MacArthur Green

West of Orkney Windfarm

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West of Orkney Windfarm

Offshore Ornithology Additional Information

Addendum to the Offshore EIA Report

Offshore Ornithology EIA Report Chapter

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CHAPTER SUMMARY

This document is part of the West of Orkney Windfarm Ornithology Additional Information and presents an updated version of Chapter 13: Offshore and intertidal ornithology in the original Offshore EIA Report.

This document assesses the potential impacts due to the offshore Project on offshore ornithological features. This includes direct, indirect, whole project, cumulative, inter-related impacts, inter- relationship, and transboundary impacts. It reflects the outcomes of the consultation with NatureScot throughout the pre- and post-EIA submission stages, carried out to agree on the methods of data presentation, analyses and assessment which satisfy NatureScot's requirements.

The baseline site-specific Digital Aerial Surveys (DAS) recorded the following key seabird species in non-trivial numbers within the offshore Project area: kittiwake, great black-backed gull, Arctic tern, great skua, guillemot, razorbill, puffin, fulmar, gannet, Manx shearwater and European storm-petrel. Species recorded regularly in most months within the survey area and its vicinity were kittiwake, guillemot, razorbill, puffin and gannet. However, for most species recorded at most times of year, abundance in the area potentially affected by the offshore Project was low or very low in the context of their population size.

The following impacts were identified as requiring assessment:

During construction:

1. Direct distributional responses and displacement effects, including vessel movements.
2. Artificial Lighting.
3. Indirect disturbance and displacement of prey species.

During operation and maintenance:

4. Direct distributional responses, displacement and barrier effects, including vessel movements.
5. Indirect effects due to habitat loss / change for key prey species.
6. Collision risk.
7. Artificial operational lighting.
8. Combined operational displacement and collision risk.

In relation to possible disturbance-displacement impacts, ornithological features not recorded during baseline DASs were also considered, based on their known distribution, abundance and sensitivity to impact. This included non-breeding waterfowl and breeding divers in proximity to the offshore Export Cable Corridor (ECC), landfall and vessel routes to and from port.

Overall, for the offshore Project alone, the assessment of potential impacts showed that for all features, impacts would have a negligible or low magnitude of impact on populations, resulting in negligible or minor adverse, and therefore not significant, effects. Disturbance and displacement during construction (including vessel movements and artificial lighting) would be short-term, temporary and reversible and considered not significant.

The assessment of the operation and maintenance stage was informed by Project-specific collision risk modelling, displacement assessment and Population Viability Analysis (PVA) to understand the potential effects on regional populations. Embedded mitigation will likely reduce impacts on birds, such as the minimum clearance between the lowest WTG blade tip and sea-level, set by the engineering requirements, which is above the minimum required clearance and therefore reduces potential collision risk.

Collision risk, disturbance, artificial lighting, displacement and barrier effects during the operation and maintenance stage were assessed as affecting very low proportions of breeding and non-breeding populations. Indirect effects from impacts to key prey species (e.g. sandeel and herring) were informed by the outcomes of other topic-specific assessments, such as fish and shellfish ecology and were assessed as being not significant. No significant transboundary effects were predicted.

For cumulative impacts with other projects, the potential for combined disturbance and collision effects on kittiwake, Arctic tern and gannet were identified. The cumulative effects on the regional populations were assessed to be negligible and not significant. The potential for cumulative displacement impacts on guillemot, razorbill and puffin were also assessed to be negligible and not significant. The potential for cumulative collision only effects on great black-backed gull were assessed to be minor adverse and not significant. In relation to cumulative impacts associated with vessel movements, a negligible effect was predicted for all features apart from great northern diver, where a minor adverse and not significant effect was predicted.

It was also assessed that there was no potential for the effects during other stages of the offshore project to interact in a way that would result in combined effects of greater significance than the assessments for each individual stage. In addition, offshore ornithology features are part of the wider ecosystem, and therefore, impacts on these features may affect other components of the ecosystem and vice versa. However, no significant effects were predicted on any key prey species and no significant change in the distribution or abundance of seabirds as predators in the offshore project area is anticipated. Therefore, no ecosystem effects were anticipated to occur in relation to ornithology features, either as direct impacts to them as predators or through indirect effects to their prey species.

The whole project assessment concluded no overlap between the effects of the onshore and offshore Project on offshore ornithology features.

Any required monitoring will be determined post-consent and discussed and agreed via a regional advisory group (or equivalent). Monitoring details will be subject to approval as part of the discharge of consent conditions.

1 INTRODUCTION

1.1 Background

1. Offshore Wind Power Limited (OWPL) ('the Applicant') is proposing the development of the West of Orkney Windfarm ('the Project'), an Offshore Wind Farm (OWF), located at least 23 kilometres (km) from the north coast of Scotland and 28 km from the west coast of Hoy, Orkney.

2. The Applicant submitted an application for consent under Section 36 of the Electricity Act 1989 and Marine Licences under Part 4 of the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 to Scottish Ministers in September 2023 for the offshore components of the Project seaward of Mean High-Water Springs (MHWS).

3. In accordance with relevant EIA Regulations[1], an Offshore Environmental Impact Assessment (EIA) Report was submitted to Marine Directorate – Licensing Operations Team (MD-LOT) as part of the Applicant's consent application. Chapter 13: Offshore and intertidal ornithology of the Offshore EIA Report provided the assessment of potential effects from the offshore Project on ornithological features, both from the offshore Project alone and cumulatively with other projects, plans and activities, and whole Project perspective.

4. Following the review of the application, and upon receipt of representations from consultees, MD-LOT issued a request for Additional Information on offshore ornithology. This document is part of the Ornithology Additional Information and presents an updated Ornithology EIA Report chapter.

5. This document considers impacts on ornithological features found seaward of MHWS, including in the offshore, nearshore and intertidal environments, although throughout the chapter all species considered are referred to as "offshore" ornithology features for ease. An assessment of impacts on birds landward of MHWS is presented in the Onshore EIA Report, chapter 11: Terrestrial ornithology.

6. The chapter follows a similar structure to Chapter 13: Offshore and intertidal ornithology of the Offshore EIA Report but takes into account subsequent consultation with NatureScot.

7. Effects on Special Protected Areas (SPAs) have to be considered under the Habitats Regulation Appraisal (HRA) process, a report to inform which has been undertaken alongside this Addendum to the Offshore EIA Report. **The Addendum to the Offshore Report to Inform an Appropriate Assessment (RIAA) - Ornithology**, as part of the Offshore Ornithology Additional Information, provides an assessment of the offshore Project on SPAs.

8. Unless clearly noted, the presentation of information, analyses and assessment within this chapter follows the series of 11 guidance documents provided by NatureScot[2] (see section

[1] *The relevant EIA Regulations include the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017, and the Marine Works (Environmental Impact Assessment) Regulations 2007.*

[2] *https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/renewable-energy/marine-renewables/advice-marine-renewables-development.*

2.3), which forms a core resource to inform offshore wind development proposals in Scotland, as well as the Project-specific advice from NatureScot garnered prior to and after the submission of the original chapter 13: Offshore and intertidal ornithology of the Offshore EIA Report.

9. The chapter has been prepared using Digital Aerial Survey (DAS) data collected by HiDef Aerial Surveying Limited (HiDef). Full details of the baseline data acquired through the DAS specifically carried out within the Option Agreement Area (OAA) and a 4 km buffer can be found in **Appendix 1, Annex 1A: Digital video aerial surveys_27 month report**.

1.2 Supporting Documents

10. The supporting documents which should be read in conjunction with this assessment are listed below (those supporting the HRA process only are listed in brackets and italics, and are not integral to this EIA):

- Introduction to the Additional Ornithology EIA Information and HRA Addendum
- Revised Offshore and Intertidal Ornithology EIA Chapter
- Addendum to the Report to Inform Appropriate Assessment: HRA Stage 2 - SPA Appropriate Assessment (or 'Addendum to the RIAA' for short)
- Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report
    - Annex 1A: Digital video aerial surveys_27 month report
    - Annex 1B: abundance estimates per survey recorded for all birds (sitting and flying) V1.0
    - Annex 1C: abundance estimates per survey recorded for all flying birds V1.0
    - Annex 1D: Design-based analysis abundance estimates from each survey of sitting birds
    - Annex 1E: Design-based analysis density estimates from each survey of all birds (sitting and flying)
    - Annex 1F: Design-based density estimates from each survey recorded of flying birds
    - Annex 1G: Design-based density estimates from each survey recorded of sitting birds
    - Annex 1H: Design-based mean abundance estimates from each calendar month of all birds (sitting and flying)
    - Annex 1I: Design-based mean abundance estimates from each calendar month of flying birds
    - Annex 1J: Design-based mean abundance estimates from each calendar month of sitting birds
    - Annex 1K: Design-based mean density estimates from each calendar month of all birds (sitting and flying)

  - Annex 1L: Design-based mean density estimates from each calendar month of flying birds
  - Annex 1M: Design-based mean density estimates from each calendar month of sitting birds
  - Annex 1N: Number of birds present in transect segments
  - Annex 1O: MRSea model summaries and diagnostics
  - Annex 1P: Seabirds and Highly Pathogenic Avian Influenza: a review
  - Annex 1Q: Rarely recorded species information
  - Annex 1R: Comparison of design- and model-based abundance estimates
  - Annex 1S: SPA and regional population sizes
- *[Appendix 2 - HRA: HRA Screening Technical Report]*
- Appendix 3 - EIA and HRA: Collision Risk Modelling Technical Report
  - Annex 3A: survey densities and calendar month densities
  - Annex 3B: CRM input parameters from NatureScot March 2024
  - Annex 3C: word output files from Caneco shiny app
  - Annex 3D: bootstrapped densities inputs to CRM
  - Appendix 4 - EIA and HRA: Displacement Technical Report
  - Annex 4A: SeabORD Analysis Final Report
- *[Appendix 5 - HRA: Apportioning Technical Report]*
- *[Appendix 6 - HRA: Calculation of mortalities and change in survival rate at SPA population scales for Project alone and in-combination impacts]*
- Appendix 7 - EIA: Calculation of mortalities and change in survival rate at regional population scales for Project alone and cumulative impacts
- *[Appendix 8 - HRA: PVA at SPA population scales for Project alone and in-combination impacts]*
- Appendix 9 - EIA: PVA at regional population scales for Project alone and cumulative impacts.

11. The impact assessment also draws upon information presented within other Offshore EIA Report chapters and Additional Information documents.

12. This interaction between the impacts assessed within different topic-specific chapters on a feature is defined as an 'inter-relationship'. The chapters and impacts related to the assessment of potential effects on offshore ornithology are provided in **Table 1-1**.

Table 1-1. Offshore ornithology inter-relationships.

Chapter	Impact	Description
Benthic subtidal and intertidal ecology (chapter 10, Offshore EIA Report)	Indirect impacts through effects on habitats and prey during construction, operation & maintenance and decommissioning.	Potential impacts on benthic ecology and fish and shellfish could affect the prey resource for birds.
Fish and shellfish ecology (chapter 11, Offshore EIA Report)		

2 LEGISLATION, POLICY AND GUIDANCE

13. Over and above the legislation presented in the Offshore EIA Report chapter 3: Planning policy and legislative context, the following legislation, policy and guidance are relevant to the assessment of impacts from the offshore Project on offshore ornithology.

2.1 Legislation

- Directive 2009/147/EC on the Conservation of Wild Birds ('Birds Directive');
- Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) ('Habitats Directive');
- The Conservation (Natural Habitats and c.) Regulations 1994 (as amended);
- Environmental Impact Assessment Directive 2014/52/EU (the 'EIA Directive'[3]);
- The Conservation of Offshore Marine Habitats and Species Regulations 2017;
- The Conservation of Habitats and Species Regulations 2017;
- The Nature Conservation (Scotland) Act 2004 (as amended); and
- The Wildlife and Countryside Act 1981 (as amended).

2.2 Policy

- Scotland's National Marine Plan policy GEN 9 Natural heritage: Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species; (b) Not result in significant impact on the national status of Priority Marine Features (PMFs); and (c) Protect and, where appropriate, enhance the health of the marine area;
- Scottish Government (2023). The National Islands Plan; and
- UK Post-2010 Biodiversity Framework.

2.3 Guidance

- Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2022);

[3] *The EU Directives have been included as a reference, but it is noted that following the UK withdrawal from the EU these Directives are not legally binding, although the EU Withdrawal Act (2018) maintains the requirements of the EU Directives into domestic law as retained EU Law.*

- Advice on marine renewables development which are relevant to this EIA (NatureScot, 2023[4]. Note that guidance note #10 has not yet been published):
  - Guidance Note #1: Guidance to support Offshore Wind Applications: Marine Ornithology – Overview;
  - Guidance Note #2: Guidance to support Offshore Wind Applications: Advice for Marine Ornithology Baseline Characterisation Surveys and Reporting;
  - Guidance Note #3: Guidance to support Offshore Wind Applications: Ornithology – Identifying Theoretical Connectivity with Breeding Site Special Protection Areas using Breeding Season Foraging Ranges;
  - Guidance Note #4: Guidance to support Offshore Wind Applications: Determining connectivity of Marine Birds with Marine Special Protection Areas and Breeding Seabirds from Colony SPAs in the Non-Breeding Season;
  - Guidance Note #5: Guidance to support Offshore Wind Applications: Recommendations for Marine Bird Population Estimates
  - Guidance Note #6: Guidance to support Offshore Wind Applications: Marine Ornithology Impact Pathways for Offshore Wind Developments
  - Guidance Note #7: Guidance to support Offshore Wind Applications: Marine Ornithology – Advice for Assessing Collision Risk of Marine Birds;
  - Guidance Note #8: Guidance to support Offshore Wind Applications: Marine Ornithology Advice for assessing the Distributional Responses, Displacement and Barrier Effects of Marine Birds;
  - Guidance Note #9: Guidance to support Offshore Wind Applications: Marine Ornithology Advice for Seasonal Definitions for Birds in the Scottish Marine Environment;
  - Guidance Note #11: Guidance to support Offshore Wind Applications: Recommendations for Seabird Population Viability Analysis (PVA).
- Seasonal Definitions for Birds in the Scottish Marine Environment (NatureScot, 2020);
- A handbook on environmental impact assessment: Guidance for competent authorities, consultees and others involved in the Environmental Impact Assessment process in Scotland (SNH, 2018);
- Reports and presentations from NatureScot "Bird impact assessment guidance workshop for offshore wind"[5,6] (NatureScot, 2022);
- Joint Statutory Nature Conservation Bodies (SNCB) Interim Displacement Advice Note (SNCB, 2022);

[4] https://www.nature.scot/doc/guidance-note-1-guidance-support-offshore-wind-applications-marine-ornithology-overview
[5] https://www.webarchive.org.uk/wayback/archive/20221013130442/https://www.nature.scot/doc/bird-impact-assessment-guidance-workshop-offshore-wind-report-and-presentations.
[6] https://www.nature.scot/doc/bird-impact-assessment-guidance-workshop-offshore-wind-report-and-presentations.

- SNCB Position Note on avoidance rates for use in collision risk modelling (SNCB, 2014);
- Gull foraging offshore and onshore: developing apportioning approaches to casework (Quinn, 2019); and
- Scottish Marine Energy Research (ScotMER) Programme - Offshore wind developments - collision and displacement in petrels and shearwaters: literature review (Deakin *et al.*, 2022).

14. In addition to the above guidance, NatureScot provided extensive and detailed Project-specific advice both pre- and post-submission of the original application. This is summarised below, with more detail provided in the **Introduction to the Additional Ornithology EIA Information and HRA Addendum**.

3 SCOPING AND CONSULTATION

15. Stakeholder consultation was carried out throughout the EIA process (see **Introduction to the Additional Ornithology EIA Information and HRA Addendum** for detailed information). The Scoping Report, which covered the onshore and offshore Project, was submitted to Scottish Ministers (via Marine Scotland - Licensing Operations Team (MS-LOT[7]) on 1 March 2022[8]. MS-LOT circulated the Scoping Report to consultees relevant to the offshore Project and a Scoping Opinion was received from MS-LOT on 29 June 2022.

16. Further consultation was undertaken throughout the period prior to submission of the original application, in 2023. **Table 3-1** summarises the consultation activities carried out relevant to offshore ornithology during this period. These were previously presented in **Table 13-3** of the original Offshore EIA Report, chapter 13: Offshore ornithology.

17. Subsequent to submission of the original Offshore EIA Report, the following further consultation documents were received from NatureScot:

- Advice on EIA Report and RIAA relating to the offshore and intertidal impacts (letter dated 13 December 2023); and
- Advice on queries (letter dated 27 March 2024).

18. Extensive regular consultation via a series of meetings and emails was also undertaken with NatureScot, RSPB and MD-LOT. A summary of all post-EIA submission consultation specific to offshore ornithology is provided in **Table 3-1**.

Table 3-1. Summary of consultation for offshore ornithology.

Date	Consultee and type of consultation	Summary
November 2018 – November 2020	Various consultations with NatureScot	DAS programme for the OAA was discussed and agreed with NatureScot (then Scottish Natural Heritage (SNH) prior to July 2020). Additional meetings were held in November 2020 to confirm

[7] *MS-LOT have since been renamed Marine Directorate Licensing Operations Team (MD-LOT).*

Date	Consultee and type of consultation	Summary
		the surveys were underway in accordance with the agreed strategy.
12 July 2022	Offshore Ornithology Consultee Online Meeting - OWPL, Xodus, MacArthur Green, NatureScot and RSPB	Discussion on the following topics: Project overview, DAS key findings from the first breeding season, Habitats Regulations Appraisal (HRA) screening, scoping feedback, displacement analysis, collision analysis and Population Viability Analysis (PVA).
9 September 2022	Offshore Ornithology Consultee Online Meeting - OWPL, Xodus, MacArthur Green and NatureScot	Discussion about PVA metrics to include in the assessment including the difference between Counterfactual of Population Size (C-PS) and the Counterfactual of Growth Rate (C-PGR). Discussion also included the level of change in the C-PGR required to demonstrate that mitigation measures are likely to be beneficial.
16 November 2022	Offshore Ornithology Consultee – written letter	Letter (Ref. WO1-WOW-HSE-CN-LT-0002) to NatureScot from OWPL regarding the avoidance rate guidance for seabirds to be used in collision risk modelling. NatureScot email response received 5 December 2022.
30 September 2022	OWPL – document submission.	Submission of West of Orkney Windfarm: Offshore HRA Screening Report : L-100632-S09-A-REPT-001.
28 October 2022	Offshore Ornithology Consultee – written letter	NatureScot – submission of HRA Screening response, letter ref: CNS REN OSWF-ScotWindN1 OWPL West of Orkney Pre App
19th January 2023	OWPL – document submission.	HPAI review provided to NatureScot for comment
1st February 2023 -	Email from NatureScot	Notification that Guidance to support Offshore Wind Applications: Marine Ornithology has been published.
8 February 2023	Offshore Ornithology Consultee Online Meeting - OWPL, Xodus, MacArthur Green and NatureScot	Discussion about the final baseline outputs, initial EIA assessment results and HRA approach. Approach to cumulative assessment presented and discussed. Breeding season based on Pentland Firth Offshore Wind Farm (PFOWF), Moray West, Moray East, Beatrice. Non-breeding season based on both Biologically Defined Minimum Population Scales (BDMPS) North Sea ("east") and Western Waters ("west") due to the Project being near the boundary between BDMPS regions.
2 March 2023	Offshore Ornithology Consultee – written letter	Letter (Ref. WO1-WOW-HSE-EV-LT-0007). Letter to NatureScot from OWPL regarding follow up actions from meeting 8th February 2023 and clarifications regarding changes to NatureScot

Date	Consultee and type of consultation	Summary
		guidance. NatureScot letter response (Ref. CNS REN OSWF-ScotWind-N1 OWPL West of Orkney Pre App) received 5 April 2023.
5th April 2023	email from OWPL TO NatureScot (following receipt of NatureScot letter earlier the same day)	Various issues / clarifications relating to NatureScot letter response (Ref. CNS REN OSWF-ScotWind-N1 OWPL West of Orkney Pre App) received 5 April 2023.
18 April 2023	Offshore Ornithology Consultee Online Meeting - OWPL, Xodus and NatureScot	Presentation of changes to DAS area that took place during programme and reflected the awarded OAA area.
25 April 2023	Offshore Ornithology Online Meeting - OWPL, Xodus, MacArthur Green, NatureScot and MS-LOT	Discussed updates to the EIA results following feedback from NatureScot and initial HRA outputs.
17th May 2023 -	Email from NatureScot	Queries relating to RIAA
18 May 2023	Offshore Ornithology Consultee – written letter	Letter (Ref. WO1-WOW-HSE-EV-LT-0020). Letter to NatureScot from OWPL regarding follow up actions from meeting 25th April 2023. Letter outlined the concerns identified with using SeabORD to assess displacement and barrier effects and why the matrix approach should be utilised for the Offshore RIAA. NatureScot email response received 31 May 2023.
18 May 2023	Offshore Ornithology Consultee – written letter	Letter (Ref. WO1-WOW-HSE-EV-LT-00017). Letter to NatureScot, clarifying the change made to the DAS area.
19 May 2023	OWPL – written letter.	Letter to NatureScot from MacArthur Green regarding clarification on PVA projections. NatureScot email response received 31 May 2023.
24 May 2023	Offshore Ornithology Online Meeting - OWPL, Xodus, MacArthur Green, MS-LOT, and NatureScot	Initial discussion of Derogation Strategy.
31st May 2023 -	Email from NatureScot	Advice relating to SeabORD
22nd June 2023	Offshore Ornithology Online Meeting - OWPL, Xodus, MacArthur Green, MS-LOT, and NatureScot	Discussion of displacement assessment approach (as part of wider derogation discussions)
7th July 2023	Offshore Ornithology Consultee - email	NatureScot advice on displacement assessment approach.
Post-submission consultation		
13 December 2023	Offshore Ornithology Consultee – written letter.	NatureScot Interim Advice. Letter from NatureScot to MD-LOT (CNS REN OSWF ScotWind - N1 - Offshore Wind Power Limited - West of Orkney).
13 December 2023	Offshore Ornithology Consultee – written letter.	RSPB Scotland representation. Letter from RSPB to MD-LOT.
26 February 2024	Offshore Ornithology Online Meeting	MD-LOT, NatureScot Offshore ornithology workshop. Discussion on application of NatureScot guidance for EIA, baseline site characterisation,

Date	Consultee and type of consultation	Summary
		analysis methods (density estimates, collision modelling), qualitative approach to HPAI considerations.
11 March 2024	OWPL – written letter.	Letter from the Project to NatureScot (WO1-WOW-CON-EV-LT-0005 Offshore Ornithology Questions for NatureScot) based on topics discussed in 26 February 2024 meeting.
27 March 2024	Offshore Ornithology Consultee – written letter.	Letter from NatureScot to West of Orkney Windfarm (CNS REN OSWF-ScotWind - N1 - West of Orkney - Application). Clarification of matters relating to topics discussed on 26 February 2024 meeting.
12 April 2024	OWPL – written letter.	Letter from MacArthur Green to NatureScot (WO1-WOW-CON-EV-LT-0013) outlining assessment approach for design based estimates and collision modelling.
30 April 2024	Offshore Ornithology Online Meeting	NatureScot and MD-LOT consultation meeting. Discussion on collision modelling method, density inputs; and displacement means and design-model based comparisons.
7 May 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Presentation of collision modelling data and baseline characterisation
13 May 2024	OWPL – written letter.	Letter from West of Orkney Windfarm to RSPB (WO1-WOW-CON-EV-LT-0014). Update on progress and how addendum information will be presented and assessed.
14 May 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Clarifications on how input data is used for collision modelling and PVA.
21 May 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Discussion on thresholds for PVA modelling, requirements for updating EIA.
28 May 2024	OWPL – email.	Email from MacArthur Green to MD-LOT. List of projects provided for inclusion in in-combination assessment.
28 May 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Displacement mean seasonal peaks, input parameters for collision modelling, how HPAI concerns are addressed.
3 June 2024	Offshore Ornithology Consultee – written letter.	Letter from NatureScot to MacArthur Green (CNS REN OSWF-ScotWind-N1 OWPL West of Orkney A). EIA Requirements, displacement seasonal mean peak, collision modelling data usage, non-breeding season apportioning assumed for UK North Sea region.

Date	Consultee and type of consultation	Summary
4 June 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Displacement – Mean Seasonal Peak calculations, collision modelling input parameters. Obtaining estimated impacts for other projects in cumulative assessment, consideration of Berwick Bank, availability bias for auks, PVA recovery period
10 June 2024	Offshore Ornithology Consultee – email.	Email from MD-LOT to MacArthur Green. Consideration of projects for cumulative assessment.
11 June 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Inclusion of projects (Berwick Bank) in in-combination/ cumulative assessment. PVA Scenarios: Requirement for High/Low displacement and worst-case/most-likely scenario collision. Species requiring assessment and impact pathways. Collision values for Arctic tern and great skua. PVA threshold and reference populations.
18 June 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. PVA with and without Berwick Bank, worst-case/ most-likely scenarios, restricted build areas, reference populations, contents of Addendum reports.
25 June 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. PVA demographic rates, months to consider from aerial survey data, construction vessel impacts
2 July 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting.
9 July 2024	Offshore Ornithology Online Meeting	NatureScot consultation meeting. Consideration of uncertainty in assessment, provision of summary of consultation advice in Addendum, construction vessel imacts.
9 July 2024	OWPL – email.	MacArthur Green email to NatureScot. Request for advice on using density independent PVA models
9 July 2024	Offshore Ornithology Consultee – email.	NatureScot response to confirm that they are content for the PVA models to be density independent.

4 BASELINE CHARACTERISATION

19. This section describes the current baseline found within and around the OAA and Export Cable Corridor (ECC) which together, comprise the offshore Project area. The baseline characterisation is based on data collected for the Project-specific DAS plus relevant desk-based surveys.

4.1 Offshore ornithology survey area

20. A series of project-specific aerial surveys using digital video techniques were undertaken from July 2020 to September 2022 by HiDef. The data collected during the DASs have been used to identify the bird species present and their seasonal density and abundance.

21. Full methodology details of the DAS data collection and subsequent data analysis are provided in the **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report** and supporting annexes to that report.

22. The offshore ornithology survey area has been defined as being an area relevant at a biologically meaningful scale for the consideration of potential impacts on offshore ornithological features. The suitability of the survey area for the purpose of baseline characterisation and environmental impact assessment was agreed in November 2018 with NatureScot (at the time SNH), prior to DASs commencing in July 2020 (see consultation **Table 3-1**). The survey area for baseline characterisation comprises the OAA plus a 4 km buffer around it (**Figure 7-1**).

23. It should be noted that analysis of displacement impacts has used all data from the OAA plus a 2 km buffer, and for collision risk analysis, flight data from the OAA only, as per NatureScot guidance notes #8 and #7 respectively.

24. OWPL commenced the DAS programme ahead of the ScotWind leasing round which meant that the survey area was defined as the expected development area within the N1 Plan Option, rather than a refined OAA. Therefore, between July 2020 and January 2021 the survey area extent was 1,290 km^2 comprising the expected development area and a 4 km buffer. From February 2021 to September 2022, the survey area was modified slightly to reflect the refinement of the preferred OAA (ahead of the ScotWind bid application). This increased the survey area extent to 1,321 km^2 (OAA plus 4 km buffer) due to a revision of the boundary in the south-east corner (see **Figure 7-1**). This change in area was both small in absolute terms (31.1 km^2) as well as being a relatively very small part of the overall aerial survey area shown shaded on **Figure 7-1** (2.4%) or the OAA plus 4 km buffer (4%).

25. This change has been discussed with NatureScot and it was agreed that it caused no issue for determining baseline characterisation and analysis (email dated 26 February 2024).

26. The DAS transect lines, flown in a north-south axis, were separated by 2 km across the 1,290 km^2 and 1,321 km^2 survey areas in July 2020 to January 2021 and February 2021 to September 2022, respectively (see section 4.1 for description of modification to survey area). The DAS programme comprised a total of 27 DASs, generally one per month (with the exception of none in January 2022 and two surveys in February 2022), with a 12.5%. coverage, to provide distribution and density/abundance data for all observed species.

27. The baseline DAS provided information on species (or species-groups if species identification is not possible), abundance, distribution, behaviour, location, numbers, sex and age (where possible from plumage characteristics) and direction. It should be noted that flight height estimation from DAS is subject to a large degree of uncertainty and these data are not

currently supported for use in assessment of collision risk. Consequently, no flight height data from the digital aerial surveys are presented.

28. The data gathered allows baseline characterisation of the site, in the absence of any OWF impacts, i.e., seasonal differences and activities (foraging, overwintering, migrating or other) in order to determine the importance of the site relative to the wider area for seabird populations throughout the year.

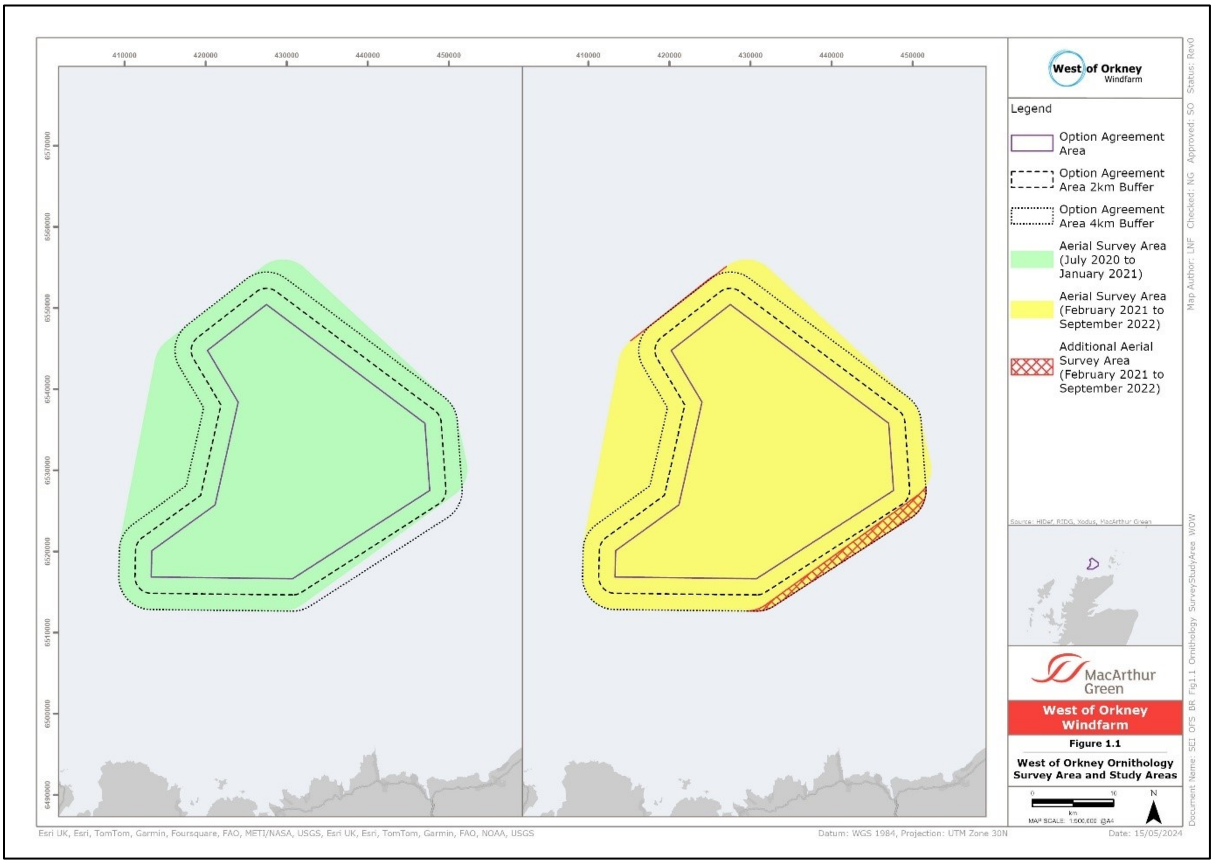


Figure 7-1. Offshore ornithology survey areas.

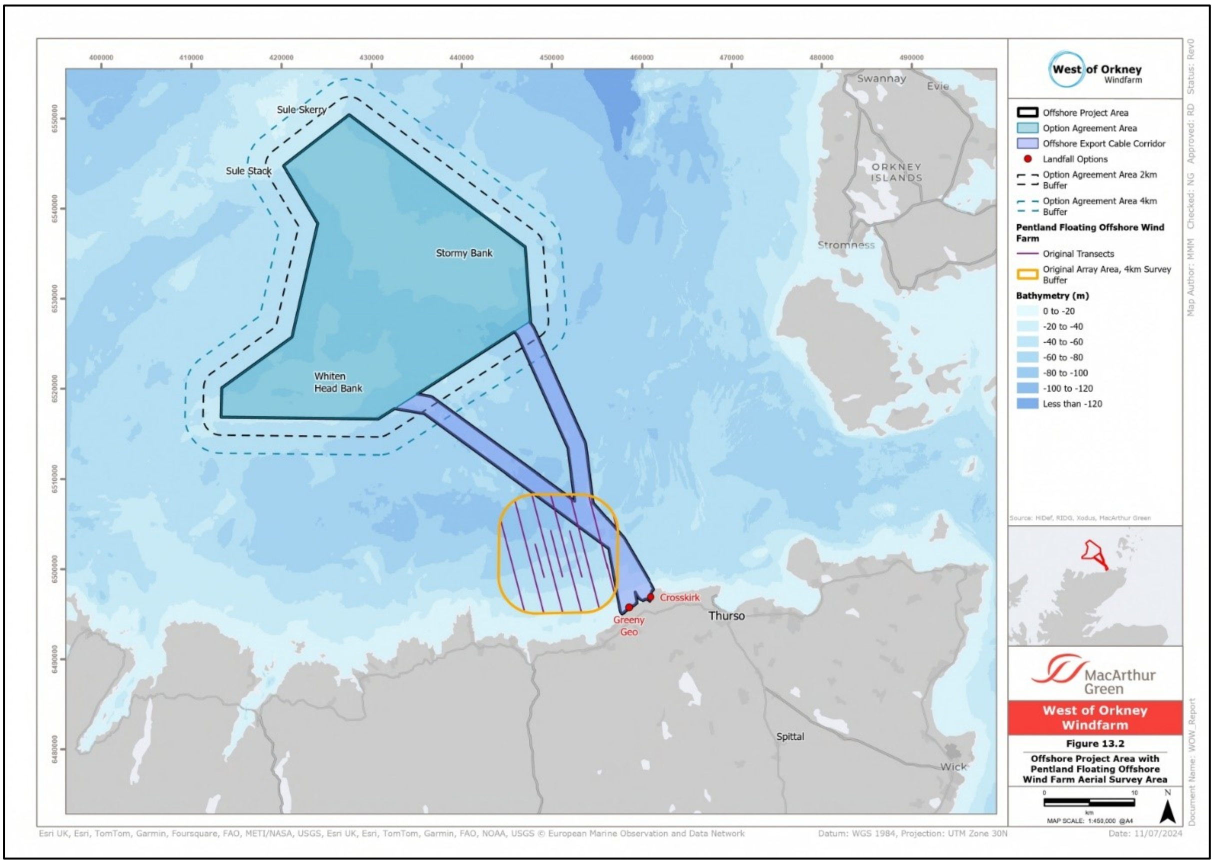


Figure 7-2. Offshore Project area with Pentland Floating Offshore Wind Farm aerial survey area.

4.2 Offshore ECC

29. In addition to the OAA plus a 4 km buffer covered by DAS, the area over which potential impacts on offshore bird species are considered includes the ECC (within which the offshore export cables would be installed) beyond the OAA up to and including the intertidal zone at Greeny Geo and/or Crosskirk, ending at the MHWS (Figure 7-2).

30. Owing to the short-term nature and small spatial scale of potential impacts on birds from installation of the offshore export cables, no DASs of the offshore ECC were undertaken. The exception to this is the area beyond the OAA which overlaps with the ECC (see **Figure 7-2**). Therefore other data sources were reviewed, in particular the DASs conducted for the Pentland Floating Offshore Wind Farm (PFOWF, see **Table 4-1**), which are considered appropriate to inform the baseline characterisation of the offshore ECC (see section 6.6).

4.3 Landfall

31. For intertidal and nearshore ornithological features, the two relatively small areas selected for the landfall at Greeny Geo and/or Crosskirk were surveyed using the standard Wetland Bird Survey (WeBS) Core Counts method (Gilbert et al., 1998). Counts were made from vantage points within a seven-hour period, commencing 3.5 hours before low tide and finishing 3.5 hours after low tide. All species using the intertidal zone or nearshore waters within the onshore Project area and 500 m buffer were recorded (see Onshore EIA Report,

Volume 2, Supporting Study 8: Terrestrial Ornithology Technical Survey Report and Onshore EIA Report, chapter 11: Terrestrial ornithology for details).

4.4 Data sources

32. The existing datasets (including project-specific and desk-based) and literature with relevant coverage to the offshore Project, which have been used to inform the baseline characterisation for offshore ornithology are outlined in **Table 4-1**.

33. Desk-based data sources to describe the baseline environment include both peer-reviewed scientific literature and 'grey literature' such as other OWF project submissions and reports. Published literature on seabird ecology and distribution, and on the potential impacts of windfarms have also been considered.

Table 4-1. Summary of key datasets and reports.

