | 3.86 | 5.60 | 61.90 |
| | | | | 100 | 2826.1 | 8.5 | 14.1 | 197.8 | 4.2 | 7.1 | 98.9 | | | 2.07 | 6.31 | 9.14 | 101.0 |
| | Autumn | 6349.6 | 3.4 | 100 | 215.9 | 0.6 | 1.1 | 15.1 | 0.3 | 0.5 | 7.6 | - | 7.0 | 0.24 | 0.56 | 0.78 | 7.79 |
| | Winter | 5823.7 | 1 | 100 | 58.2 | 0.2 | 0.3 | 4.1 | 0.1 | 0.15 | 2.0 | - | 6.1 | 0.06 | 0.16 | 0.21 | 2.06 |
| | Spring | 6302.5 | 3.4 | 100 | 214.3 | 0.6 | 1.1 | 15.0 | 0.3 | 0.5 | 7.5 | - | 5.9 | 0.20 | 0.52 | 0.74 | 7.70 |
| | Annual (61.3% adults) | | | | 2220.8 | 6.6 | 11.2 | 155.5 | 3.3 | 5.45 | 77.7 | | 21.1 | 1.8 | 5.1 | 7.2 | 79.5 |
| | Annual (100% adults) | | | | 3314.5 | 9.9 | 16.6 | 232 | 4.9 | 8.25 | 116 | | | 2.6 | 7.5 | 10.8 | 118.6 |

#### *9.5.2.5.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.5.2.5.3.1.1 DBS East in Isolation*

245. The wind farm construction displacement from DBS East in the breeding, autumn, winter and spring seasons were up to 11.9 (assuming 61.3% adults) or 19.4 (assuming 100% adults), 5.6, 1.2 and 4.3, respectively (**Table 9-28**). Displacement mortalities due to construction vessels were 0.25 (61.3% adults) or 0.41 (100% adults), 0.12, 0.02 and 0.09 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 12.2 (61.3% adults) or 19.8 (100% adults), 5.7, 1.2 and 4.3 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 1.1 (61.3% adults) or 1.8 (100% adults), 0.5, 0.1 and 0.4 respectively.

246. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 23.4 to 31.1 birds per annum. These would result in a predicted change in adult mortality rate of 0.8% to 1.06%.

247. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement would double the natural adult background mortality rate. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years in areas where there are operational offshore wind farms. But there is no such indication of mortality effects of this magnitude.

248. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (2.1 to 2.8 annually) would increase the predicted annual mortality by 0.07% to 0.09% which are below the 1% threshold for detectability and therefore no further assessment was required.

*9.5.2.5.3.1.2 DBS West in Isolation*

249. The wind farm construction displacement from DBS West in the breeding, autumn, winter and spring seasons were up to 48.9 (61.3% adults) or 79.8 (100% adults), 5.8, 1.7 and 5.3, respectively (**Table 9-28**). Displacement mortalities due to construction vessels were 1.0 (61.3% adults) or 1.7 (100% adults), 0.12, 0.03 and 0.11 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 49.9 (61.3% adults) or 81.5 (100% adults), 5.9, 1.7 and 5.4 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 4.5 (61.3% adults) or 7.4 (100% adults), 0.5, 0.15 and 0.5 respectively.

250. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 63.0 to 94.6 birds per annum. These would result in a predicted change in adult mortality rate of 2.1% to 3.2%.

251. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 247). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (5.7 to 8.5 annually) would increase the predicted annual mortality by 0.19% to 0.28% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

###### *9.5.2.5.3.1.3 DBS East and West Together*

252. The wind farm construction displacement from DBS East and DBS West in the breeding, autumn, winter and spring seasons were up to 60.6 (61.3% adults) or 98.9 (100% adults), 7.6, 2.0 and 7.5, respectively (**Table 9-28**). Displacement mortalities due to construction vessels were 1.3 (61.3% adults) or 2.1 (100% adults), 0.24, 0.06 and 0.2 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 61.9 (61.3% adults) or 101.0 (100% adults), 7.8, 2.1 and 7.7 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 5.60 (61.3% adults) or 9.1 (100% adults), 0.78, 0.21 and 0.74 respectively.

253. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 79.5 to 118.6 birds per annum. These would result in a predicted change in adult mortality rate of 2.7% to 4.0%.

254. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 247). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (7.2 to 10.8 annually) would increase the predicted annual mortality by 0.24% to 0.37% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

##### *9.5.2.5.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.5.2.5.3.2.1 DBS East in Isolation*

255. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 23.8 (assuming 61.3% adults) or 38.9 (assuming 100% adults), 11.2, 2.4 and 8.5 respectively (**Table 9-28**).

256. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 45.9 to 60.9 birds per annum. These would result in a predicted change in adult mortality rate of 1.6% to 2.07%.

257. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 247). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (3.3 to 4.3 annually) would increase the predicted annual mortality by 0.11% to 0.15% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.5.3.2.2 DBS West in Isolation*

258. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 97.9 (assuming 61.3% adults) or 159.6 (assuming 100% adults), 11.6, 3.5 and 10.6 respectively (**Table 9-28**).

259. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 123.6 to 185.3 birds per annum. These would result in a predicted change in adult mortality rate of 4.2% to 6.3%.

260. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 247). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (8.9 to 13.2 annually) would increase the predicted annual mortality by 0.3% to 0.44% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

*9.5.2.5.3.2.3 DBS East and West Together*

261. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 121.3 (assuming 61.3% adults) or 197.8 (assuming 100% adults), 15.0, 4.1 and 15.0 respectively (**Table 9-28**).

262. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding razorbill population, applying highly precautionary rates of 70% displacement and 10% mortality, is 155.5 to 232.0 birds per annum. These would result in a predicted change in adult mortality rate of 5.3% to 7.9%.

263. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 245). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (11.2 to 16.6 annually) would increase the predicted annual mortality by 0.37% to 0.56% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

#### 9.5.2.5.4 Summary

264. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-29**).

265. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

*Table 9-29 Summary of predicted razorbill displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Razorbill** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season (63.1% to 100% adults) | | 61.90-101.0 | 5.60-9.14 |
| Autumn | | 7.79 | 0.78 |
| Winter | | 2.1 | 0.21 |
| Spring | | 7.70 | 0.74 |
| Annual | | 79.5-118.6 | 7.2-10.8 |
| Effect | Reference population | 27,967 | |
| | Increase in background mortality (%) | 2.7-4.0 | 0.25-0.36 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season (63.1% to 100% adults) | | 121.3-197.8 | 8.7-14.1 |
| Autumn | | 15.1 | 1.1 |
| Winter | | 4.1 | 0.3 |
| Spring | | 15.0 | 1.1 |
| Annual | | 155.5-232.0 | 11.2-16.6 |
| Effect | Reference population | 27,967 | |
| | Increase in background mortality (%) | 5.3-7.8 | 0.37-0.56 |

### *9.5.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects*

#### *9.5.2.5.5.1 Potential Effects During Operation: Disturbance and Displacement*

266. Seasonal and annual abundance estimates of razorbill, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-30**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

267. The estimated total number of razorbills at risk of displacement from all OWFs within the UK North Sea BDMPS combined is 180,805 of which between 9,943 and 11,031 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-30**). Using displacement rates of 30% to 70% and a mortality rate of 1% to 10% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between 30 and 772.

268. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (26,967 x 0.105) adults per annum. The predicted annual in-combination mortality on the breeding razorbill population would result in a predicted change in adult mortality rate of between 1.0% and 26%. These are above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further.  The results of the PVA are considered below (paragraph 479).

*Table 9-30 Total in-combination razorbill abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.*

| Tier | Wind Farm | Breeding | | Autumn | | Winter | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 1 | Beatrice | 873 | 0 | 833 | 28 | 555 | 15 | 833 | 28 | 3094 | 72 |
| 1 | Beatrice Demonstrator | n/a | | | | | | | | | |
| 1 | Blyth Demonstration Project | 121 | 0 | 91 | 3 | 61 | 2 | 91 | 3 | 364 | 8 |
| 1 | Dudgeon | 256 | 0 | 346 | 12 | 745 | 20 | 346 | 12 | 1693 | 44 |
| 1 | East Anglia ONE | 16 | 0 | 26 | 1 | 155 | 4 | 336 | 11 | 533 | 17 |
| 1 | European Offshore Wind Deployment Centre | 161 | 0 | 64 | 2 | 7 | 0 | 26 | 1 | 258 | 3 |
| 1 | Galloper | 44 | 0 | 43 | 2 | 106 | 3 | 394 | 13 | 587 | 18 |
| 1 | Greater Gabbard | 0 | 0 | 0 | 0 | 387 | 11 | 84 | 3 | 471 | 13 |
| 1 | Gunfleet Sands | 0 | 0 | 0 | 0 | 30 | 1 | 0 | 0 | 30 | 1 |
| 1 | Hornsea Project One | 1109 | 535 | 4812 | 164 | 1518 | 41 | 1803 | 61 | 9242 | 800 |
| 1 | Humber Gateway | 27 | 0 | 20 | 1 | 13 | 0 | 20 | 1 | 80 | 2 |
| 1 | Hywind | 30 | 0 | 719 | 24 | 10 | 0 | - | - | 759 | 25 |
| 1 | Kentish Flats & Kentish Flats Extension | n/a | | | | | | | | | |
| 1 | Kincardine | 22 | 0 | | 0 | | 0 | | | 22 | 0 |
| 1 | Lincs & LID | 45 | 0 | 34 | 1 | 22 | 1 | 34 | 1 | 134 | 3 |
| 1 | London Array | 14 | 0 | 20 | 1 | 14 | 0 | 20 | 1 | 68 | 2 |
| 1 | Race Bank | 28 | 0 | 42 | 1 | 28 | 1 | 42 | 1 | 140 | 4 |
| 1 | Rampion | 630 | 0 | 66 | 2 | 1244 | 34 | 3327 | 113 | 5267 | 149 |
| 1 | Scroby Sands | n/a | | | | | | | | | |
| 1 | Sheringham Shoal | 106 | 0 | 1343 | 46 | 211 | 6 | 30 | 1 | 1690 | 52 |
| 1 | Teesside | 16 | 0 | 61 | 2 | 2 | 0 | 20 | 1 | 99 | 3 |
| 1 | Thanet | 3 | 0 | 0 | 0 | 14 | 0 | 21 | 1 | 37 | 1 |
| 1 | Westermost Rough | 91 | 91 | 121 | 4 | 152 | 4 | 91 | 3 | 455 | 102 |
| 2 | Triton Knoll | 40 | 0 | 254 | 9 | 855 | 23 | 117 | 4 | 1265 | 36 |
| 3 | Dogger Bank Creyke Beck Projects A | 1250 | 375 | 1576 | 54 | 1728 | 47 | 4149 | 141 | 8703 | 616 |
| 3 | Dogger Bank Creyke Beck Projects B | 1538 | 461 | 2097 | 71 | 2143 | 58 | 5119 | 174 | 10897 | 765 |
| 3 | Dogger Bank Teesside Projects A | 834 | 250 | 310 | 11 | 959 | 26 | 1919 | 65 | 4022 | 352 |
| 3 | Dogger Bank Teesside Projects B | 1153 | 346 | 592 | 20 | 1426 | 39 | 2953 | 100 | 6125 | 505 |
| 3 | East Anglia THREE | 1807 | 0 | 1122 | 38 | 1499 | 41 | 1524 | 52 | 5952 | 130 |
| 3 | Firth of Forth Alpha | 5876 | 0 | - | - | 1103 | 30 | - | - | 6979 | 30 |
| 3 | Firth of Forth Bravo | 3698 | 0 | - | - | 1272 | 34 | - | - | 4970 | 34 |
| 3 | Hornsea Project Three | 630 | 0 | 2020 | 69 | 3649 | 99 | 2105 | 72 | 8404 | 240 |
| 1 | Hornsea Project Two | 2511 | 1,210 | 4221 | 144 | 720 | 19 | 1668 | 57 | 9119 | 1,430 |
| 3 | Inch Cape | 1436 | 0 | 2870 | 98 | 651 | 18 | - | - | 4957 | 115 |
| 3 | Methil | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 |
| 3 | Moray Firth (EDA) | 2423 | 0 | 1103 | 38 | 30 | 1 | 168 | 6 | 3724 | 44 |
| 3 | Moray West | 2808 | 0 | 3544 | 121 | 184 | 5 | 3585 | 122 | 10121 | 247 |
| 3 | Neart na Gaoithe | 331 | 0 | 5492 | 187 | 508 | 14 | - | - | 6331 | 200 |
| 3 | Norfolk Boreas | 630 | 0 | 263 | 9 | 1065 | 29 | 345 | 12 | 2303 | 49 |
| 3 | Norfolk Vanguard | 879 | 0 | 866 | 30 | 839 | 23 | 924 | 31 | 3508 | 84 |
| 3 | East Anglia ONE North | 403 | 0 | 85 | 3 | 54 | 2 | 207 | 7 | 749 | 11 |

| Tier | Wind Farm | Breeding | | Autumn | | Winter | | Spring | | Annual | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | FFC | Total | FFC | Total | FFC | Total | FFC | Total | FFC |
| 3 | East Anglia TWO | 281 | 0 | 44.1 | 2 | 136.4 | 4 | 230 | 8 | 692 | 13 |
| 3 | Hornsea Project Four | - | 386 | - | 146 | - | 12 | - | 15 | - | 559 |
| 4 | DEP | 923 | 64 | 3741 | 127 | 845 | 23 | 320 | 11 | 5829 | 225 |
| 4 | SEP | 316 | 22 | 759 | 26 | 686 | 19 | 144 | 5 | 1905 | 71 |
| 4 | Rampion 2 | n/a | 0 | 26 | 1 | 1193 | 1 | 6303 | 72.0 | 7522 | 73.0 |
| 4 | Berwick Bank | 4040 | 0 | 8849 | 300.87 | 1399 | 13.99 | 7480 | 254.32 | 21768 | 569.2 |
| **Total without DBS** | | **37403** | **3740** | **48475** | **1798.9** | **28218** | **723.9** | **46778** | **1463.3** | **160872** | **7717.2** |
| 5 | DBS East | 555 | 340.3 | 4685.3 | 159.3 | 3376.7 | 33.8 | 3579 | 121.7 | 12196 | 655 |
| 5 | DBS West | 2281 | 1398.0 | 4886.9 | 166.2 | 5066.2 | 50.6 | 4455 | 151.5 | 12581 | 1766.3 |
| 5a | DBS East+West (61.3% adults) | 2826 | 1738 | 6350 | 216 | 5823.7 | 58 | 6303 | 214 | 19933 | 2226 |
| 5b | DBS East +West (100% adults) | | 2826 | | | | | | | | 3314 |
| **5a Total (all projects)** | | **40229** | **5472** | **54825** | **2015** | **32674** | **769** | **53081** | **1678** | **180805** | **9943** |
| **5a Total (all projects)** | | | **6566** | | | | | | | | **11031** |

*9.5.2.5.5.2 Population Viability Analysis Results for razorbill*

269. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in Annex A: SPA PVA Results.

*Table 9-31 PVA results for in-combination impacts on FFC SPA razorbill after 30 years.*

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination displacement lower (30% x 1%; 61.3% adults from DBS in the breeding season) | 30 | 0.00097806 | 0.9993 (0.9982-1.0003) | 0.9773 (0.9458-1.0103) |
| In-combination displacement lower (30% x 1%; 100% adults from DBS in the breeding season) | 33 | 0.00107586 | 0.9992 (0.9982-1.0002) | 0.9753 (0.9442-1.0082) |
| In-combination displacement Evidence based (50% x 1%; 61.3% adults from DBS in the breeding season) | 50 | 0.00163010 | 0.9988 (0.9978-0.9998) | 0.9627 (0.9315-0.9957) |
| In-combination displacement lower (50% x 1%; 100% adults from DBS in the breeding season) | 55 | 0.00179311 | 0.9986 (0.9976-0.9997) | 0.9591 (0.9273-0.9924) |
| In-combination displacement upper (70% x 10%; 61.3% adults from DBS in the breeding season) | 695 | 0.02265836 | 0.9831 (0.9818-0.9843) | 0.5900 (0.5666-0.6137) |

| PVA run scenario | Annual mortality | Decrease in adult survival rate | Mean CGR (95% c.i.) | Mean CPS (95% c.i.) |
|---|---|---|---|---|
| In-combination displacement lower (70% x 10%; 100% adults from DBS in the breeding season) | 772 | 0.02513687 | 0.9813 (0.9800-0.9825) | 0.5563 (0.5342-0.5784) |

270. After a period of 30 years, worst case in-combination displacement reduced the population growth rate by up to 1.9% (0.9813) and reduced the population size relative the baseline by up to 44.4% (0.5563). At the evidence based rates of 50% and 1%, the CPGR and CPS were 0.1% (0.9986) and 4.1% (0.9591) respectively.

271. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

272. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example the CPS after 10 years was 0.8050 (20%) which increased to 0.5563 (44.4%) after 30 years, while the CPGR after 10 years, 0.9805 (2%) was almost exactly the same 0.9813 (1.9%) as that after 30 years. Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

273. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the razorbill population at Flamborough and Filey Coast SPA has grown at an average rate of 8% per year since 2000. The maximum CPGR was 2.0% which if realised would only reduce the annual growth rate to 6%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

274. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above (paragraph 140). It is also of note that in the Hornsea 4 HRA (DESNZ, 2023) the Secretary of State considered displacement and mortality rates of 70% and 2% were appropriate for this SPA feature. This gave an in-combination mortality of 142.7 and a predicted reduction in the growth rate of 0.44% which was not considered likely to result in an AEoI. With the addition of subsequent projects, including DBS East and West, the in-combination total estimated using this approach would rise to 154, which would result in a very similar change in growth rate and therefore the same conclusion as reached for Hornsea 4 is anticipated.

275. Therefore, in conclusion, the displacement impacts predicted for razorbill at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

276. Recognising that in-combination displacement may lead the Secretary of State to conclude AEoI for the Flamborough and Filey Coast SPA, the Applicants have therefore proposed compensation measures for razorbill on a without prejudice basis. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 2 Guillemot and Razorbill Compensation Plan (application ref: 6.2.2).**

## 9.6 Coquet Island SPA

### 9.6.1 Site Description

277. Coquet Island is located 1km off the coast of Northumberland. It is a small, flat-topped island with a plateau extent of approximately seven hectares. The island consists of sandy soil and peat over a soft sandstone base. Low cliffs of up to 3.7m high result from earlier quarrying. Surrounding the island is a rocky upper shore and intertidal. There is a sandy beach on the southwest of the island and the southeast corner is shingle and rock.

#### 9.6.1.1 Qualifying Features

278. Puffin, a named component of the breeding seabird assemblage for Coquet Island SPA is screened into the assessment **Table 4-7**.

#### 9.6.1.2 Conservation Objectives

279. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

### 9.6.2 Assessment: Array Areas

#### 9.6.2.1 Puffin

280. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.6.2.1.1 Status*

281. Puffin is listed as a named component of the breeding seabird assemblage of the Coquet Island SPA.

282. The SPA breeding population at classification was cited as 31,686 breeding adults, for the period 2010 to 2014 (Natural England, 2017a). The most recent count is 25,029 apparently occupied burrows, or 50,058 breeding adults in 2019 (JNCC, 2023b). The baseline mortality of this population is 4,705 breeding adult birds per year based on the published adult mortality rate of 9.4% (Horswill and Robinson, 2015).

#### *9.6.2.1.2 Connectivity to the Projects*

283. DBS East and DBS West are 230km and 196km respectively from the Coquet Island SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Coquet Island SPA. The estimated proportion of the puffins recorded at the Projects during the breeding season that could be breeding adult birds from the Coquet Island SPA (based on the most recent count of 50,058 breeding adults) is calculated as 29.5% (**Table 9-7**).

284. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015). It is estimated that 5.3% of birds present at the Projects are breeding adults from the Coquet Island SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.6.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

285. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-26.**

286. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-26**).

*Table 9-32 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Coquet SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.6 | 29.5 | 54.3 | 10.0 | 0.03 | 0.05 | 0.70 | 0.02 | 0.03 | 0.35 | 0.12 | 0.05 | 0.007 | 0.02 | 0.03 | 0.36 |
| | | | | 100 | 18.5 | 0.06 | 0.09 | 1.29 | 0.03 | 0.05 | 0.65 | | | 0.01 | 0.04 | 0.06 | 0.66 |
| | Nonbreeding | 178.7 | 5.3 | 100 | 9.5 | 0.03 | 0.05 | 0.66 | 0.01 | 0.02 | 0.33 | 0.35 | 0.13 | 0.01 | 0.02 | 0.03 | 0.34 |
| | Annual (54.3% adults) | | | | 19.5 | 0.1 | 0.1 | 1.4 | 0.0 | 0.0 | 0.7 | | 0.18 | 0.01 | 0.04 | 0.06 | 0.70 |
| | Annual (100% adults) | | | | 27.9 | 0.1 | 0.1 | 2.0 | 0.0 | 0.1 | 1.0 | | | 0.02 | 0.06 | 0.09 | 1.00 |
| DBS West | Breeding | 109.3 | 29.5 | 54.3 | 17.5 | 0.05 | 0.09 | 1.23 | 0.03 | 0.04 | 0.61 | 0.21 | 0.08 | 0.01 | 0.04 | 0.06 | 0.63 |
| | | | | 100 | 32.2 | 0.10 | 0.16 | 2.26 | 0.05 | 0.08 | 1.13 | | | 0.02 | 0.07 | 0.10 | 1.15 |
| | Nonbreeding | 198.2 | 5.3 | 100 | 10.5 | 0.03 | 0.05 | 0.74 | 0.02 | 0.03 | 0.37 | 0.38 | 0.14 | 0.01 | 0.02 | 0.03 | 0.38 |
| | Annual (54.3% adults) | | | | 28.0 | 0.1 | 0.1 | 2.0 | 0.0 | 0.1 | 1.0 | | 0.22 | 0.02 | 0.06 | 0.09 | 1.00 |
| | Annual (100% adults) | | | | 42.7 | 0.1 | 0.2 | 3.0 | 0.1 | 0.1 | 1.5 | | | 0.03 | 0.10 | 0.14 | 1.53 |
| DBS East + DBS West | Breeding | 146.6 | 29.5 | 54.3 | 23.5 | 0.07 | 0.12 | 1.64 | 0.04 | 0.06 | 0.82 | - | 0.12 | 0.02 | 0.06 | 0.08 | 0.84 |
| | | | | 100 | 43.2 | 0.13 | 0.22 | 3.03 | 0.06 | 0.11 | 1.51 | | | 0.04 | 0.10 | 0.14 | 1.55 |
| | Nonbreeding | 372.7 | 5.3 | 100 | 19.8 | 0.06 | 0.10 | 1.38 | 0.03 | 0.05 | 0.69 | - | 0.28 | 0.01 | 0.04 | 0.06 | 0.71 |
| | Annual (54.3% adults) | | | | 43.2 | 0.1 | 0.2 | 3.0 | 0.1 | 0.1 | 1.5 | | 0.40 | 0.03 | 0.10 | 0.14 | 1.55 |
| | Annual (100% adults) | | | | 63.0 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | | | 0.05 | 0.15 | 0.21 | 2.26 |

##### 9.6.2.1.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.6.2.1.3.1.1 DBS East in Isolation

287. The wind farm construction displacement from DBS East in the breeding and nonbreeding seasons were 0.35 (assuming 54.3% adults) or 0.65 (assuming 100% adults) and 0.33 respectively (**Table 9-32**). Displacement mortalities due to construction vessels were 0.007 (at 54.3% adults) or 0.01 (at 100% adults) and 0.001 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.36 (54,3% adults) or 0.66 (100% adults) and 0.34 birds during the breeding and nonbreeding seasons.

288. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.7 to 1.0 birds per annum. These result in a predicted change in adult mortality rate of 0.01% to 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.6.2.1.3.1.2 DBS West in Isolation

289. The wind farm construction displacement from DBS West in the breeding and nonbreeding seasons were 0.61 (assuming 54.3% adults) or 1.13 (assuming 100% adults) and 0.37 respectively (**Table 9-32**). Displacement mortalities due to construction vessels were 0.01 (at 54.3% adults) or 0.02 (at 100% adults) and 0.01 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.63 (54,3% adults) or 1.15 (100% adults) and 0.34 birds during the breeding and nonbreeding seasons.

290. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.0 to 1.5 birds per annum. These result in a predicted change in adult mortality rate of 0.02% to 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.6.2.1.3.1.3 DBS East and West Together

291. The wind farm construction displacement from DBS East and DBS West combined in the breeding and nonbreeding seasons were 0.82 (assuming 54.3% adults) or 1.51 (assuming 100% adults) and 0.69 respectively (**Table 9-32**). Displacement mortalities due to construction vessels were 0.02 (at 54.3% adults) or 0.04 (at 100% adults) and 0.01 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.84 (54.3% adults) or 1.55 (100% adults) and 0.71 birds during the breeding and nonbreeding seasons.

292. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.55 to 2.26 birds per annum. These result in a predicted change in adult mortality rate of 0.03% to 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.6.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement

###### 9.6.2.1.3.2.1 DBS East in Isolation

293. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 0.7 (assuming 54.3% adults) or 1.3 (assuming 100% adults) and 0.66, respectively (**Table 9-32**).

294. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.4 to 2.0 birds per annum. These result in a predicted change in adult mortality rate of 0.03% to 0.04% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.6.2.1.3.2.2 DBS West in Isolation

295. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding and nonbreeding seasons were up to 1.23 (assuming 54.3% adults) or 2.26 (assuming 100% adults) and 0.74, respectively (**Table 9-32**).

296. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 2.0 to 3.0 birds per annum. These result in a predicted change in adult mortality rate of 0.04% to 0.06% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.6.2.1.3.2.3 DBS East and West Together*

297. The wind farm operation displacement from DBS East and DBS West combined apportioned to the SPA in the breeding and nonbreeding seasons were up to 1.64 (assuming 54.3% adults) or 3.0 (assuming 100% adults) and 1.4, respectively (**Table 9-32**).

298. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding puffin population is 3.0 to 4.4 birds per annum. These result in a predicted change in adult mortality rate of 0.06% to 0.09% which are below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.6.2.1.4 Summary*

299. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-33**).

300. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Coquet Island SPA**.

*Table 9-33 Summary of predicted puffin displacement mortality from Coquet Island SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Puffin | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season (54.3% - 100% adults) | | 0.84-1.55 | 0.08-0.14 |
| Nonbreeding season | | 0.71 | 0.06 |
| Annual | | 1.55-2.26 | 0.14-0.21 |
| Effect | Reference population | | 50,058 |
| | Increase in background mortality (%) | 0.03-0.05 | 0.003-0.004 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season (54.3% - 100% adults) | | 1.64-3.03 | 0.12-0.22 |
| Nonbreeding season | | 1.39 | 0.1 |
| Annual | | 3.03-4.4 | 0.22-0.3 |
| Effect | Reference population | | 50,058 |
| | Increase in background mortality (%) | 0.06-0.09 | 0.005-0.006 |

#### *9.6.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

301. Given that no measurable increase in the Coquet Island SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only 3 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Coquet Island SPA**.

## 9.7 Farne Islands SPA

### 9.7.1 Site Description

302. The Farne Islands are a group of low-lying islands situated between 2km and 6km off the coast of Northumberland in northeast England. The islands are important nesting areas for a range of seabirds, especially terns, gulls and auks. Seabirds breeding at the SPA feed outside it in nearby waters, as well as more distantly in the North Sea.

#### 9.7.1.1 Qualifying Features

303. The qualifying features of the Farne Islands SPA screened into the Assessment are listed in **Table 4-7**. These are breeding guillemot and two named components of the breeding seabird assemblage, kittiwake and puffin.

#### 9.7.1.2 Conservation Objectives

304. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

### 9.7.2 Assessment: Array Areas

#### 9.7.2.1 Kittiwake

305. Kittiwake has been screened in to assess the impacts from collision risk in the operation phase.

##### *9.7.2.1.1 Status*

306. Kittiwake is listed as a named component of the breeding seabird assemblage of the Farne Islands SPA.

307. The SPA breeding population at classification was cited as 8,241 pairs or 16,482 breeding adults, for the period 2010 to 2014 (Natural England, 2017b). The most recent count is 4,402 apparently occupied nests, or 8,804 breeding adults in 2019 (JNCC, 2023a). The baseline mortality of this population is 1,285 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015).

308. Supplementary advice on the conservation objectives were added for named components of the breeding seabird assemblage of the Farne Islands SPA in 2023 (Natural England, 2023). For kittiwake, these are:

- Maintain the overall abundance of the assemblage at a level which is above 163,819 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;
- Maintain the species diversity of the bird assemblage;
- Reduce the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Reduce predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding).
- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period;
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg L-1 (at 35 salinity) for 95 % of year) avoiding deterioration from existing levels;

- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is < 12 μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

##### *9.7.2.1.2 Connectivity to the Projects*

309. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the Farne Islands SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the Farne Islands SPA (based on the most recent count of 8,804 breeding adults) is calculated as 2.5% (**Table 9-6**).

310. Outside the breeding season breeding kittiwakes, including those from the Farne Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

311. During the autumn migration and spring migration seasons, 60% of the Farne Islands SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.5% and 0.7% of birds respectively present in the Project Array Areas are considered to be breeding adults from the Farne Islands SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.7.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

##### *9.7.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-34 Summary of kittiwake total collisions and those apportioned to the Farne Islands SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 2 | 53 | 0.45 | 0.88 | 1.79 |
| | | | | | | 100 | 0.85 | 1.67 | 3.37 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.5 | 100 | 0.07 | 0.21 | 0.41 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.7 | 100 | 0.05 | 0.10 | 0.20 |
| | Annual (53% adults) | 66.9 | 139.3 | 261.3 | - | - | 0.57 | 1.19 | 2.40 |
| | Annual (100% adults) | | | | | | 0.97 | 1.98 | 3.98 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 2 | 53 | 0.39 | 1.14 | 2.98 |
| | | | | | | 100 | 0.74 | 2.16 | 5.62 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.5 | 100 | 0.05 | 0.19 | 0.41 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.7 | 100 | 0.05 | 0.10 | 0.19 |
| | Annual (53% adults) | 55.9 | 160.6 | 327.0 | - | - | 0.49 | 1.44 | 3.57 |
| | Annual (100% adults) | | | | | | 0.84 | 2.45 | 6.21 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 2 | 53 | 1.02 | 2.03 | 4.01 |
| | | | | | | 100 | 1.92 | 3.82 | 7.57 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.5 | 100 | 0.15 | 0.40 | 0.72 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.7 | 100 | 0.12 | 0.21 | 0.33 |
| | Annual (53% adults) | 150.9 | 299.9 | 540.5 | - | - | 1.29 | 2.63 | 5.06 |
| | Annual (100% adults) | | | | | | 2.19 | 4.43 | 8.61 |

##### *9.7.2.1.3.1.1 DBS East in Isolation*

312. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is 0.9 (0.4 to 1.8) or 1.7 (0.8 to 3.4) birds in the breeding season, 0.2 (0.07 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-34).**

313. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is 1.2 (0.6 to 2.4) or 2.0 (1.0 to 4.0) birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.7.2.1.3.1.2 DBS West in Isolation*

314. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is 1.1 (0.4 to 3.0) or 2.2 (0.7 to 5.6) birds in the breeding season, 0.2 (0.05 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-34).**

315. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population is 1.4 (0.5 to 3.6) or 2.4 (0.8 to 6.2) birds per annum. These result in a predicted change in adult mortality rate of 0.11% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.7.2.1.3.1.3 DBS East and DBS West Together*

316. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is 2.0 (1.0 to 4.0) or 3.8 (1.9 to 7.6) birds in the breeding season, 0.4 (0.15 to 0.7) birds during autumn migration and 0.2 (0.12 to 0.33) birds during spring migration  (**Table 9-34).**

317. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects on the breeding kittiwake population is 2.6 (1.3 to 5.1) or 4.4 (2.2 to 8.6) birds per annum. These result in a predicted change in adult mortality rate of 0.2% to 0.34% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.7.2.1.4 Summary of DBS alone*

318. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-35**).

319. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

*Table 9-35 Summary of predicted Kittiwake collision mortality from Fane Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean. | Upper c.i. |
| Breeding season (53% - 100% adults) | | 1.0-1.9 | 2.0-3.8 | 4.0-7.6 |
| Autumn | | 0.15 | 0.40 | 0.7 |
| Spring | | 0.12 | 0.21 | 0.33 |
| Annual | | 1.3-2.2 | 2.6-4.4 | 5.1-8.6 |
| Effect | Reference population | 8,804 | | |
| | Increase in background mortality (%) | 0.1-0.2 | 0.2-0.34 | 0.39-0.67 |

##### *9.7.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

320. Given that no measurable increase in the Farne Islands SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 8.6 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, it is concluded that predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Farne Islands SPA**.

#### 9.7.2.2 Guillemot

321. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

322. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

##### *9.7.2.2.1 Status*

323. Guillemot is listed as a designated species of the Farne Islands SPA.

324. The SPA breeding population at classification was 32,875 pairs (65,750 breeding adults) for the period 2010 to 2014 (Natural England, 2017b). Burnell *et al*. (2023) give an updated count of 64,042 individuals which has been used in this assessment.

##### *9.7.2.2.2 Connectivity to the Projects*

325. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Farne Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

326. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

327. It is estimated that 3.7% of birds present at the Projects are breeding adults from the Farne Islands SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.7.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

328. The seasonal peak total number of guillemots recorded in DBS East and DBS West and the number apportioned to the Farne Islands SPA is provided in **Table 9-36**.

329. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, guillemot displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-36**).

*Table 9-36 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Farne Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 3.7 | 100 | 464.4 | 1.4 | 2.3 | 32.5 | 0.7 | 1.2 | 16.3 | 24.62 | 9.3 | 0.3 | 1.0 | 1.5 | 16.6 |
| | Annual | 21582.3 | | | 464.4 | 1.4 | 2.3 | 32.5 | 0.7 | 1.2 | 16.3 | 24.62 | 9.3 | 0.3 | 1.0 | 1.5 | 16.6 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 3.7 | 100 | 462.4 | 1.4 | 2.3 | 32.4 | 0.7 | 1.2 | 16.2 | 24.08 | 9.1 | 0.3 | 1.0 | 1.5 | 16.5 |
| | Annual | 21281.9 | | | 462.4 | 1.4 | 2.3 | 32.4 | 0.7 | 1.2 | 16.2 | 24.08 | 9.1 | 0.3 | 1.0 | 1.5 | 16.5 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 3.7 | 100 | 745.0 | 2.2 | 3.7 | 52.2 | 1.1 | 1.9 | 26.1 | - | 18.4 | 0.7 | 1.8 | 2.5 | 26.8 |
| | Annual | 35063.7 | | | 745.0 | 2.2 | 3.7 | 52.2 | 1.1 | 1.9 | 26.1 | - | 18.4 | 0.7 | 1.8 | 2.5 | 26.8 |

###### *9.7.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.7.2.2.3.1.1 DBS East in Isolation*

330. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.6 birds per annum (**Table 9-36**). This would result in a predicted change in adult mortality rate of 0.43%.

331. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

332. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.7.2.2.3.1.2 DBS West in Isolation*

333. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.7 birds per annum (**Table 9-36**). This would result in a predicted change in adult mortality rate of 0.4%.

334. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 181). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.7.2.2.3.1.3 DBS East and West Together*

335. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from the Projects alone including vessel displacement on the breeding guillemot population is 27.0 birds per annum (**Table 9-36**). This results in a predicted change in adult mortality rate of 0.7% which is below the 1% threshold for detectability and therefore no further assessment was required.

336. At a more appropriate construction displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b) the annual displacement mortality apportioned to the Farne Islands SPA would be 2.6. This would reduce the predicted annual mortality to 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.7.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

*9.7.2.2.3.2.1 DBS East in Isolation*

337. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from DBS East alone on the breeding guillemot population is 32.8 birds per annum (**Table 9-36**). This results in a predicted change in adult mortality rate of 0.84% which is below the 1% threshold for detectability and therefore no further assessment was required.

338. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be 2.3. This would reduce the predicted annual mortality to 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.7.2.2.3.2.2 DBS West in Isolation*

339. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from DBS East alone on the breeding guillemot population is 32.6 birds per annum (**Table 9-36**). This results in a predicted change in adult mortality rate of 0.84%. which is below the 1% threshold for detectability and therefore no further assessment was required. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.

340. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be 2.3 birds in the breeding and nonbreeding seasons respectively. This would reduce the predicted annual mortality to 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.7.2.2.3.2.3 DBS East and West Together*

341. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from the Projects alone on the breeding guillemot population is 52.6 birds per annum (**Table 9-36**). This results in a predicted change in adult mortality rate of 1.3%. This is above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.

342. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be 3.8 birds. This would reduce the predicted annual mortality to 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.7.2.2.4 Summary of DBS alone*

343. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

*Table 9-37 Summary of predicted guillemot displacement mortality from Farne Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 26.8 | 2.5 |
| Annual | | 26.8 | 2.5 |
| Effect | Reference population | 64,402 | |
| | Increase in background mortality (%) | 0.7 | 0.06 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 52.2 | 3.7 |
| Annual | | 52.2 | 3.7 |
| Effect | Reference population | 64,402 | |
| | Increase in background mortality (%) | 1.34 | 0.09 |

##### *9.7.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

344. Given that no measurable increase in the Farne Islands SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 4 birds per year during operation), it is concluded that the Projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Farne Islands SPA**.

