Salamander Offshore Wind Farm

Offshore EIA Report

Volume ER.A.3, Chapter 12: Offshore and Intertidal Ornithology

SALAMANDER

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Glossary

Term	Definition
Applicant	Salamander Wind Project Company Limited (formerly called Simply Blue Energy (Scotland) Limited), a joint venture between Ørsted, Simply Blue Group and Subsea7.
Applicant Approach	The Salamander Project specific displacement and mortality rates applied to assessment of distributional responses (displacement) and the Ozsanlav-Harris *et al.* (2023) avoidance rates applied to collision risk modelling (CRM).
Cumulative Effects	The combined effect of the Salamander Project with the effects from a number of different projects, on the same single receptor/resource.
Cumulative Impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Salamander Project.
Design Envelope	A description of the range of possible elements that make up the Salamander Project design options under consideration, as set out in detail in the project description. This envelope is used to define Salamander Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known.
Distributional Responses	Seabird responses to offshore wind farms which involve change in abundance and distribution, comprising displacement and barrier effects
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which the likely significant effects of certain projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment (EIA) Regulations, including the publication of an Environmental Impact Assessment Report (EIAR).
EIA Regulations	The regulations that apply to this project are the Electricity Works (EIA) (Scotland) Regulations 2017, the Marine Works (EIA) (Scotland) Regulations 2017, the Marine Works (EIA) Regulations 2007, and the Town and Country Planning (EIA) (Scotland) Regulations 2017.
Habitats Regulations Appraisal	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites (when these are also an SPA or SAC). The process consists of a multi stage assessment which incorporates screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Impact	An impact is considered to be the change to the baseline as a result of an activity or event related to the Salamander Project. Impacts can be both adverse or beneficial impacts on the environment and be either temporary or permanent.

Term	Definition
Inter-Related Effect (or inter-Relationships)	The likely effects of multiple impacts from the proposed development on one receptor. For example, noise and air quality together could have a greater effect on a residential receptor than each impact considered separately.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore Export Cable Corridor, intertidal working area and landfall compound, where the offshore cables come ashore north of Peterhead.
Offshore Array Area	The offshore area within which the wind turbine generators, foundations, mooring lines and anchors, and inter-array cables and associated infrastructure will be located.
Offshore Array Area plus 2.0 km Buffer	The Offshore Array Area with a 2.0 km buffer applied in all directions, used specifically for assessing displacement of seabirds from the Offshore Array Area due to Wind Turbine Generators (WTGs) during the operation and maintenance phase.
Offshore Development	The offshore components of the Salamander Project, including all infrastructure and works in the Offshore Array Area and the Offshore Export Cable Corridor.
Offshore Development Area	The total area comprising the Offshore Array Area and the Offshore Export Cable Corridor.
Offshore Export Cable(s)	The export cable(s) that will bring electricity from the Offshore Array Area to the Landfall. The cable(s) will include fibre optic cable(s).
Offshore Export Cable Corridor	The area that will contain the Offshore Export Cable(s) between the boundary of the Offshore Array Area and Mean High Water Springs (MHWS).
Population Viability Analysis	Population modelling to predict future trends and population estimates for a range of input scenarios
Receptor (Offshore)	Any physical, biological or anthropogenic element of the environment that may be affected or impacted by the Salamander Project. Receptors can include natural features such as the seabed and wildlife habitats as well as man-made features like fishing vessels and cultural heritage sites.
Salamander Project	The proposed Salamander Offshore Wind Farm. The term covers all elements of both the offshore and onshore aspects of the Salamander Project.
Scoping	An early part of the EIA process by which the key potential significant impacts of the Salamander Project are identified, and methodologies identified for how these should be assessed. This process gives the relevant authorities and key consultees opportunity to comment and define the scope and level of detail to be provided as part of the EIAR – which can also then be tailored through the consultation process.
Stochastic Collision Risk Model	Collision risk model that accounts for variability and uncertainty
Site Specific Study Area	The full area covered by the Digital Aerial Survey (DAS), based on the Salamander Area of Search plus 4.0 km buffer.

Acronyms

Term	Definition
°	Degrees (angle)
°C	Degrees Celsius / Centigrade
ALDFG	Abandoned, Lost, or Discarded Fishing Gear
AOB	Apparently Occupied Burrow
AON	Apparently Occupied Nest
AOS	Apparently Occupied Site
BoCC	Birds of Conservation Concern
BTO	British Trust for Ornithology
CEA	Cumulative Effects Assessment
CEF	Cumulative Effects Framework
CEMP	Construction Environmental Management Plan
CI	Confidence Interval
CMS	Construction Method Statement
CPC	Counterfactual of Population Growth Rate
CPS	Counterfactual of Population Size
CRH	Collision Risk Height
CRM	Collision Risk Modelling
DAS	Digital Aerial Survey
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
FHD	Flight Height Distribution
FLOW	Floating Offshore Wind Farm
HPAI	Highly Pathogenic Avian Influenza, 'Bird Flu'

Term	Definition
HRA	Habitats Regulations Appraisal
indv.	Individuals
indv. km^{-2}	Individuals per square kilometre
indv. mo^{-1}	Individuals per month
IUCN	International Union for the Conservation of Nature
JV	Joint Venture
km	Kilometre
km^2	Square kilometre
LC	Least Concern (IUCN Red List)
m	Metre
m^2	Square metre
m^3	Cubic metre
mCRM	Migratory Collision Risk Modelling
MD-LOT	Marine Directorate - Licensing and Operations Team
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MPCP	Marine Pollution Contingency Plan
MW	Megawatt
OAA	Offshore Array Area
OEMP	Operation Environmental Management Plan
OSPAR	Oslo-Paris
OWF	Offshore Wind Farm
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
ROV	Remotely Operated Vehicle
rpm	Revolutions per minute

Term	Definition
RSPB	Royal Society for the Protection of Birds
RTD	Red-throated Diver
SWPC	Salamander Wind Project Company Ltd
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SOSS-MAT	Strategic Ornithological Support Services Migration Assessment Tool
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SST	Sea Surface Temperature
SWPC	Salamander Wind Project Company Limited (formerly called SBES)
VMP	Vessel Management Plan
VU	Vulnerable (IUCN Red List)
WTG	Wind Turbine Generator
ZOI	Zone of Influence

12 Offshore and Intertidal Ecology

12.1 Introduction

12.1.1.1 The Applicant, Salamander Wind Project Company Ltd (SWPC), a joint venture (JV) partnership between Ørsted, Simply Blue Group and Subsea7, is proposing the development of the Salamander Offshore Wind Farm (hereafter 'Salamander Project'). The Salamander Project will consist of the installation of a floating offshore wind farm (up to 100 megawatts (MW) capacity) approximately 35 kilometres (km) east of Peterhead. It will consist of both offshore and onshore infrastructure, including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume ER.A.2, Chapter 4: Project Description** for full details on the Salamander Project Design).

12.1.1.2 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the Environmental Impact Assessment (EIA) of potential effects of the Salamander Project on Offshore and Intertidal Ornithology. Specifically, this chapter considers the potential impact of the Salamander Project seaward of Mean High Water Springs (MHWS) during the construction, operation and maintenance, and decommissioning phases of the Offshore Development.

12.1.1.3 The chapter provides an overview of the existing environment for the proposed Offshore Development Area, followed by an assessment of significance of effect on Offshore and Intertidal Ornithology receptors, as well as an assessment of potential cumulative effects with other relevant projects and effects arising from interactions on receptors across topics.

12.1.1.4 This chapter should be read alongside and in consideration of the following:

- **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report**;
- **Volume ER.A.4, Annex 12.2: Intertidal Baseline Ornithology Report**;
- **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report**;
- **Volume ER.A.4, Annex 12.4: Population Viability Analysis**;
- **Volume ER.A.4, Annex 12.5: Displacement Assessment**;
- **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report;**
- **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**;
- **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**;
- **Accompanying Report RP.A.1: Report to Inform Appropriate Assessment Sections 7 and 11: Birds Assessment**;
- **RIAA Annex A.2.1: Apportioning Report**;
- **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (considered in assessment of supporting habitat);
- **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (considered in assessment of supporting habitat);
- **Volume ER.A.3, Chapter 20: Climate Change and Carbon** (considered in future baseline determination);
- **Volume ER.A.2, Chapter 4: Project Description**; and

- **Volume ER.A.2, Chapter 6: EIA Methodology**.

12.1.1.5 This chapter has been authored by ERM. HiDef Aerial Surveying Ltd (HiDef) have supplied the Digital Aerial Survey (DAS) baseline environment, Collision Risk Modelling (CRM) and displacement assessment outputs, and Population Viability Analysis (PVA). Further competency details of the authors of this chapter are outlined in **Volume ER.A.4, Annex 1.1: Details of the Salamander Project Team.**

12.2 Purpose

12.2.1.1 The primary purpose of this EIAR is for the application for the Salamander Project satisfying the requirements of Section 36 of the Electricity Act 1989 and associated Marine Licences. This EIAR chapter describes the potential environmental impacts from the Offshore Development and assesses the significance of their effect.

12.2.1.2 The EIAR has been finalised following the completion of the pre-application consultation **Volume RP.A.4, Report 1: Pre-Application Consultation (PAC) Report** and the Salamander EIA Scoping Report (SBES, 2023), (and takes account of the relevant advice set out within the Scoping Opinion from Marine Scotland – Licensing Operations Team (MD-LOT) (MD-LOT, 2023) relevant to the Offshore Development. Comments relating to the Energy Balancing Infrastructure (EBI) will be addressed within the Onshore EIAR. The Offshore EIAR will accompany the application to MD-LOT for Section 36 Consent under the Electricity Act 1989, and Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009.

12.2.1.3 This EIAR chapter:

- Outlines the existing environmental baseline determined from assessment of publicly available data, project-specific survey data and stakeholder consultation;
- Presents the potential environmental impacts and resulting effects arising from the Salamander Project on Offshore and Intertidal Ornithology receptors;
- Identifies mitigation measures designed to prevent, reduce, or offset adverse effects and enhance beneficial effects on the environment;
- Identifies any uncertainties or limitations in the methods used and conclusions drawn from the compiled environmental information.

12.3 Planning and Policy Context

12.3.1.1 The preparation of the Offshore and Intertidal Ornithology Chapter has been informed by the following policy, legislation, and guidance outlined in **Table 12-1**.

Table 12-1 Relevant policy, legislation and guidance relevant to the Offshore and Intertidal Ornithology assessment

Relevant policy, legislation, and guidance
Policy
Scotland's National Marine Plan: A Single Framework for Managing Our Seas (Scottish Government, 2015)
Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020)
Scottish Biodiversity Strategy to 2045: Tackling the Nature Emergency in Scotland (Scottish Government, 2022a)

Relevant policy, legislation, and guidance
National Planning Framework (NPF) 4 (Scottish Government, 2023)
Legislation
Wildlife and Countryside Act 1981
Nature Conservation (Scotland) Act 2004
Wildlife and Natural Environment (Scotland) Act 2011
Ramsar Convention on Wetlands of International Importance 1971
The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)
The Conservation of Offshore Marine Habitats and Species Regulations 2017
Guidance
NatureScot Marine Ornithology Guidance Notes to support Offshore Wind Applications (NatureScot, 2023a-k): • Guidance Note 1: Guidance to support Offshore Wind Applications: Marine Ornithology – NatureScot, 2023a); • Guidance Note 2: Guidance to support Offshore Wind Applications: Advice for Marine Ornithology Baseline Characterisation Surveys and Reporting (NatureScot, 2023b); • Guidance Note 3: Guidance to support Offshore Wind applications: Marine Birds – Identifying theoretical connectivity with breeding site Special Protection Areas using breeding season foraging ranges (NatureScot, 2023c); • Guidance Note 4: Guidance to Support Offshore Wind Applications: Ornithology – Determining Connectivity of Marine Birds with Marine Special Protection Areas and Breeding Seabirds from Colony SPAs in the Non-Breeding Season (NatureScot, 2023d); • Guidance Note 5: Guidance to support Offshore Wind Applications: Recommendations for marine bird population estimates (NatureScot, 2023e); • Guidance Note 6: Guidance to support Offshore Wind Applications – Marine Ornithology Impact Pathways for Offshore Developments (NatureScot, 2023f); • Guidance Note 7: Guidance to support Offshore Wind Applications: Marine Ornithology – Advice for assessing collision risk of marine birds (NatureScot, 2023g); • Guidance Note 8: Guidance to support Offshore Wind applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds (NatureScot, 2023h); • Guidance Note 9: Guidance to support Offshore Wind applications: Marine Ornithology Advice for Seasonal Definitions for Birds in the Marine Environment (NatureScot, 2023i); • Guidance Note 10: Guidance to support Offshore Wind applications: Marine Ornithology Advice for apportioning impacts to breeding colonies (NatureScot, 2023j); and • Guidance Note 11: Guidance to support Offshore Wind Applications: Marine Ornithology – Recommendations for Seabird Population Viability Analysis (PVA) (NatureScot, 2023k).
Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments (Wade *et al.*, 2016)
Assessing vulnerability of marine bird populations to offshore wind farms (Furness *et al.*, 2013)
Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index (Garthe and Hüppop, 2004)

Relevant policy, legislation, and guidance
Joint Statutory Nature Conservation Bodies (SNCB) Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm developments (SNCB, 2022)
Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines (Johnston *et al.*, 2014)
Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms (Band, 2012)
A Stochastic Collision Risk Model for Seabirds in Flight (McGregor *et al.*, 2018)
Assessing the risk of offshore wind farm development to migratory birds designated as features of UK Special Protection Areas (and other Annex 1 species) (Wright *et al.*, 2012)
Strategic assessment of collision risk of Scottish offshore wind farms to migrating birds (WWT Consulting and MacArthur Green, 2014)

12.3.1.2 Further details on the requirements for EIA are presented in **Volume ER.A.2, Chapter 2 Legislative Context and Regulatory Requirements.**

12.4 Consultation

12.4.1.1 Consultation is a key part of the application process. It has played an important part in ensuring that the baseline characterisation and impact assessment is appropriate to the scale of development as well as meeting the requirements of the regulators and their advisors.

12.4.1.2 An overview of the Salamander Project consultation process is outlined in **Volume ER.A.2, Chapter 5: Stakeholder Consultation.** Consultation regarding Offshore and Intertidal Ornithology has been conducted through production of the Scoping Report, an Offshore and Intertidal Ornithology specific scoping workshop held on 28 November 2022, and comments on and official response to the Scoping Report (i.e. the Scoping Opinion (MD-LOT, 2023)). In the scoping workshop, a series of questions were presented to stakeholders and discussed in detail, formal responses to these, collated by NatureScot are included in **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report.**

12.4.1.3 The issues raised during consultation specific to Offshore and Intertidal Ornithology are outlined in **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**, including consideration of where the issues have been addressed within the EIAR.

12.4.1.4 Consultation has also been undertaken with regard to the Onshore, Intertidal and Nearshore Wintering and Migratory Bird Surveys. This consultation was undertaken for NatureScot and the Royal Society for the Protection of Birds (RSPB) Scotland to provide advice and agreement on the survey methodology. The discussions on this topic are presented in full in **Table 1-2** of **Volume ER.A.4, Annex 12.2: Intertidal Baseline Ornithology Report**.

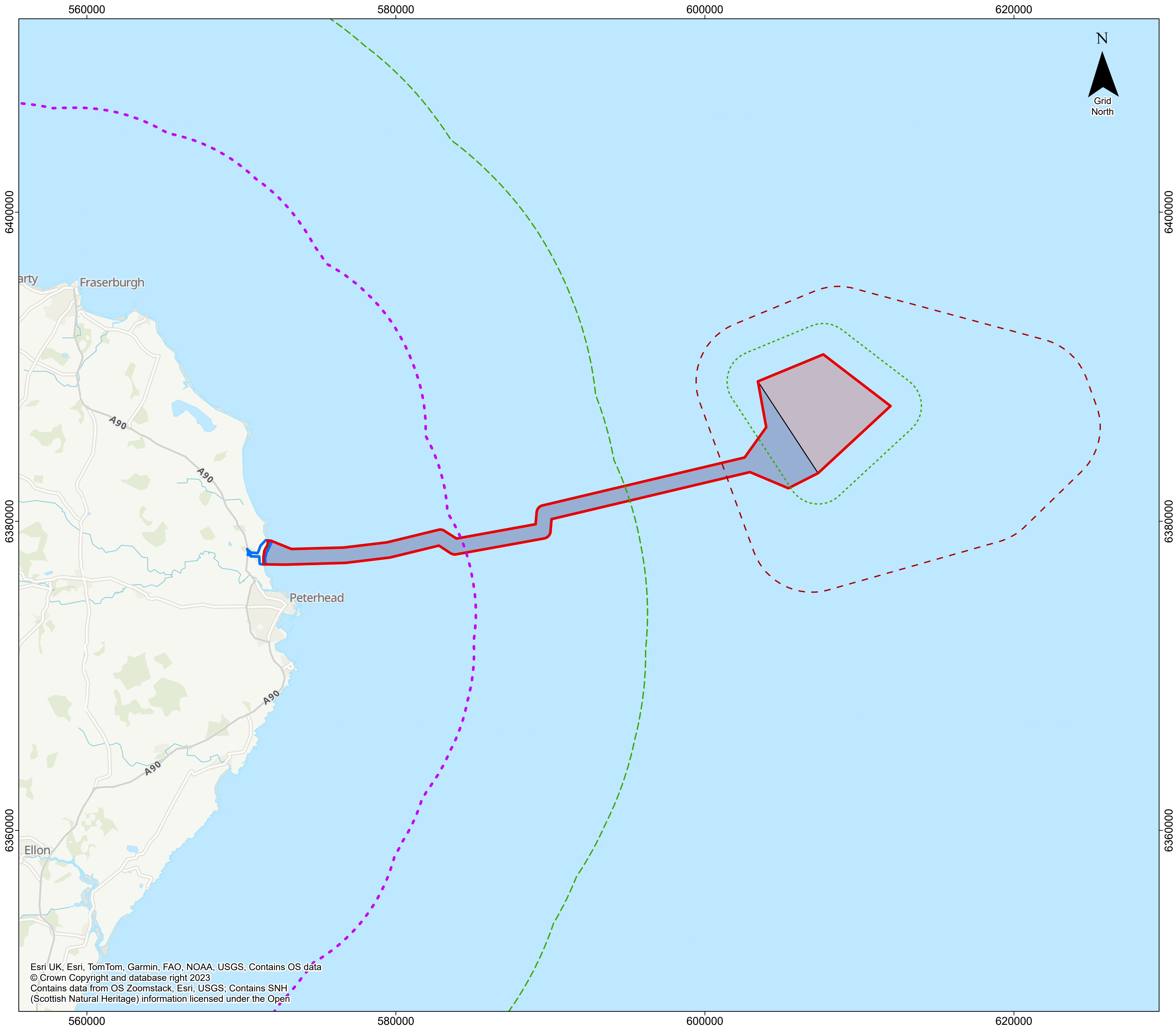
12.5 Study Area

12.5.1.1 The Offshore and Intertidal Ornithology Study Area (**Figure 12-1**) has been defined on the basis of the Offshore Development Area, and appropriate disturbance / displacement buffer (2.0 km) as agreed at scoping (MD-LOT, 2023), and species-specific seabird foraging ranges (Woodward *et al.*, 2019).

12.5.1.2 The Study Area for Offshore and Intertidal Ornithology comprises several components, depending on the species and effect being discussed. Each component is described in **Table 12-2**. The Study Area for Offshore and Intertidal Ornithology is shown on **Figure 12-1**. It should be noted that the Regional Populations Area differs by species, and therefore, is not presented on **Figure 12-1**.

Table 12-2 Overview of Offshore and Intertidal Ornithology Study Area

Reference	Area (km^2)	Spatial Coverage	Uses
Offshore Array Area (OAA)	33.25	This comprises the offshore area within which the wind turbine generators (WTGs), foundations, mooring lines and anchors, and inter-array cables and associated infrastructure will be located.	Baseline characterisation for identification of sensitive receptors and assessment of direct effects associated with infrastructure, such as collision.
OAA plus 2.0 km Buffer	92.17	This comprises the above, with a 2.0 km buffer applied in all directions, representing the area within which birds may be displaced by operational WTGs.	Baseline characterisation for identification of sensitive receptors and assessment of indirect effects associated with infrastructure, such as distributional responses (displacement and barrier effects).
Offshore Development Area	80.65	This comprises the Offshore Development Area, including both the OAA (33.25 km^2) and the Offshore Export Cable Corridor (ECC) (47.40 km^2). The landward boundary is defined by mean high water spring (MHWS), which also marks the differentiation between Offshore and Intertidal Ornithology and Terrestrial Ornithology.	Baseline characterisation and assessment of impacts where effects may occur both within the OAA and the Offshore ECC (e.g. vessel disturbance and habitat loss).
Site Specific Study Area	372.12	This comprises the Digital Aerial Survey (DAS) area, encompassing the OAA prior to refinement plus a 4.0 km buffer. The DAS were commissioned prior to site refinement; therefore, the spatial extent here is much greater than the OAA. It is important to note that the Site Specific Study Area fully encompasses and includes the refined OAA plus 2.0 km buffer applied for assessment of distributional responses.	Baseline characterisation. This area has been subset to determine baseline population and density estimates for assessment of collision and distributional responses. Details are presented in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report (Section 2.1.2)**.
Regional Populations Area	Variable	This comprises the areas within which species may forage during the breeding season, defined through application of mean maximum plus one standard deviation foraging ranges (Woodward *et al.*, 2019) as a buffer to the OAA, as well as arbitrary regions, such as UK North Sea.	Estimation of species-specific regional populations against which impacts are compared and assessed. An overview of population estimates can be found in **Sections 12.7.1**; full details on the methodology are provided in the **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report (Section 2)**.



Salamander

Figure 12-1

Offshore Ornithology Study Area

Legend

- Offshore Development Area
- Offshore Array Area
- Offshore Export Cable Corridor
- Indicative Onshore Development Area
- 6nm limit
- 12nm limit
- Site Specific Study Area
- Offshore Array Area 2.0 km Buffer

Coordinate System: WGS 1984 UTM Zone 30N

Scale @ A3 : 1:239,034

0 7 14 Kilometers

0 1.75 3.5 7 Nautical Miles

Rev	Description	Date
00	FINAL	04/04/2024
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Doc. Title : Offshore Ornithology Study Area
Doc. No : SWF01ER0260
Created by : NB
Checked by : IW
Approved by : LP

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12.6 Methodology to Inform Baseline

12.6.1 Site Specific Surveys

12.6.1.1 In order to provide site specific and up to date information on which to base the impact assessment, a DAS campaign was conducted, as presented in **Table 12-3**.

Table 12-3 Summary of site-specific surveys for Offshore and Intertidal Ornithology

Survey	Conducted by	Outcome of Survey
Digital Aerial Survey (DAS)	HiDef Aerial Surveying Ltd (HiDef)	24-month Digital Aerial Survey (DAS) transects flown over original larger OAA of Search (covering 372 km^2), as ornithology surveys commenced prior to the INTOG leasing round and requirement for a smaller OAA. To maintain sufficient power in modelling abundance and density, the full spatial extent of DAS data was analysed, the outputs were then subset to include only the OAA and appropriate buffer (2.0 km for displacement, 0 km for collision risk). Transects were flown each month, beginning in March 2021 and ending in February 2023, coinciding with the breeding and non-breeding seasons of seabirds in the region. This approach enables two full consecutive breeding and non-breeding seasons to be covered. Monthly average abundance and density estimates were produced and summarised to inform the impact assessment presented in **Section 12.11**. Full details of the baseline data collected can be found in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report (Section 3)**. The Collision Risk Modelling (CRM), displacement assessment, and Population Viability Analysis (PVA) methods and results are presented in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report**, **Volume ER.A.4, Annex 12: Population Viability Analysis,** and **Volume ER.A.4, Annex 12.5: Displacement Assessment**.

12.6.2 Data Sources

12.6.2.1 The data sources that have been used to inform this Offshore and Intertidal Ornithology Chapter of the EIAR are presented within **Table 12-4**.

Table 12-4 Summary of key publicly available datasets for Offshore and Intertidal Ornithology

Source	Year	Spatial Coverage	Summary
Mitchell *et al.* (2004)	1998 – 2002	UK and Ireland	Seabird 2000 Census, representing the previous full census of seabird populations in the UK, comparing results with previous censuses
Kober *et al.* (2010)	2010	UK Exclusive Economic Zone (EEZ)	Modelled seabird density and abundance for purpose of identifying hotspots which may be suitable for candidate Special Protection Areas (SPAs)
Wright *et al.* (2012)	2012	UK EEZ and surrounding waters linking to Iceland, Greenland, Scandinavia, and mainland Europe	Spatial analysis of ringing data and observations to identify species and subspecies specific migration routes to and from the UK / Ireland
Furness *et al.* (2013)	2013	UK EEZ	Meta analysis of seabirds to ascribe relative sensitivity to Offshore Wind Farms (OWFs)
Bradbury *et al.* (2014)	2014		
Woodward *et al.* (2019)	2019	UK EEZ and beyond, where seabird foraging ranges exceed this	Meta analysis of seabird foraging ranges used for Habitats Regulations Appraisal (HRA) screening and for determination of regional populations

Source	Year	Spatial Coverage	Summary
BirdLife International (2023)	2023	International	Up to date information on species ecology, behaviour, breeding, feeding and habitat usage, as well as summaries of population trends, conservation status and threats
BTO *et al.* (2023)	2023	UK and Ireland	Seabird Monitoring Programme (SMP) population, productivity, and survival rates collected at numerous sites around the UK and Ireland
Burnell *et al.* (2023)	2015 – 2021	UK and Ireland	Seabirds Count, the latest full census of seabird populations in the UK, comparing the results with previous censuses.
Royal Society for the Protection of Birds (RSPB) (2023)	2023	UK-wide	Information on seabirds, similar to that provided by BirdLife International (2023), with specific reference to the UK

12.7 Baseline Environment

12.7.1 Existing Baseline

Digital Aerial Surveys

12.7.1.1 A total of 32,476 birds belonging to 19 species were identified in the 24-month DAS results, with 7,735 individuals (indv.) of 12 species recorded in Year 1 (March 2021 to February 2022) and 24,741 indv. of 16 species in Year 2, giving a 24-month average of 1,353 individuals per month (indv. mo^{-1}). In the second year, particularly in late summer and early autumn, large aggregations of sitting birds were observed across the survey area. Additionally, 876 indv. (290 in Year 1 and 576 in Year 2) could not be identified confidently, and as such, were assigned to taxa groups. Individuals in the 11 taxa groups were then assigned to species level based on the proportion of birds positively identified.

12.7.1.2 Some species and taxa groups were observed in substantially higher numbers than others. For example, auks were the most common group, representing approximately 63% of all identified bird observations (20,675 indv.), whereas skua and tern numbers were very low, with just a few individuals observed across the 24-month DAS period. The numbers (raw observations) of each species and taxa groups observed are presented in **Table 12-5**. For some species, where sufficient records were available, density and population estimates were also produced; these are presented in the species accounts. Full details are provided in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report** (**Section 2.1.2** and **Section 3**).

Table 12-5 Number of each seabird species observed in the Offshore Array Area (OAA), OAA plus 2.0 km Buffer, and the Site Specific Study Area during the Salamander Project Digital Aerial Surveys in Year 1 (March 2021 to February 2022) and Year 2 (March 2022 to February 2023)

Common Name	Scientific Name	Observations in Array Area		Observations in Array Area plus 2 km Buffer		Observations in Site Specific Study Area	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Gulls							
Black-legged kittiwake	*Rissa tridactyla*	71	94	167	565	740	1,463
Black-headed gull	*Chroicocephalus ridibundus*	0	1	0	1	0	1
Little gull	*Hydrocoloeus minutus*	0	0	0	4	0	4
Common gull	*Larus canus*	0	1	1	1	4	1
Great black-backed gull	*Larus marinus*	4	11	13	63	67	580
Iceland gull	*Larus glaucoides*	0	0	0	0	0	1
European herring gull	*Larus argentatus*	6	8	11	141	44	344
Lesser black-backed gull	*Larus fuscus*	0	0	0	0	1	0
Terns							
Common tern	*Sterna hirundo*	0	6	0	7	0	8
Arctic tern	*Sterna paradisaea*	3	0	3	1	3	12
Skuas							
Great skua	*Stercorarius skua*	0	0	0	0	2	0

Common Name	Scientific Name	Observations in Array Area		Observations in Array Area plus 2 km Buffer		Observations in Site Specific Study Area	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Arctic skua	*Stercorarius parasiticus*	0	0	0	0	0	1
Auks							
Common guillemot	*Uria aalge*	466	1,006	1,340	3,015	5,237	12,640
Razorbill	*Alca torda*	18	35	67	98	208	433
Atlantic puffin	*Fratercula arctica*	37	92	78	287	313	1,844
Divers (Loons)							
Red-throated diver	*Gavia stellata*	0	0	0	0	0	1
Tubenoses							
European storm petrel	*Hydrobates pelagicus*	0	0	0	0	8	0
Northern fulmar	*Fulmarus glacialis*	98	189	206	930	726	6,923
Gannets							
Northern gannet	*Morus bassanus*	47	14	125	128	382	424

12.7.1.3 The key species which were recorded in greater numbers within the Offshore Array Area (OAA) and / or the 2.0 km buffer include:

- Black-legged kittiwake (*Rissa tridactyla*), hereto referred as 'kittiwake';
- Great black-backed gull (*Larus marinus*);
- European herring gull (*Larus argentatus*), hereto referred as 'herring gull';
- Common guillemot (*Uria aalge*), hereto referred as 'guillemot';
- Razorbill (*Alca torda*);
- Atlantic puffin (*Fratercula arctica*), hereto referred as 'puffin';
- Northern fulmar (*Fulmarus glacialis*), hereto referred as 'fulmar'; and
- Northern gannet (*Morus bassanus*), hereto referred as 'gannet'.

12.7.1.4 Several species recorded in the DAS are considered transient or have a largely coastal distribution and, therefore, were recorded in comparatively low numbers in the Site Specific Study Area. The limited presence of such species is not unexpected and is supported by distribution modelling carried out by Kober *et al.* (2010) and Waggitt *et al* (2019). Species with limited presence are listed below. Due to lack of interaction pathway, these species are scoped out of assessment and further consideration is not required.

- Black-headed gull (Chroicocephalus ridibundus);
- Little gull (Hydrocoloeus minutus);
- Common gull (*Larus canus*);
- Iceland gull (*Larus glaucoides*);
- Lesser black-backed gull (*Larus fuscus*);
- Common tern (*Sterna hirundo*);
- Arctic Tern (Sterna paradisaea);
- Great skua (Stercorarius skua);
- Arctic skua (Stercorarius parasiticus);
- Red-throated diver (*Gavia stellata*), hereto referred as RTD; and
- European storm petrel (*Hydrobates pelagicus*), hereto referred as 'storm petrel'.

12.7.1.5 Storm petrels were observed in very low numbers in the DAS, with just eight individuals recorded in the Site Specific Study Area, all in Year 1 (**Table 12-5**). As petrels are small and birds can be hard to observe and identify, DAS is not considered the optimal survey method for this species. However, storm petrels (European and Leach's) have been recorded in DAS at other developments using the exact same survey techniques, equipment, and analyses as used for the Salamander Project. Therefore, it is suggested that the low numbers observed here are true low numbers and not due to detection bias.

12.7.1.6 The DAS results are supported by published literature. Distribution derived from at-sea surveys and tracking data suggest that in storm petrels are present in Scotland during the breeding season (May to October) (NatureScot, 2020), with greatest densities recorded on the outer continental shelf, north and west of Scotland, and around Fair Isle, Shetland, and Orkney (Stone *et al.*, 1995; Kober *et al.*, 2010; Waggitt *et al.*, 2019). Based on data collected in 2006, Kober *et al.* (2010) modelled distributions on seabirds, identifying hotspots of activity west of Shetland and Orkney, and north of Shetland on the continental shelf. More recently, Waggitt *et al.* (2019) modelled seabird densities around the UK, with results showing similar storm petrel distributions as derived by Stone *et al.* (1995) and Kober *et al.* (2010): areas of increased activity to the west of Shetland and Orkney, and to the north of Scotland on the continental shelf. Both studies showed a low density in the vicinity of the Offshore Development Area.

12.7.1.7 Tracking data, such as those collected by Bolton (2021) and summarised by NatureScot (2022), suggest similar trends in distribution to those modelled by Kober *et al.* (2010) and Waggitt *et al.* (2019). The data collected from 2014 to 2017 and in 2018 show individuals using areas to the south of Shetland. RSPB tracking data showed birds using the continental shelf to the west of Scotland (NatureScot, 2022).

12.7.1.8 Therefore, based on the results of the DAS and supported by published density and tracking studies, it is concluded that storm petrel usage of the Offshore Development Area is likely to be low. As such, the species is not considered a key receptor and is scoped out of further consideration, with no impacts to the species predicted due to lack of pressure pathways.

Regional Populations and Seabird Colonies

12.7.1.9 This section provides details on regional sites, such as Special Protection Areas (SPAs) and breeding colonies, as well as information on regional seabird populations against which impacts are assessed. Impacts to classified populations of SPAs, and designated populations of Ramsar Sites and Sites of Special Scientific Interest (SSSIs) as components of SPAs, are considered in **Volume RP.A.1, Report 1: Report to Inform Appropriate Assessment (RIAA)**, **Sections 7** and **11** (Birds Assessment).

Special Protection Areas

12.7.1.10 There is a large number of SPAs on the east coast of Scotland, the Scottish Islands, and the northeast coast of England. Marine (i.e., seabird) features of these designated sites may interact with the Offshore Development Area, such as for foraging, loafing, or on passage during migration.