Title	Description	Year	Author	Location in report where reference is used
Project-specific DAS data	HiDef DAS data recorded in the OAA plus a 4 km buffer. Data available in Annex 1A to the Appendix 1: EIA and HRA Baseline site Characterisation Technical Report.	2020 to 2022	HiDef	Data used to calculate bird density and abundance estimates in impact assessment (section 7).
PFOWF Environmental Impact Assessment Report	Baseline DAS data collected in 2015 and 2020/21. EIA Report available at: https://marine.gov.scot/node/22753.	2022	Pentland Floating Offshore Wind Farm (HiDef surveys)	Baseline data used to inform the baseline characterisation for offshore ECC (section 6.6).
Britain & Ireland Seabirds Count – the fourth Breeding Seabird Census	Colony counts of 25 species surveyed within Britain & Ireland. See https://jncc.gov.uk/our-work/seabirds-count/.	2015 to 2021	Burnell *et al.* (2023)	Data used to estimate regional population sizes (see Table 6-9).
Seabird Monitoring Programme (SMP) database	Colony data to determine seabird sites with potential connectivity. Data available at: https://app.bto.org/seabirds/public/data.jsp.	2000 to 2023	Coordinated by BTO	Data used to assess regional population estimates (section 6.2).
UK seabird colony counts in 2023 following the 2021-22 outbreak of Highly Pathogenic Avian Influenza.	Trends in colony counts of target seabird species affected by Highly Pathogenic Avian Influenza (HPAI), compared to 2015-2021 Seabirds Count.	2023	Tremlett *et al.* (2024)	Used to determine influence of HPAI on baseline results and future trends (see section 6.9).
NatureScot Scientific Advisory Committee Sub-Group on Avian Influenza Report on the H5N1 outbreak in wild birds 2020-2023	An assessment of the current and emerging impact and knowledge base of HPAI on wild bird populations in Scotland. Available at: https://www.nature.scot/doc/naturescot-scientific-advisory-committee-sub-group-avian-influenza-report-h5n1-outbreak-wild-birds.	2020-2023	NatureScot (2023)	Used to determine influence of HPAI on baseline results and future trends (see section 6.9).
Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)	Report for Natural England to define species-specific non-breeding season seabird populations at BDMPS to enable the apportioning of potential impacts of marine renewable developments during the non-breeding season.	2015	Furness (2015)	See Table 6-4 and Table 6-6. Used to estimate overall annual mortality on the regional population by determining non-breeding season periods and population sizes.
Scientific paper entitled 'Distribution	Species Distribution Model (SDM) maps showing	2020	Waggitt *et al.* (2020)	Information used to assess importance of wider area

Title	Description	Year	Author	Location in report where reference is used
maps of cetacean and seabird populations in the North-East Atlantic'	predicted densities of seabirds (including key species kittiwake, puffin, guillemot, fulmar, storm-petrel, great skua, gannet and razorbill) around the British Isles available at: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.13525.			surrounding the offshore Project for key species in impact assessment (section 7).
Orkney Islands Council report entitled 'State of the Environment Assessment: A baseline assessment of the Orkney Islands Marine Region'	Report available at: https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/20210107-OIC-Report-V9-screen%20v2.pdf.	2020	Orkney Islands Council	Information used to assess importance of wider area surrounding the offshore Project for key species in impact assessment (section 7).
Scientific paper entitled 'GPS tracking reveals highly consistent use of restricted foraging areas by European Storm-petrels *Hydrobates pelagicus* breeding at the largest UK colony: implications for conservation management'	Tracks of storm-petrels from Shetland, available at: BCI_2000037 35.52 (cambridge.org).	2021	Bolton (2021)	Used in the assessment of artificial lighting impacts on storm-petrels (see sections 7.6.2 and 7.7.4).
Scientific paper entitled 'Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species'	Models showing distribution of four breeding seabird species (shag, kittiwake, guillemot and razorbill) around the British Isles. Paper available at: Ecological Applications, 27(7), pp.2074-2091, available at: https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.1591.	2017	Wakefield *et al.* (2017)	Information used to assess importance of wider area surrounding the offshore Project for key species in impact assessment (section 7).
Mapping Seabird Sensitivity to Offshore Wind Farms.	Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0106366	2014 (corrected in 2017)	Bradbury et al. (2017)	Information used to assess importance of wider area surrounding the offshore Project for key species in impact assessment (section 7).
Combining habitat modelling and hotspot analysis to reveal the location of high density seabird	Model predictions of seabird hotspot distributions around the UK. RSPB Research Report no. 63 available at: https://www.rspb.org.uk/glob	2018	Cleasby *et al.* (2018)	Information used to assess importance of wider area surrounding the offshore Project for key species in

Title	Description	Year	Author	Location in report where reference is used
areas across the UK. Technical Report	alassets/downloads/documents/conservation-science/cleasby_owen_wilson_bolton_2018.pdf.			impact assessment (section 7).
Marine Scotland Science Report 04/14: Statistical Modelling of Seabird and Cetacean data: Guidance Document	Guidance document focusing on statistical issues related to improving wildlife surveys in the measurement of distribution of animals in areas of near-shore and off-shore renewable energy development. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Mackenzie-et-al-2014.pdf.	2013	Mackenzie *et al.* (2013)	In line with guidance, DSM for key bird species recorded during site-specific DAS were produced. Details are in Annex 1O and Annex 1R of the Appendix 1: Baseline Site Characterisations Technical Report.

4.5 Data limitations and uncertainties

34. The marine environment is highly variable, both spatially and temporally. The baseline characterisation for this assessment is based on 27 months of DAS data which are considered to be representative of the OAA plus 4 km buffer for the purpose of impact assessment.

35. Although no project-specific DASs were undertaken within the majority of the offshore ECC, sufficient data are considered to be available from other sources to inform a robust assessment from cable installation, operation and maintenance and decommissioning activities.

5 ASSESSMENT METHODOLOGY

36. The assessment for offshore ornithology is undertaken following the principles set out in Offshore EIA Report chapter 7: EIA methodology, tailored to make it applicable to offshore ornithological features, and aligned with the key guidance document produced on impact assessment of ecological/ornithological features (CIEEM, 2022).

37. The CIEEM (2022) guidance states that '*significance is a concept related to the weight that should be attached to effects when decisions are made so that the decision maker is adequately informed of the environment consequences of permitting a project*'. CIEEM (2022) defines significance as follows: '*In broad terms, significant effects encompass impacts on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance, and distribution). Significant effects should be qualified with reference to an appropriate geographic scale, for example a significant effect on a Site of Special Scientific Interest … is likely to be of national significance*.'

38. The assessment uses a 'source-pathway-feature' approach, which identifies likely impacts on Important Ornithological Features (IOFs) resulting from the proposed construction, operation and decommissioning of the offshore infrastructure.

39. IOFs are defined here as being those species recorded during the DAS, or identified from desk based studies and consultation (e.g., in the case of vessel movements to and from port), which are considered to be at potential risk either due to their abundance, potential sensitivity to offshore wind farm impacts or due to biological characteristics which make them potentially susceptible (e.g. commonly fly at rotor heights).

40. The parameters of the 'source-pathway-feature' approach are defined as follows:

- Source – the origin of a potential impact (noting that one source may have several pathways and features), e.g. an activity such as WTG installation and a resultant effect such as the presence of a new WTG structure in the offshore environment;
- Pathway – the means by which the impact of the activity could affect an IOF, e.g. for the example above, presence of a WTG could potentially cause a collision risk; and
- 'Features', or IOFs, as per CIEEM (2022) guidance, can be defined as the element of the receiving environment that is impacted, e.g., bird species foraging within or passing through the wind farm.

41. The sensitivity of the IOF is combined with the magnitude of impact to determine the effect significance. Sensitivity and magnitude criteria are assigned based on professional judgement, as described below.

5.1 Sensitivity

42. **Table 5-1** provides example definitions of the different sensitivity levels for ornithology features using as an example the potential impact of disturbance through construction activity.

Table 5-1. Sensitivity criteria for Ornithological Features.

Sensitivity of feature	Definition
High	Ornithological feature (bird species) has very limited tolerance of a potential impact, e.g. strongly displaced by sources of disturbance such as noise, light, vessel movements and the sight of people.
Medium	Ornithological feature (bird species) has limited tolerance of a potential impact, e.g. moderately displaced by sources of disturbance such as noise, light, vessel movements and the sight of people.
Low	Ornithological feature (bird species) has some tolerance of a potential impact, e.g. partially displaced by sources of disturbance such as noise, light, vessel movements and the sight of people.
Negligible	Ornithological feature (bird species) is generally tolerant of a potential impact e.g. not displaced by sources of disturbance such as noise, light, vessel movements and the sight of people.

43. It should be noted that although sensitivity is a core component of the assessment, conservation value (**Table 5-2**) is also taken into account in determining each potential impact's significance of effect. Furthermore, high conservation value and high sensitivity are not necessarily linked within a particular impact. A feature could be categorised as being of high conservation value (e.g. a qualifying feature of a SPA) but have a low or negligible

physical/ecological sensitivity to an effect and vice versa. Determination of potential effect significance takes both of these into consideration.

44. The conservation value of ornithological features is based on the population from which individuals are predicted to be drawn. This reflects current understanding of the movements of bird species. Therefore, conservation value for a species can vary through the year depending on the population from which they are estimated to be drawn. Using this approach, the conservation importance of a species seen at different times of year may fall into any of the defined categories.

45. Definitions of the conservation value levels for ornithological features are given in **Table 5-2**. These are related to connectivity with populations that are protected as qualifying features of SPAs. SPAs are internationally designated sites which carry strong protection for populations of qualifying bird species and are therefore a key consideration for the ornithology assessment.

Table 5-2. Definitions of the Conservation Value Levels for an Ornithological Feature.

Value	Definition
High	A species for which all, or nearly all, individuals at risk are connected to a particular SPA or SPAs.
Medium	A species for which some individuals at risk are drawn from SPA population(s), although other non-SPA populations may also contribute to individuals at risk.
Low	A species for which individuals at risk have no known connectivity to SPAs, or for which no SPAs are designated.

5.2 Magnitude of impact

46. The definitions of the magnitudes of impact on ornithological features are set out in **Table 5-3**. This set of definitions has been determined on the basis of changes to bird populations.

Table 5-3. Magnitude criteria for an Ornithological Feature.

Magnitude criteria	Definition
High	A change in the size or extent of distribution of the regional population or the population that is the interest feature of a specific designated site that is predicted to irreversibly alter the population in the short-to-long term and to alter the long-term viability of the population and / or the integrity of the designated site. Recovery from that change predicted to be achieved in the long-term (i.e. more than 5 years) following cessation of the development activity.
Medium	A change in the size or extent of distribution of the regional population or the population that is the interest feature of a specific designated site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and / or the integrity of the designated site. Recovery from that change predicted to be achieved in the medium-term (i.e. no more than five years) following cessation of the development activity.
Low	A change in the size or extent of distribution of the regional population or the population that is the interest feature of a specific designated site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature / population. Recovery from that change predicted to be achieved in the

Magnitude criteria	Definition
	short-term (i.e. no more than one year) following cessation of the development activity.
Negligible	Very slight change from the size or extent of distribution of the regional population or the population that is the interest feature of a specific designated site. Recovery from that change predicted to be rapid (i.e. no more than circa 6 months) following cessation of the development related activity.
No change	No loss of, or gain in, size or extent of distribution of the regional population or the population that is the interest features of a specific designated site. If no change for an ornithological feature was concluded, then the feature was not included in the assessment.

5.3 Significance of effect

47. Following the identification of the ornithological feature's overall sensitivity and the determination of the magnitude of the impact, the significance of the effect can be determined. That determination will be guided by the matrix as presented in **Table 5-4**. Effects shaded red or orange represent those with the potential to be significant in the context of the EIA Regulations as defined in the Offshore EIA Report chapter 3: Planning policy and legislative context.

Table 5-4. Significance of effect.

SIGNIFICANCE OF EFFECT		MAGNITUDE			
		NEGLIGIBLE	LOW	MEDIUM	HIGH
SENSITIVITY	NEGLIGIBLE	Negligible	Negligible	Negligible	Negligible
	LOW	Negligible	Negligible	Minor	Minor
	MEDIUM	Negligible	Minor	Moderate	Moderate
	HIGH	Negligible	Minor	Moderate	Major

48. The categories provide a threshold to determine whether significant effects may result from the offshore Project, with Moderate and Major effects being potentially 'significant' in the context of the EIA Regulations as defined in the Offshore EIA Report chapter 3: Planning policy and legislative context. Minor or Negligible effects are not considered significant in EIA terms. A typical categorisation is shown below (**Table 5-5**), noting that effects can be beneficial or adverse.

Table 5-5. Definitions of significance of effect and associated significance.

Category	Definition
Major	A fundamental change to the ornithological feature, resulting in a significant effect.
Moderate	A material but non-fundamental change to the ornithological feature, resulting in a possible significant effect.
Minor	A detectable but non-material change to the ornithological feature resulting in no significant effect or small-scale temporary changes.
Negligible	No detectable change to the ornithological feature resulting in no significant effect.

49. It is important that the matrix (and indeed the definitions of sensitivity and magnitude) is seen as a framework to aid understanding of how a judgement has been reached from the narrative of each impact assessment. It is not a prescriptive formulaic method. Expert judgement has been applied to the assessment of likelihood and ecological significance of a predicted impact.

50. Where possible, the assessment is based upon quantitative and accepted criteria and/or methods (for example, guidance notes from NatureScot, SNCBs guidance on collision risk modelling (SNCB, 2014), and displacement (SNCB, 2017; updated 2022)), and/or biological removal thresholds determined through population modelling), together with the use of value judgement and expert interpretation to establish to what extent an effect is significant.

6 EXISTING BASELINE

51. A review of Project site-specific surveys, literature and other available data sources, augmented by consultation, has been undertaken to describe the current baseline environment for offshore ornithology.

6.1 Designated sites

52. In order to determine the conservation value of IOFs (see sensitivity assessment method in **section 5.1**), the impact assessment considers potential connectivity of the OAA and the offshore ECC with statutory designated sites with ornithological qualifying features. Two classes of statutory designated sites are considered: SPAs and Ramsar sites.

53. SPAs and Ramsar sites which may have connectivity to the OAA and/or offshore ECC include those designated for breeding and non-breeding seabirds, marine sites designated for wintering waterfowl and roosting gulls, and terrestrial or coastal sites which contain migratory species.

54. Seabird breeding sites may be connected during the breeding season (e.g. the OAA is within foraging range of breeding birds) or during the non-breeding season (e.g. birds pass through during spring and autumn migration or are present overwinter), or during both periods. Wintering waterfowl sites may be connected to the Project through vessels associated with the Project passing through or close to sites. Terrestrial/coastal sites designated for migrant species outside the breeding season may be connected on the grounds of passage movements through the OAA.

55. As seabirds can travel long distances it is necessary to give consideration to designated sites beyond the OAA and offshore ECC boundaries. The OAA and offshore ECC do not overlap with any SPA or Ramsar site, although the OAA lies <2km from the boundary of the Sule Skerry and Sule Stack SPA and the OAA and ECC are within foraging range of species from other SPAs. The landfall locations also lie within 2km of the North Caithness Cliffs SPA.

56. Following NatureScot online guidance, (Guidance Note #3) during the breeding season, qualifying features of SPAs and Ramsar sites were considered to have potential connectivity with the offshore Project if the mean of the maximum foraging range (km) plus one Standard

Deviation (SD) of the mean (+1SD hereafter) overlap with the OAA plus 2 km buffer and/or the offshore ECC plus 2 km buffer. Foraging ranges were taken from Woodward *et al*. (2019).

57. Full consideration of connectivity of SPAs and Ramsar sites is provided in **Appendix 2 - HRA: HRA Screening Technical Report** and the **Addendum to the RIAA – Ornithology**. These cover in more detail matters associated with statutory site designations and have been informed by consultation as part of the application and post-application process (see **Introduction to the Additional Ornithology EIA Information and HRA Addendum** and summary in **Table 3-1**). The HRA screening report has identified a long list of UK SPAs and Ramsar sites for which a Likely Significant Effect could not be ruled out and therefore the sites require further consideration in relation to the potential effects from the Project to cause an adverse effect on site integrity. The remaining UK SPA and Ramsar sites were not considered to have theoretical connectivity or to have an impact pathway in relation to the offshore Project.

6.2 Counts of seabird colonies

58. Through the British Trust for Ornithology's Seabird Monitoring Programme (SMP)[9], annual monitoring of 25 species of seabird that breed regularly in Britain and Ireland has been undertaken since 1986 to the present time. Breeding numbers are regularly monitored at many colonies, and in the British Isles there have been four comprehensive censuses of breeding seabirds in 1969-70, 1985-88, 1998-2002 (Mitchell *et al*., 2004), and 2015-2021 (Burnell *et al*., 2023) as well as single-species surveys (such as the decadal counts of breeding gannet numbers, Murray *et al*., 2015). The most recent surveys of breeding seabirds, from Seabirds Count (Burnell *et al*., 2023) were used in this assessment.

6.3 Regional distribution of seabirds

59. Aerial and vessel survey data, as well as data from GPS tagged birds, have been presented in a range of studies to show spatial and temporal distributions of seabirds, including the key seabird species assessed in this report, around the UK (Kober *et al.*, 2010; Waggitt *et al*., 2020; Bradbury *et al*., 2017; Wakefield *et al*., 2017; Cleasby *et al*., 2018). These data have been used to predict densities of seabirds in the north-east Atlantic (Waggitt *et al*., 2020), predict hotspots of distribution around Orkney and Caithness (Cleasby *et al*., 2018), map seabird sensitivity to offshore windfarms in English territorial waters (Bradbury *et al*., 2017) and identify possible SPAs in the marine environment (Kober *et al.*, 2012). These studies have provided background information on how seabirds utilise the area surrounding the offshore Project (**Table 4-1**).

6.4 GPS tracking of seabirds

60. Tracking studies for key seabird species within foraging range (mean maximum +1SD) to the offshore Project are available from the BirdLife International Seabird Tracking Database (**Table 4-1**); these data have been used as additional context to aid understanding of patterns in bird abundance and distribution.

[9] https://www.bto.org/our-science/projects/seabird-monitoring-programme.

6.5 The OAA

61. A summary of the baseline environment for offshore ornithology is provided in the following sections. Full details of the analysis undertaken to develop the offshore ornithology baseline is provided in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report**, which includes information on survey design and methods, as well as the analysis techniques implemented to characterise the baseline environment.

6.5.1 Baseline digital aerial surveys

62. A total of 27 site-specific baseline DASs were carried out within the OAA plus 4 km buffer between July 2020 and September 2022. This area was used to gather data for baseline characterisation (with data from the OAA plus 2km buffer used for determining displacement impacts, and flight data from the OAA only used for collision risk analysis).

63. Seabird abundance estimates from the site-specific digital aerial surveys and how they were derived are presented in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report**. Detail from the baseline report has not been repeated within this chapter in order to present a clear and concise impact assessment.

64. Based on NatureScot's offshore guidance notes, species taken forward for assessment are those which were recorded during DASs and which are considered to be at potential risk either due to their abundance, potential sensitivity to offshore wind farm impacts or due to biological characteristics (e.g. commonly fly at rotor heights) which make them potentially susceptible.

A summary of total raw counts of seabirds recorded during DASs is presented in **Table 6-1** and **Table 6-2.**

65. Table 6-2Some species were recorded rarely within the offshore survey area. Therefore, to concentrate the scope of the assessment on species which may be subject to significant effects (the IOFs), any species that had fewer than a total of ten records within the offshore survey area across all 27 surveys (**Table 6-2**) was considered to have a trivial abundance and is therefore not taken forward to assessment due to a lack of potential for significant effects.

66. Twelve seabird species were recorded in non-trivial abundance in the Survey Area (**Table 6-1**). Raw counts from a survey were categorised as being from the breeding season or non-breeding season according to NatureScot Guidance Note 9. Most species were present in both the breeding and non-breeding season. Of the 12 species present in non-trivial numbers, three species were not observed in the offshore survey area in the non-breeding season: European storm-petrel, Arctic tern and Manx shearwater.

Table 6-1. Raw counts of seabirds recorded in non-trivial numbers during DASs of the OAA plus 4 km buffer.

Counts are the sum of all individuals recorded within strip transects, on each of the 27 surveys (July 2020 – September 2022). This table shows species with more than 10 records across all 27 surveys, i.e. species that were present in non-trivial abundance. Green cells indicate a survey was during that species' breeding season, orange cells indicate a month which is split between the breeding and non-breeding season, blue cells indicate a survey was during the non-breeding season.

Date of survey	Guillemot	Puffin	Fulmar	Gannet	Kittiwake	Great black-backed gull	Razorbill	Great skua	European storm-petrel	Arctic tern	Herring gull	Manx shearwater
Jul-20	441	322	173	125	37	0	2	3	0	0	0	0
Aug-20	168	284	223	265	39	0	2	38	1	0	0	0
Sep-20	533	26	434	198	2	0	12	0	11	0	0	1
Oct-20	489	16	465	137	186	4	0	1	0	0	0	0
Nov-20	64	1	247	4	30	16	1	1	0	0	4	0
Dec-20	110	0	585	9	16	11	0	0	0	0	0	0
Jan-21	178	1	361	4	15	11	0	0	0	0	2	0
Feb-21	313	1	54	12	33	30	10	0	0	0	1	0
Mar-21	389	0	179	12	205	4	9	0	0	0	1	0
Apr-21	904	174	60	66	81	0	21	9	0	0	0	0
May-21	77	52	32	82	10	0	3	3	0	0	2	0
Jun-21	139	713	0	38	21	2	12	0	0	23	0	2
Jul-21	216	348	44	58	17	0	0	4	0	0	0	0
Aug-21	428	296	214	159	0	0	16	3	36	3	0	1
Sep-21	541	357	134	188	20	0	10	0	5	0	0	0
Oct-21	431	27	300	224	107	0	3	0	0	0	0	1
Nov-21	142	0	262	8	16	31	1	0	0	0	1	0
Dec-21	209	2	301	3	7	60	3	0	0	0	0	0
Feb-22	37	0	203	11	16	14	0	0	0	0	0	0
Feb-22	69	0	268	12	65	22	5	0	0	0	2	0
Mar-22	42	0	364	31	231	5	18	0	0	0	1	0
Apr-22	228	175	87	125	26	0	0	1	0	0	0	0
May-22	335	762	37	59	17	0	1	2	0	1	0	0
Jun-22	290	789	27	67	11	0	0	6	0	0	0	0
Jul-22	968	705	69	64	237	0	23	3	0	6	0	3
Aug-22	721	681	82	44	7	0	5	2	0	11	0	2
Sep-22	565	86	280	109	6	0	44	1	0	0	0	2
TOTAL	**9,027**	**5,818**	**5,485**	**2,114**	**1,458**	**210**	**203**	**77**	**53**	**44**	**14**	**12**

Table 6-2. Raw counts of marine birds recorded in trivial numbers during DASs within the OAA plus 4 km buffer.

Counts are the sum of all individuals recorded within strip transects, on each of the 27 surveys (July 2020 – September 2022). This table shows species with fewer than 10 records across all 27 surveys, i.e. species that were present in the OAA plus 4 km buffer in trivial abundance.

Date of survey	Little auk	Arctic skua	European Shag	Great northern diver	Red-throated diver	Sooty shearwater	Common tern	Black guillemot	Lesser black-backed gull	Little gull	Common gull	Cory's shearwater	Black-headed gull	Great shearwater
Jul-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-20	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Sep-20	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Oct-20	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Nov-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jan-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb-21	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr-21	0	0	3	0	0	0	0	0	0	0	1	0	0	0
May-21	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Jun-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul-21	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Aug-21	0	0	0	0	0	2	0	0	2	0	0	1	0	0
Sep-21	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Nov-21	5	0	0	0	1	0	0	0	0	0	0	0	0	0
Dec-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb-22	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Feb-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr-22	0	0	0	0	0	0	0	0	0	0	0	0	1	0
May-22	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Jun-22	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Jul-22	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Aug-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-22	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	**8**	**5**	**4**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**

67. The list of seabird species taken forward to assessment as IOFs was agreed with NatureScot during pre-application consultation (Scoping Opinion Response provided a minimum list of species expected to be assessed). This comprised all species in **Table 6-1** with the exception of herring gull, which was not taken forward for assessment due to the low counts within

the OAA and 4 km buffer (and lack of nocturnal behaviour that may make it susceptible to artificial lighting impacts).

68. Although NatureScot advised (27 March 2024) that Leach's petrel may be screened in for potential impacts associated with artificial lighting, the species was absent from baseline surveys and so is not considered further.

69. The conservation status, including population trends in relation to climate change, of the species taken forward for assessment is provided in **Table 6-3**. Estimated abundances and distributions of all species observed are presented in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report**.

Table 6-3. Summary of Nature Conservation Status of Seabird Species Screened into Assessment as IOFs.

Species	Scientific name	Conservation status
Kittiwake	*Rissa tridactyla*	BoCC Red listed (Stanbury *et al.* 2024), Birds Directive Migratory Species, IUCN Red List 'Vulnerable' status. 'High risk'[10] breeding population vulnerability to climate change (Pearce-Higgins, 2021).
Great black-backed gull	*Larus marinus*	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'High risk' breeding population vulnerability to climate change.
Arctic tern	*Sterna paradisaea*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'High risk' breeding population vulnerability to climate change.
Great skua	*Stercorarius skua*	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. Not assessed breeding population vulnerability to climate change.
Guillemot	*Uria aalge*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'Medium risk' breeding population vulnerability to climate change.
Razorbill	*Alca torda*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Near Threatened' status. 'Medium risk' breeding population vulnerability to climate change.
Puffin	*Fratercula arctica*	BoCC Red listed, Birds Directive Migratory Species. 'High risk' breeding population vulnerability to climate change.
European storm-petrel	*Hydrobates pelagicus*	BoCC Amber listed, Birds Directive Migratory Species. IUCN Red List 'Least Concern' status. 'High risk' breeding population vulnerability to climate change.
Fulmar	*Fulmarus glacialis*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'High risk' breeding population vulnerability to climate change.
Gannet	*Morus bassanus*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'Limited impact' breeding population vulnerability to climate change.
Manx shearwater	*Puffinus puffinus*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. Not assessed breeding population vulnerability to climate change.

[10] *The vulnerability score of species' populations in relation to climate change is derived from various studies and modelling, as described in Pearce-Higgins et al. (2021). Levels range from high risks to high benefits.*

6.5.2 Biological seasons

70. Impacts on bird species recorded during the site-specific DAS have been assessed in this chapter in relation to relevant breeding and non-breeding biological seasons, as advised in the NatureScot Guidance Note 9. A summary is presented in **Table 6-4**.

71. NatureScot guidance defines some months as being split between the breeding and non-breeding seasons, e.g. for kittiwake, the first half of April is considered to be part of the non-breeding season, and the second half of April is part of the breeding season.

72. For the non-breeding season, BDMPS seasons, taken from Furness (2015), are also presented in **Table 6-4**.

Table 6-4. Seasonal definitions for all species taken forward for assessment, taken from NatureScot Guidance Note 9 and the BDMPS report (Furness, 2015).

Species	NatureScot (2023)		Furness (2015)		
	Breeding season	Non-breeding season	Spring migration	Autumn migration	Winter
Kittiwake	mid-April to August	September to mid-April	January to April	August to December	-
Great black-backed gull	April to August	September to March	September to March (single non-breeding BDMPS season)		
Arctic tern	May to August	September to April[2]	Late April to May	July to early September	-
Great skua	mid-April to mid-September	mid-September to mid-April[1]	March to April	August to October	November to February
Guillemot	April to mid-August	mid-August to March	Single non-breeding season: August to February		
Razorbill	April to mid-August	mid-August to March	January to March	August to October	November to December
Puffin	April to mid-August	mid-August to March	Single non-breeding season: mid-August to March		
European storm-petrel[1]	mid-May to October	November to mid-May	No BDMPS seasons provided for European storm-petrel in BDMPS report		
Fulmar	April to mid-September	mid-September to March	December to March	September to October	November
Gannet	mid-March to September	October to mid-March	December to March	September to November	-
Manx shearwater	April to mid-October	mid-Oct to March[2]	Late March to May	-August to early October	-

1: Species not included in Furness (2015).
2: Not present in significant numbers in Scottish marine areas.

6.5.3 Density and abundance estimates

73. Details of how the density and abundance estimates for each species were estimated from the baseline data are presented in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report**. A summary of this process is provided below in sections 6.5.3.1 to 6.5.3.5.

6.5.3.1 Methods for estimating bird density and abundance: model- vs design-based

74. Two methods were used to estimate bird densities and abundances: design-based and model-based. Design-based methods extrapolate bird density estimated from observations from within the strip transects, across the OAA, OAA plus 2 km buffer, and OAA plus 4 km buffer. Model-based methods fit environmental covariates to bird observations and use these relationships to predict bird density in a grid across the OAA plus 4 km buffer. Each method is described in detail in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report.**

75. The assessment of collision and displacement impacts is based on design-based density and abundance estimates. NatureScot agreed that model-based estimates did not need to be used to inform the impact assessment in a consultation meeting (30 April 2024). However, NatureScot requested that a comparison between design-based and model-based density and abundance estimates was undertaken and presented (Consultation Meeting, 30 April 2024). A comparison of design- and model-based estimates is therefore presented in **Annex 1R: Comparison of design- and model-based abundance estimates**.

6.5.3.2 Density and abundance estimates per survey

76. For each species, density and abundance estimates for each of the 27 surveys were calculated as follows:

- Density estimates for each species for each survey were calculated, using design-based methods, as the raw observation counts divided by the area surveyed;
- Abundance estimates were calculated, using design-based methods, as the density multiplied by the total area over which the abundance was to be estimated (the OAA, and OAA plus 2 km buffer); and
- These simple extrapolations assume similar densities were present in the un-surveyed areas between the strip transects.

6.5.3.3 'Bootstrap' approach to estimate variance around density and abundance estimates

77. The simple extrapolation approach described above does not have any measure of uncertainty associated with it. To quantify uncertainty around density and abundance estimates, a nonparametric bootstrap with 1,000 iterations resampling method was used, summarised as follows:

- Each density and abundance estimate was 'bootstrapped' (refer to **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report** for description) to produce 1,000 density/abundance estimates (resamples) for each of the 27 surveys;

- The SD, lower and upper confidence intervals (lci and uci, which are the 25th and 975th value in the ranked bootstraps) and the coefficient of variation (CV) were extracted from the bootstrapped estimates to provide measures of uncertainty; and
- This resampling process was conducted separately for (i) birds recorded in flight; (ii) birds sat on the water; and (iii) both combined.

6.5.3.4 *Mean densities of birds in flight*

78. Mean density estimates of birds in flight in the OAA in each calendar month are a key input into collision risk modelling (CRM) which estimates the number of birds that might collide with the Project's WTG for each calendar month (**Appendix 3 - EIA and HRA: Collision Risk Modelling Technical Report**).

79. DAS were carried out on a monthly basis over 27 months (**section 6.5.1**). However, NatureScot advise to only use data from complete seasons, starting in March or October, over a two-year period, i.e. 24 months of data (NatureScot online Guidance Note 2). Consequently, mean density estimates for each calendar month of birds in flight in the OAA were calculated using two DAS, one from each year from October 2020 to September 2022. The 24 survey months were used to produce a mean density plus standard deviation of birds in flight for each of the 12 calendar months.

80. To produce a monthly mean density and SD for each species, the bootstrapped resampled estimates (refer to **section 6.5.3.3**) from each survey carried out in that calendar month were collated and a mean and standard deviation taken of all bootstrap estimates. For example, to derive a mean and SD for the calendar month of July, the 1,000 bootstrap estimates from the July 2021 survey and July 2022 surveys were collated into a single data set with 2,000 values. The mean and SD of those 2,000 bootstrap estimates was then taken.

81. Mean densities and SD per calendar month for birds in flight within the OAA for the five species considered to be at risk of collisions (see Impact 5, section 7.7.1.10) are presented in **Table 6-5**.

Table 6-5. Monthly mean density estimates and SDs, in parentheses, of birds in flight in the OAA by calendar month.

These are the mean and SD of all bootstrap estimates from the two digital aerial surveys carried out in that calendar month. The mean densities are inputs to deterministic (Band, 2012) CRM.

	Mean and SD of density (birds/km²) of birds in flight within the OAA											
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kittiwake	0.07 (0.03)	0.23 (0.16)	0.86 (0.29)	0.28 (0.16)	0.07 (0.05)	0.04 (0.02)	0.63 (0.68)	0.01 (0.01)	0.13 (0.13)	0.63 (0.18)	0.2 (0.09)	0.05 (0.02)
Great black-backed gull	0.04 (0.03)	0.04 (0.03)	0 (0.01)	0 (0)	0 (0)	0.01 (0.02)	0 (0)	0 (0)	0 (0)	0.01 (0.01)	0.06 (0.04)	0.09 (0.08)

	Mean and SD of density (birds/km²) of birds in flight within the OAA											
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arctic tern	0 (0)	0 (0)	0 (0)	0 (0)	0.01 (0.01)	0.07 (0.12)	0.01 (0.02)	0.01 (0.01)	0 (0)	0 (0)	0 (0)	0 (0)
Great skua	0 (0)	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0.01 (0.01)	0.01 (0.01)	0 (0)	0 (0)	0 (0)	0 (0)
Gannet	0.01 (0.01)	0.07 (0.04)	0.13 (0.1)	0.3 (0.08)	0.24 (0.16)	0.21 (0.06)	0.3 (0.07)	0.32 (0.28)	0.49 (0.22)	0.58 (0.11)	0.01 (0.01)	0.03 (0.02)

6.5.3.5 Mean seasonal peak abundance estimates of birds in flight and on sea

82. Mean Seasonal Peak (MSP) abundance estimates per biological season of all birds (flying and on the sea) in the OAA plus 2 km buffer are a key input into the displacement assessment which estimates mortality of displaced birds for each biological season (**Appendix 4 - EIA and HRA: Displacement Technical Report**).

83. Based on NatureScot Guidance Note 8, MSP abundance estimates were calculated as the peak abundance for each complete season, with seasonal peaks from each of the two years of survey then averaged. Following NatureScot advice (letter dated 3 June 2024), only complete seasons were used to calculate MSPs. As advised by NatureScot (3 June 2024), aerial survey data collected in August and September 2020 (i.e., prior to the first full non-breeding season) were also used to calculate MSPs for some species where these months were part of a complete season (e.g. August and September were included in the kittiwake autumn migration period, refer to **Table 6-6**).

84. Mean densities and SD per calendar month for birds in flight and on the sea within the OAA plus 2km buffer are presented in **Table 6-6** for each species included in the displacement assessment (see Impact 4, section 7.7.1).

Table 6-6. Summary of Annual and Mean Seasonal Peak (MSP) abundance calculations of birds recorded in flight and on the sea in the OAA plus 2 km buffer.

MSPs are presented for the breeding season (green), NatureScot non-breeding season (blue), and BDMPS spring migration (yellow), autumn migration (orange) and winter (purple).

Species and season	Seasonal abundance peaks in the OAA plus 2 km buffer (survey date month/year) Year 1	Year 2	MSP
Kittiwake			
Breeding season (NatureScot)	4,96.4 (Apr-21)	1,729.1 (Jul-22)	1112.7
Non-breeding season (NatureScot)	1,185.0 (Mar-21)	1,248.5 (Mar-22)	1,216.8
Spring migration (BDMPS)	1,185.0 (Mar-21)	1,248.5 (Mar-22)	1,216.8
Autumn migration (BDMPS)	1,000.3 (Oct-20)	5,97.1 (Oct-21)	798.7

Species and season	Seasonal abundance peaks in the OAA plus 2 km buffer (survey date month/year)		
	Year 1	Year 2	MSP
Arctic tern			
Breeding season (NatureScot)	178.3 (Jun-21)	70.2 (Aug-22)	124.3
Non-breeding season (NatureScot)	0.0 (Sep-20 to Apr-21)	0.0 (Sep-21 to Apr-	0.0
Spring migration (BDMPS)	0.0 (Apr-21 to May-21)	7.8 (May-22)	3.9
Autumn migration (BDMPS)	23.2 (Aug-21)	70.2 (Aug-22)	46.7
Guillemot			
Breeding season (NatureScot)	6887.4 (Apr-21)	9057.7 (Jul-22)	7972.5
Non-breeding season (NatureScot)	4516.7 (Sep-20)	4269.2 (Sep-21)	4392.9
Razorbill			
Breeding season (NatureScot)	139.6 (Apr-21)	142.8 (Jul-22)	141.2
Non-breeding season (NatureScot)	93.0 (Sep-20)	170.6 (Mar-22)	131.8
Spring migration (BDMPS)	92.9 (Feb-21)	170.6 (Mar-22)	131.8
Autumn migration (BDMPS)	93.0 (Sep-20)	131.6 (Aug-21)	112.3
Winter (BDMPS)	7.8 (Nov-20)	31.0 (Dec-21)	19.4
Puffin			
Breeding season (NatureScot)	4,930.0 (Jun-21)	5,613.7 (Jun-22)	5271.9
Non-breeding season (NatureScot)	1,544.6 (Aug-20)	2,727.3 (Sep-21)	2135.9
Fulmar			
Breeding season (NatureScot)	1,270.0 (Aug-21)	1,802.3 (Sep-22)	1536.1
Non-breeding season (NatureScot)	3,463.9 (Dec-20)	2,264.4 (Mar-22)	2864.1
Spring migration (BDMPS)	3,463.9 (Dec-20)	2,264.4 (Mar-22)	2864.1
Autumn migration (BDMPS)	3,191.9 (Sep-20)	1,690.4 (Oct-21)	2441.1
Winter (BDMPS)	1,085.7 (Nov-20)	541.8 (Nov-21)	813.8
Gannet			
Breeding season (NatureScot)	891.0 (Sep-21)	812.3 (Apr-22)	851.7
Non-breeding season (NatureScot)	884.0 (Oct-20)	1,457.8 (Oct-21)	1170.9
Spring migration (BDMPS)	77.5 (Feb-21)	201.6 (Mar-22)	139.5
Autumn migration (BDMPS)	1,278.3 (Sep-20)	1,457.8 (Oct-21)	1368.0

6.5.4 Regional population sizes

85. Impacts on each species' population have been assessed in relation to relevant 'regional' populations. The regional population against which impacts were assessed was defined as the sum count of all colonies collated by the 4th National Seabird Census 'Seabirds Count' data (Burnell *et al.*, 2023) (divided by the estimated adult proportion to obtain an all-age class

estimate) within species-specific foraging range defined by Woodward *et al*. (2019) of the OAA plus 2 km buffer. This approach was advised by NatureScot during a consultation meeting (11 June 2024). The Seabirds Count spreadsheet is available from the JNCC website (Version last updated December 2023[11]).

86. Following NatureScot Guidance Note 3, for guillemot and razorbill colonies in the Northern Isles, the mean max+1SD foraging range values which include data from Fair Isle were used as presented in Woodward *et al*. (2019); for guillemot and razorbill colonies south of the Pentland Firth, mean max+1SD foraging range values which discount data from Fair Isle were used as presented in Woodward *et al*. (2019).

87. Regional populations were not estimated for Manx shearwater or European storm-petrel, as the identified impact pathways for these species only required a qualitative assessment (artificial lighting impacts during construction and operation – see section 7.1).

88. The regional populations were calculated as follows:

- For each species included in the assessment, all breeding colonies (both SPA and non-SPA) within the recommended foraging range defined by Woodward et al. (2019) and presented in NatureScot Guidance Note 3 (also presented in **Table 6-7**) from the OAA plus a 2 km buffer were extracted from the JNCC Seabirds Count spreadsheet;
- Bird counts for the composition of colony sites forming each 'master' colony were summed to produce one value for each 'master' site;
- For species recorded in count units of Apparently Occupied Nests (AON; kittiwake, great black-backed gull and Arctic tern), Apparently Occupied Sites (AOS; Manx shearwater, European storm-petrel, fulmar and gannet), Apparently Occupied Burrows (AOB; puffin) or Apparently Occupied Territories (AOT; great skua), the 'master' site count total was multiplied by 2 to calculate the total number of adult individuals (
- **Table** 6-8); and
- For guillemot and razorbill which were recorded in count units of individuals (IND), the 'master' site count total was first multiplied by 0.67 to calculate the number of adult pairs and then multiplied by 2 to calculate the total number of adult individuals (
- **Table** 6-8).

Table 6-7. Mean-maximum (MM) foraging range distance + standard deviation (SD) used for identifying which seabird colonies to include in the regional population size.

Species	NatureScot recommended Foraging Range (km)	Metric
European storm-petrel	336.0	Max/MM
Northern fulmar	1200.2	MM+SD

[11] *Version last updated December 2023 entitled 'comparative-seabirds-count-dataset-revised-20231213' was downloaded from:* https://hub.jncc.gov.uk/assets/63f0ea40-485d-46dd-b967-150df90a7b2b#comparative-seabirds-count-dataset-revised-20240708.xlsx.

Species	NatureScot recommended Foraging Range (km)	Metric
Manx shearwater	2365.5	MM+SD
Northern gannet	509.4	MM+SD
Northern gannet (Forth Islands SPA)	590.0	Max
Northern gannet (Grassholm SPA)	516.7	Max
Northern gannet (St Kilda SPA)	709.0	Max
Black-legged kittiwake	300.6	MM+SD
Great black-backed gull	73.0	Max/MM
Arctic tern	40.5	MM+SD
Great skua	931.2	MM+SD
Common guillemot (for all colonies except those in the Northern Isles)	95.2	MM+SD
Common guillemot (all Northern Isles colonies)	153.7	MM+SD
Razorbill (all colonies except those in the Northern Isles)	122.2	MM+SD
Razorbill (all Northern Isles colonies)	164.6	MM+SD
Atlantic Puffin	265.4	MM+SD

Table 6-8. Regional population estimates taken from SMP database information.