#### 9.7.2.3 Puffin

345. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

346. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

#### *9.7.2.3.1 Status*

347. Puffin is listed as a named component of the breeding seabird assemblage of the Farne Islands SPA.

348. The SPA breeding population at classification was 76,798 individuals (Natural England, 2017b). The most recent published count was 87,504 individuals in 2019 (JNCC, 2023b). This is used as the reference population for the assessment.

349. Supplementary advice on the conservation objectives were added for named components of the breeding seabird assemblage of the Farne Islands SPA in 2023 (Natural England, 2023). For puffin, these are:

- Maintain the overall abundance of the assemblage at a level which is above 163,819 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;
- Maintain the species diversity of the bird assemblage;
- Reduce the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Reduce predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk);
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding).

- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period;
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg L-1 (at 35 salinity) for 95 % of year) avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is < 12 μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

##### *9.7.2.3.2 Connectivity to the Projects*

350. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Farne Islands SPA. The estimated proportion of the puffins recorded at the Projects during the breeding season that could be breeding adult birds from the Farne Islands SPA (based on the most recent count of 87,504 breeding adults) is calculated as 56% (**Table 9-7**).

351. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

352. It is estimated that 17.2% of birds present at the Projects are breeding adults from the Farne Islands SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.7.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

353. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Farne Islands SPA is provided in **Table 9-38**.

354. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-38**).

*Table 9-38 Summary of puffin density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Farne Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.6 | 43.8 | 54.3 | 14.9 | 0.04 | 0.07 | 1.04 | 0.02 | 0.04 | 0.52 | 0.12 | 0.05 | 0.01 | 0.03 | 0.05 | 0.53 |
| | | | | 100 | 27.4 | 0.08 | 0.14 | 1.92 | 0.04 | 0.07 | 0.96 | | | 0.02 | 0.06 | 0.09 | 0.98 |
| | Nonbreeding | 178.7 | 17.2 | 100 | 30.7 | 0.09 | 0.15 | 2.15 | 0.05 | 0.08 | 1.08 | 0.35 | 0.13 | 0.02 | 0.07 | 0.10 | 1.10 |
| | Annual (54.3% adults) | | | | 45.6 | 0.1 | 0.2 | 3.2 | 0.1 | 0.1 | 1.6 | | 0.18 | 0.03 | 0.10 | 0.15 | 1.63 |
| | Annual (100% adults) | | | | 58.2 | 0.2 | 0.3 | 4.1 | 0.1 | 0.1 | 2.0 | | | 0.04 | 0.13 | 0.19 | 2.08 |
| DBS West | Breeding | 109.3 | 43.8 | 54.3 | 26.0 | 0.08 | 0.13 | 1.82 | 0.04 | 0.06 | 0.91 | 0.21 | 0.08 | 0.02 | 0.06 | 0.08 | 0.93 |
| | | | | 100 | 47.9 | 0.14 | 0.24 | 3.35 | 0.07 | 0.12 | 1.68 | | | 0.03 | 0.11 | 0.15 | 1.71 |
| | Nonbreeding | 198.2 | 17.2 | 100 | 34.1 | 0.10 | 0.17 | 2.39 | 0.05 | 0.09 | 1.19 | 0.38 | 0.14 | 0.02 | 0.08 | 0.11 | 1.22 |
| | Annual (54.3% adults) | | | | 60.1 | 0.2 | 0.3 | 4.2 | 0.1 | 0.2 | 2.1 | | 0.22 | 0.04 | 0.13 | 0.19 | 2.15 |
| | Annual (100% adults) | | | | 82.0 | 0.2 | 0.4 | 5.7 | 0.1 | 0.2 | 2.9 | | | 0.06 | 0.18 | 0.26 | 2.93 |
| DBS East + DBS West | Breeding | 146.6 | 43.8 | 54.3 | 34.9 | 0.10 | 0.17 | 2.44 | 0.05 | 0.09 | 1.22 | - | 0.12 | 0.03 | 0.08 | 0.12 | 1.25 |
| | | | | 100 | 64.2 | 0.19 | 0.32 | 4.49 | 0.10 | 0.16 | 2.25 | | | 0.05 | 0.15 | 0.22 | 2.30 |
| | Nonbreeding | 372.7 | 17.2 | 100 | 64.1 | 0.19 | 0.32 | 4.49 | 0.10 | 0.16 | 2.24 | - | 0.28 | 0.05 | 0.14 | 0.21 | 2.29 |
| | Annual (54.3% adults) | | | | 99.0 | 0.3 | 0.5 | 6.9 | 0.1 | 0.2 | 3.5 | | 0.40 | 0.08 | 0.23 | 0.32 | 3.54 |
| | Annual (100% adults) | | | | 128.3 | 0.4 | 0.6 | 9.0 | 0.2 | 0.3 | 4.5 | | | 0.10 | 0.29 | 0.42 | 4.59 |

##### *9.7.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.7.2.3.3.1.1 DBS East in Isolation*

355. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population including vessel displacement is 1.63 (assuming 54.3% adults in the breeding season) or 2.1 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.02% to 0.025% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.7.2.3.3.1.2 DBS West in Isolation*

356. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population including vessel displacement is 2.15 (assuming 54.3% adults in the breeding season) or 2.93 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.029% to 0.035% which are below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.7.2.3.3.1.3 DBS East and West Together*

357. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West on the breeding puffin population including vessel displacement is 3.54 (assuming 54.3% adults in the breeding season) or 4.6 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.04% to 0.05% which are below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.7.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.7.2.3.3.2.1 DBS East in Isolation*

358. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 3.20 (assuming 54.3% adults in the breeding season) or 4.1 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.04% to 0.05% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.7.2.3.3.2.2 DBS West in Isolation*

359. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is 4.21 (assuming 54.3% adults in the breeding season) or 5.7 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.05% to 0.07% which are below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.7.2.3.3.2.3 DBS East and West Together*

360. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population is 6.9 (assuming 54.3% adults in the breeding season) or 9.0 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.08% to 0.11% which are below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.7.2.3.4 Summary*

361. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-39**).

362. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

*Table 9-39 Summary of predicted puffin displacement mortality from Farne Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Puffin | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality & Vessel displacement | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season (54.3% - 100% adults) | | 1.25-2.30 | 0.12-0.22 |
| Nonbreeding season | | 2.29 | 0.21 |
| Annual | | 3.54-4.59 | 0.32-0.42 |
| Effect | Reference population | 87,504 | |
| | Increase in background mortality (%) | 0.04-0.05 | 0.004-0.005 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season (54.3% - 100% adults) | | 2.4-4.5 | 0.17-0.32 |
| Nonbreeding season | | 4.5 | 0.32 |
| Annual | | 6.9-9.0 | 0.50-0.6 |
| Effect | Reference population | 87,504 | |
| | Increase in background mortality (%) | 0.08-0.11 | 0.006-0.007 |

### *9.7.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

363. Given that no measurable increase in the Farne Islands SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only 6.9 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Farne Islands SPA**.

## 9.8 St Abbs Head to Fast Castle SPA

### 9.8.1 Site Description

364. St Abb's Head to Fast Castle SPA was designated in 1997. The site comprises an area of sea cliffs and coastal strip stretching over 10km along the Berwickshire Coast north of St Abbs.

365. The boundary of the SPA overlaps with that of St Abb's Head to Fast Castle SSSI, and the seaward extension extends approximately 1 km into the marine environment to include the seabed, water column and surface.

#### 9.8.1.1 Qualifying Features

366. The qualifying features of St Abbs Head to Fast Castle SPA screened into the Assessment are listed in **Table 4-7**. These are three named components of the breeding seabird assemblage; kittiwake, guillemot and razorbill.

#### 9.8.1.2 Conservation Objectives

367. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.8.2 Assessment: Array Areas

#### 9.8.2.1 Kittiwake

368. Kittiwake has been screened in to assess the impacts from collision risk in the operation phase.

##### *9.8.2.1.1 Status*

369. Kittiwake is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA.

370. The SPA breeding population at classification in 1997 was cited as 21,170 pairs or 42,340 breeding adults (SNH, 2009). The most recent count is 5,150 apparently occupied nests, or 10,300 breeding adults recorded between 2018-2021 (JNCC, 2023a). The baseline mortality of this population is 1,503 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015).

##### *9.8.2.1.2 Connectivity to the Projects*

371. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the St Abbs Head to Fast Castle SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the St Abbs Head to Fast Castle SPA (based on the most recent count of 10,300 breeding adults) is calculated as 2.1% (**Table 9-6**).

372. Outside the breeding season breeding kittiwakes, including those from the St Abbs Head to Fast Castle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

373. It is estimated that 0.5% and 0.7% of birds present in the Project Array Areas are breeding adults from the St Abbs Head to Fast Castle SPA in the autumn and spring respectively. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### 9.8.2.1.3 Assessment of Potential Effects of the Projects alone and Together

#### 9.8.2.1.3.1 Potential Effects During Operation: Collision risk

*Table 9-40 Summary of kittiwake total collisions and apportioned to the St Abbs Head to Fast Castle SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 2 | 53 | 0.45 | 0.88 | 1.79 |
| | | | | | | 100 | 0.85 | 1.67 | 3.37 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.5 | 100 | 0.07 | 0.21 | 0.41 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.7 | 100 | 0.05 | 0.10 | 0.20 |
| | Annual (53% adults) | 66.9 | 139.3 | 261.3 | - | - | 0.57 | 1.19 | 2.40 |
| | Annual (100% adults) | | | | | | 0.97 | 1.98 | 3.98 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 2 | 53 | 0.39 | 1.14 | 2.98 |
| | | | | | | 100 | 0.74 | 2.16 | 5.62 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.5 | 100 | 0.05 | 0.19 | 0.41 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.7 | 100 | 0.05 | 0.10 | 0.19 |
| | Annual (53% adults) | 55.9 | 160.6 | 327.0 | - | - | 0.49 | 1.44 | 3.57 |
| | Annual (100% adults) | | | | | | 0.84 | 2.45 | 6.21 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 2 | 53 | 1.02 | 2.03 | 4.01 |
| | | | | | | 100 | 1.92 | 3.82 | 7.57 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.5 | 100 | 0.15 | 0.40 | 0.72 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.7 | 100 | 0.12 | 0.21 | 0.33 |
| | Annual (53% adults) | 150.9 | 299.9 | 540.5 | - | - | 1.29 | 2.63 | 5.06 |
| | Annual (100% adults) | | | | | | 2.19 | 4.43 | 8.61 |

#### *9.8.2.1.3.1.1 DBS East in Isolation*

374. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is 0.9 (0.4 to 1.8) or 1.7 (0.8 to 3.4) birds in the breeding season, 0.2 (0.07 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-34).**

375. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is 1.2 (0.6 to 2.4) or 2.0 (1.0 to 4.0) birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.1.3.1.2 DBS West in Isolation*

376. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is 1.1 (0.4 to 3.0) or 2.2 (0.7 to 5.6) birds in the breeding season, 0.2 (0.05 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-34).**

377. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population is 1.4 (0.5 to 3.6) or 2.4 (0.8 to 6.2) birds per annum. These result in a predicted change in adult mortality rate of 0.11% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

#### 9.8.2.1.3.1.3 DBS East and DBS West Together

378. Based on adult kittiwake proportions of 53% and 100% (**Table 9-5**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is 2.0 (1.0 to 4.0) or 3.8 (1.9 to 7.6) birds in the breeding season, 0.4 (0.15 to 0.7) birds during autumn migration and 0.2 (0.12 to 0.33) birds during spring migration (**Table 9-34).**

379. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects on the breeding kittiwake population is 2.6 (1.3 to 5.1) or 4.4 (2.2 to 8.6) birds per annum. These result in a predicted change in adult mortality rate of 0.2% to 0.34% which are below the 1% threshold for detectability and therefore no further assessment was required.

#### 9.8.2.1.4 Summary of DBS alone

380. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-35**).

381. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the St Abb's Head to Fast Castle SPA**.

*Table 9-41 Summary of predicted Kittiwake collision mortality from St Abb's Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean. | Upper c.i. |
| Breeding season (53% - 100% adults) | | 1.0-1.9 | 2.0-3.8 | 4.0-7.6 |
| Autumn | | 0.15 | 0.40 | 0.7 |
| Spring | | 0.12 | 0.21 | 0.33 |
| Annual | | 1.3-2.2 | 2.6-4.4 | 5.1-8.6 |
| Effect | Reference population | | | 8,804 |
| | Increase in background mortality (%) | 0.1-0.2 | 0.2-0.34 | 0.39-0.67 |

#### *9.8.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

382. Given that no measurable increase in the St Abb's Head to Fast Castle SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.7 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species.

383. Therefore, it is concluded that predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abb's Head to Fast Castle SPA**.

### 9.8.2.2 Guillemot

384. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.8.2.2.1 Status*

385. Guillemot is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA. The SPA breeding population at classification in 1997 was 31,750 breeding adults (SNH, 2009). Burnell *et al*. (2023) give an updated count of 45,827 individuals which has been used in this assessment.

#### *9.8.2.2.2 Connectivity to the Projects*

386. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the St Abbs Head to Fast Castle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

387. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 2.5% of birds present at the Projects are considered to be breeding adults from St Abbs Head to Fast Castle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.8.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-42 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for St Abbs Head to Fast Castle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35- 10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 2.5 | 100 | 313.8 | 0.9 | 1.6 | 22.0 | 0.5 | 0.8 | 11.0 | 25 | 9.3 | 0.23 | 0.70 | 1.02 | 11.21 |
| | Annual | | | | 313.8 | 0.9 | 1.6 | 22.0 | 0.5 | 0.8 | 11.0 | - | 16 | 0.23 | 0.70 | 1.02 | 11.21 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 2.5 | 100 | 312.5 | 0.9 | 1.6 | 21.9 | 0.5 | 0.8 | 10.9 | 24 | 9.1 | 0.23 | 0.70 | 1.01 | 11.16 |
| | Annual | | | | 312.5 | 0.9 | 1.6 | 21.9 | 0.5 | 0.8 | 10.9 | - | 15.5 | 0.23 | 0.70 | 1.01 | 11.16 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 2.5 | 100 | 503.4 | 1.5 | 2.5 | 35.2 | 0.8 | 1.3 | 17.6 | | 18.4 | 0.46 | 1.21 | 1.72 | 18.08 |
| | Annual | | | | 503.4 | 1.5 | 2.5 | 35.2 | 0.8 | 1.3 | 17.6 | | 31.4 | 0.46 | 1.21 | 1.72 | 18.08 |

#### *9.8.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.8.2.2.3.1.1 DBS East in Isolation*

388. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 11.2 birds per annum (**Table 9-42**). This would result in a predicted change in adult mortality rate of 0.4%.

389. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

390. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.0) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.8.2.2.3.1.2 DBS West in Isolation*

391. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 11.2 birds per annum (**Table 9-42)**. This would result in a predicted change in adult mortality rate of 0.4%.

392. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

393. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.0) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.8.2.2.3.1.3 DBS East and West Together*

394. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 18.1 birds per annum (**Table 9-42**). This would result in a predicted change in adult mortality rate of 0.6%.

395. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

396. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.7) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.8.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.8.2.2.3.2.1 DBS East in Isolation*

397. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 22.0 birds per annum (**Table 9-42**). This would result in a predicted change in adult mortality rate of 0.8%.

398. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

399. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.6) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.2.3.2.2 DBS West in Isolation*

400. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 22.0 birds per annum (**Table 9-42**). This would result in a predicted change in adult mortality rate of 0.8%.

401. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

402. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.6) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.2.3.2.3 DBS East and West Together*

403. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 35.2 birds per annum (**Table 9-42**). This would result in a predicted change in adult mortality rate of 1.2%.

404. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

405. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (2.5) would increase the predicted annual mortality by 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.2.4 Summary*

406. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-43)**.

407. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

*Table 9-43 Summary of predicted guillemot displacement mortality from St Abbs Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 18.1 | 1.7 |
| Annual | | 18.1 | 1.7 |
| Effect | Reference population | 45,827 | |
| | Increase in background mortality (%) | 0.64 | 0.06 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 35.2 | 2.5 |
| Annual | | 35.2 | 2.5 |
| Effect | Reference population | 45,827 | |
| | Increase in background mortality (%) | 1.26 | 0.09 |

#### *9.8.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

408. Given that no measurable increase in the St Abbs Head to Fast Castle SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 2.5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

### 9.8.2.3 Razorbill

409. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.8.2.3.1 Status*

410. Razorbill is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA.

411. The SPA breeding population at classification in 1997 was 2,180 breeding adults (SNH, 2009). Burnell *et al.* (2023) give an updated count of 2,931 individuals which has been used in this assessment.

###### *9.8.2.3.2 Connectivity to the Projects*

412. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of razorbill is 164.6km (88.7km + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the St Abbs Head to Fast Castle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

413. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

414. During the autumn and spring migration it is estimated that St Abbs Head to Fast Castle birds make up 0.4% of the BDMPS population, and during the winter 0.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.8.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-44 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for St Abbs Head to Fast Castle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.4 | 100 | 18.7 | 0.1 | 0.1 | 1.3 | 0.0 | 0.0 | 0.7 | 9.2 | 3.5 | 0.01 | 0.04 | 0.06 | 0.67 |
| | Winter | 3376.7 | 0.3 | 100 | 10.1 | 0.0 | 0.1 | 0.7 | 0.0 | 0.0 | 0.4 | 6.6 | 2.5 | 0.01 | 0.02 | 0.03 | 0.36 |
| | Spring | 3578.5 | 0.4 | 100 | 14.3 | 0.0 | 0.1 | 1.0 | 0.0 | 0.0 | 0.5 | 7.0 | 2.6 | 0.01 | 0.03 | 0.05 | 0.51 |
| | Annual | | | | 43.1 | 0.1 | 0.3 | 3 | 0 | 0 | 1.6 | - | 9 | 0.03 | 0.09 | 0.14 | 1.54 |
| DBS West | Breeding | 2280.6 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.4 | 100 | 19.5 | 0.1 | 0.1 | 1.4 | 0.0 | 0.0 | 0.7 | 9.4 | 3.5 | 0.01 | 0.04 | 0.06 | 0.70 |
| | Winter | 5066.2 | 0.3 | 100 | 15.2 | 0.0 | 0.1 | 1.1 | 0.0 | 0.0 | 0.5 | 9.7 | 3.7 | 0.01 | 0.03 | 0.05 | 0.54 |
| | Spring | 4454.6 | 0.4 | 100 | 17.8 | 0.1 | 0.1 | 1.2 | 0.0 | 0.0 | 0.6 | 8.6 | 3.2 | 0.01 | 0.04 | 0.06 | 0.64 |
| | Annual | | | | 52.5 | 0.2 | 0.3 | 3.7 | 0.1 | 0.2 | 1.9 | - | 10.4 | 0.03 | 0.11 | 0.17 | 1.88 |
| DBS East + DBS West | Breeding | 2826.1 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.4 | 100 | 25.4 | 0.1 | 0.1 | 1.8 | 0.0 | 0.1 | 0.9 | | 7.0 | 0.03 | 0.07 | 0.09 | 0.92 |
| | Winter | 5823.7 | 0.3 | 100 | 17.5 | 0.1 | 0.1 | 1.2 | 0.0 | 0.0 | 0.6 | | 6.1 | 0.02 | 0.03 | 0.04 | 0.48 |
| | Spring | 6302.5 | 0.4 | 100 | 25.2 | 0.1 | 0.1 | 1.8 | 0.0 | 0.1 | 0.9 | | 5.9 | 0.02 | 0.06 | 0.09 | 0.91 |
| | Annual | | | | 68.1 | 0.3 | 0.3 | 4.8 | 0.2 | 0.2 | 2.4 | - | 21.1 | 0.07 | 0.22 | 0.22 | 2.47 |

#### *9.8.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.8.2.3.3.1.1 DBS East in Isolation*

415. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.54 (0.7, 0.4, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 0.5%.

416. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

417. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.14) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.8.2.3.3.1.2 DBS West in Isolation*

418. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.9 (0.7, 0.5, 0.6 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 0.6%.

419. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

420. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.8.2.3.3.1.3 DBS East and West Together*

421. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 2.4 (0.9, 0.6, 0.9 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 0.8%.

422. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

423. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.8.2.3.3.2.1 DBS East in Isolation*

424. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.0 (1.3, 0.7, 1.0 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 0.9%.

425. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

426. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.2) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.8.2.3.3.2.2 DBS West in Isolation*

427. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.7 (1.4, 1.1, 1.2 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 1.2%.

428. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

429. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.8.2.3.3.2.3 DBS East and West Together*

430. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 4.8 (1.8, 1.2, 1.8 in autumn winter and spring respectively) birds per annum (**Table 9-44**). This would result in a predicted change in adult mortality rate of 1.6%.

431. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

432. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.8.2.3.4 Summary*

433. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-45)**.

434. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

*Table 9-45 Summary of predicted razorbill displacement mortality from St Abbs Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.92 | 0.09 |
| Winter | | 0.60 | 0.04 |
| Spring | | 0.91 | 0.09 |
| Annual | | 2.4 | 0.2 |
| Effect | Reference population | 2,931 | |
| | Increase in background mortality (%) | 0.8 | 0.07 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 1.8 | 0.1 |
| Winter | | 1.2 | 0.1 |
| Spring | | 1.8 | 0.1 |
| Annual | | 4.8 | 0.3 |
| Effect | Reference population | 2,931 | |
| | Increase in background mortality (%) | 1.55 | 0.1 |

##### *9.8.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

435. Given that no measurable increase in the St Abbs Head to Fast Castle SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

## 9.9 Forth Islands SPA

### 9.9.1 Site Description

436. The Forth Islands SPA consists of a series of islands supporting the main seabird colonies in the Firth of Forth. The seaward extension extends approximately 2km to include the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.9.1.1 Qualifying Features

437. The qualifying features of the Forth Islands SPA screened into the Assessment are listed in **Table 4-7**. These are breeding gannet, lesser black-backed gull and puffin and four named components of the breeding seabird assemblage (kittiwake, guillemot, razorbill and herring gull).

#### 9.9.1.2 Conservation Objectives

438. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.9.2 Assessment: Array Areas

#### 9.9.2.1 Gannet

439. Gannet has been screened in to assess the impacts from disturbance / displacement and collision risk in the construction and operation phases.

##### *9.9.2.1.1 Status*

440. Gannet is listed as a designated species of the Forth Islands SPA.

441. The SPA breeding population at classification in 1990 was cited as 21,600 pairs, 43,200 breeding adults (SNH, 2009). The most recent count is 75,259 apparently occupied nests, or 150,518 breeding adults in 2014 (JNCC, 2023a). The baseline mortality of this population is 9,765 breeding adult birds per year based on the published adult mortality rate of 8.8% (Horswill and Robinson, 2015) and the Forth Islands SPA population of 110,964 breeding adults published in Furness (2015). Burnell *et al.* (2023) give an updated count of 75,259 AON (150,518 adults) which has been used in this assessment.

#### *9.9.2.1.2 Connectivity to the Projects*

442. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). However, although DBS East and DBS West are both within potential foraging range for breeding gannet from the Forth Islands SPA, Wakefield *et al*. (2013) found very little overlap in colony foraging areas, so connectivity is considered very unlikely during the breeding season. It is considered that 100% of the breeding adult gannets recorded at the Projects during the breeding season are birds from the Flamborough and Filey Coast SPA.

443. Outside the breeding season breeding gannets, including those from the Forth Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

#### *9.9.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

444. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Forth Islands SPA is provided in **Table 9-46**.

445. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-46**).

*Table 9-46 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.*

| Site | Season | Peak no. (mean) | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | Wind farm construction displacement mortality to SPA | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 60-1 | 80-1 | 30-1 | 40-1 | | | | 30-1 & vessel | 40-1 & vessel |
| DBS East | Breeding | 754.9 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.48 | 0.56 | 0.00 | 0.00 | 0.00 |
| | Autumn | 776.1 | 24.3 | 100 | 188.6 | 1.13 | 1.51 | 0.57 | 0.75 | 1.52 | 0.57 | 0.14 | 0.70 | 0.89 |
| | Spring | 75.1 | 31.3 | 100 | 23.5 | 0.14 | 0.19 | 0.07 | 0.09 | 0.15 | 0.06 | 0.02 | 0.09 | 0.11 |
| | Annual | | | | 212.1 | 1.27 | 1.7 | 0.64 | 0.84 | - | 1.19 | 0.16 | 0.79 | 1 |
| DBS West | Breeding | 805.3 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.55 | 0.58 | 0.00 | 0.00 | 0.00 |
| | Autumn | 797.5 | 24.3 | 100 | 193.8 | 1.16 | 1.55 | 0.58 | 0.78 | 1.54 | 0.58 | 0.14 | 0.72 | 0.92 |
| | Spring | 86.2 | 31.3 | 100 | 27.0 | 0.16 | 0.22 | 0.08 | 0.11 | 0.17 | 0.06 | 0.02 | 0.10 | 0.13 |
| | Annual | | | | 220.8 | 1.32 | 1.77 | 0.66 | 0.89 | - | 1.22 | 0.16 | 0.82 | 1.05 |
| DBS East + DBS West | Breeding | 1560.2 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | | 1.14 | 0.00 | 0.00 | 0.00 |
| | Autumn | 1573.6 | 24.3 | 100 | 382.4 | 2.29 | 3.06 | 1.15 | 1.53 | | 1.15 | 0.28 | 1.43 | 1.81 |
| | Spring | 161.3 | 31.3 | 100 | 50.5 | 0.30 | 0.40 | 0.15 | 0.20 | | 0.12 | 0.04 | 0.19 | 0.24 |
| | Annual | | | | 432.9 | 2.59 | 3.46 | 1.3 | 1.73 | - | 2.41 | 0.32 | 1.62 | 2.05 |

##### *9.9.2.1.3.1.1 DBS East in Isolation*

446. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 1.0 bird per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

##### *9.9.2.1.3.1.2 DBS West in Isolation*

447. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 1.0 bird per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

##### *9.9.2.1.3.1.3 DBS East and West Together*

448. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 2.0 birds per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### *9.9.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.9.2.1.3.2.1 DBS East in Isolation*

449. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 1.7 birds per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.9.2.1.3.2.2 DBS West in Isolation*

450. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 1.8 birds per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.9.2.1.3.2.3 DBS East and West Together*

451. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 3.5 birds per annum (**Table 9-46**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

### *9.9.2.1.3.3 Potential Effects During Operation: Collision Risk*

*Table 9-47 Summary of gannet total collisions and apportioned to Forth Islands SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 0.7 | 3.4 | 7.8 | 0 | 60 | 0 | 0 | 0 |
| | Autumn | 0.3 | 1.6 | 3.8 | 24.3 | 100 | 0.1 | 0.4 | 0.9 |
| | Spring | 0.0 | 0.1 | 0.6 | 31.3 | 100 | 0.0 | 0.0 | 0.2 |
| | Annual | 1.1 | 5.1 | 12.2 | - | - | 0.1 | 0.4 | 1.1 |
| DBS West | Breeding | 0.6 | 4.9 | 15.3 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 2.1 | 6.0 | 24.3 | 100 | 0.1 | 0.5 | 1.5 |
| | Spring | 0.0 | 0.1 | 0.7 | 31.3 | 100 | 0.0 | 0.0 | 0.2 |
| | Annual | 1.5 | 7.1 | 17.7 | - | - | 0.1 | 0.5 | 1.7 |
| DBS East + DBS West | Breeding | 0.9 | 8.4 | 26.5 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.5 | 3.7 | 10.8 | 24.3 | 100 | 0.1 | 0.9 | 2.6 |

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| | Spring | 0.0 | 0.3 | 1.3 | 31.3 | 100 | 0.0 | 0.1 | 0.4 |
| | Annual | 2.7 | 12.4 | 29.8 | - | - | 0.1 | 1.0 | 3.0 |

*9.9.2.1.3.3.1 DBS East in Isolation*

452. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.4 (0.1to 1.1) birds per annum (**Table 9-47**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.1.3.3.2 DBS West in Isolation*

453. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.5 (0.1 to 1.7) birds per annum (**Table 9-47**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.1.3.3.3 DBS East and West Together*

454. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 1.0 (0.1 to 3.0) birds per annum (**Table 9-47**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.9.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

##### *9.9.2.1.3.4.1 DBS East in Isolation*

455. Since the estimated impacts from DBS East on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

##### *9.9.2.1.3.4.2 DBS West in Isolation*

456. Since the estimated impacts from DBS West on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

##### *9.9.2.1.3.4.3 DBS East and West Together*

457. Since the estimated impacts from DBS East and DBS West on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

#### *9.9.2.1.4 Summary*

458. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-48**).

459. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

*Table 9-48 Summary of predicted gannet displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Gannet** | | | | |
|---|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 1.81 | - | - |
| Spring | | 0.24 | - | - |
| Annual | | 2.05 | | |
| Effect | Reference population | 150,518 | - | - |
| | Increase in background mortality (%) | 0.01 | - | - |
| **Potential Effects During Operation: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 3.06 | - | - |
| Spring | | 0.4 | - | - |
| Annual | | 3.5 | | |
| Effect | Reference population | 150,518 | - | - |
| | Increase in background mortality (%) | 0.02 | - | - |
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | 0 | 0 | 0 |
| Autumn | | 0.1 | 0.9 | 2.6 |
| Spring | | 0.0 | 0.1 | 0.4 |
| Annual | | 0.1 | 1.0 | 3.0 |
| Effect | Reference population | 150,518 | | |
| | Increase in background mortality (%) | 0.00 | 0.01 | 0.02 |
| **Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk** | | | | |
| Combined Displacement and Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 3.16 | - | - |
| Spring | | 0.48 | - | - |
| Annual | | 3.6 | | |
| Effect | Reference population | 150,518 | - | - |
| | Increase in background mortality (%) | 0.02 | - | - |

##### *9.9.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

460. Given that no measurable increase in the Forth Islands SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 4.4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

#### 9.9.2.2 Kittiwake

461. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

##### *9.9.2.2.1 Status*

462. Kittiwake is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

463. The SPA breeding population at classification in 1990 was cited as 8,400 pairs or 16,800 breeding adults (SNH, 2009). The baseline mortality of this population is 1,339 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015). Burnell *et al.* (2023) give an updated count of 4,542 AON which has been used in this assessment.

##### *9.9.2.2.2 Connectivity to the Projects*

464. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, DBS East is outside the potential foraging range for breeding kittiwake from the Forth Islands SPA and, while DBS West is just within potential foraging range for breeding kittiwake from the Forth Islands SPA, it is considered that the likelihood of breeding season connectivity is so low that this can be ruled out.

465. Outside the breeding season breeding kittiwakes, including those from the Forth Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

466. It is estimated that 0.4% and 0.6% of birds present in the Project Array Areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Forth Islands SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.9.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-49 Summary of kittiwake total collisions and apportioned to Forth Islands SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.4 | 100 | 0.06 | 0.17 | 0.33 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.6 | 100 | 0.04 | 0.09 | 0.17 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.10 | 0.25 | 0.50 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.4 | 100 | 0.04 | 0.15 | 0.33 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.6 | 100 | 0.04 | 0.09 | 0.16 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.08 | 0.24 | 0.49 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.4 | 100 | 0.12 | 0.32 | 0.57 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.6 | 100 | 0.10 | 0.18 | 0.28 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.22 | 0.49 | 0.86 |

###### *9.9.2.2.3.1.1 DBS East in Isolation*

467. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.25 birds per annum (**Table 9-49**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.9.2.2.3.1.2 DBS West in Isolation*

468. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.24 birds per annum (**Table 9-49**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.9.2.2.3.1.3 DBS East and West Together*

469. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.5 birds per annum (**Table 9-49**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.9.2.2.4 Summary*

470. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-50**).

471. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

*Table 9-50 Summary of predicted Kittiwake collision mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean. | Upper c.i. |
| Breeding season | | 0 | 0 | 0 |
| Autumn | | 0.12 | 0.32 | 0.57 |
| Spring | | 0.10 | 0.18 | 0.28 |
| Annual | | 0.22 | 0.49 | 0.86 |
| Effect | Reference population | 9,084 | | |
| | Increase in background mortality (%) | 0.01 | 0.06 | 0.10 |

#### *9.9.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

472. Given that no measurable increase in the Forth Islands SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of less than 0.5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

### 9.9.2.3 Guillemot

473. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.9.2.3.1 Status*

474. Guillemot is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

475. The SPA breeding population at classification in 1997 was 16,000 breeding pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 26,510 individuals which has been used in this assessment.

#### *9.9.2.3.2 Connectivity to the Projects*

476. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

477. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

478. It is estimated that 1.6% of birds present at the Projects during the nonbreeding season are breeding adults from Forth Islands SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.9.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-51 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 0.552 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 0.016 | 1 | 200.8 | 0.6 | 1.0 | 14.1 | 0.3 | 0.5 | 7.0 | 25 | 9.3 | 0.15 | 0.45 | 0.65 | 7.18 |
| | Annual | | | | 200.8 | 0.6 | 1.0 | 14.1 | 0.3 | 0.5 | 7.0 | - | 16 | 0.15 | 0.45 | 0.65 | 7.18 |
| DBS West | Breeding | 8783.5 | 0 | 0.552 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 0.016 | 1 | 200.0 | 0.6 | 1.0 | 14.0 | 0.3 | 0.5 | 7.0 | 24 | 9.1 | 0.15 | 0.45 | 0.65 | 7.14 |
| | Annual | | | | 200.0 | 0.6 | 1.0 | 14.0 | 0.3 | 0.5 | 7.0 | - | 15.5 | 0.15 | 0.45 | 0.65 | 7.14 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 0.552 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 0.016 | 1 | 322.2 | 1.0 | 1.6 | 22.6 | 0.5 | 0.8 | 11.3 | | 18.4 | 0.29 | 0.78 | 1.10 | 11.57 |
| | Annual | | | | 322.2 | 1.0 | 1.6 | 22.6 | 0.5 | 0.8 | 11.3 | - | 31.4 | 0.29 | 0.78 | 1.10 | 11.57 |

##### *9.9.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.9.2.3.3.1.1 DBS East in Isolation*

479. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.2 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 0.4%.

480. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

481. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.65) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.9.2.3.3.1.2 DBS West in Isolation*

482. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.1 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 0.4%.

483. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

484. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.65) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.3.3.1.3 DBS East and West Together*

485. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 11.6 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 0.7%.

486. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

487. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.1) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.9.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

#### *9.9.2.3.3.2.1 DBS East in Isolation*

488. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.1 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 0.9%.

489. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

490. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.3.3.2.2 DBS West in Isolation*

491. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.0 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 0.9%.

492. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

493. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.3.3.2.3 DBS East and West Together*

494. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 22.6 birds per annum (**Table 9-51**). This would result in a predicted change in adult mortality rate of 1.4%, but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 55%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

495. Furthermore, there is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

496. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.9.2.3.4 Summary*

497. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-52)**.

498. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

*Table 9-52 Summary of predicted guillemot displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations*.

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 11.6 | 1.1 |
| Annual | | 11.6 | 1.1 |
| Effect | Reference population | 26,510 | |
| | Increase in background mortality (%) | 0.7 | 0.06 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 22.6 | 1.6 |
| Annual | | 22.6 | 1.6 |
| Effect | Reference population | 26,510 | |
| | Increase in background mortality (%) | 1.39 | 0.099 |

#### *9.9.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

499. Given that no measurable increase in the Forth Islands SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 1.6 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

### 9.9.2.4 Razorbill

500. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.9.2.4.1 Status*

501. Razorbill is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

502. The SPA breeding population at classification in 1990 was 1,400 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 5,695 individuals which has been used in this assessment.