12.7.1.11 Regional SPAs which may be affected by the Salamander Project are detailed in **Volume RP.A.1, Report 1: Report to Inform Appropriate Assessment (RIAA)**, **Sections 7** and **11** (Birds Assessment). The current (baseline) condition of the sites is described, and impacts are assessed against the designated populations with consideration for the site and feature specific conservation objectives. The SPAs with the greatest level of interaction and in closest proximity to the Offshore Development Area are summarised below.

Buchan Ness to Collieston Coast Special Protection Area

12.7.1.12 The Buchan Ness to Collieston Coast SPA is a 5.4 km^2 site located approximately 33.7 km to the southwest of the OAA. The SPA was classified in 1998 and spans around 15 km of coastline comprising granite and quartzite cliffs (SNH, 2009a). The site supports internationally important numbers of kittiwake, herring gull, guillemot, European shag, and fulmar during the breeding season. It also supports a seabird assemblage in excess of 20,000 birds (approximately 95,000 in 1998).

Troup, Pennan and Lion's Heads Special Protection Area

12.7.1.13 Troup, Pennan and Lion's Head SPA is a 3.4 km^2 site which covers around 9 km of cliffs and extends 2 km into the marine environment (SNH, 2009b). The SPA, which was classified in 1997, is located >50 km the OAA. The site supports breeding kittiwake, herring gull, guillemot, razorbill, fulmar, as well as a seabird assemblage in excess of 20,000 birds (150,000 birds of nine species in 1995).

Fowlsheugh Special Protection Area

12.7.1.14 The Fowlsheugh SPA is located >90 km from the OAA. The 1.3 km^2 site, which covers around 4 km of cliffs between 30 m and 60 m high, was classified in 1992. The SPA supports internationally important breeding populations of kittiwake, herring gull, guillemot, razorbill, and fulmar and also for supporting a seabird assemblage of >20,000 birds (SNH, 2009c), regularly supporting in excess of 145,000 seabirds.

East Caithness Cliffs Special Protection Area

12.7.1.15 The East Caithness Cliffs SPA is a large (114 km^2) SPA located >130 km to the northwest of the OAA. The site extends along 40 km of coastline, covering cliffs which raise up to 150 m above sea level (SNH and JNCC, 2014). The site was classified in 1996 and extended in 2009 to include foraging areas for its features (SNH, 2017). Classified seabird features of the SPA include kittiwake, great black-backed gull, herring gull, guillemot, razorbill, fulmar, great cormorant (*Phalacrocorax carbo*), European shag, and a seabird assemblage of around 300,000 birds (SNH and JNCC, 2014; SNH, 2017).

North Caithness Cliffs Special Protection Area

12.7.1.16 The North Caithness Cliffs SPA is located >145 km to the northwest of the OAA. The SPA was classified in 1996 and extended in 2009. In its current extent, it covers around 114.6 km^2 over five separate sections (SNH, 2018). North Caithness Cliffs SPA supports important populations of kittiwake, guillemot, puffin, and fulmar, as well as a seabird assemblage >20,000 birds.

Ramsar Sites

Ythan Estuary and Meikle Loch

12.7.1.17 The Ythan Estuary and Meikle Loch Ramsar Site is located 50 km to the southwest of the OAA. Covering 3.14 km^2, the site was classified in 1998 for the protection of habitat supporting international important numbers of breeding Sandwich tern, and internationally important numbers of overwintering pink-footed goose *Anser brachyrhynchus* (JNCC, 1999).

Regional Populations

12.7.1.18 Regional populations were estimated for the breeding and non-breeding season. Seasonality was informed by NatureScot advice on seasonal periods for birds in the Scottish marine environment (**Table 12-6**).

Table 12-6 Defined Seasons for Seabirds in the Scottish Marine Environment (Source: NatureScot, 2020)

Common Name	Scientific Name	Breeding Season	Non-breeding Season
Black-legged kittiwake	*Rissa tridactyla*	Mid-April to August	September to mid-April
Great black-backed gull	*Larus marinus*	April to August	September to March
European herring gull	*Larus argentatus*	April to August	September to March
Common guillemot	*Uria aalge*	April to mid-August	Mid-August to March
Razorbill	*Alca torda*	April to mid-August	Mid-August to March
Atlantic puffin	*Fratercula arctica*	April to mid-August	N/A
Northern fulmar	*Fulmarus glacialis*	April to mid-September	Mid-September to March
Northern gannet	*Morus bassanus*	Mid-March to September	October to mid-March

Breeding Season

12.7.1.19 The regional populations for birds during the breeding season were estimated using Woodward *et al.* (2019) species-specific foraging ranges, allowing for guidance published by NatureScot (2023c). The species-specific foraging ranges used to calculate the regional populations are presented in **Table 12-7**.

12.7.1.20 Different metrics (smaller foraging ranges for guillemots outside the Fair Isle colonies) were used for different species as per NatureScot (2023c) guidance. This is because, as noted by Woodward *et al.* (2019), foraging ranges from some colonies were substantially different to the wider dataset, therefore, resulting in the results being skewed.

Table 12-7 Species-specific foraging ranges used to define breeding season regional populations (Woodward *et al.*, 2019; NatureScot, 2023c)

Common Name	Scientific Name	Foraging Range (km) (Mean Maximum plus 1 Standard Deviation, where applicable)	Metric
Black-legged kittiwake	*Rissa tridactyla*	300.6	Mean maximum
Great black-backed gull	*Larus marinus*	73.0	Mean maximum
European herring gull	*Larus argentatus*	85.6	Mean maximum
Common guillemot[1]	*Uria aalge*	95.2	Mean maximum (excluding Fair Isle)
		153.7	Mean maximum (including Fair Isle)
Razorbill[1]	*Alca torda*	122.2	Mean maximum (excluding Fair Isle)
		164.6	Mean maximum (including Fair Isle)
Atlantic puffin	*Fratercula arctica*	265.4	Mean maximum
Northern fulmar[2]	*Fulmarus glacialis*	N/A	Refer to table footnote
Northern gannet[1]	*Morus bassanus*	509.4	Mean maximum
		590.0	Maximum (Forth Isle)
		516.7	Maximum (Grassholm)

NatureScot advice, some colony-specific foraging ranges were used for guillemot and gannet.

[2] Due to fulmar's large foraging range, using the mean maximum + 1 SD would incorporate all UK colonies, which is deemed unrealistic. Therefore, the regional population area was clipped to only include the North Sea, thus excluding any sites on the west of the UK.

12.7.1.21 Colony population data from 1986 – 2022 from the UK and Ireland, obtained from the Seabird Monitoring Programme (SMP), provided by the British Trust for Ornithology (BTO *et al.*, 2023), were used to estimate regional populations and review population trends.

12.7.1.22 Here, it should be noted that these data cover and were also used to inform the latest seabird census: Seabirds Count (Burnell *et al.*, 2023). The same data are used to inform the RIAA (**Volume RP.A.1, Report 1: Report to Inform Appropriate Assessment (RIAA)**, **Sections 7** and **11** (Birds Assessment)), however, sourced from Seabirds Count rather than direct from BTO *et al.* (2023).

12.7.1.23 At-sea foraging distances were used to identify connectivity between colonies and the OAA. Due to the small spatial extent of the survey area in comparison to regional foraging area availability, it was not possible to use seabird behavior (e.g. flight direction) observed in the DAS to inform connectivity. No tracking studies were undertaken as part of the baseline surveys. The populations at colonies within foraging distance were summed to provide regional population estimates for each species.

Non-breeding Season

12.7.1.24 Regional population estimates for the non-breeding season were taken from Biologically Defined Minimum Population Scales (BDMPS) (Furness, 2015). Where non-breeding season populations were not provided for a species, the smallest.

12.7.1.25 population migration BDMPS was used. The regions used to define the populations differed between species (**Table 12-8**). This approach aligns with NatureScot guidance on marine bird population estimates, where foraging ranges are used to scope in SMP colonies and populations.

12.7.1.26 Following advice from NatureScot and MD-LOT (**Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**), BDMPS were not used to estimate the non-breeding season regional populations for guillemot and herring gull. As birds do not widely disperse post-breeding (Buckingham *et al.*, 2022), the non-breeding season populations were derived from the breeding season populations. To account for influx of wintering birds, a 29.8% correction factor was applied to the herring gull regional population estimate, as per the Scoping Opinion (MD-LOT, 2023).

Table 12-8 Regions used to define non-breeding season regional populations

Common Name	Scientific Name	Region	Source
Black-legged kittiwake	*Rissa tridactyla*	UK North Sea	Furness (2015)
Great black-backed gull	*Larus marinus*	UK North Sea	Furness (2015)
European herring gull	*Larus argentatus*	Breeding season mean maximum foraging range, plus one standard deviation, plus 29.8% correction factor for influx of wintering birds[1]	Recommended correction factor applied to non-breeding population (NatureScot comments on Scoping Report; **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**)
Common guillemot	*Uria aalge*	Breeding season mean maximum foraging range, plus one standard deviation, excluding Fair Isle data	Buckingham *et al.* (2022); non-breeding derived from breeding population
Razorbill	*Alca torda*	UK North Sea and English Channel	Furness (2015)
Atlantic puffin	*Fratercula arctica*	UK North Sea and English Channel	Furness (2015)
Northern fulmar	*Fulmarus glacialis*	UK North Sea	Furness (2015)
Northern gannet	*Morus bassanus*	UK North Sea and English Channel	Furness (2015)

[1] As per advice given by NatureScot in comments on Scoping Report (05 May 2023), refer to **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**.

12.7.1.27 The breeding season and non-breeding season regional populations for each species are presented in **Table 12-9**.

Table 12-9 Species-specific breeding season and non-breeding season regional populations (individuals) against which impacts are assessed (Furness, 2015; Woodward *et al.*, 2019)

Common Name	Scientific Name	Breeding Season Population (indv.)	Non-breeding Season Population (indv.)
Black-legged kittiwake	*Rissa tridactyla*	202,258	627,816
Great black-backed gull	*Larus marinus*	98[a]	91,399
European herring gull	*Larus argentatus*	14,612	20,551
Common guillemot	*Uria aalge*	407,959	407,959
Razorbill	*Alca torda*	70,208	218,622
Atlantic puffin	*Fratercula arctica*	287,593	231,622
Northern fulmar	*Fulmarus glacialis*	373,519	568,736
Northern gannet	*Morus bassanus*	423,894	248,385

[a] Great black-backed gull has a very low breeding population in the North Sea. The data presented here and used for assessment were obtained from the SMP. Seabird 2000 (the latest UK seabird census at the time of writing) suggest that the distribution of breeding great black-backed gulls in the UK is primarily on the northern coast of Scotland and the UK west coast (Mitchell *et al.*, 2004).

Species Accounts

12.7.1.28 The following section provides an overview of the key seabird receptors associated with the Salamander Offshore Wind Farm, presenting the results of the DAS as well as information on ecology and regional populations for each species.

12.7.1.29 Site specific data were collected over a 24-month period (March 2021 to February 2023). Density and total population estimates for the OAA plus 2.0 km Buffer, have not been provided for species that were either observed in low numbers or are not sensitive to distributional responses or collision. Population and density estimates are presented for species scoped in for qualitative assessment of distributional responses and collision risk, respectively.

12.7.1.30 The specific mean seasonal peak population estimates (used for quantitative assessment of distributional responses) and the species specific monthly densities of flying birds (used to inform quantitative assessment of collision risk) are presented in full in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report** (**Section 3**).

Gulls

Black-legged Kittiwake

12.7.1.31 From mid-April to August (NatureScot, 2020), kittiwake nest on cliff edges and ledges of buildings and man-made structures in coastal areas and at sea (BirdLife International, 2023). Outside of the breeding season, individuals are almost entirely pelagic, spending the winter period at sea (del Hoyo *et al.*, 1996).

Whilst at breeding colonies, adults forage up to 300.6 km (mean maximum plus 1 standard deviation (SD)) from the nest (Woodward *et al.*, 2019).

12.7.1.32 The species feeds on marine invertebrates, such as shrimp and squid, and small fish, as well as intertidal prey such as molluscs and crustaceans (Flint *et al.*, 1984; del Hoyo *et al.*, 1996). Studies of kittiwake diet in the UK, primarily at the Isle of May colony, show sandeel (*Ammodytes* spp.) are a primary food source, peaking at 93% of stomach content by biomass (Newell *et al.*, 2019). In some study years, sandeel comprised as low as 54% of kittiwake diet, a prey shift that coincided with sea surface temperature (Wanless *et al.*, 2018), and has been associated with lower breeding success (Newell *et al.*, 2019).

12.7.1.33 Kittiwake is the most abundant gull species in the world, with a European breeding population is around 1.7 – 2.2 million pairs (BirdLife International, 2023). The previous seabird census in the UK (Seabird 2000: 1998 – 2002) indicated a UK population of 378,847 Apparently Occupied Nests (AON), 74% (282,213 AON) of which are in Scotland (Mitchell *et al.*, 2004); however, the most recent census (Seabirds Count: 2015 – 2021) indicated a reduced population size, with a 43% decline to 103,397 AON at SPAs in Scotland, and a UK-wide decline of almost 20% to 190,149 AON at SPAs (Burnell *et al.*, 2023). Despite showing a larger decline, Scotland still supports over half (54%) of the kittiwake population of the UK.

12.7.1.34 Despite being the most abundant gull in the UK, kittiwake is also one of the most vulnerable. It is on the UK Birds of Conservation Concern (BoCC) Red List (RSPB, 2024) and is listed as 'Vulnerable' (VU) on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (BirdLife International, 2019). Between 1969 and 2002, the UK population has decreased by an average of 2.2% per year, with the Scottish population reducing by 1.8% per year (Mitchell *et al.*, 2004), with greater declines seen at SPAs around the UK in recent years (Burnell *et al.*, 2023).

12.7.1.35 There are several threats to the UK and North Atlantic kittiwake population, primarily associated with food resources. Prey resources, such as sandeel, can be affected by a range of factors, including shifts in sea surface temperature (SST), habitat loss, and direct population decline due fisheries (Frederiksen *et al.*, 2004; Nikolaeva *et al.*, 2006). Habitat loss of breeding sites is also a concern, which can be exacerbated by reduced foraging success (Paredes *et al.*, 2014). Recently (2022 and 2023), Highly Pathogenic Avian Influenza (HPAI), or 'bird flu', has been recorded in kittiwake populations in Scotland, raising concerns for the success of the 2023 breeding season (NatureScot, 2023l).

12.7.1.36 Kittiwakes are sensitive to habitat loss, both of breeding grounds and foraging areas, as well as impacts to prey species, which are primarily sandeel (Frederiksen *et al.*, 2004; Nikolaeva *et al.*, 2006). A review of flight heights of birds at sea (Johnston *et al.*, 2014) found that kittiwake mostly fly below Collision Risk height (CRH), however, around 12.4% of flights are above 22 m (based on the maximum likelihood, as used in CRM), thus kittiwake are considered to be at high risk of collisions with operational wind turbine generators (WTGs) (Furness *et al.*, 2013; Bradbury *et al.*, 2014). Although kittiwake is less sensitive to disturbance and displacement effects (Furness *et al.*, 2013; Bradbury *et al.*, 2014; SNCB, 2022; NatureScot, 2023h), they are sensitive to reductions in prey availability, and therefore may be sensitive if displaced during the chick-rearing period (Searle *et al.*, 2018).

12.7.1.37 Kittiwake was the most abundant gull observed in the 24-month DAS period, where 2,203 indv. were recorded. There were more observations in the breeding season (an average of 189.1 indv. mo^{-1}) compared with the non-breeding season (19.5 indv. mo^{-1} on average). Peak counts were in June and July 2021 (290 and 220 indv., respectively) and August 2022 (988 indv.). The lowest counts were in December 2021 (2 indv.) and January and February 2022 (3 indv. mo^{-1}).

12.7.1.38 As kittiwake are sensitive to both distributional responses and collision risk, estimates were produced for the mean seasonal peak population within the OAA plus 2.0 km Buffer and the density of flying birds within the OAA. The estimated mean seasonal peak population for the OAA plus 2.0 km Buffer ranged from 220 indv. (95% CI: 49 – 595) in the non-breeding season to 3,718 indv. (95% CI: 1,382 – 7,987) in the breeding season. Density varied, ranging from 0.00 indv. km^{-2} in several months, typically December to March, to a peak of 12.73 indv. km^{-2} (95% CI: 6.81 – 21.21) in August 2022.

Great Black-backed Gull

12.7.1.39 Great black-backed gull nest on vegetated islands, dunes, rocky shores, and sometimes inland sites such as freshwater lakes and rivers (BirdLife International, 2023). Whilst at breeding colonies, adults forage up to 73.0 km (mean maximum plus 1 SD) from the nest (Woodward *et al.*, 2019). Outside of the breeding season, individuals spend time on the UK coasts, primarily in the North Sea (Kober *et al.*, 2010).

12.7.1.40 Great black-backed gull is an opportunistic species, with a varied diet comprising fish, other birds and eggs, mammals, insects, marine invertebrates, as well as carrion and refuse (del Hoyo *et al.*, 1996). Due to its diet, great black-backed gull is sometimes considered a threat to other bird species, preying on nests and young.

12.7.1.41 It is the least common of the large black-backed gulls with regular presence in the UK, with a population of 15,000 pairs in the breeding season (April to August; NatureScot, 2020) and 77,000 indv. in the winter (RSPB, 2024). As of the 2015 – 2021 census (Seabirds Count), Scotland supports the majority of the UK SPA breeding population of great black-backed gull (1,396 AON), an increase of 11% since the previous census (Seabird 2000: 1998 – 2002) (Burnell *et al.*, 2023). The species is on the UK BoCC Amber List (RSPB, 2024).

12.7.1.42 Threats to great black-backed gull include increased fishing efficiency, where the quantity of discards has reduced over recent years (Burger *et al.*, 2018). Furness *et al.* (2013) and Bradbury *et al.* (2014) determined that the species is at very high risk of collision with WTGs due to its flight height characteristics (Johnston *et al.*, 2014). With a 22 m lower tip height (air gap), 29% of flights are at CRH (based on the maximum likelihood, as used in CRM). Great black-backed gull is not sensitive to displacement from offshore wind farms (OWFs) (Furness *et al.*, 2013; Bradbury *et al.*, 2014; SNCB, 2022; NatureScot, 2023h),

12.7.1.43 Over the 24-month DAS period, 647 great black-backed gull were identified, 67 in Year 1 and 580 in Year 2. All except one (April 2022) observations were outside the breeding season, peaking at 470 indv. in January 2023. Approximately 59.1% of observations were adult birds, with 27.3% immature birds and 13.6% juvenile birds.

12.7.1.44 As the species is sensitive to collision, the density of flying great black-backed gull in the OAA was estimated. Great black-backed gulls were only recorded in the OAA in four surveys, in January and November 2022, and in January and February 2023. In months where birds were recorded flying in the OAA, the density ranged from 0.25 indv. km^{-2} (95% CI: 0.00 – 0.65) to 1.06 indv. km^{-2} (95% CI: 0.57 – 1.84).

European Herring Gull

12.7.1.45 Like great black-backed gull, herring gull is an opportunistic feeder; preying and scavenging on a wide range of food sources (del Hoyo *et al.*, 1996). The species also uses similar habitats and nest sites, although it has a smaller mean maximum plus 1 SD) foraging range of 85.6 km (Woodward *et al.*, 2019).

12.7.1.46 Some 130,000 pairs breed in the UK, and about three times as many (740,000 indv.) spend the winter in the British Isles (RSPB, 2023). It shares its seasonality with great black-backed gull, breeding in Scotland between April and August (NatureScot, 2020). The results of the latest census (Seabirds Count: 2015 – 2021) suggest that the breeding population at SPAs in Scotland is around 15,000 AON, representing just over half (51.7%)

of the UK population. Compared with the previous census (Seabird 2000: 1998 – 2002; Mitchell *et al.*, 2004), the breeding population has increased by 28% in Scotland and over 90% UK-wide.

12.7.1.47 As its characteristics and behaviours are similar, threats to the species are also similar to those of great black-backed gull (Furness *et al.*, 2013; Bradbury *et al.*, 2014; BirdLife International, 2023). The main threat to herring gulls associated with OWFs is collision with operational WTGs, with published flight heights (Johnston *et al.*, 2014) indicating around 28.5% of flights >22 m (based on the maximum likelihood, as used in CRM). It is not sensitive to displacement effects, associated with either the Array Area or vessel traffic (Furness *et al.*, 2013; Bradbury *et al.*, 2014; Fliessbach *et al.*, 2019; SNCB, 2022 NatureScot, 2023h).

12.7.1.48 Low numbers of herring gull were recorded in the DAS during the breeding season (10 in Year 1 and four in Year 2), however, more individuals were recorded in winter in both survey years, with peak counts in Year 2 (161 indv. in November 2022 and 171 in January 2023). In the OAA, a total of 14 herring gull were observed, six in Year 1 and eight in Year 2.

12.7.1.49 Herring gull density for the Array Area was modelled. Similar to great black-backed gull, very few individuals were recorded in the breeding season, therefore, the population and density estimates for the Site Specific Study Area were small (ranging from 0.00 indv. km^{-2} in several months to a peak of 3.85 indv. km^{-2} in November 2022). Due to low observations in the OAA, density was not modelled for this area, and the species is scoped out of quantitative collision assessment. In the OAA, in all months except March 2021, December 2021, January 2022, November 2022, and January 2023, flying herring gull density was 0 indv. km^{-2}. Where above 0 indv. km^{-2}, flying bird density ranged from 0.48 indv. km^{-2} (95% CI: 0.23 – 0.68) to 2.33 indv. km^{-2} (95% CI: 0.59 – 5.82).

12.7.1.50 In the OAA plus a 4.0 km buffer (applied for analyses and modelling), peak herring gull densities were recorded in November 2022 (3.85 indv km^{-2}) and January 2023 (3.71 indv. km^{-2}), with other months peaking at 0.35 indv. km^{-2}. These density peaks were associated with a tight cluster of records in one area of the survey, with similar clustering observed in other species (great black-backed gull, gannet, and fulmar). In January 2023, the cluster of birds was associated with the presence of an active fishing vessel in the east of the 4.0 km buffer (HiDef, 2023). In November 2022, no vessel presence was noted in the DAS report (HiDef, 2023). As DAS provided approximately 12% coverage of the OAA, it is possible that objects (e.g. vessels) on the periphery of or outside the transect view were not recorded but did influence bird distribution. It is also possible that a fishing vessel was present shortly prior to the transect being flown, thus, only the aftermath could be observed during the DAS. Therefore, the increased densities of herring gull present in November 2022 and January 2023 have been attributed to vessel activity: associated with a fishing vessel not observed in the DAS, residual birds remaining in the area following passage of a fishing vessel, or birds feeding on fishing discards once a vessel has left the area.

Auks

12.7.1.51 Species accounts for the three auk species recorded within the Study Area are presented below. As auks were the most abundant group of species recorded and showed a high degree of interannual variation, a discussion on general auk distribution and abundance within the region is presented after the individual species accounts.

Common Guillemot

12.7.1.52 Guillemot is a common breeding species in the UK nesting on coastal cliffs and foraging offshore during the breeding season (BirdLife International, 2023). Over winter, birds move away from breeding colonies to exploit foraging areas at sea (NatureScot, 2020).

12.7.1.53 The Scottish guillemot population begins to arrive at nesting sites on cliffs and ledges in February and March, before nesting and breeding from March to mid-August (NatureScot, 2020). During the breeding season and chick-rearing period, including Fair Isle colonies, guillemot forage up to 153.7 km (mean maximum plus 1 SD) from the coast (Woodward *et al.*, 2019), with one parent foraging at sea whilst the other attends the nest site (BirdLife International, 2023). Guillemots are pursuit divers, spending around 24% of the time underwater (Thaxter *et al.*, 2010), foraging, primarily for sandeel (Anderson *et al.*, 2014), at depths up to 180 m (Piatt and Nettleship, 1985).

12.7.1.54 At the end of the breeding season, in August and September through to mid-October, guillemot undergo a flightless moult period. During this time, adults and juveniles form dense aggregations on the sea surface. Several factors can influence auk distribution and abundance, including SST and adverse weather conditions (Buckingham *et al.*, 2022), high productivity and prey hotspots (Jessopp *et al.*, 2013; Gaston *et al.*, 2017), and prey availability (Christie, 2021; Buckingham *et al.*, 2023).

12.7.1.55 Following the flightless moult stage, guillemot spend the winter period (September to January) at sea (NatureScot, 2020). Winter distribution is greatly influenced by prey availability, with areas of heightened guillemot activity recorded shortly after the moult period, associated with time-limited prey hotspots (Jessopp *et al.*, 2013).

12.7.1.56 Guillemot is the most abundant auk in the world, with a global population estimate of over 18 million, with up to three million individuals in the European population (BirdLife International, 2023). The UK breeding population is estimated at 1.4 – 1.9 million indv. (Mitchell *et al.*, 2004; RSPB, 2024), with Scotland supporting up to 1.2 million of those (Mitchel *et al.*, 2004).

12.7.1.57 Although the UK seabird censuses (Operation Seafarer, 1969 – 1970; Seabird Colony Register, 1985 – 1988; and Seabird 2000, 1998 – 2002) show the population is increasing (from just over 600,000 indv. in 1969 – 1970 to over 1.4 million in 1998 – 2002 (Mitchell *et al.*, 2004), guillemot is on the UK BoCC Amber List (RSPB, 2023). Due its high global population (>18 million) and large range (>80 million km^2), it is listed as 'Least Concern' (LC) on the IUCN Red List (BirdLife International, 2023). UK SPA populations of guillemot showed a 14% increase since Seabird 2000 (1998 – 2002), reaching 1,259,327 indv. (Seabirds Count:2015 – 2021), however, the Scottish SPA population decreased by 20% to 749,978 indv. (Burnell *et al.*, 2023).

12.7.1.58 Whilst the Scottish population shows a general increase, there is a high degree of variation in the region, in terms of abundance (Cork Ecology, 2017; Seagreen Wind Energy, 2018a; HiDef, 2022), distribution (Buckingham *et al.*, 2022; Buckingham *et al.*, 2023), and productivity (Newell *et al.*, 2016; Lloyd *et al.*, 2019; Outram and Steel, 2023).

12.7.1.59 There are several threats to guillemot populations in Europe and the UK. Threats to the species primarily relate to prey availability, but also to anthropogenic activity and to climate variables.

12.7.1.60 Guillemots are reliant on the availability of small prey fish, especially sandeel, with collapses in the sandeel stock leading to substantial reductions in breeding populations (e.g. Nettleship *et al.*, 2018). Irish Sea guillemot colonies suffered a sharp decline in the mid-1950s, which has been associated with pollution from sunken World War II vessels (Birkhead, 2016). Irons *et al.* (2008) found that the species is sensitive to changes in SST, with a 1°C change leading to an annual population decline of around 10%. Although not linked to specific declines in population, Buckingham *et al.* (2022) suggest that distribution is linked to SST.

12.7.1.61 The risk of guillemot collision with operational WTGs is low (Bradbury *et al.*, 2014), with just 0.2% of flights at altitudes greater than 22 m, based on the maximum likelihood of generic flight height data by Johnston *et al.* (2014). Disturbance and displacement effects are considered to be a greater threat (Furness *et al.*, 2013; Bradbury *et al.*, 2014), with published guidance recommending that displacement and mortality rates of up to 60% and 5%, respectively are considered when assessing impacts from offshore wind developments (NatureScot, 2023h). Due to its foraging strategy and prey specialism, guillemot may be particularly sensitive if displaced from foraging areas during the chick-rearing period (Searle *et al.*, 2018).

12.7.1.62 Guillemot was the most abundant species recorded in the 24-month DAS period, with a total of 17,877 indv. recorded across the Site Specific Study Area, representing over half of all bird observations. Average monthly breeding season observations were greater than in the winter (946 indv. mo^{-1} and 220 indv. mo^{-1}, respectively), however, the greatest concentration of observations was in the post-breeding moult period in Year 2 (August to mid-October 2022). Here, a cumulative total of 9,966 indv. were observed, representing 55% of all guillemot records; no notable peak in abundance was recorded in Year 1 (summer 2021).

12.7.1.63 Mean seasonal peak population estimates within the OAA plus 2.0 km Buffer were produced for guillemot. The breeding season peak of 3,616 indv. (95% CI: 2,898 – 4,442) was around one third of the non-breeding season of 11,779 indv. (95% CI: 10,620 – 13,033). The monthly maximum population estimates ranged from 82 indv. (95% CI: 182 – 266) to 19,502 indv. (95% CI: 17,814 – 21,270) in January 2023 and August 2022, respectively. Population estimates discussed above account for availability bias, where approximately 24% of guillemot are assumed to be diving at the time of the surveys.

Razorbill

12.7.1.64 Similar to guillemot, razorbill breeds on cliff ledges and under boulders (Nettleship, 1996; Lavers *et al.*, 2020). Razorbills are pursuit divers, foraging for small fish at depths up to 120 m (Piatt and Nettleship, 1985). Razorbill can consume a range of prey items, including krill (Euphausiacea) and sprat (*Sprattus sprattus*) (Nettleship, 1996), however, it primarily targets sandeel and reductions in sandeel abundance are considered a threat to populations (Sandvik *et al.*, 2005). Through meta-analysis, Woodward *et al.* (2019) found that, including Northern Isle colonies, razorbill forage up to 164.6 km (mean maximum plus 1 SD) from the coast during the breeding season.

12.7.1.65 Like guillemot, in August and September through to mid-October, razorbill also undergo a flightless moult period. Juvenile birds loaf on the sea surface with their parents during this period, with distribution influenced by a number of factors, such as SST and weather (Buckingham *et al.*, 2022), productivity and prey hotspots (Jessopp *et al.*, 2013; Gaston *et al.*, 2017), and prey availability (Christie, 2021; Buckingham *et al.*, 2023).

12.7.1.66 Razorbills spend the winter period (September to January) mostly at sea, however, are considered a coastal species as they are generally recorded up to 10 km from land (Huettman *et al.*, 2005). However, as with guillemot, distribution is influenced by prey availability (Jessopp *et al.*, 2013).

12.7.1.67 The global population of razorbill is estimated at up to 2.5 million birds, with just over one million residing in Europe (BirdLife International, 2023). RSPB (2024) estimates that the UK population is around 165,000 breeding pairs, while Mitchell *et al.* (2004) recorded it as 187,052 indv. in the 1998 – 2002 seabird census, an increase of 21% since the 1985 – 1988 census. Almost three quarters of the UK population breeds in Scotland (Mitchell *et al.*, 2004), with the census showing 139,186 indv. present in the breeding season (April to mid-August; NatureScot, 2020). According to the latest census (Seabirds Count: 2015 – 2021), the

UK-wide SPA population of razorbill has increased by over 60% since Seabird 2000 (1998 – 2002) to 221,061 indv., with the Scottish population increasing by around 25% to 123,627 indv. (Burnell *et al.*, 2023).

12.7.1.68 Razorbill are listed as LC on the IUCN Red List (BirdLife International, 2023) and are on the UK BoCC Amber List (RSPB, 2024).

12.7.1.69 Threats to North Sea and North Atlantic razorbill populations include those associated with prey availability, climate change, and conflict with anthropogenic activity (BirdLife International, 2023). Several factors are confounding, linked to the availability of prey and effects on foraging success. For example, climate change has been linked to a reduction in sandeel populations and effects on razorbill populations (Sandvik *et al.*, 2005), competition with fisheries as well as SST can cause reduced prey availability (Heath *et al.*, 2009), and disturbance effects can reduce energy intake as well as increase energy expenditure.

12.7.1.70 Furness *et al.* (2013) found that razorbill is at low risk of collision with ~99% of flights below the minimum blade tip, based on the maximum likelihood generic flight height distribution data (Johnston *et al.*, 2014).

12.7.1.71 Razorbill were observed in moderate to high numbers. The abundance of razorbill in the Site Specific Study Area varied over the 24-month DAS period, ranging from zero birds in March 2021 and in January and February (2022 and 2023) to a peak of 253 indv. in August 2022. The majority of birds were recorded in the breeding season (562 out of 641 total), averaging 56.2 indv. mo^{-1}.

12.7.1.72 The mean seasonal peak population estimates within the OAA plus 2.0 km Buffer were produced for razorbill. Availability bias was taken into consideration (individuals spend around 18% of the time diving; Thaxter *et al.*, 2010). As with guillemot, the breeding season peak of 334 indv. (95% CI: 246 – 452) was lower than the non-breeding season peak of 484 indv. (95% CI: 279 – 777). The monthly maximum population estimates ranged from 0 indv. (typically, December to March) to 528 indv. (95% CI: 399 – 696) in June 2021. Density estimates for the OAA are not presented as razorbill are not sensitive to collision.

Atlantic Puffin

12.7.1.73 Although often associated with similar cliff habitats as guillemot and razorbill, puffin nest in burrows on grassy cliff tops, rather than on ledges (Nettleship *et al.*, 2014). During the breeding season (April to mid-August; NatureScot, 2020), adult puffin forage up to 265.4 km (mean maximum plus 1 SD) from the colony (Woodward *et al.*, 2019), diving up to 60 m (Piatt and Nettleship, 1985) for prey. Puffins spend around 14% of time during the day underwater (Spencer, 2012). Although puffin do consume a range of prey items (Barrett *et al.*, 1987), sandeel make up the majority of the diet (RSPB, 2024). During periods of lower sandeel availability, puffin can switch to alternative prey, however, this has been linked to reduced breeding success (Wanless *et al.*, 2005).

12.7.1.74 The global puffin population is estimated to be between 12 and 14 million indv. (BirdLife International, 2023). Of these birds, Mitchel *et al.* (2004) and RSPB (2024) suggest that up to 1.2 million (up to 10% of the global population) breed in the UK (580,714 Apparently Occupied Burrows (AOB)), a 19% increase since 1985 – 1988 and 37% since 1969 – 1970. Scotland supports 17.8% (493,042 AOB) of the UK population.