Species	Breeding season regional population size (Individual adults)[1]	Proportion of adults	Breeding season regional population size (all individuals)[2]
Kittiwake	219,608	0.53	414,355
Great black-backed gull	1,497	0.44	3,402
Arctic tern	906	0.63	1,438
Great skua	21,942	0.41	53,517
Guillemot	558,694	0.57	980,165
Razorbill	80,198	0.57	140,698
Puffin	629,864	0.55	1,145,207
Northern Fulmar	705,990	0.62	1,138,694
Gannet	509,546	0.55	926,447

1. Breeding season individual adult population size is from Seabirds Count database available at: https://jncc.gov.uk/our-work/seabirds-count/.
2. Breeding season all individuals population is calculated by dividing the total number of individual adults by the proportion of adults within the whole population. The proportion of populations assumed to be adults was taken from the stable age structures presented in the BDMPS report (Furness, 2015).

89. During the non-breeding period(s) (see **Table 6-4**), individuals from outside of the regional population may be present within the OAA plus 2 km buffer, and so an appropriate amount of the total predicted annual mortality associated with each impact assessed quantitatively (displacement and collisions) has to be apportioned to the regional population.

90. The Project sits on the northern boundary of many species' east coast and west coast BDMPS regions. This means that birds impacted by the Project could be from colonies along the west coast of the UK or the east coast of the UK (North Sea). NatureScot advised (consultation meeting of 28 May 2024) that to simplify the HRA assessment process, a worst-case scenario

could be adopted of assuming that the Project mortalities were to breeding adults from SPAs along the North Sea coast of the UK and not to SPAs along the west coast of the UK. This assumption is more precautionary due to in-combination impacts to east coast SPAs being larger than on west coast SPAs, as there are currently many more OWFs in planning, consented or operational in the North Sea, than in the Irish Sea, the Celtic Sea and the west coast of Scotland.

91. Therefore, it follows that within an EIA context, the relevant reference population for all birds present during the non-breeding season is also the species-specific UK North Sea (and Channel where appropriate for the species being assessed) (eastern region) BDMPS, taken from Furness, (2015), as shown in **Table 6-9**.

92. The proportion of estimated non-breeding season(s) mortality attributable to the regional population for each development is then calculated using the ratio of birds from the regional population compared to the appropriate BDMPS non-breeding season(s) population.

Table 6-9. Non-breeding season eastern region BDMPS population sizes taken from Furness (2015).

Species	Non-breeding BDMPS (all individuals)[1]			
	Non-breeding	Spring migration	Autumn migration	Winter
Kittiwake	N/A	627,816	829,937	N/A
Great black-backed gull	91,399	N/A	N/A	N/A
Arctic tern	N/A	163,930	163,930	N/A
Great skua	N/A	8,485	19,556	143
Guillemot[2]	980,165	N/A	N/A	N/A
Razorbill	N/A	591,874	591,874	218,622
Puffin	231,957	N/A	N/A	N/A
Fulmar	N/A	957,502	957,502	568,736
Gannet	N/A	248,385	456,298	N/A

1. Non-breeding BDMPS populations are from Furness (2015).
2. Guillemot non-breeding population is considered to be the same as the breeding season, as advised by NatureScot.

6.6 The Offshore ECC

93. Baseline DASs only covered a small portion of the offshore ECC closest to the OAA (see **Figure 7-1**). Therefore, a desk study was undertaken to determine the baseline conditions along the route of the offshore ECC. The primary source for this is the 2022 EIA Report for the PFOWF project, where baseline DASs were undertaken within proximity, and in comparable bathymetric conditions, to the offshore ECC route.

94. The PFOWF array area is located 7.5 km off the Dounreay coast, to the west of the Project offshore ECC (**Figure 7-2**). In total 25 monthly DASs were carried out. 13 surveys were undertaken between January and December 2015 (12 monthly surveys plus one extra survey in June), and a further 12 months between September 2020 and August 2021. During the 2015 surveys, a 2 km buffer was surveyed around a 25 km^2 development area, however, in 2020-21 a 2 km buffer around a 10 km^2 development area was flown between September 2020 and

March 2021, and a 4 km buffer flown between April and August 2021 (data within the 2-4 km buffer were not included in the analyses).

95. **Table 6-10** provides a summary of raw counts for each species during the two baseline survey periods. The survey results showed that in general, the species assemblage recorded for PFOWF was similar to that recorded during the baseline surveys for the Project OAA, and that relative abundance of each species are also consistent between the two project survey programmes. More inshore species such as red-throated diver, common gull and lesser black-backed gull were similarly recorded in trivial numbers that do not warrant assessment.

96. It can therefore be reasonably considered that the list of species previously scoped in as IOFs for the OAA (**Table 6-3**) are also applicable for the assessment of the offshore ECC.

Table 6-10. Total raw counts in the PFOWF Array Area plus 2 km buffer, compared to total raw counts within the Project OAA plus 4 km buffer.

Species	Project OAA + 4km buffer	PFOWF: Jan to Dec 2015	PFOWF: Sep 2020 to Aug 2021
Golden plover	0	0	1
Kittiwake	1,485	325	464
Common gull	1	2	0
Great black-backed gull	210	57	26
Herring gull	14	2	4
Lesser black-backed gull	2	0	1
Arctic tern	44	39	10
Great skua	77	3	4
Arctic skua	5	0	1
Guillemot	9,027	873	1,060
Razorbill	203	34	80
Puffin	5,818	771	2,877
Red-throated diver	3	1	4
Fulmar	5,485	619	187
Manx shearwater	12	5	3
Gannet	2,114	86	111

6.7 Landfall

97. The cable landfall options are relatively small areas of rocky shore available only at low tide (below MHWS). The two shoreline areas are at the base of cliffs to the south.

98. A limited suite of wader species was recorded onshore at the landfall areas, including curlew, dunlin, lapwing, oystercatcher, turnstone, purple sandpiper, redshank, and ringed plover. All species were recorded in small numbers, well below any thresholds of regional or national significance (see Onshore EIA Report, chapter 11: Terrestrial ornithology). Horizontal Directional Drilling (HDD) will avoid direct impacts to the intertidal area (see Embedded Mitigation, **section 7.4** and **onshore EIA Report Volume 1, Chapter 05: Project Description**). Thus, even in a worst-case scenario, no significant population level effects would occur, and thus all intertidal species are not taken forward to assessment.

99. **Common eider, great northern diver**, **shag** and **guillemot** were the species recorded most regularly in nearshore waters during coastal baseline surveys (see Onshore EIA Report, chapter 11: Terrestrial ornithology Figures 11-16a to 11-16d). These species are therefore scoped into assessments concerning landfall construction impacts (Table 6-11). Cormorant was also regularly recorded, but has not been taken forward to the landfall assessment because the species is not considered a requirement for assessment for displacement impacts (SNCB, 2017; updated 2022) and thus disturbance is considered unlikely to be impactful.

Table 6-11. Summary of Nature Conservation Status of Nearshore Species Screened into Landfall Assessment as IOFs.

Species	Scientific name	Conservation status
Guillemot	*Uria aalge*	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status. 'Medium risk' breeding population vulnerability to climate change.
Common eider	*Somateria mollissima*	BoCC Amber listed, IUCN Red List 'Near Threatened' status. 'Risk and benefit breeding population vulnerability to climate change. 'High risk' for winter population.
Great northern diver	*Gavia immer*	BoCC Amber listed, IUCN Red List 'Least Concern' status. Not assessed breeding or winter population vulnerability to climate change.
Shag	*Gulosus aristotelis*	BoCC Red listed, IUCN Red List 'Least Concern' status. 'Medium risk' breeding population vulnerability to climate change.

6.8 Future baseline

100. For seabirds, trends in breeding populations are better known, and better understood than trends in numbers at sea. Breeding numbers are regularly monitored at many colonies, and in the British Isles there have been four comprehensive censuses of breeding seabirds in 1969-70, 1985-88, 1998-2002 (see Mitchell *et al*., 2004), and 2015-2021 (Burnell *et al*., 2023) as well as single-species surveys (such as the decadal counts of breeding gannet numbers, Murray *et al*., 2015). In contrast, the European Seabirds at Sea (ESAS) database is incomplete, and few data have been added since 2000, so that current trends in numbers at sea in areas of the North Sea are more difficult to assess.

101. Results of the most recent UK seabird census (Burnell *et al*., 2023) have shown that 11 of the 21 seabird species, where there is sufficient confidence in trends, have declined by over 10% since the previous census in 1998-2002 (Mitchell *et al.*, 2004). This includes kittiwake and great black-backed gull. The breeding populations of five species (including gannet and razorbill) have increased by over 10% and a further five (including guillemot) have remained stable. These trends in British seabird populations seem likely to continue in the short to medium term, although for some species such as gannet, which has notably been susceptible to the effects of HPAI (e.g., Pearce-Higgins *et al*., 2023; Tremlett *et al.*, 2024), the long-term impact on the population trend is currently unclear, albeit there is some preliminary evidence that gannets revealed specific immunity showing exposure and recovery in a proportion of birds (Lane *et al.*, 2024). Great skua has also suffered particularly high mortalities due to HPAI, with Tremlett *et al.* (2024) finding that the number of great skua territories recorded in 2023

across all sites surveyed declined by 76% compared with the pre-HPAI baseline count. This has reversed an otherwise generally positive trend in numbers between censuses and again, long-term impacts are unclear.

6.8.1 Drivers of change

102. Burnell *et al.* (2023) identified that the main drivers for declining breeding seabird populations in the UK are predation by native and invasive predators and climate change. Adverse weather conditions potentially associated with climate change affect nesting and foraging, and increased water temperatures reduce the availability of sandeels and other prey species. These impacts are exacerbated by fish stock depletion by commercial fisheries, resulting in depleted food resources during the breeding season.

103. There are also many other smaller pressures affecting particular species of seabirds which may contribute to baseline conditions changing in the North Sea.

104. In individual studies, key drivers of seabird population size in western Europe have been identified as climate change (Sandvik *et al*., 2012; Frederiksen *et al*., 2004, 2013; Burthe et al., 2014; Macdonald *et al*., 2015; Furness, 2016; JNCC, 2016; Pearce-Higgins, 2021), and fisheries (Tasker *et al*., 2000; Frederiksen *et al.,* 2004; Ratcliffe, 2004; Carroll, *et al.,* 2017; Sydeman *et al*., 2017). Pollutants (including oil, persistent organic pollutants, plastics), alien mammal predators at colonies, disease, and loss of nesting habitat also impact on seabird populations but are generally much less important and often more local factors (Ratcliffe, 2004; Votier *et al*., 2005, 2008; JNCC, 2016). Since 2021 HPAI has adversely affected survival and productivity within seabird colonies across the UK, and investigations are underway to determine the long-term effects on species' populations, combined with the other pressures (see e.g., Pearce-Higgins *et al.,* 2023).

105. Pearce-Higgins (2021) assessed the impact that climate change has already had on UK bird populations by relating their long-term trends to separately published species' responses to climate change, temperature and rainfall. It was found that of the 20 seabird species found in the UK, 14 are regarded as being at high or medium risk of negative climate change impacts. Documented declines in sandeel populations have led to reduced breeding success in seabirds, and at least partially underpin long-term population declines (Johnston *et al*., 2021).

106. Prior to the Seabirds Count 2015-21 results being published, there was already good evidence that kittiwake, Arctic skua, puffin and fulmar are being affected by climate processes (Frederiksen *et al*., 2004, Burthe *et al*., 2014, Cook *et al.,* 2014, Perkins *et al.,* 2018).

107. Fisheries management is also likely to influence future numbers in seabird populations. The Common Fisheries Policy (CFP) Landings Obligation ('discard ban') will further reduce food supply for scavenging seabirds such as great black-backed gulls, lesser black-backed gulls, herring gulls, fulmars, kittiwakes and gannets (Votier *et al.,* 2004; Bicknell *et al.,* 2013; Votier *et al.,* 2013; Foster *et al.,* 2017). Recent changes in fisheries management that aid recovery of predatory fish stock biomass are likely to further reduce food supply for seabirds that feed primarily on small fish such as sandeels, as those small fish are major prey of large predatory fish.

108. Therefore, anticipated future increases in predatory fish abundance resulting from improved management to constrain fishing mortality on those commercially important species at more sustainable levels than in the past are likely to cause further declines in stocks of small pelagic seabird 'forage fish' such as sandeels (Frederiksen *et al.,* 2007; Macdonald *et al.,* 2015). Lindegren *et al*. (2018) concluded that sandeel stocks in the North Sea, the most important prey fish stock for North Sea seabirds during the breeding season (Furness and Tasker 2000), have been depleted by high levels of fishing effort. These stocks are unlikely to recover fully even if fishing effort was reduced, because climate change has altered the North Sea food web to the detriment of productivity of fish populations. (e.g. Dulvy *et al*., 2008; Hiddink *et al.,* 2015). As a result of climate-driven changes to plankton abundance and timing of availability, and the knock-on effect this has on sandeel and other forage fish populations, seabird populations are likely to continue to experience food shortages in the North Sea, especially for those species most dependent on sandeels as food.

6.8.2 Species threats

109. In relation to the scoped in seabird IOFs, future decreases in **kittiwake** breeding numbers are likely to be particularly pronounced, as kittiwakes are very sensitive to climate change (Frederiksen *et al.,* 2013; Carroll *et al.,* 2015) and to fishery impacts on sandeel stocks near breeding colonies (Frederiksen *et al*., 2004; Carroll *et al*., 2017, Searle *et al.,* 2023). The species has lost the opportunity to feed on fishery discards since the Landing Obligation came into effect in 2019.

110. **Gannet** numbers may continue to increase for some years, but evidence suggests that this increase is already slowing (Murray *et al*., 2015), which may be exacerbated by HPAI impacts. Tremlett *et al.* (2024) found that gannets suffered large declines between the pre-HPAI baseline and 2023 counts at several important colonies distributed across the UK range, and postulated that the declines at most sites are likely to be worse than indicated, owing to the previously increasing population and the length of time since the baseline counts were made.

111. Whilst the Landings Obligation will have reduced discard availability to gannets in European waters, in recent years increasing proportions of adult gannets have wintered in west African waters rather than in UK waters (Kubetzki *et al.,* 2009), probably because there are large amounts of fish discarded by west African trawl fisheries and decreasing amounts available in the North Sea (Kubetzki *et al.,* 2009; Garthe *et al*., 2012). The flexible behaviour and diet of gannets probably reduces their vulnerability to changes in fishery practices or to climate change impacts on fish communities (Garthe *et al.,* 2012).

112. **Fulmars, terns, common guillemot, razorbill** and **puffin** appear to be highly vulnerable to climate change, so numbers may decline over the next few decades (Burthe *et al*., 2014). Tern species recorded large declines in 2023 due to HPAI impacts, whereas guillemot trends were much more variable between colonies (Tremlett *et al.,* 2024). Strong declines in **shag** numbers are likely to continue as they are adversely affected by climate change, and especially by stormy and wet weather conditions in winter (Burthe *et al.,* 2014; Frederiksen *et al.,* 2007). Howells *et al.* (2018) has found evidence of a large reduction in the proportion of diet comprising sandeels for shags on the Isle of May, Scotland, suggesting that

substantial temporal changes in prey populations have occurred, which may have important implications for seabird population dynamics.

113. A long-term decrease in numbers of **great black-backed gulls** breeding in the north of Scotland (Moffat *et al*., 2020), and the enforcement of the Landings Obligation will probably result in further decreases in numbers of north Norwegian great black-backed gulls, and **herring gulls**, coming to the North Sea in winter. Great black-backed gulls also showed a widespread decline in 2023 compared to pre-HPAI baseline (Tremlett *et al.*, 2024).

114. It is likely that further redistribution of breeding herring gulls will occur into urban environments (Rock and Vaughan, 2013), although it is unclear how the balance between terrestrial and marine feeding by these gulls may alter over coming years; that may depend greatly on the longer-term consequences of Brexit for UK fisheries and farming.

115. Some of the human impacts on seabirds are amenable to effective mitigation (Ratcliffe *et al.*, 2009; Brooke *et al*., 2018), but the scale of efforts to reduce these impacts on seabird populations has been small by comparison with the major influences of climate change and fisheries. This is likely to continue to be the case in future, and the conclusion must be that with the probable exception of gannet, numbers of almost all other seabird species in the UK North Sea region will most likely be on a downward trend over the next few decades, due to population declines, redistributions or a combination of both.

116. For offshore ornithology, the ecological impact assessment is therefore carried out in a context of ongoing declines for most species. Where a species is declining, the assessment takes into account whether a given impact is likely to exacerbate a decline in the relevant reference population and prevent a species from recovery should environmental conditions become more favourable.

117. Climate change has been identified as the strongest influence on future seabird population trends. In this context it is noted that a key component of global strategies to reduce climate change is the development of low-carbon renewable energy developments such as offshore windfarms.

6.9 Highly pathogenic avian influenza (HPAI)

118. NatureScot advised (meeting 28 May 2024) that additional qualitative contextual information on the effects of HPAI on relevant seabird breeding colonies should be provided, where counts are available.

119. A discussion on the impacts that HPAI may have had on the reliability of baseline DAS data and wider colony count data is presented in **Appendix 1 – EIA and HRA: Baseline Site Characterisation Technical Report**, with further details in **Annex 1P: Seabirds and Highly Pathogenic Avian Influenza: a review**. A summary of the conclusions of data suitability is presented here.

120. Mortality linked to the current HPAI virus outbreak was first reported among seabirds in great skuas breeding on Scottish islands, including the Orkney Isles, in July 2021 (Banyard *et al.*, 2022). In 2022 and 2023, the HPAI virus adversely affected survival and productivity within

a host of different seabird colonies across the UK (NatureScot, 2023; Tremlett *et al.*, 2024). The HPAI virus has been found to affect a range of seabird species, particularly great skua and gannet.

121. Natural England (2022) stated that "*We expect seabird data collected prior to summer 2022 (June) to remain a valid representation of 'typical' seabird distribution and density, as this was before mass mortality events began to take place*.". Baseline DAS for the offshore Project were undertaken from July 2020 to September 2022 and therefore if this advice was also applied in Scotland only the last three, or four, months of digital aerial survey data collected would potentially not be a valid representation of typical seabird distribution and density prior to HPAI impacts.

122. The NatureScot Scientific Advisory Committee Sub-Group on Avian Influenza report (NatureScot, 2023) noted that, during the period 4 April to 11 September 2022, 20,500 dead seabirds were reported with gannets and great skuas being the most badly affected species but also guillemots, kittiwakes, terns and large gulls. Great skua were detected early on as having HPAI, whereas kittiwake and fulmar were not reported until later on in the season.

123. Given that HPAI was noted in great skuas on Orkney in 2021, with the first mortalities occurring in June 2021 (Banyard *et al.*, 2022), and also given the substantial mortality rate (NatureScot, 2023) and declines in great skua populations (Tremlett *et al.*, 2024), it is likely that DAS of the Project OAA plus 4 km buffer in 2021 and 2022 were representative of great skua abundance and density in the presence of HPAI impacts. For other species, for which impacts were more obvious in 2022, particularly later in that breeding season (NatureScot, 2023), it is likely that the Project's DAS results are more representative of pre-HPAI seabird distributions, densities and abundances.

124. Tremlett *et al.* (2024) compared these baseline colony population sizes with colony counts for the same species and colonies counted in 2023 (i.e. once colonies may have been impacted by HPAI). An overview of the change in colony sizes (baseline pre-HPAI colony size compared with 2023) for breeding seabird colonies surrounding the offshore Project for each species listed in the bullet points above is provided in the Species Accounts in **Appendix 1 - EIA and HRA: Baseline Site Characterisation Technical Report**.

125. For the purposes of this assessment, all reference populations used have been estimated from data collected prior to the widespread effects of HPAI on seabirds in 2022 and 2023, and therefore because the baseline DAS data were also mostly collected prior to the outbreak, the predicted magnitudes of impacts on seabird populations should remain consistent with current populations (i.e. it is assumed that the proportion of the population affected by an impact will be similar before and after HPAI impacts, with numbers of birds recorded within the survey area declining proportionately with population sizes). Consequently, no adjustments to account for impacts of HPAI on populations are considered necessary for the assessment.

126. Despite this, it is important to take in to account the potential effects of HPAI on populations and their likely recovery. A review of HPAI effects undertaken by Bob Furness (**Annex 1P: Seabirds and Highly Pathogenic Avian Influenza: a review**) states that, "*recovery of seabird*

populations depleted by HPAI may take many years and possibly several decades. Populations might never recover to previous numbers if carrying capacity has reduced as a consequence of ecological change (climate change in particular, but also change in fisheries management affecting availability of food to scavenging seabirds)". So, it is important to note that some of the populations assessed here were likely to have been impacted by HPAI in 2022, and 2023, and may be impacted in future breeding seasons. These populations will be smaller than the estimates used here, but it is likely that predicted impacts on these populations would be smaller by the same proportion and so the overall effects on populations would be the same, or very similar. The most important factor is to ensure that throughout the assessment, the estimated abundance of birds within the OAA (plus 2 km buffer where applicable) is matched to the appropriate seabird population size.

7 ASSESSMENT OF POTENTIAL EFFECTS

127. In the assessment of potential effects, the impacts are assessed:

- In the order of construction, operation and decommissioning;
- Following the impact assessment methodology that is described in section 5;
- Accounting for the embedded mitigation that is described in section 7.4; and
- On the basis of the worst-case scenario for each impact as set out in **section 7.5**.

7.1 Impacts requiring assessment

128. Based on NatureScot Guidance Note 6: *Guidance to support Offshore Wind Applications: Marine Ornithology Impact Pathways for Offshore Wind Developments*, the impacts identified as requiring consideration for offshore ornithology are listed in **Table 7-1**. An overview of how each impact is assessed is also provided.

Table 7-1. Impacts requiring assessment for offshore ornithology.

Potential impact	How assessed
Construction (including pre-construction) and decommissioning*	
1. Direct distributional responses and displacement effects	This impact considers a range of disturbance sources (noise, visual, vessel movements) and has been assessed qualitatively. The species considered susceptible to disturbance sources within the OAA were identified using SNCB (2017; updated 2022) guidance and discussed and agreed with consultees, with those potentially impacted by vessel movements following NatureScot guidance note #4. Impacts within the OAA, offshore ECC, landfall and vessel routes to and from port are assessed separately.
2. Artificial construction lighting	Qualitative assessment based on a review in Deakin *et al.* (2022) and other literature sources. The range of species to include in the assessment was advised in NatureScot's Screening Representation and as advised by NatureScot (letter dated 27 March 2024).
3. Indirect disturbance and displacement of prey species	This impact has been assessed qualitatively, drawing on information from **Offshore EIA Report Chapter 10: Benthic subtidal and intertidal ecology** and **Chapter 11: Fish and shellfish ecology**.
Operation and maintenance	

Potential impact	How assessed
4. Direct distributional responses, displacement and barrier effects	A screening exercise, agreed through consultation, identified seven species at potential risk to operational disturbance and displacement within the OAA. The displacement assessment followed the 'Matrix Approach' as advised by NatureScot and SNCB (2017; updated 2022). The full methodology for quantifying this impact is provided within **Appendix 4 – EIA and HRA: Displacement Technical Report** and summarised within Section 7.7.1. Displacement matrix table inputs and outputs are provided in **Appendix 4 - EIA and HRA: Displacement Technical Report.** Impacts associated with vessel movements between port and the OAA have been assessed qualitatively, similar to the construction phase.
5. Collision risk	A screening exercise, agreed through pre-application consultation, identified five species at potential risk of collision. The online stochastic CRM tool (sCRM; Caneco, 2022) was used to estimate collision mortality. The full methodology is provided within **Appendix 3 - EIA and HRA: Collision Risk Modelling Technical Report** and summarised in section 7.7.1.10. The collision risk modelling inputs and estimated collision mortality are presented in **Appendix 3 - EIA and HRA: Collision Risk Modelling Technical Report**.
6. Indirect habitat loss / change for prey species	This impact has been assessed qualitatively, drawing on information from **Offshore EIA Report chapter 10: Benthic subtidal and intertidal ecology** and **chapter 11: Fish and shellfish ecology.**
7. Artificial operational lighting	Qualitative assessment based on a review in Deakin *et al.* (2022) and other literature sources. The range of species to include in the assessment was advised in NatureScot's Screening Representation and as advised by NatureScot (letter dated 27 March 2024).
8. Combined operational displacement and collision risk	A combined displacement and collision risk assessment uses the same methodologies as outlined above for Impacts 4 and 5. The range of species to include in the assessment was agreed during consultation.

** In the absence of detailed information regarding decommissioning works, and unless otherwise stated, the impacts during the decommissioning of the offshore Project considered analogous with, or likely less than, those of the construction stage.*

7.2 Impacts not taken forward for assessment

129. The following impacts have not been taken forward for assessment:

- Construction and decommissioning:
  - Collision risk with installed but not commissioned (or decommissioned) WTGs, and construction vessels.
- Operation and maintenance:
  - Disturbance and displacement along the offshore ECC and at landfall during operation (subject to Navigational Safety & Vessel Management Plan during the operation & maintenance stage).
  - Ghost fishing: agreed with consultees that ghost fishing is not taken forward for assessment because floating WTGs have been removed from the offshore Project design.

7.3 PVA for impacts requiring assessment

130. Where a predicted Project alone impact can be estimated quantitatively (estimated collision rates and the number of birds at risk of displacement mortality), a PVA has been used to assess the effect on the appropriate breeding season reference population, in circumstances where the predicted change in survival due to that Project alone impact was 0.02% or larger (following NatureScot Guidance Note 11). The Natural England PVA tool (Searle *et al*., 2019) was used to assess population response to predicted impacts.

The estimated impacts presented in this assessment are applied to all age classes, because the birds recorded during the baseline surveys were also drawn from all age classes. It was therefore appropriate to assess these impacts against the total, all-age class, regional population for each species (see final column in

131. Table 6-8). To determine the increase in background mortality rate for these all-age class populations the predicted mortality (e.g. number of collisions) was divided by the reference population to obtain the change in mortality rate (e.g. a collision mortality of 15 individuals from a population of 10,000 gives an increase in mortality rate for that population of 0.15%). If the change in mortality was greater than 0.02% a PVA was undertaken (as advised in NatureScot Guidance Note 11).

132. In all cases, PVAs have been run for 25 years, 35 years[12], and 50 years, as per NatureScot Guidance Note 11. Following NatureScot Guidance Note 11, the two primary outputs from the PVA model which are used for interpreting population effects are the counterfactual of population growth rate (C-PGR) and the counterfactual of population size (C-PS).

133. Although the two counterfactual measures may appear to be equally informative with respect to understanding the population consequences of impacts, which one is more appropriate depends on whether density dependent regulation has been included. Consideration of the properties of density dependent and density independent population projections illustrates why this is: a population regulated by density dependent feedback will maintain itself around an equilibrium level. Since there is no long-term growth or decline for such a population, when an impact is applied the population growth rate will only change in the short term, following which the population will once again settle at a new, lower, equilibrium size. Hence the change in growth rate (i.e. C-PGR) is of limited value for understanding the effect of an impact. In contrast, the change in population size (C-PS) provides useful information on how much smaller the population will be in the presence of the impact.

134. When a population is simulated without regulation (i.e. density independent), the population will grow or decline exponentially. The baseline and impacted predictions will both change in this manner but the difference between the two will increase with duration as the baseline population grows more rapidly. Hence, the time point when the differences are considered is critical to the C-PS value obtained and how this is interpreted. However, the average growth rate of a density independent population is constant and therefore, a comparison of

[12] Although the operational life of the Project is anticipated to be 30 years, an operational period of 35 years has been assumed for population modelling as WTGs will be present in the OAA and potentially turning ahead of first power (thereby potentially resulting in displacement or collision risk).

the baseline and impacted growth rates is insensitive to the duration over which the comparison is made. Thus, for density independent PVA, as presented here, the C-PGR is the more robust and reliable metric to use.

135. For full details on the PVA methodology, including input parameters and PVA model specification refer to **Appendix 9 – EIA: PVA at regional population scales for Project alone and cumulative impacts.**

7.4 Embedded mitigation

136. Measures were adopted as part of the Project development process in order to reduce the potential for impacts to the environment. These embedded mitigation measures, outlined in **Table 7-2**, are accounted for in the assessment prior to determination of the significance of effects.

137. The requirement for additional mitigation measures (secondary mitigation) is dependent on the significance of the effects on offshore ornithology features, after embedded mitigation has been accounted for.

Table 7-2. Embedded mitigation measures relevant to offshore ornithology.

Mitigation measure	Description	How mitigation will be secured
Site selection	The offshore Project including the OAA and the offshore ECC avoids any overlap with designated sites (i.e. SPAs) for birds. The OAA's 2 km buffer overlaps with the Sule Skerry & Sule Stack SPA, however due to the Restricted Build Areas, no WTGs would be located within 3.7 km of the SPA (including marine extension) – see **Introduction to the Additional Ornithology EIA Information and HRA Addendum.** This would reduce displacement impacts by reducing the Project footprint and reduce collision risks for some species by maintaining a 2 km separation distance from the SPA.	Already secured through the OAA location.
Landfall installation	Landfall installation methodology (HDD) will avoid direct impacts to the intertidal area.	Landfall installation methodology will be detailed within the CMS, required under Section 36 Consent and/or Marine Licence conditions.
Minimum WTG blade clearance	Blade clearance of 27.05 m above MSL (29.52 m above LAT), which is in excess of the minimum requirement of 22 m above MHWS. A higher blade clearance reduces the number of birds likely to be flying at rotor swept height and so decreases potential collision mortality.	Secured through the description of the development within the Section 36 Consent and/or Marine Licence.
Navigational Safety and Vessel Management Plan (NVSMP)	Describes proposed navigational safety measures and vessel management measures including restrictions on vessels' speed and routes to be	Secured through all vessels being required to adhere to the NSVMP. An outline NSVMP was provided as part

Mitigation measure	Description	How mitigation will be secured
	used by vessels to ensure navigational safety. Details to be confirmed post-consent.	of the offshore application in OP4: Outline Navigational Safety and Vessel Management Plan.
Lighting	Excess lighting, above levels set by regulatory requirements for navigation, aviation, escape/emergency procedures and general activity, will be avoided wherever possible. External general lighting will use timers and/or passive infrared sensor devices to reduce excessive lighting of the WTGs and Offshore Substation Platforms (OSPs).	Requirements will be detailed in the LMP. An outline LMP was provided as part of the offshore application in OP6: Outline Lighting and Marking Plan. The outline LMP contains details on the proposed lighting requirements for the construction and operation and maintenance stage.
Decommissioning Programme	The development of, and adherence to, a Decommissioning Programme approved by Scottish Ministers prior to construction and updated throughout the Project lifespan.	The production and approval of a Decommissioning Programme will be required under Section 105 of the Energy Act 2004 (as amended).

7.5 Worst-case scenario

138. As detailed in **Offshore EIA Report, chapter 7: EIA methodology**, this assessment considers the scenario for the offshore Project which is predicted to result in the greatest environmental impact, known as the 'worst-case scenario'. The worst-case scenario, as shown in **Table 7-3**, represents, for any given ornithological feature and potential impact, the design option (or combination of options) that would result in the greatest potential for change.

139. Given this, the development of any alternative options within the design parameters will give rise to no worse effects than those assessed in this impact assessment.

140. Since the Project design is dependent upon site constraints, the detailed design can only take place post-consent once all data have been gathered including seabed survey data, Unexploded Ordnance (UXO) and boulder presence. The final design of the offshore Project will be confirmed through detailed ongoing engineering design studies, including the development of the ground model. The final design, including array area and number of WTGs, will be captured in the Development Specification and Layout Plan (DSLP) which will be informed by this ongoing engineering work and in consultation with interested stakeholders. However, the assessment of predicted impacts on offshore ornithological features is considered to be a worst-case scenario.

Table 7-3. Worst-case scenario specific to offshore ornithology features.

Impact	Worst-case scenario	Justification
Construction		
1. Direct distributional responses and displacement effects	• Up to a maximum of 30 construction vessels within the offshore Project simultaneously and 1,722 return vessel transits annually; • Maximum piling duration of 290 days; • Maximum construction schedule of 24 hours a day, 7 days a week; and • Maximum construction period of up to four years with an additional year of pre-construction activities (e.g. UXO clearance).	Maximum estimated number of vessels, duration of piling and construction activity within the OAA and offshore ECC would cause greatest disturbance and displacement to birds.
2. Artificial Lighting	• Up to a maximum of 30 construction vessels within the offshore Project simultaneously and 1,722 return vessel transits annually; • Maximum construction schedule of 24 hours a day, 7 days a week; • A total of up to 4 years of construction period (with an additional year of pre-construction activities).	Maximum number of artificial lighting sources within the OAA and offshore ECC over the maximum construction period would result in the greatest likelihood of impacts upon sensitive features at key times of year.
3. Indirect disturbance and displacement of prey species	• Maximum spatial disturbance to fish and shellfish during construction due to underwater noise from piling of up to 125 WTGs with monopile foundations is maximum hammer energy of 5,000 kJ with maximum of 1 pile per day and up to 16 hours piling per day (over 125 days); • Maximum temporal disturbance to fish and shellfish during construction piling of up to 125 jacket foundations (500 piles) using maximum hammer energy of 3,000 kJ with maximum of 2 piles per day and up to 8 hours piling per day (over 250 days). • Additionally piling of up to five OSP pin-pile jacket foundations, each with 16 piles required (total of 80 piles) with a maximum of two piles per day and up to eight hours of piling per day (40 piling days), at 3,000 kJ hammer energy (in hard or soft sediment).	• Breakdown is given in Offshore EIA Report chapter 11: Fish and shellfish ecology, Table 11-15. Note further consideration of impacts is also provided within Fish and Shellfish Ecology Additional Information document. • Maximum disturbance to prey species would cause greatest displacement to birds from OAA and offshore ECC.
	• Maximum area of temporary habitat disturbance or loss to benthic habitats during construction would be approximately 69.12 km^2 across the offshore Project.	• Breakdown is given in Offshore EIA Report chapter 10: Benthic subtidal and intertidal ecology, Table 11-15. Note further consideration of impacts is also provided within Benthic Subtidal and Intertidal Ecology Additional Information document.

Impact	Worst-case scenario	Justification
		• Maximum disturbance to benthic species would cause greatest displacement to prey species and consequently birds from OAA and offshore ECC.
Operation and maintenance		
4. Direct distributional responses, displacement and barrier effects	• WTGs and OSPs across the full OAA; • Maximum of 125 WTGs with minimum spacing of 944 m (smallest WTG size) between WTGs; • Maximum of five high voltage alternating current (HVAC) offshore substation platforms (OSPs); and • Up to 12,695 return transits from operation and maintenance vessels estimated throughout the operational life of the Project; and • Maximum of 19 vessels at the site simultaneously.	• Represents maximum density of WTGs and structures across the offshore Project, which maximises the potential for avoidance and displacement (including potential barrier) to birds from OAA. • Other options represent a smaller total area occupied and reduced density of WTGs (e.g. increased spacing). • Assessment assumes varying displacement from site and a buffer, where appropriate. • See Offshore EIA Report, chapter 5: Project description.
5. Indirect effects due to habitat loss / change for key prey species	• Maximum area of seabed footprint occupied by the offshore Project resulting in permanent habitat loss is up to 7.34 km^2 [13].	• Breakdown is given in Offshore EIA Report, chapter 11: Fish and shellfish ecology, Table 11-15. Note further consideration of impacts is also provided within Fish and Shellfish Ecology Additional Information document. • Maximum area of seabed lost potentially causes greatest displacement to prey species and consequently birds from OAA and offshore ECC.
	• Up to 7.34 km^2 of permanent habitat creation.	• Breakdown is given in Offshore EIA Report, chapter 11: Fish and shellfish ecology, Table 11-15. Note further consideration of impacts is also provided within Fish and Shellfish Ecology Additional Information document.

[13] *Benthic Subtidal and Intertidal Ecology Additional Information document provides further consideration of long-term impacts from the Project, particularly on boulder clearance in areas of Annex I stony reef. Due to the nature of the activity and the characteristics of the habitat this may result in a long-term habitat change across an area of up to 30.4 km^2. Although this area would not be permanently lost the habitat type may change, with boulders being relocated (largely nearby) and resulting in a sediment dominated substrate being present in the cleared area, albeit one that is already widely present across the offshore Project area.*

Impact	Worst-case scenario	Justification
		• Maximum area of permanent habitat creation causes greatest attraction to prey species and consequently birds from OAA and offshore ECC.
	• Maximum cable EMF is: ○ Inter-array HVAC cables (up to 145 kV) with a maximum length of 500 km; ○ Up to six interconnector HVAC cables (up to 420 kV) with a maximum length of 150 km; ○ Up to five offshore export HVAC cables (up to 420 kV) with a maximum length of 320 km; • A total of 10 crossings across the offshore Project area requiring cable protection at a height of 3 m, with a total area of 0.125 km^2; and • Operational life up to 30 years[14].	• Breakdown is given in Offshore EIA Report, chapter 11: Fish and shellfish ecology, Table 11-15. Note further consideration of impacts is also provided within Fish and Shellfish Ecology Additional Information document. • The maximum length of inter-array, interconnector and offshore export cable will result in the greatest potential for EMF effects on prey species.
6. Collision risk	• Maximum of 125 WTGs x 330 m rotor diameter; • WTGs and OSPs across the full OAA; and • Operational life up to 30 years[14].	• Collision risk modelling shows that 125 x 330 m rotor diameter WTGs (WTG scenario 5) have largest collision impact risk. • Other WTG scenarios have lower collision risks, although the difference in predicted collisions between different WTG options is very small (Appendix 3 – EIA and HRA: Collision Risk Modelling Technical Report).
7. Artificial operational lighting	• Artificial lighting on WTGs and OSPs will be installed in line with aviation and maritime lighting requirements. • WTGs will be marked by lights that are visible from two nautical miles from all angles.	• Details to be confirmed post-consent.
8. Combined operational displacement and collision risk	As per operational disturbance and displacement and collision risk.	Represents maximum number and density of WTGs and structures across the offshore Project. A larger number of WTGs is likely to result in increased displacement. A larger number of WTGs is also likely to increase the possibility of collisions.

[14] *An operational period of 35 years has been assumed for population modelling as WTGs will be present in the OAA and potentially turning ahead of first power.*

MacArthur Green

Impact	Worst-case scenario	Justification
Decommissioning		
Direct and indirect distributional responses and displacement effects from decommissioning activities	Disturbance is anticipated to be similar in nature but of lower magnitude than during construction, but specific details are not currently known.	Maximum estimated number of vessel movements would cause greatest displacement to birds on site.

7.6 Potential effects during construction (including pre-construction)

7.6.1 Impact 1: Direct distributional responses and displacement effects

7.6.1.1 Summary of potential impacts

141. The construction stage of the offshore Project has the potential to disturb birds in the marine environment leading to displacement from construction areas. Construction would require the mobilisation of vessels and the installation of foundations, offshore export cables and other infrastructure (WTGs and OSPs). These activities could result in temporary habitat loss through reduction in the area available for foraging, loafing and moulting birds within the OAA, offshore ECC and landfall areas, as well as on vessel routes to and from port.