#### *9.9.2.4.2 Connectivity to the Projects*

503. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of razorbill is 164.6km (88.7km + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

504. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

505. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.9% of the BDMPS population, and during the winter 0.7% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.9.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-53 Summary of razorbill density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.9 | 100 | 42.2 | 0.1 | 0.2 | 3.0 | 0.1 | 0.1 | 1.5 | 9.2 | 3.5 | 0.03 | 0.09 | 0.14 | 1.51 |
| | Winter | 3376.7 | 0.7 | 100 | 23.6 | 0.1 | 0.1 | 1.7 | 0.0 | 0.1 | 0.8 | 6.6 | 2.5 | 0.02 | 0.05 | 0.08 | 0.84 |
| | Spring | 3578.5 | 0.9 | 100 | 32.2 | 0.1 | 0.2 | 2.3 | 0.0 | 0.1 | 1.1 | 7.0 | 2.6 | 0.02 | 0.07 | 0.10 | 1.15 |
| | Annual | | | | 98 | 0.3 | 0.5 | 7 | 0.1 | 0.3 | 3.4 | - | 9 | 0.07 | 0.21 | 0.32 | 3.5 |
| DBS West | Breeding | 2280.6 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.9 | 100 | 44.0 | 0.1 | 0.2 | 3.1 | 0.1 | 0.1 | 1.5 | 9.4 | 3.5 | 0.03 | 0.10 | 0.14 | 1.57 |
| | Winter | 5066.2 | 0.7 | 100 | 35.5 | 0.1 | 0.2 | 2.5 | 0.1 | 0.1 | 1.2 | 9.7 | 3.7 | 0.03 | 0.08 | 0.11 | 1.27 |
| | Spring | 4454.6 | 0.9 | 100 | 40.1 | 0.1 | 0.2 | 2.8 | 0.1 | 0.1 | 1.4 | 8.6 | 3.2 | 0.03 | 0.09 | 0.13 | 1.43 |
| | Annual | | | | 119.6 | 0.4 | 0.6 | 8.4 | 0.2 | 0.3 | 4.2 | - | 10.4 | 0.09 | 0.27 | 0.38 | 4.27 |
| DBS East + DBS West | Breeding | 2826.1 | 0.0 | 61.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.9 | 100 | 57.1 | 0.2 | 0.3 | 4.0 | 0.1 | 0.1 | 2.0 | | 7.0 | 0.06 | 0.15 | 0.21 | 2.06 |
| | Winter | 5823.7 | 0.7 | 100 | 40.8 | 0.1 | 0.2 | 2.9 | 0.1 | 0.1 | 1.4 | | 6.1 | 0.04 | 0.10 | 0.14 | 1.47 |
| | Spring | 6302.5 | 0.9 | 100 | 56.7 | 0.2 | 0.3 | 4.0 | 0.1 | 0.1 | 2.0 | | 5.9 | 0.05 | 0.14 | 0.19 | 2.04 |
| | Annual | | | | 154.6 | 0.5 | 0.8 | 10.8 | 0.2 | 0.4 | 5.4 | - | 21.1 | 0.15 | 0.39 | 0.54 | 5.57 |

##### *9.9.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.9.2.4.3.1.1 DBS East in Isolation*

506. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 3.5 (1.5, 0.8, 1.1 in autumn winter and spring respectively) birds per annum (**Table 9-53)**. This would result in a predicted change in adult mortality rate of 0.6%.

507. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

508. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.9.2.4.3.1.2 DBS West in Isolation*

509. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.2 (1.5, 1.2, 1.4 in autumn winter and spring respectively) birds per annum (**Table 9-53**). This would result in a predicted change in adult mortality rate of 0.7%.

510. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

511. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.4.3.1.3 DBS East and West Together*

512. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 5.4 (2.0, 1.4, 2.0 in autumn, winter and spring respectively) birds per annum (**Table 9-53**). This would result in a predicted change in adult mortality rate of 0.9%.

513. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

514. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.4) would increase the predicted annual mortality by 0.07% which is below the 1% and therefore no further assessment was required.

###### *9.9.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.9.2.4.3.2.1 DBS East in Isolation*

515. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 6.8 (3.0, 1.6, 2.2 in autumn winter and spring respectively) birds per annum (**Table 9-53**). This would result in a predicted change in adult mortality rate of 1.1%, but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 66%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

516. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

517. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.5) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.4.3.2.2 DBS West in Isolation*

518. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 8.4 (3.1, 2.5, 2.8 in autumn winter and spring respectively) birds per annum (**Table 9-53**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

519. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

520. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.4.3.2.3 DBS East and West Together*

521. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 10.8 (4.0, 2.9, 4.0 in autumn winter and spring respectively) birds per annum (**Table 9-53**). This would result in a predicted change in adult mortality rate of 1.8% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 39%) or the mortality rate (e.g. to 5.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

522. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

523. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.8) would increase the predicted annual mortality by 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.4.4 Summary*

524. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-54)**.

525. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

*Table 9-54 Summary of predicted razorbill displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Razorbill** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 2.06 | 0.21 |
| Winter | | 1.47 | 0.14 |
| Spring | | 2.04 | 0.19 |
| Annual | | 5.57 | 0.54 |
| Effect | Reference population | | 5,695 |
| | Increase in background mortality (%) | 0.93 | 0.09 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 4.0 | 0.3 |
| Winter | | 2.9 | 0.2 |
| Spring | | 4.0 | 0.3 |
| Annual | | 10.8 | 0.8 |
| Effect | Reference population | | 5,695 |
| | Increase in background mortality (%) | 1.8 | 0.13 |

### *9.9.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

526. Given that no measurable increase in the Forth Islands SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted razorbill mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

#### 9.9.2.5 Puffin

527. Puffin has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.9.2.5.1 Status*

528. Puffin is listed as a designated species of the Forth Islands SPA.

529. The SPA breeding population at classification was 14,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 42,923 AOB which has been used in this assessment.

##### *9.9.2.5.2 Connectivity to the Projects*

530. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

531. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

532. It is estimated that 26.8% of birds present at the Projects are breeding adults from Forth Islands SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.9.2.5.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-55 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 26.8 | 1 | 47.9 | 0.14 | 0.24 | 3.35 | 0.07 | 0.12 | 1.68 | 0.35 | 0.13 | 0.04 | 0.11 | 0.16 | 1.71 |
| | Annual | | | | 47.9 | 0.14 | 0.24 | 3.35 | 0.07 | 0.12 | 1.68 | - | 0.18 | 0.04 | 0.11 | 0.16 | 1.71 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 26.8 | 1 | 53.1 | 0.16 | 0.27 | 3.72 | 0.08 | 0.13 | 1.86 | 0.38 | 0.14 | 0.04 | 0.12 | 0.17 | 1.90 |
| | Annual | | | | 53.1 | 0.16 | 0.27 | 3.72 | 0.08 | 0.13 | 1.86 | - | 0.22 | 0.04 | 0.12 | 0.17 | 1.90 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 26.8 | 1 | 99.9 | 0.30 | 0.50 | 6.99 | 0.15 | 0.25 | 3.50 | | 0.28 | 0.07 | 0.22 | 0.32 | 3.57 |
| | Annual | | | | 99.9 | 0.30 | 0.50 | 6.99 | 0.15 | 0.25 | 3.50 | - | 0.4 | 0.07 | 0.22 | 0.32 | 3.57 |

##### *9.9.2.5.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.9.2.5.3.1.1 DBS East in Isolation*

533. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 1.7 birds per annum (**Table 9-55)**. This would result in a predicted change in adult mortality rate of 0.02%.

534. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

535. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.16) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.9.2.5.3.1.2 DBS West in Isolation*

536. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 1.9 birds per annum (**Table 9-55**). This would result in a predicted change in adult mortality rate of 0.02%.

537. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

538. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.17) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.5.3.1.3 DBS East and West Together*

539. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-55**). This would result in a predicted change in adult mortality rate of 0.04%.

540. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

541. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.9.2.5.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.9.2.5.3.2.1 DBS East in Isolation*

542. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 3.3 birds per annum (**Table 9-55**). This would result in a predicted change in adult mortality rate of 0.04%.

543. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

544. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.2) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.5.3.2.2 DBS West in Isolation*

545. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 3.7 birds per annum (**Table 9-55**). This would result in a predicted change in adult mortality rate of 0.05%.

546. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

547. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.9.2.5.3.2.3 DBS East and West Together*

548. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 7.0 birds per annum (**Table 9-55**). This would result in a predicted change in adult mortality rate of 0.08%.

549. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

550. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.5) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.9.2.5.4 Summary*

551. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-56)**.

552. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

*Table 9-56 Summary of predicted puffin displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 3.6 | 0.3 |
| Annual | | 3.6 | 0.3 |
| Effect | Reference population | 85,846 | |
| | Increase in background mortality (%) | 0.04 | <0.01 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.0 | 0.5 |
| Annual | | 7.0 | 0.5 |
| Effect | Reference population | 85,846 | |
| | Increase in background mortality (%) | 0.086 | <0.01 |

### *9.9.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects*

553. Given that no measurable increase in the Forth Islands SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

## 9.10 Fowlsheugh SPA

554. Fowlsheugh SPA, located 4km south of Stonehaven on the east coast of Aberdeenshire in north-east Scotland, is a stretch of sheer cliffs between 30m and 60m high. Large numbers of seabirds nest on the cliffs. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

### 9.10.1 Site Description

#### 9.10.1.1 Qualifying Features

555. The qualifying features of the Fowlsheugh SPA screened into the Assessment are listed in **Table 4-7**. These are breeding kittiwake and guillemot and one named component of the breeding seabird assemblage (razorbill).

#### 9.10.1.2 Conservation Objectives

556. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.10.2 Assessment: Array Areas

#### 9.10.2.1 Kittiwake

557. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

##### *9.10.2.1.1 Status*

558. Kittiwake is listed as a designated species of the Fowlsheugh SPA.

559. The SPA breeding population at classification was cited as 36,650 pairs or 73,300 breeding adults in 2009 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 14,039 AON which has been used in this assessment.

##### *9.10.2.1.2 Connectivity to the Projects*

560. DBS East and DBS West are 360km and 327km respectively from the Fowlsheugh SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Fowlsheugh SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

561. Outside the breeding season breeding kittiwakes, including those from the Fowlsheugh SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

562. It is estimated that 1.3% and 1.8% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Fowlsheugh SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.10.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.10.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-57 Summary of kittiwake total collisions and apportioned to the Fowlsheugh SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 1.3 | 100 | 0.19 | 0.54 | 1.08 |
| | Spring | 6.8 | 14.6 | 28.0 | 1.8 | 100 | 0.12 | 0.26 | 0.50 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.31 | 0.80 | 1.58 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 1.3 | 100 | 0.12 | 0.49 | 1.06 |
| | Spring | 7.1 | 14.9 | 26.5 | 1.8 | 100 | 0.13 | 0.27 | 0.48 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.25 | 0.76 | 1.54 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 1.3 | 100 | 0.40 | 1.03 | 1.86 |
| | Spring | 16.9 | 29.5 | 47.3 | 1.8 | 100 | 0.30 | 0.53 | 0.85 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.70 | 1.56 | 2.71 |

###### *9.10.2.1.3.1.1 DBS East in Isolation*

563. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.8 birds per annum (**Table 9-58**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.10.2.1.3.1.2 DBS West in Isolation*

564. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.8 birds per annum (**Table 9-58**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.10.2.1.3.1.3 DBS East and West Together*

565. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 1.6 birds per annum (**Table 9-58**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.10.2.1.4 Summary*

566. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-58**).

567. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

*Table 9-58 Summary of predicted Kittiwake collision mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.40 | 1.03 | 1.86 |
| Spring | | 0.30 | 0.53 | 0.85 |
| Annual | | 0.70 | 1.56 | 2.71 |
| Effect | Reference population | 28,078 | | |
| | Increase in background mortality (%) | 0.01 | 0.06 | 0.11 |

#### *9.10.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

568. Given that no measurable increase in the Fowlsheugh SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 1.6 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

### 9.10.2.2 Guillemot

569. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.10.2.2.1 Status*

570. Guillemot is listed as a designated species of the Fowlsheugh SPA.

571. The SPA breeding population at classification was cited as 56,450 individuals in 1992 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 69,828 individuals which has been used in this assessment.

*9.10.2.2.2 Connectivity to the Projects*

572. DBS East and DBS West are 360km and 327km respectively from the Fowlsheugh SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Fowlsheugh SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

573. Outside the breeding season, breeding guillemots from Fowlsheugh SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

574. It is estimated that 3.0% of birds present at the Projects are considered to be breeding adults from Fowlsheugh SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.10.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-59 Summary of guillemot density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Fowlsheugh SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.71 | 6.7 | 0.20 | 0 | 0 | 0 |
| | Nonbreeding | 12551.8 | 3.0 | 100 | 376.5 | 1.1 | 1.9 | 26.2 | 0.6 | 0.9 | 13.2 | 24.62 | 9.3 | 0.28 | 0.8 | 1.2 | 13.4 |
| | Annual | | | | | 1.1 | 1.9 | 26.2 | 0.6 | 0.9 | 13.2 | - | 16 | 0.28 | 0.8 | 1.2 | 13.4 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16.92 | 6.4 | 0.20 | 0 | 0 | 0 |
| | Nonbreeding | 12498.4 | 3.0 | 100 | 374.9 | 1.1 | 1.9 | 26.0 | 0.6 | 0.9 | 13.1 | 24.08 | 9.1 | 0.27 | 0.8 | 1.2 | 13.3 |
| | Annual | | | | 374.9 | 1.1 | 1.9 | 26.0 | 0.6 | 0.9 | 13.1 | | 15.5 | 0.27 | 0.8 | 1.2 | 13.3 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 13.0 | 0.40 | 0 | 0 | 0 |
| | Nonbreeding | 20136.0 | 3.0 | 100 | 604.1 | 1.8 | 3.0 | 41.9 | 0.9 | 1.5 | 21.1 | | 18.4 | 0.55 | 1.4 | 2.0 | 21.5 |
| | Annual | | | | 604.1 | 1.8 | 3.0 | 41.9 | 0.9 | 1.5 | 21.1 | | 31.4 | 0.55 | 1.4 | 2.0 | 21.5 |

##### *9.10.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.10.2.2.3.1.1 DBS East in Isolation*

575. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.4 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.3%.

576. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

577. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.10.2.2.3.1.2 DBS West in Isolation*

578. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.3 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.3%.

579. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

580. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.10.2.2.3.1.3 DBS East and West Together*

581. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 21.5 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.5%.

582. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

583. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (2.0) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.10.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.10.2.2.3.2.1 DBS East in Isolation*

584. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 26.2 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.6%.

585. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

586. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.9) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.2.3.2.2 DBS West in Isolation*

587. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 26.0 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.6%.

588. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

589. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.9) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.2.3.2.3 DBS East and West Together*

590. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 41.9 birds per annum (**Table 9-59**). This would result in a predicted change in adult mortality rate of 0.98%.

591. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

592. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (3.0) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.10.2.2.4 Summary*

593. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-60**).

594. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

*Table 9-60 Summary of predicted guillemot displacement mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 21.5 | 2.0 |
| Annual | | 21.5 | 2.0 |
| Effect | Reference population | 69,828 | |
| | Increase in background mortality (%) | 0.51 | 0.05 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 41.9 | 3.0 |
| Annual | | 41.9 | 3.0 |
| Effect | Reference population | 69,828 | |
| | Increase in background mortality (%) | 0.98 | 0.07 |

##### *9.10.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

595. Given that no measurable increase in the Fowlsheugh SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

#### 9.10.2.3 Razorbill

596. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.10.2.3.1 Status*

597. Razorbill is listed as a named component of the breeding seabird assemblage of the Fowlsheugh SPA.

598. The SPA breeding population at classification in 1992 was cited as 5,800 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 14,063 individuals which has been used in this assessment.

##### *9.10.2.3.2 Connectivity to the Projects*

599. DBS East and DBS West are 360km and 327km respectively from Fowlsheugh SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Fowlsheugh SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

600. Outside the breeding season, breeding razorbills from Fowlsheugh SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

601. During the autumn and spring migration it is estimated that Fowlsheugh birds make up 1.2% of the BDMPS population, and during the winter 0.4% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.10.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-61 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fowlsheugh SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.1 | 0.4 | 0 | 0 | 0 | 0 |
| | Autumn | 4685.3 | 1.2 | 100 | 56.2 | 0.2 | 0.3 | 3.9 | 0.1 | 0.1 | 2.0 | 9.2 | 3.5 | 0.04 | 0.1 | 0.2 | 2.0 |
| | Winter | 3376.7 | 0.4 | 100 | 13.5 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.5 | 6.6 | 2.5 | 0.01 | 0.0 | 0.0 | 0.5 |
| | Spring | 3578.5 | 1.2 | 100 | 42.9 | 0.1 | 0.2 | 3.0 | 0.1 | 0.1 | 1.5 | 7.0 | 2.6 | 0.03 | 0.1 | 0.1 | 1.5 |
| | Annual | | | | 112.6 | 0.3 | 0.6 | 7.8 | 0.2 | 0.2 | 4 | - | 9 | 0.08 | 0.2 | 0.3 | 4 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.4 | 1.7 | 0 | 0 | 0 | 0 |
| | Autumn | 4886.9 | 1.2 | 100 | 58.6 | 0.2 | 0.3 | 4.1 | 0.1 | 0.1 | 2.1 | 9.4 | 3.5 | 0.04 | 0.1 | 0.2 | 2.1 |
| | Winter | 5066.2 | 0.4 | 100 | 20.3 | 0.1 | 0.1 | 1.4 | 0.0 | 0.1 | 0.7 | 9.7 | 3.7 | 0.01 | 0.05 | 0.07 | 0.72 |
| | Spring | 4454.6 | 1.2 | 100 | 53.5 | 0.2 | 0.3 | 3.7 | 0.1 | 0.1 | 1.9 | 8.6 | 3.2 | 0.04 | 0.1 | 0.2 | 1.9 |
| | Annual | | | | 132.4 | 0.4 | 0.7 | 9.3 | 0.2 | 0.3 | 4.6 | - | 9.1 | 0.09 | 0.25 | 0.47 | 4.72 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 2.1 | 0 | 0 | 0 | 0 |
| | Autumn | 6349.6 | 1.2 | 100 | 76.2 | 0.2 | 0.4 | 5.3 | 0.1 | 0.2 | 2.7 | | 7.0 | 0.08 | 0.2 | 0.3 | 2.7 |
| | Winter | 5823.7 | 0.4 | 100 | 23.3 | 0.1 | 0.1 | 1.6 | 0.0 | 0.1 | 0.8 | | 6.1 | 0.02 | 0.06 | 0.08 | 0.84 |
| | Spring | 6302.5 | 1.2 | 100 | 75.6 | 0.2 | 0.4 | 5.3 | 0.1 | 0.2 | 2.6 | | 5.9 | 0.07 | 0.2 | 0.3 | 2.7 |
| | Annual | | | | 175.1 | 0.5 | 0.9 | 12.3 | 0.3 | 0.4 | 6.1 | | 21.1 | 0.17 | 0.46 | 0.68 | 6.24 |

##### *9.10.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.10.2.3.3.1.1 DBS East in Isolation*

602. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0. 105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 4.0 (2.0, 0.5, 1.5 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.27%.

603. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

604. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.4) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.10.2.3.3.1.2 DBS West in Isolation*

605. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0. 105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 4.7 (2.1, 0.7, 1.9 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.32%.

606. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

607. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.5) would increase the predicted annual mortality by 0.025% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.3.3.1.3 DBS East and West Together*

608. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 6.2 (2.7, 0.8, 2.7 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.4%.

609. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

610. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.10.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.10.2.3.3.2.1 DBS East in Isolation*

611. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 7.8 (3.9, 0.9, 3.0 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.52%.

612. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

613. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.6) would increase the predicted annual mortality by 0.037% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.3.3.2.2 DBS West in Isolation*

614. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 9.3 (4.1, 1.4, 3.7 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.63%.

615. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

616. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.3.3.2.3 DBS East and West Together*

617. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 12.3 (5.3, 1.6, 5.3 in autumn winter and spring respectively) birds per annum (**Table 9-61**). This would result in a predicted change in adult mortality rate of 0.8%.

618. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

619. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.9) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.10.2.3.4 Summary*

620. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-62)**.

621. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

*Table 9-62 Summary of predicted razorbill displacement mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 2.7 | 0.3 |
| Winter | | 0.8 | 0.1 |
| Spring | | 2.7 | 0.3 |
| Annual | | 6.2 | 0.7 |
| Effect | Reference population | 14,063 | |

| Guillemot | | Displacement | |
|---|---|---|---|
| | Increase in background mortality (%) | 0.4 | 0.04 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 5.3 | 0.4 |
| Winter | | 1.6 | 0.1 |
| Spring | | 5.3 | 0.4 |
| Annual | | 12.3 | 0.9 |
| Effect | Reference population | 14,063 | |
| | Increase in background mortality (%) | 0.8 | 0.06 |

#### *9.10.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

622. Given that no measurable increase in the Fowlsheugh SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

## 9.11 Buchan Ness to Collieston Coast SPA

### 9.11.1 Site Description

623. Buchan Ness to Collieston Coast SPA was designated in 2009. The site is a stretch of south-east facing cliff in Aberdeenshire, Scotland. The 15km stretch of cliffs, formed of granite, quartzite and other rocks, runs south of Peterhead, broken only by the sandy beach of Cruden Bay. The varied coastal vegetation on the ledges and the cliff tops includes maritime heath, grassland and brackish flushes.

624. The boundary of the SPA follows the boundaries of Bullers of Buchan Coast SSSI and Collieston to Whinnyfold Coast SSSI, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.

#### 9.11.1.1 Qualifying Features

625. The qualifying features of the Buchan Ness to Collieston Coast SPA screened into the Assessment are listed in **Table 4-7**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.11.1.2 Conservation Objectives

626. The SPA's over-arching conservation objectives are to avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site;
- Distribution of the species within site;
- Distribution and extent of habitats supporting the species;
- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.

### 9.11.2 Assessment: Array Areas

#### 9.11.2.1 Kittiwake

627. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

##### *9.11.2.1.1 Status*

628. Kittiwake is listed as a named component of the breeding seabird assemblage of the Buchan Ness to Collieston Coast SPA.

629. The SPA breeding population at classification in 1998 was cited as 30,452 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 11,295 AON which has been used in this assessment.

##### *9.11.2.1.2 Connectivity to the Projects*

630. DBS East and DBS West are 357km and 340km respectively from Buchan Ness to Collieston Coast SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Buchan Ness to Collieston Coast SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

631. Outside the breeding season breeding kittiwakes, including those from Buchan Ness to Collieston Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015). It is estimated that 1.8% and 2.4% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Buchan Ness to Collieston Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.11.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

##### *9.11.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-63 Summary of kittiwake total collisions and apportioned to Buchan Ness to Collieston Coast SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | | | |
| | Autumn | 14.6 | 41.4 | 82.9 | 1.8 | 100 | 0.26 | 0.75 | 1.49 |
| | Spring | 6.8 | 14.6 | 28.0 | 2.4 | 100 | 0.16 | 0.35 | 0.67 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.43 | 1.10 | 2.16 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | | | |
| | Autumn | 9.5 | 37.9 | 81.9 | 1.8 | 100 | 0.17 | 0.68 | 1.47 |
| | Spring | 7.1 | 14.9 | 26.5 | 2.4 | 100 | 0.17 | 0.36 | 0.64 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.34 | 1.04 | 2.11 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | | | |
| | Autumn | 30.5 | 79.3 | 143.1 | 1.8 | 100 | 0.55 | 1.43 | 2.58 |
| | Spring | 16.9 | 29.5 | 47.3 | 2.4 | 100 | 0.41 | 0.71 | 1.14 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.95 | 2.14 | 3.71 |

###### *9.11.2.1.3.1.1 DBS East in Isolation*

632. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.1 birds per annum (**Table 9-63**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.11.2.1.3.1.2 DBS West in Isolation*

633. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1.0 birds per annum (**Table 9-63**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.11.2.1.3.1.3 DBS East and West Together*

634. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.1 birds per annum (**Table 9-63**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.11.2.1.4 Summary*

635. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-64**).

636. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

*Table 9-64 Summary of predicted Kittiwake collision mortality from Buchan Ness to Collieston Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean. | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.55 | 1.43 | 2.58 |
| Spring | | 0.41 | 0.71 | 1.14 |
| Annual | | 0.95 | 2.14 | 3.71 |
| Effect | Reference population | 28,078 | | |
| | Increase in background mortality (%) | 0.02 | 0.07 | 0.11 |

#### *9.11.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

637. Given that no measurable increase in the Buchan Ness to Collieston Coast SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.1 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

### 9.11.2.2 Guillemot

638. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.11.2.2.1 Status*

639. Guillemot is listed as a named component of the breeding seabird assemblage of the Buchan Ness to Collieston Coast SPA.

640. The SPA breeding population at classification in 1998 was cited as 8,640 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 29,433 individuals which has been used in this assessment.

#### *9.11.2.2.2 Connectivity to the Projects*

641. DBS East and DBS West are 357km and 340km respectively from Buchan Ness to Collieston Coast SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Buchan Ness to Collieston Coast SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

642. Outside the breeding season, breeding guillemots from Buchan Ness to Collieston Coast SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

643. It is estimated that 1.3% of birds present at the Projects are breeding adults from Buchan Ness to Collieston Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.11.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-65 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Buchan Ness to Collieston Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 1.3 | 100 | 163.2 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | 24.62 | 9.3 | 0.1 | 0.4 | 0.5 | 5.8 |
| | Annual | | | | 163.2 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | - | 16 | 0.1 | 0.4 | 0.5 | 5.8 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 1.3 | 100 | 162.5 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | 24.08 | 9.1 | 0.1 | 0.4 | 0.5 | 5.8 |
| | Annual | | | | 162.5 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | - | 15.5 | 0.1 | 0.4 | 0.5 | 5.8 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 1.3 | 100 | 261.8 | 0.8 | 1.3 | 18.3 | 0.4 | 0.7 | 9.2 | | 18.4 | 0.2 | 0.6 | 0.9 | 9.4 |
| | Annual | | | | 261.8 | 0.8 | 1.3 | 18.3 | 0.4 | 0.7 | 9.2 | | 31.4 | 0.2 | 0.6 | 0.9 | 9.4 |

##### *9.11.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.11.2.2.3.1.1 DBS East in Isolation*

644. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 5.8 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.3%.

645. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

646. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.5) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.11.2.2.3.1.2 DBS West in Isolation*

647. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 5.7 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.3%.

648. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

649. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.5) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.11.2.2.3.1.3 DBS East and West Together*

650. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 9.2 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.5%.

651. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

652. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.9) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.11.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.11.2.2.3.2.1 DBS East in Isolation*

653. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.2 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.6%.

654. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

655. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.8) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.11.2.2.3.2.2 DBS West in Isolation*

656. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.2 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.6%.

657. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

658. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.8) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.11.2.2.3.2.3 DBS East and West Together*

659. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 18.0 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 1.0% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 69%) or the mortality rate (e.g. to 9%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

660. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

661. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (1.3) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.11.2.2.4 Summary*

662. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-66)**.

663. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

*Table 9-66 Summary of predicted guillemot displacement mortality from Buchan Ness to Collieston Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 9.4 | 0.9 |
| Annual | | 9.4 | 0.9 |
| Effect | Reference population | 29,433 | |
| | Increase in background mortality (%) | 0.51 | 0.05 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |

| Guillemot | | Displacement | |
|---|---|---|---|
| Nonbreeding season | | 18.3 | 1.3 |
| Annual | | 18.3 | 1.3 |
| Effect | Reference population | 29,433 | |
| | Increase in background mortality (%) | 1.0 | 0.07 |

#### *9.11.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

664. Given that no measurable increase in the Buchan Ness to Collieston Coast SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 1.3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

## 9.12 Troup, Pennan and Lion's Heads SPA

### 9.12.1 Site Description

665. The Troup, Pennan and Lion’s Heads SPA is a 9km stretch of sea cliffs along the Aberdeenshire coast which support large colonies of breeding seabirds.

666. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.12.1.1 Qualifying Features

667. The qualifying features of the Troup, Pennan and Lion’s Heads SPA screened into the Assessment are listed in **Table 4-7**. These are breeding kittiwake and guillemot and one named component of the breeding seabird assemblage (razorbill).

#### 9.12.1.2 Conservation Objectives

668. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.12.2 Assessment: Array Areas

#### 9.12.2.1 Kittiwake

669. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

##### *9.12.2.1.1 Status*

670. Kittiwake is listed as a designated species of the Troup, Pennan and Lion's Heads SPA.

671. The SPA breeding population at classification in 1997 was cited as 31,600 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 10,616 AON which has been used in this assessment.

##### *9.12.2.1.2 Connectivity to the Projects*

672. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Troup, Pennan and Lion's Heads SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

673. Outside the breeding season breeding kittiwakes, including those from Troup, Pennan and Lion's Heads SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015). It is estimated that 2.2% and 2.8% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Troup, Pennan and Lions Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.12.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.12.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-67 Summary of kittiwake total collisions and apportioned to the Troup, Pennan and Lions Head SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 2.2 | 100 | 0.32 | 0.91 | 1.82 |
| | Spring | 6.8 | 14.6 | 28.0 | 2.8 | 100 | 0.19 | 0.41 | 0.78 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.51 | 1.32 | 2.61 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 2.2 | 100 | 0.21 | 0.83 | 1.80 |
| | Spring | 7.1 | 14.9 | 26.5 | 2.8 | 100 | 0.20 | 0.42 | 0.74 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.41 | 1.25 | 2.54 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 2.2 | 100 | 0.67 | 1.74 | 3.15 |
| | Spring | 16.9 | 29.5 | 47.3 | 2.8 | 100 | 0.47 | 0.83 | 1.32 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 1.14 | 2.57 | 4.47 |

###### *9.12.2.1.3.1.1 DBS East in Isolation*

674. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.3 birds per annum (**Table 9-67**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.12.2.1.3.1.2 DBS West in Isolation*

675. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1.2 birds per annum (**Table 9-67**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.12.2.1.3.1.3 DBS East and West Together*

676. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.6 birds per annum (**Table 9-67**). This results in a predicted change in adult mortality rate of 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.12.2.1.4 Summary*

677. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below **(Table 9-68)**.

678. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lions Head SPA**.

*Table 9-68 Summary of predicted Kittiwake collision mortality from Troup, Pennan and Lions Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean. | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.67 | 1.74 | 3.15 |
| Spring | | 0.47 | 0.83 | 1.32 |
| Annual | | 1.14 | 2.57 | 4.47 |
| Effect | Reference population | 21,232 | | |
| | Increase in background mortality (%) | 0.03 | 0.08 | 0.14 |

#### *9.12.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

679. Given that no measurable increase in the Troup, Pennan and Lions Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lions Head SPA**.

### 9.12.2.2 Guillemot

680. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.12.2.2.1 Status*

681. Guillemot is listed as a designated species of the Troup, Pennan and Lion's Heads SPA.

682. The SPA breeding population at classification in 1997 was cited as 44,600 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 23,801 individuals which has been used in this assessment.

#### *9.12.2.2.2 Connectivity to the Projects*

683. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Troup, Pennan and Lion's Heads SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

684. Outside the breeding season, breeding guillemots from Troup, Pennan and Lion's Heads SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

685. It is estimated that 0.9% of birds present at the Projects are breeding adults from Troup, Pennan and Lion's Heads SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.12.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-69 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Troup, Pennan and Lion's Heads SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 0.9 | 100 | 113.0 | 0.3 | 0.6 | 7.9 | 0.2 | 0.3 | 4.0 | 24.62 | 9.3 | 0.1 | 0.3 | 0.4 | 4.0 |
| | Annual | | | | 113.0 | 0.3 | 0.6 | 7.9 | 0.2 | 0.3 | 4.0 | - | 16 | 0.1 | 0.3 | 0.4 | 4.0 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 0.9 | 100 | 112.5 | 0.3 | 0.6 | 7.9 | 0.2 | 0.3 | 3.9 | 24.08 | 9.1 | 0.1 | 0.3 | 0.4 | 4.0 |
| | Annual | | | | 112.5 | 0.3 | 0.6 | 7.9 | 0.2 | 0.3 | 3.9 | - | 15.5 | 0.1 | 0.3 | 0.4 | 4.0 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 0.9 | 100 | 181.2 | 0.5 | 0.9 | 12.7 | 0.3 | 0.5 | 6.3 | | 18.4 | 0.2 | 0.4 | 0.6 | 6.5 |
| | Annual | | | | 181.2 | 0.5 | 0.9 | 12.7 | 0.3 | 0.5 | 6.3 | | 31.4 | 0.2 | 0.4 | 0.6 | 6.5 |

###### *9.12.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.12.2.2.3.1.1 DBS East in Isolation*

686. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,451 (23,801 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.0 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.3%.

687. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

688. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.4) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.12.2.2.3.1.2 DBS West in Isolation*

689. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.2 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.3%.

690. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

691. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.4) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.2.3.1.3 DBS East and West Together*

692. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 6.5 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.5%.

693. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

694. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.6) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.12.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.12.2.2.3.2.1 DBS East in Isolation*

695. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.9 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.6%.

696. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

697. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.6) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.2.3.2.2 DBS West in Isolation*

698. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.9 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.6%.

699. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

700. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.6) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.2.3.2.3 DBS East and West Together*

701. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 12.7 birds per annum (**Table 9-69**). This would result in a predicted change in adult mortality rate of 0.91%.

702. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

703. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.95) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.12.2.2.4 Summary*

704. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-70)**.

705. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

*Table 9-70 Summary of predicted guillemot displacement mortality from Troup, Pennan and Lion's Heads SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 6.5 | 0.6 |
| Annual | | 6.5 | 0.6 |
| Effect | Reference population | 23,801 | |
| | Increase in background mortality (%) | 0.47 | 0.04 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 12.7 | 0.9 |
| Annual | | 12.7 | 0.9 |
| Effect | Reference population | 23,801 | |
| | Increase in background mortality (%) | 0.92 | 0.07 |

##### *9.12.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

706. Given that no measurable increase in the Troup, Pennan and Lion's Heads SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 0.9 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

#### 9.12.2.3 Razorbill

707. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.12.2.3.1 Status*

708. Razorbill is listed as a named component of the breeding seabird assemblage of the Troup, Pennan and Lion's Heads SPA.

709. The SPA breeding population at classification in 1997 was cited as 4,800 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 4,518 individuals which has been used in this assessment.

#### *9.12.2.3.2 Connectivity to the Projects*

710. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Troup, Pennan and Lion's Heads SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

711. Outside the breeding season, breeding razorbills from Troup, Pennan and Lion's Heads SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

712. During the autumn and spring migration it is estimated that Troup, Pennan and Lion's Heads birds make up 0.6% of the BDMPS population, and during the winter 0.2% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.12.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-71 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Troup, Pennan and Lion's Heads SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 - 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.6 | 100 | 28.1 | 0.1 | 0.1 | 2.0 | 0.0 | 0.1 | 1.0 | 9.2 | 3.5 | 0.02 | 0.06 | 0.09 | 1.00 |
| | Winter | 3376.7 | 0.2 | 100 | 6.8 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.2 | 6.6 | 2.5 | 0.00 | 0.02 | 0.02 | 0.24 |
| | Spring | 3578.5 | 0.6 | 100 | 21.5 | 0.1 | 0.1 | 1.5 | 0.0 | 0.1 | 0.8 | 7.0 | 2.6 | 0.02 | 0.05 | 0.07 | 0.77 |
| | Annual | | | | 56.3 | 0.2 | 0.2 | 4 | 0 | 0.2 | 2 | - | 9 | 0.04 | 0.13 | 0.18 | 2.01 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.6 | 100 | 29.3 | 0.1 | 0.1 | 2.1 | 0.0 | 0.1 | 1.0 | 9.4 | 3.5 | 0.02 | 0.07 | 0.09 | 1.05 |
| | Winter | 5066.2 | 0.2 | 100 | 10.1 | 0.0 | 0.1 | 0.7 | 0.0 | 0.0 | 0.4 | 9.7 | 3.7 | 0.01 | 0.02 | 0.03 | 0.36 |
| | Spring | 4454.6 | 0.6 | 100 | 26.7 | 0.1 | 0.1 | 1.9 | 0.0 | 0.1 | 0.9 | 8.6 | 3.2 | 0.02 | 0.06 | 0.09 | 0.95 |
| | Annual | | | | 66.2 | 0.2 | 0.3 | 4.6 | 0.1 | 0.2 | 2.3 | - | 10.4 | 0.05 | 0.15 | 0.21 | 2.36 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.6 | 100 | 38.1 | 0.1 | 0.2 | 2.7 | 0.1 | 0.1 | 1.3 | | 7.0 | 0.04 | 0.10 | 0.14 | 1.38 |
| | Winter | 5823.7 | 0.2 | 100 | 11.6 | 0.0 | 0.1 | 0.8 | 0.0 | 0.0 | 0.4 | | 6.1 | 0.01 | 0.03 | 0.04 | 0.42 |
| | Spring | 6302.5 | 0.6 | 100 | 37.8 | 0.1 | 0.2 | 2.6 | 0.1 | 0.1 | 1.3 | | 5.9 | 0.04 | 0.09 | 0.13 | 1.36 |
| | Annual | | | | 87.6 | 0.3 | 0.4 | 6.1 | 0.1 | 0.2 | 3.1 | - | 21.1 | 0.09 | 0.22 | 0.31 | 3.16 |

##### *9.12.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.12.2.3.3.1.1 DBS East in Isolation*

713. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.0 (1.0, 0.24, 0.77 in autumn winter and spring respectively) birds per annum (**Table 9-71)**. This would result in a predicted change in adult mortality rate of 0.41%.

714. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

715. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.12.2.3.3.1.2 DBS West in Isolation*

716. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.4 (1.0, 0.4, 1.0 in autumn, winter and spring respectively) birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.5%.

717. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

718. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.3.3.1.3 DBS East and West Together*

719. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 3.2 (1.4, 0.4, 1.4 in autumn, winter and spring respectively) birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.6%.

720. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

721. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.12.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.12.2.3.3.2.1 DBS East in Isolation*

722. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.9 (2.0, 0.5, 1.5 in autumn winter and spring respectively) birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.8%.

723. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

724. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.3.3.2.2 DBS West in Isolation*

725. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 4.6 (2.1, 0.7, 1.9 in autumn winter and spring respectively) birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.9%.

726. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

727. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.12.2.3.3.2.3 DBS East and West Together*

728. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 6.1 (2.7, 0.8, 2.6 in autumn winter and spring respectively) birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 1.3% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 54%) or the mortality rate (e.g. to 7.7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

729. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

730. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.4) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.12.2.3.4 Summary*

731. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-72)**.

732. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

*Table 9-72 Summary of predicted razorbill displacement mortality from Troup, Pennan and Lion's Heads SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 1.38 | 0.14 |
| Winter | | 0.42 | 0.04 |
| Spring | | 1.36 | 0.13 |
| Annual | | 3.2 | 0.3 |
| Effect | Reference population | 4,518 | |
| | Increase in background mortality (%) | 0.6 | 0.05 |

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 2.7 | 0.2 |
| Winter | | 0.8 | 0.1 |
| Spring | | 2.6 | 0.2 |
| Annual | | 6.1 | 0.4 |
| Effect | Reference population | 4,518 | |
| | Increase in background mortality (%) | 1.3 | 0.08 |

*9.12.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

733. Given that no measurable increase in the Troup, Pennan and Lion's Heads SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

## 9.13 East Caithness Cliffs SPA

### 9.13.1 Site Description

734. The East Caithness Cliffs SPA is of high nature conservation and scientific importance within Britain and Europe for supporting very large populations of breeding seabirds. It includes most of the sea cliff areas between Wick and Helmsdale on the north-east coast of the Scottish mainland.

735. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.13.1.1 Qualifying Features

736. The qualifying features of the East Caithness Cliffs SPA screened into the assessment are listed in **Table 4-7**. These are breeding kittiwake, guillemot and razorbill.

#### 9.13.1.2 Conservation Objectives

737. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.13.2 Assessment: Array Areas

#### 9.13.2.1 Kittiwake

738. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.13.2.1.1 Status*

739. Kittiwake is listed as a designated species of the East Caithness Cliffs SPA.

740. The SPA breeding population at classification in 1996 was cited as 32,500 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 24,479 individuals which has been used in this assessment.

##### *9.13.2.1.2 Connectivity to the Projects*

741. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from East Caithness Cliffs SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

742. Outside the breeding season breeding kittiwakes, including those from East Caithness Cliffs SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

743. It is estimated that 5.8% and 7.7% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from East Caithness Cliffs SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.13.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

##### *9.13.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-73 Summary of kittiwake total collisions and apportioned to the East Caithness Cliffs SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 5.8 | 100 | 0.8 | 2.4 | 4.8 |
| | Spring | 6.8 | 14.6 | 28.0 | 7.7 | 100 | 0.5 | 1.1 | 2.2 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 1.4 | 3.5 | 7.0 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 5.8 | 100 | 0.6 | 2.2 | 4.8 |
| | Spring | 7.1 | 14.9 | 26.5 | 7.7 | 100 | 0.5 | 1.1 | 2.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 1.1 | 3.3 | 6.8 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 5.8 | 100 | 1.8 | 4.6 | 8.3 |
| | Spring | 16.9 | 29.5 | 47.3 | 7.7 | 100 | 1.3 | 2.3 | 3.6 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 3.1 | 6.9 | 11.9 |

###### 9.13.2.1.3.1.1 DBS East in Isolation

744. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 3.6 birds per annum (**Table 9-73**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.13.2.1.3.1.2 DBS West in Isolation

745. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 3.3 birds per annum (**Table 9-73**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.13.2.1.3.1.3 DBS East and West Together

746. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 6.9 birds per annum (**Table 9-73**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.13.2.1.4 Summary

747. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-74**).

748. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

*Table 9-74 Summary of predicted Kittiwake collision mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| Kittiwake | | Collisions | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 1.8 | 4.6 | 8.3 |
| Spring | | 1.3 | 2.3 | 3.6 |
| Annual | | 3.1 | 6.9 | 11.9 |
| Effect | Reference population | 48,958 | | |
| | Increase in background mortality (%) | 0.03 | 0.1 | 0.22 |

##### *9.13.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

749. Given that no measurable increase in the East Caithness Cliffs SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 6.9 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

#### 9.13.2.2 Guillemot

750. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.13.2.2.1 Status*

751. Guillemot is listed as a designated species of the East Caithness Cliffs SPA.

752. The SPA breeding population at classification in 1996 was cited as 106,700 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 149,228 individuals which has been used in this assessment.

##### *9.13.2.2.2 Connectivity to the Projects*

753. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from East Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

754. Outside the breeding season, breeding guillemots from East Caithness Cliffs SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

755. It is estimated that 9.2% of birds present at the Projects are considered to be breeding adults from East Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.13.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-75 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for East Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 -1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 9.2 | 100 | 1154.8 | 3.5 | 5.8 | 80.8 | 1.7 | 2.9 | 40.4 | 24.62 | 9.3 | 0.9 | 2.6 | 3.7 | 41.3 |
| | Annual | | | | 1154.8 | 3.5 | 5.8 | 80.8 | 1.7 | 2.9 | 40.4 | - | 16 | 0.9 | 2.6 | 3.7 | 41.3 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 9.2 | 100 | 1149.9 | 3.4 | 5.7 | 80.5 | 1.7 | 2.9 | 40.2 | 24.08 | 9.1 | 0.8 | 2.6 | 3.7 | 41.1 |
| | Annual | | | | 1149.9 | 3.4 | 5.7 | 80.5 | 1.7 | 2.9 | 40.2 | - | 15.5 | 0.8 | 2.6 | 3.7 | 41.1 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 9.2 | 100 | 1852.5 | 5.6 | 9.3 | 129.7 | 2.8 | 4.6 | 64.8 | - | 18.4 | 1.7 | 4.5 | 6.3 | 66.5 |
| | Annual | | | | 1852.5 | 5.6 | 9.3 | 129.7 | 2.8 | 4.6 | 64.8 | | 31.4 | 1.7 | 4.5 | 6.3 | 66.5 |

###### *9.13.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.13.2.2.3.1.1 DBS East in Isolation*

756. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 41.3 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.4%.

757. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

758. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (3.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.13.2.2.3.1.2 DBS West in Isolation*

759. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 41.1 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.4%.

760. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

761. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (3.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.13.2.2.3.1.3 DBS East and West Together*

762. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 66.5 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.7%.

763. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

764. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (6.3) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.13.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.13.2.2.3.2.1 DBS East in Isolation*

765. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 80.8 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.9%.

766. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

767. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (5.8) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.13.2.2.3.2.2 DBS West in Isolation*

768. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 80.5 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.9%.

769. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

770. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (5.7) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.13.2.2.3.2.3 DBS East and West Together*

771. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 129.7 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 49%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

772. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

773. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (9.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.13.2.2.4 Summary*

774. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-76)**.

775. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

*Table 9-76 Summary of predicted guillemot displacement mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 66.5 | 6.3 |
| Annual | | 66.5 | 6.3 |
| Effect | Reference population | 149,228 | |
| | Increase in background mortality (%) | 0.7 | 0.07 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 129.7 | 9.3 |
| Annual | | 129.7 | 9.3 |
| Effect | Reference population | 149,228 | |
| | Increase in background mortality (%) | 1.4 | 0.1 |

#### 9.13.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

776. Given that no measurable increase in the East Caithness Cliffs SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 10 birds per year during operation from a population of almost 150,000), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

### 9.13.2.3 Razorbill

777. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### 9.13.2.3.1 *Status*

778. Razorbill is listed as a designated species of the East Caithness Cliffs SPA.

779. The SPA breeding population at classification in 1996 was cited as 15,800 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 30,129 individuals which has been used in this assessment.

#### 9.13.2.3.2 *Connectivity to the Projects*

780. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from East Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

781. Outside the breeding season, breeding razorbills from East Caithness Cliffs SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

782. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 4.2% of the BDMPS population, and during the winter 1.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.13.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-77 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for East Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 4.2 | 100 | 196.8 | 0.6 | 1.0 | 13.8 | 0.3 | 0.5 | 6.9 | 9.2 | 3.5 | 0.15 | 0.44 | 0.64 | 7.03 |
| | Winter | 3376.7 | 1.3 | 100 | 43.9 | 0.1 | 0.2 | 3.1 | 0.1 | 0.1 | 1.5 | 6.6 | 2.5 | 0.03 | 0.10 | 0.14 | 1.57 |
| | Spring | 3578.5 | 4.2 | 100 | 150.3 | 0.5 | 0.8 | 10.5 | 0.2 | 0.4 | 5.3 | 7.0 | 2.6 | 0.11 | 0.34 | 0.49 | 5.37 |
| | Annual | | | | 391 | 1.2 | 2 | 27.4 | 0.6 | 1 | 13.7 | - | 9 | 0.29 | 0.88 | 1.27 | 13.97 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 4.2 | 100 | 205.2 | 0.6 | 1.0 | 14.4 | 0.3 | 0.5 | 7.2 | 9.4 | 3.5 | 0.15 | 0.46 | 0.66 | 7.33 |
| | Winter | 5066.2 | 1.3 | 100 | 65.9 | 0.2 | 0.3 | 4.6 | 0.1 | 0.2 | 2.3 | 9.7 | 3.7 | 0.05 | 0.15 | 0.21 | 2.35 |
| | Spring | 4454.6 | 4.2 | 100 | 187.1 | 0.6 | 0.9 | 13.1 | 0.3 | 0.5 | 6.5 | 8.6 | 3.2 | 0.14 | 0.42 | 0.60 | 6.68 |
| | Annual | | | | 458.2 | 1.4 | 2.3 | 32.1 | 0.7 | 1.1 | 16.0 | - | 10.4 | 0.34 | 1.03 | 1.47 | 16.36 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 4.2 | 100 | 266.7 | 0.8 | 1.3 | 18.7 | 0.4 | 0.7 | 9.3 | | 7.0 | 0.29 | 0.69 | 0.96 | 9.63 |
| | Winter | 5823.7 | 1.3 | 100 | 75.7 | 0.2 | 0.4 | 5.3 | 0.1 | 0.2 | 2.6 | | 6.1 | 0.08 | 0.19 | 0.27 | 2.73 |
| | Spring | 6302.5 | 4.2 | 100 | 264.7 | 0.8 | 1.3 | 18.5 | 0.4 | 0.7 | 9.3 | | 5.9 | 0.25 | 0.64 | 0.91 | 9.51 |
| | Annual | | | | 607.1 | 1.8 | 3.0 | 42.5 | 0.9 | 1.5 | 21.2 | | 21.1 | 0.62 | 1.52 | 2.14 | 21.87 |

###### *9.13.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.13.2.3.3.1.1 DBS East in Isolation*

783. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 14.0 (7.0, 1.6, 5.4 in autumn winter and spring respectively) birds per annum (**Table 9-77)**. This would result in a predicted change in adult mortality rate of 0.44%.

784. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

785. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (1.3) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.13.2.3.3.1.2 DBS West in Isolation*

786. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.4 (7.3, 2.4, 6.7 in autumn winter and spring respectively) birds per annum (**Table 9-77**). This would result in a predicted change in adult mortality rate of 0.52%.

787. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

788. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.13.2.3.3.1.3 DBS East and West Together*

789. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 21.9 (9.6, 2.7, 9.5 in autumn, winter and spring respectively) birds per annum (**Table 9-77**). This would result in a predicted change in adult mortality rate of 0.7%.

790. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

791. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (1.7) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.13.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.13.2.3.3.2.1 DBS East in Isolation*

792. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 27.4 (13.8, 3.0, 10.6 in autumn winter and spring respectively) birds per annum (**Table 9-77**). This would result in a predicted change in adult mortality rate of 0.87%.

793. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

794. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (2.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.13.2.3.3.2.2 DBS West in Isolation*

795. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 32.1 (14.4, 4.6, 13.1 in autumn winter and spring respectively) birds per annum (**Table 9-77**). This would result in a predicted change in adult mortality rate of 1.0%.

796. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

797. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (2.3) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.13.2.3.3.2.3 DBS East and West Together*

798. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction  impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 42.5 (18.7, 5.3, 18.5 in autumn winter and spring respectively) birds per annum (**Table 9-77**). This would result in a predicted change in adult mortality rate of 1.3% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 52%) or the mortality rate (e.g. to 7.4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).here is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

799. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (2.9) would increase the predicted annual mortality by 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.13.2.3.4 Summary*

800. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-78)**.

801. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

*Table 9-78 Summary of predicted razorbill displacement mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 9.63 | 0.96 |
| Winter | | 2.73 | 0.27 |
| Spring | | 9.51 | 0.91 |
| Annual | | 21.9 | 2.14 |
| Effect | Reference population | 30,129 | |
| | Increase in background mortality (%) | 0.7 | 0.07 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 18.7 | 1.3 |
| Winter | | 5.3 | 0.4 |
| Spring | | 18.5 | 1.3 |
| Annual | | 42.5 | 3.0 |
| Effect | Reference population | 30,129 | |
| | Increase in background mortality (%) | 1.3 | 0.09 |

### *9.13.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

802. Given that no measurable increase in the East Caithness Cliffs SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted razorbill mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

## 9.14 North Caithness Cliffs SPA

### 9.14.1 Site Description

803. The North Caithness Cliffs SPA is of special nature conservation and scientific importance within Britain and Europe for supporting very large populations of several breeding seabird species.

804. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.14.1.1 Qualifying Features

805. The qualifying features of the North Caithness Cliffs SPA screened into the assessment are listed in **Table 4-7**. These are breeding guillemot and three named components of the breeding seabird assemblage (kittiwake, razorbill and puffin).

#### 9.14.1.2 Conservation Objectives

806. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.14.2 Assessment: Array Areas

#### 9.14.2.1 Kittiwake

807. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.14.2.1.1 Status*

808. Kittiwake is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA.

809. The SPA breeding population at classification in 1996 was cited as 13,100 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 5,571 AON which has been used in this assessment.

###### *9.14.2.1.2 Connectivity to the Projects*

810. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from North Caithness Cliffs SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

811. Outside the breeding season breeding kittiwakes, including those from North Caithness Cliffs SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

812. It is estimated that 1.5% and 1.9% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from North Caithness Cliffs SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.14.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.14.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-79 Summary of kittiwake total collisions and apportioned to the North Caithness Cliffs SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 1.5 | 100 | 0.2 | 0.6 | 1.2 |
| | Spring | 6.8 | 14.6 | 28.0 | 1.9 | 100 | 0.1 | 0.3 | 0.5 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.3 | 0.9 | 1.8 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 1.5 | 100 | 0.1 | 0.6 | 1.2 |
| | Spring | 7.1 | 14.9 | 26.5 | 1.9 | 100 | 0.1 | 0.3 | 0.5 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.3 | 0.9 | 1.7 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 1.5 | 100 | 0.5 | 1.2 | 2.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 1.9 | 100 | 0.3 | 0.6 | 0.9 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.8 | 1.8 | 3.0 |

*9.14.2.1.3.1.1 DBS East in Isolation*

813. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.9 birds per annum (**Table 9-79**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.1.3.1.2 DBS West in Isolation*

814. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.9 birds per annum (**Table 9-79**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.1.3.1.3 DBS East and West Together*

815. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 1.8 birds per annum (**Table 9-79**). This results in a predicted change in adult mortality rate of 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.14.2.1.4 Summary*

816. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-80**).

817. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

*Table 9-80 Summary of predicted Kittiwake collision mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.5 | 1.2 | 2.1 |
| Spring | | 0.3 | 0.6 | 0.9 |
| Annual | | 0.8 | 1.8 | 3.0 |
| Effect | Reference population | 11,142 | | |
| | Increase in background mortality (%) | 0.05 | 0.11 | 0.18 |

##### *9.14.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

818. Given that no measurable increase in the North Caithness Cliffs SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 1.7 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

#### 9.14.2.2 Guillemot

819. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.14.2.2.1 Status*

820. Guillemot is listed as a designated species of the North Caithness Cliffs SPA.

821. The SPA breeding population at classification in 1996 was cited as 38,300 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 38,898 individuals which has been used in this assessment.

##### *9.14.2.2.2 Connectivity to the Projects*

822. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

823. Outside the breeding season, breeding guillemots from North Caithness Cliffs SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

824. It is estimated that 4.1% of birds present at the Projects are considered to be breeding adults from North Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.14.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-81 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 4.1 | 100 | 514.6 | 1.5 | 2.6 | 36.0 | 0.8 | 1.3 | 18.0 | 24.62 | 9.3 | 0.4 | 1.2 | 1.7 | 18.4 |
| | Annual | | | | 514.6 | 1.5 | 2.6 | 36.0 | 0.8 | 1.3 | 18.0 | - | 16 | 0.4 | 1.2 | 1.7 | 18.4 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 4.1 | 100 | 512.4 | 1.5 | 2.6 | 35.9 | 0.8 | 1.3 | 17.9 | 24.08 | 9.1 | 0.4 | 1.1 | 1.7 | 18.3 |
| | Annual | | | | 512.4 | 1.5 | 2.6 | 35.9 | 0.8 | 1.3 | 17.9 | - | 15.5 | 0.4 | 1.1 | 1.7 | 18.3 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 4.1 | 100 | 825.6 | 2.5 | 4.1 | 57.8 | 1.2 | 2.1 | 28.9 | | 18.4 | 0.8 | 2.0 | 2.8 | 29.6 |
| | Annual | | | | 825.6 | 2.5 | 4.1 | 57.8 | 1.2 | 2.1 | 28.9 | | 31.4 | 0.8 | 2.0 | 2.8 | 29.6 |

##### *9.14.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.14.2.2.3.1.1 DBS East in Isolation*

825. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 18.4 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 0.7%.

826. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

827. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (1.7) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.2.3.1.2 DBS West in Isolation*

828. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 18.3 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 0.7%.

829. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

830. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (1.7) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.2.3.1.3 DBS East and West Together*

831. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 29.6 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 56%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

832. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

833. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (2.8) would increase the predicted annual mortality by 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.14.2.2.3.2.1 DBS East in Isolation*

834. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 36 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

835. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

836. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (2.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.2.3.2.2 DBS West in Isolation*

837. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 35.9 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

838. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

839. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (2.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.2.3.2.3 DBS East and West Together*

840. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 57.8 birds per annum (**Table 9-81**). This would result in a predicted change in adult mortality rate of 2.4% but is based on highly precautionary impact rates. A reduction in the mortality rate alone to 4% or to 5% together with a displacement rate of 57% would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

841. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

842. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (4.1) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.14.2.2.4 Summary*

843. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-82)**.

844. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

*Table 9-82 Summary of predicted guillemot displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 29.6 | 2.8 |
| Annual | | 29.6 | 2.8 |
| Effect | Reference population | 38,898 | |
| | Increase in background mortality (%) | 1.24 | 0.11 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 57.8 | 4.1 |
| Annual | | 57.8 | 4.1 |
| Effect | Reference population | 39,898 | |
| | Increase in background mortality (%) | 2.4 | 0.17 |

##### *9.14.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

845. Given that no measurable increase in the North Caithness Cliffs SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

#### 9.14.2.3 Razorbill

846. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.14.2.3.1 Status*

847. Razorbill is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA.

848. The SPA breeding population at classification in 1996 was cited as 4,000 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 3,579 individuals which has been used in this assessment.

##### *9.14.2.3.2 Connectivity to the Projects*

849. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

850. Outside the breeding season, breeding razorbills from North Caithness Cliffs SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

851. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.5% of the BDMPS population, and during the winter 0.2% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.14.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-83 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.5 | 100 | 23.4 | 0.1 | 0.1 | 1.6 | 0.0 | 0.1 | 0.8 | 9.2 | 3.5 | 0.02 | 0.05 | 0.08 | 0.84 |
| | Winter | 3376.7 | 0.2 | 100 | 6.8 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.2 | 6.6 | 2.5 | 0.00 | 0.02 | 0.02 | 0.24 |
| | Spring | 3578.5 | 0.5 | 100 | 17.9 | 0.1 | 0.1 | 1.3 | 0.0 | 0.0 | 0.6 | 7.0 | 2.6 | 0.01 | 0.04 | 0.06 | 0.64 |
| | Annual | | | | 48.1 | 0.2 | 0.2 | 3.4 | 0 | 0.1 | 1.6 | - | 9 | 0.03 | 0.11 | 0.16 | 1.72 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.5 | 100 | 24.4 | 0.1 | 0.1 | 1.7 | 0.0 | 0.1 | 0.9 | 9.4 | 3.5 | 0.02 | 0.05 | 0.08 | 0.87 |
| | Winter | 5066.2 | 0.2 | 100 | 10.1 | 0.0 | 0.1 | 0.7 | 0.0 | 0.0 | 0.4 | 9.7 | 3.7 | 0.01 | 0.02 | 0.03 | 0.36 |
| | Spring | 4454.6 | 0.5 | 100 | 22.3 | 0.1 | 0.1 | 1.6 | 0.0 | 0.1 | 0.8 | 8.6 | 3.2 | 0.02 | 0.05 | 0.07 | 0.80 |
| | Annual | | | | 56.8 | 0.2 | 0.3 | 4.0 | 0.1 | 0.1 | 2.0 | - | 10.4 | 0.05 | 0.12 | 0.18 | 2.03 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.5 | 100 | 31.7 | 0.1 | 0.2 | 2.2 | 0.0 | 0.1 | 1.1 | | 7.0 | 0.04 | 0.08 | 0.11 | 1.15 |
| | Winter | 5283.7 | 0.2 | 100 | 11.6 | 0.0 | 0.1 | 0.8 | 0.0 | 0.0 | 0.4 | | 6.1 | 0.01 | 0.03 | 0.04 | 0.42 |
| | Spring | 6302.5 | 0.5 | 100 | 31.5 | 0.1 | 0.2 | 2.2 | 0.0 | 0.1 | 1.1 | | 5.9 | 0.03 | 0.08 | 0.11 | 1.13 |
| | Annual | | | | 74.8 | 0.2 | 0.4 | 5.2 | 0.1 | 0.2 | 2.6 | - | 21.1 | 0.08 | 0.19 | 0.26 | 2.7 |

###### 9.14.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.14.2.3.3.1.1 DBS East in Isolation

852. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 1.7 (0.84, 0.24, 0.64 in autumn winter and spring respectively) birds per annum (**Table 9-83)**. This would result in a predicted change in adult mortality rate of 0.44%.

853. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

854. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.14.2.3.3.1.2 DBS West in Isolation

855. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.0 (0.9, 0.4, 0.8 in autumn winter and spring respectively) birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.53%.

856. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

857. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.3.3.1.3 DBS East and West Together*

858. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.7 (1.1, 0.4, 1.1 in autumn, winter and spring respectively) birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.72%.

859. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

860. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.3) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

*9.14.2.3.3.2.1 DBS East in Isolation*

861. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.4 (1.6, 0.5, 1.2 in autumn winter and spring respectively) birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.9%.

862. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

863. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.14.2.3.3.2.2 DBS West in Isolation

864. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 4.0 (1.7, 0.7, 1.6 in autumn winter and spring respectively) birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 1.1%.

865. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

866. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.3) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.14.2.3.3.2.3 DBS East and West Together

867. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 5.2 (2.2, 0.8, 2.2 in autumn winter and spring respectively) birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 1.3% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 50%) or the mortality rate (e.g. to 7.2%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

868. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

869. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.4) would increase the predicted annual mortality by 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.14.2.3.4 Summary*

870. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-84**).

871. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

*Table 9-84 Summary of predicted razorbill displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations*.

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 1.15 | 0.11 |
| Winter | | 0.42 | 0.04 |
| Spring | | 1.13 | 0.11 |
| Annual | | 2.7 | 0.26 |
| Effect | Reference population | 3,579 | |

| Guillemot | | Displacement | |
|---|---|---|---|
| | Increase in background mortality (%) | 0.72 | 0.07 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 2.2 | 0.2 |
| Winter | | 0.8 | 0.1 |
| Spring | | 2.2 | 0.2 |
| Annual | | 5.2 | 0.40 |
| Effect | Reference population | 3,579 | |
| | Increase in background mortality (%) | 1.3 | 0.1 |

#### *9.14.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

872. Given that no measurable increase in the North Caithness Cliffs SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

### 9.14.2.4 Puffin

873. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.14.2.4.1 Status*

874. Puffin is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA.

875. The SPA breeding population at classification in 1996 was cited as 2,080 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 3,039 AOB which has been used in this assessment.

##### *9.14.2.4.2 Connectivity to the Projects*

876. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

877. Outside the breeding season, breeding puffins from North Caithness Cliffs SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

878. It is estimated that 0.1% of birds present at the Projects are breeding adults from North Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.14.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-85 Summary of puffin density and abundance estimates and SPA apportioning rates and  used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 0.001 | 1 | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.35 | 0.13 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | - | 0.18 | 0.00 | 0.00 | 0.00 | 0.01 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 0.001 | 1 | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.38 | 0.14 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | - | 0.22 | 0.00 | 0.00 | 0.00 | 0.01 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 0.001 | 1 | 0.4 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 | | 0.28 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.4 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 | | 0.4 | 0.00 | 0.00 | 0.00 | 0.01 |

##### 9.14.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.14.2.4.3.1.1 DBS East in Isolation

879. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

880. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

881. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.14.2.4.3.1.2 DBS West in Isolation

882. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

883. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

884. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.14.2.4.3.1.3 DBS East and West Together*

885. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

886. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

887. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.14.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.14.2.4.3.2.1 DBS East in Isolation*

888. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

889. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

890. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.4.3.2.2 DBS West in Isolation*

891. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

892. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

893. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.14.2.4.3.2.3 DBS East and West Together*

894. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.03 birds per annum (**Table 9-85**). This would result in a predicted change in adult mortality rate of <0.01%.

895. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

896. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.14.2.4.4 Summary*

897. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-86)**.

898. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

*Table 9-86 Summary of predicted puffin displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.01 | <0.01 |
| Annual | | 0.01 | <0.01 |
| Effect | Reference population | 6,078 | |
| | Increase in background mortality (%) | <0.01 | <0.01 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.03 | <0.01 |
| Annual | | 0.03 | <0.01 |
| Effect | Reference population | 6,078 | |
| | Increase in background mortality (%) | <0.01 | <0.01 |

#### *9.14.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

899. Given that no measurable increase in the North Caithness Cliffs SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

## 9.15 Copinsay SPA

### 9.15.1 Site Description

900. The Copinsay SPA was designated in 1994. The site comprises a group of islands 4km off the east coast of Orkney Mainland. The islands have a cliffed rocky coastline and maritime vegetation that support large colonies of breeding seabirds.

901. The boundary of the SPA encompasses Copinsay SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

#### 9.15.1.1 Qualifying Features

902. The qualifying features of the Copinsay Cliffs SPA screened into the assessment are listed in **Table 4-7**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.15.1.2 Conservation Objectives

903. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.15.2 Assessment

#### 9.15.2.1 Kittiwake

904. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.15.2.1.1 Status*

905. Kittiwake is listed as a named component of the breeding seabird assemblage of Copinsay SPA.

906. The SPA breeding population at classification in 1994 was cited as 9,550 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 955 AON which has been used in this assessment.

##### *9.15.2.1.2 Connectivity to the Projects*

907. DBS East and DBS West are 537km and 520km respectively from Copinsay SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Copinsay SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

908. Outside the breeding season breeding kittiwakes, including those from Copinsay SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

909. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Copinsay SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.15.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.15.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-87 Summary of kittiwake total collisions and apportioned to the Copinsay SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

###### *9.15.2.1.3.1.1 DBS East in Isolation*

910. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-87**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.15.2.1.3.1.2 DBS West in Isolation*

911. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-87**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.15.2.1.3.1.3 DBS East and West Together*

912. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 4279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.11 birds per annum (**Table 9-87**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.15.2.1.4 Summary*

913. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-88**).

914. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Copinsay SPA**.

*Table 9-88 Summary of predicted Kittiwake collision mortality from Copinsay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 1,910 | | |
| | Increase in background mortality (%) | <0.01 | 0.04 | 0.06 |

#### *9.15.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

915. Given that no measurable increase in the Copinsay SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.11 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Copinsay SPA**.

### 9.15.2.2 Guillemot

916. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.15.2.2.1 Status*

917. Guillemot is listed as a named component of the breeding seabird assemblage of Copinsay SPA.

918. The SPA breeding population at classification in 1994 was cited as 29,450 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 18,479 individuals which has been used in this assessment.

*9.15.2.2.2 Connectivity to the Projects*

919. DBS East and DBS West are 537km and 520km respectively from Copinsay SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Copinsay SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

920. Outside the breeding season, breeding guillemots from Copinsay SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

921. It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Copinsay SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.15.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-89 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Copinsay SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 0.5 | 100 | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.62 | 9.3 | 0.0 | 0.1 | 0.2 | 2.2 |
| | Annual | | | | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 16 | 0.0 | 0.1 | 0.2 | 2.2 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 0.5 | 100 | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.08 | 9.1 | 0.0 | 0.1 | 0.2 | 2.2 |
| | Annual | | | | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 15.5 | 0.0 | 0.1 | 0.2 | 2.2 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 0.5 | 100 | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 18.4 | 0.1 | 0.2 | 0.3 | 3.6 |
| | Annual | | | | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 31.4 | 0.1 | 0.2 | 0.3 | 3.6 |

#### *9.15.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.15.2.2.3.1.1 DBS East in Isolation*

922. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-89**). This would result in a predicted change in adult mortality rate of 0.2%.

923. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

924. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.2) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.15.2.2.3.1.2 DBS West in Isolation*

925. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-89)**. This would result in a predicted change in adult mortality rate of 0.2%.

926. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

927. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.2) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.15.2.2.3.1.3 DBS East and West Together*

928. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-89**). This would result in a predicted change in adult mortality rate of 0.3%.

929. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

930. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.3) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.15.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.15.2.2.3.2.1 DBS East in Isolation*

931. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-89**). This would result in a predicted change in adult mortality rate of 0.4%.

932. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

933. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.3) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.15.2.2.3.2.2 DBS West in Isolation*

934. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-89**). This would result in a predicted change in adult mortality rate of 0.4%.

935. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

936. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.3) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.15.2.2.3.2.3 DBS East and West Together*

937. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7 birds per annum (**Table 9-89**). This would result in a predicted change in adult mortality rate of 0.6%.

938. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

939. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.15.2.2.4 Summary*

940. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-90**).

941. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Copinsay SPA**.

*Table 9-90 Summary of predicted guillemot displacement mortality from Copinsay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 2.2 | 0.2 |
| Annual | | 2.2 | 0.2 |
| Effect | Reference population | 18,479 | |
| | Increase in background mortality (%) | 0.3 | 0.03 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.0 | 0.5 |
| Annual | | 7.0 | 0.5 |
| Effect | Reference population | 18,479 | |
| | Increase in background mortality (%) | 0.6 | 0.04 |

##### *9.15.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

942. Given that no measurable increase in the Copinsay SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Copinsay SPA**.

## 9.16 Hoy SPA

### 9.16.1 Site Description

943. Hoy is a mountainous island at the south-western end of the Orkney archipelago. Hoy SPA covers the northern and western two-thirds of Hoy island and adjacent coastal waters. These upland areas and the high sea cliffs at the coast support an important assemblage of moorland breeding birds and breeding seabirds.

944. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.16.1.1 Qualifying Features

945. The qualifying features of the Hoy SPA screened into the assessment are listed in **Table 4-7**. These are three named components of the breeding seabird assemblage (kittiwake, guillemot and puffin).

#### 9.16.1.2 Conservation Objectives

946. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within site;
    - Distribution and extent of habitats supporting the species;
    - Structure, function and supporting processes of habitats supporting the species; and
    - No significant disturbance of the species.

### 9.16.2 Assessment: Array Areas

#### 9.16.2.1 Kittiwake

947. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.16.2.1.1 Status*

948. Kittiwake is listed as a named component of the breeding seabird assemblage of Hoy SPA.

949. The SPA breeding population at classification in 2000 was cited as 3,000 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 266 AON which has been used in this assessment.

##### *9.16.2.1.2 Connectivity to the Projects*

950. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Hoy SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

951. Outside the breeding season breeding kittiwakes, including those from Hoy SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

952. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Hoy SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.16.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.16.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-91 Summary of kittiwake total collisions and apportioned to the Hoy SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

###### *9.16.2.1.3.1.1 DBS East in Isolation*

953. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-91**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.1.3.1.2 DBS West in Isolation*

954. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-91**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.1.3.1.3 DBS East and West Together*

955. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-91**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.16.2.1.4 Summary*

956. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-92**).

957. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

*Table 9-92 Summary of predicted Kittiwake collision mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 532 | | |
| | Increase in background mortality (%) | <0.01 | 0.1 | 0.1 |

#### *9.16.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

958. Given that no measurable increase in the Hoy SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.07 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

### 9.16.2.2 Guillemot

959. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.16.2.2.1 Status*

960. Guillemot is listed as a named component of the breeding seabird assemblage of Hoy SPA.

961. The SPA breeding population at classification in 2000 was cited as 13,400 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 9,246 individuals which has been used in this assessment.

#### *9.16.2.2.2 Connectivity to the Projects*

962. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Hoy SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

963. Outside the breeding season, breeding guillemots from Hoy SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

964. It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Hoy SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.16.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-93 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hoy SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12551.8 | 0.5 | 100 | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.62 | 9.3 | 0.0 | 0.1 | 0.2 | 2.2 |
| | Annual | | | | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 16 | 0.0 | 0.1 | 0.2 | 2.2 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 12498.4 | 0.5 | 100 | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.08 | 9.1 | 0.0 | 0.1 | 0.2 | 2.2 |
| | Annual | | | | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 15.5 | 0.0 | 0.1 | 0.2 | 2.2 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Nonbreeding | 20136.0 | 0.5 | 100 | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 18.4 | 0.1 | 0.2 | 0.3 | 3.6 |
| | Annual | | | | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 31.4 | 0.1 | 0.2 | 0.3 | 3.6 |

##### 9.16.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.16.2.2.3.1.1 DBS East in Isolation

965. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.4%.

966. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

967. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.16.2.2.3.1.2 DBS West in Isolation

968. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-93)**. This would result in a predicted change in adult mortality rate of 0.4%.

969. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

970. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.16.2.2.3.1.3 DBS East and West Together*

971. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.6%.

972. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

973. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.16.2.2.3.2.1 DBS East in Isolation*

974. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.8%.

975. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

976. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.2.3.2.2 DBS West in Isolation*

977. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.8%.

978. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

979. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.16.2.2.3.2.3 DBS East and West Together*

980. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 56%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

981. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

982. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.5) would increase the predicted annual mortality by 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.16.2.2.4 Summary*

983. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-94**).

984. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

*Table 9-94 Summary of predicted guillemot displacement mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 2.2 | 0.2 |
| Annual | | 2.2 | 0.2 |
| Effect | Reference population | 9,246 | |
| | Increase in background mortality (%) | 0.64 | 0.06 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.0 | 0.5 |
| Annual | | 7.0 | 0.5 |
| Effect | Reference population | 9,246 | |
| | Increase in background mortality (%) | 1.24 | 0.09 |

###### *9.16.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

985. Given that no measurable increase in the Hoy SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

##### 9.16.2.3 Puffin

986. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

###### *9.16.2.3.1 Status*

987. Puffin is listed as a named component of the breeding seabird assemblage of Hoy SPA. The SPA breeding population at classification in 2000 was cited as 3,500 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 430 AOB which has been used in this assessment.

###### *9.16.2.3.2 Connectivity to the Projects*

988. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from Hoy SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

989. Outside the breeding season, breeding puffins from Hoy SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

990. It is estimated that 0.5% of birds present at the Projects are breeding adults from Hoy SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.16.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-95 Summary of puffin density and abundance estimates and SPA apportioning rates and  used in the operation and construction displacement assessment for Hoy SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 0.5 | 1 | 0.9 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.03 | 0.35 | 0.13 | 0.00 | 0.00 | 0.00 | 0.03 |
| | Annual | | | | 0.9 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.03 | - | 0.18 | 0.00 | 0.00 | 0.00 | 0.03 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 0.5 | 1 | 1.0 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.03 | 0.38 | 0.14 | 0.00 | 0.00 | 0.00 | 0.04 |
| | Annual | | | | 1.0 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.03 | - | 0.22 | 0.00 | 0.00 | 0.00 | 0.04 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 1.0 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.03 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 0.5 | 1 | 1.9 | 0.01 | 0.01 | 0.13 | 0.00 | 0.00 | 0.07 | | 0.28 | 0.00 | 0.00 | 0.01 | 0.07 |
| | Annual | | | | 1.9 | 0.01 | 0.01 | 0.13 | 0.00 | 0.00 | 0.07 | | 0.4 | 0.00 | 0.00 | 0.01 | 0.07 |

#### *9.16.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.16.2.3.3.1.1 DBS East in Isolation*

991. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.03 birds per annum (**Table 9-95)**. This would result in a predicted change in adult mortality rate of 0.04%.

992. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

993. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.16.2.3.3.1.2 DBS West in Isolation*

994. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.04 birds per annum (**Table 9-95**). This would result in a predicted change in adult mortality rate of 0.04%.

995. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

996. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.16.2.3.3.1.3 DBS East and West Together*

997. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.07 birds per annum (**Table 9-95**). This would result in a predicted change in adult mortality rate of 0.08%.

998. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

999. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.16.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.16.2.3.3.2.1 DBS East in Isolation*

1000. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.06 birds per annum (**Table 9-95**). This would result in a predicted change in adult mortality rate of 0.08%.

1001. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1002. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.3.3.2.2 DBS West in Isolation*

1003. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.07 birds per annum (**Table 9-95**). This would result in a predicted change in adult mortality rate of 0.08%.

1004. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1005. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.16.2.3.3.2.3 DBS East and West Together*

1006. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.13 birds per annum (**Table 9-95**). This would result in a predicted change in adult mortality rate of 0.16%.