12.7.1.75 The latest census in the UK (Seabirds Count) was undertaken from 2015 – 2021 (Burnell *et al.*, 2023). For puffin, two datasets were collected at UK-wide SPAs: the full count and a comparable count. Based on the full count, the population estimates for puffin are 477,203 AOB in the UK, with over three quarters of that (359,540 AOB) located in Scotland. When comparing with previous data (Seabird 2000: 1998 – 2002; Mitchell *et al.*, 2004), this suggests a 10% decline at SPAs UK-wide, with a 30% decline at Scottish SPAs.

12.7.1.76 Puffin is listed as VU on the IUCN Red List as the European population has seen rapid declines in recent years (BirdLife International, 2023), and it is on the UK BoCC Red List due to threats to the species (RSPB, 2023).

12.7.1.77 Similar to the other auk species in the UK, puffin populations are threatened by climate change impacts (e.g. increased SST) and shifts in prey distribution, due to both natural and anthropogenic factors (Durant *et al.*, 2003, Sandvik et al., 2005). Food shortages, due to mismatches in prey abundance and breeding seasons, extreme weather events, and competition between puffin and commercial fisheries have been linked to reduced breeding success (Breton and Diamond, 2014; Melillo *et al.*, 2014; Anker-Nilssen *et al.*, 2016; Newell *et al.*, 2016).

12.7.1.78 As puffin nest in burrows on grassy clifftops, slopes, and hills near the coast, they can be susceptible to mammalian predators, such as rats (*Rattus* spp.) and the invasive American mink (*Neovison vison*) (Harris and Wanless, 2011). However, recolonisation and recovery have been observed following eradication of predators (Lock, 2006).

12.7.1.79 Offshore windfarms can displace puffin (Furness *et al.*, 2013; Bradbury *et al.*, 2014). Due to the species flight height characteristics (Johnston *et al.*, 2014), the species is not considered to be sensitive to collision with operational WTGs (Bradbury *et al.*, 2014).

12.7.1.80 In the Site Specific Study Area, a total of 2,157 puffin were recorded over the two years. The species was more common in Year 2 than in Year 1 (1,844 indv. and 313 indv., respectively). Peak observations were in August 2022 (Year 2), when over 75% of all puffin observations were recorded (1,553 indv.). In the OAA plus 2.0 km Buffer, a total of 365 puffin were observed, with a peak of 237 indv. in August 2022.

12.7.1.81 As puffin are sensitive to distributional responses, the population within the OAA plus 2.0 km Buffer was estimated, adjusted for availability bias, with birds assumed to spend up to 14.2% of the time underwater (Spencer, 2012). During the non-breeding season, puffin is considered to be pelagic, and therefore, not affected by the presence of WTGs. In the breeding season (April to mid-August; NatureScot, 2020), the mean seasonal peak population was 357 indv. (95% CI: 290 – 441). As puffin are not sensitive to collision, density estimates within the OAA are not presented.

Variation in Auk Abundance

12.7.1.82 The number of auks observed in the DAS showed substantial variation between the first and second years of surveys, with the most notable changes observed in August and September. In August and September 2022, guillemot abundance was approximately four times that observed in the same months the previous year (**Figure 12-2**). Razorbill and puffin showed similar trends, albeit with lower overall abundances, in August of each year (**Figure 12-3 and Figure 12-4,** respectively). The numbers of each species observed in the Site Specific Study Area each month are presented in the Year 2 Digital Aerial Survey Report (HiDef, 2023).

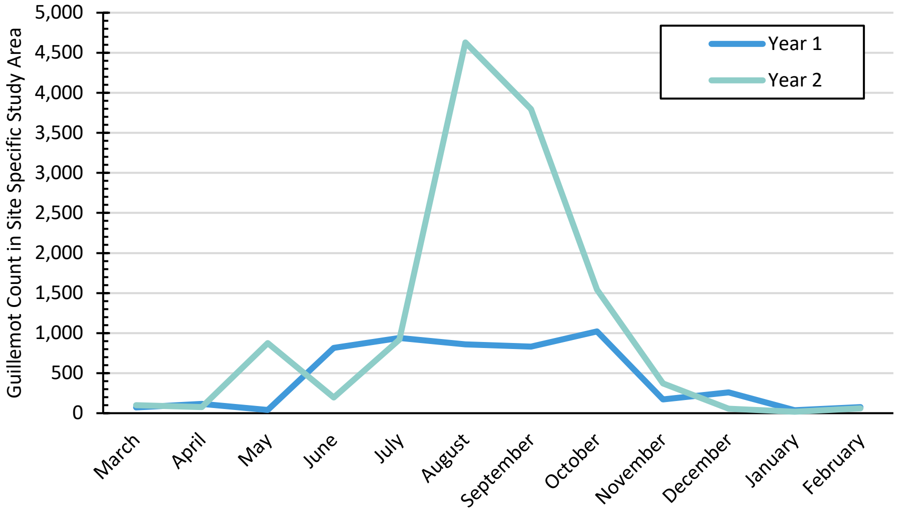

Figure 12-2 Monthly digital aerial survey counts of common guillemot (*Uria aalge*) at the Salamander Project in Year 1 (2021 – 22) and Year 2 (2022 – 23)

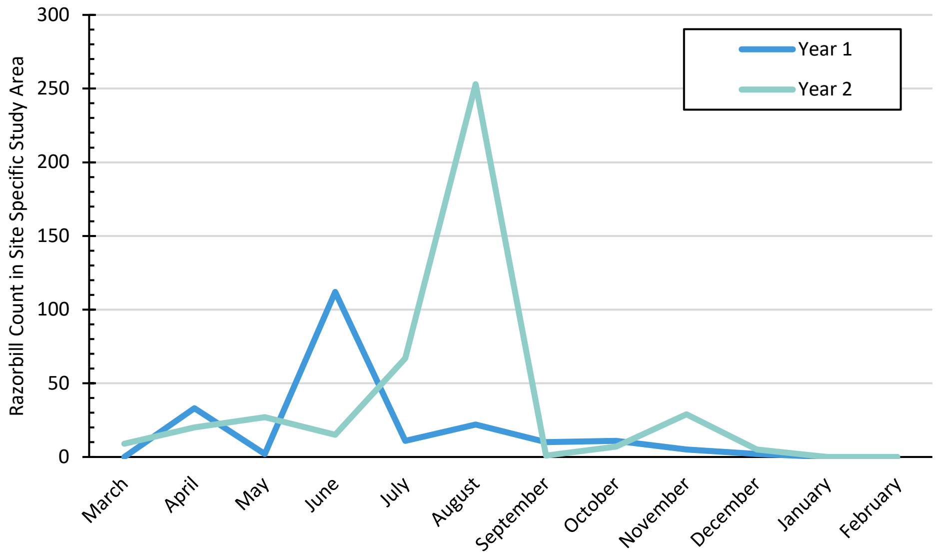

Figure 12-3 Monthly digital aerial survey counts of razorbill (*Alca torda*) at the Salamander Project in Year 1 (2021 – 22) and Year 2 (2022 – 23)

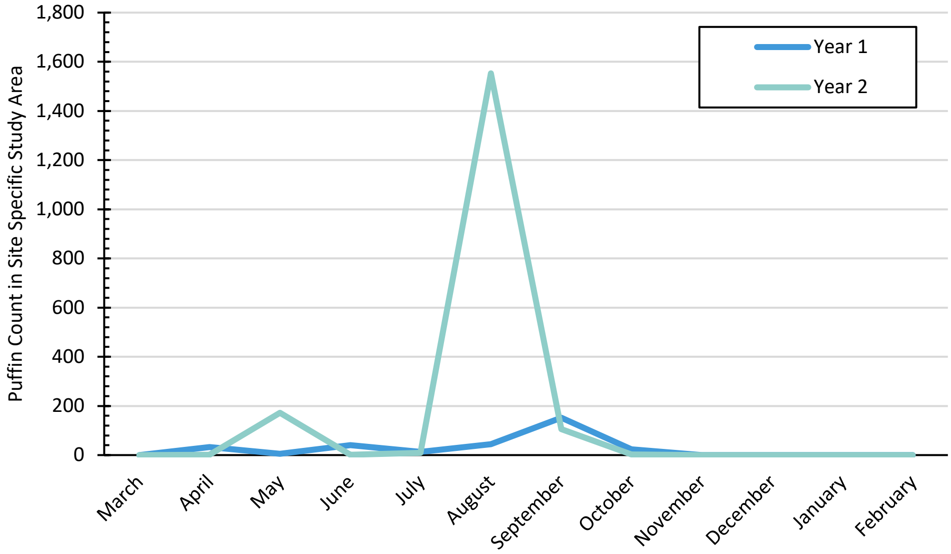

Figure 12-4 Monthly digital aerial survey counts of Atlantic puffin (*Fratercula arctica*) at the Salamander Project in Year 1 (2021 – 22) and Year 2 (2022 – 23)

12.7.1.83 Variations have been observed at other Scottish OWFs on the east coast (Cork Ecology, 2017; Seagreen Wind Energy, 2018a; HiDef, 2022), as described in detail in response to NatureScot's comments on the Final DAS Report. Where variations in abundance were investigated at existing projects (e.g. Seagreen A and B), the variation was attributed to increased kittiwake and auk prey availability, resulting in a higher number of foraging birds (Seagreen Wind Energy, 2018b). As such, the variation in the numbers of auks observed within the Site Specific Study Area is not unexpected or considered unusual. An overview of the variation at other OWFs in August and September is presented in **Table 12-10**.

Table 12-10 The range of auk counts for August and September and the peak and low counts (individuals) recorded during the baseline surveys at four Scottish east coast offshore wind farms

Project	Indv.			
	August	**September**	**Peak**	**Low**
Common Guillemot (Uria aalge)				
Salamander	858 – 4,629	831 – 3,795	4,629 (August)	37 (January)
Berwick Bank	11,899 – 14,250	1,813 – 17,021	22,527 (April)	733 (November)
Neart na Gaoithe	27 – 4,857	1,400 – 2,222	7,020 (October)	27 (August)
Seagreen A and B	820 – 1,556	138 – 1,445	23,418 (July)	138 (September)
Razorbill (Alca torda)				
Salamander	22 – 253	1 – 10	253 (August)	0 (January-March)

Project	Indv.			
	August	September	Peak	Low
Berwick Bank	907 – 1,209	516 – 5,353	5,353 (August)	133 (June)
Neart na Gaoithe	78 – 1,529	182 – 723	2,655 (October)	0 (January)
Seagreen A and B	545 – 2,318	1,447 – 1,985	11,933 (July)	145 (October)
Atlantic Puffin (Fratercula arctica)				
Salamander	45 – 1,553	105 – 152	1,553 (August)	0 (November-March)
Berwick Bank	624 – 865	393 – 3,281	3,281 (September)	0 (December)
Neart na Gaoithe	496 – 3,507	336 – 832	3,812 (April)	0 (November-February)
Seagreen A and B	1,449 – 3,651	2,797 – 6,849	8,224 (June)	0 (January)

12.7.1.84 Auk abundance is largely influenced by environmental parameters (e.g. Fort *et al.*, 2012; Buckingham *et al.*, 2022), as well as breeding success for the season (e.g. Newell *et al.*, 2016; Outram and Steel, 2023). SST, sea fronts, and prey availability are commonly discussed factors associated with auk distribution (Fort *et al.*, 2012; Jessopp *et al.*, 2013; Gaston *et al.*, 2017; Linnebjerg *et al.*, 2018; Johns *et al.*, 2020; Buckingham *et al.*, 2022).

12.7.1.85 Adverse weather conditions, such as high winds, high rainfall, and / or extreme temperatures have been linked to auk abundance (Heubeck *et al.*, 2011; Buckingham *et al.*, 2022). MetOffice (2024) wind speed and air temperature at midday, and cumulative daily rainfall data were acquired from Ventusky (2024) for the five days prior to each survey. The weather conditions in the days leading up to each survey showed variation, although the differences between years (2021 and 2022) were not considered significant. When compared with the numbers of guillemot, as a representative species for auks, observed in the surveys, the five-day average shows no correlation (**Figure 12-5**). Although adverse weather can affect auks, this is more commonly associated with winter storms (Heubeck *et al.*, 2011). The data presented here suggest that weather conditions (specifically wind speed, rainfall, and air temperature) are unlikely to have resulted in the changes in auk numbers between August and September 2021 and 2022.

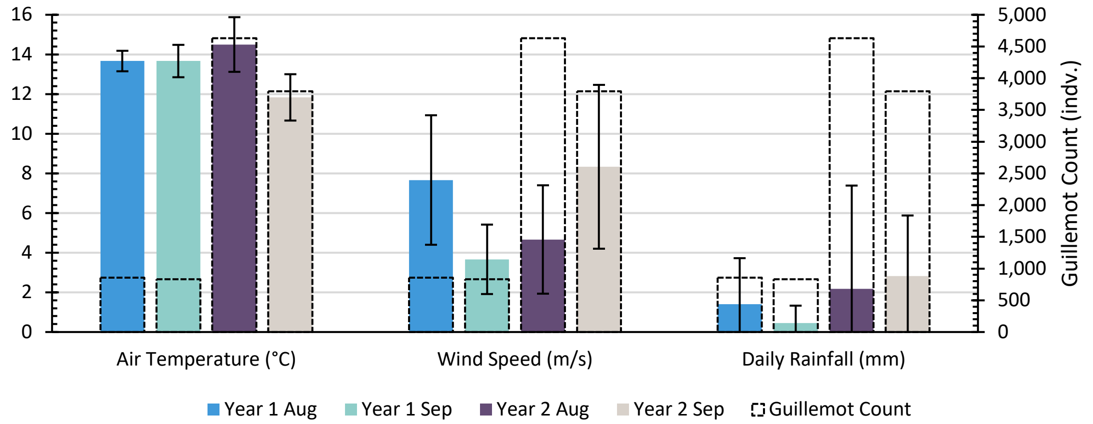

Figure 12-5 Average and standard deviation of air temperature (°C) and wind speed (m/s) at noon and cumulative daily rainfall (mm) in the five days leading up to the August and September Digital Aerial Surveys (Source: Ventusky, 2024) overlain with common guillemot (*Uria aalge*) count within the Site Specific Study Area

12.7.1.86 SST data for the DAS dates (19 and 17 August and 7 and 20 September 2021 and 2022) were acquired from Copernicus (2023). In August, SST was marginally higher in Year 2 (2022) than in Year 1, whilst the opposite was true for September, with higher SST observed in Year 1 than in Year 2 (**Table 12-11**). It should be noted that SST in the weeks and months leading up to the survey dates may also have influenced auk abundance, however, data are available on a daily basis, and therefore, the full time series for each breeding season or moult period is not presented.

Table 12-11 Sea Surface Temperature within the Site Specific Study Area for the August and September Digital Aerial Survey dates in Year 1 and Year 2 (Source: Copernicus, 2023)

Date	Year	Sea Surface Temperature (SST) (°C)			
		Minimum	Maximum	Average	Standard Deviation
19 August 2021	1	14.10	14.75	14.31	0.14
17 August 2022	2	15.58	16.20	15.89	0.16
07 September 2021	1	14.97	15.54	15.28	0.13
20 September 2022	2	13.95	14.25	14.07	0.06

12.7.1.87 Whilst SST is a contributing factor in auk distribution (Fort *et al.*, 2012), it is believed that this is largely as a proxy to prey distribution (Linnebjerg *et al.*, 2018; Buckingham *et al.*, 2023), rather than a direct reaction to temperature. SST can also affect breeding success, with a 1°C change associated with a 10% decrease in productivity (Irons *et al.*, 2008), however, this is an average over a multiple month period, and SST can also be linked to prey availability.

12.7.1.88 Fronts, as areas of higher productivity, can be associated with auk abundance and distribution. Fronts are the boundary where well-mixed and vertically stratified waters meet and are typically associated with local patterns of enhanced nutrient distribution and ecosystem development. As shown on **Figure 12-6**, a sea front moved through the OAA in 2022, particularly in May and September, although was also present on the Offshore ECC from June to August. No such sea front was observed during August and September 2021.

12.7.1.89 The presence of this front, along with differences in SST and vertical stratification, may have influenced auk abundance and distribution in the region. The Site Specific Study Area only covers a small proportion of the front, which can extend several hundred kilometres (Hill *et al.*, 1993; Hill *et al.*, 2005), and only partially covers stratified waters. Therefore, effects can only be inferred.

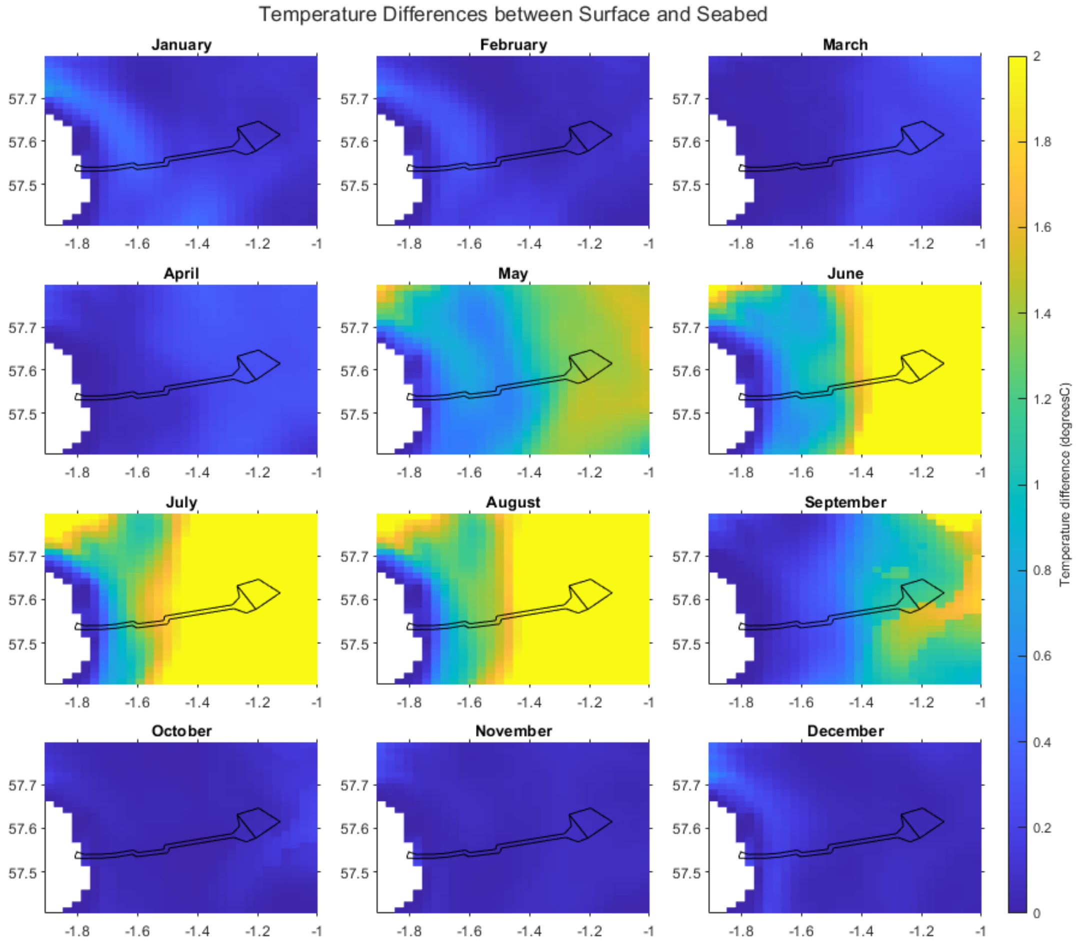

Figure 12-6 Monthly average near-surface to near-bed temperature differences across the Offshore Development Area throughout 2022, showing movement of a front through from May to September (Source: Copernicus, 2023)

12.7.1.90 The number of harmful algal bloom events in Scottish coastal waters is increasing. Toxins from such blooms have been detected in a range of fish species, including Atlantic mackerel (*Scomber scombrus*) and Atlantic herring (*Clupea harengus*), which play a key role in the diet of auks (Kershaw *et al.*, 2021). It may be the case that toxins resulted in an increase in prey mortalities, or changes in prey availability and distribution, causing auks to alter their distribution in accordance with their food source. However, there is no empirical evidence that this is the cause of the interannual variation in auk abundance observed. What is recognised is that toxins associated with algal blooms may be harmful to seabirds themselves and the complex predator-prey dynamics they partake in, thus potentially playing a role in the abundance and variations seen between and within aerial surveys, however it is not yet understood to what extent (Gobler, 2020; Scottish Government, 2022b).

12.7.1.91 It is likely that prey distribution (driven by environmental conditions) is the primary driving factor in auk distribution, where anthropogenic factors (e.g. disturbance) do not play a direct role. Auks primarily forage on sandeel species (Sandvik *et al.*, 2005; Anderson *et al.*, 2014; RSPB, 2024), therefore, information on sandeel distribution and abundance is discussed below.

12.7.1.92 Sandeel aggregations may be able to explain the auk numbers, with an inherent link to abundance, distribution, and breeding success. Review of published literature and reports, as well as sandeel survey results, identified no datasets which are both spatially and temporally relevant. Fisheries data were largely low resolution, providing limited relevant information on sandeels in the Offshore Development Area for August and September 2021 and 2022 specifically.

12.7.1.93 Several factors can affect the distribution of sandeels, including depth, slope, temperature, salinity, currents and waves, primary production, and sediment composition (Franco *et al.*, 2022). Depth, slope, and sediment composition are largely consistent from year to year, with only minor variations expected. Franco *et al.* (2022) found that current and wave energy were the most influential factors in predicting sandeel aggregations, with low energy typically characterising sandeel grounds. In higher energy environments, seabed temperature, salinity, and primary production contributed to sandeel aggregations.

12.7.1.94 In addition to prey abundance and environmental factors, productivity during the 2021 and 2022 breeding season, and specific fledging dates for the nearest auk colonies may have an effect on the abundance of birds observed in the Site Specific Study Area. The RSPB and BTO were contacted for data at their respective sites; however, no information on 2021 and 2022 fledging success rates and dates were available at the time of writing. Fledging dates were also not available through the SMP data.

12.7.1.95 During the 24-month DAS, several deceased seabirds were recorded and identified to species-level where possible. The majority of these were gannet, however, a small number of auks were also recorded. In the Site Specific Study Area, four deceased auks were present, one of which was located within the OAA. It was not possible to differentiate between guillemot and razorbill. Given the size of the regional population of auks, the number of HPAI or suspected HPAI mortalities for these species was fairly small.

12.7.1.96 Across the whole of Scotland, the minimum guillemot casualties attributed to HPAI is 1,908 birds (NatureScot, 2023l, 2023m). Only four deceased auks were recorded in the survey area across all survey periods, with just one recorded in the OAA itself. It is noted that one or two auk colonies were more strongly affected by HPAI than others, however, the likely catchment for the Site Specific Study Area overall was not greatly affected. Given the size of the regional population of auks and kittiwake the number of HPAI or suspected HPAI mortalities observed for these species was relatively small. The DAS results are not considered to be notably influenced by HPAI.

12.7.1.97 With the data available, it is not possible to confidently identify the reason for the change in auk abundance between Year 1 and Year 2 in August and September. As described, there is a large number of factors that can affect the distribution of these species, ranging from anthropogenic influences, such as disturbance, to disease outbreaks, weather conditions and prey availability.

12.7.1.98 However, the difference in abundance is not considered unusual or unexpected. Similar levels of monthly and yearly variation have been observed at existing OWF sites on the Scottish east coast. The high numbers of auks, therefore, have not been discounted as outliers, but have been considered in the impact assessment. The baseline population estimates were established by calculating the seasonal peak mean for the breeding and non-breeding season; and impacts are assessed against the regional populations for each species.

Tubenoses

12.7.1.99 Petrels and shearwaters, or 'Tubenoses', are birds in the order Procellariiformes, with the common name arising from the external salt glands on the top of the bill. The group includes petrels, storm petrels, shearwaters, albatrosses, and fulmars. Two tubenoses were recorded in the Site Specific Study Area: storm petrel and fulmar, however, storm petrels were observed in very low numbers and scoped out of assessment.

Northern Fulmar

12.7.1.100 In the breeding season (April to mid-September; NatureScot, 2020), fulmar inhabit cliffs and rockfaces, using ledges to nest, although the species has been known to nest on ledges of buildings in coastal towns and flatter areas up to 1 km inland (BirdLife International, 2023). Whilst attending the breeding colony, fulmar can make extensive trips in search of food, with a mean maximum plus 1 SD foraging range of 1,182.2 km (Woodward *et al.*, 2019). Outside the breeding season, birds are not tied to a specific colony and are largely pelagic. Fish, squid and zooplankton make up the majority of its diet (del Hoyo *et al.*, 1992).

12.7.1.101 The global fulmar population trend is increasing, with the most recent measurement showing a population of around seven million breeding pairs or a total of 20 million birds (Carboneras *et al.*, 2016). The European population is estimated to be up to 3.5 million pairs (BirdLife International, 2023), with around 500,000 AOS in the UK (Mitchell *et al.*, 2004). In the winter, the UK supports between 1.4 and 1.8 million fulmar (RSPB, 2024). Scotland supports almost the entire UK breeding population (485,852 AOS), a 4% decrease since the previous census in 1985 – 1988. From 2015 – 2021, the SPA populations of fulmar were counted as part of the latest census (Seabirds Count). The results show that around 88% of the UK SPA population of fulmar are located in Scotland: 188,001 AON are in Scottish SPAs and 213,049 in SPAs UK-wide (Burnell *et al.*, 2023).

12.7.1.102 Due to its high global population, increasing population trend, and the large spatial extent of its range, fulmar is listed as LC on the IUCN Red List (BirdLife International, 2023). However, in the UK, the population has not seen the same trend as the global population (Mitchell *et al.*, 2004), therefore, the species is on the UK BoCC Amber List (RSPB, 2024).

12.7.1.103 There are several threats to fulmar populations, including predation from invasive mammals, bycatch in fisheries, and plastic ingestion (BirdLife International, 2023). At some breeding colonies, rats, domestic and feral cats (*Felis catus*), and red fox (*Vulpes vulpes*) have been observed feeding on eggs and chicks, resulting in reduced breeding success (Mendel *et al.*, 2008). In the North East Atlantic, fulmar have been recorded as bycatch in longline, trawl, and gill-net fisheries (Dunn and Steel, 2001; Anderson *et al.*, 2011; Žydelis *et al.*, 2013), however, these have not been attributed as contributing to population decline (BirdLife International, 2023). Almost all beached fulmar recovered from the North Sea had plastic ingestion (van Franeker *et al.*, 2011; Trevail *et al.*, 2015), and most individuals exceeded the acceptable limit of 0.1 g under the OSPAR agreement.

12.7.1.104 Fulmar sensitivity to displacement and collision at OWF developments is largely unknown, however, Furness *et al.* (2013) suggest that it has a very low sensitivity to displacement and a low sensitivity to collision. Fulmar are considered to be at low risk of displacement impacts, with studies suggesting the species displays a weak avoidance reaction to OWFs (Dierschke *et al.*, 2016), potentially due to a lack of fishing vessels (Neumann *et al.*, 2013; Braasch *et al.*, 2015). Based on generic flight height distribution data (Johnston *et al.*, 2014), most fulmar flights are at altitudes below 22 m, with just 0.6% above 22 m (based on the maximum likelihood proportion of flights within each 1-metre height band), suggesting it has a very low risk of collision with operational WTGs. However, individuals may fly at higher altitudes in stronger winds and adverse weather (Spear and Ainley, 1997; Ainley *et al.*, 2015).

12.7.1.105 Fulmar were observed in moderate to high numbers in the DAS in the Site Specific Study Area, with counts ranging from four in March 2021 to 3,782 in January 2023. A total of 7,650 birds were recorded, 287 of which were within the OAA. The fulmar population density within the OAA ranged from 0.00 indv. km^{-2} in March and April to 38.34 indv. km^{-2} in November 2022.

Gannets

12.7.1.106 Gannet is the only species in the Sulidae order with regular presence in the UK (British Ornithologists' Union, 2022). During the breeding season (mid-March to September; NatureScot, 2020), gannet aggregate in large colonies on cliffs and offshore islands (BirdLife International, 2023). During this time, the species has an extensive foraging range (457.5 km; mean maximum plus 1 SD; up to 709 km (Woodward *et al.*, 2019)). Gannets are plunge-divers, circling above the water to locate prey, which primarily comprises shoaling pelagic fish, then diving from altitudes of around 11 – 60 m, with maximum altitudes of around 100 m (Garthe *et al.*, 2014). Diving from such altitudes allows gannet to reach speeds of up to 54 m s^{-1} (≈120 mph). Despite the high impact speed, Garthe *et al.* (2014) recorded an average dive depth of 4.2 m, with a maximum of 9.2 m. Similar results were obtained by Ropert-Coudert *et al.* (2009), where plunge depths reached a maximum of 11 m; however, underwater wingbeats allowed individuals to more than double diving depths to around 24 m.

12.7.1.107 The global population is estimated at 1.5 – 1.8 million birds, with Europe forming up to 94% of this (1.37 million indv.) (BirdLife International, 2023). The UK population is around 295,000 pairs (Mitchell *et al.*, 2004; Murray *et al.*, 2015; RSPB, 2024), and the 1998 – 2002 census (Seabird 2000) results show there were 243,505 AON / AOS in Scotland, representing over 80% of the UK population. In Scotland, the population increased by 32% between 1969 – 1970 and 1985 – 1988, a further 43% by 2003 – 2004, and by another 33% between 2003 – 2004 and 2013 – 2014 (Murray *et al.*, 2015). The latest census, conducted from 2013 – 2015 (Gannet Census) and 2015 – 2021 (Seabirds Count), suggests that the populations of gannet in UK SPAs has doubled since the previous gannet census in 2003 – 2005, reaching 349,804 AON / AOS in UK-wide SPAs and 252,369 AON / AOS in Scottish SPAs (Burnell *et al.*, 2023). The European population trend is also estimated to be increasing (BirdLife International, 2023). Gannet are marked as LC on the IUCN Red List, however, are on the UK BoCC Amber list (RSPB, 2024).

12.7.1.108 Threats to gannet populations include bycatch in commercial fisheries, interaction with anthropogenic activity and developments, pollution such as oil and plastic, and avian influenza. In the Atlantic, especially in Portuguese waters, gannet is at risk of entanglement and bycatch in demersal longline, as well as set-nets and purse-seines (Oliveira *et al.*, 2015). Plastic ingestion is also considered a threat to populations, resulting in malnutrition and reduced breeding success (Pierce *et al.*, 2004).

12.7.1.109 Due to breeding colony characteristics (i.e., large numbers of nests near to one another), gannet is at risk of bird flu. In 2022, gannet colonies in Scotland were affected by the increased magnitude of HPAI (NatureScot, 2023l, 2023m); which may have continued into 2023, with several deceased gannets observed in the Site Specific Study Area. Population-level effects of the 2022 and 2023 HPAI seasons are not yet observable in available data or reviewed studies, although some colonies (e.g. Bass Rock) are showing early signs of recovery, with population increases of over 150% (Tyndall *et al*, 2024).

12.7.1.110 Although Bradbury *et al.* (2014) assessed gannet as at very low risk of displacement effects from OWFs, studies have shown that up to 70% of individuals can be displaced from within the OAA (SNCB, 2022; NatureScot, 2023h). Due to their flight height characteristics, gannet is considered to be at high risk of collision with operational WTGs (Furness *et al.*, 2013; Bradbury *et al.*, 2014). Generic flight height distribution data (Johnston *et al.*, 2014) suggest that approximately 10.2% of flights are at altitudes greater than 22 m (based on the maximum likelihood, as used in CRM).

12.7.1.111 A total of 806 gannet were observed in the Site Specific Study Area during the 24-month DAS period, 382 indv. in Year 1 and 424 indv. in Year 2. The peak counts in each year were 210 indv. in August 2021 (Year 1) and 147 indv. in November 2022 (Year 2). The species was more abundant in the breeding season (average of 76.9 indv. mo^{-1}) than in the non-breeding season (average of 44.7 indv. mo^{-1}).

12.7.1.112 In addition, 57 deceased gannets were observed in the Site Specific Study Area over the 24-month period, suggesting the on-going 2023 HPAI season may be affecting regional gannet populations.

12.7.1.113 As gannet are sensitive to displacement and collision, mean seasonal peak population estimates were produced for the OAA plus 2.0 km Buffer and the monthly density of flying birds in the OAA was estimated. The mean seasonal peak population in the OAA plus 2.0 km Buffer was higher in the breeding season (442 indv. (95% CI: 324 – 590)) than in the non-breeding season (363 indv. (95% CI: 156 – 715)), although there was a greater degree of variation in the latter season. In the OAA, gannet density ranged from 0.00 indv. km^{-2} (e.g. in March 2021 and July 2022) to 3.17 indv. km^{-2} (95% CI: 1.93 – 4.81) in November 2022.

Intertidal Species

12.7.1.114 Intertidal ornithology surveys were undertaken at the landfall site. Details of the survey can be found in **Volume ER.A.4, Annex 12.2 Intertidal Baseline Ornithology Report**. The key receptors identified through the intertidal bird surveys are discussed below.

12.7.1.115 Barnacle goose (*Branta leucopsis*) was recorded in two surveys in low to moderate numbers, with up to 113 observed in a single survey, in October2022. Pink-footed goose (*Anser brachyrhynchus*) was more frequent and observed in eight surveys, with a peak count of 3,353 individuals in October 2022. All observed geese, except for one pink-footed goose, were recorded flying over the survey area, suggesting relatively limited usage of the intertidal zone portion of the Offshore ECC.

12.7.1.116 Common eider (*Somateria mollissima*) was recorded in all surveys. Most individuals were observed on the ground or sea, with a peak count of 101 individuals. Most of the birds observed on the water were outside the intertidal zone, foraging in the shallow subtidal water. Distribution was mostly concentrated at rocky outcrops in the northeast and east of the intertidal zone of the Offshore ECC.