142. Causes of potential disturbance would comprise presence of construction vessels and associated human activity, noise and vibration from construction activities associated with construction sites. Artificial lighting impacts are considered separately under Impact 2.

143. The principal source of noise during construction would be subsea noise from piling works within the OAA associated with the installation of foundations for WTGs and offshore substation platforms; the maximum duration of piling within the OAA would be 290 days. Due to the limited empirical evidence available showing the affect that noise disturbance alone has on wild marine birds, subsea and above water noise disturbance from construction activities is not considered in isolation as a risk factor for birds; but rather, combined with the presence of vessels, man-made structures, and human activity, part of the overall worst-case disturbance stimulus that causes birds to avoid boats and other structures.

144. Offshore Project construction may last up to four years, under the assumption that the construction programme is likely to be seasonally constrained by the metocean conditions on site. Construction activities would therefore occur within distinct construction seasons, with delays between each season (i.e. construction is not continuous throughout this period, see **Offshore EIA Report, chapter 5: Project description** for information on construction schedule). Offshore construction works would typically be undertaken 24 hours a day, seven days a week, dependent upon weather conditions. It is anticipated that construction is most likely to only occur up to nine months a year.

145. Construction will therefore not occur across the whole of the offshore Project area simultaneously or every day and in all months of the year. Consequently, the effects will occur only in the discrete areas where vessels are operating at any given point and not across the entire offshore Project area.

146. A range of vessels will be associated with construction of the offshore Project, undertaking activities including UXO survey and intervention, dredging, piling and WTG installation, cable laying and rock/mattress protection placement. Other vessels will be required to transport personnel and infrastructure to the offshore Project area and to support these vessels, e.g. tugs, supply vessels, etc. Most vessels associated with construction of the Project will spend most of the time in the OAA or offshore ECC. During construction, certain vessels will remain offshore for the entire season without entering any port and will therefore require regular servicing by offshore supply vessels. Other vessels will make regular port calls.

7.6.1.2 *Screening of IOFs for assessment of direct distributional responses and displacement effects*

147. NatureScot's Guidance Note 8 (*Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds*) and Project-specific consultation advice have been the primary sources used to inform the scope of the assessment of the various construction impacts. This has been separated into impacts associated with (i) the OAA and offshore ECC; (ii) the landfall; and (iii) vessel movements to and from ports and the offshore Project area.

7.6.1.2.1 OAA and offshore ECC

148. NatureScot Guidance Note 8 refers to Section 5 in the joint SNCB (2017; updated 2022) guidance note for considering whether an assessment of displacement is required for a particular species. In this SNCB guidance, it is recommended that consideration is given to each species observed within a development site and is informed by:

- Species' presence at the development site; and
- Susceptibility to disturbance and habitat specialisation scores for species found in Scottish waters (Furness *et al*., 2013), and the expanded list for wider UK waters (Bradbury *et al*., 2014), covering additional species not previously included in Furness *et al*. (2013).

149. SNCB (2017; updated 2022) advises that any species scoring 3 or more 'Disturbance Susceptibility' or 'Habitat Specialization' from Bradbury *et al*. (2014), and which are present in the OWF site or buffer should be progressed to (operational displacement) assessment unless there is strong empirical evidence to the contrary.

150. Both NatureScot and SNCB guidance advises that the priority species for assessment of displacement effects (assumed to refer to construction, operation and/or decommissioning) will typically be diver and sea duck species, guillemot, razorbill, puffin and gannet.

151. Based on the guidance, an assessment list of seven species regularly found within the OAA plus 2 km buffer and potentially at risk of disturbance and displacement was agreed with NatureScot during pre-application submission consultation (meeting dated 8 February 2023 and letter dated 5 April 2023), including the inclusion of fulmar (11 June 2024):

- kittiwake;
- Arctic tern;
- guillemot;
- razorbill;
- puffin;
- fulmar; and
- gannet.

152. Although primarily concerned with operation and maintenance phase impacts (see Impact 4), these species are also considered appropriate for a qualitative assessment of construction

impacts due to their susceptibility to disturbance. Due to the similarities in seabird assemblage between the OAA and offshore ECC (see section 6.6), these species are also applicable for the assessment of cable installation disturbance within the offshore ECC.

7.6.1.2.2 Landfall

153. On the basis of the results of baseline surveys covering the inshore and intertidal areas, the following IOFs are taken forward to the assessment of vessel movements, visual and noise disturbance impacts associated with the landfall, due to their recorded distributions, abundances and susceptibility to disturbance: **guillemot, common eider, great northern diver** and **shag**.

154. The landfall is within potential foraging range of breeding red-throated divers located within the Caithness & Sutherland Peatlands SPA and wider countryside. The species is known to be particularly sensitive to vessel activity (Jarrett *et al*., 2018; Garthe and Hüppop, 2004; Schwemmer *et al*., 2011; Furness and Wade, 2012; Bradbury *et al*., 2017; Dierschke *et al*., 2017), but was rarely recorded in the baseline DASs (**Table 6-2).**

155. or shore-based intertidal/nearshore surveys for the Project, as well as for PFOWF (**Table 6-10**). Additionally, the marine area lying between the ECC and the Caithness and Sutherland Peatlands SPA has a rocky shoreline with no sheltered shallow bays. It is therefore unlikely that red-throated divers would be foraging in any marine areas in the vicinity of the ECC. Furthermore, Black *et al*. (2015) did not identify areas suitable for classification as SPAs for foraging red-throated divers in the breeding season from Caithness and Sutherland Peatlands SPA due this being "*deemed inappropriate because of the dispersed nature of both the nest sites within this SPA*" and also that, "*only two grid cells were classed as suitable around Caithness and Sutherland waters*". Red-throated diver is therefore not taken forward for the assessment of impacts at landfall due to a lack of potential for significant effects.

7.6.1.2.3 Vessel movements to and from ports

156. NatureScot Interim advice (13 December 2023) raised the requirement for considering disturbance from vessel movements (albeit as part of the HRA process), between ports and the OAA, offshore ECC and landfall. In relation to this, NatureScot Guidance Note 4: *Overview of connectivity to marine SPAs* advises that for all inshore wintering waterfowl and non-breeding seabird qualifying features of marine SPAs, impact pathways need to be considered within 15 km of the marine SPA. This includes vessel traffic routes.

157. In relation to EIA impacts on offshore ornithological qualifying features due to vessel movements associated with the offshore Project, three impact pathways have been identified:

- Offshore non-breeding seabirds and inshore wintering waterfowl being disturbed by vessel movements;
- Breeding seabirds using waters adjacent to the colony engaging in maintenance activities such as preening, bathing and displaying, being disturbed by vessel movements; and
- Breeding red-throated divers being disturbed by vessel movements whilst foraging in inshore waters.

158. Which impact pathways, and which species may be affected by vessel movements to and from the offshore Project depends on the location of the port(s) used and routes taken, which at present, are unconfirmed from a list of possible port options. However, to cover all possibilities, breeding and non-breeding seabirds, wintering divers, seaducks and grebes, and breeding red-throated divers have been screened into the assessment in section 7.6.1.6.

7.6.1.3 *Disturbance associated with the OAA*

7.6.1.3.1 Sensitivity

159. Six of the IOFs (kittiwake, Arctic tern, guillemot, razorbill, puffin and gannet) that have been screened into the assessment of construction impacts associated with the OAA are considered to have a **medium** sensitivity to disturbance and displacement, based on their sensitivity to ship traffic noted in Garthe and Hüppop (2004), Furness and Wade (2012), Furness *et al*. (2013) and Bradbury *et al*. (2014). Fulmar has generally not been assessed for displacement impacts in other offshore wind farm EIA Reports, however, NatureScot (11 June 2024) requested that fulmar is assessed for barrier effects. Its inclusion in the assessment of construction disturbance, and its assumed medium sensitivity rating, is therefore considered precautionary.

7.6.1.3.2 Impact

160. There is potential for disturbance and displacement of seabirds due to construction activities within the OAA, including the construction of WTGs and other infrastructure, and associated vessels. However, construction will not occur across the whole of the OAA simultaneously or during every day but will be phased. Consequently, impacts will occur only in the areas where vessel aggregations are operating at any given point and not the entire OAA.

161. NatureScot's Guidance Note 8: *Guidance to support Offshore Wind applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of marine birds* is more readily relevant to operational phase impacts, although it can be used as a basis for determining possible worst-case magnitude of impact.

162. Recommended displacement rates for each species (see **Table 7-4** under Impact 4) shows that displacement rates within 2 km around a disturbance source are likely to vary widely between species, from 20% of fulmar individuals, to 70% for gannet.

163. If, during construction, it is assumed that a species-specific displacement percentage is applied to birds within a 2 km radius (area of 12.57 km^2) of construction activity (e.g. an aggregation of vessels around a WTG under construction), then a rough indication of numbers of birds potentially affected can be estimated. Taking guillemot as an example, a peak density estimate of 7.26 birds per km^2 (including apportioned unidentified auks) was recorded within the OAA in April 2021. Based on this, 91 individuals could be located with a 2 km radius of construction activity, of which, 60% (55 individuals) would be temporarily displaced. This would equate to 0.006% of the regional population (980,165 individuals).

164. Thus, it is likely that very small proportions of regional populations for each species would be affected at any time, and considerably fewer individuals than across the whole OAA during operation (where it is predicted that negligible impacts would occur – see Impact 4). It is reasonable to assume that birds displaced will reoccupy areas following construction

cessation, and so compared to long-term displacement during the operation phase, mortality impacts are much less likely to occur. Overall, therefore, it can be reasonably concluded that a **negligible** impact magnitude would occur for all seven IOFs.

7.6.1.4 *Disturbance associated with the offshore ECC*

7.6.1.4.1 Sensitivity

165. All of the seven IOFs (kittiwake, Arctic tern, guillemot, razorbill, puffin, fulmar and gannet) that have been screened into the assessment of construction impacts associated with the offshore ECC are considered to have a **medium** sensitivity to disturbance and displacement, based on their sensitivity noted in Garthe and Hüppop (2004), Furness and Wade (2012), Furness *et al.* (2013) and Bradbury *et al.* (2014).

7.6.1.4.2 Impact

166. Up to five offshore export cables will be required within the offshore ECC, to the two landfalls at Caithness. The offshore export cables will either be split across these two cable route options or located within one of the two cable route options, and this will be determined post-consent. The offshore ECC is 1 km in width at its widest point and the anticipated spacing between the offshore export cables is 17 m within this area.

167. The Indicative Construction Programme, as presented in Figure 5-7 of **Offshore EIA Repot, chapter 5: Project description**, shows that offshore ECC work is scheduled to take place over two months (indicatively May and June, but assumed to be sometime during spring/summer) across years 1-3. This would mean that individuals present during the non-breeding season would not be affected.

168. Within the offshore ECC, there is therefore potential for disturbance and displacement resulting from the presence of construction vessels installing the offshore cables, most likely during the breeding season. However, cable laying vessels are static for large periods of time and move only short distances as cable installation takes place, and offshore cable installation activity is a relatively low noise emitting operation. Additionally, the offshore ECC works are scheduled to only take place over a period of two months. Therefore, although it is possible that there could be temporary disruption of foraging to a small number of individuals, the overall risk of mortality to any birds resulting from disturbance is very small. This would also be the case for non-breeding birds, should work occur during the autumn/winter, and as such, impacts are considered to be of **negligible** magnitude for all IOFs.

7.6.1.5 *Disturbance associated with the landfall*

7.6.1.5.1 Sensitivity

169. Based on the sensitivity ratings given in Garthe and Hüppop (2004), Furness and Wade (2012), Furness *et al.* (2013) and Bradbury *et al.* (2014), guillemot and shag are rated as being of **medium** sensitivity to disturbance, with common eider and great northern diver being of **high** sensitivity.

7.6.1.5.2 Impact

170. At the landfall, birds using inshore waters could be disturbed by construction works. It is currently anticipated that the five offshore export cables may landfall into a single location at either Crosskirk or Greeny Geo. However, if constrained, the offshore export cables will be split across these two landfall options. HDD is the only technique being considered for the installation of the offshore export cables at the landfalls. The anticipated location of the HDD exit point is between water depths of 10 m – 40 m below LAT, within the offshore ECC.

171. As the cable will be installed using HDD rather than trenching across the foreshore and seabed in nearshore waters, this is likely to be limited to a relatively small spatial extent and short period of time when vessels are located offshore for the HDD works and cable pull through. As such the disturbance will likely only be due to the presence of nearshore vessels, with associated personnel and noise.

172. The Indicative Construction Programme, as presented in Figure 5-7 of **Offshore EIA Report, chapter 5: Project description**, shows that offshore ECC work is scheduled to take place over two months (indicatively May and June) across years 1-3. This would mean that HDD works are likely to be limited to the breeding season, which would remove the risk of adverse impacts for great northern diver (only present in the non-breeding season) and common eider, where although present in small numbers in the breeding season baseline surveys, there was no indication of breeding within the onshore survey area.

173. Shag is an inshore foraging species and although there was no breeding evidence recorded within the onshore survey area during baseline surveys, birds present in summer months may be breeding individuals (there was a shag count of 14 AON at nearby Ushat Head in 2023, SMP database). Although the presence of vessels associated with HDD works may cause temporary, localised displacement for these species in the breeding season, it is considered unlikely that this would affect foraging ability for any breeding attempt.

174. For guillemot, it has already been established for the OAA (section 7.6.1.3) and offshore ECC (section 7.6.1.4) that any disturbance impacts associated with construction activities would be of negligible magnitude, and with landfall activity even more restricted in space and time, this would again be the case.

175. Disturbance from offshore vessels during cable installation is predicted to be short term (relative to the longevity of the species distributed), temporary (disturbance is only during cable installation) and reversible (once the works are complete the impact source will be removed). The magnitude of impact for all IOFs is therefore assessed as **negligible**.

7.6.1.6 Vessel movements to and from ports

7.6.1.6.1 Sensitivity

176. Sensitivity of seabird species to vessel movements are considered to be of the same levels as determined above for disturbance impacts associated with the OAA and offshore ECC (i.e., medium at most).

177. For non-seabird species, some are more sensitive to the presence of vessels than others. For species and species groups that have a distribution that might overlap with Project vessel

transit routes, the susceptibility of the species to disturbance was considered based on reviews by Schwemmer *et al*. (2011) and Goodship & Furness (2022).

178. Schwemmer *et al*. (2011) investigated flush distances from vessels by several species of diver and seaduck, within and outwith shipping lanes. Flush distances for the seaduck and diver species that were included in this study were described as: very high for common scoter, moderate to high for long-tailed duck, low to moderate for common eider, moderate to high for velvet scoter and very high for red-throated and black-throated divers. Flush distances were highly variable among individuals of the same species. Schwemmer *et al*. (2011) also found that, unlike seaduck, divers did not habituate to vessels, showing no reduction in flushing distance in shipping lanes, compared to other areas.

179. Goodship & Furness (2022) undertook a review of flush distances of a range of species, including divers, grebes and seaduck, both during the breeding season and the non-breeding season.

180. Divers are considered to have a high sensitivity to boat disturbance and human activity in marine areas during the non-breeding season. Red-throated and black-throated divers are considered to be particularly sensitive to marine activity, and both species are known to avoid shipping lanes (Schwemmer *et al*., 2011). Goodship & Furness (2022) suggest that during the non-breeding season, a disturbance distance of up to 1km from source for red-throated and black-throated divers should be considered.

181. Great northern divers are considered to have a medium/high response to human disturbance, and a disturbance distance of up to 350 m has been suggested for this species during the non-breeding season (Goodship & Furness, 2022). This diver species has been identified as having a high vulnerability to disturbance by boats (Furness *et al*., 2013, Jarrett *et al*., 2018), and may swim away from the path of ferries up to 4 km away (Jarrett *et al*., 2018), although as great northern divers spend a high proportion of daylight hours foraging during the non-breeding season it may be difficult to distinguish between behaviours of diving to avoid nearby boats and diving to hunt for food.

182. Slavonian grebes are known to have a high sensitivity to boat disturbance (Jarrett *et al*., 2018), and a disturbance distance of up to 350 m has been suggested for this species during the non-breeding season (Goodship & Furness, 2022). However, flushing distances of individual birds depends on the extent of habituation and tolerance of disturbance in different areas (Ruddock and Whitfield, 2007). In Argyll, Orkney and Shetland, Slavonian grebes are known to overwinter in areas with frequent ferry and fishing vessel traffic, salmon and mussel farming activity (Argyll Bird Reports volumes 12 to 29[15]; Upton *et al*., 2018; Jackson, 2018), and these populations appear to be tolerant of these practices.

183. Seaducks are considered to be sensitive to boat disturbance and human activity in marine areas during the non-breeding season (Goodship & Furness, 2022). Scoters are considered to be the most sensitive seaduck species in the UK, and common scoter may flush from boats that are over 3 km away (Schwemmer *et al*., 2011). Goldeneye are also vulnerable to boat disturbance and a disturbance distance of up to 800 m has been suggested for this species

[15] Argyll Bird Reports available at: https://argyllbirdclub.org/publications/the-argyll-bird-report/

during the non-breeding season (Goodship & Furness, 2022). Disturbance distances of up to 450 m to 500 m have been suggested for greater scaup and common eider during the non-breeding season, and both of these seaduck species are considered to a high vulnerability to disturbance by boats (Furness *et al*., 2013; Mendel *et al*., 2008; Jarrett *et al*., 2018), although flush distances vary between individuals, in different weather conditions and stage of moult. Long-tailed duck and red-breasted merganser were not reviewed by Goodship & Furness (2022), but these seaduck species were considered to have a moderate disturbance susceptibility score similar to that of common eider and Slavonian grebe in a review by Bradbury *et al*. (2014).

184. It is important to note that most, if not all, bird species are likely, to some degree, to habituate to disturbance, and birds present in highly disturbed areas (e.g. those within or close to shipping lanes) are more likely to show some habituation to disturbance and tolerate a shorter disturbance than birds of the same species in less disturbed areas. As well as differing levels of habituation between individuals, a wide range of other factors (e.g. weather, flock size, bird age etc.) can influence behavioural responses to disturbance and therefore response to vessel traffic is very likely to vary between individuals (reviewed in Goodship & Furness, 2022).

7.6.1.6.2 Impact

185. An outline Navigational and Safety Vessel Management Plan (NSVMP) was submitted with the original Project application (see **Table 7-2** – this is considered as embedded mitigation for the assessment). This will be further developed post-consent, once there is certainty over which ports/harbours will be used during construction. Vessels will be required to adhere to the NSVMP, including adhering to measures to follow existing shipping routes where possible.

186. In general, important areas for aggregations of non-breeding waterbirds around the Scottish coastline have been identified through a series of aerial surveys carried out by JNCC[16] and have been used to inform the selection of marine SPA areas. Thus, it is likely that most key aggregations of offshore ornithological features that are not breeding seabirds reside within marine SPA boundaries. In the absence of comprehensive at-sea survey data, the SPAs are therefore used as surrogates for where the most important bird aggregations are found in proximity to vessel routes. The OAA and offshore ECC do not overlap with any marine SPAs, nor are within 15 km of any marine SPAs, but vessel routes from port may pass through or near marine SPAs, or SPA marine extensions, en route. The assessment of impacts on the SPAs themselves are presented in the **Addendum to the RIAA - Ornithology**.

187. Currently, the Applicant is not able to confirm which ports or harbours will be used for construction activities. Potential ports for marshalling and/or assembly are Scapa Flow Deep water Quay, Nigg (Cromarty Firth), Port of Cromarty, Ardersier, Stornoway, Leith or Dundee. Additionally, Scrabster and Aberdeen are potential ports that could be used by the Project but for logistics only as they do not have facilities for marshalling or assembly of OWF components.

[16] https://hub.jncc.gov.uk/assets/10fb6f1b-6d8d-449c-a572-f9411dd65d46.

188. Impacts associated with these ports are considered below. Aberdeen and Stornoway ports can be accessed without transiting through a marine SPA. In some cases, potential routes used by vessels transiting to/from these ports could travel within 15 km of marine SPAs, but it is unlikely that they would transit through important bird areas. These two ports are therefore not considered further due to a lack of potential for significant effects.

189. As noted in section 7.6.1.2, impacts may occur to (i) non-breeding seabirds and inshore wintering waterfowl (in marine SPAs); (ii) breeding seabirds using waters adjacent to the colony (in colony SPA marine extensions); and (iii) breeding red-throated divers whilst foraging in inshore waters (in marine SPAs). These impact pathways are considered for each port below.

Ports near marine SPAs

190. Port of Leith, Port of Dundee, Ardersier, Port of Nigg, Port of Cromarty Firth and Scapa Flow Deep Water Quay all have marine SPAs adjacent to them. This means that vessels associated with the Project would need to transit through the marine SPA to reach the port. Consequently, it is possible that inshore wintering waterfowl and non-breeding seabirds may be impacted. Vessels passing through would however only be present in an area for a short period of time, after which any disturbed birds can return to their behaviours they were undertaking prior to the disturbance. There may be a delay before birds return to the same area or behaviour, depending on the species' sensitivity to disturbance and also individual variation in response to presence of a vessel.

191. Construction vessels transiting through marine SPAs are all large slow-moving vessels. Vessels range in size from 74 m up to 225 m in length and have a transit speed across the water of between 8-13 kts with most travelling at 10 kts or less. These types of vessels will need to follow existing vessel routes for navigational safety.

Leith and Dundee

192. The ports of Dundee and Leith may have capacity only to be used for WTG installation at the Project, and the maximum number of vessel transits to/from these ports has been estimated as 382 one-way transits per year during construction.

193. The ports are adjacent to the boundaries of the inshore Firth of Forth SPA and the Firth of Tay and Eden Estuary SPA respectively. Of the qualifying features of these SPAs, those which could potentially be disturbed or displaced by vessel traffic are red-throated diver, scoters and other seaducks.

194. Vessels associated with the Project that use the port of Dundee or Leith will be using established shipping lanes (see **Figure 7-1** for indicative routes). Consequently, there will be no increase in the spatial extent of any disturbance caused by vessels associated with the Project.

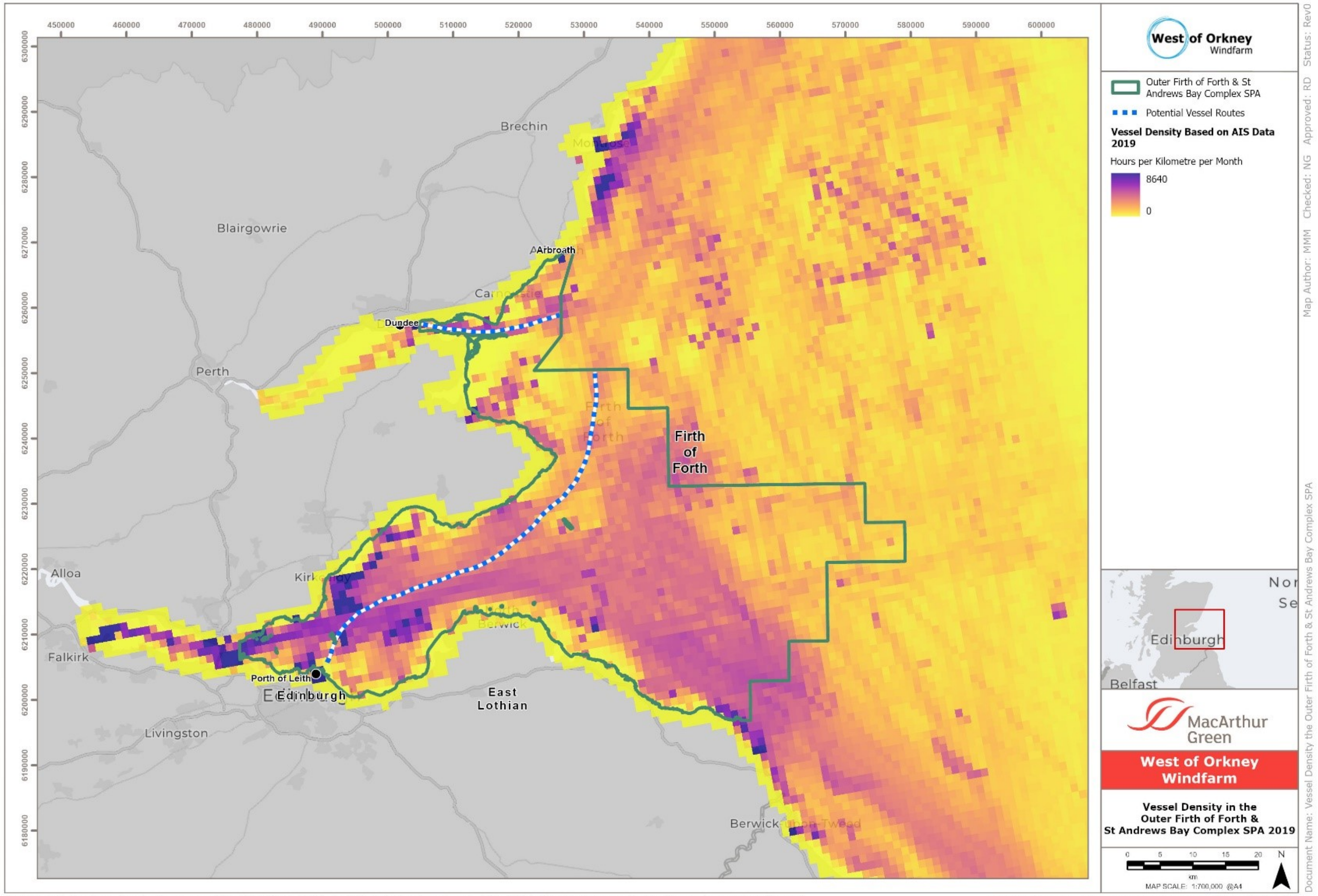
195. Automatic Identification System (AIS) shipping traffic data obtained from the Marine Directorate's National Marine Planning Interactive (NMPi) mapping tool[17] indicates that there is no overlap between the inshore Firth of Forth SPA and the Firth of Tay and Eden Estuary

[17] https://marinescotland.atkinsgeospatial.com/nmpi/.

SPA boundaries and the ports of Leith and Dundee, or vessel routes to/from the port. Therefore, it is unlikely that the inshore aggregations of qualifying features of the two SPAs would come within close proximity to the Project's vessel traffic from the ports of Leith or Dundee, assuming that established shipping routes are used.

196. Vessels could also transit through the Outer Firth of Forth and St Andrews Bay Complex SPA or could use areas within the SPA for shelter/lie up. This has the potential to cause disturbance/displacement to SPA qualifying features, in particular divers and seaducks found further offshore.

197. The two ports have been used for storage and marshalling for several OWF projects that have been constructed including Neart na Gaoithe. The most recent 2019 data for AIS vessels passing through the ports of Dundee and Leith (**Figure 7-1**) gives an indication of which transit routes construction vessels associated with the Project might take through the Outer Firth of Forth and St Andrews Bay Complex SPA, under the assumption that vessels will be subject to the same navigational safety constraints as construction vessels associated with Neart na Gaoithe OWF. Vessels may also use anchorages near the ports as sheltering/lie up areas.



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Datum: WGS 1984, Projection: UTM Zone 30N Date: 19/07/2024

Figure 7-1. Vessel density in the Firth of Forth and Firth of Tay in 2019.

Vessel density data downloaded from the Marine Directorate's NMPi tool. Potential indicative routes that may be used by Project vessels to/from the ports of Leith and Dundee through the Outer Firth of Forth and St Andrews Bay Complex SPA are indicated with a blue/white line.

198. Based on the NMPi mapping tool which can also show distribution of bird distributions with the Forth and Tay areas, and AIS shipping data, in general, vessel transit routes from the Port of Leith overlap little with more inshore divers and seaducks within the Outer Firth of Forth and St Andrews Bay Complex SPA. Anchorages in the Firth of Forth show limited overlap with waterfowl distribution although low densities of some species that tend to occur further offshore may overlap with anchorages.

199. Many of the wintering waterfowl species had a high-density aggregation in St Andrews Bay. At the coarse scale of the mapping, it appears that the shipping lanes for the port of Dundee pass through the middle of this aggregation and could therefore cause some disturbance/ displacement. However, as this is an existing shipping lane, seaducks will have already habituated to the presence of vessels and divers will not occur in high densities in shipping lanes (Schwemmer *et al*., 2011).

200. The species most sensitive to the presence of vessels (red-throated diver, common scoter) may exhibit a localised change to distribution due to the volume of vessels transiting through the area, if the Project decides to use the Port of Dundee for construction. However, any change in distribution will be short term in nature, as the period of construction activities, requiring lots of vessels, will be of short duration. Seabird species may also be temporarily affected by vessel movements, but as described above for the OAA and offshore ECC, the magnitude of impact within a regional population context is likely to be negligible.

201. Therefore, when accounting for embedded mitigation measures as part of the NSVMP, the impact on all species due vessel numbers along established shipping routes from the Port of Leith or Dundee is considered to be of **negligible** magnitude.

Ardersier, Cromarty Firth and Nigg

202. The Ports of Ardersier, Cromarty Firth and Nigg are <15 km from the boundary of the Moray Firth SPA. The wintering waterbird assemblage species of the SPA could be disturbed or displaced by vessel traffic moving near to the SPA. Additionally, vessels may use the sheltered waters of the Moray Firth SPA, particularly the Cromarty Firth, for anchoring while sheltering from bad weather or during periods of lie-up. The main species that may be affected are great northern diver, red-throated diver, Slavonian grebe, seaducks and breeding shag.

203. The ports of Nigg and Ardersier have the capacity to be used for storage, marshalling and construction of foundations as well as WTGs, and the maximum number of vessel transits for the construction phase of the Project to/from these ports is 718 one-way transits per year during construction.

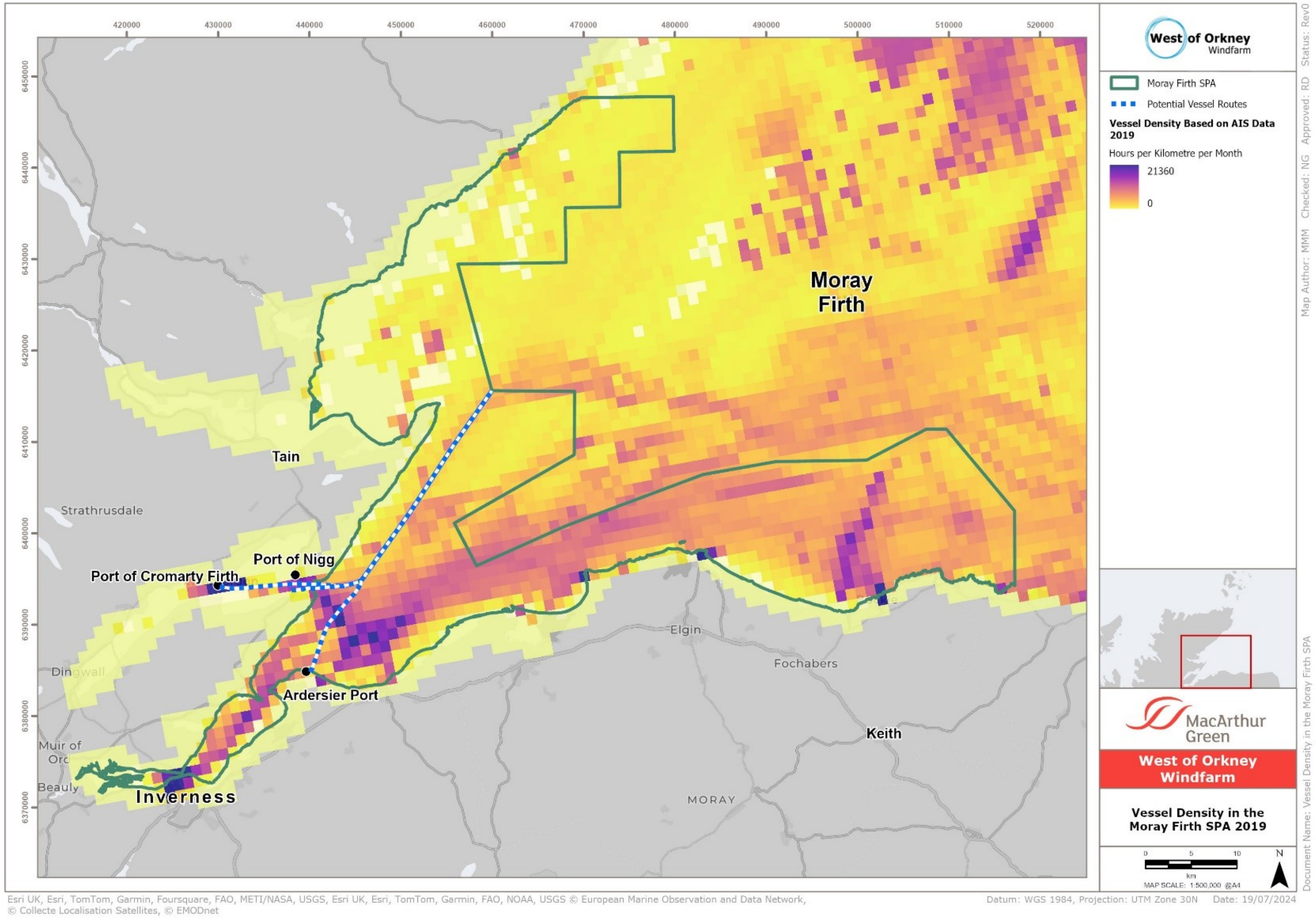

Figure 7-2. Vessel density in the Moray Firth SPA in 2019.

Vessel density data downloaded from the Marine Directorate's NMPi tool. Potential indicative routes that may be used by Project vessels to/from the ports of Nigg, Cromarty Firth and Ardersier through the Moray Firth SPA are indicated with a blue/white line.

204. The port of Cromarty Firth may have the capacity only to be used for WTG installation, therefore the number of vessel transits estimated is a maximum of 382 per year during construction. It has been used as an intermediary port for other OWFs.

205. For The ports of Nigg and Cromarty Firth, whilst the presence of Project vessels using shipping lanes might continue disturbance impacts, there will be no increase in the spatial extent of any disturbance caused by these vessels (see **Figure 7-2** for vessel densities). However, the port of Ardersier is currently being redeveloped and at present, there is not a regularly used route from the port (inshore from the established routes used by vessels using port of Nigg and port of Cromarty Firth). It was therefore assumed that vessels would leave the port of Ardersier and head northeast, along the Caithness coast towards the Project (as shown indicatively on **Figure 7-2**).

206. Great northern divers were recorded throughout most of the Moray Firth SPA, including to the east of the Black Isle, where vessels from Ardersier could transit (based on data downloaded from the Marine Directorate's NMPi mapping tool). There are also higher densities of great northern divers along the Easter Ross coast that vessels leaving the Cromarty Firth would potentially transit through. However, routes that these vessels would use are existing shipping lanes and great northern diver density in these shipping lanes would be expected to be very low (Schwemmer *et al.,* 2011). The high-density concentrations in Spey Bay and Dornoch Firth are in areas where vessels associated with the Project will not transit or anchor. There is therefore potential for some aggregations of this species to be disturbed/displaced by vessels associated with the Project, but this is restricted to vessels using the port of Ardersier and the sea area to the east of the Black Isle.

207. Red-throated divers occur in higher densities in the Dornoch Firth and Spey Bay which are areas that vessels associated with the Project will not use. However, red-throated divers do occur along the Black Isle coast, an area through which vessels using the port of Ardersier would transit. There are also higher densities of red-throated divers along the Easter Ross coast that vessels leaving the Cromarty Firth would potentially transit through. Despite this, routes that these vessels use are existing shipping lanes and red-throated diver density in these shipping lanes would be expected to be very low (Schwemmer *et al.,* 2011). Generally, red-throated divers tend to occur closer inshore than the larger great northern diver and vessels associated with the Project are unlikely to be using these areas.

208. Because species such as Slavonian grebe, common scoter, goldeneye, greater scaup, red-breasted merganser and common eider generally occur only close inshore in shallow waters, there is no overlap with potential vessel transit routes from the ports of Cromarty Firth, Nigg or Ardersier. Vessels associated with the Project would be highly unlikely to cause disturbance/displacement to these species.

209. The highest concentration of long-tailed ducks in the Moray Firth SPA is around Burghead, along the Moray coast. However, lower densities were recorded along the Black Isle coast, an area through which vessels using the port of Ardersier could potentially transit. Long-tailed ducks can occur further offshore than some other species of grebe and seaduck. Therefore, there is a possibility of low numbers of long-tailed ducks occurring in areas used by vessels from Ardersier. Vessels using Nigg or Cromarty Firth ports would not be expected to transit through any areas of high densities of long-tailed ducks. Given this species'

moderate sensitivity to the presence of vessels, disturbance of this qualifying feature is unlikely.

210. The Moray Firth SPA is one of the most important sites for wintering velvet scoter in Britain, supporting 60% of the GB population. Velvet scoters were concentrated along the Moray coast and in the Dornoch Firth but were absent from the Black Isle and Easter Ross coasts. Therefore, despite the high sensitivity of this species to vessels and the importance of this area for this species, vessels associated with the Project will not transit areas used by this species.

211. European shag distribution in the Moray Firth was concentrated around the area adjacent to East Caithness Cliffs SPA and near Cullen. The species was not present in high densities in areas through which vessels associated with the Project would transit.

212. The Port of Ardersier is also <15 km from the boundary of the Inner Moray Firth SPA, and its wintering waterbird assemblage which could potentially be disturbed or displaced by vessel traffic includes goldeneye, red-breaster merganser and scaup, which are found further offshore than other species. However, there is no overlap between the SPA boundary and the port of Ardersier or vessel routes to and from the port. Therefore, it is very unlikely that the qualifying features of the Inner Moray Firth SPA would be in close proximity to any vessel traffic from the port of Ardersier, if the Project chose to use this port for construction.

213. Therefore, when accounting for embedded mitigation measures as part of the NSVMP, the impact on all species due to vessel movements along established shipping routes from the Ports of Ardersier, Cromarty Firth or Nigg is considered to be of **negligible** magnitude.

Scapa Flow Deep Water Quay

214. The Scapa Deep Water Quay (once constructed) would be located in the east of Scapa Flow, next to the parish of Holm, in the Bay of Deepdale. If the Project decides to use Scapa Deep Water Quay, vessels will pass through the Scapa Flow SPA when travelling to and from the Project. Additionally, vessels may use the sheltered waters of Scapa Flow for anchoring while sheltering from bad weather or during periods of lie-up. The estimated maximum number of Project construction vessel transits is 382 one-way transits per year during construction.

215. According to the Marine Directorate's NMPi mapping tool, Scapa Flow is frequently used by many vessels, and density is particularly high in the west of Scapa Flow, close to Hoy, and is also high in the eastern part of the area, with lower vessel densities in the middle of Scapa Flow (see **Figure 7-4**).

216. Scapa Flow SPA hosts important numbers of non-breeding great northern diver, black-throated diver and seaducks, and breeding shag, which may be disturbed/ displaced by vessels associated with the Project.

217. According to the Marine Directorate's NMPi mapping tool, great northern divers were recorded in high numbers throughout most of the Scapa Flow, with the exception of an area close to Hoy (**Figure 7-3**). This means they are likely to occur in high densities in areas that could be used by vessels associated with the Project for transiting between Scapa Deep

Water Quay and the Project and sheltering/lie up areas, and therefore there is potential for this species to be disturbed/displaced during construction.