1007. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1008. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.01) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.16.2.3.4 Summary*

1009. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-96**).

1010. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

*Table 9-96 Summary of predicted puffin displacement mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.07 | <0.01 |
| Annual | | 0.07 | <0.01 |
| Effect | Reference population | 860 | |
| | Increase in background mortality (%) | 0.08 | <0.01 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.13 | 0.01 |
| Annual | | 0.13 | 0.01 |
| Effect | Reference population | 860 | |
| | Increase in background mortality (%) | 0.16 | 0.01 |

#### *9.16.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1011. Given that no measurable increase in the Hoy SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

## 9.17 Rousay SPA

### 9.17.1 Site Description

1012. Rousay SPA was designated in 2000. Rousay is an island off the north-east coast of Mainland, Orkney. The SPA consists of sea cliffs and areas of maritime heath and grassland in the northwest and northeast of the island.

1013. The boundary of the Special Protection Area overlaps with the boundary of Rousay SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

#### 9.17.1.1 Qualifying Features

1014. The qualifying features of the Rousay SPA screened into the assessment are listed in **Table 4-7**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.17.1.2 Conservation Objectives

1015. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.17.2 Assessment: Array Areas

#### 9.17.2.1 Kittiwake

1016. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.17.2.1.1 Status*

1017. Kittiwake is listed as a named component of the breeding seabird assemblage of Rousay SPA.

1018. The SPA breeding population at classification in 2000 was cited as 4,900 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 330 AON which has been used in this assessment.

##### *9.17.2.1.2 Connectivity to the Projects*

1019. DBS East and DBS West are 557km and 540km respectively from Rousay SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Rousay SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1020. Outside the breeding season breeding kittiwakes, including those from Rousay SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1021. It is estimated that 0.3% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Rousay SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### *9.17.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

#### *9.17.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-97 Summary of kittiwake total collisions and apportioned to the Rousay SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.3 | 100 | 0.0 | 0.1 | 0.2 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.3 | 100 | 0.0 | 0.0 | 0.1 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.1 | 0.2 | 0.3 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.3 | 100 | 0.0 | 0.1 | 0.2 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.3 | 100 | 0.0 | 0.0 | 0.1 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.2 | 0.3 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0 | 0 | 0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.3 | 100 | 0.1 | 0.2 | 0.4 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.3 | 100 | 0.1 | 0.1 | 0.1 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.1 | 0.3 | 0.6 |

##### *9.17.2.1.3.1.1 DBS East in Isolation*

1022. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.2 birds per annum (**Table 9-97**). This results in a predicted change in adult mortality rate of 0.16% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.17.2.1.3.1.2 DBS West in Isolation*

1023. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.2 birds per annum (**Table 9-97**). This results in a predicted change in adult mortality rate of 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.17.2.1.3.1.3 DBS East and West Together*

1024. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.3 birds per annum (**Table 9-97**). This results in a predicted change in adult mortality rate of 0.31% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.17.2.1.4 Summary*

1025. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-98**).

1026. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Rousay SPA**.

*Table 9-98 Summary of predicted Kittiwake collision mortality from Rousay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.1 | 0.2 | 0.4 |
| Spring | | 0.1 | 0.1 | 0.1 |
| Annual | | 0.1 | 0.3 | 0.6 |
| Effect | Reference population | | | 660 |
| | Increase in background mortality (%) | 0.1 | 0.31 | 0.6 |

##### *9.17.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1027. Given that no measurable increase in the Rousay SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Rousay SPA**.

### 9.17.2.2 Guillemot

1028. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.17.2.2.1 Status*

1029. Guillemot is listed as a named component of the breeding seabird assemblage of Rousay SPA. The SPA breeding population at classification in 2000 was cited as 10,600 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 5,911 individuals which has been used in this assessment.

#### *9.17.2.2.2 Connectivity to the Projects*

1030. DBS East and DBS West are 557km and 540km respectively from Rousay SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Rousay SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1031. Outside the breeding season, breeding guillemots from Rousay SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1032. It is estimated that 0.1% of birds present at the Projects are considered to be breeding adults from Rousay SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.17.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-99 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Rousay SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35- 10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 0.5 | 100 | 12.6 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | 24.62 | 9.3 | 0.01 | 0.03 | 0.04 | 0.45 |
| | Annual | | | | 12.6 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | - | 16 | 0.01 | 0.03 | 0.04 | 0.45 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 0.5 | 100 | 12.5 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | 24.08 | 9.1 | 0.01 | 0.03 | 0.04 | 0.45 |
| | Annual | | | | 12.5 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | - | 15.5 | 0.01 | 0.03 | 0.04 | 0.45 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 0.5 | 100 | 20.1 | 0.1 | 0.1 | 1.4 | 0.0 | 0.1 | 0.7 | | 18.4 | 0.02 | 0.05 | 0.07 | 0.72 |
| | Annual | | | | 20.1 | 0.1 | 0.1 | 1.4 | 0.0 | 0.1 | 0.7 | | 31.4 | 0.02 | 0.05 | 0.07 | 0.72 |

#### *9.17.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.17.2.2.3.1.1 DBS East in Isolation*

1033. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.45 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.1%.

1034. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1035. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.04) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.17.2.2.3.1.2 DBS West in Isolation*

1036. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.45 birds per annum (**Table 9-99)**. This would result in a predicted change in adult mortality rate of 0.1%.

1037. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1038. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.04) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.17.2.2.3.1.3 DBS East and West Together*

1039. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.72 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.2%.

1040. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1041. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.07) would increase the predicted annual mortality by 0.02 which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.17.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.17.2.2.3.2.1 DBS East in Isolation*

1042. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 0.9 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.2%.

1043. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1044. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.17.2.2.3.2.2 DBS West in Isolation*

1045. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 0.9 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.2%.

1046. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1047. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.17.2.2.3.2.3 DBS East and West Together*

1048. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 1.4 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.4%.

1049. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1050. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.17.2.2.4 Summary*

1051. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-100**).

1052. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Rousay SPA**.

*Table 9-100 Summary of predicted guillemot displacement mortality from Rousay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.72 | 0.07 |
| Annual | | 0.72 | 0.07 |
| Effect | Reference population | 5,911 | |
| | Increase in background mortality (%) | 0.2 | 0.02 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 1.4 | 0.1 |
| Annual | | 1.4 | 0.1 |
| Effect | Reference population | 5,911 | |
| | Increase in background mortality (%) | 0.4 | 0.03 |

##### *9.17.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1053. Given that no measurable increase in the Rousay SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Rousay SPA**.

## 9.18 Calf of Eday SPA

### 9.18.1 Site Description

1054. Calf of Eday SPA was designated in 1998.

1055. The site is a small maritime island to the north of Eday in Orkney. Calf of Eday has a rocky shoreline with cliffs to the north and the west. The island is covered by maritime heath and grassland. The boundary of the SPA encompasses the boundary of the Calf of Eday SSSI, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.

#### 9.18.1.1 Qualifying Features

1056. The qualifying features of the Calf of Eday SPA screened into the assessment are listed in **Table 4-7**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.18.1.2 Conservation Objectives

1057. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.18.2 Assessment: Array Areas

#### 9.18.2.1 Kittiwake

1058. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.18.2.1.1 Status*

1059. Kittiwake is listed as a named component of the breeding seabird assemblage of the Calf of Eday SPA.

1060. The SPA breeding population at classification in 1998 was cited as 1,717 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 336 AON which has been used in this assessment.

##### *9.18.2.1.2 Connectivity to the Projects*

1061. DBS East and DBS West are 550km and 533km respectively from the Calf of Eday SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Calf of Eday SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1062. Outside the breeding season breeding kittiwakes, including those from the Calf of Eday SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1063. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Calf of Eday SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.18.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

#### *9.18.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-101 Summary of kittiwake total collisions and apportioned to the Calf of Eday SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

##### *9.18.2.1.3.1.1 DBS East in Isolation*

1064. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-5) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum ((**Table 9-101**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.18.2.1.3.1.2 DBS West in Isolation

1065. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum ((**Table 9-101**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.18.2.1.3.1.3 DBS East and West Together

1066. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-101**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### 9.18.2.1.4 Summary

1067. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-102**).

1068. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Calf of Eday SPA**.

*Table 9-102 Summary of predicted Kittiwake collision mortality from Calf of Eday SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 672 | | |
| | Increase in background mortality (%) | <0.01 | 0.13 | 0.2 |

#### *9.18.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1069. Given that no measurable increase in the Calf of Eday SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.13 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Calf of Eday SPA**.

### 9.18.2.2 Guillemot

1070. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.18.2.2.1 Status*

1071. Guillemot is listed as a named component of the breeding seabird assemblage of the Calf of Eday SPA. The SPA breeding population at classification in 1998 was cited as 12,645 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 3,493 individuals which has been used in this assessment.

#### *9.18.2.2.2 Connectivity to the Projects*

1072. DBS East and DBS West are 550km and 533km respectively from the Calf of Eday SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Calf of Eday SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding guillemots from Calf of Eday SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Calf of Eday SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.18.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-103 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Calf of Eday SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 0.5 | 100 | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.62 | 9.3 | 0.05 | 0.14 | 0.20 | 2.24 |
| | Annual | | | | 62.8 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 16 | 0.05 | 0.14 | 0.20 | 2.24 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 0.5 | 100 | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | 24.08 | 9.1 | 0.05 | 0.14 | 0.20 | 2.23 |
| | Annual | | | | 62.5 | 0.2 | 0.3 | 4.4 | 0.1 | 0.2 | 2.2 | - | 15.5 | 0.05 | 0.14 | 0.20 | 2.23 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 0.5 | 100 | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 18.4 | 0.09 | 0.24 | 0.34 | 3.62 |
| | Annual | | | | 100.7 | 0.3 | 0.5 | 7.0 | 0.2 | 0.3 | 3.5 | | 31.4 | 0.09 | 0.24 | 0.34 | 3.62 |

##### *9.18.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.18.2.2.3.1.1 DBS East in Isolation*

1073. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 1.0% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 68%) or the mortality rate (e.g. to 9%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1074. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1075. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.18.2.2.3.1.2 DBS West in Isolation*

1076. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-103)**. This would result in a predicted change in adult mortality rate of 1.0%, but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 68%) or the mortality rate (e.g. to 9%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1077. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1078. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.18.2.2.3.1.3 DBS East and West Together*

1079. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 1.7% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 41%) or the mortality rate (e.g. to 5.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1080. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1081. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.34) would increase the predicted annual mortality by 0.16 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.18.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.18.2.2.3.2.1 DBS East in Isolation*

1082. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 2.1% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).

1083. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1084. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.3) would increase the predicted annual mortality by 0.14% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.18.2.2.3.2.2 DBS West in Isolation*

1085. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 2.0%, but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).

1086. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1087. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.3) would increase the predicted annual mortality by 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.18.2.2.3.2.3 DBS East and West Together*

1088. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.0 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 3.3%, but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).

1089. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1090. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.5) would increase the predicted annual mortality by 0.23% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.18.2.2.4 Summary*

1091. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-104)**.

1092. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Calf of Eday SPA**.

*Table 9-104 Summary of predicted guillemot displacement mortality from Calf of Eday SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 3.6 | 0.34 |
| Annual | | 3.6 | 0.34 |
| Effect | Reference population | 3,493 | |
| | Increase in background mortality (%) | 1.7 | 0.16 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.0 | 0.5 |
| Annual | | 7.0 | 0.5 |
| Effect | Reference population | 3,493 | |
| | Increase in background mortality (%) | 3.3 | 0.23 |

##### *9.18.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1093. Given that no measurable increase in the Calf of Eday SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Calf of Eday SPA**.

## 9.19 Marwick Head SPA

### 9.19.1 Site Description

1094. Marwick Head SPA was designated in 1994. The SPA is a 2 km stretch of sea cliffs, and adjacent coastal waters, along the west coast of Orkney Mainland. The cliffs support large colonies of breeding seabirds.

#### 9.19.1.1 Qualifying Features

1095. The qualifying features of Marwick Head SPA screened into the assessment are listed in **Table 4-7**. These are breeding guillemot one named component of the breeding seabird assemblage (kittiwake).

#### 9.19.1.2 Conservation Objectives

1096. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.19.2 Assessment: Array Areas

#### 9.19.2.1 Kittiwake

1097. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.19.2.1.1 Status*

1098. Kittiwake is listed as a named component of the breeding seabird assemblage of Marwick Head SPA.

1099. The SPA breeding population at classification in 1994 was cited as 7,700 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 906 AON which has been used in this assessment.

##### *9.19.2.1.2 Connectivity to the Projects*

1100. DBS East and DBS West are 595km and 564km respectively from Marwick Head SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Marwick Head SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1101. Outside the breeding season breeding kittiwakes, including those from Marwick Head SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1102. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Marwick Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### 9.19.2.1.3 Assessment of Potential Effects of the Projects alone and Together

##### 9.19.2.1.3.1 Potential Effects During Operation: Collision risk

*Table 9-105 Summary of kittiwake total collisions and apportioned to the* Marwick Head *SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

###### 9.19.2.1.3.1.1 DBS East in Isolation

1103. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-5) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-105**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.19.2.1.3.1.2 DBS West in Isolation*

1104. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-105**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.19.2.1.3.1.3 DBS East and West Together*

1105. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum Table 9-58 (**Table 9-105**). This results in a predicted change in adult mortality rate of 0.3% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.19.2.1.4 Summary*

1106. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-106**).

1107. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Marwick Head SPA**.

*Table 9-106 Summary of predicted Kittiwake collision mortality from Marwick Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 1,812 | | |
| | Increase in background mortality (%) | <0.01 | 0.03 | 0.08 |

##### *9.19.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1108. Given that no measurable increase in the Marwick Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.09 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Marwick Head SPA**.

#### 9.19.2.2 Guillemot

1109. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.19.2.2.1 Status*

1110. Guillemot is listed as a designated species of Marwick Head SPA. The SPA breeding population at classification in 1994 was cited as 37,700 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 11,905 individuals which has been used in this assessment.

##### *9.19.2.2.2 Connectivity to the Projects*

1111. DBS East and DBS West are 595km and 564km respectively from Marwick Head SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Marwick Head SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1112. Outside the breeding season, breeding guillemots from Marwick Head SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1113. It is estimated that 1% of birds present at the Projects are considered to be breeding adults from Marwick Head SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.19.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-107 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Marwick Head SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 1 | 100 | 125.5 | 0.4 | 0.6 | 8.8 | 0.2 | 0.3 | 4.4 | 24.62 | 9.3 | 0.09 | 0.28 | 0.41 | 4.49 |
| | Annual | | | | 125.5 | 0.4 | 0.6 | 8.8 | 0.2 | 0.3 | 4.4 | - | 16 | 0.09 | 0.28 | 0.41 | 4.49 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 1 | 100 | 125.0 | 0.4 | 0.6 | 8.7 | 0.2 | 0.3 | 4.4 | 24.08 | 9.1 | 0.09 | 0.28 | 0.40 | 4.47 |
| | Annual | | | | 125.0 | 0.4 | 0.6 | 8.7 | 0.2 | 0.3 | 4.4 | - | 15.5 | 0.09 | 0.28 | 0.40 | 4.47 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 1 | 100 | 201.4 | 0.6 | 1.0 | 14.1 | 0.3 | 0.5 | 7.0 | | 18.4 | 0.18 | 0.49 | 0.69 | 7.23 |
| | Annual | | | | 201.4 | 0.6 | 1.0 | 14.1 | 0.3 | 0.5 | 7.0 | | 31.4 | 0.18 | 0.49 | 0.69 | 7.23 |

##### *9.19.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.19.2.2.3.1.1 DBS East in Isolation*

1114. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.5 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 0.6%.

1115. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1116. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.41) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.19.2.2.3.1.2 DBS West in Isolation*

1117. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.5 birds per annum (**Table 9-107)**. This would result in a predicted change in adult mortality rate of 0.6%.

1118. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1119. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.4) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.19.2.2.3.1.3 DBS East and West Together*

1120. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.2 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 0.9%.

1121. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1122. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.69) would increase the predicted annual mortality by 0.09 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.19.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.19.2.2.3.2.1 DBS East in Isolation*

1123. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 8.8 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 58%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1124. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1125. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.6) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.19.2.2.3.2.2 DBS West in Isolation*

1126. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 8.7 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 59%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1127. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1128. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.6) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.19.2.2.3.2.3 DBS East and West Together

1129. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.1 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1130. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1131. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (1.0) would increase the predicted annual mortality by 0.14% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.19.2.2.4 Summary

1132. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-108)**.

1133. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Marwick Head SPA**.

*Table 9-108 Summary of predicted guillemot displacement mortality from Marwick Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.23 | 0.69 |
| Annual | | 7.23 | 0.69 |
| Effect | Reference population | 11,985 | |
| | Increase in background mortality (%) | 1.2 | 0.08 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 14.1 | 1.0 |
| Annual | | 14.1 | 1.0 |
| Effect | Reference population | 11,985 | |
| | Increase in background mortality (%) | 1.9 | 0.14 |

#### *9.19.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1134. Given that no measurable increase in the Marwick Head SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Marwick Head SPA**.

## 9.20 West Westray SPA

### 9.20.1 Site Description

1135. West Westray SPA is an 8km stretch of sea cliffs, adjacent grassland and heathland, along the west coast of the island of Westray in Orkney. The cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland areas support breeding colonies of skuas and terns.

1136. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.20.1.1 Qualifying Features

1137. The qualifying features of the West Westray SPA screened into the assessment are listed in **Table 4-7**. These are breeding guillemot and two named components of the breeding seabird assemblage (kittiwake and razorbill).

#### 9.20.1.2 Conservation Objectives

1138. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.20.2 Assessment: Array Areas

#### 9.20.2.1 Kittiwake

1139. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.20.2.1.1 Status*

1140. Kittiwake is listed as a named component of the breeding seabird assemblage of the West Westray SPA.

1141. The SPA breeding population at classification in 1996 was cited as 23,900 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 2,755 AON which has been used in this assessment.

##### *9.20.2.1.2 Connectivity to the Projects*

1142. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from West Westray SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1143. Outside the breeding season breeding kittiwakes, including those from West Westray SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1144. It is estimated that 1.7% and 2.3% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from West Westray SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.20.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.20.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-109 Summary of kittiwake total collisions and apportioned to the* West Westray *SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 1.7 | 100 | 0.2 | 0.7 | 1.4 |
| | Spring | 6.8 | 14.6 | 28.0 | 2.3 | 100 | 0.2 | 0.3 | 0.6 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.4 | 1.0 | 2.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 1.7 | 100 | 0.2 | 0.6 | 1.4 |
| | Spring | 7.1 | 14.9 | 26.5 | 2.3 | 100 | 0.2 | 0.3 | 0.6 |

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.3 | 1.0 | 2.0 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 1.7 | 100 | 0.5 | 1.3 | 2.4 |
| | Spring | 16.9 | 29.5 | 47.3 | 2.3 | 100 | 0.4 | 0.7 | 1.1 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.9 | 2.0 | 3.5 |

###### *9.20.2.1.3.1.1 DBS East in Isolation*

1145. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-5) the number of individuals from the West Westray SPA population expected to die is 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.0 birds per annum (**Table 9-109**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.20.2.1.3.1.2 DBS West in Isolation*

1146. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1 bird per annum (**(Table 9-109**). This results in a predicted change in adult mortality rate of 0.12% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.20.2.1.3.1.3 DBS East and West Together*

1147. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.0 birds per annum **(Table 9-109**). This results in a predicted change in adult mortality rate of 0.25% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### 9.20.2.1.4 Summary

1148. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-110**).

1149. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

*Table 9-110 Summary of predicted Kittiwake collision mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.5 | 1.3 | 2.4 |
| Spring | | 0.4 | 0.7 | 1.1 |
| Annual | | 0.9 | 2.0 | 3.5 |
| Effect | Reference population | 5,510 | | |
| | Increase in background mortality (%) | 0.1 | 0.25 | 0.43 |

#### 9.20.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

1150. Given that no measurable increase in the West Westray SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

### 9.20.2.2 Guillemot

1151. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.20.2.2.1 Status*

1152. Guillemot is listed as a designated species of the West Westray SPA.

1153. The SPA breeding population at classification in 1996 was cited as 42,150 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 28,697 individuals which has been used in this assessment.

##### *9.20.2.2.2 Connectivity to the Projects*

1154. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the West Westray SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1155. Outside the breeding season, breeding guillemots from West Westray SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1156. It is estimated that 2.9% of birds present at the Projects are considered to be breeding adults from West Westray SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.20.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-111 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for West Westray SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 2.9 | 100 | 364.0 | 1.1 | 1.8 | 25.5 | 0.5 | 0.9 | 12.7 | 24.62 | 9.3 | 0.27 | 0.82 | 1.18 | 13.01 |
| | Annual | | | | 364.0 | 1.1 | 1.8 | 25.5 | 0.5 | 0.9 | 12.7 | - | 16 | 0.27 | 0.82 | 1.18 | 13.01 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 2.9 | 100 | 362.5 | 1.1 | 1.8 | 25.4 | 0.5 | 0.9 | 12.7 | 24.08 | 9.1 | 0.26 | 0.81 | 1.17 | 12.95 |
| | Annual | | | | 362.5 | 1.1 | 1.8 | 25.4 | 0.5 | 0.9 | 12.7 | - | 15.5 | 0.26 | 0.81 | 1.17 | 12.95 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 2.9 | 100 | 583.9 | 1.8 | 2.9 | 40.9 | 0.9 | 1.5 | 20.4 | | 18.4 | 0.53 | 1.41 | 1.99 | 20.97 |
| | Annual | | | | 583.9 | 1.8 | 2.9 | 40.9 | 0.9 | 1.5 | 20.4 | | 31.4 | 0.53 | 1.41 | 1.99 | 20.97 |

#### *9.20.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.20.2.2.3.1.1 DBS East in Isolation*

1157. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.0 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 0.7%.

1158. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1159. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.20.2.2.3.1.2 DBS West in Isolation*

1160. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 12.9 birds per annum (**Table 9-111)**. This would result in a predicted change in adult mortality rate of 0.7%.

1161. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1162. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.2.3.1.3 DBS East and West Together*

1163. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 20.9 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 58%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1164. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1165. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (2.0) would increase the predicted annual mortality by 0.11 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.20.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.20.2.2.3.2.1 DBS East in Isolation*

1166. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 25.5 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 48%) or the mortality rate (e.g. to 6.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1167. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1168. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.8) would increase the predicted annual mortality by 0.1 which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.2.3.2.2 DBS West in Isolation*

1169. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 25.4 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 48%) or the mortality rate (e.g. to 6.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1170. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1171. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.8) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.20.2.2.3.2.3 DBS East and West Together*

1172. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 41 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 2.3%, but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 30%) or the mortality rate (e.g. to 4.3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1173. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1174. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (2.9) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.20.2.2.4 Summary*

1175. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-112)**.

1176. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

*Table 9-112 Summary of predicted guillemot displacement mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 20.97 | 1.99 |
| Annual | | 20.97 | 1.99 |
| Effect | Reference population | 28,697 | |
| | Increase in background mortality (%) | 1.19 | 0.11 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 40.9 | 2.9 |
| Annual | | 40.9 | 2.9 |
| Effect | Reference population | 28,697 | |
| | Increase in background mortality (%) | 2.33 | 0.17 |

##### *9.20.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1177. Given that no measurable increase in the West Westray SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

#### 9.20.2.3 Razorbill

##### *9.20.2.3.1 Status*

1178. Razorbill is listed as a named component of the breeding seabird assemblage of the West Westray SPA.

1179. The SPA breeding population at classification in 1996 was cited as 1,946 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 2,159 individuals which has been used in this assessment.

##### *9.20.2.3.2 Connectivity to the Projects*

1180. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from West Westray SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1181. Outside the breeding season, breeding razorbills from West Westray SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

1182. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.2% of the BDMPS population, and during the winter 0.1% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.20.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-113 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for West Westray SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.2 | 100 | 9.4 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.3 | 9.2 | 3.5 | 0.01 | 0.02 | 0.03 | 0.33 |
| | Winter | 3376.7 | 0.1 | 100 | 3.4 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 6.6 | 2.5 | 0.00 | 0.01 | 0.01 | 0.12 |
| | Spring | 3578.5 | 0.2 | 100 | 7.2 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.3 | 7.0 | 2.6 | 0.01 | 0.02 | 0.02 | 0.26 |
| | Annual | | | | 20 | 0 | 0 | 1.4 | 0 | 0 | 0.7 | - | 9 | 0.02 | 0.05 | 0.06 | 0.71 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.2 | 100 | 9.8 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.3 | 9.4 | 3.5 | 0.01 | 0.02 | 0.03 | 0.35 |
| | Winter | 5066.2 | 0.1 | 100 | 5.1 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | 9.7 | 3.7 | 0.00 | 0.01 | 0.02 | 0.18 |
| | Spring | 4454.6 | 0.2 | 100 | 8.9 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.3 | 8.6 | 3.2 | 0.01 | 0.02 | 0.03 | 0.32 |
| | Annual | | | | 23.8 | 0.1 | 0.1 | 1.7 | 0.0 | 0.1 | 0.8 | - | 10.4 | 0.02 | 0.05 | 0.08 | 0.85 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.2 | 100 | 12.7 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | | 7.0 | 0.01 | 0.03 | 0.05 | 0.46 |
| | Winter | 5823.7 | 0.1 | 100 | 5.8 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | | 6.1 | 0.01 | 0.01 | 0.02 | 0.21 |
| | Spring | 6302.5 | 0.2 | 100 | 12.6 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.4 | | 5.9 | 0.01 | 0.03 | 0.04 | 0.45 |
| | Annual | | | | 31.1 | 0.1 | 0.2 | 2.2 | 0.0 | 0.1 | 1.1 | | 21.1 | 0.03 | 0.07 | 0.11 | 1.12 |

##### *9.20.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.20.2.3.3.1.1 DBS East in Isolation*

1183. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 0.7 (0.33, 0.12, 0.26 in autumn winter and spring respectively) birds per annum (**Table 9-113)**. This would result in a predicted change in adult mortality rate of 0.31%.

1184. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1185. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.06) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.20.2.3.3.1.2 DBS West in Isolation*

1186. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 0.8 (0.35, 0.18, 0.32 in autumn winter and spring respectively) birds per annum (**Table 9-113**). This would result in a predicted change in adult mortality rate of 0.3%.

1187. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1188. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.08) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.3.3.1.3 DBS East and West Together*

1189. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 1.1 (0.46, 0.21, 0.45 in autumn, winter and spring respectively) birds per annum (**Table 9-113**). This would result in a predicted change in adult mortality rate of 0.48%.

1190. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1191. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.1) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

*9.20.2.3.3.2.1 DBS East in Isolation*

1192. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.4 (0.7, 0.2, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-113**). This would result in a predicted change in adult mortality rate of 0.6%.

1193. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1194. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.1) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.3.3.2.2 DBS West in Isolation*

1195. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.7 (0.7, 0.4, 0.6 in autumn winter and spring respectively) birds per annum (**Table 9-113**). This would result in a predicted change in adult mortality rate of 0.7%.

1196. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1197. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.1) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.20.2.3.3.2.3 DBS East and West Together*

1198. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 2.2 (0.9, 0.4, 0.9 in autumn winter and spring respectively) birds per annum (**Table 9-113**). This would result in a predicted change in adult mortality rate of 0.97%.

1199. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1200. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.2) would increase the predicted annual mortality by 0.09% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.20.2.3.4 Summary*

1201. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below **(Table 9-114)**.

1202. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

*Table 9-114 Summary of predicted razorbill displacement mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.46 | 0.05 |
| Winter | | 0.21 | 0.02 |
| Spring | | 0.45 | 0.04 |
| Annual | | 1.12 | 0.11 |
| Effect | Reference population | 2,159 | |

| Guillemot | | Displacement | |
|---|---|---|---|
| | Increase in background mortality (%) | 0.5 | 0.04 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.9 | 0.1 |
| Winter | | 0.4 | 0.0 |
| Spring | | 0.9 | 0.1 |
| Annual | | 2.2 | 0.2 |
| Effect | Reference population | 2,159 | |
| | Increase in background mortality (%) | 0.97 | 0.09 |

#### *9.20.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1203. Given that no measurable increase in the West Westray SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.2 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

## 9.21 Fair Isle SPA

### 9.21.1 Site Description

1204. Fair Isle SPA is situated on the most southerly island of the Shetland group, lying halfway between Mainland and Orkney. It has a rocky, cliff coastline and supports a wide range of breeding seabird populations of international importance.

1205. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.21.1.1 Qualifying Features

1206. The qualifying features of the Fair Isle SPA screened into the assessment are listed in **Table 4-7**. These are breeding guillemot and four named components of the breeding seabird assemblage (kittiwake, razorbill, puffin and gannet).

#### 9.21.1.2 Conservation Objectives

1207. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.21.2 Assessment: Array Areas

#### 9.21.2.1 Gannet

1208. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

##### *9.21.2.1.1 Status*

1209. Gannet is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

1210. The SPA breeding population at classification in 1994 was cited as 1,166 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 4,971 AON which has been used in this assessment.

#### *9.21.2.1.2 Connectivity to the Projects*

1211. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Fair Isle SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1212. Outside the breeding season breeding gannets, including those from the Fair Isle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

1213. During the autumn migration and spring migration seasons it is estimated that 1.4% and 2.2% of birds respectively present in the Project array areas are considered to be breeding adults from the Fair Isle SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.21.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

1214. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Fair Isle SPA is provided in **Table 9-115**.

1215. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-115**).

*Table 9-115 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.*

| Site | Season | Peak no. (mean) | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | Wind farm construction displacement mortality to SPA | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 60-1 | 80-1 | 30-1 | 40-1 | | | | 30-1 & vessel | 40-1 & vessel |
| DBS East | Breeding | 754.9 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.48 | 0.56 | 0.00 | 0.00 | 0.00 |
| | Autumn | 776.1 | 1.4 | 100 | 10.9 | 0.07 | 0.09 | 0.03 | 0.04 | 1.52 | 0.57 | 0.01 | 0.04 | 0.05 |
| | Spring | 75.1 | 6.2 | 100 | 1.7 | 0.01 | 0.01 | 0.00 | 0.01 | 0.15 | 0.06 | 0.00 | 0.01 | 0.01 |
| | Annual | | | | 12.6 | 0.08 | 0.1 | 0.03 | 0.05 | - | 1.19 | 0.01 | 0.05 | 0.06 |
| DBS West | Breeding | 805.3 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.55 | 0.58 | 0.00 | 0.00 | 0.00 |
| | Autumn | 797.5 | 1.4 | 100 | 11.2 | 0.07 | 0.09 | 0.03 | 0.04 | 1.54 | 0.58 | 0.01 | 0.04 | 0.05 |
| | Spring | 86.2 | 2.2 | 100 | 1.9 | 0.01 | 0.02 | 0.01 | 0.01 | 0.17 | 0.06 | 0.00 | 0.01 | 0.01 |
| | Annual | | | | 13.1 | 0.08 | 0.11 | 0.04 | 0.05 | - | 1.22 | 0.01 | 0.05 | 0.06 |
| DBS East + DBS West | Breeding | 1560.2 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | - | 1.14 | 0.00 | 0.00 | 0.00 |
| | Autumn | 1573.6 | 1.4 | 100 | 22.0 | 0.13 | 0.18 | 0.07 | 0.09 | | 1.15 | 0.02 | 0.08 | 0.10 |
| | Spring | 161.3 | 2.2 | 100 | 3.5 | 0.02 | 0.03 | 0.01 | 0.01 | | 0.12 | 0.00 | 0.01 | 0.02 |
| | Annual | | | | 25.5 | 0.15 | 0.21 | 0.08 | 0.1 | | 2.41 | 0.02 | 0.09 | 0.12 |

##### 9.21.2.1.3.1.1 DBS East in Isolation

1216. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.6 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

##### 9.21.2.1.3.1.2 DBS West in Isolation

1217. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.6 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

##### 9.21.2.1.3.1.3 DBS East and West Together

1218. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.12 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### 9.21.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement

##### 9.21.2.1.3.2.1 DBS East in Isolation

1219. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.1 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.21.2.1.3.2.2 DBS West in Isolation*

1220. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.11 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.21.2.1.3.2.3 DBS East and West Together*

1221. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.21 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.21.2.1.3.3 Potential Effects During Operation: Collision Risk*

*Table 9-116 Summary of gannet total collisions and apportioned to Fair Isle SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 0.7 | 3.4 | 7.8 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 1.6 | 3.8 | 1.4 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 0.0 | 0.1 | 0.6 | 2.2 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 1.1 | 5.1 | 12.2 | - | - | 0.0 | 0.0 | 0.1 |
| DBS West | Breeding | 0.6 | 4.9 | 15.3 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 2.1 | 6.0 | 1.4 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 0.0 | 0.1 | 0.7 | 2.2 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 1.5 | 7.1 | 17.7 | - | - | 0.0 | 0.0 | 0.1 |
| DBS East + DBS West | Breeding | 0.9 | 8.4 | 26.5 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.5 | 3.7 | 10.8 | 1.4 | 100 | 0.0 | 0.1 | 0.2 |
| | Spring | 0.0 | 0.3 | 1.3 | 2.2 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 2.7 | 12.4 | 29.8 | - | - | 0.0 | 0.1 | 0.2 |

##### 9.21.2.1.3.3.1 DBS East in Isolation

1222. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.02 (0.0 to 0.1) birds per annum (**Table 9-116**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.21.2.1.3.3.2 DBS West in Isolation

1223. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.03 (0.0 to 0.1) birds per annum (**Table 9-116**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### 9.21.2.1.3.3.3 DBS East and West Together

1224. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.1 (0.0 to 0.2) birds per annum (**Table 9-116**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### 9.21.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk

##### 9.21.2.1.3.4.1 DBS East in Isolation

1225. Since the estimated impacts from DBS East on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

##### 9.21.2.1.3.4.2 DBS West in Isolation

1226. Since the estimated impacts from DBS West on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

##### 9.21.2.1.3.4.3 DBS East and West Together

1227. Since the estimated impacts from DBS East and DBS West on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

### *9.21.2.1.4 Summary*

1228. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-117**).

1229. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

*Table 9-117 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Gannet** | | | | |
|---|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.10 | - | - |
| Spring | | 0.02 | - | - |
| Annual | | 0.12 | | |
| Effect | Reference population | 9,942 | - | - |
| | Increase in background mortality (%) | <0.01 | - | - |
| **Potential Effects During Operation: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.18 | - | - |
| Spring | | 0.03 | - | - |
| Annual | | 0.21 | | |
| Effect | Reference population | 9,942 | - | - |
| | Increase in background mortality (%) | <0.01 | - | - |
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | 0.0 | 0.0 | 0.0 |
| Autumn | | 0.1 | 0.9 | 2.6 |
| Spring | | 0.0 | 0.1 | 0.4 |
| Annual | | 0.1 | 1.0 | 3.0 |
| Effect | Reference population | 9,942 | | |
| | Increase in background mortality (%) | <0.01 | <0.01 | 0.01 |

| Gannet | | | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk** | | | | |
| Combined Displacement and Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.23 | - | - |
| Spring | | 0.04 | - | - |
| Annual | | 0.27 | | |
| Effect | Reference population | 9.942 | - | - |
| | Increase in background mortality (%) | <0.01 | - | - |

### *9.21.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1230. Given that no measurable increase in the Fair Isle SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 0.27 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

### 9.21.2.2 Kittiwake

1231. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

### *9.21.2.2.1 Status*

1232. Kittiwake is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

1233. The SPA breeding population at classification in 1994 was cited as 18,160 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 488 AON which has been used in this assessment.

### *9.21.2.2.2 Connectivity to the Projects*

1234. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Fair Isle SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1235. Outside the breeding season breeding kittiwakes, including those from the Fair Isle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1236. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from the Fair Isle SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.21.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.21.2.2.3.1 Potential Effects During Operation: Collision risk*

*Table 9-118 Summary of kittiwake total collisions and apportioned to the* Fair Isle *SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

*9.21.2.2.3.1.1 DBS East in Isolation*

1237. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-5) the number of individuals from the Fair Isle SPA population expected to die is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-118**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.2.3.1.2 DBS West in Isolation*

1238. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-118**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.2.3.1.3 DBS East and West Together*

1239. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-118**). This results in a predicted change in adult mortality rate of 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.2.4 Summary*

1240. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-119**).

1241. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

*Table 9-119 Summary of predicted Kittiwake collision mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 896 | | |
| | Increase in background mortality (%) | <0.01 | 0.08 | 0.20 |

### *9.21.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1242. Given that no measurable increase in the Fair Isle SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.11 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

## 9.21.2.3 Guillemot

1243. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

### *9.21.2.3.1 Status*

1244. Guillemot is listed as a designated species of the Fair Isle SPA.

1245. The SPA breeding population at classification in 1994 was cited as 32,300 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 18,295 individuals which has been used in this assessment.