12.7.1.117 Great cormorant (*Phalacrocorax carbo*) and European shag (*Gulosus aristotelis*) were recorded in the intertidal surveys, although were absent from the DAS. Both species were recorded in moderate numbers, with 100 and 90 great cormorants recorded on the ground or sea in October and November, respectively. European shags were recorded more frequently and in higher numbers, with peak counts of 265 birds on the ground or sea in January and 300 flying birds in December. There is potential for interaction with the offshore works in the nearshore parts of the ECC, where operational vessels may disturb roosting, loafing, or foraging birds.

12.7.1.118 Thirteen wader species were recorded in the intertidal surveys. The most frequent species were common redshank (*Tringa totanus*), recorded in ten visits, followed by ruddy turnstone (*Arenaria interpres*), golden plover (*Pluvialis apricaria*), and dunlin (*Calidris alpina*), all of which were recorded in eight visits. Golden plover was the most abundant species, with a total of 1,104 observed over the survey period, with a peak count of 110 individuals on the ground and 300 flying. Common redshank, sanderling (*Calidris alba*), and red knot (*C. canutus*) were also recorded in moderate numbers, with total counts of 204 indv., 189 indv., and 176 indv., respectively. Other species of note were Eurasian curlew (*Numenius arquata*) and northern lapwing (*Vanellus vanellus*), with 171 indv. and 140 indv. recorded, respectively. These species are all considered to make moderate usage of the intertidal zone of the Offshore ECC, and thus, may interact with the offshore works.

12.7.1.119 Five species of gull were recorded, with great black-backed gull and herring gull being the most frequent and abundant. These species have low sensitivity to disturbance effects (Garthe and Hüppop, 2004; Furness *et al.*, 2013; Bradbury *et al.*, 2014). Gulls are typically generalist feeders and scavengers, making use of a range of habitats, and thus, are unlikely to be sensitive small-scale habitat loss in the intertidal zone. Great black-backed and herring gull were recorded in the DAS and thus have been discussed further detail previously.

12.7.1.120 Common guillemot and razorbill were recorded in moderate to high numbers, with respective peak counts of 500 indv. and 334 indv. These species are generally present in the offshore environment, with rapid dispersal from breeding grounds occurring in the early autumn. Both species were recorded in high numbers in the DAS, and thus, have been considered in detail previously in this chapter.

Migratory Species

12.7.1.121 No shorebirds (waders, waterfowl, or wildfowl) or terrestrial birds were recorded in the Site Specific Study Area in the 24-month DAS period. Therefore, the information presented in this section is based on migration routes and populations by Wright *et al.* (2012), as part of the Strategic Ornithological Support Services Migration Assessment Tool (SOSS-MAT). The OAA, which covers just 33.25 km^2 overlaps with a negligibly small proportion of migratory routes for all species and is sufficiently distant from the coast to result in no interaction with species which migrate parallel to land.

Wildfowl

12.7.1.122 Wright *et al.* (2012) suggest that 13 species of swan, goose, or duck (excluding sea ducks) have migratory routes that overlap with the OAA. The majority of these species have extensive migration routes, or the Offshore Development Area only overlaps with the extreme outer limits of the migration route. For example, bean goose (*Anser fabalis*) migrate from the UK to mainland Europe and Scandinavia, using the entire North Sea as a migration pathway.

Sea Ducks

12.7.1.123 Seven sea duck species have migration routes that overlap with the Offshore Development Area, most of which migrate between the UK and Scandinavia and mainland Europe. Most species have wide migration corridors (Wright *et al.*, 2012), where the Salamander Project occupies a small proportion. Long-tailed duck use the entire length of the North Sea for migration, however, there may be a higher proportion of individuals migrating between Scotland and Scandinavia.

Owls and Raptors

12.7.1.124 Two raptor and one owl species have migration corridors that overlap with the OAA (Wright *et al.*, 2012). For example, hen harrier (*Circus cyaneus*) has two migration corridors, one southward from the UK to mainland Europe, and one between the UK and Scandinavia, both of which overlap with the Offshore Development Area.

Waders

12.7.1.125 The majority of birds with migration routes overlapping the OAA are waders, with 20 species with potential interaction (Wright *et al.*, 2012). Waders generally have wide migration corridors with minimal overlap with the small spatial footprint of the OAA. For example, oystercatcher migrating within the UK use the UK proportion of the North Sea to move between England and the Shetland Islands; and individuals migrating to Europe and Scandinavia make use of the entire North Sea.

Overview

12.7.1.126 The SOSS-MAT was used to identify which migration routes may interact with the Salamander Project (e.g. routes migrating between the UK and Ireland were excluded, whereas routes across the North Sea were included). The tool was used to determine the proportion of included routes with overlap with the OAA. As observed in **Table 12-12**, overlap is minimal for all species. The greatest potential for interaction is with common eider and Eurasian dotterel (*Charadrius morinellus*), at just over 4% each. Interaction potential for all other species is minor.

12.7.1.127 Common eiders are generally sedentary in the UK, with the majority of individuals remaining in Britain rather than migrating elsewhere. Few individuals migrate between the UK and Norway / Russia, and some migrate southwards through the North Sea to mainland Europe and the Baltic Sea (Woodward *et al*., 2023). As the majority of movements are along the UK coast, there is limited potential for interaction with the OAA.

12.7.1.128 In the UK, Eurasian dotterel breed in northern Scotland. There is limited information on migration routes, although there are records of small numbers of individuals moving between Scotland and Norway during the breeding season (Woodward *et al*., 2023). Dotterel primarily winter in Morocco, suggesting that migration routes from Scotland take birds south-southwest, rather than east across the North Sea. Ringing data support this, with recoveries of Scottish-ringed birds recorded in central and northwestern Morocco (Whitfield *et al.*, 1996). As such, interaction with the OAA is considered to be minimal, with very few birds expected to cross the North Sea, and even fewer likely to interact.

12.7.1.129 Considering the small likelihood of interaction, and the spatial extent of the OAA (33.25 km), impacts to migratory birds, as listed in **Table 12-12**, are scoped out of assessment and not considered further within this chapter.

Table 12-12 Overlap (%) between bird migration routes and the Offshore Development Area (Source: Wright *et al.*, 2012)

Common Name	Scientific Name	Overlap (%)	Common Name	Scientific Name	Overlap (%)
Wildfowl (Swans, Geese, and Ducks)			*Waders and Wildfowl*		
Whooper swan	*Cygnus cygnus*	0.76	Oystercatcher	*Haematopus ostralegus*	1.11 (non-breeding) 0.70 (breeding)
Bean goose	*Anser fabilis*	1.02	Ringed plover	*Charadrius hiaticula*	1.20 (non-breeding) 0.72 (breeding)
Pink-footed goose	*Anser brachyrhynchus*	1.25	Dotterel	*Charadrius morinellus*	1.49 (breeding / passage) 4.06 (breeding)
Barnacle goose	*Branta leucopsis*	2.12	Golden plover	*Pluvialis apricaria*	0.84 (non-breeding) 0.72 (breeding)

Common Name	Scientific Name	Overlap (%)	Common Name	Scientific Name	Overlap (%)
Shelduck	*Tardona tadorna*	1.20	Grey plover	*Pluvialis squatarola*	1.20
Wigeon	*Anas penelope*	1.10	Lapwing	*Vanellus vanellus*	1.20
Teal	*Anas crecca*	1.11	Knot	*Calidris canutus*	1.09
Mallard	*Anas platyhynchos*	1.20	Sanderling	*Calidris alba*	1.09
Pintail	*Anas acuta*	1.11	Dunlin	*Calidris alpina schinzii* and *C. a. arctica*	1.11 (passage)
Shoveler	*Anas clypeata*	1.00		*C. a. alpina*	0.11 (passage / winter)
Pochard	*Aythya ferina*	1.00	Ruff	*Philomachus pugnax*	0.57
Scaup	*Aythya marila*	0.10	Snipe	*Gallinago gallinago*	1.09
Sea Ducks and Grebes			Black-tailed godwit	*Limosa limosa islandica*	0.80
Common eider	*Somateria mollissima*	4.07	Bar-tailed godwit	*Limosa lapponica*	1.32
Long-tailed duck	*Clangula hyemalis*	1.20	Whimbrel	*Numenius phaeopus*	1.11
Common scoter	*Melanitta nigra*	1.11	Curlew	*Numenius arquata*	1.10 (non-breeding) 0.73 (breeding)
Velvet scoter	*Melanitta fusca*	1.40	Greenshank	*Tringa nebularia*	0.72
Goldeneye	*Bucephala clangula*	1.20	Redshank	*Tringa totanus Britannica*	0.87 (breeding)
Red-breasted merganser	*Mergus serrator*	1.30		*T. t. robusta*	0.80 (non-breeding)
Common merganser	*Mergus mergus*	1.34 (non-breeding) 2.15 (breeding)		*T. t. totanus*	1.39 (non-breeding)
Slavonian grebe	*Podiceps auritus*	1.11	Turnstone	*Arenaria interpres*	1.10
Raptors and Falcons			Red-necked phalarope	*Phalaropus lobatus*	0.67
Hen harrier	*Circus cyaneus*	1.42 (non-breeding) 0.44 (breeding)	*Owls*		
Merlin	*Falco columbarius*	0.71	Short-eared owl	*Asio flammeus*	1.15

12.7.2 Future Baseline

12.7.2.1 Over the operational life of the Salamander Project (35 years) it is expected that the offshore ornithological baseline will change without the influence of the Salamander Project. These changes are expected to reflect existing cycles and processes, as well as the potential effects of climate change on the marine environment.

12.7.2.2 **Volume ER.A.4, Annex 12.4: Population Viability Analysis** (**Section 3**, **Tables 4 – 8**) presents the predicted changes to baseline regional seabird populations over a 35-year period independent of the impacts expected from the Salamander Project. Current regional population estimates, informed by the SMP, were used in combination with demographic rates (productivity, juvenile and adult survival, and age at first breeding) to estimate how populations may change from current levels. From these results, it is apparent that populations are expected to experience a level of decline or increase as a result of factors external to the Salamander Project.

12.7.2.3 The breeding regional populations of kittiwake, razorbill, and puffin are all predicted to experience decline, with kittiwake reducing by approximately 4.8% from a current regional population of 202,258 to 192,638 breeding indv. Similarly, razorbill is predicted to experience a 70% decline from 70,208 to 20,836 breeding indv., and puffin a decline of approximately 68% from 287,593 to 90,733 breeding indv.

12.7.2.4 Conversely, some populations show a predicted increase across the next 35-year period independent of the implementation and operation of the Salamander Project. The regional guillemot breeding population is expected to experience an increase of approximately 196% from 407,959 to 1,209,339 breeding indv. by 2065. Gannets experience a similar trend with a predicted 31% increase from 423,894 to 555,445 breeding indv.

12.7.2.5 While populations and abundance are expected to change, the assessment of impacts will remain valid as changes to regional seabird populations are likely to result in proportional changes in the Salamander Project baseline data. For example, if the regional population of gannet is expected to increase by 31%, it is expected that the baseline population of gannet will also increase by 31%, as will the predicted impacts. Therefore, the proportion of the regional population affected does not change.

12.7.2.6 There are a variety of environmental factors that have been identified historically that alter the growth or decline of bird populations and are expected to continue to do so in accordance with their current trajectory. Most recently, HPAI has risen to the status of a global pandemic, with UK bird populations experiencing an unprecedented number of cases. A number of environmental variables have contributed to the expansion of HPAI presence, including alterations in migratory routes increasing exposure, an increase in the abundance and spread of the virus, and changes in behavior and susceptibility to HPAI as a result of stressors such as climate change, habitat loss, anthropogenic disturbance, and extremes in weather (Defra, 2023). Whilst the future impacts of HPAI are unknown, and a range of mitigation strategies are being considered to tackle the spread of the virus, should the trend of the last three years continue, whereby tens of thousands of seabirds have died as a result of the virus, seabird populations may continue to decline (RSPB, 2023).

12.7.2.7 Whilst climate change is suggested as one of the possible enhancers of HPAI spread, it is predicted that the impacts of climate change on the environment will also have impacts on current populations that will extend into the future. It is not possible to produce accurate population projections for seabirds within the Offshore Development Area specifically. This is due to the relatively small spatial extent of the Site Specific Study Area in comparison to the regional populations area, and the amount of data available. As such, it is reasonable to assume that, without development of the Salamander Project, seabird populations within the Offshore Development Area would largely follow similar trends, as described previously.

12.7.3 Summary of Baseline Environment

12.7.3.1 Following review and analysis of the DAS data for the Salamander Project, several key sensitivities have been identified that require specific consideration within the Impact Assessment in **Section 12.11**. These are described below.

12.7.3.2 Kittiwake was the most abundant gull recorded in the OAA. The species is considered sensitive to both collision and distributional responses (Furness *et al.*, 2013; Bradbury *et al.*, 2014). The region is known to be of high importance to the species, with a number of coastal SPAs supporting internationally important breeding colonies, notably those at Buchan Ness / Collieston Coast, Troup, Pennan and Lion's Head, Fowlsheugh, and the cliffs of North and East Caithness. Kittiwakes are at risk of cumulative impacts from existing developments, as well as environmental factors and competition with commercial fisheries for prey resources.

12.7.3.3 Great black-backed gull was much less common, however, were still frequently recorded in the OAA. Although the species is not sensitive to distributional responses, its flight characteristics and altitudes (Johnston *et al.*, 2014) make it sensitive to collision with operational WTGs (Furness *et al.*, 2013; Bradbury *et al.*, 2014).

12.7.3.4 Auks, including guillemot, razorbill, and puffin were recorded in moderate to high numbers in the OAA. Guillemot was the most abundant, with a peak population estimate of 7,743 indv., followed by puffin (879 indv.) and razorbill (221 indv.), in August 2022. The number of birds observed at the end of the breeding season was substantially higher in August and September 2022 (Year 1) than in the previous year. Environmental data, such as movement of sea fronts and SST, were reviewed alongside the abundance data. A number of studies (e.g. Buckingham *et al.*, 2022; Buckingham *et al.*, 2023) link environmental variables to the abundance and distribution of post-breeding auks, and thus, the difference in survey results were not considered abnormal.

12.7.3.5 Guillemot, razorbill, and puffin are not sensitive to collision (Johnston *et al.*, 2014), however, all three species are considered sensitive to distributional responses, specifically displacement from the OAA (Furness *et al.*, 2013; Bradbury *et al.*, 2014). The region is of importance to these species, especially guillemot and razorbill, which are classified features of several SPAs. Guillemot colonies may also be under threat from existing and proposed developments, and all three auk species are also at risk of reduced food availability due to environmental factors (e.g. SST changes) and human activity (e.g. commercial fisheries).

12.7.3.6 Fulmar were also observed in high numbers, with a total of 287 indv. Observed in the OAA over the 24-month DAS period. The peak count (123 indv.) was in November 2022. Due to its flight height altitudes (Johnston *et al.*, 2014), fulmar is considered to be at low risk of collision (Furness *et al.*, 2013; Bradbury *et al.*, 2014). However, these studies are based on limited data, and therefore, the true sensitivity of fulmar is not fully understood. Study of distributional responses show a weak displacement effect (Dierschke *et al.*, 2016); which Neumann *et al.* (2013) and Braasch *et al.* (2015) suggest may be due to a lack of fishing vessels. Therefore, a quantitative assessment of collision has been undertaken, whereas distributional responses are assessed qualitatively.

12.7.3.7 Gannet were observed in low numbers, ranging from zero to 35 indv. in the OAA itself. Analyses of the data show the peak population estimate within the OAA plus 2.0 km Buffer was 676 indv. In Year 1 and 705 indv. In Year 2; and the peak population density in the OAA was 2.70 indv. km^{-2} and 3.17 indv. km^{-2} in Year 1 and Year 2, respectively. Due to its flight height (Johnston *et al.*, 2014), the species is sensitive to collision (Furness *et al.*, 2013; Bradbury *et al.*, 2014), and studies at existing developments show a relative high avoidance rate (Furness *et al.*, 2013; Bradbury *et al.*, 2014).

12.7.3.8 No terrestrial species were recorded in the Site Specific Study Area in the DAS transects. Review of published information on migration routes and populations shows that the Salamander Project occupies a negligibly small proportion of migration routes for all species (Wright *et al.*, 2012). As such, migratory species are not scoped in for assessment within the EIAR, and no measurable impact is expected. Migratory species as part of SPA populations are considered in **Volume RP.A.1, Report 1: Report to Inform Appropriate Assessment (RIAA)**, **Sections 7** and **11** (Birds Assessment).

12.8 Limitations and Assumptions

12.8.1.1 The following limitations and assumptions have been identified for Offshore and Intertidal Ornithology:

- The Salamander Project specific DAS cover the Site Specific Study Area, which encompasses the OAA plus 2.0 km Buffer only and does not cover the Offshore Export Cable Corridor (ECC). Information on seabird use of the Offshore ECC is available through published sources of seabird distribution, however, most of these are modelled (e.g. Kober et al., 2010), or relate to specific colonies (e.g. SPA populations). The DAS data, combined with published sources, have been used to infer seabird usage and importance of the Offshore ECC.
- The DAS were conducted over a 24-month period, with one survey per month, as is standard practice at UK OWFs, and as agreed with NatureScot. The results of the surveys show typically high variation within and between years, which is especially noticeable in the kittiwake, auk, and fulmar results for the end of the breeding season (August and September). This level of variation is not unexpected, and the numbers observed are considered to be representative of the true populations in the Site Specific Study Area.
- There are certain limitations within DAS methodology, these include:
  - Spatial coverage, where DAS typically covers 10-15% of the survey area, with population modelling used to predict seabird abundance and density in spatial gaps between transects.
  - DAS only provides a snapshot of seabird abundance and distribution at the time the transect is flown. Bird abundance outside these periods is not observed. A level of this uncertainty is accounted for by ensuring two full breeding and non-breeding seasons are flown, and population modelling outputs include a level of variation.
  - In adverse weather, it may not be possible to conduct flights. In this situation, the missed flight is flown at the next available opportunity, and, if required, the following flight is postponed to ensure a two-week period remains between survey dates.

12.8.2 Impacts Scoped out of the EIAR

12.8.2.1 The Offshore and Intertidal Ornithology assessment covers all potential impacts identified during scoping, as well as any further potential impacts that have been highlighted as the EIA has progressed as outlined in **Section 12.1**.

12.8.2.2 However, following consideration of the baseline environment, the Salamander Project description outlined in **Volume ER.A.2, Chapter 4: Project Description** and in line with the Scoping Opinion (MD-LOT, 2023) a number of impacts are not considered in detail within this EIAR, as illustrated in **Table 12-13**. Impacts which are not applicable to specific phases of the Salamander Project are also included in **Table 12-13** for clarity.

12.8.2.3 Intertidal ornithology is considered here, where effects of offshore works may impact receptors (birds and habitat) between mean low water spring (MLWS) and MHWS. Impacts on intertidal ornithology arising from onshore or intertidal works will be considered in the Terrestrial Ornithology chapter of the Onshore EIAR. Only disturbance effects are expected to result in any level of impact on intertidal receptors, where vessels and equipment operating near to MHWS may cause temporary disturbance of roosting and foraging shorebirds. All other effects are scoped out of assessment with regard to intertidal ornithology.

12.8.2.4 Due to the limited spatial interaction between the Offshore Development Area and migration routes, and the small spatial extent in comparison with the width of migration corridors, impacts to migratory birds are scoped out of assessment. SOSS-MAT suggests that a minor proportion of any migration corridor is occupied by the OAA. As a worst-case scenario, the OAA interacts with 4% of the North Sea migration lines for common eider and dotterel. WWT Consulting and MacArthur Green (2014) suggest that migratory bird (including dotterel and common eider) risk of collision with Scottish wind farms is low and not likely to be significant. With the addition of the Salamander Project, this risk is considered to remain low. WWT Consulting and MacArthur Green (2014) suggest that the greatest risk of collision during migration is to seabirds, specifically common gull (*Larus canus*), great black-backed gull, herring gull, lesser black-0backed gull, common tern, and great cormorant.

12.8.2.5 Although Wright *et al.* (2012) suggest that just over 4% of dotterel migration route may overlap with the OAA (SOSS-MAT outputs), review of ringing data and tracking studies show that the main Scottish population migrates southwards towards Morocco, with very few breeding individuals migrating between the UK and Scandinavia (Wernham *et al.*, 2002).

12.8.2.6 Woodward *et al.* (2023) and review of ringing recoveries show that the majority of the UK common eider population are sedentary, with few migration passages across the North Sea. Additionally, further suggesting that migratory birds have limited presence in the OAA, no migratory birds were recorded in the 24-month project specific DAS, including in the Site Specific Study Area.

12.8.2.7 Considering the small scale of the development, and the limited potential for interaction to occur, barrier to movement and collision risk to migratory birds are expected to be **Negligible** and are scoped out of assessment.

Table 12-13 Impacts scoped out of the Offshore and Intertidal Ornithology assessment

Potential Impact	Project Aspect	Project Phase	Justification
Distributional responses	Offshore Array Area (OAA)	Construction and Decommissioning	The term 'distributional responses' refers specifically to displacement / barrier effect within the OAA arising from the presence of wind turbine generators (WTGs); this impact is considered for the operation and maintenance phase only. Disturbance (i.e. disturbance of birds arising from vessels, helicopter traffic, and machinery or equipment) is considered for all phases of the Salamander Project and assessed separately.
Collision	OAA	Construction and Decommissioning	Collision with operational WTGs cannot occur during construction; this impact is considered for the operation and maintenance phase only.
Entanglement	OAA	Construction and Decommissioning	Entanglement refers to ghost fishing gear becoming caught on mooring lines or floating structures, presenting a trapping hazard to diving birds. This impact is assessed under the operation and maintenance phase. Entanglement is not expected to occur during construction, prior to installation of the offshore infrastructure and associated auxiliaries.
Temporary habitat loss (short-term)	Offshore Development Area	Operation and Maintenance	Short-term impacts to supporting habitat are primarily associated with installation and removal of infrastructure, as well as repair works which involve interaction with the seabed or water column. Short-term habitat loss is also expected to occur during operation; however, the extent and duration will be substantially smaller than during the construction phase. Long-term direct impacts to supporting habitats are scoped in for the operation and maintenance phase, and this impact covers the maximum volume and extent of habitat loss (i.e. infrastructure placement, including scour protection) that can occur throughout the duration of the Salamander Project, including any impacts from ongoing maintenance or repairs. As a result, short-term habitat loss is not considered during operation separately.
Temporary habitat loss (long-term)	Offshore Development Area	Construction and Decommissioning	Impacts to supporting habitat may occur during the construction phase; however, impacts occurring at this time are considered short-term (i.e. lasting the duration of the construction phase only). Although long-term impacts, such as those associated with infrastructure, may begin during the construction phase, they are considered to occur throughout the duration of the Salamander Project and thus assessed under the operation and maintenance phase only.
Turbidity	Offshore Development Area	Operation and Maintenance	There is the potential for operation and maintenance activities to result in increased suspended sediment concentrations which may result in indirect impacts on benthic communities. The nature of works associated with operation and maintenance activities and the discrete areas within which these activities will be undertaken, will result in significantly lower suspended sediment concentrations than those associated with construction activities. For this reason, this impact has been scoped out for further assessment.

Potential Impact	Project Aspect	Project Phase	Justification
Hydrodynamics	OAA	Construction, Operation and Maintenance, and Decommissioning	Impacts to supporting habitat due to the presence of structures in the water column are not expected to result in any measurable effect on seabird populations. The total volume of space which will be occupied by Salamander Project infrastructure is 6,000,000 m^3, which is negligibly small compared with the volume of water available as pelagic supporting habitat (**Volume ER.A.3, Chapter 7: Marine Physical Processes** and **Volume ER.A.4, Annex 7.1: Marine Physical Processes Technical Annex**). Infrastructure may result in changes in hydrodynamics and sediment transport, including scour of seabed sediments. Scour protection is encompassed within Loss or Alteration of Supporting Habitat (Long-term), which considers effects of the maximum extent of scour protection which may be placed.
Artificial Light Emissions	Offshore Development Area	Construction, Operation and Maintenance, and Decommissioning	Species which are sensitive to artificial light emissions include petrels and shearwaters. These species were recorded in very low abundance (eight individual storm petrels) in the Site Specific Study Area. Review of modelled density data, such as those provided by Kober *et al.* (2010), Waggitt *et al.* (2019) and NatureScot (2022), support the conclusion that the Offshore Development Area supports low densities. Therefore, artificial light impacts are scoped out of assessment due to lack of impact pathway.
Toxic Contamination	Offshore Development Area	Construction, Operation and Maintenance, and Decommissioning	Accidental release of oil and fluid emissions from Salamander Project vessels. The magnitude of an accidental spill incident from vessels is limited by the size of chemical or oil inventory on such vessels. Embedded mitigation measures in the form of a Marine Pollution Contingency Plan (MPCP) will be adopted to ensure that the potential for accidental release of pollutants is limited, including strict controls on vessel activities and procedures. With application of the MPCP and considering the negligible likelihood of spillages, toxic contamination is scoped out of assessment.

12.8.3 Embedded Mitigation

12.8.3.1 The embedded mitigation relevant to the Offshore and Intertidal Ornithology assessment is presented in **Table 12-14**. Mitigation measures will be secured under Section 36 and / or Marine Licence condition.

Table 12-14 Embedded Mitigation for the Offshore and Intertidal Ornithology assessment

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Primary				
Temporary habitat Loss	Co14	Avoidance of sensitive features during cable routing wherever practicable. Cables will be buried as the primary cable protection method, however other cable protection methods will be used where adequate burial cannot be achieved. A Cable Burial Risk Assessment (CBRA) will be completed to determine suitable cable protection measures, and will be implemented within relevant Project plans. *Co14 included as sensitive features may constitute supporting habitat for seabirds or their prey species, during cable routing wherever practicable.*	Offshore ECC and OAA	Construction and Operation and Maintenance
Tertiary				
Disturbance (Vessel-related), Toxic Contamination	Co9	Construction Environmental Management Plan (CEMP) will be developed and will include details of: - A Marine Pollution Contingency Plan (MPCP) to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; - A chemical risk review to include information regarding how and when chemicals are to be used, stored and transported in accordance with recognised best practice guidance; - A biosecurity plan (offshore) detailing how the risk of introduction and spread of invasive non-native species will be minimised; - Waste management and disposal arrangements; and - Protocol for management of Dropped Objects.	Offshore ECC and OAA	Construction
Disturbance (Vessel-related), Toxic Contamination	Co10	Operational Environmental Management Plan (OEMP) will be developed and will include details of: - A Marine Pollution Contingency Plan (MPCP) to address the risks, methods and procedures to protect the Offshore Development Area from potential polluting events associated with the Salamander Project; and - Waste management and protection of the marine environment.	Offshore ECC and OAA	Operation and Maintenance

Potential Impact and Effect	Mitigation ID	Mitigation	Project Aspect	Project Phase
Primary				
Disturbance (Vessel-related)	Co11	A Vessel Management Plan (VMP) will be developed and include details of: - Vessel routing to and from construction sites and ports, - Vessel notifications including Notice to Mariners and Kingfisher Bulletin; and - Code of conduct for vessel operators including for the purpose of reducing disturbance and collision with marine fauna.	Offshore ECC and OAA	Construction, Operation and Maintenance, and Decommissioning
Entanglement	Co17	Mooring lines and floating dynamic Inter-array Cables will be inspected according to the maintenance plan to confirm the structural integrity of the cable systems using a risk-based adaptive management approach. During these inspections, the presence of discarded fishing gear will be evaluated for entanglement risk and appropriate actions to remove will be taken if deemed necessary.	OAA	Operation and Maintenance

12.9 Project Design Envelope Parameters

12.9.1.1 Given that the worst-case scenario is based on the design option (or combination of options) that represents the greatest potential for change, as set out in **Volume ER.A.2, Chapter 4: Project Description**, confidence can be taken that development of any alternative options within the Project Design Envelope parameters will give rise to no effects greater or worse than those assessed in this impact assessment. The Project Design Envelope parameters relevant to the Offshore and Intertidal Ornithology Chapter assessment are outlined in **Table 12-15**.

Table 12-15 Project Design Envelope parameters for Offshore and Intertidal Ornithology

Potential Impact and Effect	Project Design Envelope parameters
Construction	
Temporary Disturbance (Vessel-related)	**Number of vessel trips (up to 660 return trips)** • Jack-Up Vessels: 2 • Heavy Lift Crane Vessels: 21 • Cable Laying Vessels: 14 • Cable Burial / Jointing Vessels: 14 • Shallow Water Cable Barge: 2 • Anchor Handling Vessels: 161 • Offshore Construction Vessels: 14 • Support Vessels:238 • Crew Transfer Vessels: 194

Potential Impact and Effect	Project Design Envelope parameters
	Helicopter activity during construction (1 helicopter; 21 trips)
Temporary Habitat Loss (Short-term)	**Vessels and mobile equipment (244,440 m²)** • Total area of seabed disturbance from vessel anchors: 242,400 m² • Total area of seabed disturbance from Jack-up events: 2,040 m² **Within Offshore Array Area (OAA) (1,532,900 m²)** • Total area of seabed disturbance during installation of cables: 1,400,000 m² • Total area of seabed disturbance during installation of anchors: 125,900 m² (for gravity base anchors) • Total area of seabed disturbance during installation of subsea hubs: 7,000 m² **Export Cable Corridor (ECC) (3,400,000 m²)** • Dimensions: 85 km length at 40 m width • Total area of seabed disturbance during installation of cables: 3,400,000 m² **Landfall (1,000 m²)** • Duration of Landfall works: ≤8 months • Total area of exit pits: 1,000 m² **Total area of temporary habitat loss (short-term) or disturbance: 5,178,340 m² (5.2 km²)**
Turbidity (Suspended Sediment)	**Drilling for anchor installation** • Maximum number of pile anchors: 56 • Maximum number of Subsea Hub piles: 24 • Maximum dimensions of drilled pile anchor section: 3.0 m diameter, 70 m max penetration depth • Maximum dimensions of drilled Subsea Hub pile section: 1.5 m diameter, 30 m max penetration depth • Maximum volume of material per anchor pile: 495 m³ • Maximum volume of material per Subsea Hub pile: 53 m³ • Maximum volume of material all piles: 29,992 m³ **Inter-array cable installation** • Maximum total length of cable trenches: <35 km • Trench dimensions: 7.5 m wide (at seabed); average 2 m deep; 'V' shape profile • Cable burying method: Jetting, Vertical Injection, Mass Flow Excavation, Ploughing / Pre-Ploughing, Trenching / Pre-Trenching (incl. dredging, cutting) (with or without backfill) **Offshore export cable installation** • Maximum total length of trench: ≤85 km (i.e. up to 2 x 42.5 km trench) • Trench dimensions: 7.5 m wide (at seabed); average 2 m deep; 'V' shape profile • Cable burial method: as above for inter-array

Potential Impact and Effect	Project Design Envelope parameters
	Seabed levelling associated with anchor installation • Maximum spoil volume: 48,600 m³ (for gravity base anchors) **Sandwave levelling (within OAA)** • Localised sandwave height: 2 m • Maximum volume of material that will be subject to levelling / temporary removal for offshore inter-array cables: Total = 1,624,000 m³ **Sandwave levelling (within Offshore ECC)** • Localised sandwave height: 4 to 5 m • Maximum volume of material that will be subject to levelling / temporary removal: Total = 5,576,000 m³
Operation and Maintenance	
Temporary Disturbance (Vessel-related)	**Number of vessel trips (up to 7,350 return trips)** • Average annual service operation vessel (SOV) / crew transfer vessel (CTV) movements: up to 190 per year × 35 years = 6,650 • Average annual heavy lift vessel trips (in-field maintenance): up to 3 per year × 35 years = 105 • Average annual towing spread movements (tow-to-port maintenance): up to 5 per year × 35 years = 175 • Average annual anchor handling vessel trips: up to 12 per year × 35 years = 420 **Number of helicopter movements (up to 4,900 return trips)** • Transfers: up to 140 per year × 35 years = 4,900
Distributional Responses (Displacement and Barrier Effect)	**OAA: 33.25 km²**
Collision (Collision Risk Modelling Parameters)	• Latitude: 57.616 • Windfarm width: 8.7 km • Tidal offset: 0 m (floating WTGs) • No. WTGs: 7 • No. blades: 3 per WTG • Air gap: 22 m • Rotor radius: 125 m • Blade width (maximum): 6.5 m • Rotation speed (average): 6.3 rpm • Blade pitch: 2.7 ° • Proportion of time operational (wind availability): 94.5%
Temporary Habitat Loss (Long-term)	**Maximum operational period: 35 years**

Potential Impact and Effect	Project Design Envelope parameters
	Short-term (e.g. intermittent or shorter term loss associated with reburial of cable etc.) **(1,574,800 m²)** • Subsea cable repair and replacement events: 14 • Length of subsea cable reburial: 7,400 m (7.4 km) • Total area of seabed impacted by cable repair and reburial: 1,468,000 m² • Total area of seabed impact from vessel anchors during operations: 16,800 m² • Total area of seabed impact from anchor and mooring replacement: 90,000 m² **Long-term** (e.g. continuous habitat disturbance) **(4,620,000 m²)** • Total swept area of seabed by mooring lines: 3,920,000 m² • Total swept area of seabed by untethered dynamic-cable ends: 700,000 m² **Long-term** (e.g. habitat lost for duration of operational phase due to infrastructure) **(753,700 m²)** • **OAA (409,540 m²):** • Total seabed footprint of (gravity base) anchors after installation: 8,100 m² • Total seabed footprint of scour protection (gravity base anchor): 117,800 m² • Total seabed footprint of dynamic cable tether anchors: 22,400 m² • Total area of new scour protection for mooring and anchor replacement: 84,200 m² • Total seabed footprint of cable stabilisation protection: 70,000 m² • Total area of new cable installation protection for cable repair and replacement: 36,000 m² • Total seabed footprint of scour protection (cable jointing): 64,000 m² • Total seabed footprint of subsea hubs: 450 m² • Total seabed footprint of scour protection for subsea hubs: 6,550 m² • Total seabed footprint of wave buoy anchor: 40 m² • **Offshore ECC (344,160 m²):** • Total area of cable stabilisation protection: 170,000 m² • Total area of scour protection on seabed (cable jointing): 16,000 m² • Total area of cable protection material on seabed: 158,160 m² **Total area of temporary habitat loss (long-term) or disturbance: 6,948,500 m² (7.0 km²)**
Decommissioning	
Currently realistic worst-case and likely scenarios for decommissioning operations will involve full removal of all infrastructure, therefore, similar impacts to the construction phase and magnitude of seabed disturbance have been considered. This assumption is subject to best practice methods and technology appropriate at the time of decommissioning.	
Disturbance (Vessel-related)	**Number of vessel trips (up to 516 return trips)** • Heavy lift vessel trips: 21 • Anchor handling vessels trips: 77 • Support vessel trips: 238 • Crew transfer vessels: 180

Potential Impact and Effect	Project Design Envelope parameters
	Helicopter activity during decommissioning (1 helicopter; 14 trips)

12.10 Assessment Methodology

12.10.1.1 **Volume ER.A.2, Chapter 6: EIA Methodology** sets out the general approach to the assessment of likely significant effects that may arise from the Salamander Project.