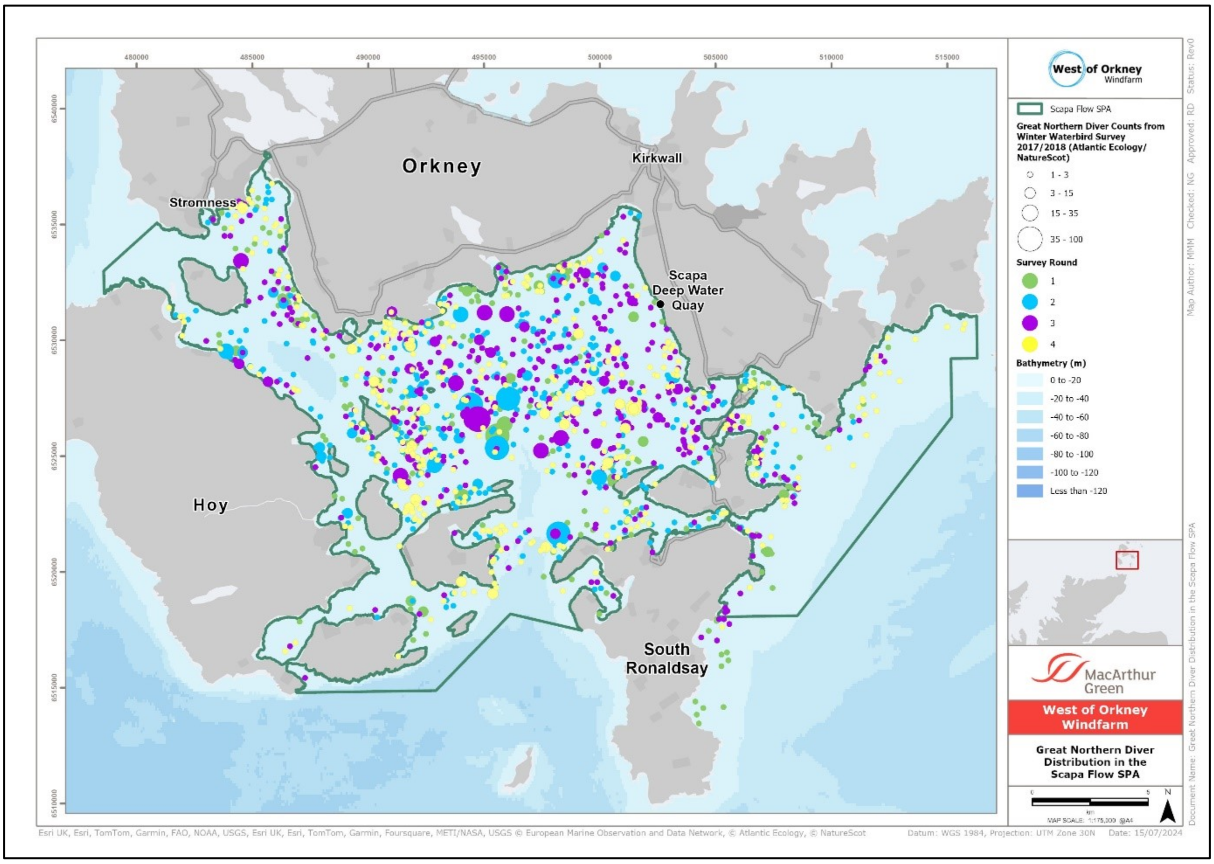

Figure 7-3. Great northern diver distribution in Scapa Flow from surveys during the 2017/2018 non-breeding season. Reproduced from Jackson (2018).

218. A 2017/18 Scapa Flow survey of black-throated diver distribution (Jackson, 2018) found that individuals tended to be concentrated along the north and west of the Scapa Flow SPA, with large areas in the central and eastern part of Scapa Flow in which no black-throated divers were recorded. The Scapa Deep Water Quay is on the eastern edge of Scapa Flow, with vessels potentially transiting across Scapa Flow in an east-west direction or a south-west to north-east direction. The distribution of black-throated divers would not overlap with these transit route options. Black-throated divers were not recorded in the vicinity of designated anchor points and anchor areas within Scapa Flow, meaning that sheltering and vessels lying up would be unlikely to overlap with black-throated diver distribution.

219. Generally, eiders and long-tailed ducks have a close inshore distribution within Scapa Flow and there would be limited overlap between areas of higher eider density and transiting vessels in the proximity of Scapa Deep Water Quay or vessels at anchor. Vessels exiting Scapa Flow to the west, near to Stromness, could transit close to areas of high eider and long-tailed duck densities. However, if vessels exit via a southerly route, around the south end of Hoy, transiting vessels will not encounter any large aggregations.

220. As Slavonian grebe and red-breasted merganser occur only close inshore in shallow waters, there is no overlap with potential vessel transit routes from Scapa Deep Water Quay or anchorage areas.

221. Shags were recorded throughout Scapa Flow, although tended to be relatively coastal and avoid the central part of the SPA. Relatively low counts were recorded in areas of anchorages and along potential transit routes from Scapa Deep Water Quay, with the exception of entrance/exit routes to Scapa Flow, where vessels are required to pass close to the islands of Flotta (southerly exit) or Graemsay (westerly exit). In these areas, vessels will pass through areas with high densities of shags.

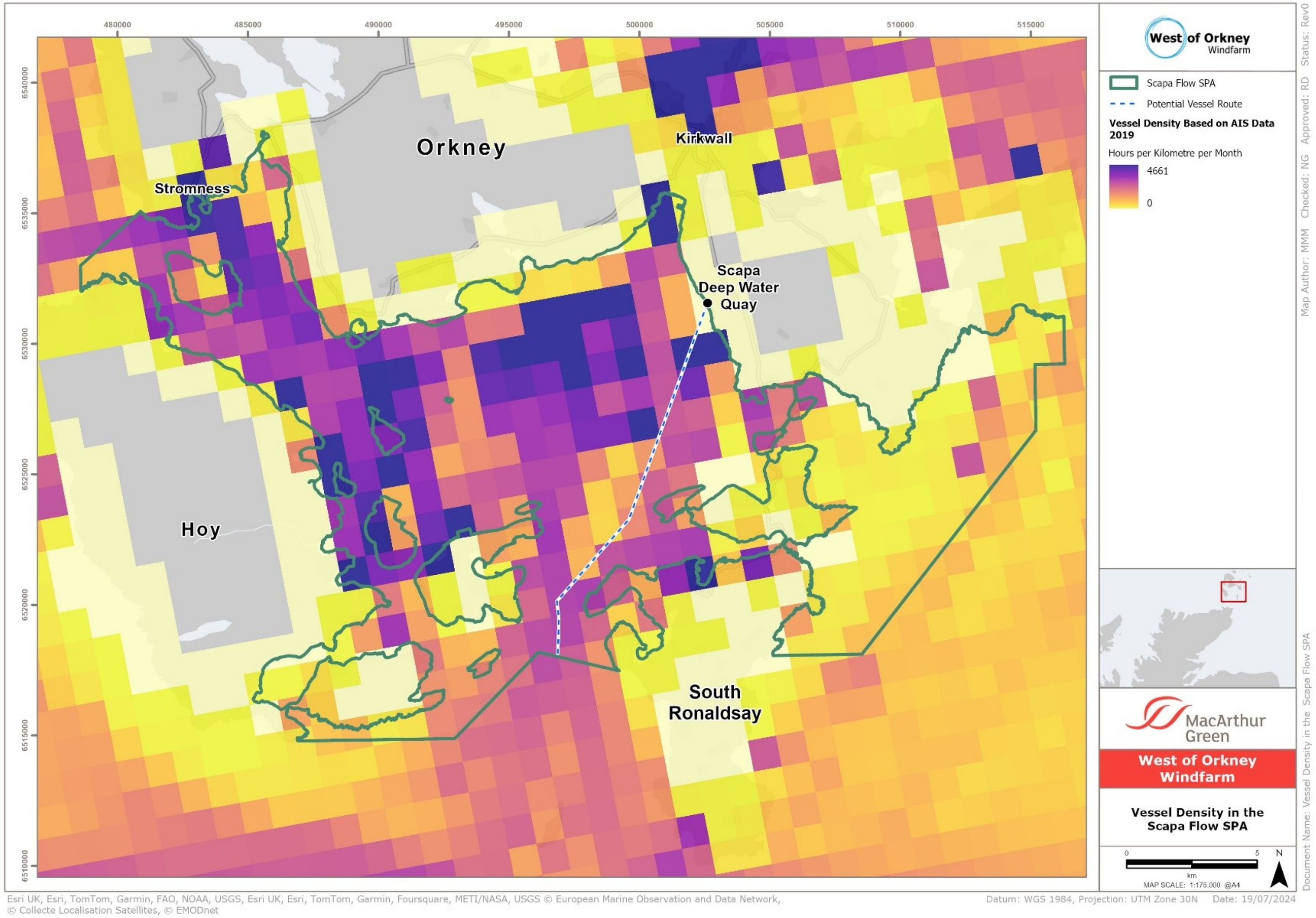

Figure 7-4. Vessel density in the Scapa Flow SPA in 2019. Vessel density data downloaded from the Marine Directorate's NMPi tool.
Potential indicative routes that may be used by Project vessels to/from Scapa Deep Water Quay through the Scapa Flow SPA are indicated with a blue/white line.

222. Overall, vessel disturbance from Scapa Deep Water Quay is only likely to impact upon substantial numbers of a few species present within Scapa Flow, most likely great northern diver, and in localised areas, shags.

223. In contrast to red-throated and black-throated divers, which tend to avoid areas of human activity such as piers, harbours and ferry terminals, great northern divers can often be watched foraging under piers or in harbours, close to human activity, which suggests that this species, or at least some individuals, are less sensitive to human disturbance than the smaller diver species (reviewed in Goodship & Furness, 2022). European shag has a moderate sensitivity to boat disturbance, with Bradbury *et al.* (2014) giving shags a score of 3 for disturbance susceptibility (on a scale of 1 to 5).

224. Therefore, despite relatively large numbers of some species being present in proximity to vessel routes, any displacement impact that does occur will be short-term, both as a vessel passes through an area, after which birds would return to the area, and for the duration of the Project construction period, after which the species' distribution would be expected to return to baseline conditions. The overall impact magnitude is therefore considered to be **negligible** at a population level for all species apart from great northern diver, which, given that Scapa Flow SPA holds almost a quarter of the UK wintering population, is considered to be of **low** magnitude (assuming only a small proportion of these individuals is affected).

Breeding Red-throated Divers: Scapa Deep Water Quay

225. Black *et al.* (2015) found red-throated divers forage in coastal waters within 10 km of their nest site. Red-throated divers that nest on Hoy and parts of the Orkney mainland are therefore likely to forage within Scapa Flow SPA, which is designated for the species during the breeding season. It is therefore possible that they could be disturbed by vessel movements from Scapa Deep Water Quay.

226. Data downloaded from the Marine Directorate's NMPi mapping tool suggests that the species' distribution in Scapa Flow reflects their breeding location, with highest numbers seen in the west of Scapa Flow (i.e. the east coast of Hoy) and along the north-western side of Scapa Flow (**Figure 7-5**).

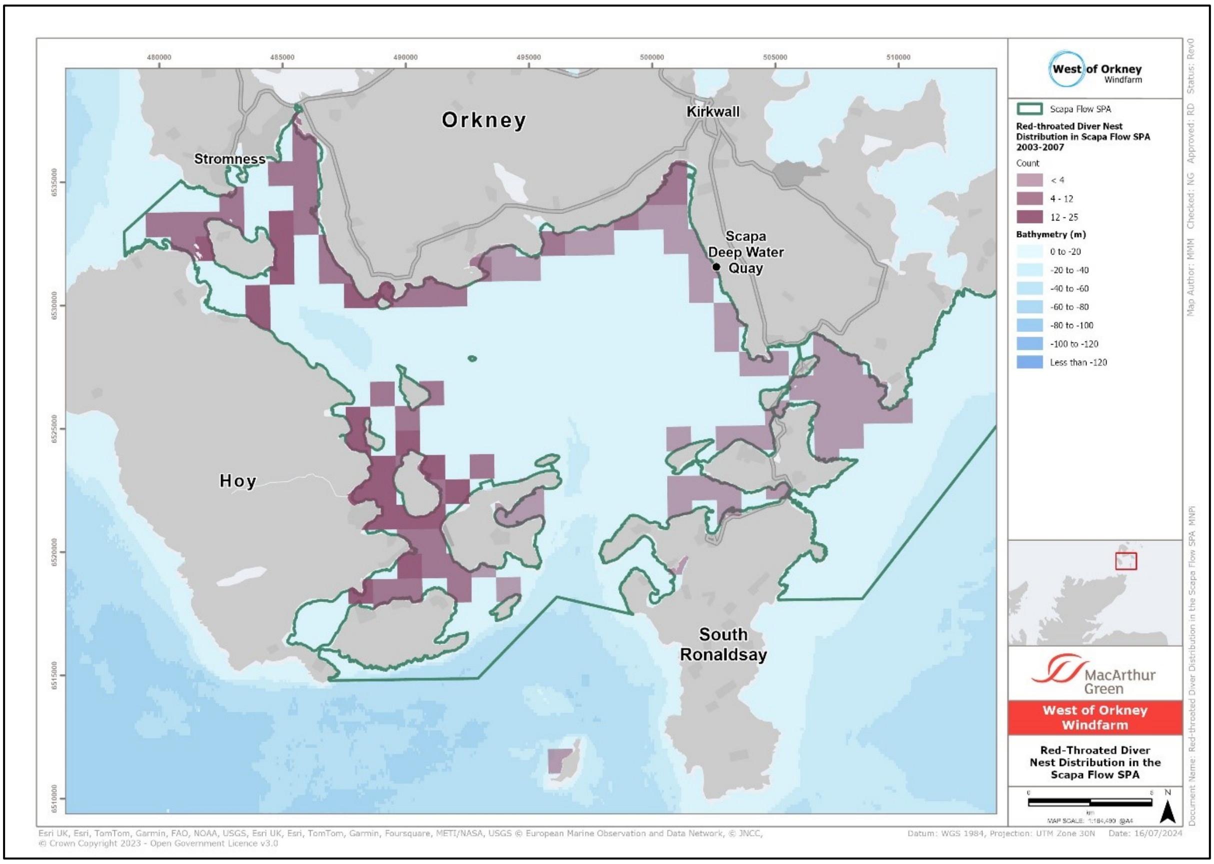

Figure 7-5. Red-throated diver breeding distribution in Scapa Flow.

Data downloaded from the Marine Directorate's NMPi mapping tool - these data represent the outputs of GAM modelling and analysis of nesting locations within foraging distance. Modelled outputs are assigned to 1km-by-1km cells.

227. There would therefore be expected to be little overlap between vessel transit routes and anchorage areas with red-throated diver distribution, due to this species being concentrated in areas well away from the Scapa Deep Water Quay (in the east of Scapa Flow) and anchor points/areas in the middle of the Scapa Flow. The Scapa Flow Conservation and Management Advice[18] notes that the more restricted breeding season distribution of red-throated divers in Scapa Flow will limit potential exposure to large marine developments.

228. Vessels transiting between the Project and Scapa Deep Water Quay would not pass through any areas of higher densities of red-throated divers if vessels exited Scapa Flow via a southerly route (see **Figure 7-4**). Exiting via a westerly route could bring vessels in closer proximity to higher densities of red-throated divers around the northern end of Hoy, the island of Graemsay and mainland Orkney. However, given this species' preference for foraging in inshore areas, it is likely that vessels would be >1 km from any higher density areas, meaning that any disturbance/ displacement is unlikely. Impacts are therefore likely to be of **negligible** magnitude.

Waters Adjacent to Breeding Colonies: Scrabster Port

229. Scrabster Harbour will be used by some vessels associated with the Project logistics during construction and operation. A worst-case estimate of up to 2,726 one-way transits of all

[18] https://sitelink.nature.scot/site/10510.

vessels in each year of the construction programme has been made, although in some years total numbers would be lower. The potential routes taken are shown in **Figure 7-6**.

230. Whilst no marine SPAs with divers, seaduck or grebe qualifying features are within 15 km of the harbour, a marine extension to the seabird colony of North Caithness Cliffs SPA does extend across Thurso Bay. Therefore, vessels entering and leaving Scrabster Harbour will transit through this SPA, which is likely to be used for breeding seabird maintenance activities.

231. Currently much vessel traffic in and out of Scrabster Harbour passes through the SPA marine extension, and so a degree of habituation is likely to be exhibited by breeding seabirds. The vessel movements associated with the offshore Project would however increase the frequency of traffic and it is therefore possible that more temporary disturbance events would occur during the breeding season.

232. The species that are likely to be using the marine area adjacent to the cliffs are kittiwake, guillemot, razorbill, puffin and, potentially, fulmar. Kittiwakes tend to generally not be disturbed by the presence of vessels and will actually associate with vessels, probably looking for fishing discards (personal observation, S. O'Brien), whereas guillemot, razorbill and puffin tend to be slightly more disturbed by the presence of vessels. Fulmars are less likely to be sat on the sea adjacent to the colony and so a low sensitivity to the presence of vessels.

233. The North Caithness Cliffs SPA is a large site with a total area of 146 km^2. Vessels from Scrabster Harbour would follow established vessel transit routes through the marine component of the SPA, with approximately 2 km of the transit route within the SPA boundary. Assuming that birds were disturbed by the presence of vessels out to a precautionary distance of 1 km either side of the vessel track, this would represent an area of 4 km^2 over which there was the possibility of birds being disturbed, i.e. only 2.7% of the site. Importantly, this does not equate to 2.7% of the species' colony populations being disturbed as only a small fraction of birds breeding on the cliffs would be using the adjacent marine area at any one time.

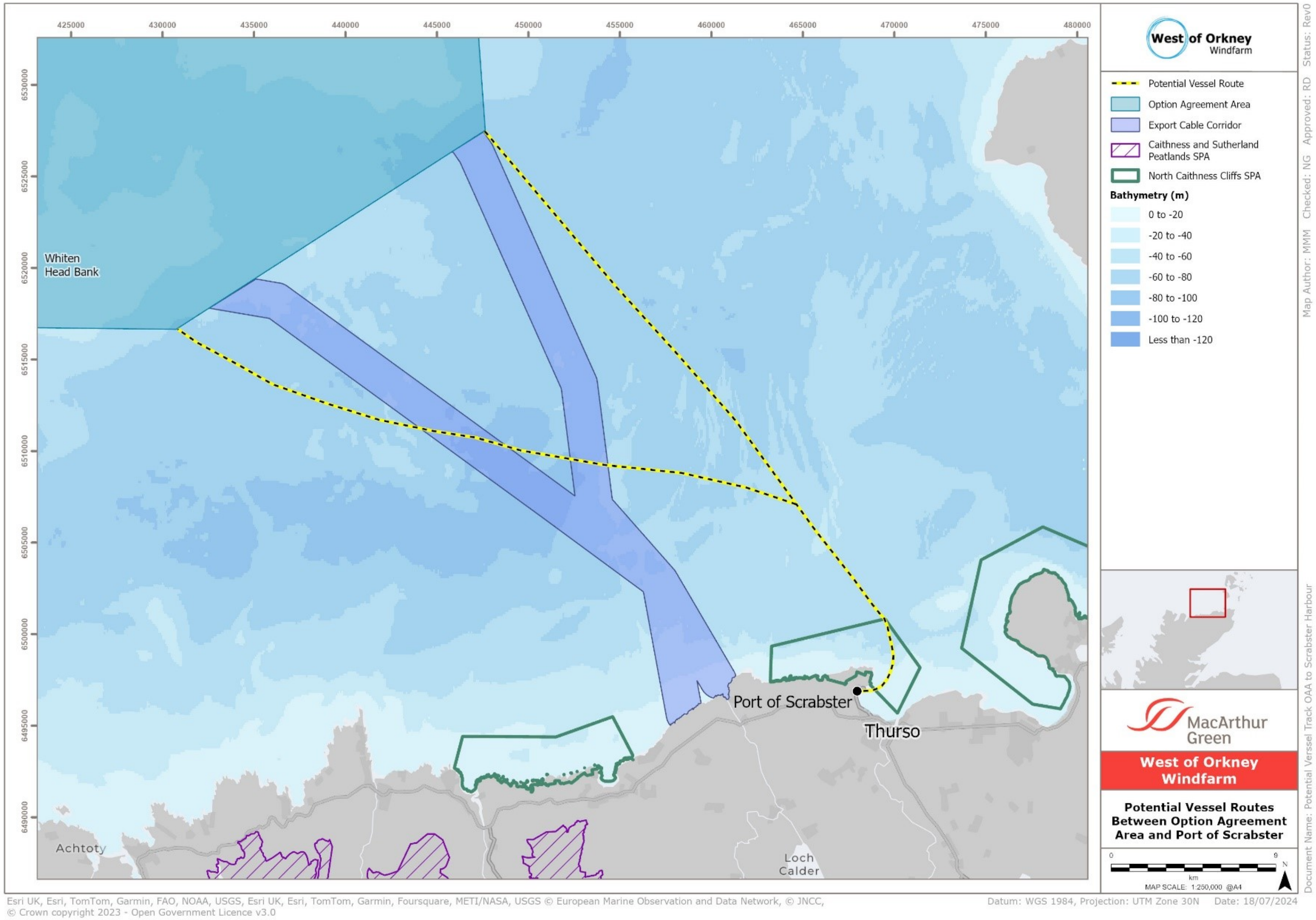

Figure 7-6. Potential vessel routes between OAA and Port of Scrabster.

234. Because Project vessels will follow existing vessel transit routes from the harbour for navigational safety reasons, seabirds using the marine area in the vicinity of Scrabster Harbour transit routes will already be habituated to the presence of vessels and so are unlikely to be significantly disturbed by additional vessels using the same routes.

235. Therefore, when accounting for the size of the SPA and the small numbers of breeding adults affected by any disturbance event within a regional population context, impacts are likely to be of **negligible** magnitude.

7.6.1.7 Overall significance of impact 1: Direct distributional responses and displacement effects

236. The construction works associated with the OAA, offshore ECC and landfall are temporary and localised in nature and the magnitude of effect has been determined as negligible in each case, for all IOFs of medium or high sensitivity. The overall effect significance is therefore **negligible** for all IOFs, which is not significant in EIA terms.

237. In the case of disturbance associated with vessel movements to and from ports, the temporary and localised nature of the impact also means that for all species of medium or high sensitivity, a negligible effect is predicted. The exception to this is for great northern diver, where due to the high sensitivity and relatively large population present within Scapa Flow, a **minor adverse** effect is predicted, only if Scapa Deep Water Quay is used as a port for construction vessels.

7.6.2 Impact 2: Artificial construction lighting impacts

238. In addition to visual and noise impacts associated with construction activities, lighting of construction sites, vessels and other structures at night may potentially be a source of attraction (phototaxis), disorientation or displacement for birds. Thus, as recommended by NatureScot during consultation (letter, 27th March 2024), a review, based on Deakin *et al.* (2022) *A review to inform the assessment of the risk of collision and displacement in petrels and shearwaters from offshore wind developments in Scotland* has been conducted to determine which IOFs should be screened in for lighting impacts. In Deakin *et al.* (2022), key species included **European storm-petrel** and **Manx shearwater**, both of which are likely to be present within the offshore Project area, are active at night and may be affected, and are thus considered as IOFs. In addition, evidence summarised below suggests that **puffin** fledglings may also be susceptible to artificial lighting.

7.6.2.1 Sensitivity

239. Although rated as of very low sensitivity to disturbance associated with construction vessels, noise and visual stimuli, Manx shearwater and European storm-petrel are considered to be of **high** sensitivity to artificial lighting impacts, on the basis of the Deakin *et al.* (2022) review and consultee requests. In an assessment of the marine-based conservation issues facing the storm-petrels (Hydrobatidae and Oceanitidae). Dias *et al.* (2019) highlighted attraction to artificial light sources as one of the main threats.

240. Puffin is considered to be of **medium** sensitivity due to similar behavioural lighting impacts on fledglings only.

7.6.2.2 Impact

241. European storm-petrels and Manx shearwaters were recorded very infrequently within the survey area during the baseline DAS: storm-petrels were recorded in August and September 2020 and 2021 (one to 36 birds per survey) and Manx shearwaters were recorded during the breeding season prior to dispersal in very low numbers (one to three birds per survey). Puffins were recorded in relatively high numbers in the late spring, summer and autumn months (**Table 6-1** and **Table 6-2**).

242. Construction is planned to take place 24 hours in a day and so artificial lighting would be required around areas of work, on structures and on vessels (noting that the Project is at relatively high latitude and therefore there would be shorter hours of darkness during the months when offshore construction is most likely to take place).

243. Lighting of construction sites, vessels and other structures at night may potentially be a source of attraction (phototaxis), or displacement for birds (see Furness 2018, Deakin *et al.,* 2022 for reviews). Phototaxis can be a serious hazard for fledglings of burrow-nesting seabird species, particularly families belonging to the Procellariiformes including shearwaters and storm-petrels (Rodríguez *et al.*, 2014). Adults of shearwater and storm-petrel species are nocturnally active at their breeding colonies and their chicks fledge from the burrows at night; strong phototaxis helps nestlings navigate away from their dark burrows towards the sea, as light intensity is naturally higher over the sea than onshore (Furness, 2018). Puffin, also a burrow nesting species whose chicks fledge at night, show the same response to light as petrels (Furness, 2018).

244. Shearwater, petrel, and puffin fledglings can be exposed to a high mortality by colliding with onshore structures with bright lights or becoming grounded due to attraction to onshore artificial lights (Montevecchi, 2006; Wilhelm *et al.*, 2013; Rodriguez *et al.*, 2012a, b; Rodriguez *et al.*, 2014; 2017; Gineste *et al.*, 2017). In Scotland, on the islands of Rum and St Kilda (Harris *et al.*, 1978; Miles *et al.*, 2010), Manx shearwaters, European storm-petrels, Leach's storm-petrels and Atlantic puffin fledglings have been found grounded at street lights and illuminated windows during the short period in late summer when chicks are departing from nesting burrows, possibly in part due to an under-developed visual acuity due to a lack of visual stimulation in the darkness of the nest chamber (Atchoi *et al.*, 2020).

245. Attraction towards bright artificial light can be strong at times of poor visibility, particularly affecting migrating birds during the autumn, but it is generally seen where birds are exposed to intense white lighting, such as from lighthouses (Furness 2018; Ronconi *et al.*, 2015; and Day *et al.*, 2015) all report that poor weather (e.g. fog, rain, low cloud cover) exacerbate nocturnal attraction of migrant bird to lights at oil and gas production platforms, with on occasions thousands of birds being killed in a night, especially where gas is being flared. However, there is limited evidence for attraction of shearwaters and storm-petrels to oil and gas platform in the UK (Bourne, 1979; Sage, 1979), likely due to low densities of these species in the northern North Sea where seabird interactions with oil platforms have been studied.

246. In relation to construction phase impacts, the Deakin *et al.* (2022) review included a section looking at the potential for interaction of Procellariiformes with wind farm service vessels. Anecdotally there is evidence that birds, including petrels, are found on ships' decks,

particularly during foggy conditions, likely becoming disorientated by the ship's floodlights. This may particularly affect recently fledged young, who may still have under-developed visual capabilities. It was however unclear to what extent birds were attracted to the ship, or whether they were attracted by other cues such as a recognised food source. Evidence suggests that storm-petrels generally can be attracted to vessels, probably for food which can be brought to the surface by lighting, or for fishing discards. In the context of use of vessels for service operations for wind turbines, nocturnally active Procellariiformes (especially storm-petrels) are sensitive to attraction (by phototaxis, olfaction, or visual cues associated with food sources), and may subsequently become disorientated, either by lighting associated with the vessel, or navigation lights on nearby turbines.

247. Deakin *et al.* (2022) concluded that there is currently a lack of evidence on which to judge the existence and strength of light attraction in Manx shearwaters and storm-petrels. The authors however found that the number of individuals recovered in campaigns to rescue grounded fledglings are typically very low in relation to the local population size, suggesting that birds are not attracted over large distances, or if so, only a small proportion of individuals are affected, or recovered. An example is provided relating to the number of fledgling Manx Shearwaters recovered in the town of Mallaig, Scotland (Syposz *et al*. 2018), which broadly corresponds, given the size and distance of the colony that is the likely source of the majority of individuals (Rum, 27 km away), with the number predicted if birds disperse randomly in all directions and the small proportion that orientate towards Mallaig are then attracted from very short range. Two cases (Barau's Petrels on Reunion Island, Indian Ocean and Cory's Shearwaters on Tenerife) are referred to where a large numbers of fledglings, representing large proportions (up to 40%) of the local population, were encountered grounded in brightly illuminated urban areas. In both cases, however, nesting sites are mainly located in high altitude areas in the island interior, and fledglings fly over brightly lit coastal areas to reach the sea.

248. On St Kilda, considerable numbers of Leach's and European Storm-petrels breed within 2 km and in direct line of sight of the village illuminations, but the number of grounded fledglings is <1% of the size of the breeding populations (Miles *et al*., 2010). This suggests that fledglings are not susceptible to attraction to these light sources from long range, albeit the level of illumination in the village was relatively low (32 outside lights and 11 buildings with indoor lighting; Miles *et al.*, 2010).

249. The closest seabird colony to the offshore Project is Sule Skerry and Sule Stack SPA (refer to **Addendum to the RIAA – Ornithology**) which is designated for breeding seabirds, including amongst other species, European storm-petrel and puffin. Sule Skerry has an unmanned lighthouse, and according to Archer & Taylor (2009), it is in the centre of the puffin colony and many fledglings are attracted to the base of the lighthouse, both by the light and by the noise of the lighthouse generator when it is running.

250. Evidence suggests that puffin fledglings are attracted to light when they first leave the burrow and take their first flight to the sea, and that attraction of fledglings towards artificial light on the sea likely occurs only over short distances (hundreds of metres) in response to bright white light close to breeding colonies (Furness, 2018). However, unlike the Procellariformes, once fledged, puffins do not show any attraction to or avoidance of

artificial lighting. The offshore construction areas within the OAA lit with artificial light would be very small and restricted to isolated areas which are active at a given time. The boundary of the OAA is 1.7 km from the Sule Stack and Sule Skerry SPA marine extension boundary at its closest point. However, when considering the Restricted Build Area (see **Introduction to the Additional Ornithology EIA Information and HRA Addendum**), WTGs will be built at least 3.7 km from the SPA boundary (the marine extension to the SPA and not the colony itself). At other times, activity may be at considerably larger distances (potentially up to 37 km), depending on the final windfarm layout. Thus, the construction sites associated with the offshore Project are considered to be far enough removed from any seabird breeding colonies as to render the risk to fledgling phototaxis negligible.

251. There are no records of phototaxis of nocturnal migrating birds towards navigation lights and although young birds may show phototaxis over short distances during fledging, there seems to be little or no attraction of older birds to lights except when they are exposed to intense white lighting such as from lighthouses. As light from construction sites is likely to be one or two orders of magnitude less powerful than that from lighthouses (Furness, 2018), phototaxis of migrating birds towards areas of construction is also considered a low risk.

252. Overall, the impact of artificial lighting on these species is considered to be of **negligible** magnitude.

7.6.2.3 Significance

253. The impacts of artificial lighting during construction are temporary and localised in nature and the magnitude of effect has been determined as negligible for Manx shearwater, European storm-petrel and puffin. Although the species are of medium or high sensitivity to artificial lighting, the effect significance is **negligible**, which is not significant in EIA terms.

7.6.3 Impact 3: Indirect disturbance and displacement of prey species

254. 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.

255. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour. Temporary habitat loss and disturbance may cause fish and mobile invertebrates to avoid the construction area. These mechanisms may result in less prey being available within the construction area to foraging seabirds. Such potential effects on benthic invertebrates and fish have been assessed in the **Offshore EIA Report, chapter 10: Benthic subtidal and intertidal ecology** and **chapter 11: Fish and shellfish ecology** and the conclusions of those assessments inform this assessment of indirect effects on IOFs[19].

[19] Further consideration of impacts is provided in the Benthic Subtidal and Intertidal Additional Information and Fish and Shellfish Additional Information, albeit neither have resulted in changes to the conclusions of the Offshore EIA Report.

256. With regard to changes to the seabed and to suspended sediment levels, the **Offshore EIA Report, chapter 10: Benthic subtidal and intertidal ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. The impact on benthic habitats is predicted to be of low or negligible magnitude with no significant impacts to any benthic receptors (this conclusion has not changed as a result of the Benthic Subtidal and Intertidal Additional Information). The consequent effect for fish and shellfish ecology is considered to be minor and not significant, 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 the **Offshore EIA Report, chapter 11: Fish and shellfish ecology**, sandeel and herring are potentially vulnerable to seabed disturbance 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 (this conclusion has not changed as a result of the Fish and Shellfish Additional Information). The majority of the OAA is not suitable as spawning habitat for herring. The majority of benthic sediment samples were suitable habitats for sandeel spawning (see **Offshore EIA Report, chapter: 11 Fish and shellfish ecology, section 11.4.4.2.1**), although only a small proportion of the offshore Project area is considered to represent prime sandeel habitat (see Fish and Shellfish Additional Information). The impact of increased suspended sediments during the construction stage on fish and shellfish ecology was not taken forward for assessment in the EIA, as outlined in the **Offshore EIA Report, chapter 11: Fish and shellfish ecology**, and therefore, any effect would be negligible. The Fish and Shellfish Additional Information considers increased suspended sediments impacts to common skate and sandeel (as requested by MDLOT and NatureScot) reaching a conclusion of minor and no significant effect. Therefore, with a minor effect (or below) on fish that are bird prey species, it is concluded that the indirect impact significance on seabirds occurring in or around the OAA during the construction stage is similarly a minor or negligible adverse impact.

257. With regard to noise impacts on fish, the **Offshore EIA Report, chapter 11: Fish and shellfish ecology** discusses the potential impacts upon fish relevant to ornithology as prey species of the proposed Project. For species such as herring, sprat and sandeel, which are the main prey items of seabirds such as gannet and auks, underwater noise impacts (physical injury or behavioural changes) during construction are considered to be minor for herring and sprat (group 3, most sensitive species) and minor for sandeel (group 1, least sensitive species). The Fish and Shellfish Additional Information provides further consideration to underwater noise impacts to common skate eggs and sandeel eggs and larvae, with both assessments concluding a minor and not significant effect. With a minor effect on fish that are bird prey species, it is concluded that the significance on seabirds occurring in or around the OAA during the construction stage is similarly a minor adverse impact.

258. Based on the information summarised above, the magnitude of impact during construction is predicted to be **negligible or low**, and the overall effects to species of medium or high sensitivity is considered to be **negligible or minor adverse** and not significant in EIA terms.

7.7 Potential effects during operation and maintenance

7.7.1 Impact 4: Direct distributional responses, displacement and barrier effects

7.7.1.1 Summary of potential impacts

259. The operation phase of the offshore Project has the potential to disturb and displace birds in the marine environment due to the presence of permanent structures (WTGs and OSPs), as well as operational maintenance activities. These impact pathways could result in temporary or permanent habitat loss through reduction in the area available for foraging, loafing and moulting birds (i) within and around the OAA; and (ii) on vessel routes to and from port. These are addressed below. Artificial lighting impacts are considered separately under Impact 7.

7.7.1.2 Displacement within the OAA

260. The method used to assess operational displacement associated with the Project has been based on NatureScot's Guidance Note 8: *Guidance to support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds*, with details agreed with NatureScot during consultation.

261. Displacement mortality was quantified using both SeabORD and the displacement matrix approach. Details of the SeabORD modelling (for puffin and guillemot, the two species assessed, as advised by NatureScot by letter dated 31 May 2023) are presented in **Annex 4A: SeabORD Analysis Final Report**.

262. Following NatureScot Guidance Note 8, displacement effects have been assessed using the matrix approach, as advised by SNCB (2017; updated 2022). This approach applies a range of displacement rates (anywhere from 0% to 100% as appropriate for the species) to the population estimate (mean seasonal peak abundance of all birds flying and on sea in the OAA plus 2 km buffer). A species-specific and sometimes, season-specific mortality rate range, is then assumed for displaced birds. Both displacement rates and mortality rates for displaced birds used in the estimation of displacement mortality followed NatureScot Guidance Note 8. Data inputs into the matrix approach, methods, and all matrix table outputs are presented in **Appendix 4 – EIA and HRA: Displacement Technical Report**.

263. Based on NatureScot Guidance Note 8, the species required to be assessed are those that met the following criteria:

- Species recorded regularly within the OAA plus 2 km buffer during DASs undertaken between July 2020 to September 2022 (see **Table 6-1**); and
- Species considered susceptible to disturbance (i.e. have medium or high 'Disturbance Sensitivity' and 'Habitat Specialisation' scores as assessed by Bradbury *et al.*, 2014 (expanded from Furness *et al.*, 2013), and summarised by SNCB, 2017; updated 2022).

264. NatureScot Guidance Note 8 advises that the priority species for assessment of displacement effects will typically be diver and sea duck species, guillemot, razorbill, puffin and gannet. However, pre-application consultation with NatureScot (8 February 2023), led to agreement that a displacement assessment was required for six species regularly found within the OAA plus 2 km buffer:

- kittiwake;
- Arctic tern;
- guillemot;
- razorbill;
- puffin; and
- gannet.

265. NatureScot advised during consultation (11 June 2024) that although not listed in the species for assessment in their guidance, fulmar should also be assessed for the Project alone because of recent scientific evidence of barrier effects, and the location of the Project. NatureScot, in the same consultation meeting, advised that a cumulative impact assessment of displacement impacts on the fulmar regional population was not required, as other OWFs had not previously assessed these impacts on fulmar.

266. NatureScot Guidance Note 8 was used to provide the appropriate displacement and mortality percentage ranges used in the displacement matrices for kittiwake, guillemot, razorbill, puffin and gannet (**Table 7-4**). Displacement and mortality values for fulmar were advised by RSPB during formal scoping consultation (26 May 2022). NatureScot advised in a letter (dated 5 April 2023) on the displacement and mortality rates to be used for Arctic tern which are based on disturbance-sensitivity indices as assessed by Bradbury *et al.* (2014).

267. Following the SNCB (2017; updated 2022) guidance, and as agreed with NatureScot during consultation, 'high' and 'low' displacement mortality rates are presented for each species below (**Table 7-4**). NatureScot advised that a 'low' and 'high' mortality rate should be applied due to a lack of empirical evidence and consequent uncertainty over the actual mortality rate, and it was acknowledged that most likely rates would lie somewhere between the high and low scenarios.

Table 7-4. Displacement rates and mortality rate ranges used in impact assessments.

Species	Displacement rate	Mortality rate – breeding season	Mortality rate – non-breeding season
Kittiwake	30%	1% and 3%	1% and 3%
Arctic tern	30% and 50%	3%	3%
Guillemot	60%	3% and 5%	1% and 3%
Razorbill	60%	3% and 5%	1% and 3%
Puffin	60%	3% and 5%	1% and 3%
Fulmar	20%	1% and 3%	1% and 3%
Gannet	70%	1% and 3%	1% and 3%

268. As agreed during consultation with NatureScot, in order to determine the magnitude of impact for each species due to 'low' or 'high' displacement mortality, calculations are made to determine the total annual losses that may occur on the species' regional population (see **Table 6-9**), which may be only a proportion of birds present in the non-breeding season, autumn migration or spring migration periods (refer to species' BDMPS seasons in **Table 6-4**).

The ratio of birds from the regional breeding season population compared to the total non-breeding season reference population(s) have been agreed with NatureScot and are presented in the respective tables for each species below.