### 9.21.2.3.2 Connectivity to the Projects

1246. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1247. Outside the breeding season, breeding guillemots from the Fair Isle SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1248. During the non-breeding season, 70% of Fair Isle SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.1% of birds present at the Projects are considered to be breeding adults from the Fair Isle SPA, and impacts are apportioned accordingly (**Table 9-120**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

1249. It is estimated that 1.1% of birds present at the Projects are considered to be breeding adults from Fair Isle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### 9.21.2.3.3 Assessment of Potential Effects of the Projects alone and Together

*Table 9-120 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 1.1 | 100 | 138.1 | 0.4 | 0.7 | 9.7 | 0.2 | 0.3 | 4.8 | 24.62 | 9.3 | 0.10 | 0.31 | 0.45 | 4.93 |
| | Annual | | | | | 0.4 | 0.7 | 9.7 | 0.2 | 0.3 | 4.8 | - | 16 | 0.10 | 0.31 | 0.45 | 4.93 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 1.1 | 100 | 137.5 | 0.4 | 0.7 | 9.6 | 0.2 | 0.3 | 4.8 | 24.08 | 9.1 | 0.10 | 0.31 | 0.44 | 4.91 |
| | Annual | | | | 137.5 | 0.4 | 0.7 | 9.6 | 0.2 | 0.3 | 4.8 | - | 15.5 | 0.10 | 0.31 | 0.44 | 4.91 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 1.1 | 100 | 221.5 | 0.7 | 1.1 | 15.5 | 0.3 | 0.6 | 7.8 | | 18.4 | 0.20 | 0.53 | 0.76 | 7.95 |
| | Annual | | | | 221.5 | 0.7 | 1.1 | 15.5 | 0.3 | 0.6 | 7.8 | | 31.4 | 0.20 | 0.53 | 0.76 | 7.95 |

##### *9.21.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.21.2.3.3.1.1 DBS East in Isolation*

1250. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.93 birds per annum (**Table 9-120**). This would result in a predicted change in adult mortality rate of 0.44%.

1251. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1252. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.45) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.3.3.1.2 DBS West in Isolation*

1253. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.91 birds per annum (**Table 9-120)**. This would result in a predicted change in adult mortality rate of 0.44%.

1254. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1255. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.44) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.3.3.1.3 DBS East and West Together*

1256. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.95 birds per annum (**Table 9-120**). This would result in a predicted change in adult mortality rate of 0.71%.

1257. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1258. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.76) would increase the predicted annual mortality by 0.07 which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.21.2.3.3.2.1 DBS East in Isolation*

1259. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 9.7 birds per annum (**Table 9-120)**. This would result in a predicted change in adult mortality rate of 0.86%.

1260. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1261. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.7) would increase the predicted annual mortality by 0.06 which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.3.3.2.2 DBS West in Isolation*

1262. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 9.6 birds per annum (**Table 9-120**). This would result in a predicted change in adult mortality rate of 0.86%.

1263. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1264. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.7) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.3.3.2.3 DBS East and West Together*

1265. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 15.5 birds per annum (**Table 9-120**). This would result in a predicted change in adult mortality rate of 1.38% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1266. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1267. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (1.1) would increase the predicted annual mortality by 0.17% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

#### *9.21.2.3.4 Summary*

1268. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-121**).

1269. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

*Table 9-121 Summary of predicted guillemot displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 7.95 | 0.76 |
| Annual | | 7.95 | 0.76 |
| Effect | Reference population | 18,295 | |
| | Increase in background mortality (%) | 0.71 | 0.07 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 15.5 | 1.1 |
| Annual | | 15.5 | 1.1 |
| Effect | Reference population | 18,295 | |
| | Increase in background mortality (%) | 1.38 | 0.10 |

##### *9.21.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1270. Given that no measurable increase in the Fair Isle SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.1 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

#### 9.21.2.4 Razorbill

1271. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.21.2.4.1 Status*

1272. Razorbill is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

1273. The SPA breeding population at classification in 1994 was cited as 3,400 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 1,925 individuals which has been used in this assessment.

##### *9.21.2.4.2 Connectivity to the Projects*

1274. DBS East and DBS West are 585km and 559km respectively from Fair Isle SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1275. Outside the breeding season, breeding razorbills from Fair Isle SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

1276. During the autumn and spring migration it is estimated that Fair Isle birds make up 0.3% of the BDMPS population, and during the winter 0.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.21.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-122 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.3 | 100 | 14.1 | 0.0 | 0.1 | 1.0 | 0.0 | 0.0 | 0.5 | 9.2 | 3.5 | 0.01 | 0.03 | 0.05 | 0.50 |
| | Winter | 3376.7 | 0.3 | 100 | 10.1 | 0.0 | 0.1 | 0.7 | 0.0 | 0.0 | 0.4 | 6.6 | 2.5 | 0.01 | 0.02 | 0.03 | 0.36 |
| | Spring | 3578.5 | 0.3 | 100 | 10.7 | 0.0 | 0.1 | 0.8 | 0.0 | 0.0 | 0.4 | 7.0 | 2.6 | 0.01 | 0.02 | 0.03 | 0.38 |
| | Annual | | | | 34.9 | 0 | 0.3 | 2.5 | 0 | 0 | 1.3 | - | 9 | 0.03 | 0.07 | 0.11 | 1.24 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.3 | 100 | 14.7 | 0.0 | 0.1 | 1.0 | 0.0 | 0.0 | 0.5 | 9.4 | 3.5 | 0.01 | 0.03 | 0.05 | 0.52 |
| | Winter | 5066.2 | 0.3 | 100 | 15.2 | 0.0 | 0.1 | 1.1 | 0.0 | 0.0 | 0.5 | 9.7 | 3.7 | 0.01 | 0.03 | 0.05 | 0.54 |
| | Spring | 4454.6 | 0.3 | 100 | 13.4 | 0.0 | 0.1 | 0.9 | 0.0 | 0.0 | 0.5 | 8.6 | 3.2 | 0.01 | 0.03 | 0.04 | 0.48 |
| | Annual | | | | 43.3 | 0.1 | 0.2 | 3.0 | 0.1 | 0.1 | 1.5 | - | 9.1 | 0.03 | 0.09 | 0.14 | 1.54 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.3 | 100 | 19.0 | 0.1 | 0.1 | 1.3 | 0.0 | 0.0 | 0.7 | | 7.0 | 0.02 | 0.05 | 0.07 | 0.69 |
| | Winter | 5823.7 | 0.3 | 100 | 17.5 | 0.1 | 0.1 | 1.2 | 0.0 | 0.0 | 0.6 | | 6.1 | 0.02 | 0.04 | 0.06 | 0.63 |
| | Spring | 6302.5 | 0.3 | 100 | 18.9 | 0.1 | 0.1 | 1.3 | 0.0 | 0.0 | 0.7 | | 5.9 | 0.02 | 0.05 | 0.06 | 0.68 |
| | Annual | | | | 55.4 | 0.2 | 0.3 | 3.9 | 0.1 | 0.1 | 1.9 | | 18.2 | 0.06 | 0.14 | 0.19 | 2.0 |

##### *9.21.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.21.2.4.3.1.1 DBS East in Isolation*

1277. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.2 (0.5, 0.4, 0.4 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.6%.

1278. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1279. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.1) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.4.3.1.2 DBS West in Isolation*

1280. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.5 (0.5, 0.5, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.7%.

1281. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1282. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.1) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.21.2.4.3.1.3 DBS East and West Together*

1283. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 2.0 (0.7, 0.6, 0.7 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.9%.

1284. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1285. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.21.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.21.2.4.3.2.1 DBS East in Isolation*

1286. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 2.4 (1.0, 0.7, 0.8 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 59%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1287. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1288. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.2) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.4.3.2.2 DBS West in Isolation*

1289. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.0 (1.0, 1.1, 0.9 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 47%) or the mortality rate (e.g. to 6.7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1290. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1291. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.4.3.2.3 DBS East and West Together*

1292. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.9 (1.3, 1.2, 1.3 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5.2%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1293. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1294. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.21.2.4.4 Summary*

1295. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-123)**.

1296. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

*Table 9-123 Summary of predicted razorbill displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations*.

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.69 | 0.07 |
| Winter | | 0.63 | 0.06 |
| Spring | | 0.68 | 0.06 |
| Annual | | 2.0 | 0.19 |
| Effect | Reference population | 2,159 | |
| | Increase in background mortality (%) | 0.9 | 0.09 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 1.3 | 0.1 |
| Winter | | 1.2 | 0.1 |
| Spring | | 1.3 | 0.1 |
| Annual | | 3.9 | 0.3 |
| Effect | Reference population | 2,159 | |
| | Increase in background mortality (%) | 1.9 | 0.1 |

#### *9.21.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1297. Given that no measurable increase in the Fair Isle SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

### 9.21.2.5 Puffin

1298. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

#### *9.21.2.5.1 Status*

1299. Puffin is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

1300. The SPA breeding population at classification in 1994 was cited as 23,000 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 6,666 AOB which has been used in this assessment.

#### *9.21.2.5.2 Connectivity to the Projects*

1301. DBS East and DBS West are 585km and 559km respectively from Fair Isle SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1302. Outside the breeding season, breeding puffins from Fair Isle SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

1303. It is estimated that 1.4% of birds present at the Projects are breeding adults from Fair Isle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.21.2.5.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-124 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 1.4 | 1 | 2.5 | 0.01 | 0.01 | 0.18 | 0.00 | 0.01 | 0.09 | 0.35 | 0.13 | 0.00 | 0.01 | 0.01 | 0.09 |
| | Annual | | | | 2.5 | 0.01 | 0.01 | 0.18 | 0.00 | 0.01 | 0.09 | - | 0.18 | 0.00 | 0.01 | 0.01 | 0.09 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 1.4 | 1 | 2.8 | 0.01 | 0.01 | 0.19 | 0.00 | 0.01 | 0.10 | 0.38 | 0.14 | 0.00 | 0.01 | 0.01 | 0.10 |
| | Annual | | | | 2.8 | 0.01 | 0.01 | 0.19 | 0.00 | 0.01 | 0.10 | - | 0.22 | 0.00 | 0.01 | 0.01 | 0.10 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 1.4 | 1 | 5.2 | 0.02 | 0.03 | 0.37 | 0.01 | 0.01 | 0.18 | | 0.28 | 0.00 | 0.01 | 0.02 | 0.19 |
| | Annual | | | | 5.2 | 0.02 | 0.03 | 0.37 | 0.01 | 0.01 | 0.18 | | 0.4 | 0.00 | 0.01 | 0.02 | 0.19 |

##### 9.21.2.5.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.21.2.5.3.1.1 DBS East in Isolation

1304. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.09 birds per annum (**Table 9-124)**. This would result in a predicted change in adult mortality rate of <0.01%.

1305. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1306. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### 9.21.2.5.3.1.2 DBS West in Isolation

1307. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.1 birds per annum (**Table 9-124**). This would result in a predicted change in adult mortality rate of <0.01%.

1308. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1309. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.21.2.5.3.1.3 DBS East and West Together*

1310. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.19 birds per annum (**Table 9-124**). This would result in a predicted change in adult mortality rate of 0.01%.

1311. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1312. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.21.2.5.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.21.2.5.3.2.1 DBS East in Isolation*

1313. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.18 birds per annum (**Table 9-124**). This would result in a predicted change in adult mortality rate of 0.01%.

1314. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1315. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.21.2.5.3.2.2 DBS West in Isolation*

1316. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.19 birds per annum (**Table 9-124**). This would result in a predicted change in adult mortality rate of 0.01%.

1317. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1318. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.21.2.5.3.2.3 DBS East and West Together*

1319. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.37 birds per annum (**Table 9-124**). This would result in a predicted change in adult mortality rate of 0.03%.

1320. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1321. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.21.2.5.4 Summary*

1322. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-125)**.

1323. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

*Table 9-125 Summary of predicted puffin displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.19 | 0.02 |
| Annual | | 0.19 | 0.02 |
| Effect | Reference population | 13,332 | |
| | Increase in background mortality (%) | 0.015 | <0.01 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.37 | 0.03 |
| Annual | | 0.37 | 0.03 |
| Effect | Reference population | 13,332 | |
| | Increase in background mortality (%) | 0.03 | <0.01 |

*9.21.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1324. Given that no measurable increase in the Fair Isle SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.03 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

## 9.22 Sumburgh Head SPA

### 9.22.1 Site Description

1325. Sumburgh Head SPA was designated in 1996.

1326. The site covers an area of cliffs and boulder beaches at the southern tip of Mainland, Shetland.

1327. The boundary of the SPA is coincident with that of Sumburgh Head SSSI and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.

#### 9.22.1.1 Qualifying Features

1328. The qualifying features of the Sumburgh Head SPA screened into the assessment are listed in **Table 4-7.**These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.22.1.2 Conservation Objectives

1329. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.22.2 Assessment: Array Areas

#### 9.22.2.1 Kittiwake

1330. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.22.2.1.1 Status*

1331. Kittiwake is listed as a named component of the breeding seabird assemblage of the Sumburgh Head SPA.

1332. The SPA breeding population at classification in 1996 was cited as 1,366 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 966 AON which has been used in this assessment.

##### *9.22.2.1.2 Connectivity to the Projects*

1333. DBS East and DBS West are 615km and 590km respectively from the Sumburgh Head SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Sumburgh Head SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1334. Outside the breeding season breeding kittiwakes, including those from the Sumburgh Head SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1335. It is estimated that 0.03 and 0.04% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Sumburgh Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### *9.22.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

#### *9.22.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-126 Summary of kittiwake total collisions and apportioned to the Sumburgh Head SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.03 | 100 | 0.0 | 0.0 | 0.0 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.04 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.0 | 0.0 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.03 | 100 | 0.0 | 0.0 | 0.0 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.04 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.0 | 0.0 |
| DBS East + | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS West | Autumn | 30.5 | 79.3 | 143.1 | 0.03 | 100 | 0.0 | 0.0 | 0.0 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.04 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.0 | 0.1 |

*9.22.2.1.3.1.1 DBS East in Isolation*

1336. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-5) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-126**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.1.3.1.2 DBS West in Isolation*

1337. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-126**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.1.3.1.3 DBS East and West Together*

1338. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-126**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.1.4 Summary*

1339. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-127**).

1340. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Sumburgh Head SPA**.

*Table 9-127 Summary of predicted Kittiwake collision mortality from Sumburgh Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.0 | 0.0 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.0 | 0.1 |
| Effect | Reference population | 1,932 | | |
| | Increase in background mortality (%) | <0.01 | 0.01 | 0.03 |

### *9.22.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1341. Given that no measurable increase in the Sumburgh Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.04 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Sumburgh Head SPA**.

## 9.22.2.2 Guillemot

1342. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

### *9.22.2.2.1 Status*

1343. Guillemot is listed as a named component of the breeding seabird assemblage of the Sumburgh Head SPA.

1344. The SPA breeding population at classification in 1996 was 16,000 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 17,810 individuals which has been used in this assessment.

*9.22.2.2.2 Connectivity to the Projects*

1345. DBS East and DBS West are 615km and 590km respectively from the Sumburgh Head SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Sumburgh Head SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1346. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1347. During the non-breeding season, 70% of the Sumburgh Head SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from the Sumburgh Head SPA, and impacts are apportioned accordingly **(Table 9-128**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

1348. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from Sumburgh Head SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.22.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-128 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Sumburgh Head SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 0.4 | 100 | 50.2 | 0.2 | 0.3 | 3.5 | 0.1 | 0.1 | 1.8 | 24.62 | 9.3 | 0.04 | 0.11 | 0.16 | 1.79 |
| | Annual | | | | 50.2 | 0.2 | 0.3 | 3.5 | 0.1 | 0.1 | 1.8 | - | 16 | 0.04 | 0.11 | 0.16 | 1.79 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 0.4 | 100 | 50.0 | 0.1 | 0.2 | 3.5 | 0.1 | 0.1 | 1.7 | 24.08 | 9.1 | 0.04 | 0.11 | 0.16 | 1.79 |
| | Annual | | | | 50.0 | 0.1 | 0.2 | 3.5 | 0.1 | 0.1 | 1.7 | - | 15.5 | 0.04 | 0.11 | 0.16 | 1.79 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 0.4 | 100 | 80.5 | 0.2 | 0.4 | 5.6 | 0.1 | 0.2 | 2.8 | | 18.4 | 0.07 | 0.19 | 0.27 | 2.89 |
| | Annual | | | | 80.5 | 0.2 | 0.4 | 5.6 | 0.1 | 0.2 | 2.8 | | 31.4 | 0.07 | 0.19 | 0.27 | 2.89 |

##### *9.22.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.22.2.2.3.1.1 DBS East in Isolation*

1349. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.16%.

1350. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1351. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.11) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.22.2.2.3.1.2 DBS West in Isolation*

1352. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-128)**. This would result in a predicted change in adult mortality rate of 0.16%.

1353. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1354. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.11) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.2.3.1.3 DBS East and West Together*

1355. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is2.89 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.26%.

1356. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1357. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.19) would increase the predicted annual mortality by 0.02 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.22.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.22.2.2.3.2.1 DBS East in Isolation*

1358. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.32%.

1359. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1360. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.3) would increase the predicted annual mortality by 0.02 which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.2.3.2.2 DBS West in Isolation*

1361. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.32%.

1362. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1363. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.3) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.22.2.2.3.2.3 DBS East and West Together*

1364. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 5.6 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.5%.

1365. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1366. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.4) would increase the predicted annual mortality by 0.04% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

##### *9.22.2.2.4 Summary*

1367. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-129**).

1368. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Sumburgh Head SPA**.

*Table 9-129 Summary of predicted guillemot displacement mortality from Sumburgh Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 2.89 | 0.19 |
| Annual | | 2.89 | 0.19 |
| Effect | Reference population | 17,810 | |
| | Increase in background mortality (%) | 0.26 | 0.02 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |

| Guillemot | | Displacement | |
|---|---|---|---|
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 5.6 | 0.4 |
| Annual | | 5.6 | 0.4 |
| Effect | Reference population | 17,810 | |
| | Increase in background mortality (%) | 0.51 | 0.04 |

#### *9.22.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1369. Given that no measurable increase in the Sumburgh Head SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.2 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Sumburgh Head SPA**.

## 9.23 Noss SPA

### 9.23.1 Site Description

1370. Noss SPA is an offshore island lying 5km east of Lerwick, Shetland. It supports breeding seabirds on cliffs, inland heathlands and grasslands.

1371. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

#### 9.23.1.1 Qualifying Features

1372. The qualifying features of the Noss SPA screened into the assessment are listed in **Table 4-7**. These are breeding gannet and guillemot and two named components of the breeding seabird assemblage (kittiwake and puffin).

#### 9.23.1.2 Conservation Objectives

1373. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.23.2 Assessment: Array Areas

#### 9.23.2.1 Gannet

1374. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

##### *9.23.2.1.1 Status*

1375. Gannet is listed as a designated species of the Noss SPA.

1376. The SPA breeding population at classification in 1996 was cited as 6,860 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 13,765 AON which has been used in this assessment.

##### *9.23.2.1.2 Connectivity to the Projects*

1377. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Noss SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1378. Outside the breeding season breeding gannets, including those from the Noss SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

1379. During the autumn migration and spring migration seasons it is estimated that 3.4% and 5.5% of birds respectively present in the Project array areas are considered to be breeding adults from the Noss SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.23.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

###### *9.23.2.1.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

1380. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Noss SPA is provided in **Table 9-130**.

1381. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-130**).

*Table 9-130 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.*

| Site | Season | Peak no. (mean) | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | Wind farm construction displacement mortality to SPA | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 60-1 | 80-1 | 30-1 | 40-1 | | | | 30-1 & vessel | 40-1 & vessel |
| DBS East | Breeding | 754.9 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.48 | 0.56 | 0.00 | 0.00 | 0.00 |
| | Autumn | 776.1 | 3.4 | 100 | 26.4 | 0.16 | 0.21 | 0.08 | 0.11 | 1.52 | 0.57 | 0.02 | 0.10 | 0.13 |
| | Spring | 75.1 | 5.5 | 100 | 4.1 | 0.02 | 0.03 | 0.01 | 0.02 | 0.15 | 0.06 | 0.00 | 0.02 | 0.02 |
| | Annual | | | | 30.5 | 0.18 | 0.24 | 0.09 | 0.13 | - | 1.19 | 0.02 | 0.12 | 0.15 |
| DBS West | Breeding | 805.3 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.55 | 0.58 | 0.00 | 0.00 | 0.00 |
| | Autumn | 797.5 | 3.4 | 100 | 27.1 | 0.16 | 0.22 | 0.08 | 0.11 | 1.54 | 0.58 | 0.02 | 0.10 | 0.13 |
| | Spring | 86.2 | 5.5 | 100 | 4.7 | 0.03 | 0.04 | 0.01 | 0.02 | 0.17 | 0.06 | 0.00 | 0.02 | 0.02 |
| | Annual | | | | 31.8 | 0.19 | 0.26 | 0.09 | 0.13 | - | 1.22 | 0.02 | 0.12 | 0.15 |
| DBS East + DBS West | Breeding | 1560.2 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | - | 1.14 | 0.00 | 0.00 | 0.00 |
| | Autumn | 1573.6 | 3.4 | 100 | 53.5 | 0.32 | 0.43 | 0.16 | 0.21 | | 1.15 | 0.04 | 0.20 | 0.25 |
| | Spring | 161.3 | 5.5 | 100 | 8.9 | 0.05 | 0.07 | 0.03 | 0.04 | | 0.12 | 0.01 | 0.03 | 0.04 |
| | Annual | | | | 62.4 | 0.37 | 0.5 | 0.19 | 0.25 | | 2.41 | 0.05 | 0.23 | 0.29 |

###### *9.23.2.1.3.1.1 DBS East in Isolation*

1382. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.15 birds per annum (**Table 9-130**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

###### *9.23.2.1.3.1.2 DBS West in Isolation*

1383. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.15 birds per annum (**Table 9-130**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

###### *9.23.2.1.3.1.3 DBS East and West Together*

1384. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.3 birds per annum (**Table 9-115**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

##### *9.23.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.23.2.1.3.2.1 DBS East in Isolation*

1385. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.24 birds per annum (**Table 9-130**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### *9.23.2.1.3.2.2 DBS West in Isolation*

1386. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.25 birds per annum (**Table 9-130**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### *9.23.2.1.3.2.3 DBS East and West Together*

1387. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.5 birds per annum (**Table 9-130**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

### *9.23.2.1.3.3 Potential Effects During Operation: Collision Risk*

*Table 9-131 Summary of gannet total collisions and apportioned to Noss SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 0.7 | 3.4 | 7.8 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 1.6 | 3.8 | 3.4 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 0.0 | 0.1 | 0.6 | 5.5 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 1.1 | 5.1 | 12.2 | - | - | 0.0 | 0.1 | 0.2 |
| DBS West | Breeding | 0.6 | 4.9 | 15.3 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 2.1 | 6.0 | 3.4 | 100 | 0.0 | 0.1 | 0.2 |
| | Spring | 0.0 | 0.1 | 0.7 | 5.5 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 1.5 | 7.1 | 17.7 | - | - | 0.0 | 0.1 | 0.2 |
| DBS East + DBS West | Breeding | 0.9 | 8.4 | 26.5 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.5 | 3.7 | 10.8 | 3.4 | 100 | 0.0 | 0.1 | 0.4 |
| | Spring | 0.0 | 0.3 | 1.3 | 5.5 | 100 | 0.0 | 0.0 | 0.1 |
| | Annual | 2.7 | 12.4 | 29.8 | - | - | 0.0 | 0.1 | 0.4 |

*9.23.2.1.3.3.1 DBS East in Isolation*

1388. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.1 (0.01 to 0.20) birds per annum (**Table 9-131**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.1.3.3.2 DBS West in Isolation*

1389. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.1 (0.01 to 0.2) birds per annum (**Table 9-131**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.1.3.3.3 DBS East and West Together*

1390. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.1 (0.0 to 0.4) birds per annum (**Table 9-131**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

*9.23.2.1.3.4.1 DBS East in Isolation*

1391. Since the estimated impacts from DBS East on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

*9.23.2.1.3.4.2 DBS West in Isolation*

1392. Since the estimated impacts from DBS West on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

*9.23.2.1.3.4.3 DBS East and West Together*

1393. Since the estimated impacts from DBS East and DBS West on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

### *9.23.2.1.4 Summary*

1394. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-132)**.

1395. It is concluded that predicted gannet mortality due to construction and operational phase displacement , as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

*Table 9-132 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Gannet** | | | | |
|---|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.25 | - | - |
| Spring | | 0.04 | - | - |
| Annual | | 0.3 | | |
| Effect | Reference population | 27,530 | - | - |
| | Increase in background mortality (%) | 0.01 | - | - |
| **Potential Effects During Operation: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.43 | - | - |
| Spring | | 0.07 | - | - |
| Annual | | 0.5 | | |
| Effect | Reference population | 27,530 | - | - |
| | Increase in background mortality (%) | 0.02 | - | - |
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | 0.0 | 0.0 | 0.0 |
| Autumn | | 0.0 | 0.1 | 0.4 |
| Spring | | 0.0 | 0.0 | 0.1 |
| Annual | | 0.0 | 0.1 | 0.4 |
| Effect | Reference population | 27,530 | | |
| | Increase in background mortality (%) | <0.01 | 0.01 | 0.02 |

| Gannet | | | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk** | | | | |
| Combined Displacement and Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.56 | - | - |
| Spring | | 0.08 | - | - |
| Annual | | 0.64 | | |
| Effect | Reference population | 27,530 | - | - |
| | Increase in background mortality (%) | 0.02 | - | - |

### *9.23.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1396. Given that no measurable increase in the Noss SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 0.64 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

### 9.23.2.2 Kittiwake

1397. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

### *9.23.2.2.1 Status*

1398. Kittiwake is listed as a named component of the breeding seabird assemblage of the Noss SPA.

1399. The SPA breeding population at classification in 1996 was cited as 7,020 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 179 AON which has been used in this assessment.

### *9.23.2.2.2 Connectivity to the Projects*

1400. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Noss SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1401. Outside the breeding season breeding kittiwakes, including those from the Noss SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1402. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Noss SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.23.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

##### *9.23.2.2.3.1 Potential Effects During Operation: Collision risk*

*Table 9-133 Summary of kittiwake total collisions and apportioned to the Sumburgh Head SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

###### *9.23.2.2.3.1.1 DBS East in Isolation*

1403. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-133**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.2.3.1.2 DBS West in Isolation*

1404. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-133**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.2.3.1.3 DBS East and West Together*

1405. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-133**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.23.2.2.4 Summary*

1406. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-134**).

1407. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Noss SPA**.

*Table 9-134 Summary of predicted Kittiwake collision mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 358 | | |
| | Increase in background mortality (%) | <0.01 | 0.07 | 0.16 |

### *9.23.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1408. Given that no measurable increase in the Noss SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.04 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

### 9.23.2.3 Guillemot

1409. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1410. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

#### *9.23.2.3.1 Status*

1411. Guillemot is listed as a designated species of the Noss SPA.

1412. The SPA breeding population at classification in 1996 was 38,970 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 24,456 individuals which has been used in this assessment.

#### *9.23.2.3.2 Connectivity to the Projects*

1413. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Noss SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1414. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1415. During the non-breeding season, 70% of the Foula SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.3% of birds present at the Projects are considered to be breeding adults from the Noss SPA, and impacts are apportioned accordingly (**Table 9-135**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

1416. It is estimated that 1.3% of birds present at the Projects are considered to be breeding adults from Noss SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### *9.23.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-135 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km2) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 1.3 | 100 | 163.2 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | 24.62 | 9.3 | 0.12 | 0.37 | 0.53 | 5.83 |
| | Annual | | | | 163.2 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | - | 16 | 0.12 | 0.37 | 0.53 | 5.83 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 1.3 | 100 | 162.5 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | 24.08 | 9.1 | 0.12 | 0.36 | 0.52 | 5.80 |
| | Annual | | | | 162.5 | 0.5 | 0.8 | 11.4 | 0.2 | 0.4 | 5.7 | - | 15.5 | 0.12 | 0.36 | 0.52 | 5.80 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 1.3 | 100 | 261.8 | 0.8 | 1.3 | 18.3 | 0.4 | 0.7 | 9.2 | | 18.4 | 0.24 | 0.63 | 0.89 | 9.40 |
| | Annual | | | | 261.8 | 0.8 | 1.3 | 18.3 | 0.4 | 0.7 | | | 31.4 | 0.24 | 0.63 | 0.89 | 9.40 |

##### *9.23.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.23.2.3.3.1.1 DBS East in Isolation*

1417. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 5.83 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 0.39%.

1418. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1419. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.53) would increase the predicted annual mortality by 0.35% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.3.3.1.2 DBS West in Isolation*

1420. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 5.80 birds per annum (**Table 9-135)**. This would result in a predicted change in adult mortality rate of 0.38%.

1421. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1422. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.52) would increase the predicted annual mortality by 0.35% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.3.3.1.3 DBS East and West Together*

1423. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 9.4 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 0.63%.

1424. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1425. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.89) would increase the predicted annual mortality by 0.06 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.23.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.23.2.3.3.2.1 DBS East in Isolation*

1426. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.4 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 0.76%.

1427. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1428. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.8) would increase the predicted annual mortality by 0.05 which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.3.3.2.2 DBS West in Isolation*

1429. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.4 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 0.76%.

1430. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1431. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.8) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.3.3.2.3 DBS East and West Together*

1432. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 18.3 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 57%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1433. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1434. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (1.3) would increase the predicted annual mortality by 0.08% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

### *9.23.2.3.4 Summary*

1435. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-136**).

1436. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

*Table 9-136 Summary of predicted guillemot displacement mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 9.4 | 0.89 |
| Annual | | 9.4 | 0.89 |
| Effect | Reference population | 24,456 | |
| | Increase in background mortality (%) | 0.63 | 0.06 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 18.3 | 1.3 |
| Annual | | 18.3 | 1.3 |
| Effect | Reference population | 24,456 | |
| | Increase in background mortality (%) | 1.2 | 0.08 |

##### 9.23.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

1437. Given that no measurable increase in the Noss SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.3 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

#### 9.23.2.4 Puffin

1438. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1439. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

##### 9.23.2.4.1 *Status*

1440. Puffin is listed as a named component of the breeding seabird assemblage of the Noss SPA.

1441. The SPA breeding population at classification in 1995 was 48,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 1,174 AOB which has been used in this assessment.

##### 9.23.2.4.2 *Connectivity to the Projects*

1442. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Noss SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1443. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

1444. It is estimated that 0.1% of birds present at the Projects are breeding adults from Noss SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.23.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-137 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 0.1 | 1 | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.35 | 0.13 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | - | 0.18 | 0.00 | 0.00 | 0.00 | 0.01 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 0.1 | 1 | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.38 | 0.14 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.2 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | - | 0.22 | 0.00 | 0.00 | 0.00 | 0.01 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 0.1 | 1 | 0.4 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 | | 0.28 | 0.00 | 0.00 | 0.00 | 0.01 |
| | Annual | | | | 0.4 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 | | 0.4 | 0.00 | 0.00 | 0.00 | 0.01 |

##### *9.23.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.23.2.4.3.1.1 DBS East in Isolation*

1445. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-137)**. This would result in a predicted change in adult mortality rate of <0.01%.

1446. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1447. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.4.3.1.2 DBS West in Isolation*

1448. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.1 birds per annum (**Table 9-137**). This would result in a predicted change in adult mortality rate of <0.01%.

1449. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1450. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.4.3.1.3 DBS East and West Together*

1451. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-137**). This would result in a predicted change in adult mortality rate of <0.01%.

1452. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1453. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.23.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.23.2.4.3.2.1 DBS East in Isolation*

1454. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-137**). This would result in a predicted change in adult mortality rate of <0.01%.

1455. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1456. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.23.2.4.3.2.2 DBS West in Isolation*

1457. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-137**). This would result in a predicted change in adult mortality rate of <0.01%.

1458. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1459. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.23.2.4.3.2.3 DBS East and West Together*

1460. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.03 birds per annum (**Table 9-137**). This would result in a predicted change in adult mortality rate of 0.01%.

1461. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1462. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.23.2.4.4 Summary*

1463. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-138)**.

1464. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

*Table 9-138 Summary of predicted puffin displacement mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.01 | <0.01 |
| Annual | | 0.01 | <0.01 |
| Effect | Reference population | 2,348 | |
| | Increase in background mortality (%) | <0.01 | <0.01 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.03 | <0.01 |
| Annual | | 0.03 | <0.01 |
| Effect | Reference population | 2,348 | |
| | Increase in background mortality (%) | 0.01 | <0.01 |

##### *9.23.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1465. Given that no measurable increase in the Noss SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of <0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

## 9.24 Foula SPA

### 9.24.1 Site Description

1466. Foula is the most westerly of the Shetland Islands, lying 20km west of Shetland Mainland. It consists of a rocky coastline, large areas of mire, and adjacent coastal waters which support internationally important breeding populations of seabirds.

1467. The boundary of the SPA extends approximately 2km into the marine environment to include the seabed, water column and surface.

#### 9.24.1.1 Qualifying Features

1468. The qualifying features of the Foula SPA screened into the assessment are listed in **Table 4-7.** These are breeding guillemot and puffin and two named components of the breeding seabird assemblage (kittiwake and razorbill).

#### 9.24.1.2 Conservation Objectives

1469. The over-arching conservation objectives of the site are as follows:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.24.2 Assessment: Array Areas

#### 9.24.2.1 Kittiwake

1470. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

##### *9.24.2.1.1 Status*

1471. Kittiwake is listed as a named component of the breeding seabird assemblage of the Foula SPA.

1472. The SPA breeding population at classification in 1995 was cited as 3,840 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 425 AON which has been used in this assessment.

##### *9.24.2.1.2 Connectivity to the Projects*

1473. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Foula SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1474. Outside the breeding season breeding kittiwakes, including those from the Foula SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1475. It is estimated that 0.05% and 0.1% of birds present in the Project array areas in the autumn and spring migration seasons are considered to be breeding adults from Foula SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### *9.24.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

#### *9.24.2.1.3.1 Potential Effects During Operation: Collision risk*

*Table 9-139 Summary of kittiwake total collisions and apportioned to the Foula SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.05 | 100 | 0.0 | 0.0 | 0.0 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.0 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.05 | 100 | 0.0 | 0.0 | 0.0 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.0 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.05 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.1 |

##### *9.24.2.1.3.1.1 DBS East in Isolation*

1476. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-139**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.24.2.1.3.1.2 DBS West in Isolation*

1477. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.06 birds per annum (**Table 9-139**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.24.2.1.3.1.3 DBS East and West Together*

1478. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-139**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.24.2.1.4 Summary*

1479. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-140**).

1480. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Foula SPA**.

*Table 9-140 Summary of predicted Kittiwake collision mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.0 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.1 |
| Effect | Reference population | 850 | | |
| | Increase in background mortality (%) | 0.01 | 0.05 | 0.10 |

##### *9.24.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1481. Given that no measurable increase in the Foula SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.06 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

#### 9.24.2.2 Guillemot

1482. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

##### *9.24.2.2.1 Status*

1483. Guillemot is listed as a designated species of the Foula SPA.

1484. The SPA breeding population at classification in 1995 was 37,500 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 5,289 individuals which has been used in this assessment.

##### *9.24.2.2.2 Connectivity to the Projects*

1485. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1486. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1487. During the non-breeding season, 70% of the Foula SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.4% of birds present at the Projects are considered to be breeding adults from the Foula SPA, and impacts are apportioned accordingly (**Table 9-141**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

1488. It is estimated that 1.4% of birds present at the Projects are considered to be breeding adults from Foula SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.24.2.2.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-141 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 1.4 | 100 | 175.7 | 0.5 | 0.9 | 12.3 | 0.3 | 0.4 | 6.2 | 24.62 | 9.3 | 0.13 | 0.39 | 0.57 | 6.28 |
| | Annual | | | | 175.7 | 0.5 | 0.9 | 12.3 | 0.3 | 0.4 | 6.2 | - | 16 | 0.13 | 0.39 | 0.57 | 6.28 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 1.4 | 100 | 175.0 | 0.5 | 0.9 | 12.2 | 0.3 | 0.4 | 6.1 | 24.08 | 9.1 | 0.13 | 0.39 | 0.56 | 6.25 |
| | Annual | | | | 175.0 | 0.5 | 0.9 | 12.2 | 0.3 | 0.4 | 6.1 | - | 15.5 | 0.13 | 0.39 | 0.56 | 6.25 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 1.4 | 100 | 281.9 | 0.8 | 1.4 | 19.7 | 0.4 | 0.7 | 9.9 | | 18.4 | 0.26 | 0.68 | 0.96 | 10.12 |
| | Annual | | | | 281.9 | 0.8 | 1.4 | 19.7 | 0.4 | 0.7 | 9.9 | | 31.4 | 0.26 | 0.68 | 0.96 | 10.12 |

##### 9.24.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

###### 9.24.2.2.3.1.1 DBS East in Isolation

1489. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 6.28 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1490. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1491. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.57) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.2.3.1.2 DBS West in Isolation*

1492. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 6.25 birds per annum (**Table 9-141)**. This would result in a predicted change in adult mortality rate of 1.93% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1493. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1494. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.56) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.2.3.1.3 DBS East and West Together*

1495. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 10.12 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 3.13% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together).

1496. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1497. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.96) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.24.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement*

##### *9.24.2.2.3.2.1 DBS East in Isolation*

1498. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 12.3 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 3.8% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together.

1499. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1500. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.9) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.2.3.2.2 DBS West in Isolation*

1501. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 12.2 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 3.8% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together.

1502. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1503. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.9) would increase the predicted annual mortality by 0.3% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.24.2.2.3.2.3 DBS East and West Together*

1504. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 19.7 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 16.1% but is based on highly precautionary impact rates.