12.10.1.2 Whilst **Volume ER.A.2, Chapter 6: EIA Methodology** provides a general framework for identifying impacts and assessing the significance of their effects, in practice the approaches and criteria applied across different topics vary.

12.10.1.3 The proposed approach to the Offshore and Intertidal Ornithology assessment that has been addressed in the EIA is outlined below.

12.10.2 Identification of Receptors

12.10.2.1 Offshore and Intertidal Ornithology receptors scoped into the assessment have been identified through review of the Salamander Project DAS and the intertidal survey results (abundance in the Offshore Development Area), determining which populations make use of the OAA and Offshore ECC. Conservation status was also considered during scoping, where species of high conservation importance or threatened species where small effects may have measurable impacts on populations are scoped in if effect-receptor pathways are present. Sensitivity assessments conducted by Furness *et al.* (2013) and Bradbury *et al.* (2014) were also reviewed, to scope out effects to which receptors are not sensitive. NatureScot's 2023 Guidance Notes (**Table 12-1**) were adhere to.

12.10.3 Impact Assessment Criteria

12.10.3.1 The Impact Assessment identifies the significance of impact based upon the sensitivity of a receptor and the magnitude of impact. For the purposes of this assessment, the definition of sensitivity of a receptor is described in **Table 12-16**. For some impacts, such as vessel disturbance, recognised published literature has been used to inform species-specific sensitivities. Where this is the case, this is clearly stated, and the methodology presented in the corresponding assessment text. The definition of the magnitude of impact is described in **Table 12-17.**

Table 12-16 Categories and definitions used to determine the level of sensitivity of a receptor

Sensitivity	Definition
High	Very limited tolerance to the impact for a receptor of international or national importance. The receptor is unable to adapt to the impact and will be unable to undergo a permanent recovery.
Medium	Very limited tolerance to the impact for a receptor of regional importance. The receptor is unable to adapt to the impact and will be unable to undergo a permanent recovery. Or Limited tolerance to the considered impact is displayed by a receptor of international or national importance, where adaptability and recovery is limited, with return to acceptable status taking 1-5 years.
Low	Limited tolerance to the considered impact is displayed by a receptor of local importance, where adaptability and recovery is very limited, with return to acceptable status taking 5-10 years. Or

Sensitivity	Definition
	Moderate tolerance to the considered impact is displayed by a receptor of regional importance, where adaptability and recovery is limited, with return to acceptable status taking 1-5 years. Or High tolerance to the considered impact is displayed by a receptor of international or national importance, where adaptability and recovery is rapid, with return to acceptable status taking 0-12 months.
Negligible	High tolerance to the considered impact is displayed by a receptor of local importance, where adaptability and recovery is rapid, with return to acceptable status taking 0-12 months. Or Total tolerance to the considered impact is displayed by a receptor of international, national or regional importance.

Table 12-17 Categories and definitions used to determine the level of magnitude of an impact

Magnitude	Definition
High	Total change or major alteration to key elements / features of the baseline conditions: Occurs over a large spatial extent, resulting in widespread, long-term, or permanent changes of the baseline conditions, or affects a large proportion of a receptor population. And / or The impact is very likely to occur and/or will occur at a high frequency or intensity.
Medium	Partial change or alteration to one or more key elements/features of the baseline conditions: The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions or affects a moderate proportion of a receptor population. And / or The impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	Minor shift away from the baseline conditions: The impact is localised and temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population. And / or The impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	Very slight change from baseline conditions: The impact is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or a receptor population. And / or The impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.
No change	No change from baseline conditions.

12.10.3.2 The significance of an impact, based upon the sensitivity or a receptor and magnitude of an impact is determined using the matrix shown in **Table 12-18**. For the purpose of this assessment, any effects with a significance level that is major and / or moderate are considered to be significant in EIA terms, whilst those of minor or negligible are considered non-significant.

Table 12-18 Significance of effect matrix

Significance of effect		Receptor Sensitivity			
		Negligible	*Low*	*Medium*	*High*
Magnitude of impact	*Negligible*	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major

12.10.4 Distributional Responses

12.10.4.1 Displacement assessment and barrier effects are difficult to distinguish from one another, and therefore, are assessed together under 'Distributional Responses', as per NatureScot guidance (NatureScot, 2023h).

12.10.4.2 Distributional responses are assessed through the use of Displacement Matrices. This approach uses displacement rates (proportion of birds which are displaced from within the OAA plus 2.0 km Buffer) and mortality rates (proportion of displaced birds which may die) to produce annual mortality estimates for the breeding and non-breeding seasons. Displacement and mortality rates vary based on species, however, the full matrices (1 – 100% displacement and 1 – 100% mortality) are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.10.4.3 The displacement and mortality rates for each species are presented in Table 12-19 in terms of the values defined in NatureScot (2023h) alongside values that represent the 'Applicant Approach'. Both sets of values are provided to enable a comparison to be made.

A 30% Displacement Rate and 1% Mortality Rate is applied for Kittiwake in the Applicant Approach

12.10.4.4 In terms of distributional response, NatureScot recommends (NatureScot, 2023h) that a 30% displacement rate is applied to kittiwake, with a 1-3% mortality in both the breeding and non-breeding season. The 30% displacement rate is applied in the Applicant Approach, with justification for a mortality rate of 1% provided below.

12.10.4.5 Prior to the current ScotWind and INTOG Rounds of east coast Scotland offshore wind applications and projects awaiting consent, Scottish Minister advice on EIA ornithological assessments for kittiwake distributional response (e.g. Marine Scotland, 2017) was for a distributional response rate of 30%, a mortality rate of 2% in the breeding season and a qualitative assessment only in the non-breeding season (in contrast to the advice in the same document from NatureScot (at that time SNH), which for kittiwake distributional response was "*that there was no need to include kittiwake, the data available from post construction monitoring indicates no significant avoidance behaviour by this species*"). In the updated and interim advice note on distributional response (SNCB, 2022), kittiwake is not included in the 'more sensitive' category, scoring too low. In recent consented offshore wind farm projects in England, kittiwake is not typically included within an assessment of distributional response as a result of the low sensitivity of the species to the pressure (e.g. for Hornsea Four, kittiwake at Flamborough and Filey Coast SPA was assessed for collision only and not distributional response (Ørsted, 2022; DESNZ, 2023).

12.10.4.6 The low sensitivity of kittiwake to distributional response is supported by a number of post-construction studies of seabirds at offshore wind farms, which have concluded that kittiwake was one of the species hardly affected by distributional response (Dierschke *et al.*, 2016). Most recently, the Beatrice Year Two monitoring report (Macarthur Green, 2023) found there was an overall increase in kittiwake abundance between 2015 and 2021, although this was not significant, with some areas of increase and some of decrease. In relation to turbine locations, kittiwake densities were variable in both survey years and, overall, slightly higher in 2021, but there was no indication of any significant responses, either avoidance or attraction in either year. For kittiwake, the report concluded 'neither of the pre- versus post-construction comparisons indicated any decreases across the wind farm'.

12.10.4.7 A 30% distributional response is therefore considered highly precautionary.

12.10.4.8 The 1% mortality value for kittiwake is also precautionary when considered alongside project level SeabORD modelling (**Volume ER.A.4, Annex 12.6: Displacement Assessment SeabORD**), which modelled the difference in kittiwake mortality at four SPAs (Troup Pennan and Lion's Head SPA, Buchan Ness to Collieston Coast SPA, Fowlsheugh SPA, and East Caithness Cliffs SPA). The difference in mortality between the wind farm presence / absence scenarios was at most 0.007%. Further, the overall available kittiwake foraging area (Ruffino *et al.*, 2023) clearly shows foraging across the region and a limited potential for overlap with the Salamander Project, with the OAA itself representing a fraction of the total available foraging habitat. Therefore, any kittiwakes that are displaced from the OAA will have access to an extensive alternative foraging area. The potential for a distributional response mortality to result in the non-breeding season, when kittiwake is not associated with a breeding colony, is even less. A mortality rate of 1% is therefore considered highly precautionary.

A 50% Displacement Rate and 1% Mortality Rate is applied for Auks in the Applicant Approach

12.10.4.9 In terms of distributional response, NatureScot recommends (NatureScot, 2023h) that a 60% displacement rate is applied to auk species in both the breeding and non-breeding season (noting that apportioning is not required for puffin in the non-breeding season). However, real-world displacement rates are variable. Considering the abundance of auks within the OAA plus 2.0 km buffer, a 50% displacement rate is considered appropriate and (given the findings described below) precautionary for the Salamander Project to assess auk distributional responses.

12.10.4.10 In terms of the mortality rate, NatureScot recommends (NatureScot, 2023h) that a 1-3% mortality rate is applied to auk species in the non-breeding season and a 3-5% mortality rate in the breeding season. For the reasons outlined below, notably the scale of the Salamander Project and recent studies, the lower end of the recommended mortality rates is considered appropriate and therefore, a 1% mortality rate is applied for the assessment in all seasons.

12.10.4.11 The Applicant Approach is in line with many previous offshore wind farms (e.g. the recent Green Volt application (Green Volt, 2023)). The values are considered precautionary, especially in light of the recent publication of the Beatrice Year Two monitoring (Macarthur Green, 2023) and when taking into account the size of the Salamander Project (i.e. seven WTGs over 33.25 km^2). Evidence shows that auk species exhibit a medium level of sensitivity to vessel and helicopter traffic (Wade *et al.*, 2016). Furthermore, distributional response impacts from post-consent monitoring studies (from 13 different European offshore wind farm sites) were collated and reviewed by Dierschke *et al.* (2016), which found auk species to show 'weak displacement' overall, but results were highly variable.

12.10.4.12 Since the UK Statutory Nature Conservation Bodies (SNCBs) published guidance on defining displacement rates for auks in 2017, a number of studies have been undertaken. This has included work by Searle *et al.* (2018), van Kooten *et al.* (2019), and work undertaken for the Hornsea Four Offshore Wind Farm (APEM, 2022), which suggest that the recommended rates are overly precautionary.

12.10.4.13 The Hornsea Four review (APEM, 2022) summarised all post consent-monitoring studies undertaken to that date within UK waters and provides an extensive study and analysis of the empirical data from offshore wind farms. This review found that auk distributional response varies considerably across different sites, with distributional response rates ranging from +112% (i.e. attraction) to -75%. However, this review concluded that a displacement rate of 50% and mortality rate of 1% was appropriate for use in relation to distributional response assessments being undertaken for the Hornsea Four Offshore Wind Farm. The review suggests that in areas of high abundance, displacement is limited and postulates that this may be due to higher importance of the underlying habitat to birds, meaning birds are more likely to tolerate the presence of structures in the area. For areas with low abundance, displacement rates were increased, and the review postulates that this may be that birds are able to forage in other areas as competition between birds is reduced. Although greater than 50% displacement was observed at five developments in the study, all had very low densities of auks within the Study Area. Where auk density was greater, <50% distributional response was recorded. Of the wind farms included in the APEM study, those regarded as having a low abundance or density of auks tended to be non-UK or southern North Sea UK projects. A value of >5 indv. km^{-2} is given for moderate to high density. Auk density at the Salamander Project is presented in a series of figures in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report**, and exceeds the medium to high density value for several months of the year for each auk species, supporting the use of <50% for a distributional response.

12.10.4.14 Most recently, Beatrice OWF (Macarthur Green, 2023), a project located in the northeast region of Scotland, published the results from the second year of post construction monitoring. The study used an approach investigating the distribution of seabirds in relation to turbine locations, which suggested that auk species did not avoid turbines. The abundance of both guillemot and razorbill increased significantly from the pre-construction period into the post-construction period. This would suggest that these species are not displaced by offshore wind farms and that even the use of a 50% distributional response rate, as suggested by APEM (2022) is highly precautionary. Specifically, for puffin that report concluded that the lower end of the 30-70% displacement rate to be appropriate for similarly located wind farms, for guillemot the report concluded that even the lower end of the 30-70% displacement rate range is probably precautionary, and for razorbill that the current 30-70% displacement rates are likely to over-estimate distributional response.

12.10.4.15 Outside the breeding season, auks are typically more widely dispersed and are not tied to a specific coastal site or colony (Camphuysen, 2002; Christie, 2021). With wider dispersal, pressure on individuals to forage in specific areas is lower, and thus distributional response is likely to result in lesser effects. That is particularly relevant in the post breeding period, when peaks in auk density were observed at the Salamander Project (**Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report**), and when parents with chicks are moving rapidly offshore. Furthermore, evidence suggests that although auk species are somewhat sensitive to distributional response, the effects are short-term, and studies indicate auk habituation to offshore windfarms. For example, a study at Thanet Offshore Windfarm found auk species became habituated and the distributional response rate of 75% to 85% in the first year of operations fell to 31% to 41% within years two and three of operations (Royal Haskoning, 2013).

12.10.4.16 Further evidence is emerging through additional post-construction monitoring of offshore windfarms. For instance, there are reports of auk numbers increasing and observations of foraging behaviour within wind farm areas (Leopold and Verdaat, 2018). This suggests the distributional response rates of auk species within the Salamander Project will reduce over time, and, given that the site is close to other operational offshore wind farms (such as Beatrice, Moray East, and Hywind), some habituation may have already occurred within local populations that would result in reduced avoidance of the Salamander Project compared to a new offshore wind farm in a previously unimpacted region.

12.10.4.17 With regards the mortality rates applied, the studies by Searle *et al.* (2018) and van Kooten *et al.* (2019) used individual based models and prey distributions to assess the effects of displacement on auks. The results indicated that breeding season mortality rates in displaced birds are likely to be in the region of 0.5% (Searle *et al.*, 2018) to 1.0% (van Kooten *et al.*, 2019). Outside the breeding season, auks are typically more widely dispersed and are not tied to a specific coastal site or colony (Camphuysen, 2002; Christie, 2021). With wider dispersal, pressure on individuals to forage in specific areas is lower, and thus displacement is likely to result in lesser effects. This is particularly relevant for a physically small project such as the Salamander Project, in the post breeding period, when peaks in auk density were observed at the Salamander Project OAA, and when parents with chicks are moving rapidly offshore. A breeding and non-breeding season mortality of 1% is therefore deemed precautionary.

A 70% Displacement Rate and 1% Mortality Rate is applied for Gannet in the Applicant Approach

12.10.4.18 In terms of distributional response, NatureScot recommends (NatureScot, 2023h) that a 70% displacement rate is applied to gannet, with a 1-3% mortality in both the breeding and non-breeding season. The 70% displacement rate is applied in the Applicant Approach, with justification for a mortality rate of 1% provided below. It should be noted that earlier advice from NatureScot (and Marine Scotland Science) noted that the assessment of distributional response impacts on gannet is not required, based on work undertaken by Searle *et al.* (2014) that, although showing gannet were displaced by offshore wind farms, no population-level effects resulted.

12.10.4.19 Masden *et al.* (2010) assessed the energetic costs of distributional response in seabirds. Results suggest that increasing gannet flight distance by 2 km increases energetic cost by 1.25%. A 10 km increase may result in a 4.50% increase in energy expenditure. However, this is based on a foraging range of 160 km, where 10 km represents a 6.25% increase in distance flown. Scaling this to the mean maximum plus 1 SD foraging range of 709 km (Woodward *et al.*, 2019), an additional flight distance of 10 km (4.5%) represents a scaled 1.02% increase in expenditure. This minimal increase in energy expenditure is unlikely to result in notable mortalities. Therefore, also considering the small spatial extent of the Salamander Project, the lower end of the NatureScot recommended (NatureScot, 2023h) mortality rate (1%) is considered appropriate.

Table 12-19 Displacement and mortality rates included for consideration in assessment of distributional responses

Common Name	Scientific Name	Displacement and Mortality Rates as Defined in NatureScot (2023h)			Applicant Approach		
		Displacement	Breeding Season Mortality	Non-breeding Season Mortality	Displacement	Breeding Season Mortality	Non-breeding Season Mortality
Black-legged kittiwake	***Rissa tridactyla***	30%	1% and 3%	1% and 3%	30%	1%	1%
Common guillemot	***Uria aalge***	60%	3% and 5%	1% and 3%	50%	1%	1%
Razorbill	***Alca torda***	60%	3% and 5%	1% and 3%	50%	1%	1%
Atlantic puffin	***Fratercula arctica***	60%	3% and 5%	N/A	50%	1%	N/A
Northern gannet	***Morus bassanus***	70%	1% and 3%	1% and 3%	70%	1%	1%

12.10.5 Collision Risk Modelling

12.10.5.1 The most robust version of the stochastic Collision Risk Model (sCRM) was used for the assessment, as recommended by NatureScot (2023g). The Caneco *et al.* (2022) model allows for stochasticity (variance and uncertainty) (McGregor *et al.*, 2018) to be included in the model, but can also present deterministic (Band, 2012) results for context.

12.10.5.2 Biological input parameters were obtained from NatureScot (2023g), as built into the sCRM (Caneco *et al.*, 2022). Seabird densities were derived from population modelling of the baseline data collected over 24-months of surveys in the OAA, producing monthly means and standard deviation (as presented in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Report**). Site-specific flight height data were not used due to small sample sizes (<100 usable samples per season for all species). Therefore, generic Flight Height Distribution (FHD) (Johnston *et al.*, 2014) has been used for all CRM scenarios.

12.10.5.3 Salamander Project input parameters are outlined in **Table 12-15**, with full detail provided in **Volume ER.A.2. Chapter 4: Project Description**. For further details on the CRM methodology and input parameters, refer to **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** (**Section 2.2**).

Avoidance Rates

12.10.5.4 Flight height and density information, along with the turbine specifications, number of turbines, and other seabird parameters (e.g. size, flight type, and nocturnal activity), are used to estimate the number of collisions. Initially, it is assumed that birds within the wind farm do not avoid individual turbines, swept areas, or blades. Avoidance rates are used to adjust collision estimates; it is noted that advice in the Scoping response (referenced in **Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**) referred to the SNCB-advised rates (Cook *et al.*, 2014). Revised avoidance rates are now available (Ozsanlav-Harris *et al.*, 2023). It is understood that NatureScot is currently reviewing its advice on avoidance rates in light of the updated information and "*while* [NatureScot] *do not anticipate any significant changes, an updated version of our guidance note should be available online shortly*" (as referenced in the Morven Scoping Response). For completeness, in the SNCB approach conclusions, the Cook *et al.* (2014) rates are applied, with the updated Ozsanlav-Harris *et al.* (2023) rates applied in the Applicant approach. The specific values applied under both approaches are presented in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report**. SNCB rates and the Applicant Approach rates are shown in **Table 12-20**.

12.10.5.5 Assessment conclusions are based on the Applicant Approach, however, collision estimates based on the 2014 avoidance rates are presented for additional context. RSPB suggested that a 98% avoidance rate is applied for gannet as the recommended rates are based on breeding season foraging only and may not account for macro-avoidance (i.e. displacement). Collision estimates based on this lower avoidance rate are also presented for context, with further details provided in the assessment discussion (**Section 12.11**).

12.10.5.6 Full details on the sCRM methodology, input variables, and outputs, including stochastic and deterministic results, are presented in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report**.

Table 12-20 Stochastic Collision Risk Modelling (sCRM) avoidance rates and associated standard deviation

Common Name	Scientific Name	Stochastic Collision Risk Modelling Avoidance Rates	
		Cook et al. (2014)	*Ozsanlav-Harris et al. (2023)*
Black-legged kittiwake	*Rissa tridactyla*	0.989 (± 0.002)*	0.993 (± 0.0003)*
Great black-backed gull	*Larus marinus*	0.995 (± 0.001)	0.994 (± 0.0004)
European herring gull	*Larus argentatus*	0.995 (± 0.001)	0.994 (± 0.0004)
Northern gannet	*Morus bassanus*	0.989 (± 0.002)	0.993 (± 0.0003)

* For kittiwake, the 'all gull' avoidance rate was used, as per NatureScot (2023g) guidance.

12.10.6 Regional Populations and Population Modelling

12.10.6.1 Distributional responses and collision risk were assessed using baseline population estimates for the OAA plus 2.0 km Buffer and predicted impacts were assessed against regional population estimates. Regional populations for each species were produced by applying species-specific foraging ranges (Woodward *et al.*, 2019; NatureScot, 2023c) to the OAA. SMP counts at sites within foraging range were summed, providing an estimate of the regional population. For some species with extensive foraging ranges (e.g. fulmar), the regional populations study area was proportionately limited to the North Sea.

12.10.6.2 Where the breeding season regional populations are based on foraging range (Woodward *et al.*, 2019) and non-breeding season regional populations are based on BDMPS (Furness, 2015), that is for kittiwake, gannet and razorbill, the breeding season population forms only part of those birds subject to impact in the non-breeding season. Therefore, the number of mortalities estimated to occur during the non-breeding season will also include impacts to birds that are not part of the breeding season regional population. To account for this, the estimated mortality in the non-breeding season was multiplied by the ratio of birds from the regional breeding population compared to the BDMPS non-breeding population. The proportion of non-breeding season mortality which applied to the regional population was added to the breeding season mortality estimate, to obtain the mean annual impact on adult survival rate, which was inputted into the NE PVA tool.

12.10.6.3 In the case of gannet, the non-breeding population within the BDMPS is smaller than the regional breeding population, despite the BDMPS non-breeding season population being made up of UK and non-UK birds. This is because some UK breeding birds leave UK waters entirely during the non-breeding season. To account for this, mortality estimates from collision and distributional responses in the non-breeding season were scaled in proportion to the UK contribution to the estimated North Sea and English Channel non-breeding season population (as presented in Furness (2015); approximately 90%).

12.10.6.4 Where predicted mortalities resulted in an 0.02%-point decrease in baseline survival, these were input into PVA (Searle *et al.*, 2019) in order to estimate the effect that the Salamander Project may have on seabird populations throughout its lifespan. PVA scenarios were run for 25 years, 35 years (operational life) and 50 years, with impacted scenario outputs compared with baseline (unimpacted) outputs.

12.10.6.5 Details on baseline population modelling can be found in **Volume ER.A.4, Annex 12.1: Offshore Ornithology Baseline Data Report** (**Section 2.1.2**). Further details on PVA are provided in **Volume ER.A.4, Annex 12.4: Population Viability Analysis**, refer to **Appendix I** of this report for details on adjustments to account for breeding bird presence in the non-breeding season. Detail on regional populations is also provided in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**.

12.11 Impact Assessment

12.11.1 Construction

12.11.1.1 During the construction phase, which encompasses pre-construction surveys, enabling works, and installation itself, the following potential impacts have been assessed:

- disturbance (vessel-related) within the Offshore Development Area, including cable laying, helicopter trips as well as tow-out events should floating structures be assembled outside the Offshore Development Area and subsequently towed (included in the Scoping Report (SBES, 2023));
- temporary habitat loss (short-term), including impacts to prey species (e.g. fish), arising from initial installation of the maximum spatial extent of infrastructure and cable burial, including scour protection and seabed preparation (included in Scoping Report (SBES, 2023)); and
- turbidity (suspended sediment), including impacts to prey species (e.g. fish), associated with installation of infrastructure as well as any seabed preparation that is required (not included in Scoping Report (SBES, 2023); but identified as a potential effect due to presence of diving birds).

12.11.1.2 Although attraction to artificial lighting was included in the Scoping Report and scoped in (SBES, 2023), review of the DAS data, as well as third party resources (e.g. Waggitt *et al.*, 2019), showed that species which are sensitive to artificial light (petrels and shearwaters) are not present in the Offshore Development Area. Therefore, artificial light has been scoped out.

Disturbance (Vessel-related)

Background

12.11.1.3 A range of vessels and helicopters will be used within the Offshore Development Area during the construction phase. Vessels and helicopters will be used for all aspects of construction, including pre-construction seabed preparation works, installation of Salamander Project infrastructure, and support vessels and crew transfers.

12.11.1.4 Vessel and helicopter presence has the potential to disturb seabirds and displace them from the Offshore Development Area, comprising both the OAA and the Offshore ECC. Disturbance may result in increased energy expenditure as birds may exhibit flight responses to vessel and helicopter presence. Displacement would constitute temporary habitat loss, as the area available for foraging and loafing is reduced. Reduced available habitat can increase inter- and intra-specific competition for space and prey resources, reducing the energy intake of individual birds.

12.11.1.5 Vessel activity in the region, including in the Offshore Development Area, is presented in **Volume ER.A.3, Chapter 14: Shipping and Navigation**, as informed by **Volume ER.A.4, Annex 14.1: Navigational Risk Assessment**. Salamander Project vessel activity is detailed in **Volume ER.A.2, Chapter 4: Project Description**, with a relevant summary provided in **Table 12-21**.

Table 12-21 Summary of construction phase vessel and helicopter activities

Metric	Number
Vessel trips	660
Maximum vessels on-site	Mooring and anchor installation: 6 Cable installation: 24 Substructure and WTG installation: 9
Helicopter trips	Cable installation: 14 Substructure and WTG installation: 7
Construction period (excluding pre-construction surveys)	Mooring and anchor installation: 18 months Cable installation: 18 months Substructure and WTG installation: 8 months **Offshore Construction Phase: 18 months**

12.11.1.6 Effects arising from vessel and helicopter disturbance are expected to be relatively short-term, temporary, and reversible, with no population-level impacts predicted. Once vessels have left the construction area, disturbance effects will cease, and any seabirds which have been displaced will be able to return to the area. It should be noted that displacement effects are assessed separately to distributional responses resulting from the presence of Salamander Project infrastructure within the OAA.

12.11.1.7 A Vessel Management Plan (VMP) is proposed as Tertiary Mitigation for the Salamander Project. The VMP will outline vessel best practices and transit routes, which will be in place to reduce environmental impacts whilst maintaining operational efficiency and health and safety.

12.11.1.8 Some seabird species and groups are more susceptible to vessel and helicopter disturbance than others. Fliessbach *et al.* (2019) assessed flush distances (the distance at which an individual bird or flock of birds initiates flight response to an approaching vessel) of various seabirds. The results of the study were used to produce a 'Disturbance Vulnerability Index'. The scores ranged from 3.3 (Arctic tern; least sensitive) to 77.8 (RTD; most sensitive).

12.11.1.9 Additionally, Furness *et al.* (2013) assessed species specific sensitivity to vessel and helicopter disturbance at OWF developments; and Bradbury *et al.* (2014) used the assessment results to determine species-specific sensitivities. Furness *et al.* (2013) sensitivity scores ranged from one (sooty shearwater (*Ardenna grisea*); least sensitive) to 32 (RTD; most sensitive).

12.11.1.10 These studies have been used to assess the sensitivity of seabird receptors discussed in the baseline (**Section 12.7**). To make the results comparable, all three studies have been indexed to score birds from one to five, with one being the least sensitive and five the most sensitive to vessel disturbance. Garthe and Hüppop (2004) scored sensitivity based on a scale of one to five; these ratings (**Table 12-22**) have been applied to the worst-case indexed scores, and are used to scope species in or out of assessment.

Table 12-22 Seabird disturbance sensitivity scores based on Garthe and Hüppop (2004)

Sensitivity	Indexed Score
High	4 to < 5
Medium	3 to < 4
Low	2 to < 3
Negligible	1 to < 2

12.11.1.11 The indexed scores presented in **Table 12-22** were used to scope seabird species for vessel disturbance. The worst-case scoring, based on Furness *et al.* (2013), Bradbury *et al.* (2014) and Fliessbach *et al.* (2019), and associated sensitivity for each species observed in notable numbers in the OAA is listed in **Table 12-23**. Species which were observed in comparatively low abundance, as listed in the baseline (**Section 12.7.1**), and those with negligible sensitivity to vessel disturbance, are scoped out of the vessel-related disturbance assessment.

Table 12-23 Worst-case indexed vessel disturbance sensitivity scoring and scoping for vessel-related disturbance

Common Name	Scientific Name	Sensitivity (Indexed Score)	Scoping
Black-legged kittiwake	*Rissa tridactyla*	Negligible (1.8)	Out
Great black-backed gull	*Larus marinus*	Negligible (1.8)	Out
European herring gull	*Larus argentatus*	Negligible (1.5)	Out
Common guillemot	*Uria aalge*	Low (2.8)	In
Razorbill	*Alca torda*	Medium (3.6)	In
Atlantic puffin	*Fratercula arctica*	Low (2.3)	In
Northern fulmar	*Fulmarus glacialis*	Negligible (1.4)	Out
Northern gannet	*Morus bassanus*	Negligible (1.8)	Out

<u>Auks</u>

Sensitivity

12.11.1.12 Auks are considered to have a medium-low sensitivity to vessel disturbance (Furness *et al.*, 2013; Bradbury *et al.*, 2014), with disturbance ratings ranging from eight to 14 (2.0 to 2.6 out of 5 when indexed).

12.11.1.13 Of the three species recorded in the Offshore Development Area, puffin is least susceptible to disturbance associated with OWF vessel and helicopter traffic. Fliessbach *et al.* (2019) suggest that razorbill have a higher sensitivity to disturbance than guillemot. Guillemot had a mean flush distance of 127 ± 110 m, compared with razorbill, which had a flush distance over three times greater (395 ± 216 m). Puffin were not recorded by Fliessbach *et al.* (2019).

12.11.1.14 Based on worst-case sensitivity scores and taking the high abundance during the post-breeding moult period into account, razorbill is considered to have a **Medium** sensitivity to vessel disturbance. Guillemot and puffin sensitivity to disturbance is lower than razorbill (Furness *et al.*, 2013; Bradbury *et al.*, 2014), and therefore, it is considered to have an overall **Low** sensitivity to vessel disturbance during the construction phase of the Salamander Project.

Magnitude

12.11.1.15 The auk group was the most abundant group recorded during baseline surveys, with guillemot representing over half of all bird sightings in the Site Specific Study Area. Due to their high presence in the Offshore Development Area, interaction between vessels and auks is highly likely during the construction phase.

12.11.1.16 Vessel traffic is expected to increase above baseline levels during the construction phase, with up to 660 transits occurring over 18-months. However, vessels will be operating within discrete sections of the Offshore Development Area (10 km^2 total). Disturbance effects cover a small proportion of the Offshore Development Area and the marine area available to auks for foraging, and are considered time-limited, with disturbance ceasing once vessels leave the area. The magnitude of vessel disturbance on auks is considered to be **Low** due to the limited spatial extent and duration of vessel disturbance.

Significance

12.11.1.17 Guillemots and puffins are considered to have a **Low** sensitivity and **Low** magnitude of disturbance, therefore, the significance of vessel disturbance in the construction phase is **Negligible**. Razorbills have **Medium** sensitivity and a **Low** magnitude, therefore, the significance is **Minor**. Disturbance impacts to auks are **Not Significant** in EIA terms.

<u>Intertidal Ornithology</u>

Sensitivity

12.11.1.18 As recorded during the intertidal surveys (**Volume ER.A.4, Annex 12.2: Intertidal Baseline Ornithology Report**), a number of species forage and roost in the intertidal zone and make use of nearshore subtidal areas out to around 500 m. The key species in this area include common redshank, ruddy turnstone, golden plover, dunlin, sanderling, red knot, Eurasian curlew, and northern lapwing. These species can be flushed by operational vessels at distances up to 1000 m, although less than 500 m disturbance distance is more common (Goodship and Furness, 2022). Goodship and Furness (2022) suggest that species with a flush distance of >500 m should be considered to have a **High** sensitivity to disturbance. To maintain a precautionary approach to assessment, this sensitivity has been applied.

Magnitude

12.11.1.19 Several species of birds were recorded in the intertidal zone, including common eider, cormorants and shags, and a range of wader species, notably common redshank and golden plover. Therefore, there is potential for vessel-related disturbance effects to occur. As previously noted, up to 660 additional vessel transits may occur during the construction phase. However, these will primarily be associated with the OAA, where the majority of infrastructure is to be installed. Operations near the intertidal zone will be associated with the Offshore ECC only, including any seabed preparation works, cable burial, transition between offshore and onshore cable, and installation of scour protection. Due to the small spatial extent, and the limited interaction between the intertidal zone and offshore works during construction, the overall magnitude of disturbance on intertidal ornithology is considered to be **Low**.

Significance

12.11.1.20 Intertidal species having **High** sensitivity to vessel-related disturbance and with a **Low** magnitude (due to the small spatial extent and duration of works near the intertidal zone), the overall significance is **Minor**. This is **Not Significant** in EIA terms.

Summary

12.11.1.21 A summary of the impacts of vessel-related disturbance on Offshore and Intertidal Ornithology during construction and pre-construction is presented in **Table 12-24**.