269. As advised in NatureScot Guidance Note 8, matrices are presented in **Appendix 4 - EIA and HRA: Displacement Technical Report** for the non-breeding season, as defined using NatureScot's seasonal definitions guidance note[20]. The resultant total non-breeding season mortality estimates are presented for each species (shaded row in tables) but are not considered in the assessment, if there are separate BDMPS seasons for that species. As per NatureScot Guidance Note 8, the predicted annual mortality impacts on the regional population are derived from the total estimated mortality from the species' appropriate BDMPS seasons (Furness, 2015), for those species where the autumn and spring passage and winter periods are defined within the non-breeding season (kittiwake, Arctic tern, razorbill, fulmar and gannet).

7.7.1.3 *Kittiwake*

7.7.1.3.1 Sensitivity

270. The mean maximum foraging range (+1SD) for kittiwake is 300.6 km (**Table 6-7**) which places the OAA within theoretical potential foraging range of 25 SPA kittiwake breeding colonies (refer to **Addendum to the RIAA - Ornithology**). Although a very high proportion of the regional population is associated with SPAs, some other non-SPA populations are also likely to contribute to individuals at risk. The total regional population size is estimated to be 219,608 adult individuals (**Table 6-9**). This species is assessed to have a medium conservation value based on connectivity to SPA populations (**Table 5-2**).

271. Although kittiwakes have a low disturbance susceptibility and habitat specialisation score (SNCB, 2017; updated 2022; Furness *et al.*, 2013; Bradbury *et al.*, 2017), and are not considered by Natural England to be sensitive to disturbance (see also Trinder *et al.*, 2024 who found no avoidance or attraction behaviour at Beatrice Offshore Wind Farm), kittiwakes have been considered to have an overall **medium** sensitivity to disturbance and displacement, based on NatureScot consultation advice.

7.7.1.3.2 Impact

272. **Table 7-5** summarises the results of the displacement matrix approach used for kittiwake, as presented in **Appendix 4 - EIA and HRA: Displacement Technical Report**.

273. Under the 'low' displacement mortality scenario (30% displacement and 1% mortality rates) it is predicted that there would be a total annual estimated mortality of 9.4 individuals due to displacement impacts. When considering the proportion of mortality that is attributable to the regional population only (as defined in **section 6.5.4**), this is reduced to 6.94 individuals.

274. Under the 'high' displacement mortality scenario (30% displacement and 3% mortality rates) it is predicted that there would be a total annual estimated mortality of 28.2 individuals due to displacement impacts. When considering the proportion of mortality that is attributable

[20] https://www.nature.scot/sites/default/files/2020-10/Guidance%20note%20-%20Seasonal%20definitions%20for%20birds%20in%20the%20Scottish%20Marine%20Environment.pdf

to the regional population only (as defined in section 6.5.4), the annual mortality is reduced to 20.85 individuals.

275. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.002% (low scenario) to 0.005% (high scenario) (**Table 7-6**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.1.3.3 Significance

276. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-5. Kittiwake seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2 km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	112.7	414,355	1.00	3.3	3.3	10.0	10.0
Non-breeding season (NatureScot)	1,216.8	N/A	N/A	3.7	N/A	11.0	N/A
BDMPS Spring migration	1,216.8	627,816	0.66	3.7	2.44	11.0	7.26
BDMPS Autumn migration	798.7	829,937	0.50	2.4	1.20	7.2	3.59
Annual (Breeding + BDMPS seasons)				9.4	**6.94**	28.2	**20.85**

1.Displacement mortality of all individuals, as derived from matrix tables in **Appendix 4 - EIA and HRA: Displacement Technical Report**.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-6. Impact on kittiwake survival resulting from displacement mortality in the OAA plus 2 km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	6.94	414,355	0.002%	N
Annual High	20.85		0.005%	N

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.1.4 Arctic tern

7.7.1.4.1 Sensitivity

277. The mean maximum foraging range (+1SD) for Arctic tern is 40.5 km (**Table 6-7**) which places the OAA beyond potential foraging range of SPA Arctic tern breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations may contribute to individuals at risk. The total breeding season regional population size is estimated to be 906 adult individuals (**Table 6-9**).

278. Arctic terns are assessed to have a low conservation value based on a lack of connectivity to SPA populations (**Table 5-2**) and are assessed to have an overall **medium** sensitivity to disturbance and displacement based on their disturbance susceptibility and habitat specialisation (SNCB, 2022; Furness *et al*., 2013; Bradbury *et al*., 2017).

7.7.1.4.2 Impact

279. **Table 7-7** summarises the results of the displacement matrix approach used for Arctic tern, as presented in **Appendix 4 - EIA and HRA: Displacement Technical Report**.

280. Under the 'low' displacement mortality scenario (30% displacement and 3% mortality rates) it is predicted that there would be a total annual estimated mortality of 1.5 individuals due to displacement impacts. When considering the proportion of mortality that is attributable to the regional population only (as defined in **section 6.5.4**), the predicted mortality is reduced to 1.1 individuals.

281. Under the 'high' displacement mortality scenario (50% displacement and 3% mortality rates) it is predicted that there would be a total annual estimated mortality of 2.7 individuals due to displacement impacts. When considering the proportion of mortality that is attributable to the regional population only (as defined in **section 6.5.4**), the annual mortality is reduced to 1.91 individuals.

282. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.08% (low scenario) to 0.13% (high scenario) (**Table 7-8**). This change is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so population modelling was conducted (see **Appendix 9 - EIA: PVA at regional population scales for Project alone and cumulative impacts**).

283. With an additional mortality of up to 1.91 individuals the model predicts over 35 years a reduction in growth rate by up to 0.15% (C-PGR = 0.9985) and a reduction in population size by up to 3.7% (C-PS = 0.9634) (**Table 7-9**).

284. Based on the C-PGR predictions, this magnitude of increase in mortality is considered as being of **negligible** magnitude.

7.7.1.4.3 Significance

285. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-7. Arctic tern seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2 km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	124.3	1,438	1.00	1.1	1.1	1.9	1.9
Non-breeding season (NatureScot)	0.0	N/A	N/A	0.0	N/A	0.0	N/A
BDMPS Spring migration	3.9	163,930	0.01	0.0	0.0	0.1	0.001
BDMPS Autumn migration	46.7	163,930	0.01	0.4	0.004	0.7	0.01
Annual (Breeding + BDMPS seasons)				1.5	**1.10**	2.7	**1.91**

1.Displacement mortality of all individuals, as derived from matrix tables in **Appendix 4 - EIA and HRA: Displacement Technical Report**.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-8. Impact on Arctic tern survival resulting from displacement mortality in the OAA plus 2 km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	1.10	1,438	0.08%	Y
Annual High	1.91		0.13%	Y

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

Table 7-9. Projected PVA metrics after 25, 35 and 50 years for Arctic tern for the Project alone.

		Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Timeframe (years)	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
Low	25	0.9991	0.9991	0.0047	0.9900	1.0084	0.9805	0.9854	0.1226	0.7641	1.2405	48.2	52.4
High	25	0.9986	0.9985	0.0048	0.9892	1.0084	0.9675	0.9705	0.1233	0.7517	1.2358	47.0	54.3
Low	35	0.9993	0.9993	0.0049	0.9898	1.0089	0.9810	0.9898	0.1750	0.6863	1.3881	47.8	53.3
High	35	0.9985	0.9985	0.0050	0.9886	1.0079	0.9444	0.9634	0.1752	0.6666	1.3302	45.1	56.1
Low	50	0.9993	0.9992	0.0059	0.9878	1.0103	0.9630	1.0062	0.3159	0.5347	1.7085	48.1	52.9
High	50	0.9986	0.9987	0.0058	0.9873	1.0103	0.9300	0.9752	0.2948	0.5208	1.6739	47.1	54.5

(SD = standard deviation, LCI = lower confidence interval, UCI = upper confidence interval, U=50%I = the quantile from the unimpacted population that matched the 50% quantile for the impacted population, I=50%U = the quantile from the impacted population that match the 50% quantile for the unimpacted population).

7.7.1.5 Guillemot

7.7.1.5.1 Sensitivity

286. Guillemots were regularly recorded within the OAA and 2 km buffer in all calendar months (**Table 6-1**). Mean abundance estimates were generally higher during the breeding season (February to August) compared with the non-breeding season (September to January). The seasonal peaks recorded in July and September are likely associated with birds dispersing away from colonies out to sea.

287. The mean maximum foraging range (+1SD) for guillemot (Northern Isles colonies foraging ranges, refer to section 13.4.4.5.4) is 153.7 km (**Table 6-7**) which places the OAA within the potential foraging range of 14 SPA guillemot breeding colonies (refer to **Addendum to the RIAA-Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk. The total breeding season regional population size is estimated to be 558,694 adult individuals (**Table 6-9**). As agreed with NatureScot, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

288. Guillemots are assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**) and have a **medium** sensitivity to disturbance and displacement based on their disturbance susceptibility and habitat specialisation (SNCB, 2022; Furness *et al.*, 2013; Bradbury *et al.*, 2017).

7.7.1.5.2 Impact

289. **Table 7-10** summarises the results of the displacement matrix approach used for guillemot, as presented in **Appendix 4 - EIA and HRA: Displacement Technical Report**. Under the 'low' displacement mortality scenario (60% displacement rate and 3% breeding season and 1% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 169.9 individuals due to displacement impacts.

290. Under the 'high' displacement mortality scenario (60% displacement rate and 5% breeding season and 3% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 318.3 individuals due to displacement impacts.

291. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.017% (low scenario) to 0.032% (high scenario) (**Table 7-10**). This change (high scenario) is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so population modelling was conducted (see **Appendix 9 - EIA: PVA at regional population scales for Project alone and cumulative impacts**).

292. With an additional mortality of up to 318.3 individuals the model predicts over 35 years a reduction in growth rate by up to 0.04% (C-PGR = 0.9996) and a reduction in population size by up to 1.3% (C-PS = 0.9871) (**Table 7-12**). Based on the C-PGR predictions, this magnitude of increase in mortality is considered as being of **negligible** magnitude.

7.7.1.5.3 Significance

293. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-10. Guillemot seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2 km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	7972.5	980,165	1.00	143.5	143.5	239.2	239.2
Non-breeding season	4392.9	980,165	1.00	26.4	26.4	79.1	79.1
Annual (Breeding + BDMPS season)				169.9	**169.9**	318.3	**318.3**

1.Displacement mortality of all individuals, as derived from matrix tables in **Appendix 4 - EIA and HRA: Displacement Technical Report**.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-11. Impact on guillemot survival resulting from displacement mortality in the OAA plus 2 km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	169.9	980,165	0.0173%	N
Annual High	318.3		0.0325%	Y

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

Table 7-12. Projected PVA metrics after 25, 35 and 50 years for guillemot for the Project alone.

		Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Timeframe (years)	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
Low	25	0.9998	0.9998	0.0001	0.9997	0.9999	0.9951	0.9951	0.0016	0.9918	0.9981	48.8	50.7
High	25	0.9996	0.9996	0.0001	0.9995	0.9998	0.9907	0.9907	0.0016	0.9876	0.9939	46.9	51.9
Low	35	0.9998	0.9998	0.0001	0.9997	0.9999	0.9932	0.9932	0.0018	0.9896	0.9966	48.8	51.7
High	35	0.9996	0.9996	0.0001	0.9995	0.9997	0.9871	0.9871	0.0019	0.9833	0.9907	47.7	53.1
Low	50	0.9999	0.9999	0.0000	0.9998	0.9999	0.9932	0.9932	0.0021	0.9893	0.9972	48.8	51.3
High	50	0.9997	0.9997	0.0000	0.9997	0.9998	0.9871	0.9871	0.0021	0.9831	0.9912	47.2	52.0

(SD = standard deviation, LCI = lower confidence interval, UCI = upper confidence interval, U=50%I = the quantile from the unimpacted population that matched the 50% quantile for the impacted population, I=50%U = the quantile from the impacted population that match the 50% quantile for the unimpacted population).

7.7.1.6 *Razorbill*

7.7.1.6.1 Sensitivity

294. Razorbills were regularly recorded within the OAA and 2 km buffer in all calendar months except January (refer to **Table 6-1**). Mean abundance estimates were generally higher during the breeding season (March to August) compared with the non-breeding season (September to February). Within the OAA + 2 km buffer, the estimated peak mean abundance for all razorbills was in April when birds were likely returning to breeding colonies after the winter, and in September when razorbills were likely dispersing away from colonies out to sea.

295. The mean maximum foraging range (+1SD) for razorbill (all Northern Isles colonies) is 164.6 km (**Table 6-7**) which places the OAA within the potential foraging range of 11 SPA razorbill breeding colonies (refer to **Addendum to RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk.

296. Razorbills are assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**) and are assessed to have a **medium** sensitivity to disturbance and displacement based on their disturbance susceptibility and habitat specialisation (SNCB, 2107; updated 2022; Furness et al., 2013; Bradbury et al., 2017).

7.7.1.6.2 Impact

297. **Table 7-13** summarises the results of the displacement matrix approach used for razorbill, as presented in **Appendix 3: EIA and HRA Displacement technical report**.

298. Under the 'low' displacement mortality scenario (60% displacement rate and 3% breeding season and 1% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 4.1 individuals due to displacement impacts. When considering the proportion of mortality that is attributable to the regional population only (as defined in **section 6.5.4**), the predicted mortality is reduced to 2.92 individuals.

299. Under the 'high' displacement mortality scenario (60% displacement rate and 5% breeding season and 3% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 8.9 individuals due to displacement impacts. When considering the proportion of mortality that is attributable to the regional population only (as defined in **section 6.5.4**), the annual mortality is reduced to 5.44 individuals.

300. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.002% (low scenario) to 0.004% (high scenario) (**Table 7-13**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.1.6.3 Significance

301. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-13 Razorbill seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	141.2	140,698	1.00	2.5	2.5	4.2	4.2
Non-breeding season	131.8	N/A	N/A	0.8	N/A	2.4	N/A
BDMPS Spring migration	131.8	591,874	0.24	0.8	0.19	2.4	0.57
BDMPS Autumn migration	112.3	591,874	0.24	0.7	0.17	2.0	0.48
BDMPS Winter	19.4	218,622	0.64	0.1	0.06	0.3	0.19
Annual (Breeding + BDMPS seasons)				4.1	**2.92**	8.9	**5.44**

1.Displacement mortality of all individuals, as derived from matrix tables in **Appendix 4 - EIA and HRA: Displacement Technical Report**.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-14 Impact on razorbill survival resulting from displacement mortality in the OAA plus 2km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	2.92	140,698	0.002%	N
Annual High	5.44		0.004%	N

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.1.7 *Puffin*

7.7.1.7.1 Sensitivity

302. Puffins were regularly recorded within the OAA and 2 km buffer in all calendar months except March and November (refer to **Table 6-1**). Mean abundance estimates were higher during the breeding season (Mid-March to August) compared with the non-breeding season (September to mid-March). Within the OAA + 2 km buffer, the estimated peak mean abundance for puffins was in June and August and both peaks are likely associated with birds dispersing away from colonies out to sea.

303. The mean maximum foraging range (+1SD) for puffin is 265.4 km (**Table 6-7**) which places the OAA within the potential foraging range of 13 SPA puffin breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk.

304. Puffins are assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**) and are assessed to have a **medium** sensitivity to disturbance and displacement based on their disturbance susceptibility and habitat specialisation (SNCB, 2017; updated 2022; Furness et al., 2013; Bradbury et al., 2017).

7.7.1.7.2 Impact

305. **Table 7-15** summarises the results of the displacement matrix approach used for puffin, as presented in **Appendix 4: EIA and HRA Displacement technical report**. As the total breeding reference population is larger than the total non-breeding reference population, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

306. Under the 'low' displacement mortality scenario (60% displacement rate and 3% breeding season and 1% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 107.7 individuals due to displacement impacts.

307. Under the 'high' displacement mortality scenario (60% displacement rate and 5% breeding season and 3% non-breeding season mortality rates) it is predicted that there would be a total annual estimated mortality of 196.6 individuals due to displacement impacts.

308. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.009% (low scenario) to 0.017% (**Table 7-16**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.1.7.3 Significance

309. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms

Table 7-15 Puffin seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	5271.9	1,145,207	1.0	94.9	94.9	158.2	158.2
Non-breeding season	2135.9	231,957	1.0	12.8	12.8	38.4	38.4
Annual (Breeding + BDMPS season)				107.7	**107.7**	196.6	**196.6**

1.Displacement mortality of all individuals, as derived from matrix tables in **Appendix 4 - EIA and HRA: Displacement Technical Report**.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-16 Impact on puffin survival resulting from displacement mortality in the OAA plus 2km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	107.7	1,145,207	0.009%	N
Annual High	196.6		0.017%	N

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.1.8 *Fulmar*

7.7.1.8.1 Sensitivity

310. The mean maximum foraging range (+1SD) for fulmar is 1,200.2 km (**Table 6-7**) which places the OAA within the potential foraging range of 23 SPA fulmar breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk.

311. Although fulmar have a low disturbance susceptibility and habitat specialisation score (SNCB, 2017; updated 2022; Furness et al., 2013; Bradbury et al., 2017), the species may be susceptible to barrier effects. Fulmar is assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**). The species is therefore assessed as having an overall **medium** sensitivity to disturbance and displacement.

7.7.1.8.2 Impact

312. **Table 7-17** summarises the results of the displacement matrix approach used for fulmar, as presented in **Appendix 4: EIA and HRA Displacement technical report**. As the total breeding reference population is larger than the total non-breeding reference population, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

313. Under the 'low' displacement mortality scenario (20% displacement rate and 1% mortality rate) it is predicted that there would be a total annual estimated mortality of 15.3 individuals due to displacement impacts.

314. Under the 'high' displacement mortality scenario (20% displacement rate and 3% mortality rate) it is predicted that there would be a total annual estimated mortality of 45.9 individuals due to displacement impacts.

315. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.001% (low scenario) to 0.004% (high scenario) (**Table 7-17**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.1.8.3 Significance

316. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-17 Fulmar seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	1536.1	1,138,694	1.0	3.1	3.1	9.2	9.2
Non-breeding season	2864.1	N/A	N/A	5.7	N/A	17.2	N/A
BDMPS Spring migration	2864.1	957,502	1.0	5.7	5.7	17.2	17.2
BDMPS Autumn migration	2441.1	957,502	1.0	4.9	4.9	14.6	14.6
BDMPS Winter	813.8	568,736	1.0	1.6	1.6	4.9	4.9
			Annual (Breeding + BDMPS seasons)	15.3	**15.3**	45.9	**45.9**

1.Displacement mortality of all individuals, as derived from matrix tables in Appendix 4 - EIA and HRA: Displacement Technical Report.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-18 Impact on fulmar survival resulting from displacement mortality in the OAA plus 2km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	15.3	1,138,694	0.001%	N
Annual High	45.9		0.004%	N

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.1.9 Gannet

7.7.1.9.1 Sensitivity

317. The general mean maximum foraging range (+1SD) for gannet is 509.4 km (exceptions apply to Forth Islands SPA, Grassholm SPA and St Kilda SPA; **Table 6-7**) which places the OAA within the potential foraging range of 8 SPA gannet breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk.

318. Although gannets have a low disturbance susceptibility and habitat specialisation score (SNCB, 2017; updated 2022; Furness et al., 2013, Bradbury et al., 2017), this species is assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**). Gannets are therefore assessed to have an overall **medium** sensitivity to disturbance and displacement.

7.7.1.9.2 Impact

319. **Table 7-19** summarises the results of the displacement matrix approach used for gannet, as presented in **Appendix 3: EIA and HRA Displacement technical report**. As the total breeding reference population is larger than the total non-breeding reference population, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

320. Under the 'low' displacement mortality scenario (70% displacement rate and 1% mortality rate) it is predicted that there would be a total annual estimated mortality of 16.6 individuals due to displacement impacts.

321. Under the 'high' displacement mortality scenario (70% displacement rate and 3% mortality rate) it is predicted that there would be a total annual estimated mortality of 49.5 individuals due to displacement impacts.

322. The predicted displacement mortality would result in an addition to the mortality of the regional population, ranging from 0.002% (low scenario) to 0.005% (high scenario) (**Table 7-20**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.1.9.3 Significance

323. As the species is of medium sensitivity to displacement, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms

Table 7-19 Gannet seasonal displacement mortality estimates for all birds in flight and on the sea in the OAA plus 2km buffer by season, and total annual.

Season	Mean Seasonal Peak abundance (all birds in OAA + 2km buffer)	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	Total LOW displacement mortality[1]	LOW displacement mortality within regional population[2]	Total HIGH displacement mortality[1]	HIGH displacement mortality within regional population[2]
Breeding season	851.7	926,447	1.00	6.0	6.0	17.9	17.9
Non-breeding season	1170.9	N/A	N/A	8.2	N/A	24.6	N/A
BDMPS Spring migration	139.5	248,385	1.00	1.0	1.0	2.9	2.9
BDMPS Autumn migration	1368.0	456,298	1.00	9.6	9.6	28.7	28.7
Annual (Breeding + BDMPS seasons)				16.6	**16.6**	49.5	**49.5**

1.Displacement mortality of all individuals, as derived from matrix tables in Appendix 4 - EIA and HRA: Displacement Technical Report.
2.Displacement mortality of the regional population impacted in the breeding, non-breeding season, spring migration or autumn migration periods (a proportion of the reference populations). Calculated as the regional breeding season population divided by the seasonal BDMPS reference population, then multiplied by the estimated total seasonal displacement mortality.

Table 7-20 Impact on gannet survival resulting from displacement mortality in the OAA plus 2km buffer.

Displacement scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	16.6	926,447	0.002%	N
Annual High	49.5		0.005%	N

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population displacement mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.1.10 Vessel movements to and from ports

324. The information relating to sensitivities of species to vessel disturbance, outlined in Impact 1 (see section 7.6.1), remains equally applicable for vessel movements during the operation and maintenance phase, and is therefore not repeated here.

325. During Project operation, vessels could use Scrabster Harbour for activities including inspection, maintenance and repair of WTGs, cables and substructure (although it is not yet confirmed which port/harbour vessels performing these activities would use). A worst-case scenario, assuming all vessels use Scrabster Harbour results in an estimated number of one-way transits to/from Scrabster Harbour of 896 transits per year.

326. Other ports may be used occasionally by vessels required for specific maintenance tasks. These vessels will be very few in number and will be transiting between the port and Project for only a short period. Therefore, vessels from these occasionally used ports will have no impacts on offshore ornithological features.

327. As the transit route between Scrabster and the offshore Project area is >15 km from any marine SPA, this impact pathway was screened out for non-breeding seabirds, seaducks, divers and grebes using the fully marine SPAs. The transit route from Scrabster to the OAA is also more than 9 km from the Caithness coast and Scapa Flow, and so vessels would not cause disturbance or displacement of breeding red-throated divers in these areas, as they would be beyond foraging ranges. However, the North Caithness Cliffs SPA does have an extension into the marine environment which extends across the entrance of the natural harbour of Thurso and the port of Scrabster. It is therefore possible that vessels associated with the Project during operation may cause disturbance to breeding seabird populations there.

328. Currently much vessel traffic in and out of Scrabster Harbour passes through the SPA marine extension, and so a degree of habituation is likely to be exhibited by breeding seabirds. The operation and maintenance vessel movements associated with the offshore Project would however increase the frequency of traffic over the long-term and it is therefore possible that more temporary disturbance events would occur during the breeding season.

329. Because Project vessels will follow existing well established vessel transit routes from the harbour for navigational safety reasons, seabirds using the marine area in the vicinity of Scrabster Harbour transit routes will already be habituated to the presence of vessels and so are unlikely to be significantly disturbed by additional vessels using the same routes.

330. The species that are more likely to be subject to disturbance are guillemot, razorbill and puffin, which are considered to be of medium sensitivity. It is likely that only a small fraction of birds breeding on the nearby cliffs would be using the adjacent marine area at any one time, and only a fraction of those would be subject to disturbance due to a vessel.

331. Therefore, when accounting for the size of the colony and the small numbers of breeding adults affected by any disturbance event within a regional population context, impacts are likely to be of **negligible** magnitude. As the three auk species most likely to be subject to disturbance events are of medium sensitivity, the effects are considered to be of **negligible** significance.

7.7.2 Impact 5: Collision risk

332. The method used to assess collision risk associated with the Project follows NatureScot's Guidance Note 7: *Guidance to support Offshore Wind Applications: Marine Ornithology - Advice for assessing collision risk of marine birds*. This guidance has been supplemented by project-specific advice in pre-application consultation meetings and in written advice from NatureScot (letter dated 27 March 2024). Further advice from NatureScot has also been provided in weekly consultation meetings. The online sCRM tool (Caneco, 2022) was used to estimate collisions for birds in flight within the OAA. Data inputs into the sCRM tool and all collision mortality outputs are presented in **Appendix 3 EIA and HRA: Collision Risk Modelling Technical Report**.

333. Based on the guidance and results of baseline DASs (numbers of birds in flight within the OAA, see **Table 6-1** for raw counts and **Table 6-5** for monthly mean densities), consultation with NatureScot led to agreement that collision risk assessment was required for five species:

- kittiwake;
- great black-backed gull;
- Arctic tern;
- great skua; and
- gannet.

334. These five species are considered to be vulnerable to colliding with turbines (Furness, et al., 2013). Other species recorded in the OAA either generally fly too low to be at risk of collision or they were recorded too infrequently and in very small numbers in the OAA to warrant collision risk modelling (refer to **Table 6-2** and NatureScot's Guidance Note 7).

335. NatureScot advised avoidance rates to use in their letter to the Project (dated 27 March 2024). These were used in the collision risk modelling and are presented in **Table 7-21**. Other biometrics were advised by NatureScot during consultation on 27 March 2024.

336. Collision estimates for the five species under the 'worst-case scenario' (WCS) design (Option 5: 125 turbines each with 330m turbine diameter) are presented in the following sections. Collision rates were also estimated for the 'most likely scenario' (MLS) design (Option 3: 125 turbines each with a 265m diameter). Collision rate estimates for the MLS are presented in **Appendix 3 EIA and HRA: Collision Risk Modelling Technical Report**, but the WCS has been assessed within this section.

Table 7-21 Species biometrics, including Nocturnal Activity Factor (NAF) and avoidance rates (AR) used in stochastic and deterministic CRMs to generate collision estimates.

Species	Band (deterministic CRM) AR [a]	Stochastic CRM AR - mean (SD) [b]	Body length mean (metres) (SD) [c]	Wingspan mean (metres) (SD) [c]	Flight speed mean (m/s) (SD) [d]	NAF mean (SD) [e]	Flight type: Flapping or Gliding	% of flights upwind
Kittiwake	0.9924	0.9928 (0.0003)	0.39 (0.005)	1.08 (0.0625)	13.1 (0.4)	0.5 (0)	Flapping	50
Great black-backed gull	0.9936	0.9939 (0.0004)	0.71 (0.035)	1.58 (0.0375)	13.7 (1.2)	0.5 (0)	Flapping	50
Arctic tern	0.9902	0.9907 (0.0004)	0.34 (0.005)	0.8 (0.025)	10.9 (0.9)	0.125 (0)	Flapping	50
Great skua	0.9902	0.9907 (0.0004)	0.56 (0.0375)	1.36 (0.04)	14.9 (1.825)	0 (0)	Flapping	50
Gannet	0.9924	0.9928 (0.0003)	0.94 (0.0325)	1.72 (0.0375)	14.9 (0)	0.08 (0.1)	Gliding	50

a. Avoidance Rates for the Band (2012) model, i.e. deterministic CRM, are those presented in Appendix 1, Table 1 of NatureScot's letter dated 27 March 2024. The 'All gulls and terns rate' was used for Arctic tern.
b. Avoidance Rates for the stochastic CRM are those presented in Appendix 1, Table 2 of NatureScot's letter dated 27 March 2024. The 'All gulls and terns rate' was used for great skua and Arctic tern.
c. Body length and wind span biometrics were from Snow & Perrins, 1988.
d. All flight speeds from Alerstam *et al.,* 2007, except for gannet and Arctic tern, which is from Pennycuick, 1997.
e. All nocturnal activity factors based on Garthe & Hüppop, 2004, except gannet which is from Furness et al. (2018).

7.7.2.1 *Kittiwake*

7.7.2.1.1 Sensitivity

337. Kittiwakes were assessed to have a **medium** sensitivity to collision risk based on available data on the percentage of time spent flying at heights within the rotor swept area of offshore WTGs, flight agility, the percentage of time flying, the extent of nocturnal flight activity and conservation importance (with reference to Garthe and Hüppop, 2004; Furness and Wade, 2012; Furness et al., 2013; Wade et al., 2016).

338. The mean maximum foraging range (+1SD) for kittiwake is 300.6 km (Woodward et al., 2019) which places the OAA within the potential foraging range of 25 SPA kittiwake breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk. Kittiwake is therefore assessed to have a medium conservation value.

7.7.2.1.2 Impact

339. The total annual mean number of kittiwake collisions for the regional population under the WCS is estimated to be 40.44 individuals (**Table 7-22**).

340. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.010% (**Table 7-23**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.2.1.3 Significance

341. As the species is of medium sensitivity to collision risk, with a negligible impact magnitude, the effect significance is **negligible**, which is not significant in EIA terms.

Table 7-22 Kittiwake seasonal and annual Worst-case Scenario (WCS) mean collision rate estimates.

Season	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	WCS total seasonal collision rate (individuals)	WCS collision rates (all individuals) within regional population[1]
Breeding season	414,355	1.00	17.86	17.86
Non-breeding season	N/A	N/A	38.18	N/A
BDMPS Spring migration	627,816	0.66	21.87	14.43
BDMPS Autumn migration	829,937	0.50	16.31	8.14
		Annual (Breeding + BDMPS seasons)	**56.04**	**40.44**

1.Annual collision rate for the regional population. Outside of the breeding season this is calculated as the regional breeding season population divided by the BDMPS population then multiplied by the estimated seasonal WCS collision rate.

Table 7-23 Impact on kittiwake survival resulting from WCS collision mortality.

CRM Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
WCS	40.44	414,355	0.010%	N

1 Collision mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population collision mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.2.2 *Great black-backed gull*

7.7.2.2.1 Sensitivity

342. The mean maximum foraging (+1SD) range for great black-backed gull is 73 km (Woodward et al., 2019) which places the OAA within the potential foraging range of six SPA great black-backed gull breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk. The total breeding season regional population size is estimated to be 1,497 adult individuals (**Table 6-9**).

343. Great black-backed gulls were assessed to have a high sensitivity to collision risk based on available data on the percentage of time spent flying at heights within the rotor swept area of offshore WTGs, flight agility, the percentage of time flying, the extent of nocturnal flight activity and conservation importance (with reference to Garthe and Hüppop, 2004; Furness and Wade, 2012; Furness et al., 2013; Wade et al., 2016). Great black-backed gull is assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**), and an overall **high** level of sensitivity.

7.7.2.2.2 Impact

344. The total annual mean number of great black-backed gull collisions for the regional population under the WCS is estimated to be 1.22 individuals (**Table 7-24**).

345. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.036% (**Table 7-25**). This change is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so population modelling was conducted (see **Appendix 9 EIA: PVA at regional population scales for Project alone and cumulatively**).

346. With an additional mortality of 1.22 individuals the model predicted over 35 years a reduction in growth rate by 0.04% (C-PGR = 0.9996) and a reduction in population size by 1.4% (C-PS = 0.9859) (**Table 7-26**).

347. Based on the C-PGR predictions, this magnitude of increase in mortality is considered as being of **negligible** magnitude.

7.7.2.2.3 Significance

348. Taking the high sensitivity of great black-backed gulls and the negligible magnitude of impact, the overall effect on great black-backed gull is considered to be **negligible** and not significant in EIA terms.

Table 7-24 Great black-backed gull seasonal and annual Worst-case Scenario (WCS) mean collision rate estimates.

Season	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	WCS total seasonal collision rate (individuals)	WCS collision rates (all individuals) within regional population[1]
Breeding season	3,402	1.00	0.81	0.81
Non-breeding season	91,399	0.04	11.13	0.41
		Annual (Breeding + BDMPS seasons)	11.94	**1.22**

1.Annual collision rate for the regional population. Outside of the breeding season this is calculated as the regional breeding season population divided by the BDMPS population then multiplied by the estimated seasonal WCS collision rate.

Table 7-25 Impact on great black-backed gull survival resulting from WCS collision mortality.

CRM Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
WCS	1.22	3,402	0.036%	Y

1 Collision mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population collision mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

Table 7-26 Projected PVA metrics for WCS collision mortality after 25, 35 and 50 years for great black backed gull for the Project alone.

	Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
WCS 25	0.9996	0.9996	0.0006	0.9986	1.0007	0.9896	0.9899	0.0154	0.9598	1.0210	48.6	50.8
WCS 35	0.9996	0.9996	0.0004	0.9989	1.0004	0.9849	0.9859	0.0153	0.9570	1.0172	48.1	50.9
WCS 50	0.9997	0.9997	0.0003	0.9992	1.0003	0.9853	0.9859	0.0152	0.9570	1.0165	49.3	50.2

7.7.2.3 *Arctic tern*

7.7.2.3.1 Sensitivity

349. Arctic terns are assessed to have a medium sensitivity to collision risk based on available data on the percentage of time spent flying at heights within the rotor swept area of offshore WTGs, flight agility, the percentage of time flying, the extent of nocturnal flight activity and conservation importance (with reference to Garthe and Hüppop, 2004; Furness and Wade, 2012; Furness et al., 2013; Wade et al., 2016).

350. Arctic terns were assessed to have a low conservation value, and therefore an overall **medium** level of sensitivity.

351. The mean maximum foraging range (+1SD) for Arctic tern is 40.5 km (**Table 6-7**) which places the OAA beyond potential foraging range of SPA Arctic tern breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations may contribute to individuals at risk. The total breeding season regional population size is estimated to be 906 adult individuals (**Table 6-9**).

7.7.2.3.2 Impact

352. The total annual mean number of Arctic tern collisions for the regional population under the WCS is estimated to be 0.43 individuals, or one every 2-3 years (**Table 7-27**).

353. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.030% (**Table 7-28**). This change is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so population modelling was conducted (see **Appendix 9 EIA: PVA at regional population scales for Project alone and cumulatively**).

354. With an additional mortality of 0.43 individuals the model predicts over 35 years a reduction in growth rate by 0.01% (C-PGR = 0.9999) and no reduction in population size (C-PS = 1.0103) (**Table 7-29**).

355. This magnitude of mortality is considered to be of **negligible** magnitude.

7.7.2.3.3 Significance

356. Taking the medium sensitivity of Arctic tern and the negligible magnitude of impact, the overall effect on Arctic tern is considered to be **negligible** and not significant in EIA terms.

Table 7-27 Arctic tern seasonal and annual Worst-case Scenario (WCS) mean collision rate estimates.

Season	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	WCS total seasonal collision rate (individuals)	WCS collision rates (all individuals) within regional population[1]
Breeding season	1,438	1.00	0.43	0.43
Non-breeding season	N/A	N/A	0	0
BDMPS Spring migration	163,930	0.01	0	0
BDMPS Autumn migration	163,930	0.01	0	0
		Annual (Breeding + BDMPS seasons)	0.43	**0.43**

1.Annual collision rate for the regional population. Outside of the breeding season this is calculated as the regional breeding season population divided by the BDMPS population then multiplied by the estimated seasonal WCS collision rate.

Table 7-28 Impact on Arctic tern survival resulting from WCS collision mortality.

CRM Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
WCS	0.43	1,438	0.0299%	Y

1 Collision mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population collision mortality / regional population*] **100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

Table 7-29 Projected PVA metrics for WCS collision mortality after 25, 35 and 50 years for Arctic tern for the Project alone.

	Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
WCS 25	0.9998	0.9997	0.0046	0.9900	1.0088	0.9958	1.0000	0.1209	0.7784	1.2601	49.4	50.4
WCS 35	0.9998	0.9999	0.0048	0.9898	1.0098	0.9939	1.0103	0.1782	0.6914	1.4289	49.4	51.9
WCS 50	0.9999	0.9998	0.0056	0.9885	1.0112	1.0000	1.0323	0.3168	0.5650	1.7500	49.6	51.7

7.7.2.4 *Great skua*

7.7.2.4.1 Sensitivity

357. The mean maximum foraging range (+1SD) for great skua is 931.2 km (**Table 6-7**) which places the OAA within the potential foraging range of eight SPA great skua breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations may contribute to individuals at risk. The total breeding season regional population size is estimated to be 21,942 adult individuals (**Table 6-9**).

358. Great skua is assessed as having a medium sensitivity to collision risk based on available data on the percentage of time spent flying at heights within the rotor swept area of offshore WTGs, flight agility, the percentage of time flying, the extent of nocturnal flight activity and conservation importance (with reference to Garthe and Hüppop, 2004; Furness and Wade, 2012; Furness et al., 2013; Wade et al., 2016). Great skua was also assessed to have a medium conservation value based on connectivity to SPAs (**Table 5-2**), and overall sensitivity is considered to be **medium**.

359. As the total breeding reference population is larger than the total non-breeding reference population, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

7.7.2.4.2 Impact

360. The total annual mean number of great skua collisions for the regional population under the WCS is estimated to be 0.38 individuals, or one every 2-3 years (**Table 7-30**).

361. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.0007% (**Table 7-31**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.2.4.3 Significance

362. Taking the medium sensitivity of great skua and the negligible magnitude of impact, the overall effect on great skua is considered to be **negligible** and not significant in EIA terms.

Table 7-30 Great skua seasonal and annual Worst-case Scenario (WCS) mean collision rate estimates.

Season	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	WCS total seasonal collision rate (individuals)	WCS collision rates (all individuals) within regional population[1]
Breeding season	53,517	1.00	0.25	0.25
Non-breeding season	N/A	N/A	0.13	N/A
BDMPS Spring migration	8,485	1.00	0.13	0.13
BDMPS Autumn migration	19,556	1.00	0	0
BDMPS Winter	143	1.00	0	0
		Annual (Breeding + BDMPS seasons)	0.38	**0.38**

1.Annual collision rate for the regional population. Outside of the breeding season this is calculated as the regional breeding season population divided by the BDMPS population then multiplied by the estimated seasonal WCS collision rate.

Table 7-31 Impact on great skua survival resulting from WCS collision mortality.

CRM Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
WCS	0.38	53,517	0.0007%	N

1 Collision mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population collision mortality / regional population] *100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.2.5 *Gannet*

7.7.2.5.1 Sensitivity

363. Gannet is assessed to have a medium sensitivity to collision risk based on available data on the percentage of time spent flying at heights within the rotor swept area of offshore WTGs, flight agility, the percentage of time flying, the extent of nocturnal flight activity and conservation importance (with reference to Garthe and Hüppop, 2004; Furness and Wade, 2012; Furness et al., 2013; Wade et al., 2016). Gannet is also assessed to have a medium conservation value, and therefore an overall sensitivity of **medium**.

364. The mean maximum foraging range for gannet (+1SD) is 315.2 + 194.2 km (**Table 6-7**) which places the OAA within the potential foraging range of eight SPA gannet breeding colonies (refer to **Addendum to the RIAA - Ornithology**), although other non-SPA populations are also likely to contribute to individuals at risk. The total breeding season regional population size is estimated to be 509,546 adult individuals (**Table 6-9**).

365. As the total breeding reference population is larger than the total non-breeding reference population, it has been assumed that all remaining individuals present during the non-breeding season are from the breeding population (i.e. ratio used is 1.0).