1505. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1506. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (1.4) would increase the predicted annual mortality by 0.45% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

#### *9.24.2.2.4 Summary*

1507. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-142**).

1508. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

*Table 9-142 Summary of predicted guillemot displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 10.12 | 0.96 |
| Annual | | 10.12 | 0.96 |
| Effect | Reference population | 5,289 | |
| | Increase in background mortality (%) | 3.13 | 0.3 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 19.7 | 1.4 |
| Annual | | 19.7 | 1.4 |
| Effect | Reference population | 5,289 | |
| | Increase in background mortality (%) | 6.1 | 0.45 |

##### *9.24.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1509. Given that no measurable increase in the Foula SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.4 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

#### 9.24.2.3 Razorbill

1510. Razorbill has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1511. The razorbill assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

*9.24.2.3.1 Status*

1512. Razorbill is listed as a named component of the breeding seabird assemblage of the Foula SPA.

1513. The SPA breeding population at classification in 1995 was 6,200 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 474 individuals which has been used in this assessment.

*9.24.2.3.2 Connectivity to the Projects*

1514. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1515. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

1516. During the autumn and spring migration it is estimated that Foula birds make up 0.1% of the BDMPS population, and during the winter 0.1% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.24.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-143 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 555.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4685.3 | 0.1 | 100 | 4.7 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 9.2 | 3.5 | 0.00 | 0.01 | 0.02 | 0.17 |
| | Winter | 3376.7 | 0.1 | 100 | 3.4 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 6.6 | 2.5 | 0.00 | 0.01 | 0.01 | 0.12 |
| | Spring | 3578.5 | 0.1 | 100 | 3.6 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 7.0 | 2.6 | 0.00 | 0.01 | 0.01 | 0.13 |
| | Annual | | | | 11.7 | 0 | 0 | 0.8 | 0 | 0 | 0.4 | - | 9 | 0 | 0.03 | 0.04 | 0.42 |
| DBS West | Breeding | 2280.6 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 1.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 4886.9 | 0.1 | 100 | 4.9 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 9.4 | 3.5 | 0.00 | 0.01 | 0.02 | 0.17 |
| | Winter | 5066.2 | 0.1 | 100 | 5.1 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | 9.7 | 3.7 | 0.00 | 0.01 | 0.02 | 0.18 |
| | Spring | 4454.6 | 0.1 | 100 | 4.5 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 8.6 | 3.2 | 0.00 | 0.01 | 0.01 | 0.16 |
| | Annual | | | | 14.5 | 0.0 | 0.1 | 1.0 | 0.0 | 0.0 | 0.5 | - | 9.1 | 0 | 0.03 | 0.05 | 0.51 |
| DBS East + DBS West | Breeding | 2826.1 | 0 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 2.1 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Autumn | 6349.6 | 0.1 | 100 | 6.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | | 7.0 | 0.01 | 0.02 | 0.02 | 0.23 |
| | Winter | 5823.7 | 0.1 | 100 | 5.8 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | | 6.1 | 0.01 | 0.01 | 0.02 | 0.21 |
| | Spring | 6302.5 | 0.1 | 100 | 6.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.2 | | 5.9 | 0.01 | 0.02 | 0.02 | 0.23 |
| | Annual | | | | 18.4 | 0.1 | 0.1 | 1.3 | 0.0 | 0.0 | 0.6 | | 18.2 | 0.03 | 0.05 | 0.06 | 0.7 |

##### *9.24.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.24.2.3.3.1.1 DBS East in Isolation*

1517. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.4 (0.2, 0.1, 0.1 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 0.8%.

1518. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1519. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.04) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.24.2.3.3.1.2 DBS West in Isolation*

1520. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.5 (0.17, 0.18, 0.16 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 1.0%.

1521. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1522. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.05) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.3.3.1.3 DBS East and West Together*

1523. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.7 (0.23, 0.21, 0.23 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1524. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1525. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.06) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.24.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.24.2.3.3.2.1 DBS East in Isolation*

1526. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 0.8 (0.3, 0.2, 0.2 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 1.6% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 49%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1527. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1528. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.06) would increase the predicted annual mortality by 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.3.3.2.2 DBS West in Isolation*

1529. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.0 (0.3, 0.4, 0.3 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 2.0% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 35%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1530. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1531. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.1) would increase the predicted annual mortality by 0.2% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.3.3.2.3 DBS East and West Together*

1532. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.3 (0.4, 0.4, 0.4 in autumn winter and spring respectively) birds per annum (**Table 9-143**). This would result in a predicted change in adult mortality rate of 2.6% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 3.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality combined with reductions in the displacement rate).

1533. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1534. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.1) would increase the predicted annual mortality by 0.2% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.24.2.3.4 Summary*

1535. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-144)**.

1536. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

*Table 9-144 Summary of predicted razorbill displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.23 | 0.02 |
| Winter | | 0.21 | 0.02 |
| Spring | | 0.23 | 0.02 |
| Annual | | 0.7 | 0.06 |
| Effect | Reference population | 474 | |
| | Increase in background mortality (%) | 1.4 | 0.1 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Autumn | | 0.4 | 0.03 |
| Winter | | 0.4 | 0.02 |
| Spring | | 0.4 | 0.03 |
| Annual | | 1.3 | 0.1 |
| Effect | Reference population | 474 | |
| | Increase in background mortality (%) | 2.6 | 0.2 |

#### *9.24.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1537. Given that no measurable increase in the Foula SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

### 9.24.2.4 Puffin

1538. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1539. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

#### *9.24.2.4.1 Status*

1540. Puffin is listed as a named component of the breeding seabird assemblage of the Noss SPA.

1541. The SPA breeding population at classification in 1995 was 48,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 4,234 AOB which has been used in this assessment.

##### *9.24.2.4.2 Connectivity to the Projects*

1542. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1543. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

1544. It is estimated that 2.9% of birds present at the Projects are breeding adults from Foula SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

##### *9.24.2.4.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-145 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km²) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 2.9 | 1 | 5.2 | 0.02 | 0.03 | 0.36 | 0.01 | 0.01 | 0.18 | 0.35 | 0.13 | 0.00 | 0.01 | 0.02 | 0.19 |
| | Annual | | | | 5.2 | 0.02 | 0.03 | 0.36 | 0.01 | 0.01 | 0.18 | - | 0.18 | 0.00 | 0.01 | 0.02 | 0.19 |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 2.9 | 1 | 5.7 | 0.02 | 0.03 | 0.40 | 0.01 | 0.01 | 0.20 | 0.38 | 0.14 | 0.00 | 0.01 | 0.02 | 0.21 |
| | Annual | | | | 5.7 | 0.02 | 0.03 | 0.40 | 0.01 | 0.01 | 0.20 | - | 0.22 | 0.00 | 0.01 | 0.02 | 0.21 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 2.9 | 1 | 10.8 | 0.03 | 0.05 | 0.76 | 0.02 | 0.03 | 0.38 | | 0.28 | 0.01 | 0.02 | 0.03 | 0.39 |
| | Annual | | | | 10.8 | 0.03 | 0.05 | 0.76 | 0.02 | 0.03 | 0.38 | | 0.4 | 0.01 | 0.02 | 0.03 | 0.39 |

##### *9.24.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.24.2.4.3.1.1 DBS East in Isolation*

1545. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.19 birds per annum (**Table 9-145)**. This would result in a predicted change in adult mortality rate of 0.02%.

1546. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1547. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.24.2.4.3.1.2 DBS West in Isolation*

1548. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.21 birds per annum (**Table 9-145**). This would result in a predicted change in adult mortality rate of 0.02%.

1549. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1550. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.4.3.1.3 DBS East and West Together*

1551. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.39 birds per annum (**Table 9-145**). This would result in a predicted change in adult mortality rate of 0.05%.

1552. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1553. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.24.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.24.2.4.3.2.1 DBS East in Isolation*

1554. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.36 birds per annum (**Table 9-145**). This would result in a predicted change in adult mortality rate of 0.04%.

1555. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1556. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.24.2.4.3.2.2 DBS West in Isolation*

1557. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.4 birds per annum (**Table 9-145**). This would result in a predicted change in adult mortality rate of 0.05%.

1558. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1559. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.24.2.4.3.2.3 DBS East and West Together*

1560. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.76 birds per annum (**Table 9-145**). This would result in a predicted change in adult mortality rate of 0.09%.

1561. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1562. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.05) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

### *9.24.2.4.4 Summary*

1563. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-146)**.

1564. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

*Table 9-146 Summary of predicted puffin displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.39 | 0.03 |
| Annual | | 0.39 | 0.03 |
| Effect | Reference population | 8,468 | |
| | Increase in background mortality (%) | 0.05 | <0.01 |
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.76 | 0.05 |
| Annual | | 0.76 | 0.05 |
| Effect | Reference population | 8,468 | |
| | Increase in background mortality (%) | 0.095 | <0.01 |

#### *9.24.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1565. Given that no measurable increase in the Foula SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.05 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

## 9.25 Hermaness, Saxa Vord and Valla Field SPA

### 9.25.1 Site Description

1566. Hermaness, Saxa Vord and Valla Field SPA lies in the north-west corner of the island of Unst, Shetland. It consists of 100m to 200m high sea cliffs and adjoining areas of grassland, heath and blanket bog. The seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

#### 9.25.1.1 Qualifying Features

1567. The qualifying features of the Hermaness, Saxa Vord and Valla Field SPA screened into the assessment are listed in **Table 4-7.** These are breeding gannet and puffin and two named components of the breeding seabird assemblage (kittiwake and guillemot).

#### 9.25.1.2 Conservation Objectives

1568. The over-arching conservation objectives of the site are as follows:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

### 9.25.2 Assessment: Array Areas

#### 9.25.2.1 Gannet

1569. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

##### *9.25.2.1.1 Status*

1570. Gannet is listed as a designated species of the Hermaness, Saxa Vord and Valla Field SPA.

1571. The SPA breeding population at classification was cited as 16,400 pairs or 32,800 breeding adults in 1999 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 29,562 AON which has been used in this assessment.

##### *9.25.2.1.2 Connectivity to the Projects*

1572. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Hermaness, Saxa Vord and Valla Field SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1573. Outside the breeding season breeding gannets, including those from the Hermaness, Saxa Vord and Valla Field SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

1574. During the autumn migration and spring migration seasons it is estimated that 8.5% and 13.7% of birds respectively present in the Project array areas are considered to be breeding adults from the Hermaness, Saxa Vord and Valla Field SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

*9.25.2.1.3 Assessment of Potential Effects of the Projects alone and Together*

*9.25.2.1.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

1575. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Hermaness, Saxa Vord and Valla Field SPA is provided in **Table 9-147**.

1576. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-147**).

*Table 9-147 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.*

| Site | Season | Peak no. (mean) | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | Wind farm construction displacement mortality to SPA | | Peak density (birds/ $km^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 60-1 | 80-1 | 30-1 | 40-1 | | | | 30-1 & vessel | 40-1 & vessel |
| DBS East | Breeding | 754.9 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.48 | 0.56 | 0.00 | 0.00 | 0.00 |
| | Autumn | 776.1 | 8.5 | 100 | 66.0 | 0.40 | 0.53 | 0.20 | 0.26 | 1.52 | 0.57 | 0.05 | 0.25 | 0.31 |
| | Spring | 75.1 | 13.7 | 100 | 10.3 | 0.06 | 0.08 | 0.03 | 0.04 | 0.15 | 0.06 | 0.01 | 0.04 | 0.05 |
| | Annual | | | | 76.3 | 0.46 | 0.61 | 0.23 | 0.3 | - | 1.19 | 0.06 | 0.29 | 0.36 |
| DBS West | Breeding | 805.3 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 1.55 | 0.58 | 0.00 | 0.00 | 0.00 |
| | Autumn | 797.5 | 8.5 | 100 | 67.8 | 0.41 | 0.54 | 0.20 | 0.27 | 1.54 | 0.58 | 0.05 | 0.25 | 0.32 |
| | Spring | 86.2 | 13.7 | 100 | 11.8 | 0.07 | 0.09 | 0.04 | 0.05 | 0.17 | 0.06 | 0.01 | 0.04 | 0.06 |
| | Annual | | | | 79.6 | 0.48 | 0.63 | 0.24 | 0.32 | - | 1.22 | 0.06 | 0.29 | 0.38 |
| DBS East + DBS West | Breeding | 1560.2 | 0 | 60 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | - | 1.14 | 0.00 | 0.00 | 0.00 |
| | Autumn | 1573.6 | 8.5 | 100 | 133.8 | 0.80 | 1.07 | 0.40 | 0.54 | | 1.15 | 0.10 | 0.50 | 0.63 |
| | Spring | 161.3 | 13.7 | 100 | 22.1 | 0.13 | 0.18 | 0.07 | 0.09 | | 0.12 | 0.02 | 0.08 | 0.10 |
| | Annual | | | | 155.9 | 0.93 | 1.25 | 0.47 | 0.63 | | 2.41 | 0.12 | 0.58 | 0.73 |

*9.25.2.1.3.1.1 DBS East in Isolation*

1577. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.36 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.25.2.1.3.1.2 DBS West in Isolation*

1578. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.38 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.25.2.1.3.1.3 DBS East and West Together*

1579. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.74 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

*9.25.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement*

*9.25.2.1.3.2.1 DBS East in Isolation*

1580. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.61 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### 9.25.2.1.3.2.2 DBS West in Isolation

1581. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.64 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

#### 9.25.2.1.3.2.3 DBS East and West Together

1582. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 1.25 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

### 9.25.2.1.3.3 Potential Effects During Operation: Collision Risk

*Table 9-148 Summary of gannet total collisions and apportioned to Hermaness, Saxa Vord and Valla Field SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 0.7 | 3.4 | 7.8 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 1.6 | 3.8 | 8.5 | 100 | 0.0 | 0.1 | 0.3 |
| | Spring | 0.0 | 0.1 | 0.6 | 13.7 | 100 | 0.0 | 0.0 | 0.1 |
| | Annual | 1.1 | 5.1 | 12.2 | - | - | 0.0 | 0.1 | 0.4 |
| DBS West | Breeding | 0.6 | 4.9 | 15.3 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.3 | 2.1 | 6.0 | 8.5 | 100 | 0.0 | 0.2 | 0.5 |
| | Spring | 0.0 | 0.1 | 0.7 | 13.7 | 100 | 0.0 | 0.0 | 0.1 |
| | Annual | 1.5 | 7.1 | 17.7 | - | - | 0.0 | 0.2 | 0.6 |
| DBS East + DBS West | Breeding | 0.9 | 8.4 | 26.5 | 0 | 60 | 0.0 | 0.0 | 0.0 |
| | Autumn | 0.5 | 3.7 | 10.8 | 8.5 | 100 | 0.0 | 0.3 | 0.9 |
| | Spring | 0.0 | 0.3 | 1.3 | 13.7 | 100 | 0.0 | 0.0 | 0.2 |
| | Annual | 2.7 | 12.4 | 29.8 | - | - | 0.0 | 0.4 | 1.1 |

*9.25.2.1.3.3.1 DBS East in Isolation*

1583. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.1 (0.0 to 0.4) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.1.3.3.2 DBS West in Isolation*

1584. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.2 (0.0 to 0.6) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.1.3.3.3 DBS East and West Together*

1585. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.4 (0.0 to 1.1) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

*9.25.2.1.3.4.1 DBS East in Isolation*

1586. Since the estimated impacts from DBS East on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

###### 9.25.2.1.3.4.2 DBS West in Isolation

1587. Since the estimated impacts from DBS West on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

###### 9.25.2.1.3.4.3 DBS East and West Together

1588. Since the estimated impacts from DBS East and DBS West on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

##### 9.25.2.1.4 Summary

1589. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-149)**.

1590. It is concluded that predicted gannet mortality due to construction and operational phase displacement , as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

*Table 9-149 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Gannet** | | | | |
|---|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 0.63 | - | - |
| Spring | | 0.1 | - | - |
| Annual | | 0.73 | | |
| Effect | Reference population | 59,124 | - | - |
| | Increase in background mortality (%) | 0.01 | - | - |
| **Potential Effects During Operation: Disturbance and Displacement** | | | | |
| Displacement mortality (80% + 1%) | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 1.07 | - | - |

| Gannet | | | | |
|---|---|---|---|---|
| Spring | | 0.18 | - | - |
| Annual | | 1.25 | | |
| Effect | Reference population | 59,124 | - | - |
| | Increase in background mortality (%) | 0.02 | - | - |
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | 0 | 0 | 0 |
| Autumn | | 0.0 | 0.3 | 0.9 |
| Spring | | 0.0 | 0.0 | 0.2 |
| Annual | | 0.0 | 0.4 | 1.1 |
| Effect | Reference population | 59,124 | | |
| | Increase in background mortality (%) | <0.01 | 0.01 | 0.02 |
| **Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk** | | | | |
| Combined Displacement and Collision mortality | | Mean | Lower c.i. | Upper c.i. |
| Breeding season | | 0 | - | - |
| Autumn | | 1.39 | - | - |
| Spring | | 0.22 | - | - |
| Annual | | 1.61 | | |
| Effect | Reference population | 59,124 | - | - |
| | Increase in background mortality (%) | 0.03 | - | - |

##### *9.25.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1591. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 1.61 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

#### 9.25.2.2 Kittiwake

1592. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

*9.25.2.2.1 Status*

1593. Kittiwake is listed as a named component of the breeding seabird assemblage of the Hermaness, Saxa Vord and Valla Field SPA.

1594. The SPA breeding population at classification was cited as 922 pairs or 1,844 breeding adults in 2009 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 177 AON which has been used in this assessment.

*9.25.2.2.2 Connectivity to the Projects*

1595. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Hermaness, Saxa Vord and Valla Field SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1596. Outside the breeding season breeding kittiwakes, including those from the Hermaness, Saxa Vord and Valla Field SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

1597. It is estimated that 0.1% of birds present in the Project array areas in the autumn and spring migration seasons are considered to be breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

### 9.25.2.2.3 Assessment of Potential Effects of the Projects alone and Together

#### 9.25.2.2.3.1 Potential Effects During Operation: Collision risk

*Table 9-150 Summary of kittiwake total collisions and apportioned to the Hermaness, Saxa Vord and Valla Field SPA.*

| Site | Season | Collision mortality | | | SPA % | Adult % | Collisions apportioned to SPA | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lower 95% c.i. | Mean | Upper 95% c.i. | | | Lower 95% c.i. | Mean | Upper 95% c.i. |
| DBS East | Breeding | 42.3 | 83.3 | 168.5 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 14.6 | 41.4 | 82.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 6.8 | 14.6 | 28.0 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 66.9 | 139.3 | 261.3 | - | - | 0.0 | 0.1 | 0.1 |
| DBS West | Breeding | 36.9 | 107.8 | 280.8 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 9.5 | 37.9 | 81.9 | 0.1 | 100 | 0.0 | 0.0 | 0.1 |
| | Spring | 7.1 | 14.9 | 26.5 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 55.9 | 160.6 | 327.0 | - | - | 0.0 | 0.1 | 0.1 |
| DBS East + DBS West | Breeding | 96.2 | 191.1 | 378.4 | 0 | 53 | 0.0 | 0.0 | 0.0 |
| | Autumn | 30.5 | 79.3 | 143.1 | 0.1 | 100 | 0.0 | 0.1 | 0.1 |
| | Spring | 16.9 | 29.5 | 47.3 | 0.1 | 100 | 0.0 | 0.0 | 0.0 |
| | Annual | 150.9 | 299.9 | 540.5 | - | - | 0.0 | 0.1 | 0.2 |

##### 9.25.2.2.3.1.1 DBS East in Isolation

1598. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.2.3.1.2 DBS West in Isolation*

1599. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.2.3.1.3 DBS East and West Together*

1600. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.07 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

#### *9.25.2.2.4 Summary*

1601. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-151**).

1602. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA.**

*Table 9-151 Summary of predicted Kittiwake collision mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.*

| **Kittiwake** | | **Collisions** | | |
|---|---|---|---|---|
| **Potential Effects During Operation: Collision Risk** | | | | |
| Collision mortality | | Lower c.i. | Mean | Upper c.i. |
| Breeding season | | - | - | - |
| Autumn | | 0.0 | 0.1 | 0.1 |
| Spring | | 0.0 | 0.0 | 0.0 |
| Annual | | 0.0 | 0.1 | 0.2 |
| Effect | Reference population | 354 | | |
| | Increase in background mortality (%) | <0.01 | 0.13 | 0.29 |

##### *9.25.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1603. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.07 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

#### 9.25.2.3 Guillemot

1604. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1605. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

##### *9.25.2.3.1 Status*

1606. Guillemot is listed as a named component of the breeding seabird assemblage of the Hermaness, Saxa Vord and Valla Field SPA.

1607. The SPA breeding population at classification was 25,000 individuals over two surveys carried out in 1996 and 1999 (SNH, 2009). Burnell *et al.* (2023) give an updated count of 6,109 individuals which has been used in this assessment.

##### *9.25.2.3.2 Connectivity to the Projects*

1608. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Hermaness, Saxa Vord and Valla Field SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1609. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

1610. During the non-breeding season, 70% of the Hermaness, Saxa Vord and Valla Field SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from the Hermaness, Saxa Vord and Valla Field SPA, and impacts are apportioned accordingly **(Table 9-152**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

1611. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

###### *9.25.2.3.3 Assessment of Potential Effects of the Projects alone and Together*

*Table 9-152 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 9030.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.71 | 6.7 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12551.8 | 0.4 | 100 | 50.2 | 0.2 | 0.3 | 3.5 | 0.1 | 0.1 | 1.8 | 24.62 | 9.3 | 0.04 | 0.11 | 0.16 | 1.79 |
| | Annual | | | | 50.2 | 0.2 | 0.3 | 3.5 | 0.1 | 0.1 | 1.8 | - | 16 | 0.04 | 0.11 | 0.16 | 1.79 |
| DBS West | Breeding | 8783.5 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.92 | 6.4 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 12498.4 | 0.4 | 100 | 50.0 | 0.1 | 0.2 | 3.5 | 0.1 | 0.1 | 1.7 | 24.08 | 9.1 | 0.04 | 0.11 | 0.16 | 1.79 |
| | Annual | | | | 50.0 | 0.1 | 0.2 | 3.5 | 0.1 | 0.1 | 1.7 | - | 15.5 | 0.04 | 0.11 | 0.16 | 1.79 |
| DBS East + DBS West | Breeding | 14927.7 | 0 | 55.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 13.0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 20136.0 | 0.4 | 100 | 80.5 | 0.2 | 0.4 | 5.6 | 0.1 | 0.2 | 2.8 | | 18.4 | 0.07 | 0.19 | 0.27 | 2.89 |
| | Annual | | | | 80.5 | 0.2 | 0.4 | 5.6 | 0.1 | 0.2 | 2.8 | | 31.4 | 0.07 | 0.19 | 0.27 | 2.89 |

#### *9.25.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

##### *9.25.2.3.3.1.1 DBS East in Isolation*

1612. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.48%.

1613. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1614. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.16) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.3.3.1.2 DBS West in Isolation*

1615. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-152)**. This would result in a predicted change in adult mortality rate of 0.47%.

1616. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1617. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.16) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.3.3.1.3 DBS East and West Together*

1618. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.89 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.77%.

1619. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1620. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.07) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.25.2.3.3.2.1 DBS East in Isolation*

1621. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.94%.

1622. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1623. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.3) would increase the predicted annual mortality by 0.06 which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.3.3.2.2 DBS West in Isolation*

1624. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.93%.

1625. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1626. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.3.3.2.3 DBS East and West Together*

1627. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 5.6 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 1.51% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1628. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1629. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.4) would increase the predicted annual mortality by 0.11% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

### *9.25.2.3.4 Summary*

1630. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-153**).

1631. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

*Table 9-153 Summary of predicted guillemot displacement mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 2.98 | 0.27 |
| Annual | | 2.98 | 0.27 |
| Effect | Reference population | 6,109 | |
| | Increase in background mortality (%) | 0.77 | 0.07 |

| Guillemot | | Displacement | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 5.6 | 0.4 |
| Annual | | 5.6 | 0.4 |
| Effect | Reference population | 6,109 | |
| | Increase in background mortality (%) | 1.51 | 0.11 |

#### *9.25.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1632. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.4 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

### 9.25.2.4 Puffin

1633. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

1634. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

#### *9.25.2.4.1 Status*

1635. Puffin is listed as a designated species of the Hermaness, Saxa Vord and Valla Field SPA.

1636. The SPA breeding population at classification was 55,000 individuals in 1999 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 14,375 AOB which has been used in this assessment.

#### 9.25.2.4.2 Connectivity to the Projects

1637. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Hermaness, Saxa Vord and Valla Field SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

1638. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

1639. It is estimated that 3.1% of birds present at the Projects are breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

#### 9.25.2.4.3 Assessment of Potential Effects of the Projects alone and Together

*Table 9-154 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.*

| Site | Season | Peak no. | SPA % | Adult % | No. apportioned to SPA | Wind farm operation displacement mortality to SPA | | | Wind farm construction displacement mortality to SPA | | | Peak density (birds/ km$^2$) | Total vessel displacement mortality (2km around 3 vessels, 1% mortality) | Vessel mortality to SPA | Total construction displacement mortality to SPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 30-1 | 50-1 | 70-10 | 15-1 | 25 - 1 | 35-10 | | | | 15-1 & vessel | 25 – 1 & vessel | 35-10 & vessel |
| DBS East | Breeding | 62.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 178.70 | 3.1 | 1 | 5.5 | 0.02 | 0.03 | 0.39 | 0.01 | 0.01 | 0.19 | 0.35 | 0.13 | 0.00 | 0.01 | 0.02 | 0.20 |
| | Annual | | | | 5.5 | 0.02 | 0.03 | 0.39 | 0.01 | 0.01 | 0.19 | - | 0.18 | | | | |
| DBS West | Breeding | 109.3 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 198.2 | 3.1 | 1 | 6.1 | 0.02 | 0.03 | 0.43 | 0.01 | 0.02 | 0.22 | 0.38 | 0.14 | 0.00 | 0.01 | 0.02 | 0.22 |
| | Annual | | | | 6.1 | 0.02 | 0.03 | 0.43 | 0.01 | 0.02 | 0.22 | - | 0.22 | 0.00 | 0.01 | 0.02 | 0.22 |
| DBS East + DBS West | Breeding | 146.60 | 0 | 0.543 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Nonbreeding | 372.70 | 3.1 | 1 | 11.6 | 0.03 | 0.06 | 0.81 | 0.02 | 0.03 | 0.40 | | 0.28 | 0.01 | 0.03 | 0.04 | 0.41 |
| | Annual | | | | 11.6 | 0.03 | 0.06 | 0.81 | 0.02 | 0.03 | 0.40 | | 0.4 | 0.01 | 0.03 | 0.04 | 0.41 |

##### *9.25.2.4.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

###### *9.25.2.4.3.1.1 DBS East in Isolation*

1640. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.20 birds per annum (**Table 9-154)**. This would result in a predicted change in adult mortality rate of <0.01%.

1641. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1642. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.25.2.4.3.1.2 DBS West in Isolation*

1643. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.22 birds per annum (**Table 9-154**). This would result in a predicted change in adult mortality rate of <0.01%.

1644. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1645. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

*9.25.2.4.3.1.3 DBS East and West Together*

1646. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.41 birds per annum (**Table 9-154**). This would result in a predicted change in adult mortality rate of 0.01%.

1647. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1648. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.04) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

###### *9.25.2.4.3.2.1 DBS East in Isolation*

1649. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.39 birds per annum (**Table 9-154**). This would result in a predicted change in adult mortality rate of 0.01%.

1650. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1651. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.25.2.4.3.2.2 DBS West in Isolation*

1652. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.43 birds per annum (**Table 9-154**). This would result in a predicted change in adult mortality rate of 0.01%.

1653. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1654. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

###### *9.25.2.4.3.2.3 DBS East and West Together*

1655. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.81 birds per annum (**Table 9-154**). This would result in a predicted change in adult mortality rate of 0.03%.

1656. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1657. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.06) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

##### *9.25.2.4.4 Summary*

1658. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-155)**.

1659. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

*Table 9-155 Summary of predicted puffin displacement mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.*

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Construction: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@35% x 10%) | Mean (@25% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.41 | 0.04 |
| Annual | | 0.41 | 0.04 |
| Effect | Reference population | 28,750 | |
| | Increase in background mortality (%) | 0.01 | <0.01 |

| **Guillemot** | | **Displacement** | |
|---|---|---|---|
| **Potential Effects During Operation: Disturbance and Displacement** | | | |
| Displacement mortality | | Mean (@70% x 10%) | Mean (@50% x 1%) |
| Breeding season | | 0 | 0 |
| Nonbreeding season | | 0.81 | 0.06 |
| Annual | | 0.81 | 0.06 |
| Effect | Reference population | 28,750 | |
| | Increase in background mortality (%) | 0.03 | <0.01 |

#### *9.25.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects*

1660. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.06 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

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# Annex A: SPA PVA Results

*Table A-1 Inputs: GX FFC Annual*

| **Baseline parameters** | **Settings** | **Impact parameters** | **Values** |
|---|---|---|---|
| Reference name | GX FFC Annual | Number of scenarios of impact | 5 |
| Type | Simulation | Are impacts applied separately to each subpopulation | FALSE |
| Case studies | None | Are impacts specified separately for immatures | FALSE |
| Model to use for environmental stochasticity | Beta/Gamma | Are standard errors of impacts available | FALSE |
| Choose model for density dependence | No density dependence | Should random seeds be matched for impact scenarios | TRUE |
| Include demographic stochasticity in model | TRUE | Impacts are specified as | Relative |
| Number of simulations | 5000 | Years in which impacts are assumed to begin | 2027 |
| Random seed | 1971 | Years in which impacts are assumed to end | 2057 |
| Years for burn in | 5 | Scenario A name | Incomb disp lwr |
| Species | Northern gannet | Scenario A Impact on productivity rate per pair mean | 0 |
| Age at first breeding | 5 | Scenario A Impact on adult survival rate | 0.0023238 |
| Is there an upper constraint on productivity in the model | Yes | Scenario A Impact on immature survival rate mean | - |
| Maximum brood size per pair chicks will be constrained to be no greater than | 1 | Scenario B name | Incomb disp upr |
| Number of subpopulations | 1 | Scenario B Impact on productivity rate per pair mean | 0 |
| Units for initial population size | Breeding adults | Scenario B Impact on adult survival rate | 0.0033143 |
| Are baseline demographic rates specified separately for immatures | Yes | Scenario B Impact on immature survival rate mean | - |
| Initial population size | 26250 | Scenario C name | Incomb crm |
| Year | 2024 | Scenario C Impact on productivity rate per pair mean | 0 |

| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Productivity rate per pair mean | 0.823 | Scenario C Impact on adult survival rate per pair mean | 0.0029105 |
| Productivity rate per pair standard deviation | 0.038 | Scenario C Impact on immature survival rate mean | - |
| Adult survival rate Mean | 0.919 | Scenario D name | In-combination disp.crm lwr |
| Adult survival rate standard deviation | 0.042 | Scenario D Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 0 to 1 mean | 0.424 | Scenario D Impact on adult survival rate | 0.005219 |
| Immatures survival rates 0 to 1 standard deviation | 0.045 | Scenario D Impact on immature survival rate mean | - |
| Immatures survival rates 1 to 2 mean | 0.829 | Scenario E name | Incomb disp.crm upr |
| Immatures survival rates 1 to 2 standard deviation | 0.026 | Scenario E Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 2 to 3 mean | 0.891 | Scenario E Impact on adult survival rate | 0.0062095 |
| Immatures survival rates 2 to 3 standard deviation | 0.019 | Scenario E Impact on immature survival rate mean | - |
| Immatures survival rates 3 to 4 mean | 0.895 | Scenario F name | |
| Immatures survival rates 3 to 4 standard deviation | 0.019 | Scenario F Impact on productivity rate per pair mean | |
| Immatures survival rates 4 to 5 mean | 0.919 | Scenario F Impact on adult survival rate | |
| Immatures survival rates 4 to 5 standard deviation | 0.042 | Scenario F Impact on immature survival rate mean | |
| Immatures survival rates 5 to 6 mean | | Scenario G name | |
| Immatures survival rates 5 to 6 standard deviation | | Scenario G Impact on productivity rate per pair mean | |
| Units for output | breeding.adults | Scenario G Impact on adult survival rate | |
| | | Scenario G Impact on immature survival rate mean | |

*Table A-2 Outputs: GX FFC Annual*

| Scenario | Impact | Increase in mortality rate | Years since impact | C-PGR | | | | | C-PS | | | | | 50% Quantiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Med. | Mean | SD | LCI | UCI | Med. | Mean | SD | LCI | UCI | Q-UNIMP-50% | Q-IMP-50% |
| Incomb disp lwr | 61 | 0.0023238 | 10 | 0.9982 | 0.9982 | 0.0007 | 0.9968 | 0.9997 | 0.9809 | 0.9809 | 0.0081 | 0.9653 | 0.9972 | 43.44 | 56.44 |
| Incomb disp upr | 87 | 0.0033143 | 10 | 0.9975 | 0.9975 | 0.0007 | 0.9961 | 0.9989 | 0.9730 | 0.9730 | 0.0082 | 0.9570 | 0.9890 | 40.72 | 59.22 |
| Incomb crm | 76 | 0.0029105 | 10 | 0.9978 | 0.9978 | 0.0007 | 0.9964 | 0.9992 | 0.9762 | 0.9764 | 0.0081 | 0.9608 | 0.9923 | 41.90 | 58.18 |
| In-combination disp.crm lwr | 137 | 0.0052190 | 10 | 0.9961 | 0.9961 | 0.0007 | 0.9947 | 0.9975 | 0.9577 | 0.9578 | 0.0080 | 0.9422 | 0.9736 | 35.98 | 64.76 |
| Incomb disp.crm upr | 163 | 0.0062095 | 10 | 0.9953 | 0.9953 | 0.0007 | 0.9939 | 0.9967 | 0.9499 | 0.9499 | 0.0080 | 0.9341 | 0.9653 | 33.26 | 67.24 |
| Incomb disp lwr | 61 | 0.0023238 | 20 | 0.9983 | 0.9983 | 0.0005 | 0.9973 | 0.9993 | 0.9650 | 0.9650 | 0.0102 | 0.9456 | 0.9857 | 40.58 | 59.26 |
| Incomb disp upr | 87 | 0.0033143 | 20 | 0.9976 | 0.9976 | 0.0005 | 0.9966 | 0.9985 | 0.9505 | 0.9505 | 0.0102 | 0.9303 | 0.9705 | 37.32 | 62.86 |
| Incomb crm | 76 | 0.0029105 | 20 | 0.9979 | 0.9979 | 0.0005 | 0.9969 | 0.9988 | 0.9564 | 0.9564 | 0.0101 | 0.9371 | 0.9759 | 38.62 | 61.20 |
| In-combination disp.crm lwr | 137 | 0.0052190 | 20 | 0.9962 | 0.9962 | 0.0005 | 0.9952 | 0.9972 | 0.9231 | 0.9231 | 0.0099 | 0.9041 | 0.9428 | 30.54 | 69.96 |
| Incomb disp.crm upr | 163 | 0.0062095 | 20 | 0.9955 | 0.9955 | 0.0005 | 0.9945 | 0.9965 | 0.9092 | 0.9092 | 0.0098 | 0.8903 | 0.9286 | 27.38 | 73.44 |
| Incomb disp lwr | 61 | 0.0023238 | 30 | 0.9983 | 0.9983 | 0.0004 | 0.9976 | 0.9991 | 0.9491 | 0.9492 | 0.0116 | 0.9265 | 0.9723 | 38.66 | 61.28 |
| Incomb disp upr | 87 | 0.0033143 | 30 | 0.9976 | 0.9976 | 0.0004 | 0.9968 | 0.9984 | 0.9286 | 0.9285 | 0.0114 | 0.9063 | 0.9509 | 34.18 | 66.08 |
| Incomb crm | 76 | 0.0029105 | 30 | 0.9979 | 0.9979 | 0.0004 | 0.9971 | 0.9987 | 0.9368 | 0.9369 | 0.0114 | 0.9153 | 0.9597 | 36.44 | 64.16 |
| In-combination disp.crm lwr | 137 | 0.0052190 | 30 | 0.9962 | 0.9962 | 0.0004 | 0.9955 | 0.9970 | 0.8896 | 0.8897 | 0.0110 | 0.8685 | 0.9113 | 25.74 | 74.22 |
| Incomb disp.crm upr | 163 | 0.0062095 | 30 | 0.9955 | 0.9955 | 0.0004 | 0.9947 | 0.9963 | 0.8700 | 0.8702 | 0.0108 | 0.8492 | 0.8916 | 22.04 | 78.00 |