Table 12-24 Summary of the impacts of disturbance (vessel-related) on Offshore and Intertidal Ornithology during the construction phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Common guillemot	*Uria aalge*	Low	Low	Negligible
Razorbill	*Alca torda*	Medium	Low	Minor
Atlantic puffin	*Fratercula arctica*	Low	Low	Negligible
Intertidal birds	N/A	High	Low	Minor

Temporary Habitat Loss (Short-term)

Background

12.11.1.22 Direct impacts to supporting habitat and impacts to prey populations, termed 'temporary habitat loss (short-term)' throughout this assessment refers only to impacts during the construction phase. Details on the cumulative spatial extent of impacts are provided in **Table 12-9**. Temporary impact to supporting habitat can occur through several mechanisms, such as installation and burial of cables (trenchless installation methods shall be used to bring the marine export cable to shore with an exit pit no closer than 200 m below MHWS), installation of mooring line anchors, and direct contact between vessels (anchors and jack-up legs) and the seabed. The total area of habitat which may be temporarily disturbed during construction is <5.3 km^2, approximately 1.5 km^2 in the OAA and 3.4 km^2 in the Offshore ECC, with an additional 0.25 km^2 associated with vessel contact.

12.11.1.23 Impacts to pelagic fish and the water column (as supporting habitat for seabirds) are unlikely to be substantial due to the negligible volume of water that is directly displaced by infrastructure. Therefore, this impact is considered to affect demersal fish species and benthic habitats and communities only.

Sensitivity

12.11.1.24 Kittiwake were observed in relatively high numbers in the OAA. The species feeds in the upper water column, however, its primary prey source is sandeel (Anderson *et al.*, 2014), and reductions in sandeel stocks have been linked to population decline (Frederiksen *et al.*, 2004; Nikolaeva *et al.*, 2006). As kittiwake are reliant on sandeel as a specific prey item, if sandeel populations were to be affected, reducing the prey availability, kittiwake sensitivity to temporary habitat loss (short-term) at the Salamander Project would be **Medium**.

12.11.1.25 Similarly, auks feed primarily on sandeel, foraging both in the water column and at the seabed. Reductions in prey availability, including through habitat loss and direct competition with commercial fisheries, as well as changes in climate conditions (e.g. SST) have been linked to reduced breeding success and population decline (Sandvik *et al.*, 2005; Nettleship *et al.*, 2018). However, short-term habitat impacts at the Salamander Project are not expected to have notable effect (Minor) on sandeel species (refer to **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)). If impacts on sandeel populations were to occur, auk populations would also be expected to reduce. The species is known to respond negatively to reduced prey availability (e.g. Fort *et al.*, 2012; Gaston *et al.*, 2017; Buckingham *et al.*, 2022), and therefore, also considering the short recovery period expected auk sensitivity to temporary habitat loss (short-term) is **Medium**.

Magnitude

12.11.1.26 The magnitude of effect is based on the maximum extent of seabed footprint associated with the preparatory works and subsequent installation of infrastructure that directly interacts with the seabed. The total area of seabed which may exhibit short-term habitat impacts is 5,178,340 m^2, or up to 5.2 km^2, lasting up to 36 months. This represents 4.6% of the OAA and 7.2% of the Offshore ECC. Considering the spatial extent of habitat available in the region, a low proportion of total habitat may be affected.

12.11.1.27 Short-term habitat impacts are predicted to have no notable impact (Minor at worst) on either Benthic Ecology receptors (**Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.11**; **Table 9-28**)) or Fish and Shellfish Ecology (**Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)). As effects on seabird supporting habitats are Minor at worst, recovery is expected to take place over a relatively short period of time. With no population-level effects on prey resources predicted, seabirds are likely to be able to continue to use supporting habitat shortly after works have finished. Therefore, recoverability from temporary habitat loss (short-term) is high.

12.11.1.28 Gannets are plunge-diving birds, with maximum dive depths of around 11 m (Garthe *et al.*, 2014), although can reach as deep as 24 m by using their wings underwater to propel themselves after prey (Ropert-Coudert *et al.*, 2009). The species feeds on pelagic fish in the offshore environment, and therefore, short-term habitat impacts will not occur.

12.11.1.29 Kittiwake primarily feed on sandeel (Newell *et al.*, 2019), a demersal prey species with specific habitat requirements. Loss of sandeel supporting habitat may result in impacts to sandeel stocks, thus reducing prey availability for kittiwake. However, the Fish and Shellfish Ecology impact assessment (**Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)) determined that impacts to sandeel, and all other demersal fish, were not significant (Minor at worst). Additionally, kittiwake feed in the upper water column, meaning impacts on seabed habitats are less likely to affect prey and feeding. Therefore, the magnitude of short-term habitat impacts on kittiwake is **Negligible**.

12.11.1.30 The three auk species dive for prey from resting on the sea surface, reaching maximum depths of 60 – 180 m (Piatt and Nettleship, 1985). Although prey items vary, sandeel are a primary food source for all three species (Sandvik *et al.*, 2005; Anderson *et al.*, 2014; RSPB, 2024). As previously noted, impacts to sandeel habitat may also have impacts on prey availability. However, this will only occur over a relatively small spatial extent and impacts to fish and shellfish are not significant. With diving depths that exceed water depths within the OAA, there is higher potential for effects at the seabed to impact auk feeding; therefore, magnitude is marginally higher than for kittiwake, despite having similar prey requirements. Therefore, impact magnitude to auks is **Low**.

Significance

12.11.1.31 The magnitude of short-term habitat impacts on kittiwake is **Negligible** and sensitivity is **Medium**, therefore, significance is **Negligible**. The magnitude of effect on auks is **Low**, due to their higher presence in the area and ability to dive to seabed within the Offshore Development Area, but also considering the relating small spatial extent. Auk sensitivity to habitat loss (i.e. reduced sandeel availability) is **Medium**, with evidence of links between prey availability and auk populations. Overall impacts on auks are **Minor**. Short-term habitat impacts are **Not Significant** in EIA terms.

Summary

12.11.1.32 **Table 12-25** provides an overview of the assessment of temporary habitat loss (short-term).

Table 12-25 Summary of the impacts of temporary habitat loss (short-term) on Offshore and Intertidal Ornithology during the construction phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Black-legged Kittiwake	*Rissa tridactyla*	Medium	Negligible	Negligible
Common Guillemot	*Uria aalge*	Medium	Low	Minor
Razorbill	*Alca torda*	Medium	Low	Minor
Atlantic Puffin	Fratercula arctica	Medium	Low	Minor

Turbidity (Suspended Sediment)

Background

12.11.1.33 Interaction with seabed habitats during the construction phase of the Salamander Project, such as infrastructure installation, is likely to result in suspension of seabed sediments into the water column. The most significant activities in terms of the potential for suspension of seabed substrates includes the installation and burial of cables, and the installation of anchors / mooring points.

12.11.1.34 Sand-dominated substrates, with limited mud content, are the primary seabed types (refer to **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.7.1**, **Figure 9-3**)). Therefore, the resulting suspended sediment concentrations are expected to be short-term and localised, particularly within the Offshore ECC, where sediment composition shifts from sand-dominated to gravel-dominated. Coarser sediments such as gravels are expected to settle closer to the point of disturbance than finer sediments.

12.11.1.35 It is noted that the nature of this impact is highly specific to the point of disturbance, and therefore, will occur during discrete events throughout the construction phase, as opposed to simultaneously throughout the Offshore Development Area.

Sensitivity

12.11.1.36 Gannets are plunge-diving, visual-foraging seabirds, soaring at altitudes up to 100 m and dive into the water at speeds up to 120 mph (Garthe *et al.*, 2014). Gannet diving depths of up to 11 m from plunge-diving alone (Garthe *et al.*, 2014) and up to 24 m when using wings for underwater propulsion (Ropert-Coudert *et al.*, 2009) have been recorded. Gannets generally foraging in the upper and mid water column, rarely reaching the seabed, therefore, sensitivity is considered to be **Low**.

12.11.1.37 Guillemot, razorbill, and puffin, dive from the surface of the water to depths between 60 m and 180 m (Piatt and Nettleship, 1985), foraging primarily on sandeel species (Sandvik *et al.*, 2005; Anderson *et al.*, 2014; RSPB, 2024), but also other small pelagic fish (Barrett *et al.*, 1987; Nettleship, 1996). Reductions in foraging success have been linked to decreased breeding success and population decline in auks (Heath *et al.*, 2009;

Nettleship *et al.*, 2018). As these birds target demersal species (sandeel), can dive to depths greater than the maximum depth across the Offshore Development Area, and are visual foraging seabirds, all three species are considered to have a **Medium** sensitivity to increased suspended sediment concentration.

Magnitude

12.11.1.38 Monthly averaged satellite imagery of suspended particulate matter suggests that within the OAA and Offshore ECC average (surface) concentration is generally very low, ranging from 0.5 – 1.5 mg l^{-1} and 0.6 – 1.2 mg l^{-1}, respectively (Silva, 2016), with higher values anticipated during large spring tides and storm conditions. Higher concentrations are also expected to be observed at any given time closer to the seabed. Modelled residual sediment transport direction varies around the OAA but is broadly to the northeast along the western margin, and southeasterly in central / eastern areas. Residual transport along the Offshore ECC is southward.

12.11.1.39 The assessment of changes to suspended sediment concentration arising from construction activities can be summarised broadly into three main zones, based on the distance from the activity causing sediment disturbance:

- **< 50 m from the source** has the highest turbidity increase. At the time of active disturbance, very high sediment concentrations (tens to hundreds of thousands of mg l^{-1}) are predicted, lasting for the duration of active disturbance plus up to 30 minutes following the end of disturbance. One hour after the active disturbance, suspended sediment is expected to have returned to within natural variation.
- **50 to 500 m from the source** is predicted to experience measurable increases in suspended sediment. At the time of active disturbance, high suspended sediment concentration (hundreds to low thousands of mg l^{-1}) is predicted, lasting for the duration of active disturbance, plus up to 30 minutes following end of disturbance. More than one hour after end of disturbance, no measurable change in suspended sediment from the baseline is predicted.
- **From 500 m to the tidal excursion buffer** is predicted to experience lesser but measurable increase in suspended sediment. At the time of active disturbance, it is predicted that there will be low to intermediate suspended sediment concentration increase (tens to low hundreds of mg l^{-1}) as a result of any remaining fines in suspension, only within a narrow plume (tens to a few hundreds of metres wide). Suspended sediment concentrations are then predicted to decrease rapidly by dispersion to return to background levels between six to 24 hours. No measurable change from baseline suspended sediment is predicted after 24 hours following cessation of activities.

12.11.1.40 It is noted here, that in shallower waters (< 30 m) during storm events, wave driven currents can naturally cause very high suspended sediment concentrations (> 1,000 mg l^{-1}) close to the seabed in areas where mobile sediment is present. Accordingly, even when suspended sediment increases occur as a result of wind farm construction activities, they are expected to be comparable to (or less than) increases which can occur naturally under (extreme) baseline conditions.

12.11.1.41 Guillemot, razorbill, puffin, and gannet are all present in sufficient numbers that interaction is likely to occur, and with each species diving varying depths below the surface, it is likely that some individuals will encounter regions of increased turbidity when foraging. However, magnitude is considered **Low** due to the limited spatial and temporal extent of suspended sediment plumes, thus foraging success is not likely to be notably affected.

Significance

12.11.1.42 For guillemot, razorbill, puffin, and gannet, the magnitude of increased suspended sediment concentration is **Low**. Combined with a **Medium** sensitivity for auks, results in an overall **Minor** significance. Gannets have a **Low** sensitivity, with overall significance considered to be **Negligible**. An overview of the magnitude and sensitivity ratings applied to each species is presented in **Table 12-26**. Impacts are **Not Significant** in EIA terms.

Table 12-26 Summary of the impacts of turbidity (suspended sediment) on Offshore and Intertidal Ornithology during the construction phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Common Guillemot	*Uria aalge*	Medium	Low	Minor
Razorbill	*Alca torda*	Medium	Low	Minor
Atlantic Puffin	*Fratercula arctica*	Medium	Low	Minor
Northern Gannet	*Morus bassanus*	Low	Low	Negligible

12.11.2 Operation and Maintenance

12.11.2.1 Under the operation and maintenance phase, the following potential impacts have been assessed:

- disturbance (vessel-related), including helicopter traffic, throughout the operational phase of the Salamander Project (included in the Scoping Report (SBES, 2023));
- distributional responses (displacement and barrier effect), arising from the presence of the WTG structures within the OAA (included in the Scoping Report (SBES, 2023));
- collision, with the operational WTGs in the OAA (included in the Scoping Report (SBES, 2023));
- temporary habitat loss (long-term), the spatial extent of which also covers short-term habitat loss associated with emplacement of additional scour and cable burial, including potential impacts to prey items such as fish (included in the Scoping Report (SBES, 2023)); and
- entanglement, arising from diving seabirds becoming entangled in debris caught on project infrastructure, such as cables and mooring lines (included in the Scoping Report (SBES, 2023)).

Disturbance (Vessel-related)

Background

12.11.2.2 Vessel and helicopter presence has the potential to disturb seabirds and displace them from the Offshore Development Area, comprising both the OAA and the Offshore ECC. Disturbance may result in increased energy expenditure if birds exhibit flight responses to vessel and helicopter presence. Displacement would constitute temporary habitat loss, as the area available for foraging and loafing is reduced while vessels or helicopters are present. A reduction in available habitat can increase inter- and intra-specific competition for space and prey resources, reducing the energy intake of individual birds.

12.11.2.3 Vessel activity in the region, including in the Offshore Development Area, is presented in **Volume ER.A.3, Chapter 14: Shipping and Navigation**, as informed by **Volume ER.A.4, Annex 14.1: Navigational Risk**

Assessment. Salamander Project related vessel activity within the Offshore Development Area is detailed in **Volume ER.A.2, Chapter 4: Project Description**, with a relevant summary provided below.

12.11.2.4 Operation and maintenance activities may result in up to 210 vessel return trips to and from the Offshore Development Area per year. Additionally, up to 140 helicopter trips may be made each year. The operation and maintenance phase is expected to last for up to 35 years (operational life), giving a cumulative total of 7,350 vessel trips and 4,900 helicopter trips over the operational life of the Salamander Project.

12.11.2.5 Effects arising from vessel and helicopter disturbance are expected to be regular, short-term, temporary, and reversible, with no population-level impacts predicted. It should be noted that disturbance effects (i.e. vessel and helicopter disturbance) are assessed separately to distributional responses resulting from the presence of infrastructure within the OAA. Operational WTGs are expected to have a more notable effect on seabirds, with wider displacement radius and permanent presence for the duration of the operation and maintenance phase. Therefore, the effects of distributional responses may overshadow vessel displacement.

12.11.2.6 A VMP is proposed as Tertiary Mitigation for the Salamander Project. The VMP will outline vessel best practices and transit routes, which will be in place to minimise environmental impacts whilst maintaining operational efficiency and health and safety.

12.11.2.7 Studies by Furness *et al.* (2013), Bradbury *et al.* (2014) and Fliessbach *et al.* (2019) have been used to assess the sensitivity of seabird receptors discussed in the baseline (**Section 12.7**). The same approach to assessment during construction has been applied here, where seabird species are scoped based on presence in the DAS (receptor-pressure pathway) and the indexed sensitivity scores. **Table 12-27** presents a summary of the scoping, where only auk species are scoped in for assessment.

Table 12-27 Worst-case indexed vessel disturbance sensitivity scoring and scoping for vessel-related disturbance

Common Name	Scientific Name	Sensitivity (Indexed Score))	Scoping
Black-legged kittiwake	*Rissa tridactyla*	Negligible (1.8)	Out
Great black-backed gull	*Larus marinus*	Negligible (1.8)	Out
European herring gull	*Larus argentatus*	Negligible (1.5)	Out
Common guillemot	*Uria aalge*	Low (2.8)	In
Razorbill	*Alca torda*	Medium (3.6)	In
Atlantic puffin	*Fratercula arctica*	Low (2.3)	In
Northern fulmar	*Fulmarus glacialis*	Negligible (1.4)	Out
Northern gannet	*Morus bassanus*	Negligible (1.8)	Out

Auks

Sensitivity

12.11.2.8 As per **Table 12-27**, based on review of disturbance sensitivity and studies conducted by Furness *et al.* (2013), Bradbury *et al.* (2014) and Fliessbach *et al.* (2019), auks are considered to have a medium to low sensitivity. Razorbill is the most sensitive of the three species, with the greatest flush distances (Fliessbach *et al.*, 2019), whereas guillemot and puffin are less susceptible (Fliessbach *et al.*, 2019). Therefore, razorbill has **Medium** sensitivity, and guillemot and puffin have **Low** sensitivity to vessel disturbance during the operation phase.

Magnitude

12.11.2.9 Due to high presence in the Offshore Development Area, interaction between vessels and auks is highly likely to occur. However, it is expected that up to 60% of birds within the OAA plus 2.0 km Buffer will be displaced by operational WTGs. Therefore, birds remaining are likely to be individuals less susceptible to disturbance. Population-level effects are not expected to occur due to the extent of habitat available in the region, with vessel disturbance covering a small proportion. The magnitude of disturbance effects on guillemot, razorbill, and puffin are **Low**.

Significance

12.11.2.10 Razorbill has **Medium** sensitivity and the magnitude of disturbance is **Low**, therefore, the significance of vessel disturbance in the construction phase is **Minor**. Guillemots and puffins have **Low** sensitivity and a **Low** magnitude of effect is predicted, giving an overall **Negligible** significance. Therefore, disturbance impacts to auks are **Not Significant** in EIA terms.

Intertidal Birds

Sensitivity

12.11.2.11 As recorded during the intertidal surveys, a number of species forage and roost in the intertidal zone and along the strandline. Intertidal species recorded in the surveys include common redshank, ruddy turnstone, golden plover, sanderling, and red knot. An overview of the key species is presented in **Section 12.7.1**, with full details in **Volume ER.A.4, Annex 12.2: Intertidal Baseline Ornithology Report**. These species can be flushed by vessels at distances up to 1,000 m, although less than 500 m disturbance distance is more common (Goodship and Furness, 2022). Goodship and Furness (2022) suggest that species with a flush distance of >500 m should be considered to have a **High** sensitivity to disturbance. To maintain a precautionary approach to assessment, this sensitivity has been applied.

Magnitude

12.11.2.12 Therefore, there is potential for vessel-related disturbance effects on intertidal species. Vessel activity during operation and maintenance will primarily be associated with the OAA. Operations near the intertidal zone will be associated with the Offshore Export Cable only. Due to the small spatial extent, and the limited interaction between the intertidal zone and offshore works during operation, the magnitude of disturbance on intertidal ornithology is **Low**.

Significance

12.11.2.13 Intertidal species having **High** sensitivity to vessel-related disturbance and with a **Low** magnitude (due to the small spatial extent and duration of works near the intertidal zone), the overall significance is **Minor**. This is **Not Significant** in EIA terms.

Summary

12.11.2.14 **Table 12-28** presents an overview of the assessment of vessel-related disturbance on Offshore and Intertidal Ornithology. Predicted impacts to all species are either **Negligible** or **Minor**, which are **Not Significant** in EIA terms.

Table 12-28 Summary of the impacts of disturbance (vessel-related) on Offshore and Intertidal Ornithology during the operation and maintenance phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Common Guillemot	*Uria aalge*	Low	Low	Negligible
Razorbill	*Alca torda*	Medium	Low	Minor
Atlantic Puffin	*Fratercula arctica*	Low	Low	Negligible
Intertidal Birds	N/A	High	Low	Minor

Distributional Responses (Displacement and Barrier Effects)

Background

12.11.2.15 The term 'distributional responses' refers to the displacement of seabirds from foraging or loafing areas within the OAA and to barrier effects presenting an obstacle between seabird colonies and foraging areas or along migration routes arising from the presence of infrastructure. The two effects are difficult to distinguish, and therefore, are assessed together under distributional responses. Vessel trips are not considered here.

12.11.2.16 The presence of operational WTGs can limit seabird access to foraging areas, resulting in reduced energy intake and reduced foraging success. Displacement effects can also cause increased inter- and intra-specific competition for alternative foraging areas and prey resources. Barrier effects can result in increased energy expenditure as birds alter their flight paths to avoid the OAA. Reduced intake and increased expenditure result in similar effects, where birds can become malnourished or unable to feed and care for young.

12.11.2.17 Distributional responses are assessed through the use of 'Displacement Matrices', where displacement rates and mortality rates are applied to the populations within the OAA plus 2.0 km Buffer. This approach is in line with current NatureScot (2023h) guidance. **Volume ER.A.4, Annex 12.5: Displacement Assessment** provides details on the methodology and approach (**Section 2.1**), as well as the results (**Section 3.1** and **Appendix I**). Regional population estimates are presented in **Table 12-9** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report** (**Section 2, Table 2** and **Table 3**). The outputs of this are used to inform the following impact assessment.

12.11.2.18 Species which were either observed in negligibly low numbers or which are not sensitive to displacement effects (Furness *et al.*, 2013; Bradbury *et al.*, 2014) are not scoped in for assessment. Species scoped in are kittiwake, guillemot, razorbill, puffin, and gannet.

12.11.2.19 For species which are sensitive to both distributional responses and collision, the effects have been summed. This assessment is presented in **Section 12.16 Inter-related Effects**.

Black-legged Kittiwake

Sensitivity

12.11.2.20 Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that kittiwake have a very low sensitivity to displacement, with respective sensitivity scores of six and five out of 32. The scoring takes a number of factors into consideration, including proportion of birds displaced from the OAA, species habitat use flexibility, and conservation importance (Furness *et al.*, 2013).

12.11.2.21 SNCB (2017, 2022) and NatureScot (2023h) suggest that up to 30% of kittiwake within the OAA may be displaced and recommend a 1 – 3% mortality rate is applied to displaced birds in all seasons. However, as discussed in **Section 12.11**, these rates are considered highly precautionary when compared with project level SeabORD modelling and evidence from existing developments. Therefore, a 1% mortality rate is considered appropriate and has been applied for the assessment. Kittiwake sensitivity to displacement is, therefore, considered to be **Low**.

Magnitude

12.11.2.22 The OAA will contain up to seven WTGs once operational, thus distributional responses are expected to be measurable against baseline levels, where no fixed structures are present. However, the spatial extent will be limited to within the OAA, covering up to 33.25 km^2, with displacement expected to occur up to 2 km away (92.17 km^2 total). Kittiwakes forage up to 300.6 km (mean maximum plus 1 SD) (Woodward *et al.*, 2019), therefore, the spatial extent is small in comparison to the foraging area.

12.11.2.23 Kittiwake were observed in moderate to high numbers in the OAA, with peak counts in June and July 2021 and August 2022. The mean seasonal peak kittiwake population in the OAA 2.0 km Buffer is 3,718 indv. in the breeding season and 220 indv. in the non-breeding season. Distributional responses may affect a small proportion of the kittiwake population (1.83% in the breeding season and 0.04% in the non-breeding season) over a small spatial extent, resulting in Low magnitude of effect.

Significance

12.11.2.24 Kittiwake has an average survival rate of 0.854 (Horswill and Robinson, 2015), giving a mortality rate of 14.6%. Using this rate, and the regional population estimates, baseline mortalities have been calculated. Estimated mortalities associated with distributional responses were added onto the baseline mortalities to give impacted mortality and survival rates, with impacts in the non-breeding season adjusted to account for breeding birds which form part of the non-breeding population, as described in **Section 12.11** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**. The impacted survival rate for kittiwake is 85.394% (**Table 12-29**), a 0.006%-point decrease. Seasonal displacement matrices considering a range of displacement and mortality rates are presented in **Table 12-30** and **Table 12-31**, further detail, including confidence limits, are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.11.2.25 Considering the Low magnitude and Low sensitivity of kittiwake and noting that distributional responses will result in a small effect on baseline mortality and population, the significance is Negligible. This is Not Significant in EIA terms.

12.11.2.26 The impacts predicted for the lower (assessment) and upper range of the recommended mortality rates for kittiwake are also presented in **Table 12-29**. The upper rates are presented for context, showing that if higher mortality were to occur, this would also result in a small effect on the overall population with a <0.02%-point change in baseline survival rate for all seasons.

Table 12-29 Black-legged kittiwake (*Rissa tridactyla*) regional population estimates and distributional responses mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Applicant Approach displacement rates (30%) and mortality rates (1%)							
Breeding	202,258	85.400%	29,530	11	29,542	**85.394%**	**-0.006**
Non-breeding	627,816		91,661	1			
SNCB (2017, 2022) displacement rates (30%) and worst-case mortality rates (3%)							
Breeding	202,258	85.400%	29,530	33	29,564	85.383%	-0.017
Non-breeding	627,816		91,661	1			

Table 12-30 Black-legged kittiwake (*Rissa tridactyla*) estimated breeding season displacement mortalities (indv. Year-1)

Black-legged Kittiwake (Breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	4	7	11	15	19	37	56	74	112	186	297	372
	20	0	7	15	22	30	37	74	112	149	223	372	595	744
	30	0	**11**	22	33	45	56	112	167	223	335	558	892	1,115
	40	0	15	30	45	59	74	149	223	297	446	744	1,190	1,487
	50	0	19	37	56	74	93	186	279	372	558	930	1,487	1,859
	60	0	22	45	67	89	112	223	335	446	669	1,115	1,785	2,231
	70	0	26	52	78	104	130	260	390	521	781	1,301	2,082	2,603
	80	0	30	59	89	119	149	297	446	595	892	1,487	2,380	2,974
	90	0	33	67	100	134	167	335	502	669	1,004	1,673	2,677	3,346
	100	0	37	74	112	149	186	372	558	744	1,115	1,859	2,974	3,718

Key

(blue)	**Applicant Approach displacement and mortality rate / lower SNCB (2014) displacement and mortality rate**
(green)	Upper SNCB (2014) displacement and mortality rate

Table 12-31 Black-legged kittiwake (*Rissa tridactyla*) estimated non-breeding season displacement mortalities (indv year^{-1})

Black-legged Kittiwake (Non-breeding)		Mortality Rate (%)												
		0	1	2	3	4	5	10	15	20	30	50	80	100
Displacement Rate (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	1	1	1	2	3	4	7	11	18	22
	20	0	0	1	1	2	2	4	7	9	13	22	35	44
	30	0	**1**	1	2	3	3	7	10	13	20	33	53	66
	40	0	1	2	3	4	4	9	13	18	26	44	70	88
	50	0	1	2	3	4	6	11	17	22	33	55	88	110
	60	0	1	3	4	5	7	13	20	26	40	66	106	132
	70	0	2	3	5	6	8	15	23	31	46	77	123	154
	80	0	2	4	5	7	9	18	26	35	53	88	141	176
	90	0	2	4	6	8	10	20	30	40	59	99	158	198
	100	0	2	4	7	9	11	22	33	44	66	110	176	220

Key

(blue)	**Applicant Approach displacement and mortality rate / lower SNCB (2014) displacement and mortality rate**
(green)	Upper SNCB (2014) displacement and mortality rate

Common Guillemot

Sensitivity

12.11.2.27 Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that guillemot have a medium sensitivity to displacement, with respective sensitivity scores of 14 and 13 out of 32. The scoring takes a number of factors into consideration, including proportion of birds displaced from the OAA, species habitat use flexibility, and conservation importance (Furness *et al.*, 2013).

12.11.2.28 NatureScot (2023h) recommend that mortality rates of 3% and 5% are used for displaced birds in the breeding season and 1 – 3% in the non-breeding season. However, review of data collected at existing OWF developments suggest that these rates are over precautionary considering the scale of the Salamander Project (i.e. seven WTGs over 33.25 km^2). Since the UK SNCBs published recommended rates for auks in 2017, a number of studies have been undertaken. Studies such as Searle *et al.* (2018), van Kooten *et al.* (2019), and APEM (2022a) suggest that the recommended rates are overly precautionary. Outside the breeding season, auks are typically more widely dispersed (Camphuysen, 2002; Christie, 2021), therefore, pressure on individuals to forage in specific areas is lower. Therefore, as detailed in **Section 12.11**, a 1%

mortality rate is applied for the assessment. This rate is applicable for all auk species assessed: guillemot, razorbill, and puffin.

12.11.2.29 Considering the assessments by Furness *et al.* (2013) and Bradbury *et al.* (2014), the low mortality of displaced birds (Searle *et al.*, 2018; van Kooten *et al.*, 2019), and the dispersal in the non-breeding seasons, guillemot sensitivity is **Medium**.

Magnitude

12.11.2.30 Guillemot were observed in high numbers in the OAA, especially in the post-breeding moult period in Year 2 (August and September). The mean seasonal peak guillemot population in the OAA plus 2.0 km Buffer is 3,616 indv. In the breeding season and 11,779 indv. In the non-breeding season, therefore, there is high potential for distributional responses to occur. Due to the large numbers of guillemot observed, interaction with the Salamander Project is expected to be frequent.

12.11.2.31 The OAA will contain up to seven WTGs once operational, thus distributional responses are expected to be measurable against baseline levels, where no fixed structures are present. However, the spatial extent will be limited to within the OAA, covering up to 33.25 km^2, with displacement expected to occur up to 2 km away (92.17 km^2 total). Including the Fair Isle colonies, guillemot forage up to 153.7 km (mean maximum plus 1 SD), excluding these birds, the foraging range is 95.2 km (Woodward *et al.*, 2019), therefore, the spatial extent is small in comparison to the foraging area available.

12.11.2.32 NatureScot recommends that a 60% displacement rate is applied to auks in both the breeding and non-breeding season. Data collected at existing OWF developments were reviewed and summarised by APEM (2022a). Displacement rates are variable (APEM, 2022a), for example, 44 – 63% was recorded at sites in the German North Sea (Peschko *et al.*, 2020). Following review of 21 developments, APEM (2022a) suggest that a 50% displacement rate is more appropriate for auks. Therefore, as discussed in **Section 12.11**, this rate is applicable for all auk species assessed: guillemot, razorbill, and puffin.

12.11.2.33 Although peak population estimates in the OAA plus 2.0 km Buffer were high, these represent <3% of the regional population. With a displacement rate of 50% applied, up to 1.44% of the regional population may be displaced, representing a **Low** magnitude of effect.

Significance

12.11.2.34 The average survival rate of guillemot is 0.939 or 93.9% (Horswill and Robinson, 2015), representing a regional baseline mortality of 24,885 indv. Assuming a 50% displacement rate and 1% mortality rate, the estimated impact is up to 18 mortalities in the breeding season and 59 in the non-breeding season, totalling 77 per year. As the breeding and non-breeding populations are the same, no adjustments to non-breeding mortality estimates are required (described in **Section 12.11**, also refer to **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). The resultant decrease in survival rate is 0.004% and 0.014% in each season, respectively, with an annual decrease of 0.019% when combined seasonal impacts are assessed against the regional population (**Table 12-32**). Seasonal displacement matrices considering a range of displacement and mortality rates are presented in **Table 12-33**, further detail, including confidence limits, are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.11.2.35 Considering the small decrease in baseline survival rate (93.9% to 93.881%), and the **Medium** sensitivity and **Low** magnitude, overall significance of distributional responses is **Minor**. This is **Not Significant** in EIA terms.

12.11.2.36 The upper range of the recommended displacement and mortality rates for guillemot are also presented in **Table 12-32**, alongside the Applicant Approach rates taken forward for assessment. These rates are presented for additional context, with the Applicant Approach (50% displacement and 1% mortality; **Section**

12.11) taken forward for assessment. It is unlikely that 60% displacement will occur (based on data collected at existing developments; APEM, 2022a), and, due to the small size of the Salamander Project, 5% mortality of displaced birds is also unlikely to occur.

12.11.2.37 It is noted that if the upper range of the recommended avoidance rates are applied, the threshold for PVA (>0.02%-point change in baseline survival rate) is met. Therefore, to provide full context, PVA has been undertaken, as presented in **Volume ER.A.4, Annex 12.4: Population Viability Analysis** (**Section 3, Table 5**).

Table 12-32 Common guillemot (*Uria aalge*) regional population estimates and distributional responses mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Applicant Approach displacement rates (50%) and mortality rates (1%)							
Breeding	407,959	93.900%	24,885	18	24,962	**93.881%**	**-0.019**
Non-breeding	407,959		24,885	59			
SNCB (2017, 2022) displacement rates (50%) and worst-case mortality rates (5% breeding; 3% non-breeding)							
Breeding	407,959	93.900%	24,885	108	25,205	93.822%	-0.078
Non-breeding	407,959		24,885	212			

Table 12-33 Common guillemot (*Uria aalge*) estimated breeding season displacement mortalities (indv. year^{-1})

Common Guillemot (Breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	4	7	11	14	18	36	54	72	108	181	289	362
	20	0	7	14	22	29	36	72	108	145	217	362	579	723
	30	0	11	22	33	43	54	108	163	217	325	542	868	1,085
	40	0	14	29	43	58	72	145	217	289	434	723	1,157	1,446
	50	0	**18**	36	54	72	90	181	271	362	542	904	1,446	1,808
	60	0	22	43	65	87	108	217	325	434	651	1,085	1,736	2,170
	70	0	25	51	76	101	127	253	380	506	759	1,266	2,025	2,531
	80	0	29	58	87	116	145	289	434	579	868	1,446	2,314	2,893
	90	0	33	65	98	130	163	325	488	651	976	1,627	2,604	3,254
	100	0	36	72	108	145	181	362	542	723	1,085	1,808	2,893	3,616

Key

(purple)	**Applicant Approach displacement and mortality rate**
(teal)	SNCB (2014) displacement and mortality rates

Table 12-34 Common guillemot (*Uria aalge*) estimated non-breeding season displacement mortalities (indv. year[-1])

Common Guillemot (Non-breeding)	Mortality Rate (%)												
Displacement Rate (%)	0	1	2	3	4	5	10	15	20	30	50	80	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	12	24	35	47	59	118	177	236	353	589	942	1,178
20	0	24	47	71	94	118	236	353	471	707	1,178	1,885	2,356
30	0	35	71	106	141	177	353	530	707	1,060	1,767	2,827	3,534
40	0	47	94	141	188	236	471	707	942	1,413	2,356	3,769	4,712
50	0	59	118	177	236	294	589	883	1,178	1,767	2,945	4,712	5,890
60	0	71	141	212	283	353	707	1,060	1,413	2,120	3,534	5,654	7,067
70	0	82	165	247	330	412	825	1,237	1,649	2,474	4,123	6,596	8,245
80	0	94	188	283	377	471	942	1,413	1,885	2,827	4,712	7,539	9,423
90	0	106	212	318	424	530	1,060	1,590	2,120	3,180	5,301	8,481	10,601
100	0	118	236	353	471	589	1,178	1,767	2,356	3,534	5,890	9,423	11,779

Key

	Applicant Approach displacement and mortality rate
	SNCB (2014) displacement and mortality rates

Razorbill

Sensitivity

12.11.2.38 Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that razorbill have a medium sensitivity to displacement, with respective sensitivity scores equal to those ascribed to guillemot (14 and 13 out of 32). The scoring takes a number of factors into consideration, including proportion of birds displaced from the OAA, species habitat use flexibility, and conservation importance (Furness *et al.*, 2013). However, the study does not consider the post-breeding moult period, where razorbill is flightless and spend time loafing and feeding offshore before migrating.