7.7.2.5.2 Impact

366. The total annual mean number of gannet collisions for the regional population under the WCS is estimated to be 45.07 individuals (**Table 7-32**).

367. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.005% (**Table 7-33**). This change falls below the 0.02% threshold for a PVA, as advised by NatureScot during consultation, and is considered to be of **negligible** magnitude of impact.

7.7.2.5.3 Significance

368. Taking the medium sensitivity of gannet and the negligible magnitude of impact, the overall effect on gannet is considered to be **negligible** and not significant in EIA terms.

Table 7-32 Gannet seasonal and annual Worst-case Scenario (WCS) mean collision rate estimates.

Season	Reference population (all individuals)	Ratio of birds from the regional population compared to the reference population.	WCS total seasonal collision rate (individuals)	WCS collision rates (all individuals) within regional population[1]
Breeding season	926,447	1.00	35.3	35.3
Non-breeding season	N/A	N/A	9.77	N/A
BDMPS Spring migration	248,385	1.00	2.04	2.04
BDMPS Autumn migration	456,298	1.00	7.73	7.73
		Annual (Breeding + BDMPS seasons)	45.07	**45.07**

1.Annual collision rate for the regional population. Outside of the breeding season this is calculated as the regional breeding season population divided by the BDMPS population then multiplied by the estimated seasonal WCS collision rate.

Table 7-33 Impact on gannet survival resulting from WCS collision mortality.

CRM Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Reference population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
WCS	45.07	926,447	0.0049%	N

1 Collision mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional population as summarised in
Table 6-8.
3 Change in survival is calculated as [*regional population collision mortality / regional population] *100.*
4 As agreed with NatureScot, a PVA is presented if the impact on survival is > or = 0.02%.

7.7.3 Impact 6: Indirect habitat loss / change for prey species

7.7.3.1.1 Sensitivity

369. Seven seabird species (kittiwake, Arctic tern, guillemot, razorbill, puffin, fulmar and gannet) were screened into the direct and indirect disturbance and displacement assessment for the construction phase and operation and maintenance stage. Based on previous considerations of sensitivity, an overall **medium** sensitivity to indirect operational impacts during the operation and maintenance stage has been concluded for all seven species.

7.7.3.1.2 Impact

370. Indirect disturbance and displacement of birds may occur during the operation and maintenance stage of the offshore Project 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. the turning of the WTGs), electro-magnetic fields (EMF), habitat loss and disturbance and the generation of suspended sediments (e.g. due to scour or maintenance activities) that may alter the behaviour or availability of bird prey species. Underwater noise and EMF may cause fish and mobile invertebrates to avoid the operational area and also affect their physiology and behaviour. Habitat loss and disturbance may reduce suitable habitats for key prey species (e.g. spawning or burrowing habitat for sandeel) and suspended sediments may cause fish and mobile invertebrates to avoid the operational area and may smother and hide immobile benthic prey. These mechanisms could result in less prey being available within the operational area to foraging seabirds. Changes in fish and invertebrate communities due to changes in presence of hard substrate (resulting in colonisation by epifauna) may also occur, and changes in fishing activity could influence the communities present.

371. With regard to noise impacts on fish, as outlined in **Offshore EIA Report, chapter 11: Fish and shellfish ecology**, this impact was not taken forward for assessment for all receptors with the exception of diadromous fish in relation to barrier effects. For key prey species such as herring, sprat and sandeel, underwater noise impacts during the operation and maintenance stage are expected to be negligible, and therefore, **Offshore EIA Report, chapter 11: Fish and shellfish ecology** concludes that the effects on fish and shellfish species to operational noise are considered to be not significant. With a non-significant effect on fish that are bird prey species, it can be concluded that the indirect effects on seabirds occurring in or around the OAA and the offshore ECC during the operation and maintenance stage would be of **negligible** magnitude.

372. With regard to changes to the seabed and to suspended sediment levels, **Offshore EIA Report, chapter 8: Marine physical and coastal processes** and **Offshore EIA Report, chapter 10: Benthic subtidal and intertidal ecology** discuss the nature of any change and impact. They conclude that changes in physical processes, temporary habitat loss/disturbance, long term habitat loss or damage would be not significant. While the Benthic Subtidal and Intertidal Additional Information considers impacts to the seabed further in line with the MDLOT and NatureScot request, none of the conclusions of the Offshore EIA have changed. For fish and shellfish, habitat loss and disturbance could result in a reduction of spawning, nursery or feeding habitats for key prey species. This effect may be long-term in areas of habitat loss (e.g. cable protection) but highly localised, as described in **Offshore EIA Report, chapter 11:**

Fish and shellfish ecology. Therefore, the impact is considered to be minor adverse and not significant. As per the construction stage, increased suspended sediments was not taken forward for assessment of effects on fish and shellfish ecology. The Fish and Shellfish Additional Information considers increased suspended sediments impacts to common skate and sandeel (as requested by MDLOT and NatureScot) reaching a conclusion of minor impact and no significant effect. With a non-significant unmitigated effect on both benthic habitats and species and fish and shellfish ecology, it could be concluded that the indirect impacts on seabirds occurring in or around the OAA and the offshore ECC during the operation and maintenance stage would be of **negligible** magnitude.

373. With regard to EMF effects, these are identified as localised with the majority of cables being buried to a target depth of 1-3 m depth, further reducing the effect of EMF. The significance of effect is considered minor adverse on benthic communities and negligible or minor adverse for fish and shellfish ecology, and so it could be concluded that the indirect impact on seabirds occurring in or around the OAA and the offshore export cable during the operation and maintenance stage is of **negligible** magnitude.

374. Very little is known about potential long-term changes in invertebrate and fish communities due to colonisation of hard substrate, the potential of new structures to cause fish aggregation and changes in commercial fishing pressures associated with offshore windfarms. The impact of the colonisation of introduced hard substrate is seen as low magnitude in terms of benthic ecology (as it is a change from the baseline conditions). The impact of potential fish or predator aggregation is considered to be negligible to minor. The consequences for seabirds may be positive or negative locally but are predicted to be **negligible** (either beneficially or adversely) in EIA terms, at a wider scale.

375. Based on the low numbers of birds present within the OAA or offshore ECC that may be affected by indirect impacts, within the context of each species' relevant breeding season reference population (see Impacts 3 and 4) the overall magnitude of impact due to the combined indirect impacts during the operation and maintenance phase is considered to be **negligible**.

7.7.3.1.3 Significance

376. Taking the medium sensitivity of kittiwake, Arctic tern, guillemot, razorbill, puffin, fulmar and gannet and the negligible magnitude of impact, the overall effect for all species is considered to be **negligible** and not significant in EIA terms.

7.7.4 Impact 7: Artificial operational lighting

7.7.4.1 *Sensitivity*

377. Artificial lighting impacts during the construction phase were assessed under Impact 1 (see section 7.6.2). The scope of the assessment for operational and maintenance phase impacts is similar, with the focus being on Manx shearwater and European storm-petrel (both **high** sensitivity) and puffin (**medium** sensitivity).

7.7.4.2 *Impact*

378. Embedded mitigation includes a commitment by the Project that excess lighting, above levels set by regulatory requirements for navigation, aviation, escape/emergency procedures and general activity, will be avoided wherever possible (see section 7.4).

379. The sources of artificial lighting during the operation and maintenance phase of the Project are likely to be in the main, associated with WTGs, OSPs and support vessels. For vessels, the impacts are likely to be similar in nature, but smaller in extent than during construction (negligible impacts, as described for Impact 1, section 7.6.2), and so the assessment concentrates on potential impacts associated with permanent structures (WTGs and OSPs), reviewing Deakin *et al.* (2022) and other relevant literature sources.

380. Deakin *et al.* (2022) reviewed the risks associated with artificial lighting at offshore wind farms. The authors do not consider light attraction to be a separate impact pathway, but instead may exacerbate one or more of the recognised impact pathways (e.g. collision or displacement). The authors also note the importance of making a distinction between attraction and disorientation, and the spatial scales at which they operate. The first will affect the number of birds brought into the vicinity of the wind farm ("macro" and "meso" scales, Cook et al., 2018), and the second will affect the length of time birds remain within the proximity of potential collision sources, particularly WTGs ("micro" scale, Cook et al., 2018). These two impacts may have different drivers, and impact juveniles and adults differently.

381. The young of Manx shearwaters and storm-petrels appear particularly sensitive to light-induced attraction/disorientation on fledging flights from the colony (Atchoi et al., 2020). Puffin, also a burrow nesting species whose chicks fledge at night, can show similar responses to light as petrels (Furness, 2018; and as witnessed by Archer & Taylor (2009) around Sule Skerry lighthouse). There is some evidence for Leach's storm-petrel that adults may be attracted on occasion too.

382. Evidence is presented in Deakin *et al.* (2022) for light-induced disorientation, including grounding of Manx shearwaters and storm-petrels, although the distance to which the attraction takes place is generally unknown. Many studies describe procellariform seabirds being drawn downwards towards bright light shining from below, but it is not clear to what extent Manx shearwaters and storm-petrels, generally considered to be of very low risk of collisions, mainly flying close to the sea below WTG rotor heights, would be drawn upwards (therefore placing them at risk of collisions).

383. Attraction towards bright artificial light can be strong at times of poor visibility, particularly affecting migrating birds during the autumn, but it is generally seen where birds are exposed to intense white lighting, such as from lighthouses. Furness (2018); Ronconi *et al.* (2015) and

Day *et al*. (2015) all report that poor weather (e.g. fog, rain, low cloud cover) exacerbate nocturnal attraction of migrant bird to lights at oil and gas production platforms, with on occasions thousands of birds being killed in a night, especially where gas is being flared. However, there is limited evidence for attraction of shearwaters and storm-petrels to oil and gas platform in the UK (Bourne, 1979; Sage, 1979), likely due to low densities of these species in the northern North Sea where seabird interactions with oil platforms have been studied.

384. If WTG lighting caused disorientation, this could lead to individual birds circling the navigation lights for protracted periods (as has been reported for birds disorientated by lighthouses or gas flares), increasing the probability of collisions, or becoming vulnerable to predation by gulls or skuas. Sub-lethal affects may also occur, including on productivity or loss of body condition resulting in birds becoming more vulnerable to starvation or predation.

385. Long-range light attraction may result in birds being displaced from foraging areas and activities, but the extent of such attraction is difficult to quantify. As noted earlier under Impact 1 (section 7.6.2), Deakin *et al.* (2022) state that numbers of grounded birds recovered are typically very low in relation to the local population size, suggesting that birds are not attracted over large distances, or if so, only a small proportion of individuals are affected, albeit recovery rates, for storm-petrels in particular, may be low due to their smaller size and greater ability to take off again than Manx shearwaters.

386. In relation to displacement impacts due to artificial lighting, Manx shearwater and storm-petrel are considered to have a low vulnerability to displacement and disturbance from offshore wind farms (Furness and Wade, 2012, Furness et al., 2013, Bradbury et al., 2014). Deakin *et al.* (2022) do provide some evidence of Manx shearwaters avoiding offshore wind farms during the construction and operation phases, albeit it is suggested that a higher level of disturbance may occur during the construction phase, when activity, noise and light levels may be greatest.

387. Although Manx shearwaters and storm-petrels cover large distances when foraging, they may still target particular oceanographic features, and therefore displacement from these may affect foraging or rafting behaviours.

388. Most storm-petrel breeding colonies in northwest Europe are located close to the continental shelf edge and in Britain and Ireland colonies are located on the northern and western coasts, mostly within 150 km of the shelf edge. Bolton (2021) suggests that storm-petrels are therefore reliant on the biologically productive waters of the shelf edge for feeding, and this has been supported by boat-based survey results (Kober et al., 2012, Waggitt et al., 2020).

389. Bolton (2021) reported on a study that tracked of storm-petrels breeding within the largest UK colony on Mousa, Shetland. It was found that storm-petrels regularly ranged up to 300 km from the colony and showed highly consistent use of continental shelf waters to the south of the colony. Storm-petrels avoided coastal waters during daylight (potentially to avoid avian predators), but high usage of the area close to colony was recorded during the hours of darkness.

390. Although most identified impacts are adverse, Deakin *et al.* (2022) also note that there is a possibility that birds could benefit from increased foraging opportunities due to artificial lighting around wind farm developments, particularly if there are increases in prey availability by attracting it close to the sea surface. Evidence is provided that, as an example, storm-petrels have been observed foraging around illuminated fish farms at night in the Faroe Islands.

391. Overall, based on the evidence provided, the impact of artificial lighting on Manx shearwater, European storm-petrel and puffin due to the operation and maintenance of the Project is considered to be of **low** magnitude, due to the following reasons:

- The lower intensity of WTG lighting compared to other recognised sources of attraction such as oil platforms or lighthouses;
- The lack of apparent high suitability foraging habitat within the OAA for shearwaters and petrels, based on known species' preferences and survey data;
- Due to the Restricted Build Areas, the distance of any WTG from the nearest colonies being at least 3.7 km from the SPA boundary (the marine extension to the SPA and not the colony itself), reducing the likelihood of attraction by significant numbers of young birds on fledging flight;
- The likely low proportion of the overall breeding season population that would be affected; and
- The low susceptibility of Manx shearwater, European storm-petrel and puffin to collisions with WTGs due to flight behaviour, even allowing for possible attraction to structures.

7.7.4.3 Significance

392. The impacts of artificial lighting during operation and maintenance are localised in nature and the magnitude of effect has been determined as low for Manx shearwater, European storm-petrel and puffin. As the species are of medium or high sensitivity to artificial lighting, the effect significance is **minor adverse**, which is not significant in EIA terms.

7.7.5 Impact 8: Combined operational displacement and collision risk

393. During consultation (10th and 11th June 2024), NatureScot provided confirmation regarding which species required quantitative assessments for particular impact pathways. For the operation and maintenance phase, **kittiwake, Arctic tern** and **gannet** were identified as having both displacement and collision impacts due to the Project.

394. It is therefore possible that these impacts could combine to adversely affect the relevant populations of these species, and this section assesses the combined impacts, based on results presented above for Impact 4 (displacement) and Impact 5 (collision risk).

7.7.5.1 Kittiwake

7.7.5.1.1 Sensitivity

395. Kittiwake has been assessed to have a **medium** sensitivity to disturbance and displacement (Impact 4) and collision risk (Impact 5).

7.7.5.1.2 Impact

396. Under the ‘low’ displacement mortality scenario (30% displacement and 1% mortality rates) it is predicted that there would be a total annual mortality of 6.94 individuals within the regional population due to displacement impacts.

397. Under the ‘high’ displacement mortality scenario (30% displacement and 3% mortality rates) it is predicted that there would be a total annual mortality of 20.85 individuals within the regional population due to displacement impacts.

398. The total annual mean number of kittiwake collisions for the regional population under the WCS is estimated to be 40.44 individuals.

399. Thus, when displacement and collision risk impacts are combined, the total annual mortality is predicted to be 47.38 (low) to 61.29 (high) individuals.

400. The predicted combined displacement and collision mortality would result in an addition to the mortality of the regional population by 0.011% (**Table 7-34**). This change falls below the 0.02% threshold for a PVA advised by NatureScot during consultation and is considered to be a **negligible** magnitude of impact.

7.7.5.1.3 Significance

401. Taking the medium sensitivity of kittiwakes and the negligible magnitude of impact, the overall effect is considered to be **negligible** and not significant in EIA terms.

Table 7-34 Combined Impact on kittiwake survival resulting from displacement + collision mortality.

Displacement scenario	Annual displacement mortality within regional population (all indivs.)	Annual collision rate WCS within regional population (all indivs.)	Estimated combined annual mortality within regional population (all indivs.)	Regional population (all individuals)	Additional impact on survival	PVA required (Y/N)
Displacement (low)	6.94	40.44	47.38	414,355	0.0098%	N
Displacement (high)	20.85		61.29		0.0114%	N

Table 7-35 Combined Impact on Arctic tern survival resulting from displacement + collision mortality.

Displacement scenario	Annual displacement mortality within regional population (all indivs.)	Annual collision rate WCS within regional population (all indivs.)	Estimated combined annual mortality within regional population (all indivs.)	Regional population (all individuals)	Additional impact on survival	PVA required (Y/N)
Displacement (low)	1.10	0.43	1.53	1,438	0.107%	Y
Displacement (high)	1.91		2.34		0.162%	Y

Table 7-36 Combined Impact on gannet survival resulting from displacement + collision mortality.

Displacement scenario	Annual displacement mortality within regional population (all indivs.)	Annual collision rate WCS within regional population (all indivs.)	Estimated combined annual mortality within regional population (all indivs.)	Regional population (all individuals)	Additional impact on survival	PVA required (Y/N)
Displacement (low)	16.6	45.07	61.7	926,447	0.007%	N
Displacement (high)	49.5		94.6		0.010%	N

7.7.5.2 *Arctic tern*

7.7.5.2.1 Sensitivity

402. Arctic tern has been assessed to have a **medium** sensitivity to disturbance and displacement (Impact 4) and collision risk (Impact 5).

7.7.5.2.2 Impact

403. Under the 'low' displacement mortality scenario (30% displacement and 3% mortality rates) it is predicted that there would be a total annual mortality of 1.1 individuals within the regional population due to displacement impacts.

404. Under the 'high' displacement mortality scenario (50% displacement and 3% mortality rates) it is predicted that there would be a total annual mortality of 1.91 individuals within the regional population due to displacement impacts.

405. The total annual mean number of Arctic tern collisions for the regional population under the WCS is estimated to be 0.43 individuals, or one every 2-3 years.

406. Thus, when displacement and collision risk impacts are combined, the total annual mortality within the regional population is predicted to be 1.53 (low) to 2.34 (high) individuals.

407. The predicted combined displacement and collision mortality would result in an addition to the mortality of the regional population by 0.16% (**Table 7-35**). This change is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling was conducted (see **Appendix 9 EIA: PVA at regional population scales for Project alone and cumulatively**).

408. With an additional mortality of up to 2.34 individuals the model predicts over 35 years a reduction in growth rate by up to 0.19% (C-PGR = 0.9981) and a reduction in population size by up to 5.2% (C-PS = 0.9480) (**Table 7-37**). Based on the C-PGR predictions, this magnitude of increase in mortality is considered to be of **negligible** magnitude.

Table 7-37 Projected PVA metrics after 25, 35 and 50 years for Arctic tern for the Project alone (displacement + collision mortality).

	Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50 %I	I=50% %U
Low 25	0.9988	0.9987	0.0046	0.9899	1.0085	0.9702	0.9742	0.1202	0.7625	1.2408	47.3	53.6
High 25	0.9981	0.9981	0.0048	0.9882	1.0076	0.9491	0.9595	0.1214	0.7326	1.2190	46.3	55.4
Low 35	0.9989	0.9988	0.0048	0.9892	1.0083	0.9585	0.9727	0.1745	0.6810	1.3575	45.1	55.9
High 35	0.9980	0.9981	0.0049	0.9886	1.0081	0.9309	0.9480	0.1702	0.6560	1.3479	44.5	55.2
Low 50	0.9992	0.9991	0.0057	0.9867	1.0103	0.9590	0.9961	0.3045	0.5000	1.6977	48.1	53.2
High 50	0.9987	0.9986	0.0058	0.9870	1.0096	0.9377	0.9720	0.2937	0.5118	1.6472	45.0	56.0

7.7.5.2.3 Significance

409. Taking the medium sensitivity of Arctic tern and the negligible magnitude of impact, the overall effect on Arctic tern is considered to be **negligible** and not significant in EIA terms.

7.7.5.3 *Gannet*

7.7.5.3.1 Sensitivity

410. Gannet has been assessed to have a **medium** sensitivity to disturbance and displacement (Impact 4) and collision risk (Impact 5).

7.7.5.3.2 Impact

411. Under the 'low' displacement mortality scenario (70% displacement and 1% mortality rates) it is predicted that there would be a total annual mortality of 16.6 individuals within the regional population due to displacement impacts.

412. Under the 'high' displacement mortality scenario (70% displacement and 3% mortality rates) it is predicted that there would be a total annual mortality of 49.5 individuals within the regional population due to displacement impacts.

413. The total annual mean number of gannet collisions for the regional population under the WCS is estimated to be 45.07 individuals.

414. Thus, when displacement and collision risk impacts are combined, the total annual mortality within the regional population is predicted to be 61.7 (low) to 94.6 (high) individuals.

415. The predicted combined displacement and collision mortality would result in an addition to the mortality of the regional population by 0.010% (**Table 7-35**). This change falls below the 0.02% threshold for a PVA advised by NatureScot during consultation, and is considered to be a **negligible** magnitude of impact.

7.7.5.3.3 Significance

416. Taking the medium sensitivity of gannet and the negligible magnitude of impact, the overall effect is considered to be **negligible** and not significant in EIA terms.

7.8 Potential effects during decommissioning

417. There are two potential impacts that may affect bird populations during the decommissioning stage of the Project:

- Direct distributional responses and displacement effects; and
- Indirect effects as a result of disturbance and displacement of prey species.

418. Any impacts generated during the decommissioning stage of the Project are expected to be similar, or of reduced magnitude, to those generated during the construction stage, as certain activities such as piling would not be required. This is because it would generally involve a reverse of the construction stage through the removal of some structures and materials installed.

419. It is anticipated that any future activities would be programmed in close consultation with the relevant statutory marine and nature conservation bodies, to allow any future guidance and best practice to be incorporated to minimise any potential impacts.

7.8.1 Direct and indirect distributional responses and displacement effects

420. Direct impacts (disturbance and displacement) and indirect impacts (displacement of seabird prey species) have already been assessed for relevant bird species in the construction section above and have been found to be of negligible magnitude.

421. Any impacts generated during the decommissioning stage of the Project are expected to be similar, but likely of reduced magnitude compared to those generated during the construction stage; therefore, the magnitude of impact is predicted to be negligible. The resultant effect on a range of species of medium or high sensitivity to disturbance is of **negligible** significance.

7.9 Summary of potential effects due to Project alone

422. A summary of the outcomes of the assessment of potential effects from the construction, operation and maintenance and decommissioning of the Project is provided in **Table 7-38**.

423. No significant effects on offshore ornithology features were identified. Therefore, mitigation measures in addition to the embedded mitigation measures listed in section 7.4 are not considered necessary.

Table 7-38 Summary of potential effects due to Project alone.

Potential impact	IOF	Sensitivity of IOF	Magnitude of impact	Consequence (significance of effect)	Secondary mitigation requirements	Residual consequence (significance of effect)
Construction and decommissioning						
1. Direct distributional responses and displacement effects	Great northern diver	High	Low (vessel movement at Scapa Deep Water Quay only[21])	Minor adverse	None required above embedded mitigation measures.	Minor adverse (not significant)
	All other IOFs - breeding and non-breeding.	Medium or High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
2. Artificial lighting	Manx shearwater	High	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
	European storm-petrel	High	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
	Puffin	Medium	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
3. Indirect disturbance and displacement of prey species	All IOFs - breeding and non-breeding.	Medium	Negligible or Low	Negligible or Minor adverse (not significant)	None required above embedded mitigation measures.	Negligible or Minor adverse (not significant)
Operation and maintenance						
4. Direct distributional responses, displacement & barrier effects	Kittiwake	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Arctic tern	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Guillemot	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

[21] Due to Scapa Flow hosting important numbers of non-breeding great northern divers, and vessel movements from Scapa Deep Water Quay passing through Scapa Flow.

Potential impact	IOF	Sensitivity of IOF	Magnitude of impact	Consequence (significance of effect)	Secondary mitigation requirements	Residual consequence (significance of effect)
	Razorbill	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Puffin	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Fulmar	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Gannet	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	All other species - breeding and non-breeding (vessel movements).	Medium or High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
5. Collision risk	Kittiwake	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Great black-backed gull	High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Arctic tern	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Great skua	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Gannet	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
6. Indirect habitat loss / change for prey species	All IOFs - breeding and non-breeding.	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
7.Artificial operational lighting	Manx shearwater	High	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
	European storm-petrel	High	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)

Potential impact	IOF	Sensitivity of IOF	Magnitude of impact	Consequence (significance of effect)	Secondary mitigation requirements	Residual consequence (significance of effect)
	Puffin	Medium	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
8. Combined operational displacement and collision risk	Kittiwake	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Arctic tern	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Gannet	Medium	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)

8 ASSESSMENT OF CUMULATIVE EFFECTS

8.1 Scope of assessment

424. Impacts due to the offshore Project have the potential to interact with those from other developments, resulting in possible cumulative impacts on offshore ornithology features. The general approach to cumulative assessment is described in **Offshore EIA Report, chapter 7: EIA methodology** and further detail relating to the assessment of offshore ornithological features is provided below.

425. All developments for which an application had been submitted, were under construction or were operational were included in the quantitative cumulative assessment. MD-LOT advised on the developments to include (email dated 3 June 2024).

426. The developments identified as being relevant to the assessment of cumulative impacts to offshore ornithology features are those within the UK North Sea (and Channel where appropriate for the species being assessed) (eastern region BDMPS, from Furness, 2015) as shown in **Table 8-1**.

Table 8-1 Developments within the Eastern Region BDMPS screened into the cumulative assessment.

Offshore wind farm	Current project status
Berwick Bank	Application submitted
Blyth Demo	Operational
Beatrice Offshore Wind Farm	Operational
Dudgeon Extension Project and Sheringham Extension Project	Consented
Dogger Bank Creyke Beck A and B	Under Construction
Dogger Bank Teesside A and Sofia (formerly Dogger Bank Teesside B)	Under Construction/consented
Dudgeon	Operational
East Anglia One	Operational
East Anglia ONE North	Consented
East Anglia Three	Under Construction
East Anglia TWO	Consented
EOWDC	Operational
Forthwind	Consented
Galloper	Operational
Greater Gabbard	Operational
Greenvolt	Consented
Gunfleet Sands (I and II)	Operational
Hornsea Project Four	Consented
Hornsea Project One	Operational
Hornsea Project Three	Under Construction
Hornsea Project Two	Operational
Humber Gateway	Operational
Hywind	Operational
Inchcape	Under construction

Offshore wind farm	Current project status
Kentish Flats & Extension	Operational
Kincardine	Operational
Lincs, Lynn & Inner Dowsing	Operational
London Array	Operational
Methil	Operational
Moray East	Operational
Moray West	Under construction
Neart na Gaoithe	Under construction
Norfolk Boreas	Consented
Norfolk Vanguard	Consented
PFOWF	Consented
Race Bank	Operational
Rampion	Operational
Salamander	Application submitted
Seagreen Alpha & Bravo (including Phase 1A)	Operational (Phase 1A consented)
Sheringham Shoal	Operational
Teesside	Operational
Thanet	Operational
Triton Knoll	Operational
Westermost Rough	Operational

427. MD-LOT advised (email dated 3rd June 2024) that, as well as a quantitative assessment of all developments listed in **Table 8-1**, a qualitative cumulative assessment should be undertaken for all developments for which a Scoping Opinion has been adopted. As of 19th June 2024, the following developments had a Scoping Opinion: Broadshore Hub including Scaraben and Sinclair, Buchan, Caledonia, Cenos, Culzean, Marramwind, Morven, Muir Mhor, Ossian, Spiorad na Mara and Stromar. Scoping Reports published on the Marine Directorate's website[22] were reviewed and information on seabird species recorded in higher abundance in each project's offshore development area was noted. A summary is provided in Section 2.2 of **Appendix 7 - EIA: Cumulative mortalities at regional population scales.** Each of these developments were noted as potentially adding to the predicted cumulative impacts.

428. Due to the low likelihood of additional mortality on birds, and low proportion of populations affected, most construction phase impacts have not been taken forward for cumulative assessment. This includes potential impacts on seabirds in the OAA and offshore ECC, and on intertidal/ nearshore features (great northern diver, common eider, guillemot and shag) associated with the landfall (Impact 1), and artificial lighting impacts (for Manx shearwater, European storm-petrel and puffin) (Impact 2). This is also considered to be the case for indirect impacts for all IOFs (Impact 3). The exception to this is the possible cumulative effects of vessel movements between the Project and ports, covered under Impact 1 (construction) which has been scoped into the cumulative assessment.

[22] https://marine.gov.scot/marine-projects

429. For the operation and maintenance phase, the cumulative assessment considers displacement within the OAA (as per Impact 4) and collision risk (as per Impact 5). Again, indirect impacts (Impact 6) and impacts due to artificial lighting (Impact 7) have not been taken forward for assessment due to sufficiently low likelihood of non-trivial impacts on populations. Vessel movements during operation and maintenance, as previously assessed under Impact 4, have also been included in the cumulative assessment.

430. For cumulative effects due to vessel movements during construction and operation & maintenance, an assessment has been made for relevant seabirds, wintering waterfowl and breeding red-throated diver, following the same principles as the assessment of vessel movements for the Project alone in section 7.6.1.6 and section 7.7.1.10 respectively.

431. Based on the assessments of operational displacement and collision risk for the Project alone, a total of six seabird species are included in the cumulative assessment (**Table 8-2**). For kittiwake and gannet, displacement and collision risk have been identified as impact pathways, and so a combined cumulative displacement and collision risk assessment has been conducted (as per Impact 8).

432. For Arctic tern, great skua and fulmar, although these species were included in the Project alone assessment, insufficient data were available to quantify displacement and collision impacts from other OWF due to these species rarely or never being assessed in planning applications for other OWFs. Therefore, these species were not included in the cumulative assessment.

Table 8-2 Scope of potential cumulative impacts for offshore ornithology features.

Species	Operational displacement	Collision risk	Combined operational displacement + collision risk
Kittiwake	✓	✓	✓
Great black-backed gull	-	✓	-
Arctic tern	-	-	-
Great skua	-	-	-
Guillemot	✓	-	-
Razorbill	✓	-	-
Puffin	✓	-	-
European storm-petrel	-	-	-
Fulmar	-	-	-
Gannet	✓	✓	✓
Manx shearwater	-	-	-
Great northern diver	-	-	-
Common eider	-	-	-
Shag	-	-	-

433. In order to obtain cumulative annual mortality estimates, breeding and non-breeding season populations must be considered, and the spatial extent of these populations are used to inform which developments are screened into each cumulative assessment.

434. As advised by NatureScot (4th June 2024), to estimate breeding season impacts, developments incorporated into the cumulative assessment are those within species-specific foraging ranges (+1SD) from the OAA and the offshore ECC + 2 km buffers for screened in species.

435. During the species-specific periods within the non-breeding season, the developments included in the cumulative assessment are those within the UK North Sea (and Channel where appropriate for the species being assessed) (eastern region BDMPS), from Furness (2015). The exceptions to this are (i) guillemot, where, similar to the Project alone, the non-breeding season population is considered to be the same as the breeding season population; and (ii) kittiwake, where to date, for EIA, Natural England has not requested an assessment of displacement impacts on kittiwake due to English offshore wind farm developments, and because of this, it was agreed with NatureScot (meeting, 4th June 2024) that for non-breeding season impacts, all English developments can be excluded from the cumulative assessment (all relevant Scottish developments are however included).

436. The predicted collision mortalities, and abundances used for displacement mortality calculations, were extracted from the relevant documents from other developments to give an overall estimated cumulative value. These values are presented in **Appendix 6 - HRA: Calculation of mortalities and change in survival rate at SPA population scales for Project alone and in-combination impacts** and are not reproduced in the assessment below for brevity.

437. The total annual cumulative impact is calculated as follows:

- Determining which developments are within species-specific foraging range of the OAA and offshore ECC (and 2 km buffer), and therefore within a potential zone of influence of the regional population;
- For the breeding season, assuming all predicted mortality associated with these screened-in developments within foraging range is on the regional population;
- For non-breeding seasons, all developments within the eastern region BDMPs are included. The proportion of estimated mortality attributable to the regional population for each development is then calculated using the ratio of birds from the regional population compared to the appropriate BDMPS non-breeding season(s) population (see **Table 6-9**).

438. The sum of the estimated breeding season and non-breeding season(s) mortality from all developments is then determined to give the overall annual mortality on the regional population.

439. NatureScot also advised that consideration should be given to total cumulative mortality values with and without those associated with Berwick Bank Offshore Wind Farm (3rd June 2024). Thus, a range of mortality estimates are provided where applicable.

440. As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

8.2 Kittiwake

8.2.1 Sensitivity

441. Kittiwake is assessed as having a **medium** level of sensitivity to displacement and collision risks.

442. The recommended breeding season foraging range distance for kittiwake is 300.6 km (**Table 6-7**). Within this distance from the Project, there are nine other developments in Scottish Waters that may contribute to breeding season displacement (and collision) mortality within the regional population: PFOWF, BOWL, Moray East, Moray West, EOWDC, Hywind Scotland, Kincardine, Greenvolt and Salamander.

8.2.2 Displacement impact

443. To determine total cumulative annual displacement mortality, the displacement matrix approach was used on cumulative breeding season abundance values for the Project and the nine developments within foraging range; and for all Scottish developments within the eastern region BDMPS in the non-breeding (autumn and spring) seasons. For the non-breeding total, the relevant ratios of birds from the regional population compared to the BDMPS non-breeding populations (0.66 in spring and 0.50 in autumn) were applied to determine the total non-breeding season displacement mortality associated with the regional population.

444. The total annual cumulative displacement mortality within the regional population was estimated to be 122 ('low' displacement scenario) to 367 ('high' displacement scenario) individuals. When excluding Berwick Bank, this reduces to 95 (low) to 285 (high).

445. The predicted displacement mortality would result in an addition to the mortality of the regional population by 0.029% (low scenario) to 0.089% (high scenario) (**Table 8-3**). When Berwick Bank is excluded, the values are 0.023% to 0.069%. These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling is required (see section 8.2.4).

8.2.3 Collision impact

446. To determine total cumulative annual collision mortality, the total cumulative breeding season mortality for the Project and the nine developments within foraging range was added to the appropriate proportions of total non-breeding season collision mortality associated with all Scottish and English developments within the eastern region BDMPS. In the case of kittiwake, 0.66 of all cumulative collision mortality in spring and 0.50 in autumn was attributable to the regional population.

447. The total annual cumulative collision mortality was estimated to be 1,271 individuals, reducing to 1,196 individuals when excluding Berwick Bank.

448. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.307%, or 0.289% when excluding Berwick Bank (**Table 8-3**). These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so population modelling is required (see section 8.2.4).

8.2.4 Combined displacement and collision impact

449. A range of cumulative annual displacement + collision mortality within the regional population was predicted, totalling 1,393 individuals under the 'low' displacement and WCS CRM scenario, and 1,638 individuals under the 'high' displacement and WCS CRM scenario (**Table 8-3**). When Berwick Bank is excluded, the total mortality reduces to 1,214 individuals and 1,371 individuals under these two scenarios, respectively.

450. The predicted combined displacement and collision mortality would result in an addition to the mortality of the regional population by 0.336% to 0.395% (0.293% to 0.331% when excluding Berwick Bank, **Table 8-7**).

451. With an additional cumulative mortality of 1,393 individuals (low) to 1,638 individuals (high) the PVA model predicts over 35 years a reduction in population growth rate by 0.40 to 0.47% (C-PGR = 0.9960 to 0.9953) and a reduction in population size by 13.4% to 15.5% (C-PS = 0.8663 to 0.8446) (**Table 8-4**).

452. When Berwick Bank is excluded from the combined displacement and collision mortality estimates, the reduction in growth rate is 0.35 to 0.39% (C-PGR = 0.9965 to 0.9961) and the reduction in population size is 11.7% to 13.1% (C-PS = 0.8826 to 0.8685).

453. Based on C-PGR predictions, this decrease in growth rate due to cumulative displacement and collision mortality is considered to be of **negligible** magnitude.

8.2.5 Significance

454. Taking the medium sensitivity of kittiwake to displacement and collision risks, and the negligible magnitude of impact, the overall cumulative effects on kittiwake are considered to be **negligible** and not significant in EIA terms.

Table 8-3 Cumulative impact on kittiwake survival resulting from displacement and collision mortality.

Scenario[1]	Estimated annual mortality within regional population (all indivs.) [2]	Regional population (all individuals)[3]	Additional impact on survival[4]	PVA required (Y/N)[5]
Displacement – Low	122	414,355	0.029%	Y
Displacement – Low excluding Berwick Bank	95		0.023%	Y
Displacement – High	367		0.089%	Y
Displacement – High excluding Berwick Bank	285		0.069%	Y
Worst Case Scenario Collision Risk Modelling	1,271		0.307%	Y
Worst Case Scenario Collision Risk Modelling excluding Berwick Bank	1,196		0.289%	Y
Low Displacement + WCS CRM	1,393		0.336%	Y
Low Displacement + WCS CRM exc. Berwick Bank	1,214		0.293%	Y
High Displacement + WCS CRM	1,638		0.395%	Y
High Displacement + WCS CRM exc. Berwick Bank	1,371		0.331%	Y

1 WCS = worst-case collision risk model scenario.
2 Mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
3 Regional reference populations are summarised in **Table 6-9.**
4 Additional impact on survival is calculated as [*annual mortality / regional population*] * *100*.
5 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-4 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on kittiwake (displacement + collision mortality).

					Counterfactual of Growth Rate			Counterfactual of Population Size			Quantiles		
Scenario	Period (years)	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%l	l=50%% U
Disp low + CRM WCS ex BB	25	0.9965	0.9965	0.0002	0.9962	0.9969	0.9137	0.9136	0.0039	0.9059	0.9216	39.5	60.1
Disp high + CRM WCS ex BB	25	0.9961	0.9961	0.0002	0.9958	0.9964	0.9033	0.9031	0.0042	0.8948	0.9112	38.7	61.1
Disp low + CRM WCS inc BB	25	0.9960	0.9960	0.0002	0.9957	0.9963	0.9015	0.9014	0.0040	0.8938	0.9087	38.5	61.3
Disp high + CRM WCS inc BB	25	0.9953	0.9953	0.0002	0.9950	0.9956	0.8853	0.8851	0.0039	0.8771	0.8926	36.6	62.8
Disp low + CRM WCS ex BB	35	0.9965	0.9965	0.0001	0.9962	0.9968	0.8826	0.8824	0.0045	0.8732	0.8907	39.2	60.5
Disp high + CRM WCS ex BB	35	0.9961	0.9961	0.0001	0.9958	0.9964	0.8685	0.8683	0.0047	0.8586	0.8775	37.7	61.7
Disp low + CRM WCS inc BB	35	0.9960	0.9960	0.0001	0.9957	0.9963	0.8663	0.8663	0.0045	0.8574	0.8752	37.6	62.1
Disp high + CRM WCS inc BB	35	0.9953	0.9953	0.0001	0.9950	0.9956	0.8448	0.8446	0.0046	0.8357	0.8531	36.0	63.7
Disp low + CRM WCS ex BB	50	0.9975	0.9975	0.0001	0.9973	0.9978	0.8825	0.8823	0.0056	0.8710	0.8933	40.4	59.1
Disp high + CRM WCS ex BB	50	0.9972	0.9972	0.0001	0.9970	0.9975	0.8684	0.8684	0.0055	0.8582	0.8794	38.9	60.2
Disp low + CRM WCS inc BB	50	0.9972	0.9972	0.0001	0.9969	0.9974	0.8665	0.8663	0.0054	0.8550	0.8767	38.7	60.4
Disp high + CRM WCS inc BB	50	0.9967	0.9967	0.0001	0.9964	0.9969	0.8447	0.8446	0.0056	0.8338	0.8555	36.6	63.0

BB = Berwick Bank Offshore Wind Farm. WCS = worst-case collision risk scenario. Disp = displacement scenario (either Low or High). CRM = collision risk modelling.