*Figure A-1GX FFC Annual*

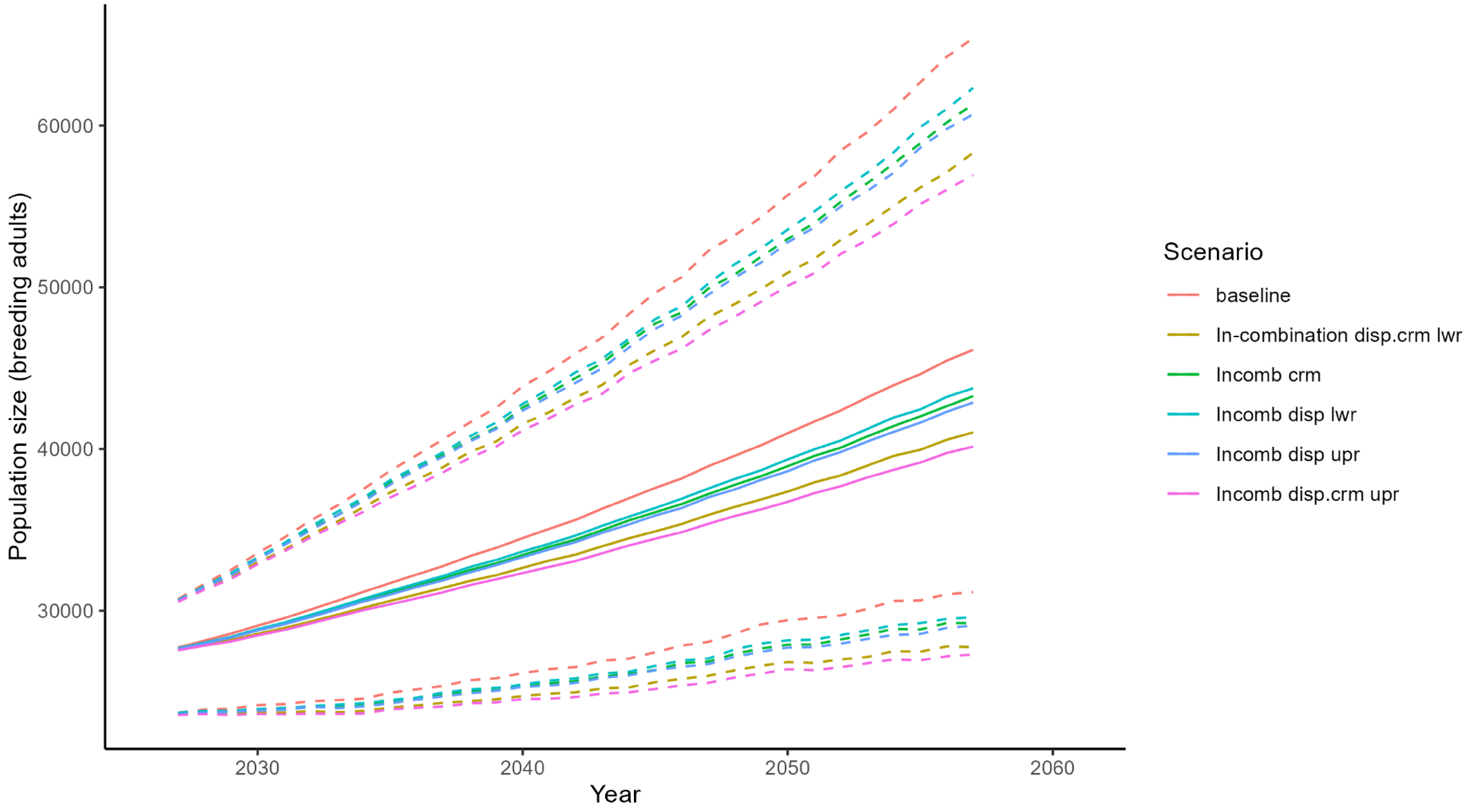


*Table A-3 Inputs: KI FFC Annual*

| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Reference name | KI FFC Annual | Number of scenarios of impact | 2 |
| Type | Simulation | Are impacts applied separately to each subpopulation | FALSE |
| Case studies | None | Are impacts specified separately for immatures | FALSE |
| Model to use for environmental stochasticity | Beta/Gamma | Are standard errors of impacts available | FALSE |
| Choose model for density dependence | No density dependence | Should random seeds be matched for impact scenarios | TRUE |
| Include demographic stochasticity in model | TRUE | Impacts are specified as | Relative |
| Number of simulations | 5000 | Years in which impacts are assumed to begin | 2027 |
| Random seed | 1971 | Years in which impacts are assumed to end | 2057 |
| Years for burn in | 5 | Scenario A name | Incomb crm lwr |
| Species | Black-legged kittiwake | Scenario A Impact on productivity rate per pair mean | 0 |
| Age at first breeding | 4 | Scenario A Impact on adult survival rate | 0.0038458 |
| Is there an upper constraint on productivity in the model | Yes | Scenario A Impact on immature survival rate mean | 0 |
| Maximum brood size per pair chicks will be constrained to be no greater than | 2 | Scenario B name | Incomb crm upr |
| Number of subpopulations | 1 | Scenario B Impact on productivity rate per pair mean | 0 |
| Units for initial population size | Breeding adults | Scenario B Impact on adult survival rate | 0.0049007 |
| Are baseline demographic rates specified separately for immatures | Yes | Scenario B Impact on immature survival rate mean | - |
| Initial population size | 91008 | Scenario C name | |
| Year | 2024 | Scenario C Impact on productivity rate per pair mean | |
| Productivity rate per pair mean | 0.737 | Scenario C Impact on adult survival rate per pair mean | |

| **Baseline parameters** | **Settings** | **Impact parameters** | **Values** |
|---|---|---|---|
| Productivity rate per pair standard deviation | 0.2015 | Scenario C Impact on immature survival rate mean | |
| Adult survival rate Mean | 0.854 | Scenario D name | |
| Adult survival rate standard deviation | 0.077 | Scenario D Impact on productivity rate per pair mean | |
| Immatures survival rates 0 to 1 mean | 0.79 | Scenario D Impact on adult survival rate | |
| Immatures survival rates 0 to 1 standard deviation | 0.077 | Scenario D Impact on immature survival rate mean | |
| Immatures survival rates 1 to 2 mean | 0.854 | Scenario E name | |
| Immatures survival rates 1 to 2 standard deviation | 0.077 | Scenario E Impact on productivity rate per pair mean | |
| Immatures survival rates 2 to 3 mean | 0.854 | Scenario E Impact on adult survival rate | |
| Immatures survival rates 2 to 3 standard deviation | 0.077 | Scenario E Impact on immature survival rate mean | |
| Immatures survival rates 3 to 4 mean | 0.854 | Scenario F name | |
| Immatures survival rates 3 to 4 standard deviation | 0.077 | Scenario F Impact on productivity rate per pair mean | |
| Immatures survival rates 4 to 5 mean | | Scenario F Impact on adult survival rate | |
| Immatures survival rates 4 to 5 standard deviation | | Scenario F Impact on immature survival rate mean | |
| Immatures survival rates 5 to 6 mean | | Scenario G name | |
| Immatures survival rates 5 to 6 standard deviation | | Scenario G Impact on productivity rate per pair mean | |
| Units for output | breeding.adults | Scenario G Impact on adult survival rate | |
| | | Scenario G Impact on immature survival rate mean | |

*Table A-4 Outputs: KI FFC Annual*

| Scenario | Impact | Increase in mortality rate | Years since impact | C-PGR | | | | | C-PS | | | | | 50% Quantiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Med. | Mean | SD | LCI | UCI | Med. | Mean | SD | LCI | UCI | Q-UNIMP-50% | Q-IMP-50% |
| Incomb crm lwr | 350 | 0.0038458 | 10 | 0.9973 | 0.9973 | 0.0005 | 0.9964 | 0.9983 | 0.9710 | 0.9710 | 0.0054 | 0.9602 | 0.9816 | 45.02 | 54.82 |
| Incomb crm upr | 446 | 0.0049007 | 10 | 0.9966 | 0.9966 | 0.0005 | 0.9956 | 0.9975 | 0.9633 | 0.9632 | 0.0054 | 0.9523 | 0.9737 | 43.48 | 56.10 |
| Incomb crm lwr | 350 | 0.0038458 | 20 | 0.9974 | 0.9974 | 0.0003 | 0.9967 | 0.9980 | 0.9469 | 0.9468 | 0.0066 | 0.9334 | 0.9597 | 43.38 | 57.14 |
| Incomb crm upr | 446 | 0.0049007 | 20 | 0.9967 | 0.9967 | 0.0003 | 0.9960 | 0.9973 | 0.9328 | 0.9327 | 0.0067 | 0.9196 | 0.9457 | 41.34 | 58.78 |
| Incomb crm lwr | 350 | 0.0038458 | 30 | 0.9974 | 0.9974 | 0.0003 | 0.9969 | 0.9979 | 0.9233 | 0.9233 | 0.0075 | 0.9082 | 0.9378 | 41.00 | 58.32 |
| Incomb crm upr | 446 | 0.0049007 | 30 | 0.9967 | 0.9967 | 0.0003 | 0.9962 | 0.9972 | 0.9034 | 0.9033 | 0.0075 | 0.8883 | 0.9180 | 38.52 | 60.34 |

*Figure A-2 KI FFC Annual*

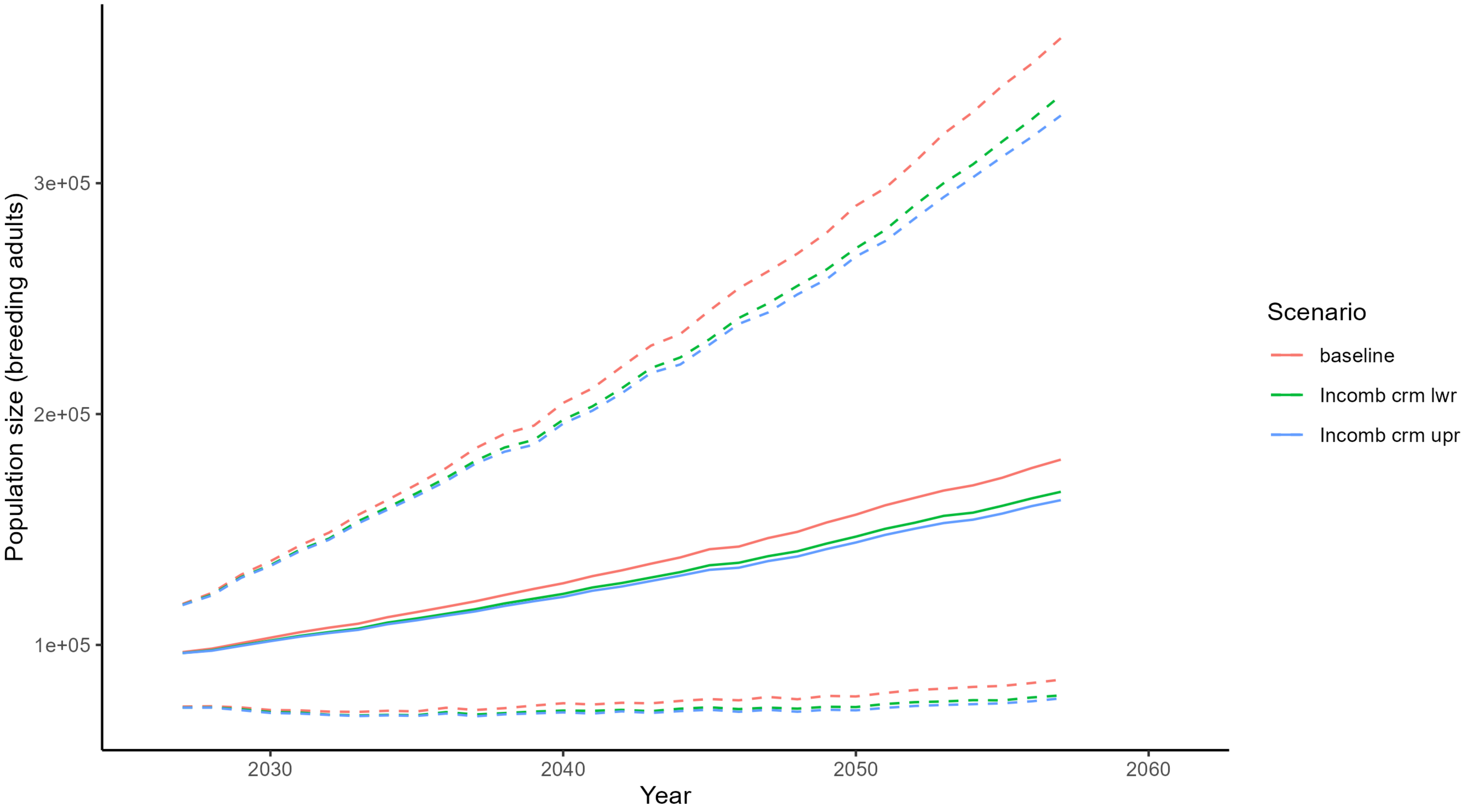


*Table A-5 Inputs: GU FFC Annual*

| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Reference name | GU FFC Annual | Number of scenarios of impact | 6 |
| Type | Simulation | Are impacts applied separately to each subpopulation | FALSE |
| Case studies | None | Are impacts specified separately for immatures | FALSE |
| Model to use for environmental stochasticity | Beta/Gamma | Are standard errors of impacts available | FALSE |
| Choose model for density dependence | No density dependence | Should random seeds be matched for impact scenarios | TRUE |
| Include demographic stochasticity in model | TRUE | Impacts are specified as | Relative |
| Number of simulations | 5000 | Years in which impacts are assumed to begin | 2027 |
| Random seed | 1971 | Years in which impacts are assumed to end | 2057 |
| Years for burn in | 5 | Scenario A name | Incomb disp lwr1 |
| Species | Common Guillemot | Scenario A Impact on productivity rate per pair mean | 0 |
| Age at first breeding | 6 | Scenario A Impact on adult survival rate | 0.0007734468 |
| Is there an upper constraint on productivity in the model | TRUE | Scenario A Impact on immature survival rate mean | - |
| Maximum brood size per pair  chicks  will be constrained to be no greater than | 1 | Scenario B name | Incomb disp lwr2 |
| Number of subpopulations | 1 | Scenario B Impact on productivity rate per pair mean | 0 |
| Units for initial population size | breeding.adults | Scenario B Impact on adult survival rate | 0.0009334702 |
| Are baseline demographic rates specified separately for immatures | TRUE | Scenario B Impact on immature survival rate mean | - |
| Initial population size | 149978 | Scenario C name | Incomb disp mid1 |
| Year | 2024 | Scenario C Impact on productivity rate per pair mean | 0 |

| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Productivity rate per pair mean | 0.6879 | Scenario C Impact on adult survival rate per pair mean | 0.001293523 |
| Productivity rate per pair standard deviation | 0.0825 | Scenario C Impact on immature survival rate mean | - |
| Adult survival rate Mean | 0.94 | Scenario D name | Incomb disp mid2 |
| Adult survival rate standard deviation | 0.025 | Scenario D Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 0 to 1 mean | 0.56 | Scenario D Impact on adult survival rate | 0.001560229 |
| Immatures survival rates 0 to 1 standard deviation | 0.058 | Scenario D Impact on immature survival rate mean | - |
| Immatures survival rates 1 to 2 mean | 0.792 | Scenario E name | Incomb disp upr1 |
| Immatures survival rates 1 to 2 standard deviation | 0.152 | Scenario E Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 2 to 3 mean | 0.917 | Scenario E Impact on adult survival rate | 0.01811599 |
| Immatures survival rates 2 to 3 standard deviation | 0.098 | Scenario E Impact on immature survival rate mean | - |
| Immatures survival rates 3 to 4 mean | 0.938 | Scenario F name | Incomb disp upr2 |
| Immatures survival rates 3 to 4 standard deviation | 0.107 | Scenario F Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 4 to 5 mean | 0.94 | Scenario F Impact on adult survival rate | 0.02183654 |
| Immatures survival rates 4 to 5 standard deviation | 0.025 | Scenario F Impact on immature survival rate mean | |
| Immatures survival rates 5 to 6 mean | 0.94 | Scenario G name | |
| Immatures survival rates 5 to 6 standard deviation | 0.025 | Scenario G Impact on productivity rate per pair mean | |
| Units for output | breeding.adults | Scenario G Impact on adult survival rate | |
| | | Scenario G Impact on immature survival rate mean | |

*Table 6 Outputs: GU FFC Annual*

| Scenario | Impact | Increase in mortality rate | Years since impact | C-PGR | | | | | C-PS | | | | | 50% Quantiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Med. | Mean | SD | LCI | UCI | Med. | Mean | SD | LCI | UCI | Q-UNIMP-50% | Q-IMP-50% |
| Incomb disp lwr1 | 116 | 0.0007734468 | 10 | 0.9994 | 0.9994 | 0.0002 | 0.9990 | 0.9999 | 0.9940 | 0.9939 | 0.0028 | 0.9885 | 0.9994 | 47.38 | 52.70 |
| Incomb disp lwr2 | 140 | 0.0009334702 | 10 | 0.9993 | 0.9993 | 0.0002 | 0.9989 | 0.9998 | 0.9927 | 0.9927 | 0.0027 | 0.9873 | 0.9980 | 46.80 | 53.48 |
| Incomb disp mid1 | 194 | 0.0012935231 | 10 | 0.9991 | 0.9991 | 0.0002 | 0.9986 | 0.9995 | 0.9899 | 0.9898 | 0.0028 | 0.9845 | 0.9952 | 45.70 | 54.80 |
| Incomb disp mid2 | 234 | 0.0015602288 | 10 | 0.9989 | 0.9989 | 0.0002 | 0.9984 | 0.9994 | 0.9878 | 0.9878 | 0.0027 | 0.9824 | 0.9932 | 44.88 | 55.74 |
| Incomb disp upr1 | 2,717 | 0.0181159903 | 10 | 0.9871 | 0.9871 | 0.0004 | 0.9863 | 0.9879 | 0.8673 | 0.8673 | 0.0041 | 0.8591 | 0.8752 | 6.54 | 93.84 |
| Incomb disp upr2 | 3,275 | 0.0218365360 | 10 | 0.9845 | 0.9845 | 0.0005 | 0.9836 | 0.9854 | 0.8424 | 0.8423 | 0.0045 | 0.8332 | 0.8510 | 3.64 | 96.82 |
| Incomb disp lwr1 | 116 | 0.0007734468 | 20 | 0.9995 | 0.9995 | 0.0002 | 0.9992 | 0.9998 | 0.9890 | 0.9889 | 0.0034 | 0.9823 | 0.9956 | 46.44 | 53.58 |
| Incomb disp lwr2 | 140 | 0.0009334702 | 20 | 0.9994 | 0.9994 | 0.0002 | 0.9991 | 0.9997 | 0.9867 | 0.9867 | 0.0033 | 0.9801 | 0.9931 | 46.04 | 54.14 |
| Incomb disp mid1 | 194 | 0.0012935231 | 20 | 0.9991 | 0.9991 | 0.0002 | 0.9988 | 0.9994 | 0.9815 | 0.9815 | 0.0033 | 0.9751 | 0.9881 | 44.44 | 55.94 |
| Incomb disp mid2 | 234 | 0.0015602288 | 20 | 0.9989 | 0.9989 | 0.0002 | 0.9986 | 0.9992 | 0.9777 | 0.9777 | 0.0033 | 0.9713 | 0.9843 | 43.52 | 56.84 |
| Incomb disp upr1 | 2,717 | 0.0181159903 | 20 | 0.9877 | 0.9877 | 0.0003 | 0.9871 | 0.9882 | 0.7704 | 0.7704 | 0.0046 | 0.7614 | 0.7792 | 1.78 | 98.54 |
| Incomb disp upr2 | 3,275 | 0.0218365360 | 20 | 0.9851 | 0.9851 | 0.0003 | 0.9845 | 0.9858 | 0.7303 | 0.7303 | 0.0050 | 0.7205 | 0.7400 | 0.66 | 99.60 |
| Incomb disp lwr1 | 116 | 0.0007734468 | 30 | 0.9995 | 0.9995 | 0.0001 | 0.9992 | 0.9997 | 0.9839 | 0.9838 | 0.0038 | 0.9763 | 0.9914 | 46.08 | 54.88 |
| Incomb disp lwr2 | 140 | 0.0009334702 | 30 | 0.9994 | 0.9994 | 0.0001 | 0.9991 | 0.9996 | 0.9807 | 0.9806 | 0.0037 | 0.9734 | 0.9878 | 45.12 | 56.12 |
| Incomb disp mid1 | 194 | 0.0012935231 | 30 | 0.9991 | 0.9991 | 0.0001 | 0.9989 | 0.9994 | 0.9732 | 0.9732 | 0.0037 | 0.9660 | 0.9804 | 43.24 | 58.14 |
| Incomb disp mid2 | 234 | 0.0015602288 | 30 | 0.9989 | 0.9989 | 0.0001 | 0.9987 | 0.9992 | 0.9678 | 0.9678 | 0.0036 | 0.9609 | 0.9751 | 41.74 | 59.88 |
| Incomb disp upr1 | 2,717 | 0.0181159903 | 30 | 0.9878 | 0.9878 | 0.0002 | 0.9874 | 0.9883 | 0.6842 | 0.6842 | 0.0048 | 0.6747 | 0.6935 | 0.50 | 99.60 |
| Incomb disp upr2 | 3,275 | 0.0218365360 | 30 | 0.9854 | 0.9854 | 0.0003 | 0.9849 | 0.9858 | 0.6331 | 0.6331 | 0.0051 | 0.6230 | 0.6430 | 0.06 | 99.92 |

*Figure A-3 GU FFC Annual*

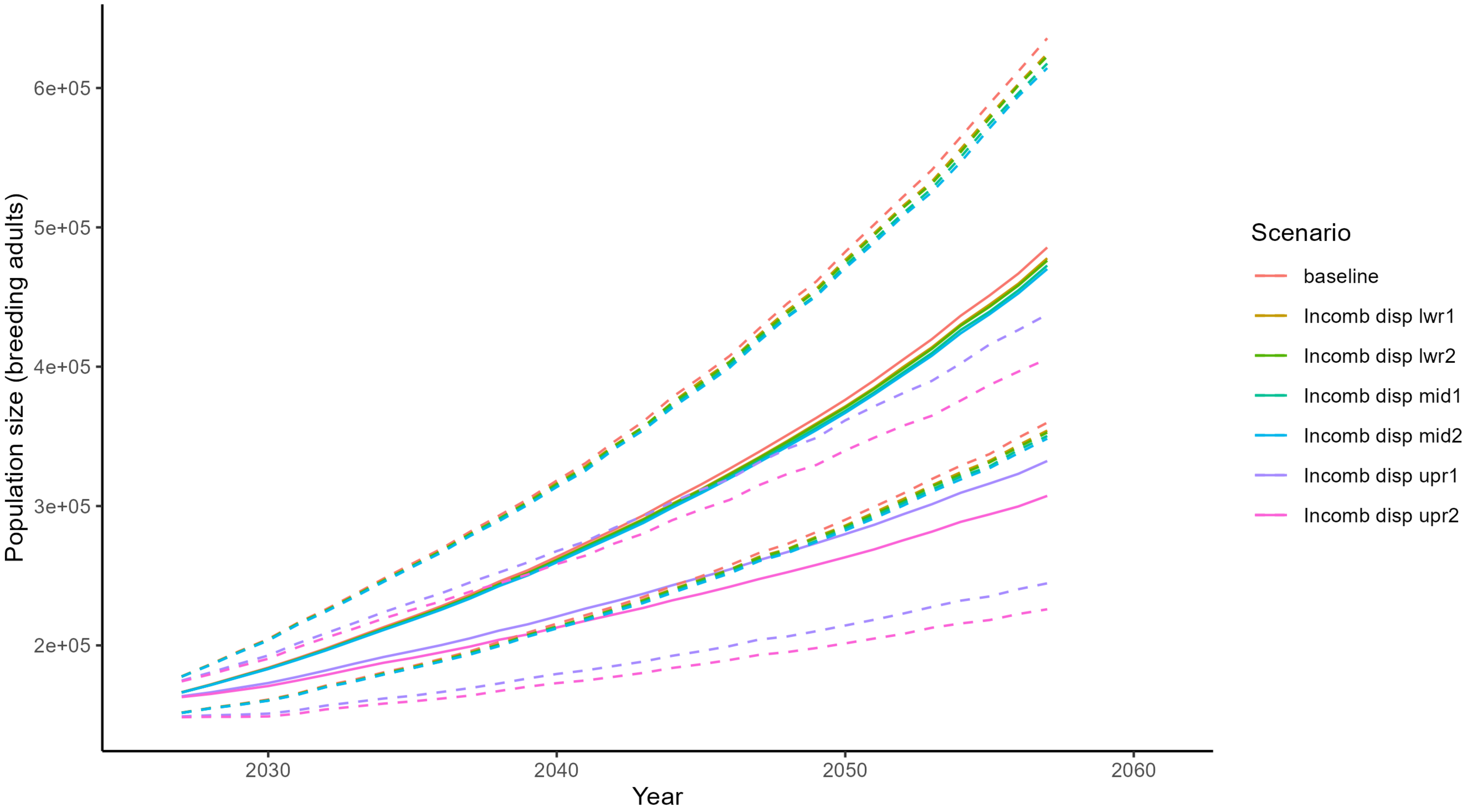


*Table A-7 Inputs: RA FFC Annual*

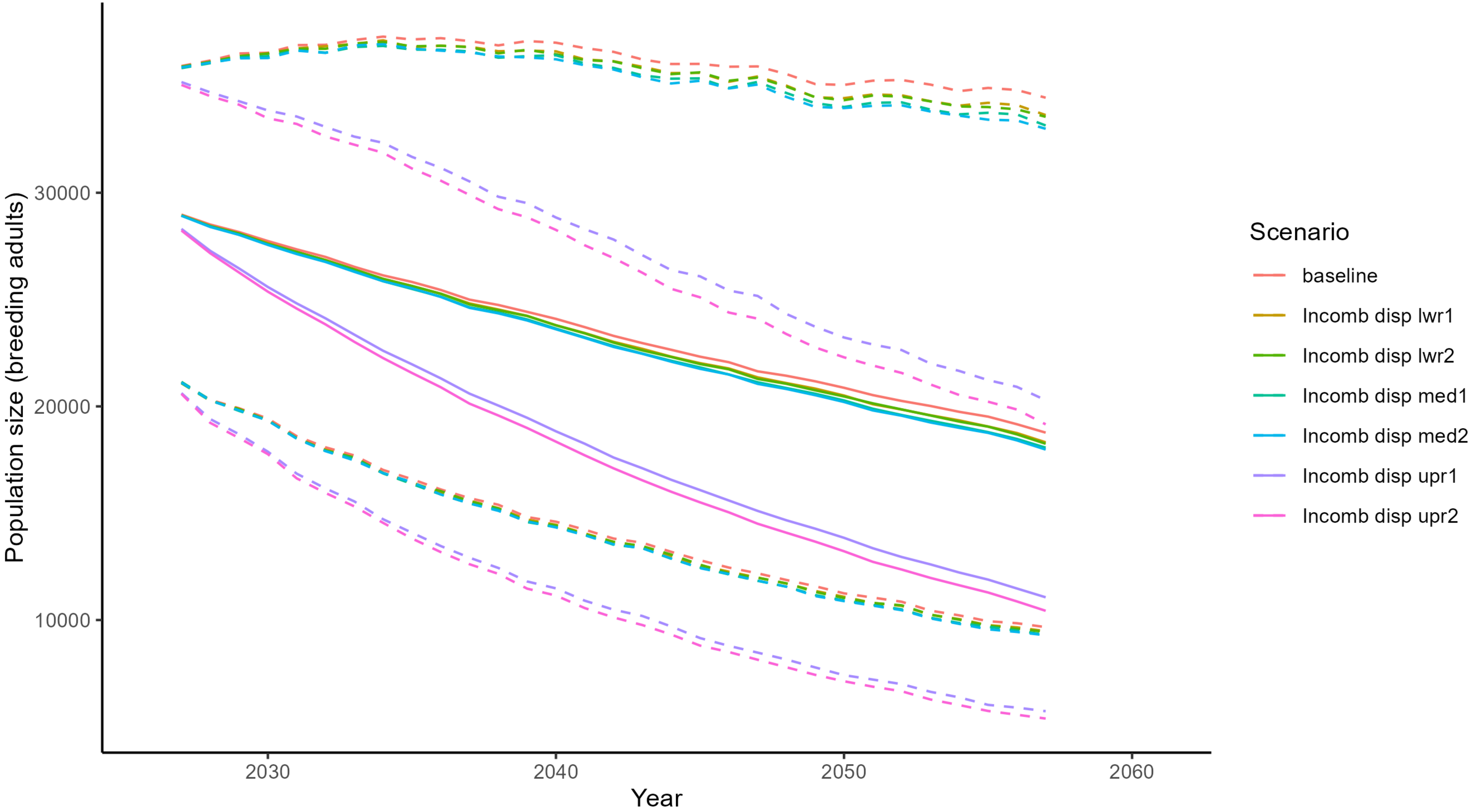
| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Reference name | RA FFC Annual | Number of scenarios of impact | 6 |
| Type | Simulation | Are impacts applied separately to each subpopulation | FALSE |
| Case studies | None | Are impacts specified separately for immatures | FALSE |
| Model to use for environmental stochasticity | Beta/Gamma | Are standard errors of impacts available | FALSE |
| Choose model for density dependence | No density dependence | Should random seeds be matched for impact scenarios | TRUE |
| Include demographic stochasticity in model | TRUE | Impacts are specified as | Relative |
| Number of simulations | 5000 | Years in which impacts are assumed to begin | 2027 |
| Random seed | 1971 | Years in which impacts are assumed to end | 2057 |
| Years for burn in | 5 | Scenario A name | Incomb disp lwr1 |
| Species | Razorbill | Scenario A Impact on productivity rate per pair mean | 0 |
| Age at first breeding | 5 | Scenario A Impact on adult survival rate | 0.00097806 |
| Is there an upper constraint on productivity in the model | Yes | Scenario A Impact on immature survival rate mean | 0 |
| Maximum brood size per pair chicks will be constrained to be no greater than | 1 | Scenario B name | Incomb disp lwr2 |
| Number of subpopulations | 1 | Scenario B Impact on productivity rate per pair mean | 0 |
| Units for initial population size | Breeding adults | Scenario B Impact on adult survival rate | 0.0010759 |
| Are baseline demographic rates specified separately for immatures | Yes | Scenario B Impact on immature survival rate mean | - |
| Initial population size | 30673 | Scenario C name | Incomb disp med1 |
| Year | 2022 | Scenario C Impact on productivity rate per pair mean | 0 |
| Productivity rate per pair mean | 0.618 | Scenario C Impact on adult survival rate per pair mean | 0.0016301 |

| Baseline parameters | Settings | Impact parameters | Values |
|---|---|---|---|
| Productivity rate per pair standard deviation | 0.085 | Scenario C Impact on immature survival rate mean | - |
| Adult survival rate Mean | 0.895 | Scenario D name | Incomb disp med2 |
| Adult survival rate standard deviation | 0.067 | Scenario D Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 0 to 1 mean | 0.63 | Scenario D Impact on adult survival rate | 0.0017931 |
| Immatures survival rates 0 to 1 standard deviation | 0.067 | Scenario D Impact on immature survival rate mean | - |
| Immatures survival rates 1 to 2 mean | 0.63 | Scenario E name | Incomb disp upr1 |
| Immatures survival rates 1 to 2 standard deviation | 0.067 | Scenario E Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 2 to 3 mean | 0.895 | Scenario E Impact on adult survival rate | 0.022658 |
| Immatures survival rates 2 to 3 standard deviation | 0.067 | Scenario E Impact on immature survival rate mean | - |
| Immatures survival rates 3 to 4 mean | 0.895 | Scenario F name | Incomb disp upr2 |
| Immatures survival rates 3 to 4 standard deviation | 0.067 | Scenario F Impact on productivity rate per pair mean | 0 |
| Immatures survival rates 4 to 5 mean | 0.895 | Scenario F Impact on adult survival rate | 0.025136 |
| Immatures survival rates 4 to 5 standard deviation | 0.067 | Scenario F Impact on immature survival rate mean | - |
| Immatures survival rates 5 to 6 mean | | Scenario G name | |
| Immatures survival rates 5 to 6 standard deviation | | Scenario G Impact on productivity rate per pair mean | |
| Units for output | breeding.adults | Scenario G Impact on adult survival rate | |
| | | Scenario G Impact on immature survival rate mean | |

*Table A-8 Outputs: RA FFC Annual*

| Scenario | Impact | Increase in mortality rate | Years since impact | C-PGR | | | | | C-PS | | | | | 50% Quantiles | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Med. | Mean | SD | LCI | UCI | Med. | Mean | SD | LCI | UCI | Q-UNIMP-50% | Q-IMP-50% |
| Incomb disp lwr1 | 30 | 0.00097806 | 10 | 0.9992 | 0.9992 | 0.0009 | 0.9975 | 1.0009 | 0.9915 | 0.9914 | 0.0103 | 0.9711 | 1.0120 | 48.70 | 51.28 |
| Incomb disp lwr2 | 33 | 0.00107586 | 10 | 0.9991 | 0.9991 | 0.0009 | 0.9975 | 1.0009 | 0.9906 | 0.9906 | 0.0104 | 0.9705 | 1.0116 | 48.28 | 51.64 |
| Incomb disp med1 | 50 | 0.00163010 | 10 | 0.9987 | 0.9987 | 0.0009 | 0.9970 | 1.0004 | 0.9858 | 0.9860 | 0.0103 | 0.9658 | 1.0065 | 47.06 | 52.00 |
| Incomb disp med2 | 55 | 0.00179311 | 10 | 0.9986 | 0.9986 | 0.0009 | 0.9969 | 1.0003 | 0.9844 | 0.9846 | 0.0104 | 0.9641 | 1.0058 | 46.90 | 52.50 |
| Incomb disp upr1 | 695 | 0.02265836 | 10 | 0.9824 | 0.9824 | 0.0010 | 0.9805 | 0.9843 | 0.8227 | 0.8228 | 0.0095 | 0.8044 | 0.8419 | 18.92 | 82.44 |
| Incomb disp upr2 | 771 | 0.02513611 | 10 | 0.9805 | 0.9805 | 0.0010 | 0.9785 | 0.9825 | 0.8053 | 0.8053 | 0.0096 | 0.7866 | 0.8241 | 16.38 | 85.12 |
| Incomb disp lwr1 | 30 | 0.00097806 | 20 | 0.9992 | 0.9992 | 0.0006 | 0.9980 | 1.0005 | 0.9842 | 0.9844 | 0.0135 | 0.9578 | 1.0117 | 47.88 | 51.96 |
| Incomb disp lwr2 | 33 | 0.00107586 | 20 | 0.9992 | 0.9992 | 0.0006 | 0.9979 | 1.0004 | 0.9833 | 0.9831 | 0.0136 | 0.9560 | 1.0109 | 47.32 | 52.10 |
| Incomb disp med1 | 50 | 0.00163010 | 20 | 0.9988 | 0.9988 | 0.0006 | 0.9975 | 1.0000 | 0.9743 | 0.9743 | 0.0135 | 0.9485 | 1.0014 | 46.04 | 53.62 |
| Incomb disp med2 | 55 | 0.00179311 | 20 | 0.9986 | 0.9986 | 0.0006 | 0.9974 | 0.9999 | 0.9718 | 0.9718 | 0.0135 | 0.9457 | 0.9988 | 45.44 | 53.90 |
| Incomb disp upr1 | 695 | 0.02265836 | 20 | 0.9829 | 0.9829 | 0.0007 | 0.9815 | 0.9844 | 0.6969 | 0.6968 | 0.0112 | 0.6751 | 0.7189 | 10.28 | 91.12 |
| Incomb disp upr2 | 771 | 0.02513611 | 20 | 0.9811 | 0.9811 | 0.0007 | 0.9796 | 0.9825 | 0.6696 | 0.6698 | 0.0108 | 0.6486 | 0.6907 | 8.42 | 93.24 |
| Incomb disp lwr1 | 30 | 0.00097806 | 30 | 0.9993 | 0.9993 | 0.0005 | 0.9982 | 1.0003 | 0.9772 | 0.9773 | 0.0164 | 0.9458 | 1.0103 | 47.10 | 52.64 |
| Incomb disp lwr2 | 33 | 0.00107586 | 30 | 0.9992 | 0.9992 | 0.0005 | 0.9982 | 1.0002 | 0.9752 | 0.9753 | 0.0164 | 0.9442 | 1.0082 | 46.68 | 52.98 |
| Incomb disp med1 | 50 | 0.00163010 | 30 | 0.9988 | 0.9988 | 0.0005 | 0.9978 | 0.9998 | 0.9626 | 0.9627 | 0.0162 | 0.9315 | 0.9957 | 45.18 | 54.48 |
| Incomb disp med2 | 55 | 0.00179311 | 30 | 0.9987 | 0.9986 | 0.0005 | 0.9976 | 0.9997 | 0.9592 | 0.9591 | 0.0163 | 0.9273 | 0.9924 | 44.58 | 55.40 |
| Incomb disp upr1 | 695 | 0.02265836 | 30 | 0.9831 | 0.9831 | 0.0006 | 0.9818 | 0.9843 | 0.5900 | 0.5900 | 0.0118 | 0.5666 | 0.6137 | 5.74 | 95.36 |
| Incomb disp upr2 | 771 | 0.02513611 | 30 | 0.9813 | 0.9813 | 0.0006 | 0.9800 | 0.9825 | 0.5571 | 0.5571 | 0.0112 | 0.5353 | 0.5790 | 3.94 | 96.90 |

*Figure A-4 RA FFC Annual*



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