12.11.2.39 As previously detailed (**Section 12.11**), recommended mortality rates for all auks are 1 – 5%, however, review of data and monitoring at existing developments suggest that these rates are over precautionary given the scale of the Salamander Project. It is considered that a 1% mortality rate is more applicable, especially when considering the Salamander Project is an innovation development of seven WTGs covering 33.25 km^2. Considering the assessments by Furness *et al.* (2013) and Bradbury *et al.* (2014), but also low mortality of displaced birds, razorbill sensitivity is **Medium**.

Magnitude

12.11.2.40 Razorbill were observed in lower numbers than guillemot, being the least abundant auk in the OAA. However, the peak count was during the post-breeding moult period in Year 2. The mean seasonal peak razorbill population in the OAA plus 2.0 km Buffer is 334 indv. in the breeding season and 484 indv. in the non-breeding season, therefore, there is potential for distributional responses to occur.

12.11.2.41 The OAA will contain up to seven WTGs once operational, thus distributional responses are expected to be measurable against baseline levels, where no fixed structures are present. However, the spatial extent will be limited to within the OAA, covering up to 33.25 km^2, with displacement having potential to occur up to 2 km away (92.17 km^2 total). Including the Northern Isle colonies, razorbill forage up to 164.6 km (mean maximum plus 1 SD), excluding these birds, the foraging range is 122.2 (Woodward *et al.*, 2019), therefore, the spatial extent is small in comparison to the foraging area available.

12.11.2.42 Razorbill population estimates in the OAA plus 2.0 km Buffer were 334 indv. and 484 indv. in the breeding and non-breeding seasons, respectively. These represent up to 0.48% of the regional population estimates. As discussed in **Section 12.11**, a 50% displacement rate for all auks is considered more appropriate. Application of this rate suggests that <0.25% of the regional razorbill population may be affected by displacement. Therefore, magnitude is considered **Negligible**.

Significance

12.11.2.43 Razorbill baseline survival rate is 89.5% (Horswill and Robinson, 2015), representing 7,372 indv. in the breeding season and 22,955 indv. in the non-breeding season. Applying 50% displacement and 1% mortality rates to the mean seasonal peak populations within the OAA plus 2.0 km Buffer results in estimated impacts of two razorbill mortalities in the breeding season and one in the non-breeding season, once adjusted to account for breeding birds forming part of the non-breeding population (described in **Section 12.11** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Compared with the baseline mortalities, these result in an increase of 0.004% in mortality rate and equal decrease in survival rate (**Table 12-35**). Seasonal displacement matrices considering a range of displacement and mortality rates are presented in **Table 12-36** and **Table 12-37**, further detail, including confidence limits, are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.11.2.44 Taking this small increase in mortality into consideration, and accounting for **Medium** sensitivity and **Negligible** magnitude of effects, razorbill sensitivity is considered to be **Negligible**. This is **Not Significant** in EIA terms.

12.11.2.45 In addition to the 50% displacement and 1% mortality considered appropriate for the Salamander Project (**Section 12.11**), the upper values of the recommended displacement and mortality rates are also presented in **Table 12-35**. These rates are presented for additional context only, and exceed the displacement and mortality expected to occur due to the Salamander Project, based on review of data at existing developments (APEM, 2022a). If these higher rates were to occur, the predicted impacts would result in a <0.02%-point change in baseline survival of razorbill.

Table 12-35 Razorbill (*Alca torda*) regional population estimates and distributional responses mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Applicant Approach displacement rates (50%) and mortality rates (1%)							
Breeding	70,208	89.500%	7,372	2	7,374	**89.496%**	**-0.004**
Non-breeding	218,622		22,955	1			
SNCB (2017, 2022) displacement rates (50%) and worst-case mortality rates (5% breeding; 3% non-breeding)							
Breeding	70,208	89.500%	7,372	10	7,385	89.482%	-0.018
Non-breeding	218,622		22,955	3			

Table 12-36 Razorbill (*Alca torda*) estimated breeding season displacement mortalities (indv. Year^{-1})

Razorbill (Breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	1	1	1	2	3	5	7	10	17	27	33
	20	0	1	1	2	3	3	7	10	13	20	33	53	67
	30	0	1	2	3	4	5	10	15	20	30	50	80	100
	40	0	1	3	4	5	7	13	20	27	40	67	107	134
	50	0	2	3	5	7	8	17	25	33	50	84	134	167
	60	0	2	4	6	8	10	20	30	40	60	100	160	200
	70	0	2	5	7	9	12	23	35	47	70	117	187	234
	80	0	3	5	8	11	13	27	40	53	80	134	214	267
	90	0	3	6	9	12	15	30	45	60	90	150	240	301
	100	0	3	7	10	13	17	33	50	67	100	167	267	334

Key

(purple)	**Applicant Approach displacement and mortality rate**
(teal)	SNCB (2014) displacement and mortality rates

Table 12-37 Razorbill (*Uria aalge*) estimated non-breeding season displacement mortalities (indv. Year-1)

Razorbill (Non-breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	1	1	2	2	5	7	10	15	24	39	48
	20	0	1	2	3	4	5	10	15	19	29	48	77	97
	30	0	1	3	4	6	7	15	22	29	44	73	116	145
	40	0	2	4	6	8	10	19	29	39	58	97	155	194
	50	0	**2**	5	7	10	12	24	36	48	73	121	194	242
	60	0	3	6	9	12	15	29	44	58	87	145	232	290
	70	0	3	7	10	14	17	34	51	68	102	169	271	339
	80	0	4	8	12	15	19	39	58	77	116	194	310	387
	90	0	4	9	13	17	22	44	65	87	131	218	348	436
	100	0	5	10	15	19	24	48	73	97	145	242	387	484

Key

	Applicant Approach displacement and mortality rate
	SNCB (2014) displacement and mortality rates

Atlantic Puffin

Sensitivity

12.11.2.46 Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that puffin have a low sensitivity to displacement, respectively applying sensitivity scores of 10 and eight to the species, which are marginally lower than guillemot and razorbill. The scoring takes a number of factors into consideration, including proportion of birds displaced from the OAA, species habitat use flexibility, and conservation importance (Furness *et al.*, 2013).

12.11.2.47 Unlike guillemot and razorbill, which undergo a flightless moult period post-breeding, puffins disperse from breeding colonies to spend the autumn and winter at sea. During this time, young are not dependent on adults, and the species is almost entirely pelagic. As it is not bound to specific breeding sites or overwintering colonies, and spends its time offshore, it is much less susceptible to effects of stationary infrastructure (e.g. distributional responses to OWF developments).

12.11.2.48 As previously discussed in **Section 12.11**, following review of existing developments and recent studies, auk mortality rates recommended by NatureScot are considered to be over precautionary given the scale of the Salamander Project. Therefore, a mortality rate of 1% has been applied, which is more appropriate to the scale of the Salamander Project (seven WTGs covering no more than 33.25 km^2). Considering this and based on this and Furness *et al.* (2013) and Bradbury *et al.* (2014), puffin has a **Low** sensitivity to displacement.

Magnitude

12.11.2.49 Puffin were observed in higher numbers than razorbill but lower numbers than guillemot, with the peak count in August Year 2 (2022). The mean seasonal peak puffin population in the OAA plus 2.0 km Buffer is 357 indv. In the breeding season. Puffin are assumed to disperse rapidly and widely post-breeding and are therefore assumed to be unlikely to be affected by the presence of the proposed Salamander Project outside the breeding season. The DAS data support this, showing limited to no presence outside the breeding season. Therefore, non-breeding season impacts are scoped out, with displacement expected to have no impact during this period.

12.11.2.50 The OAA will contain up to seven WTGs once operational, thus distributional responses are expected to be measurable against baseline levels, where no fixed structures are present. However, the spatial extent will be limited to within the OAA, covering up to 33.25 km^2, with displacement expected to occur up to 2 km away (92.17 km^2 total). Puffins forage up to 265.4 km (mean maximum plus 1 SD) (Woodward *et al.*, 2019), therefore, the spatial extent is small in comparison to the foraging area available.

12.11.2.51 Taking regional population estimates into consideration, 357 indv. Represents just 0.12% of the breeding season population. Appling a 50% displacement rate (refer to **Section 12.11**) for details), just 0.06% of the baseline puffin population may be affected. Considering the small proportion of population and small scale of the development, magnitude is **Negligible**.

Significance

12.11.2.52 Baseline survival rate for puffin is 90.6% (Horswill and Robinson, 2015). The estimated mortalities associated with distributional responses is 2 indv., which represents a 0.001%-point increase in baseline mortality rate and equal decrease in survival rate (**Table 12-38**). Seasonal displacement matrices considering a range of displacement and mortality rates are presented in **Table 12-39**, further detail, including confidence limits, are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.11.2.53 Considering this, and the **Low** sensitivity and **Negligible** magnitude, overall significance of distributional responses impacts on puffin is **Negligible**. This is **Not Significant** in EIA terms.

12.11.2.54 For additional context, the upper ends of the recommended displacement and mortality rates (60% displacement; 5% mortality) are presented in **Table 12-38**, alongside the Applicant Approach (50% displacement, 1% mortality). Application of the higher rates results in a predicted impact of <0.02%-point change in baseline survival in the regional puffin population. As previously discussed, due to the small scale of the Salamander Project (7 WTGs over 33.25 km^2 and based on review of data at existing developments (APEM, 2022a), this level of displacement and mortality is not expected to occur and the lower rates presented are taken forward for assessment.

Table 12-38 Atlantic puffin (*Fratercula arctica*) regional population estimates and distributional responses mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Applicant Approach displacement rates (50%) and mortality rates (1%)							

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Breeding	287,593	90.600%	27,034	2	27,036	**90.599%**	**-0.001**
SNCB (2017, 2022) displacement rates (50%) and worst-case mortality rates (5%)							
Breeding	287,593	90.600%	27,034	11	27,036	90.596%	-0.004

Table 12-39: Atlantic puffin (*Fratercula arctica*) estimated breeding season displacement mortalities (indv. year-1)

Atlantic Puffin (Breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	1	1	1	2	4	5	7	11	18	29	36
	20	0	1	1	2	3	4	7	11	14	21	36	57	71
	30	0	1	2	3	4	5	11	16	21	32	54	86	107
	40	0	1	3	4	6	7	14	21	29	43	71	114	143
	50	0	2	4	5	7	9	18	27	36	54	89	143	179
	60	0	2	4	6	9	11	21	32	43	64	107	171	214
	70	0	2	5	7	10	12	25	37	50	75	125	200	250
	80	0	3	6	9	11	14	29	43	57	86	143	228	286
	90	0	3	6	10	13	16	32	48	64	96	161	257	321
	100	0	4	7	11	14	18	36	54	71	107	179	286	357

Key

(purple)	**Applicant Approach displacement and mortality rate**
(teal)	SNCB (2014) displacement and mortality rates

Northern Gannet

Sensitivity

12.11.2.55 Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that gannet have a very low sensitivity to displacement, with sensitivity scores of three out of 32. The scoring takes a number of factors into consideration, including proportion of birds displaced from the OAA, species habitat use flexibility, and conservation importance (Furness *et al.*, 2013).

12.11.2.56 NatureScot recommends a 1 – 3% mortality rate for gannet is applied to breeding gannet (**Volume ER.A.4, Annex 12.7: Offshore Ornithology Consultation Report**). Masden *et al.* (2010) assessed the energetic costs of displacement in seabirds, suggesting that 2 – 10 km increases in flight distance result in small increases in energetic costs. This minimal increase in energy expenditure is unlikely to result in notable mortalities. Therefore, also considering the small spatial extent of the Salamander Project, a 1% mortality rate is considered appropriate (further details are provided in **Section 12.11**). Sensitivity is, therefore, considered to be **Low**.

Magnitude

12.11.2.57 Gannet were observed in in the OAA plus 2.0 km Buffer in low to moderate numbers. The mean seasonal peak gannet population in the OAA plus 2.0 km Buffer is 442 indv. in the breeding season and 363 indv. in the non-breeding season. Therefore, there is likely to be interaction between the Salamander Project and foraging or transiting gannet.

12.11.2.58 The OAA will contain up to seven WTGs once operational, thus distributional responses are expected to be measurable against baseline levels, where no fixed structures are present. However, the spatial extent will be limited to within the OAA, covering up to 33.25 km^2, with displacement expected to occur up to 2 km away (92.17 km^2 total). Gannet forage 509.4 km (mean maximum plus 1 SD), up to 709 km (maximum) (Woodward *et al.*, 2019), therefore, the spatial extent is small in comparison to the foraging area available.

12.11.2.59 NatureScot (and other UK SNCBs) advise a 70% displacement rate is applied to gannet (SNCB, 2017, 2022; NatureScot, 2023h), however, RSPB suggest that 60% is more appropriate for the breeding season. Gannet displacement data collected at existing OWFs, and recent studies were reviewed (APEM, 2022a). A displacement rate of 70% for both the breeding and non-breeding season is considered appropriate and proportionate to the Salamander Project (refer to **Section 12.11**). Taking regional population estimates into consideration, assuming 70% displacement during the breeding season and non-breeding season, <0.2% of the regional gannet population may be affected. This approach is marginally more precautionary than applying a 60% displacement rate; however, the assessment conclusions remain the same regardless. Overall magnitude is, therefore, **Negligible**.

Significance

12.11.2.60 Gannet baseline survival rate is 91.9% (Horswill and Robinson, 2015). Application of a 70% displacement rate and 1% mortality rate (refer to **Section 12.11** for further detail) gives mortality estimates of 3 indv. in the breeding season and three in the non-breeding season (after adjustment to account for breeding birds forming part of the non-breeding population as described in **Section 12.11** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Compared with the baseline mortality rate and regional populations, the level of effect is small, representing a 0.001%-point increase in baseline mortality rate and equal decrease in survival rate (**Table 12-40**). Seasonal displacement matrices considering a range of displacement and mortality rates are presented in **Table 12-41** and **Table 12-42**, further detail, including confidence limits, are presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment** (**Appendix I**).

12.11.2.61 Accounting for this, and the **Low** sensitivity and **Negligible** magnitude of effect, overall significance is **Negligible**. This is **Not Significant** in EIA terms.

12.11.2.62 The Applicant Approach (70% displacement and 1% mortality rates) are akin to the lower end of the recommended rates for displacement assessment. For additional context, the upper rates (70% displacement and 3% mortality) for gannet are also presented in **Table 12-40**. This level of displacement would result in a small impact (<0.02%-point change in baseline survival).

Table 12-40 Northern gannet (*Morus bassanus*) regional population estimates and distributional responses mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Applicant Approach displacement rates (70%) and mortality rates (1%)							
Breeding	423,894	91.900%	34,335	3	34,341	**91.899%**	**-0.001**
Non-breeding	248,385		20,119	3			
SNCB (2017, 2022) displacement rates (70%) and worst-case mortality rates (3% breeding, 1% non-breeding)							
Breeding	423,894	91.900%	34,335	9	34,352	91.896%	-0.004
Non-breeding	248,385		20,119	8			

Table 12-41 Northern gannet (*Morus bassanus*) estimated breeding season displacement mortalities (indv. year^{-1})

Northern Gannet (Breeding)		**Mortality Rate (%)**												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	1	1	2	2	4	7	9	13	22	35	44
	20	0	1	2	3	4	4	9	13	18	27	44	71	88
	30	0	1	3	4	5	7	13	20	27	40	66	106	133
	40	0	2	4	5	7	9	18	27	35	53	88	141	177
	50	0	2	4	7	9	11	22	33	44	66	111	177	221
	60	0	3	5	8	11	13	27	40	53	80	133	212	265
	70	0	**3**	6	9	12	15	31	46	62	93	155	248	309
	80	0	4	7	11	14	18	35	53	71	106	177	283	354
	90	0	4	8	12	16	20	40	60	80	119	199	318	398
	100	0	4	9	13	18	22	44	66	88	133	221	354	442

Key

(blue)	**Applicant Approach displacement and mortality rate / lower SNCB (2014) displacement and mortality rate**
(green)	Upper SNCB (2014) displacement and mortality rate

Table 12-42 Northern gannet (*Morus bassanus*) estimated non-breeding season displacement mortalities (indv. year[-1])

Northern Gannet (Non-breeding)		Mortality Rate (%)												
		0	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*30*	*50*	*80*	*100*
Displacement Rate (%)	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	1	1	1	2	4	6	7	11	18	30	37
	20	0	1	1	2	3	4	7	11	15	22	37	59	74
	30	0	1	2	3	4	6	11	17	22	33	55	89	111
	40	0	1	3	4	6	7	15	22	30	44	74	118	148
	50	0	2	4	6	7	9	18	28	37	55	92	148	185
	60	0	2	4	7	9	11	22	33	44	66	111	177	221
	70	0	**3**	5	8	10	13	26	39	52	77	129	207	258
	80	0	3	6	9	12	15	30	44	59	89	148	236	295
	90	0	3	7	10	13	17	33	50	66	100	166	266	332
	100	0	4	7	11	15	18	37	55	74	111	185	295	369

Key

(blue)	**Applicant displacement and mortality rate / lower SNCB (2014) displacement and mortality rate**
(green)	Upper SNCB (2014) displacement and mortality rate

<u>Summary</u>

12.11.2.63 An overview of assessment of distributional responses is presented in **Table 12-43**. At worst, impacts are **Minor**, which is **Not Significant** in EIA terms.

Table 12-43 Summary of the impacts of distributional responses (displacement and barrier effects) on Offshore and Intertidal Ornithology during the operation and maintenance phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Black-legged Kittiwake	*Rissa tridactyla*	Low	Low	Negligible
Common Guillemot	*Uria aalge*	Medium	Low	Minor
Razorbill	*Alca torda*	Medium	Negligible	Negligible
Atlantic Puffin	*Fratercula arctica*	Low	Negligible	Negligible
Northern Gannet	*Morus bassanus*	Low	Negligible	Negligible

Collision

Background

12.11.2.64 Operational WTGs and associated infrastructure present a collision risk for seabirds flying in the OAA. This includes birds commuting between breeding and foraging sites, migrating birds, and those foraging for food within the OAA. Direct collision with infrastructure may result in injury or death, however, it is assumed that all collisions with operational WTGs result in mortality.

12.11.2.65 As per current NatureScot (2023g) guidance, CRM was undertaken using the *StochLab* R package produced by Caneco *et al.* (2022) to produce mathematical-based quantitative estimates of the number of collisions per species per season for each year of operation. The CRM methodology is discussed in detail in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** (**Section 2**).

12.11.2.66 The assessment made is informed by the 2014 avoidance rates (Cook et al., 2014), as specified in Section 6 of Guidance Note 7: “The Joint Response SNCB to the Marine Scotland Science Avoidance Rate Review guidance note (2014) on avoidance rates should be used with +/- 2 standard deviations” (NatureScot, 2023g). Since running the models, JNCC has published further information on avoidance rates (Ozsanlav-Harris et al., 2023). Subsequent runs were completed using these rates, with an overview the outputs presented in the following assessments and full details (deterministic outputs and confidence limits) presented in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** (**Section 3**, **Table 6** and **Table 7**; **Appendix I**, **Tables 9 – 11**). Where there is difference in the outputs, this is briefly discussed in the individual species assessments.

12.11.2.67 Collision estimates, or predicted mortalities due to collision, are put into context of species-specific breeding seasons and non-breeding seasons and assessed against regional population estimates. NatureScot (2020) information on seasonality in the Scottish marine environment was used to determine seasonality for each species considered. Regional populations were estimated using species foraging ranges and SMP data. The methodology and results are detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report** (**Section 2**, **Table 2** and **Table 3**).

12.11.2.68 For species which are sensitive to both distributional responses and collision, the effects have been summed. This assessment is presented in **Section 12.16 Inter-related Effects**.

Black-legged Kittiwake

Sensitivity

12.11.2.69 Based on generic maximum likelihood FHD data (Johnston *et al.*, 2014), approximately 12.4% kittiwake flights are at CRH for a 22 m air gap. Largely based on flight heights, but also considering variables such as flight agility, nocturnal activity, and conservation importance, Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that kittiwake have high risk of collision, however, this is assuming a 20 m air gap, where almost 15% of flights are at CRH.

12.11.2.70 Additionally, kittiwake do exhibit some sensitivity to displacement, although, as previously discussed, up to 30% of birds may avoid the OAA in response to operational WTGs (SNCB, 2017, 2022; NatureScot, 2023h). Birds which do not avoid the OAA in its entirety may display localised avoidance behaviour, reacting to the presence of individual WTGs or blades. The recommended avoidance rate for kittiwake is 98.9% (Cook *et al.*, 2014; NatureScot, 2023g), although recent evidence suggests this could be as high as 99.3% (Ozsanlav-Harris *et al.*, 2023). To maintain a precautionary assessment, kittiwake sensitivity to collision risk is considered to be **High**.

Magnitude

12.11.2.71 Kittiwake were observed in moderate to high numbers in the OAA, with peak counts in June and July 2021 and August 2022. Monthly kittiwake density ranged from 0 indv. km^{-2} to a peak of 12.73 indv. km^{-2}, therefore, there is potential for interaction between operational WTGs and birds transiting through or foraging within the OAA.

12.11.2.72 However, taking regional population estimates into consideration, as well as the foraging area available to kittiwake (Woodward *et al.*, 2019) in the wider region, it is likely that only a relatively small proportion of the total regional population of 830,074 indv. may fly through the OAA. The site was not identified as being an area of specifically high importance to kittiwake.

12.11.2.73 Although individuals cannot recover from collision (i.e. a collision event is assumed to result in mortality of the affected bird), with a small proportion of the population present within the OAA, and overall predicted impacts representing a <0.02%-point increase in mortality, the population-level recovery period (after decommissioning) is expected to be relatively short. Once WTGs are decommissioned at the end of the operation and maintenance phase, the risk of collision will return to baseline levels (i.e. zero). **Low** magnitude of collision is expected for kittiwake.

Significance

12.11.2.74 CRM outputs suggest that up to 14 kittiwake collisions could occur per year of operation, all in the breeding season and none in the non-breeding season, following adjustment to account for breeding birds forming part of the non-breeding population (as described in **Section 12.11** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Refer to **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** for full details on CRM methodology (**Section 2.1**), input variables (**Section 2.2**), and outputs (**Section 3, Table 6** and **Table 7**). The mean impact on survival rate is a 0.007%-point decrease compared to baseline levels (**Table 12-44**). With a **Low** magnitude of effect, **High** sensitivity results in an overall **Minor** significance of collision. This is **Not Significant** in EIA terms.

12.11.2.75 With application of the previous avoidance rates (Cook *et al.*, 2023), the collision estimates are marginally higher, with up to 24 collisions expected per year. This also results in a small (<0.02% -point) decrease in baseline survival (**Table 12-44**).

Table 12-44 Black-legged kittiwake (*Rissa tridactyla*) regional population estimates and collision mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Cook et al. *(2014) Avoidance Rate (98.9%)*							
Breeding	202,258	85.400%	29,530	23	29,554	85.388%	-0.012
Non-breeding	627,816		91,661	1			
Ozsanlav-Harris et al. *(2023) Avoidance Rate (99.3%)*							
Breeding	202,258	85.400%	29,530	14	29,544	**85.393%**	**-0.007**
Non-breeding	627,816		91,661	0			

Great Black-backed Gull

Sensitivity

12.11.2.76 Based on generic FHD data (Johnston *et al.*, 2014), approximately 29.1% great black-backed gull flights are at CRH for a 22 m air gap. Largely based on flight heights, but also considering variables such as flight agility, nocturnal activity, and conservation importance, Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that great black-backed gull have very high risk of collision, however, this is assuming a 20 m air gap, where 32.6% of flights are at CRH.

12.11.2.77 Great black-backed gull is not sensitive to displacement, so it is reasonable to assume that most birds will fly through the OAA if it is on their intended flight path. Birds may display localised avoidance behaviour, reacting to the presence of individual WTGs or blades, within the OAA. Ozsanlav-Harris *et al.* (2023) recommend a 99.4% avoidance rate for great black-backed. Great black-backed gull sensitivity to collision risk is considered to be **High**.

Magnitude

12.11.2.78 Great black-backed gull was observed in relatively low numbers in the OAA, with all observations recorded in the winter period (November to February). Average monthly modelled density ranged from 0 indv. km^{-2} to a peak of 1.06 indv. km^{-2}, therefore, there is potential for interaction between operational WTGs and birds transiting through or foraging within the OAA.

12.11.2.79 Taking regional population estimates into consideration, as well as the foraging area available to great black-backed gull (Woodward *et al.*, 2019) in the wider region, a relatively small proportion of the population may be at risk of collision.

12.11.2.80 Although individuals cannot recover from collision (i.e. a collision event is assumed to result in mortality of the affected bird). The population-level recovery period is expected to be relatively short with a 0.003%-point increase in baseline mortality expected. Once WTGs are decommissioned at the end of the operation and maintenance phase, the risk of collision will return to baseline levels (i.e. zero). Therefore, **Negligible** magnitude of collision is expected for great black-backed gull.

Significance

12.11.2.81 CRM outputs suggest that up to three collisions could occur per year of operation in the non-breeding season. Refer to **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** for full details on CRM methodology (**Section 2.1**), input variables (**Section 2.2**), and outputs (**Section 3**, **Table 6** and **Table 7**). However, once adjusted to account for non-breeding birds which may form part of the breeding population (described in **Section 12.11**, also refer to **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**), and assessed against the breeding population of 98 indv, impacts are small. Compared with baseline survival rates, at a worst-case, collision mortality may result in a 0.003%-point decrease in survival (**Table 12-45**). As such, impacts to the regional population are not expected to be measurable against baseline levels. **Negligible** magnitude of effect and **High** sensitivity result in an overall **Negligible** significance of collision. This is **Not Significant** in EIA terms.

12.11.2.82 For great black-backed gull, applying the previous avoidance rates (cook *et al.*, 2014), there is no material difference in the predicted number of collisions (**Table 12-45**).

Table 12-45 Great black-backed gull (*Larus marinus*) regional population estimates collision mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Cook et al. *(2014) Avoidance Rate (99.5%)*							
Breeding	98	88.500%	11	0	12	88.497%	-0.003
Non-breeding	91,399		10,511	<0.1			
Ozsanlav-Harris et al. *(2023) Avoidance Rate (99.4%)*							
Breeding	98	88.500%	11	0	12	**88.497%**	**-0.003**
Non-breeding	91,399		10,511	<0.1			

European Herring Gull

Sensitivity

12.11.2.83 Based on generic FHD data (Johnston *et al.*, 2014), approximately 28.5% herring gull flights are at CRH for a 22 m air gap. Largely based on flight heights, but also considering variables such as flight agility, nocturnal activity, and conservation importance, Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that herring gull have very high risk of collision, however, this is assuming a 20 m air gap, where 32.0% of flights are at CRH.

12.11.2.84 Similar to great black-backed gull, herring gull are not considered sensitive to displacement, therefore, it is reasonable to assume that most birds will fly through the OAA if it is on their intended flight path. Birds flying through the OAA may display localised avoidance behaviour, reacting to the presence of individual WTGs or blades. The recommended avoidance rate for large gulls, including herring gull, is 99.4% (Ozsanlav-Harris *et al.*, 2023). However, a relatively high proportion of flights are at CRH, therefore, herring gull sensitivity to collision risk is considered to be **High**.

Magnitude

12.11.2.85 Herring gulls were observed in relatively low numbers in the OAA, with peak abundances recorded in the winter period (November to January). Modelled density ranged from 0 indv. km^{-2} to a peak of 2.33 indv. km^{-2}, therefore, there is potential for interaction between operational WTGs and birds transiting through or foraging within the OAA.

12.11.2.86 Considering regional population estimates as well as the foraging area available to herring gull (Woodward *et al.*, 2019) in the wider region, a relatively small proportion of the population may be at risk of collision.

12.11.2.87 Although individuals cannot recover from collision (i.e. a collision event is assumed to result in mortality of the affected bird), with a small proportion of the population present within the OAA, collision may result in a 0.024%-point decrease baseline survival rate. Once WTGs are decommissioned at the end of the operation and maintenance phase, the risk of collision will return to baseline levels (i.e. zero). It is important to note that the regional herring gull population is considered to be relatively low, especially in comparison to other species scoped in for assessment. Herring gulls were observed in low numbers in all DAS surveys, with the exception of November 2022, where an unusually high number of individuals was recorded. This is suggested to be due to presence of a fishing vessel, fishing discards, or detritus, attracting foraging gulls. Therefore, a **Low** magnitude of collision is expected for herring gull.

Significance

12.11.2.88 CRM outputs suggest that up to four collisions could occur per year of operation, with zero estimated collisions for the breeding season. Refer to **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** for full details on CRM methodology (**Section 2.1**), input variables (**Section 2.2**), and outputs (**Section 3**, **Table 6** and **Table 7**). As described in **Section 12.11** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**, the non-breeding season collision estimates are adjusted to account for breeding birds which also form part of the non-breeding population. Impacts were then assessed against the smallest population (i.e., 14,612 indv. in the breeding season).

12.11.2.89 At a worst-case, collision may result in a 0.024%-point increase above baseline mortality rates and equal decrease in survival (**Table 12-46**). **Low** magnitude of effect and **High** sensitivity result in a **Minor** significance of collision. This is **Not Significant** in EIA terms.

12.11.2.90 Ozsanlav-Harris *et al.* (2023) recommends that 99.4% avoidance rate is applied to herring gull, rather than the 99.5% recommended by Cook *et al.* (2014). When this slightly higher avoidance rate is applied, adjusted collision estimates decrease from four to three per year, resulting in a smaller decrease in survival rate (0.019%-point change) (**Table 12-46**).

12.11.2.91 As discussed in **Section 12.7.1**, it is highly likely that the observed number and distribution of herring gull was influenced by the presence of fishing boat activity in the area (HiDef, 2023). Once the Offshore Development is present, there may be limited use of the OAA by fishing vessels, thus, such increases in herring gull abundance are likely to be less frequent. Given the likely cause of the temporary elevation in herring gull number in a discrete part of the OAA, and despite the calculation that mortality would have marginally exceeded the 0.02%-point change, it was decided that full population modelling for herring gull would not be necessary.

Table 12-46 European herring gull (*Larus argentatus*) regional population estimates and collision mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
	Population	*Survival Rate*	*Mortalities*				
Cook et al. *(2014) Avoidance Rate (99.5%)*							
Breeding	14,612	83.400%	2,426	0	2,429	83.381%	-0.019
Non-breeding	20,551		3,411	3			
Ozsanlav-Harris et al. *(2023) Avoidance Rate (99.4%)*							
Breeding	14,612	83.400%	2,426	0	2,430	**83.376%**	**-0.024**
Non-breeding	20,551		3,411	4			

Northern Gannet

Sensitivity

12.11.2.92 Based on generic FHD data (Johnston *et al.*, 2014), approximately 10.2% gannet flights are at CRH for a 22 m air gap. Largely based on flight heights, but also considering variables such as flight agility, nocturnal activity, and conservation importance, Furness *et al.* (2013) and Bradbury *et al.* (2014) suggest that gannet have very high risk of collision, however, this is assuming a 20 m air gap, where 12.6% of flights are at CRH.

12.11.2.93 Gannets are also sensitive to displacement, with up to 70% of birds displaced from the OAA plus 2.0 km Buffer. This is not considered in the CRM outputs, thus with post-hoc application of macro-avoidance, collision estimates are <50% of those presented in **Table 12-47**. Additionally, birds flying through the OAA may display localised avoidance behaviour, reacting to the presence of individual WTGs or blades. The avoidance rate for gannet is 99.3% (Ozsanlav-Harris *et al.*, 2023), to maintain a precautionary approach, however, sensitivity to collision risk is considered to be **High**. This is in line with recommendations made by Furness *et al.* (2013) and Bradbury *et al.* (2014).

Magnitude

12.11.2.94 Gannet were observed in moderate numbers in the OAA, with peak abundances recorded in the late breeding season (August). Modelled density ranged from 0 indv. km^{-2} to a peak of 3.17 indv. km^{-2}, with a monthly average peak of 1.70 indv. km^{-2}. Therefore, there is potential for interaction between operational WTGs and birds transiting through or foraging within the OAA.

12.11.2.95 Considering regional population estimates as well as the foraging area available to gannet (Woodward *et al.*, 2019) in the wider region, a relatively small proportion of the population may be at risk of collision, with no more than nine collisions predicted per year. As such, a **Negligible** magnitude of collision is expected for gannet.