8.3 Great Black-backed Gull

8.3.1 Displacement impact

455. This species was not taken forward for an assessment of displacement impacts for the Project alone, and so no cumulative assessment has been undertaken for this impact pathway.

8.3.2 Collision impact

8.3.2.1 Sensitivity

456. Great black-backed gull is assessed as having a **high** level of sensitivity to collisions.

8.3.2.2 Impact

457. The recommended breeding season foraging range distance for great black-backed gull is 73 km (**Table 6-7**). Within this distance from the Project, there is only one other development: PFOWF (where zero collisions were predicted for this species).

458. The estimation of annual collision mortality attributable to the regional population was conducted in a similar manner as described for kittiwake in section 8.2.3.

459. During the non-breeding season, the total cumulative collision mortality within the regional population due to all developments (including the Project) was estimated to be 30.5 individuals. Including the 0.8 individuals attributable to the Project in the breeding season, the total annual cumulative collision rate within the regional population is 31.3 individuals. Berwick Bank predicted zero great black-backed gull collisions.

460. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.920% (**Table 8-5**). This change is above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so PVA modelling was conducted.

461. With an additional mortality of 31.3 individuals the model predicts over 35 years a reduction in growth rate by 0.99% (C-PGR = 0.9901) and a reduction in population size by 30.2% (C-PS = 0.6980) (**Table 8-6**).

462. Based on C-PGR predictions, this decrease in growth rate due to cumulative collision mortality is considered to be of **low** magnitude.

8.3.2.3 Significance

463. Taking the high sensitivity of great black-backed gulls and the low magnitude of cumulative impact, the overall cumulative effect on great black-backed gull is considered to be **minor adverse** and not significant in EIA terms.

Table 8-5 Cumulative impact on great black-backed gull survival resulting from collision mortality.

Scenario[1]	Estimated annual collision mortality within regional population (all indivs.)[2]	Regional population (all individuals)[3]	Additional impact on survival[4]	PVA required (Y/N)[5]
WCS Collision Risk Modelling	31.3	3,402	0.920%	Y

1 WCS = worst-case collision risk model scenario.
2 Mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
3 Regional reference populations are summarised in **Table 6-9.**
4 Additional impact on survival is calculated as [*annual mortality / regional population*] * *100*.
5 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-6 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on great black-backed gull (collision mortality).

		Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Period (years)	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
WCS CRM	25	0.9901	0.9901	0.0006	0.9889	0.9913	0.7715	0.7714	0.0129	0.7466	0.7978	25.8	73.9
WCS CRM	35	0.9901	0.9901	0.0004	0.9892	0.9909	0.6980	0.6980	0.0119	0.6748	0.7214	22.2	77.5
WCS CRM	50	0.9930	0.9930	0.0003	0.9924	0.9936	0.6981	0.6980	0.0119	0.6749	0.7214	26.3	72.4

8.4 Guillemot

8.4.1 Sensitivity

464. Guillemot is assessed as having a **medium** level of sensitivity to displacement.

8.4.2 Collision impact

465. This species was not taken forward for an assessment of collision impacts for the Project alone, and so no cumulative assessment has been undertaken for this impact pathway.

8.4.3 Displacement impact

466. The recommended breeding season foraging range distance for guillemot is 153.7 km (**Table 6-7**). NatureScot advise to also apply this distance for screening in developments within a zone of influence during the non-breeding season, rather than the east region BDMPS approach used for other species, as guillemots tend to remain close to their breeding colonies during the non-breeding season. Within this distance from the Project, there are four other developments that may contribute to the regional population annual displacement mortality: PFOWF, BOWL, Moray East and Moray West. Berwick Bank was not included in the cumulative assessment because it is beyond the foraging range of guillemots.

467. The total annual cumulative displacement mortality was estimated to be 1,305 (low) to 2,547 (high) individuals.

468. The predicted displacement mortality would result in an addition to the mortality of the regional population by 0.133% to 0.260% (**Table 8-7**). These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling is required.

469. With an additional mortality range of 1,305 to 2,547 individuals the model predicted over 35 years a reduction in population growth rate by 0.15% to 0.29% (C-PGR = 0.9985 to 0.9971) and a reduction in population size by 5.1% to 9.9% (C-PS = 0.9481 to 0.9012) (**Table 8-8**).

470. Based on C-PGR predictions, this decrease in growth rate due to cumulative displacement mortality is considered to be of **negligible** magnitude.

8.4.3.1 Significance

471. Taking the medium sensitivity of guillemot and the negligible magnitude of cumulative impact, the overall cumulative effect on guillemot is considered to be **negligible** and not significant in EIA terms.

Table 8-7 Cumulative impact on guillemot survival resulting from displacement mortality.

Displacement Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Regional population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Annual Low	1,305	980,165	0.133%	Y
Annual High	2,547		0.260%	Y

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional reference populations are summarised in **Table 6-9**.
3 Additional impact on survival is calculated as [*displacement mortality / regional population*] * *100*.
4 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-8 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on guillemot (displacement mortality).

			Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Period (years)	Mortality	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%% U
Disp low	25	1,305	0.9985	0.9985	0.0001	0.9984	0.9986	0.9623	0.9623	0.0016	0.9592	0.9652	41.9	58.9
Disp high	25	2,547	0.9971	0.9971	0.0001	0.9970	0.9972	0.9278	0.9278	0.0016	0.9246	0.9310	33.8	66.8
Disp low	35	1,305	0.9985	0.9985	0.0001	0.9984	0.9986	0.9481	0.9481	0.0018	0.9446	0.9515	39.3	60.1
Disp high	35	2,547	0.9971	0.9971	0.0001	0.9970	0.9972	0.9012	0.9012	0.0017	0.8977	0.9046	28.9	69.5
Disp low	50	1,305	0.9990	0.9990	0.0000	0.9989	0.9990	0.9479	0.9479	0.0020	0.9440	0.9517	41.0	58.4
Disp high	50	2,547	0.9980	0.9980	0.0000	0.9979	0.9980	0.9007	0.9007	0.0020	0.8969	0.9045	32.3	66.0

Disp = displacement scenario (either Low or High).

8.5 Razorbill

8.5.1 Sensitivity

472. Razorbill is assessed as having a **medium** level of sensitivity to displacement.

8.5.2 Collision impact

473. This species was not taken forward for an assessment of collision impacts for the Project alone, and so no cumulative assessment has been undertaken.

8.5.3 Displacement impact

474. The recommended breeding season foraging range distance for razorbill is 164 km (**Table 6-7**). Within this distance from the Project, there are four other developments that may contribute to the regional population annual displacement mortality: PFOWF, BOWL, Moray East and Moray West.

475. To determine total cumulative annual displacement mortality, the displacement matrix approach was used on cumulative breeding season abundance values for the Project and the four developments within foraging range; and for all eastern region BDMPS developments in the non-breeding (autumn, winter and spring) seasons. For the non-breeding total, the relevant ratios of birds from the regional population compared to the BDMPS non-breeding populations (0.64 in winter and 0.24 in spring and autumn) were applied to determine the non-breeding season displacement mortality associated with the regional population.

476. The total annual cumulative displacement mortality within the regional population was estimated to be 358 (low) to 920 (high) individuals. When excluding Berwick Bank in these estimates, the mortality reduced to 329 (low) to 844 (high) individuals.

477. The predicted displacement mortality would result in an addition to the mortality of the regional population by 0.254% to 0.654% (**Table 8-9**). If Berwick Bank is excluded the range is 0.234% to 0.600%. These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling is required.

478. With an additional mortality range of 358 to 920 individuals the model predicted over 35 years a reduction in population growth rate by 0.30% to 0.77% (C-PGR = 0.9970 to 0.9923) and a reduction in population size by 10.1% to 24.2% (C-PS = 0.8982 to 0.7583) (**Table 8-10**). When excluding Berwick Bank, the values are 0.27% to 0.70% (C-PGR = 0.9973 to 0.9930) and 9.4% to 22.4% (C-PS = 0.9061 to 0.7756).

479. Based on C-PGR predictions, this decrease in growth rate due to cumulative displacement mortality is considered to be of **negligible** magnitude.

8.5.4 Significance

480. Taking the medium sensitivity of razorbill and the negligible magnitude of cumulative impact, the overall cumulative effect on razorbill is considered to be **negligible** and not significant in EIA terms.

Table 8-9 Cumulative impact on razorbill survival resulting from displacement mortality.

Displacement Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Regional population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Displacement – Low	358	140,698	0.254%	Y
Displacement – Low excluding Berwick Bank	329		0.234%	Y
Displacement – High	920		0.654%	Y
Displacement – High excluding Berwick Bank	844		0.600%	Y

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional populations are summarised in **Table 6-9**.
3 Additional impact on survival is calculated as *[displacement mortality / regional population] * 100*.
4 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-10 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on razorbill (displacement mortality).

			Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Period (years)	Mortality	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
Disp low ex BB	25	329	0.9973	0.9973	0.0003	0.9966	0.9979	0.9315	0.9313	0.0084	0.9147	0.9479	40.8	58.1
Disp high ex BB	25	844	0.9930	0.9930	0.0004	0.9922	0.9937	0.8329	0.8326	0.0080	0.8158	0.8477	28.2	71.8
Disp low inc BB	25	358	0.9970	0.9970	0.0003	0.9963	0.9976	0.9254	0.9252	0.0083	0.9085	0.9413	40.1	58.1
Disp high inc BB	25	920	0.9924	0.9923	0.0004	0.9916	0.9931	0.8193	0.8190	0.0079	0.8026	0.8343	26.6	74.1
Disp low ex BB	35	329	0.9973	0.9973	0.0003	0.9966	0.9979	0.9063	0.9061	0.0106	0.8856	0.9265	38.3	59.5
Disp high ex BB	35	844	0.9930	0.9930	0.0003	0.9922	0.9936	0.7762	0.7756	0.0095	0.7553	0.7945	24.6	73.9
Disp low inc BB	35	358	0.9970	0.9970	0.0003	0.9964	0.9976	0.8984	0.8982	0.0101	0.8784	0.9169	37.7	60.3
Disp high inc BB	35	920	0.9924	0.9923	0.0003	0.9917	0.9930	0.7587	0.7583	0.0093	0.7394	0.7760	22.8	75.7
Disp low ex BB	50	329	0.9981	0.9981	0.0003	0.9974	0.9987	0.9056	0.9055	0.0145	0.8758	0.9341	39.3	58.7
Disp high ex BB	50	844	0.9950	0.9950	0.0003	0.9943	0.9956	0.7753	0.7751	0.0131	0.7475	0.7997	26.8	71.5
Disp low inc BB	50	358	0.9979	0.9979	0.0003	0.9972	0.9985	0.8981	0.8974	0.0147	0.8658	0.9260	38.3	58.9
Disp high inc BB	50	920	0.9946	0.9946	0.0003	0.9939	0.9952	0.7581	0.7579	0.0129	0.7327	0.7828	25.6	73.9

8.6 Puffin

8.6.1 Sensitivity

481. Puffin is assessed as having a **medium** level of sensitivity to displacement.

8.6.2 Collision impact

482. This species was not taken forward for an assessment of collision impacts for the Project alone, and so no cumulative assessment has been undertaken for this impact pathway.

8.6.3 Displacement impact

483. The recommended breeding season foraging range distance for puffin is 265.4 km (**Table 6-7**). Within this distance from the Project, there are nine other developments that may contribute to the regional population displacement mortality during the breeding season: PFOWF, BOWL, Moray East, Moray West, EOWDC, Hywind Scotland, Kincardine, Greenvolt and Salamander.

484. To determine total cumulative annual displacement mortality within the regional population, the displacement matrix approach was used on cumulative breeding season abundance values for the Project and the nine developments within foraging range; and for all eastern region BDMPS developments in the non-breeding season. For the non-breeding total, it was assumed that all mortality associated with developments was attributable to the regional population.

485. The total annual cumulative displacement mortality within the regional population was estimated to be 461 (low) to 1,046 (high) individuals. When excluding Berwick Bank in these estimates, the mortality reduced to 408 (low) to 886 (high) individuals.

486. The predicted displacement mortality would result in an addition to the mortality of the regional population by 0.040% to 0.091% on the population (**Table 8-11**). If Berwick Bank is excluded the range is 0.036% to 0.077%. These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling is required.

487. With an additional mortality range of 461 to 1,046 individuals the model predicts over 35 years a reduction in growth rate by 0.05% to 0.11% (C-PGR = 0.9995 to 0.9989) and a reduction in population size by 1.7% to 3.7% (C-PS = 0.9831 to 0.9625) (**Table 8-12**). When excluding Berwick Bank, the values are 0.04% to 0.09% (C-PGR = 0.9996 to 0.9991) and 1.5% to 3.2% (C-PS = 0.9851 to 0.9678).

488. Based on C-PGR predictions, this decrease in growth rate due to cumulative displacement mortality is considered to be of **negligible** magnitude.

8.6.4 Significance

489. Taking the medium sensitivity of puffin and the low magnitude of cumulative impact, the overall cumulative effect on puffin is considered to be **negligible** and not significant in EIA terms.

Table 8-11 Cumulative impact on puffin survival resulting from displacement mortality.

Displacement Scenario	Estimated annual displacement mortality within regional population (all indivs.) [1]	Regional population (all individuals)[2]	Additional impact on survival[3]	PVA required (Y/N)[4]
Displacement – Low	461	1,145,207	0.040%	Y
Displacement – Low excluding Berwick Bank	408		0.036%	Y
Displacement – High	1,046		0.091%	Y
Displacement – High excluding Berwick Bank	886		0.077%	Y

1 Displacement mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
2 Regional populations are summarised in **Table 6-9**.
3 Additional impact on survival is calculated as *[displacement mortality / regional population] * 100*.
4 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-12 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on puffin (displacement mortality).

			Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
Scenario	Period (years)	Mortality	Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
Disp low ex BB	25	408	0.9996	0.9996	0.0001	0.9993	0.9998	0.9893	0.9893	0.0033	0.9825	0.9958	48.7	51.0
Disp high ex BB	25	886	0.9991	0.9991	0.0001	0.9988	0.9993	0.9767	0.9768	0.0033	0.9704	0.9829	47.3	51.8
Disp low inc BB	25	461	0.9995	0.9995	0.0001	0.9993	0.9998	0.9879	0.9878	0.0033	0.9811	0.9941	48.8	51.3
Disp high inc BB	25	1,046	0.9989	0.9989	0.0001	0.9987	0.9992	0.9728	0.9727	0.0033	0.9660	0.9788	47.2	52.2
Disp low ex BB	35	408	0.9996	0.9996	0.0001	0.9993	0.9998	0.9852	0.9851	0.0045	0.9765	0.9942	48.5	51.2
Disp high ex BB	35	886	0.9991	0.9991	0.0001	0.9988	0.9993	0.9679	0.9678	0.0043	0.9593	0.9764	47.0	52.3
Disp low inc BB	35	461	0.9995	0.9995	0.0001	0.9993	0.9998	0.9832	0.9831	0.0043	0.9744	0.9910	48.5	51.3
Disp high inc BB	35	1,046	0.9989	0.9989	0.0001	0.9987	0.9992	0.9627	0.9625	0.0044	0.9534	0.9714	46.2	52.7
Disp low ex BB	50	408	0.9997	0.9997	0.0001	0.9994	1.0000	0.9848	0.9850	0.0065	0.9717	0.9983	49.4	51.0
Disp high ex BB	50	886	0.9994	0.9994	0.0001	0.9991	0.9996	0.9679	0.9676	0.0062	0.9547	0.9790	47.8	52.4
Disp low inc BB	50	461	0.9997	0.9997	0.0001	0.9994	0.9999	0.9831	0.9828	0.0065	0.9693	0.9950	49.1	51.0
Disp high inc BB	50	1,046	0.9993	0.9992	0.0001	0.9990	0.9995	0.9625	0.9621	0.0064	0.9480	0.9739	47.3	52.6

8.7 Gannet

8.7.1 Sensitivity

490. Gannet is assessed as having a **medium** level of sensitivity to displacement and collision risks.

8.7.2 Displacement impact

491. The recommended breeding season foraging range distance for gannet is 509 km (**Table 6-7**). Within this distance from the Project, there are 16 other developments within the eastern region BDMPS which may contribute to the breeding season displacement (and collision) mortality within the regional population.

492. To determine total cumulative annual displacement mortality within the regional population, the matrix approach was used on cumulative breeding season abundance values for the Project and the 16 developments within foraging range; and for all eastern region BDMPS developments in the non-breeding (autumn and spring) seasons. For the non-breeding total, it was assumed that all mortality associated with developments was attributable to the breeding season population.

493. The total annual cumulative displacement mortality was estimated to be 341 (low) to 1,022 (high) individuals. When excluding Berwick Bank, this reduces to 295 (low) to 885 (high).

494. The predicted displacement mortality would result in an addition to the mortality of the regional population by 0.220% to 0.294% (**Table 8-13**). When Berwick Bank is excluded, the values are 0.195 to 0.258%. These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so PVA modelling is required (see section 8.7.4).

8.7.3 Collision impact

495. To determine total cumulative annual collision mortality within the regional population, the total cumulative breeding season mortality for the Project and the 16 developments within foraging range was added to the total non-breeding season collision mortality associated with all Scottish and English developments within the eastern region BDMPS.

496. The total annual cumulative collision mortality was estimated to be 1,700 individuals, reducing to 1,509 individuals when excluding Berwick Bank.

497. The predicted collision mortality would result in an addition to the mortality of the regional population by 0.183%, or 0.163% when excluding Berwick Bank (**Table 8-14**). These changes are above the 0.02% threshold for a PVA advised by NatureScot during consultation, and so modelling is required (see section 8.7.4).

8.7.4 Combined displacement and collision impact

498. A range of cumulative annual displacement + collision mortality within the regional population was predicted, totalling 2,041 individuals under the 'low' displacement and WCS CRM scenario, and 2,722 individuals under the 'high' displacement and WCS CRM scenario (**Table 8-13**). When Berwick Bank is excluded, the total mortality reduces to 1,804 individuals and 2,394 individuals under these two scenarios respectively.

499. The predicted combined displacement and collision mortality would result in an addition to the mortality of the regional population by 0.220% to 0.294% (0.195% to 0.258% when excluding Berwick Bank, **Table 8-13**).

500. With an additional cumulative mortality of 2,041 individuals (low) to 2,722 individuals (high) the model predicts over 35 years a reduction in growth rate by 0.26% to 0.34% (C-PGR = 0.9974 to 0.9966) and a reduction in population size by 8.9% to 11.7% (C-PS = 0.9110 to 0.8830) (**Table 8-14**).

501. When Berwick Bank is excluded from the combined displacement and collision mortality estimates, the reduction in growth rate is 0.23 to 0.30% (C-PGR = 0.9977 to 0.9970) and the reduction in population size is 7.9% to 10.4% (C-PS = 0.9210 to 0.8963).

502. Based on C-PGR predictions, this decrease in growth rate due to cumulative displacement and collision mortality is considered to be of **negligible** magnitude.

8.7.5 Significance

503. Taking the medium sensitivity of gannet to displacement and collision risks, and the medium magnitude of impact, the overall cumulative effects on gannet are considered to be **negligible** and not significant in EIA terms.

Table 8-13 Cumulative impact on gannet survival resulting from displacement and collision mortality.

Scenario[1]	Estimated annual displacement mortality within regional population (all indivs.) [2]	Regional population (all individuals)[3]	Additional impact on survival[4]	PVA required (Y/N)[5]
Displacement – Low	341	926,447	0.037%	Y
Displacement – Low excluding Berwick Bank	295		0.032%	Y
Displacement – High	1,022		0.110%	Y
Displacement – High excluding Berwick Bank	885		0.096%	Y
Worst Case Scenario Collision Risk Modelling	1,700		0.183%	Y
Worst Case Scenario Collision Risk Modelling excluding Berwick Bank	1,509		0.163%	Y
Low Displacement + WCS CRM	2,041		0.220%	Y
Low Displacement + WCS CRM exc. Berwick Bank	1,804		0.195%	Y
High Displacement + WCS CRM	2,722		0.294%	Y
High Displacement + WCS CRM exc. Berwick Bank	2,041		0.258%	Y

1 WCS = worst-case collision risk model scenario.
2 Mortality for all birds within regional population, including birds of all ages as well as sabbatical birds.
3 Regional populations are summarised in **Table 6-9**.
4 Additional impact on survival is calculated as [*annual mortality / regional population*] * *100*.
5 As agreed with NatureScot, a PVA is presented if the impact on survival is >0.02%. For inclusion in cumulative assessments, the total annual mortality attributable to the Project alone must also be >0.2 individuals per annum.

Table 8-14 Projected PVA metrics after 25, 35 and 50 years for cumulative impacts on gannet (displacement + collision mortality).

Scenario	Period (years)	Mortality	Counterfactual of Growth Rate					Counterfactual of Population Size					Quantiles	
			Median	Mean	SD	L CI	U Ci	Median	Mean	SD	L CI	U CI	U=50%I	I=50%%U
Disp low + CRM WCS ex BB	25	1,804	0.9977	0.9977	0.0001	0.9976	0.9979	0.9425	0.9424	0.0021	0.9382	0.9465	37.3	63.4
Disp high + CRM WCS ex BB	25	2,394	0.9970	0.9970	0.0001	0.9968	0.9971	0.9243	0.9242	0.0020	0.9203	0.9283	32.0	66.8
Disp low + CRM WCS inc BB	25	2,041	0.9974	0.9974	0.0001	0.9973	0.9976	0.9350	0.9351	0.0020	0.9311	0.9391	35.5	64.7
Disp high + CRM WCS inc BB	25	2,722	0.9966	0.9966	0.0001	0.9964	0.9967	0.9144	0.9143	0.0021	0.9100	0.9184	30.7	70.2
Disp low + CRM WCS ex BB	35	1,804	0.9977	0.9977	0.0001	0.9976	0.9979	0.9210	0.9210	0.0023	0.9162	0.9255	33.1	63.4
Disp high + CRM WCS ex BB	35	2,394	0.9970	0.9970	0.0001	0.9968	0.9971	0.8962	0.8963	0.0023	0.8919	0.9010	30.1	69.0
Disp low + CRM WCS inc BB	35	2,041	0.9974	0.9974	0.0001	0.9973	0.9975	0.9110	0.9110	0.0023	0.9065	0.9153	31.8	65.8
Disp high + CRM WCS inc BB	35	2,722	0.9966	0.9966	0.0001	0.9964	0.9967	0.8831	0.8830	0.0024	0.8780	0.8875	27.0	70.8
Disp low + CRM WCS ex BB	50	1,804	0.9984	0.9984	0.0001	0.9983	0.9985	0.9205	0.9204	0.0027	0.9153	0.9256	36.6	63.5
Disp high + CRM WCS ex BB	50	2,394	0.9978	0.9978	0.0001	0.9977	0.9980	0.8956	0.8956	0.0027	0.8900	0.9008	33.2	67.5
Disp low + CRM WCS inc BB	50	2,041	0.9982	0.9982	0.0001	0.9980	0.9983	0.9104	0.9103	0.0027	0.9051	0.9152	35.8	65.4
Disp high + CRM WCS inc BB	50	2,722	0.9975	0.9975	0.0001	0.9974	0.9977	0.8823	0.8822	0.0028	0.8766	0.8873	31.2	69.4

BB = Berwick Bank Offshore Wind Farm. WCS = worst-case collision risk scenario. Disp = displacement scenario (either Low or High). CRM = collision risk modelling.

8.8 Cumulative effects due to vessel movements from ports

Construction

504. Some of the ports considered for Project use are already used for large scale OWF projects, and port of Cromarty Firth has been used as an anchorage for vessels of substantial size (drilling rigs etc) over a long-term period. The Ports of Leith and Dundee have been used for construction by Neart na Gaoithe and are very likely to be used by other ScotWind and InTOG OWFs which are currently in the planning process. Other OWFs which are currently in the planning process may use ports in the Moray Firth or Cromarty Firth for construction.

505. Thus, because the ports are currently being used for OWF construction, and have restricted capacities, usage for future OWFs needs to be staggered across a relatively long timeframe, rather than volumes of vessel movements increasing with more OWFs. This means that current vessel movements are likely to be reasonably reflective of a worst-case scenario and that there would be no significant change in marine traffic volumes at these ports for new OWFs (including the Project) compared to current volumes. It is acknowledged that there would be an increase in overall duration of vessel movements as more OWF projects are added to the list of those using particular ports, but because movements are likely to occur along familiar shipping lanes, no increased numbers of birds would be impacted, and indeed for most species, increased tolerance may occur over time.

506. Overall, although the duration of impacts may be extended, there are not considered to be any increases in impact magnitude on offshore ornithological features due to cumulative vessel movements during construction, above those predicted for the Project alone (i.e., no more than **minor adverse,** and **not significant** for any IOF).

Operation & Maintenance

507. The worst-case scenario for the Project alone was the assumption that during operation, all vessels would use Scrabster Harbour for activities including inspection, maintenance and repair of WTGs, cables and substructure. The routes to the OAA would likely pass through the marine extension of the North Caithness Cliffs SPA (see **Figure 7-6**), and it is possible that vessels associated with the Project during operation may cause disturbance to breeding seabird populations there.

508. The operation and maintenance base for PFOWF would be at Scrabster Harbour[23], but it is not currently known whether any other OWF would use Scrabster Harbour as a base during operation and maintenance.

509. The operation and maintenance vessel movements associated with the Project and PFOWF could therefore increase the frequency of traffic over the long-term and it is possible that more temporary disturbance events would occur during the breeding season. However, as noted for the Project alone, because vessels will follow existing well established vessel transit routes from the harbour for navigational safety reasons, seabirds using the marine area in the vicinity of Scrabster Harbour transit routes will already be habituated to the

[23] https://pentlandfloatingwind.com/onshore/news-item/?id=834

presence of vessels and so are unlikely to be significantly disturbed by additional vessels using the same routes.

510. Because only a small fraction of birds breeding on the nearby cliffs would be using the adjacent marine area at any one time, and only a fraction of those would be subject to disturbance due to a vessel, cumulative impacts are likely to be of negligible magnitude. As the species most likely to be subject to disturbance events are of medium sensitivity (guillemot, razorbill and puffin), the cumulative effects on regional populations are considered to be **negligible** and not significant.

8.9 Cumulative decommissioning effects

511. As there is limited information on the decommissioning of the offshore Project and around the lifecycle of other developments, it is not possible to provide a meaningful cumulative assessment. However, the decommissioning effects are expected to be less than or equal to those predicted for the construction stage. As such, based on the cumulative assessment of construction impacts (relating to vessel movements) cumulative decommissioning impacts are not expected to result in an increased impact magnitude compared to the Project only decommissioning effects (negligible significance, see **section 7.8**).

512. A Decommissioning Programme will be developed pre-construction to address the principal decommissioning measures for the offshore Project and will be written in accordance with applicable guidance. The Decommissioning Programme will detail the environmental management, and schedule for decommissioning and will be reviewed and updated throughout the lifetime of the offshore Project to account for changing best practices.

8.10 Summary of cumulative effects

513. A summary of the outcomes of the assessment of cumulative effects for the construction, operation and maintenance and decommissioning stages of the offshore Project is provided in **Table 8-15**.

Table 8-15 Summary of assessment of cumulative effects.

Potential impact	Feature	Sensitivity	Magnitude of impact	Consequence (significance of effect)	Secondary mitigation requirements	Residual consequence (significance of effect)
Construction						
Vessel movements to and from port	Great northern diver	High	Low	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
	All IOFs	Medium or High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Operation and maintenance						
Collisions	Great black-backed gull	High	Medium	Minor adverse (not significant)	None required above embedded mitigation measures.	Minor adverse (not significant)
Displacement	Guillemot	Medium	Medium	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Razorbill	Medium	Medium	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Puffin	Medium	Low	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Combined displacement and collision mortality	Kittiwake	Medium	Medium	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
	Gannet	Medium	Medium	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Vessel movements to and from port	All IOFs	Medium or High	Negligible	Negligible (not significant)	None required above embedded mitigation measures.	Negligible (not significant)
Decommissioning						
Cumulative effects are expected to be less than or equal to the construction stage.						

9 INTER-RELATED EFFECTS

514. Inter-related effects are the potential effects of multiple impacts, affecting one feature or a group of features. Inter-related effects include interactions between the impacts of the different stages of the offshore Project (i.e. interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a feature within the same offshore Project stage.

515. Potential impacts on offshore ornithology features would occur during the operation and maintenance stage, when there is potential for direct and indirect displacement as well as collision mortality associated with the Project. Where a particular feature is considered to be sensitive to both impacts, combined displacement and collision mortality has been taken into account under Impact 8 (section 7.7.5). Indirect impacts are considered to be negligible or minor adverse for all features, and unlikely to contribute materially to inter-related effects.

516. There is no potential for the effects during other stages of the offshore Project to interact in a way that would result in combined effects of greater significance than the assessments for each individual stage.

10 WHOLE PROJECT ASSESSMENT

517. The onshore Project is summarised in **Offshore EIA Report, chapter 5: Project description** and a summary of the onshore EIA is provided in **Offshore EIA Report, chapter 21: Onshore EIA summary**. These onshore aspects of the Project have been considered in relation to the impacts assessed for the offshore Project.

518. There is considered to be no overlap between the onshore Project (above landfall) and the impacts on offshore ornithology features assessed in this chapter, and therefore, there is no potential for the onshore Project to exacerbate any of the effects assessed here. Any construction impacts associated with the onshore Project would be short term, temporary and reversible and so the offshore ornithology features assessed in this chapter would not be significantly negatively affected in the long term.

11 ECOSYSTEM EFFECTS

519. Seabirds largely operate at the upper levels of the North Sea food web and are considered top predators along with marine mammals and certain fish species (BEIS, 2022). A holistic approach has been undertaken in the identification of impacts to consider any potential impacts that may occur at an ecosystem scale and particularly across trophic levels (e.g. impacts on prey species affecting their availability for predators). Changes in the availability or distribution of seabirds could have cascading effect on other species within the ecosystem and may indirectly affect prey species that they feed on (fish species) as well as other predators through any subsequent changes in prey availability. Ecosystem effects are also assessed within **chapter 10: Benthic subtidal and intertidal ecology**, **chapter 11: Fish and shellfish ecology** and **chapter 12: Marine mammals and megafauna of the Offshore EIA Report**.

520. Key drivers of seabird population size in western Europe are climate change (Sandvik *et al.*, 2012; Frederiksen *et al.*, 2004, 2013; Burthe *et al.*, 2014; Macdonald *et al.*, 2015; Furness 2016;

JNCC 2016; Pearce-Higgins 2021), and fisheries (Tasker *et al*., 2000; Frederiksen *et al*., 2004; Ratcliffe 2004; Carroll *et al*., 2017; Sydeman *et al*., 2017). In relation to seabirds, a key impact of climate change and fisheries is largely on prey species abundance and distribution, which subsequently affects seabird numbers. Lindegren et al. (2018) concluded that sandeel stocks in the North Sea, the most important prey fish stock for North Sea seabirds during the breeding season (Furness and Tasker 2000), were depleted by high levels of fishing effort. In the ICES Sandeel Area (SA) relevant to the offshore Project (SA7), there has been no fishing effort on sandeels since the collapse of the stock in the 1980's and 1990's. Whilst recovery of the stock has been slow, the indication of recovery in seabird breeding success in Scotland may be, at least in part, due to the recovery of sandeel stocks in SA7 (Moffat *et al*., 2020). The UK Government announced the closing of all Scottish waters and the English North Sea to sandeel fishing in January 2024, and this came into force on 26th March 2024.

521. The key trends in seabird numbers are presented in section 6.8.2.

522. A number of offshore ornithology species (kittiwake, Arctic tern, guillemot, razorbill, puffin, fulmar and gannet) are considered to be of medium sensitivity to indirect effects to prey species. Impacts to benthic ecology and fish and shellfish ecology could affect seabird prey species abundance and distribution, and subsequently the foraging ability and success of seabirds. The introduction of infrastructure may result in habitat loss or disturbance for prey species resulting in less prey being available. Infrastructure also may attract prey species (fish aggregation) and changes in commercial fishing pressure may result in changes in prey communities. The benthic subtidal and intertidal ecology assessments and fish and shellfish assessments concluded no significant effect as a result of the offshore Project. Indirect effects to prey species were assessed under Impact 3 and Impact 6, and also concluded no significant effects.

523. In addition, as no significant effects were identified for any impact on offshore ornithology features, there is not considered to be a significant long-term change in the presence, abundance or distribution of seabirds at the offshore Project which could cascade to result in an ecosystem-scale effect.

524. Consideration of ecosystem effects has been considered holistically throughout the ecological chapters of the Offshore EIA Report. Seabird populations are closely linked with availability and quality of prey. As a result of the offshore Project no ecosystem effects are anticipated to occur in relation to offshore ornithology either as direct impacts to seabirds as predators or through indirect effects to their prey species.

12 TRANSBOUNDARY EFFECTS

525. Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

526. With regard to the potential for transboundary cumulative impacts, there is clearly potential for collisions and displacement at offshore wind farms outside UK waters. Due to the location of the Project, connectivity, even hypothetically, is highly unlikely to occur in the breeding season.

527. The spatial scale and hence relevant seabird regional non-breeding population sizes for a transboundary assessment would be much larger than used for the EIA and cumulative assessment here. Thus, the impacts from the Project alone and cumulatively would have a lower impact on survival than assessed here. It is therefore reasonable to conclude that the transboundary effects on a wider population of breeding and non-breeding seabirds would be **negligible** and not significant in EIA terms.

13 SUMMARY OF MITIGATION, ENHANCEMENT AND MONITORING

528. No secondary mitigation, over and above the embedded mitigation measures outlined in section 7.4 is proposed in relation to the potential impacts of the offshore Project alone on offshore ornithological features because no adverse significant effects are predicted.

529. Details of any required monitoring will be informed by the findings of the appropriate assessment undertaken by MD-LOT and be discussed and agreed via a Regional Advisory Group (or equivalent). Monitoring details will be presented within the PEMP that will be subject to approval as part of the discharge of consent conditions.

530. The Project is committed to protecting the environment by ensuring good practice, embedded mitigation and secondary mitigation measures are followed at all times during construction, operation and maintenance and decommissioning. Additionally, the Project is committed to enhancing the environment, where possible. The approach includes, but is not limited to, partnering with key stakeholders, neighbouring developers and the local community to ensure that any proposed enhancements are suited to the environment that they are situated in benefit not only the primary species but the wider ecosystem.

531. Although no significant effects due to disturbance from vessel movements (or any other construction activities) were predicted, the following mitigation measures may be included in the final NSVMP:

- To restrict vessel speeds to 10 knots (kts) in particular areas (e.g., evidence shows that red-throated divers showed greater displacement when vessel speeds were higher);
- To restrict vessel movements to certain routes, that include a buffer zone of at least 1 km (as recommended by Goodship & Furness, 2022) from areas of higher bird density;
- Project vessels will avoid revving engines while within SPA boundaries; and
- The vessel crew will watch for aggregations of seabirds on the water and, if aggregations are seen, will alert the vessel's Master. Where necessary and having regard to maritime safety, the vessel's course and/or speed will be adjusted to avoid aggregations of birds.

532. The Project is proposing a biodiversity enhancement project in relation to European storm-petrels. European storm-petrels are pelagic in nature, and only come onto land during the summer months for breeding. They are currently listed as Amber on the UK Birds of Conservation Concern. To help better understand the breeding of European storm-petrel the Project proposes to install nesting boxes for storm-petrel on Sule Skerry and Sule Skerry Stack within which a camera would be installed. The **Outline Biodiversity Enhancement Plan** provides further information on this proposal.

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ABBREVIATIONS

Acronym	Definition
AOB	Apparently Occupied Burrows
AON	Apparently Occupied Nests
AOS	Apparently Occupied Sites
AOT	Apparently Occupied Territories
AR	Avoidance Rate
BDMPS	Biologically Defined Minimum Population Scales
CEF	Cumulative Effects Framework
CFP	Common Fisheries Policy
CGR	Counterfactual of Growth Rate
CI	Confidence Interval
CIEEM	Chartered Institute of Ecology and Environmental Management
CFP	Common Fisheries Policy
CPS	Counterfactual of Population Size
CRM	Collision Risk Model/Modelling
CV	Coefficient of Variation
DAS	Digital Aerial Surveys
DSLP	Development Specification and Layout Plan
DSM	Density Surface Models
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electro-Magnetic Fields
ESAS	European Seabirds at Sea
HDD	Horizontal Directional Drilling
HiDef	HiDef Aerial Surveying Limited
HVAC	High Voltage Alternating Current
HPAIV	Highly Pathogenic Avian Influenza Virus
HRA	Habitats Regulation Appraisal

Acronym	Definition
ICES	International Council for the Exploration of the Seas
IND	Individuals
IOF	Important Ornithological Features
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LCI	Lower Confidence Interval
LMP	Lighting and Marking Plan
MD-LOT	Marine Directorate – Licensing Operations Team
MHWS	Mean High Water Spring
MLS	Most Likely Scenario
MM	Mean Maximum
MS-LOT	Marine Scotland – Licensing Operations Team
MSL	Mean Sea Level
MSP	Mean Seasonal Peak
NAF	Nocturnal Activity Factor
NMPi	Marine Directorate's National Marine Planning Interactive
NSVMP	Navigational Safety and Vessel Management Plan
OAA	Option Agreement Area
OSPs	Offshore Substation Platforms
OWF	Offshore Wind Farm
OWPL	Offshore Wind Power Limited
PFOWF	Pentland Firth Offshore Wind Farm
PMFs	Priority Marine Features
PVA	Population Viability Analysis
RIAA	Report to Inform an Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SA	Sandeel Area
ScotMER	Scottish Marine Energy Research

Acronym	Definition
sCRM	stochastic Collision Risk Modelling
SD	Standard Deviation
SDM	Species Distribution Model/Surface Density Model
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SOSS	Strategic Ornithological Support Services
SPA	Special Protection Area
THC	The Highland Council
UCI	Upper Confidence Interval
USB	Universal Serial Bus
UXO	Unexploded Ordnance
WCS	Worst-Case Scenario
WeBS	Wetland Bird Survey
WTGs	Wind Turbine Generators

GLOSSARY

Term	Definition
Biologically Defined Minimum Population Scales (BDMPS)	A proportion of a biogeographic population present in a defined area. Nonbreeding BDMPS considered suitable for use in this EIA chapter are proportions of biogeographic populations with connectivity to UK North Sea waters during the nonbreeding season.
Biogeographic population	A group of birds which breed in a particular location (or group of locations), breed freely within the group, and rarely breed or exchange individuals with other groups.
Biogeographic populations with connectivity to UK waters	The sum of bird numbers in the UK population plus each overseas population known to visit UK waters either to winter or during migration to winter quarters elsewhere (including adult and immature birds).
Breeding (full period) season	Period of months when adult birds return to colonies in the 'spring' to the time of departure from colonies at the end of the breeding season. Includes months when some birds are on breeding grounds while other birds of the same species are travelling to or from the colonies on migration.
Breeding (migration-free) season	Core breeding months only; this season does not include months when some birds of the same species may be on migration.
Collision Risk Model (CRM)	Quantitative means to estimate the number of predicted collisions between seabirds recorded in the WOW OAA from rotating WTGs.
Diadromous fish	Fish that migrate between freshwater and marine environments to fulfil their lifecycle
Pelagic seabird species	Seabirds that mostly live a large portion of their lives on the open ocean.
Piscivorous species	A species feeding on fish.
Population Viability Analysis	Modelling methods used to explore and understand potential consequences of additional mortality on populations.