12.11.2.96 It is noted that Ozsanlav-Harris *et al.* (2023) suggest that gannet avoidance is higher than Cook *et al.* (2014), who suggested that 98.9% avoidance is applied in collision modelling. Through stakeholder consultation and in comments on the Scoping Report, RSPB recommend that 98% collision avoidance is applied to gannet. Therefore, the collision estimates associated with these avoidance rates are also presented in **Table 12-47**, for context. In all cases, impacts are minimal, with a maximum 0.002%-point decrease in survival predicted. Therefore, the determination of **Negligible** magnitude remains valid for all scenarios.

Sensitivity

12.11.2.97 Based on the Ozsanlav-Harris *et al.* (2023) avoidance rate (99.3%), CRM outputs suggest that up to six collisions could occur per year of operation. Most collision estimates are associated with the breeding season. Refer to **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report** for full details on CRM methodology (**Section 2.1**), input variables (**Section 2.2**), and outputs (**Section 3**, **Table 6** and **Table 7**). The non-breeding season collision estimates were adjusted to account for birds which are present in both seasons, as described in **Section 12.11** and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**, giving an estimated five mortalities in the breeding season and three in the non-breeding season.

12.11.2.98 Gannet collisions may result in a 0.002%-point increase in mortality rate and equal decrease in baseline survival rate (**Table 12-47**). Therefore, impacts to the regional population are not expected to be measurable against baseline levels. **Negligible** magnitude of effect and **High** sensitivity result in **Negligible** significance. This is **Not Significant** in EIA terms.

Table 12-47 Northern gannet (*Morus bassanus*) regional population estimates and collision mortality estimates, emboldened outputs are taken forward for assessment

Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)	Total Mortalities (indv.)	Impacted Survival Rate	PVA
	Population	*Survival Rate*	*Mortalities*				
Cook et al. *(2014) Avoidance Rate (98.9%)*							
Breeding	423,894	91.900%	34,335	5	34,344	91.898%	-0.002
Non-breeding	248,385		20,119	4			
Ozsanlav-Harris et al. *(2023) Avoidance Rate (99.3%)*							
Breeding	423,894	91.900%	34,335	4	34,341	**91.899%**	**-0.001**
Non-breeding	248,385		20,119	2			
RSPB-recommended Avoidance Rates (98% breeding; 98.9% non-breeding)							
Breeding	423,894	91.900%	34,335	9	34,348	91.897%	-0.003
Non-breeding	248,385		20,119	4			

Summary

12.11.2.99 Collision impacts to seabirds have been assessed through CRM. Sensitivity ratings vary between species but are primarily based upon the proportion of birds flying at CRH and studies by Furness *et al.* (2013) and Bradbury *et al.* (2014). Impacts against regional populations are unlikely to result in notable effects on survival rate. For all species, collision impacts are predicted to be **Negligible** or **Minor** (herring gull) (**Table 12-48**), which are **Not Significant** in EIA terms.

12.11.2.100 The collision estimates used to inform the assessment were based on avoidance rates provided by Ozsanlav-Harris *et al.* (2023). Outputs based on previous avoidance rates (Cook *et al.*, 2014) are also presented for additional context.

12.11.2.101 Real-world avoidance of WTGs by seabirds was recorded at Aberdeen OWF (Tjørnløv *et al.*, 2023). The study recorded seabird movements and behaviour within the array area for a two-year period, identifying avoidance and reactions to operational WTGs. During the study period, over 10,000 bird flights were recorded, however, there were zero recorded collisions between birds and the OWF infrastructure. Avoidance rates were high and in line with current recommended rates (Cook *et al.*, 2014) and other studies (e.g. Skov *et al.*, 2018). Combined meso- and micro-avoidance rates ranged from 98.9% to 99.5% for large gulls and were 100% for both kittiwake and gannet. However, it should be noted that these calculated rates are based on a relatively small subset of the data collected at Aberdeen as not all 10,000 flight records were suitable for analysis (Tjørnløv *et al.*, 2023).

12.11.2.102 Skov *et al.* (2018) investigate collision avoidance at Thanet OWF, presenting macro-avoidance rates (i.e. displacement) as well as micro- and meso-avoidance rates, separately. Considering the combination of all three metrics, overall avoidance rates are high (i.e. >99.8%) for all species, except for large gulls grouped, where 99.6% avoidance was calculated. Excluding macro avoidance resulted in avoidance rates ranging from 99.3% (great black-backed gull) to 99.8% (herring gull). Kittiwake and gannet avoidance rates were also lower with macro avoidance excluded (99.6% for both species).

12.11.2.103 These rates observed are in line with those recommended by Ozsanlav-Harris *et al.* (2023).

Table 12-48 Summary of the impacts of collision on Offshore and Intertidal Ornithology during the operation and maintenance phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Black-legged Kittiwake	*Rissa tridactyla*	High	Low	Minor
Great Black-backed Gull	*Larus marinus*	High	Negligible	Negligible
European Herring Gull	*Larus argentatus*	High	Low	Minor
Northern Gannet	*Morus bassanus*	High	Negligible	Negligible

Temporary Habitat Loss (Long-term)

Background

12.11.2.104 Long-term loss or alteration of supporting habitat refers to all habitat loss which may occur due to emplacement or installation of the Salamander Project infrastructure, and is termed 'temporary habitat loss (long-term)'. This includes presence of all WTG mooring systems, the area which may continually be swept by mooring lines, installed scour protection, and other offshore infrastructure, foundations, and scour protection. Habitat loss associated with installation of additional scour protection and cable repair works is encompassed within this assessment, where a precautionary approach has been taken.

12.11.2.105 Details on the cumulative spatial extent of impacts are provided in **Table 12-9**. The total area of habitat which may be lost throughout the operation and maintenance phase is <1.0 km^2, approximately 700,000 m^2 in the OAA and 150,000 m^2 in the Offshore ECC. This encompasses the maximum footprint of Salamander Project infrastructure.

Sensitivity

12.11.2.106 Kittiwake were observed in relatively high numbers in the OAA. The species feeds in the upper water column, however, its primary prey source is sandeel (Anderson *et al.*, 2014), and reductions in sandeel stocks have been linked to population decline (Frederiksen *et al.*, 2004; Nikolaeva *et al.*, 2006). However, effects on sandeel stocks are not expected to be significant, and therefore, kittiwake sensitivity to temporary habitat loss (long-term) at the Salamander Project is **Negligible**.

12.11.2.107 Similarly, auks feed primarily on sandeel, foraging both in the water column and at the seabed. Reductions in prey availability, including through habitat loss and direct competition with commercial fisheries, as well as changes in climate conditions (e.g. SST) have been linked to reduced breeding success and population decline (Sandvik *et al.*, 2005; Nettleship *et al.*, 2018). However, habitat impacts at the Salamander Project are expected, as a worst-case, to have a Minor effect on sandeel species (refer to **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)), and therefore, auk sensitivity to the level of effects predicted is considered to be **Negligible**.

12.11.2.108 It should also be recognised that the effects of loss of foraging habitat due to infrastructure within the OAA are likely to be overshadowed by displacement effects for some species, e.g. auks. Individuals displaced by the presence of WTGs cannot also be affected by habitat loss within the area from which they are displaced. Therefore, the population within the OAA is reduced, which may result in less competition for food resources, lessening the potential effect of habitat loss within the OAA.

Magnitude

12.11.2.109 Temporary habitat loss (long-term) is predicted to have a worst-case Minor effect on Fish and Shellfish Ecology (**Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)). Fish populations, which comprise prey items for a wide range of seabirds, are not likely to experience any population-level effects. Therefore, it is reasonable to assume that there will be no notable change in seabird prey resources due to temporary habitat loss (long-term) during the operation and maintenance phase.

12.11.2.110 The magnitude of effect is based on the maximum extent of seabed footprint associated with the preparatory works and subsequent installation of infrastructure that directly interacts with the seabed, as well as the presence of seabirds within the Offshore Development Area. The total area of seabed which may exhibit long-term habitat impacts is 6,948,500 m^2, or up to 7.0 km^2. Up to 7.7% of the seabed within the Offshore Development Area may be affected by habitat loss during the operation and maintenance phase. Considering the spatial extent of habitat available in the region, a low proportion of total regional habitat may be affected.

12.11.2.111 Different species are likely to be affected differently by temporary habitat loss (long-term), based on behaviour, habitat requirements, primary prey, and likelihood of occurrence in the Offshore Development Area, noting that abundance is likely to be reduce due to displacement effects. Species with very low presence and those which do not feed on affected receptors will not be affected, whereas seabirds which dive and primarily prey on demersal fish are more likely to be affected.

12.11.2.112 Kittiwake population can be affected by impacts to sandeel populations, however, the Fish and Shellfish Ecology impact assessment (**Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.11**; **Table 10-14**)) determined that impacts to sandeel, and all other demersal fish, were not significant (Minor at worst). Therefore, the magnitude of long-term habitat impacts on kittiwake is **Negligible**.

12.11.2.113 Auks are surface-diving species, reaching depths up to 180 m (Piatt and Nettleship, 1985). They prey on a variety of species, however, sandeel are a key resource (RSPB, 2024). Impacts to sandeel habitat may occur, although over a small spatial extent and impacts are not significant. Therefore, impact magnitude to auks is also **Low**.

Significance

12.11.2.114 The magnitude of short-term habitat impacts on kittiwake and auks is **Negligible** and **Low**, respectively. Paired with **Negligible** sensitivity, overall impacts to all species are **Negligible**. Therefore, short-term habitat impacts are **Not Significant** in EIA terms.

Summary

12.11.2.115 Long-term habitat impacts are determined to be **Negligible** for all seabirds (**Table 12-49**), which is **Not Significant** in EIA terms.

Table 12-49 Summary of the impacts of temporary habitat loss (long-term) on Offshore and Intertidal Ornithology during the operation and maintenance phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Black-legged Kittiwake	*Rissa tridactyla*	Negligible	Negligible	Negligible
Common Guillemot	*Uria aalge*	Negligible	Low	Negligible
Razorbill	*Alca torda*	Negligible	Low	Negligible
Atlantic Puffin	*Fratercula arctica*	Negligible	Low	Negligible

Entanglement

Background

12.11.2.116 Entanglement, with reference to seabirds, refers solely to ghost fishing gear. Due to the size and layout of the surface and subsurface infrastructure (cables and mooring lines), there is no potential for direct entanglement to occur.

12.11.2.117 Ghost fishing is the entrapment or entanglement of marine species within anthropogenic debris, most commonly abandoned, lost, or discarded fishing gear (ALDFG) (Richardson *et al.*, 2019). ALDFG is a well-known cause of mortality in marine life, including in seabirds (e.g. Hyrenbach *et al.*, 2020; Berón and Seco Pon, 2021). Within the context of the OAA, ALDFG may become entangled with mooring lines; however, the degree of impact is dependent on the size and location of ALDFG. Ghost fishing may impact all receptors groups (including fish and mammals) as it has a lower degree of selectivity, and although the impact may be longer than it would be if it was being used normally (i.e. during fishing activity), it typically covers a smaller spatial extent.

12.11.2.118 As the location of lost gear and the likelihood of it entering the array at any point in time is difficult to determine, a worst-case scenario for this impact is difficult to establish. As such, throughout the operational lifetime of the Salamander Project, Remotely Operated Vehicles (ROVs) will be used to periodically monitor the anchor and moorings for ALDFG which may be snagged on the substructures. Periodical monitoring and removal of ALDFG will work to reduce the potential for entanglement to occur, lessening the magnitude of impacts.

Sensitivity

12.11.2.119 ALDFG associated with ghost fishing can cause entanglement, and mortality of all entangled individuals, of any diving seabirds. Birds which spend a greater proportion of time underwater, or those which diver deeper (i.e. pass through a greater proportion of the water column) are more likely to become entangled. For plunge-diving species (gannets), sensitivity is considered **Low**. Auks spend the greatest amount of time underwater, thus have **Medium** sensitivity to entanglement.

Magnitude

12.11.2.120 The magnitude of impact associated with entanglement in ghost fishing gear is likely to be minimal. There are a relatively small number of WTGs to be installed in the Offshore Development Area (33.25 km^2), therefore, there is limited potential for ghost fishing gear to become entangled within the mooring lines and cables. Additionally, if identified; these hazards will be removed as part of the maintenance of the Salamander Project's infrastructure during the operational phase. Therefore, the magnitude of ghost fishing due to lost fishing gear becoming entangled in installed infrastructure is considered **Negligible**.

Significance of Effect

12.11.2.121 The **Negligible** magnitude of impact, combined with **Low** or **Medium** sensitivity of seabirds, results in the impact of ghost fishing due to lost fishing gear becoming entangled in installed infrastructure having a **Negligible** effect, and is therefore **Not Significant** in EIA terms (**Table 12-50**).

Table 12-50 Summary of the impacts of entanglement on Offshore and Intertidal Ornithology during the operation and maintenance phase

Common Name	Scientific Name	Sensitivity	Magnitude	Significance
Common Guillemot	*Uria aalge*	Medium	Negligible	Negligible
Razorbill	*Alca torda*	Medium	Negligible	Negligible
Atlantic Puffin	*Fratercula arctica*	Medium	Negligible	Negligible
Northern Gannet	*Morus bassanus*	Low	Negligible	Negligible

12.11.3 Decommissioning

12.11.3.1 On a precautionary basis, impacts associated with decommissioning of the Offshore Development are expected to be similar to the nature of impacts associated with the construction phase, as activities are essentially the reversal of installation, giving habitat opportunity to return to similar to baseline conditions. However, it is likely that potential impacts will be of a lower magnitude. Therefore, the same impacts are scoped in, and same assessment conclusions made. For example, if it is determined that any assets of the Offshore Development Area, such as cable protection, are to be left *in situ*, there will be a notable reduction in the potential for seabed habitat disturbance.

12.11.3.2 Preliminary information on decommissioning effects is provided in **Table 12-15** and detailed in **Volume ER.A.2, Chapter 4: Project Description**. For example, indicative vessel usage and transits are provided, however, at this stage of the Salamander Project, these are not confirmed and are subject to change. At present the magnitude of decommissioning impacts are expected to be marginally less than during construction and the sensitivity of seabird species is expected to remain the same, therefore, the same assessment conclusions can be made.

12.11.3.3 Further assessment of potential impacts associated with decommissioning of the Offshore Development will be assessed within considered as part of a Marine Licence application that will be submitted prior to the commencement of any Project-specific decommissioning works. In addition, a Decommissioning Programme will be submitted to MD-LOT for approval by the Scottish Ministers prior to construction. This document will then be reviewed and updated at various points during the operational lifetime of the Salamander Project. Prior to the commencement of any Project-specific decommissioning works.

12.11.3.4 As a result, impacts associated with decommissioning are assessed akin to those associated with construction as assessed in **Section 12.11.1**. As such, decommissioning impacts to Offshore and Intertidal Ornithology are **Not Significant**.

12.11.4 Summary of Impact Assessment

12.11.4.1 A summary of the impacts and effects identified for the Offshore and Intertidal Ornithology assessment is outlined in **Table 12-51**. At present, the decommissioning strategy is not finalised. Therefore, decommissioning impacts are not presented in detail here, as these are expected to be akin to those associated with construction, although to a lesser magnitude.

Table 12-51 Summary of Impacts and Effects for Offshore and Intertidal Ornithology

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Construction									
Disturbance (vessel-related)	Offshore Array Area (OAA) and Offshore Export Cable Corridor (ECC)	Co9 and Co11	Common Guillemot (*Uria aalge*)	Low	Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Negligible	Not Significant
			Razorbill (*Alca torda*)	Medium	Low	Minor		Minor	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Low	Low	Negligible		Negligible	Not Significant
			Intertidal Birds	High	Low	Minor		Minor	Not Significant
Temporary Habitat Loss (Short-term)	OAA and Offshore ECC	Co14	Black-legged Kittiwake (*Rissa tridactyla*)	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Negligible	Not Significant
			Common Guillemot (*Uria aalge*)	Medium	Low	Minor		Minor	Not Significant
			Razorbill (*Alca torda*)	Medium	Low	Minor		Minor	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Medium	Low	Minor		Minor	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Turbidity (Suspended Sediment)	OAA and Offshore ECC	No embedded mitigation	Common Guillemot (*Uria aalge*)	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Minor	Not Significant
			Razorbill (*Alca torda*)	Medium	Low	Minor		Minor	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Medium	Low	Minor		Minor	Not Significant
			Northern Gannet (*Morus bassanus*)	Low	Low	Negligible		Negligible	Not Significant
Operation and Maintenance									
Disturbance (Vessel-related)	OAA and Offshore ECC	Co10 and Co11	Common Guillemot (*Uria aalge*)	Low	Low	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Negligible	Not Significant
			Razorbill (*Alca torda*)	Medium	Low	Minor		Minor	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Low	Low	Negligible		Negligible	Not Significant
			Intertidal Birds	High	Low	Minor		Minor	Not Significant
	OAA	No embedded mitigation	Black-legged Kittiwake (*Rissa tridactyla*)	Low	Low	Negligible		Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Distributional Responses (Displacement and Barrier Effects)			Common Guillemot (*Uria aalge*)	Medium	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Minor	Not Significant
			Razorbill (*Alca torda*)	Medium	Negligible	Negligible		Negligible	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Low	Negligible	Negligible		Negligible	Not Significant
			Northern Gannet (*Morus bassanus*)	Low	Negligible	Negligible		Negligible	Not Significant
Collision	OAA and Offshore ECC	No embedded mitigation	Black-legged Kittiwake (*Rissa tridactyla*)	High	Low	Minor	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Minor	Not Significant
			Great Black-backed Gull (*Larus marinus*)	High	Negligible	Negligible		Negligible	Not Significant
			European Herring Gull (*Larus argentatus*)	High	Low	Minor		Minor	Not Significant
			Northern Gannet (*Morus bassanus*)	High	Negligible	Negligible		Negligible	Not Significant

Salamander Project Activity and Impact	Project Aspect	Embedded Mitigation	Receptor	Sensitivity	Magnitude	Significance of Effect	Additional Mitigation	Residual Significance of Effect	Significance of Effect in EIA terms
Temporary Habitat Loss (Long-term)	OAA and Offshore ECC	Co14	Black-legged Kittiwake (*Rissa tridactyla*)	Negligible	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Negligible	Not Significant
			Common Guillemot (*Uria aalge*)	Negligible	Low	Negligible		Negligible	Not Significant
			Razorbill (*Alca torda*)	Negligible	Low	Negligible		Negligible	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Negligible	Low	Negligible		Negligible	Not Significant
Entanglement	OAA	Co17	Common Guillemot (*Uria aalge*)	Medium	Negligible	Negligible	No additional mitigation measures have been identified for this effect above and beyond the embedded mitigation listed in **Table 12-14** as it was concluded that the effect was Not Significant.	Negligible	Not Significant
			Razorbill (*Alca torda*)	Medium	Negligible	Negligible		Negligible	Not Significant
			Atlantic Puffin (*Fratercula arctica*)	Medium	Negligible	Negligible		Negligible	Not Significant
			Northern Gannet (*Morus bassanus*)	Low	Negligible	Negligible		Negligible	Not Significant

12.12 Mitigation and Monitoring

12.12.1.1 All effects on Offshore and Intertidal Ornithology receptors in all phases of the Salamander Project were determined to be **Minor** or lesser; therefore, no additional mitigation or monitoring is required.

12.13 Cumulative Effect Assessment

12.13.1.1 A Cumulative Effects Assessment (CEA) has been made based on existing and proposed developments in the Study Area **Volume ER.A.4, Annex 6.2: Cumulative Effects Assessment Technical Annex**. The approach to the CEA is described in **Volume ER.A.2, Chapter 6: EIA Methodology**. Cumulative effects are defined as those effects on a receptor that may arise when the proposed Salamander Project is considered together with other projects.

12.13.1.2 The maximum spatial extent of potential effects on Offshore and Intertidal Ornithology as identified within this chapter are determined by seabird foraging ranges (Woodward *et al.*, 2019: NatureScot, 2023c). Areas beyond this range are unlikely to experience any measurable change. As such, only plans or projects with potential to overlap spatially or temporally will be included in the cumulative assessment.

12.13.1.3 On this basis, the projects considered within this cumulative assessment are all operational and planned OWFs within the published foraging ranges of seabirds which have been scoped into the impact assessment for the Salamander Project, and are listed within **Table 12-52**. Further information on these projects is outlined in **Volume ER.A.4, Annex 6.2: Cumulative Effects Assessment Technical Annex**.

Table 12-52 Projects within the Offshore and Intertidal Ornithology Study Area considered within the cumulative assessment

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
European Offshore Wind Deployment Centre (EOWDC); also known as Aberdeen Offshore Wind Farm	Offshore Wind Farm (OWF)	Operational	56.5	Project may affect the regional population of black-legged kittiwake (*Rissa tridactyla*) through distributional responses and collision, the regional population of common guillemot (*Uria aalge*) through distributional responses, the regional population of razorbill (*Alca torda*) through distributional responses, and the regional population of northern gannet (*Morus bassanus*) through distributional responses and collision.
Beatrice Offshore Wind Farm	OWF	Operational	121.5	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Berwick Bank Offshore Wind farm	OWF	Application submitted	121.6	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Blyth Floating Offshore Wind Farm: Demonstration Site	OWF	Operational	269.8	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Dogger Bank A & B Offshore Wind Farm	OWF	Under construction	376.9	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Dogger Bank C & Sofia Offshore Wind Farm	OWF	Pre-construction	369.4	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Dudgeon Offshore Wind Farm	OWF	Operational	542.0	Project may affect the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Dudgeon Extension Offshore Wind Farm	OWF	Application submitted	534.8	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
East Anglia One Offshore Wind Farm	OWF	Operational	678.7	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
East Anglia One NORTH Offshore Wind Farm	OWF	Consented	663.2	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
East Anglia Two Offshore Wind Farm	OWF	Consented	688.4	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
East Anglia Three Offshore Wind Farm	OWF	Pre-construction	640.1	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
ForthWind Offshore Wind Demonstration Project	OWF	Consented	211.3	Project may affect the regional population of kittiwake through collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Galloper Offshore Wind Farm	OWF	Operational	706.6	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Greater Gabbard Offshore Wind Farm	OWF	Operational	706.6	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Green Volt Offshore Wind Farm	OWF	Application submitted	24.0	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Gunfleet Sands Offshore Wind Farm	OWF	Operational	747.5	Project may affect the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Hornsea Project One Offshore Wind Farm	OWF	Operational	473.2	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Hornsea Project Two Offshore Wind Farm	OWF	Operational	466.1	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Hornsea Three Offshore Wind Farm	OWF	Consented	487.4	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Hornsea Four Offshore Wind Farm	OWF	Consented	435.0	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Humber Gateway Offshore Wind Farm	OWF	Operational	479.8	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Hywind Scotland Pilot Park	OWF	Operational	8.4	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Inch Cape Offshore Wind Farm	OWF	Consented	130.9	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Kentish Flats Offshore Wind Farm	OWF	Operational	776.3	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.
Kincardine Offshore Wind Farm	OWF	Operational	73.2	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Lincs, Lynn and Inner Dowsing Offshore Wind Farm	OWF	Operational	525.5	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
London Array Offshore Wind Farm	OWF	Operational	740.3	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.
Methil Offshore Wind Demonstration Zone	OWF	Operational	211.3	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Moray East Offshore Wind Farm	OWF	Operational	101.0	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Moray West Offshore Wind Farm	OWF	Under construction	114.6	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Neart na Gaoithe Offshore Wind Farm	OWF	Under construction	159.8	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Norfolk Boreas Offshore Wind Farm	OWF	Consented	588.2	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Norfolk Vanguard Offshore Wind Farm	OWF	Consented	602.8	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Pentland Floating Offshore Wind Farm	OWF	Variation application submitted	210.9	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Race Bank Offshore Wind Farm	OWF	Operational	524.2	Project may affect the regional population of kittiwake through collision, and the regional population of gannet through distributional responses and collision.
Rampion Offshore Wind Farm	OWF	Operational	939.4	Project may affect the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Rampion 2 Offshore Wind Farm	OWF	Application submitted	935.0	Project may affect the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Scroby Sands Offshore Wind Farm	OWF	Operational	623.6	Project may affect the regional population of gannet through collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Seagreen A & B Offshore Wind Farm	OWF	Operational*	108.3	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of guillemot and razorbill through distributional responses, and the regional population of gannet through distributional responses and collision. * A Screening Report has been submitted for a proposed increase in height of remaining consented, but not constructed, 36 turbines.
Sheringham Shoal Project Offshore Wind Farm	OWF	Operational	551.7	Project may affect the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Sheringham Shoal Extension Offshore Wind Farm	OWF	Application submitted	543.3	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Teeside Offshore Wind Farm	OWF	Operational	327.6	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Thanet Offshore Wind Farm	OWF	Operational	762.1	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.

Development	Type	Project Phase	Closest Distance from Offshore Array Area (OAA) (km)	Reasons for Inclusion
Triton Knoll Offshore Wind Farm	OWF	Operational	498.9	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
West of Orkney Offshore Wind Farm	OWF	Application submitted	207.3	Project may affect the regional population of kittiwake through distributional responses and collision, the regional population of razorbill through distributional responses, and the regional population of gannet through distributional responses and collision.
Westermost Rough Offshore Wind Farm	OWF	Operational	455.8	Project may affect the regional population of kittiwake through collision, the regional population of razorbill through distributional responses, and the regional population of gannet through collision.
Central North Sea Electrification (CNSE) Project	Interconnector	Scoping Submitted	18.1 (4.6 km from Offshore Export Cable Corridor (ECC))	Projects scoped in for assessment of habitat loss during the Salamander Project construction phase and operation and maintenance phase, considering the Benthic Ecology Far-field Study Area (**Volume ER.A.3, Chapter 9 Benthic and Intertidal Ecology (Section 9.13)**).
Eastern Green Link 2 (EGL2)	Interconnector	Consented	26.8 (2.9 km from Offshore ECC)	
Dredge Disposal Site CR070	Disposal Site	Operational	3.1	
Dredge Disposal Site CR080	Disposal Site	Operational	1.7	

12.13.2 Potential Cumulative Effects

12.13.2.1 The first stage of the CEA is to identify the potential for effects assessed alone to have cumulative pathways with other projects. The outcome of this stage is presented in **Table 12-53**. The cumulative effects note (**Volume ER.A.4, Annex 6.2: Cumulative Effects Assessment Technical Annex**) has been reviewed by NatureScot and assessment herein informed by the proposed methodology NatureScot consultation feedback.

Table 12-53 Potential cumulative effects relating to the Offshore and Intertidal Ornithology Chapter

Effect Assessed Alone	Potential for Cumulative Effect	Rationale
Construction Phase		
Disturbance (vessel-related)	No	Whilst there is vessel presence within the Salamander Project, it is not considered that there is potential for cumulative effects with other projects given the existing vessel traffic in the area, and the highly temporary and localised nature of vessel presence.
Habitat-loss (short-term)	Yes	Habitat loss will be limited to the footprint of works within the Offshore Array Area (OAA) and Offshore ECC and included within the Project Design Envelope assessed alone. Cable crossings installed over existing third-party infrastructure have been included within the Project Design Envelope for impact assessed alone, and therefore no additional cumulative effect is expected based on the distance of projects screened into the CEA for the Offshore Development. However, there is potential for temporary habitat loss (short-term) associated with the Salamander Project to coincide with habitat loss associated with other projects, affecting the same population(s) of seabirds.
Turbidity	No	Turbidity impacts associated with the Salamander Project were determined to be minimal. Effects are expected to be over a small spatial extent and suspended material is likely to return to within natural variation after a short period. The source of suspended sediment is via direct contact with the seabed, thus, birds which feed at the surface or in the upper water column will not be affected. There is expected to be very limited spatial overlap between sediment plumes of the Salamander Project and other projects. Therefore, due to the small effect size and magnitude and low sensitivity of key receptors (**Section 12.11.1, Table 12-26**), turbidity is not scoped in for cumulative effects assessment.
Operation and Maintenance		
Disturbance (vessel-related)	No	Whilst there is vessel presence within the Salamander Project, it is not considered that there is potential for cumulative effects with other projects given the existing vessel traffic in the area, and the highly temporary and localised nature of vessel presence.
Distributional responses (displacement and barrier effect)	Yes	The presence of wind turbine generators (WTGs) has the potential to displace individuals from the OAA with risk of mortality as possible impact. There may be cumulative effects from other projects on the regional populations.
Collision risk	Yes	The presence of WTGs within the Salamander Project presents risk of collision and subsequent mortality. There may be cumulative effects from other projects on the regional populations.

Effect Assessed Alone	Potential for Cumulative Effect	Rationale
Habitat-loss (long-term)	Yes	Habitat loss will be limited to the footprint of works within the OAA and Offshore ECC and included within the Project Design Envelope assessed alone. Cable crossings installed over existing third-party infrastructure have been included within the Project Design Envelope for impact assessed alone, and therefore no additional cumulative effect is expected based on the distance of projects screened into the CEA for the Offshore Development. However, there is potential for temporary habitat loss (long-term) associated with the Salamander Project to coincide with habitat loss associated with other projects, affecting the same population(s) of seabirds.
Entanglement	No	Risk of entanglement is highly localised to the Salamander Project and is highly temporary in nature, and effects associated with the Salamander Project were determined to be of **Negligible** significance and immeasurable at a population level (**Section 12.11, Table 12-50**). Therefore, there is limited scope for cumulative effects of entanglement with other projects.
Decommissioning		
It is expected that all effects associated with decommissioning assessed alone, and therefore also cumulatively, are similar and of lower magnitude as those identified within the construction phase of the Salamander Project. This assumption is subject to best practice methods and technology appropriate at the time of decommissioning.		

12.13.2.2 The second stage of the CEA is to assess the significance of each potential cumulative effect in relation to relevant external projects considered within the CEA. Please refer to **Volume ER.A.4, Annex 6.2: Cumulative Effects Assessment Technical Annex** for detailed information regarding the potential for spatial and temporal overlap with the Offshore Development.

12.13.2.3 The following CEA will, therefore, exclusively assess potential cumulative effects (identified in **Table 12-53**) of the projects identified in **Table 12-52**.

Construction

Temporary Habitat Loss (Short-term)

12.13.2.4 There is the potential for the construction and / or operation period of projects listed in **Table 12-52** to overlap with the Construction period of the Salamander Project. Construction phase temporary habitat loss (short-term) associated with the Salamander Project is up to 5.2 km^2 (**Table 12-15**), and impacts were determined to be Not Significant (**Section 12.11.1, Table 12-25**).

12.13.2.5 The nearby Hywind Scotland Pilot Park (HSPP) is operational and, therefore, cumulative effects via temporary habitat loss or disturbance would only arise if cable repair and reburial activities occurred at the same time as construction activities for the Salamander Project. Cable repair and remediation works that may be required by the HSPP are likely to be of a lesser impact than from construction activities related to the Salamander Project.

12.13.2.6 The Eastern Green Link 2 (EGL2) may result in approximately 15.2 km^2 of temporary habitat loss or disturbance (AECOM UK Ltd, 2022), however, this a small spatial extent compared with foraging habitat available to key offshore ornithology receptors in the region.

12.13.2.7 The Green Volt OWF may result in a total of 4.5 km^2 of temporary habitat disturbance (RoyalHaskoningDHV, 2023), however only a fraction of this overlaps with the Benthic and Intertidal Ecology Study Area.

12.13.2.8 The area of which may be affected by habitat loss or disturbance from the installation of the NorthConnect HDVC cable is approximately 4.6 km (NorthConnect KS, 2018). Of this approximately 0.95 km^2 is expected to occur within the Benthic and Intertidal Ecology Study Area.

12.13.2.9 The dredge disposal sites CR070 and CR080 overlap and occupy approximately 1.5 km^2 of the seabed, overlapping with the Benthic and Intertidal Ecology Study Area.

12.13.2.10 Cumulatively, including the Salamander Project, temporary habitat loss during the construction phase may be up to approximately 32 km^2. In comparison to the foraging area available to the key receptors (refer to **Table 12-7** for foraging ranges and regional populations), this is a small portion of potential habitat. Impacts associated with each project will be highly localised and, due to spacing of the projects, will not result in large continuous areas of habitat becoming unusable or result in habitat fragmentation. Considering this, and as the habitats within the Study Area are common and widespread throughout the region (**Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.7.1**, **Figure 9-3**)), cumulative effects to offshore ornithology are expected to be, as a worst-case, **Minor**, which is **Not Significant** in EIA terms.

12.13.2.11 For offshore ornithology, habitat loss can also constitute loss or reduction of prey availability. Impacts, associated with all effect scoped in for cumulative effects assessment, to both benthic ecology receptors, considered in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.13**), and to fish populations, considered in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.13**) were determined to be either Negligible or Minor. As such, impacts to foraging seabirds due to changes in prey availability are determined to be, as a worst-case, **Minor**, which is **Not Significant** in EIA terms.

Operation and Maintenance

Temporary Habitat Loss (Long-term)

12.13.2.12 There is the potential for the construction and / or operation period of projects listed in **Table 12-52** to overlap with the Construction period of the Salamander Project. Construction phase temporary habitat loss (long-term) associated with the Salamander Project is up to 7.0 km^2 (**Table 12-15**), and impacts were determined to be Not Significant (**Section 12.11.1, Table 12-49**).

12.13.2.13 Habitat loss arising from other projects is described previously under Construction cumulative effects assessment, where up to 26.8 km^2 of habitat loss may occur. This habitat loss is primarily short-term, however, it may occur concurrently with temporary habitat loss (long-term) associated with the Salamander Project. As such, cumulative habitat loss may be up to 33.8 km^2.

12.13.2.14 In comparison to the foraging area available to the key receptors (refer to **Table 12-7** for foraging ranges and regional populations), 33.8 km^2 is a small portion of potential habitat. Impacts associated with each project will be highly localised and, due to spacing of the projects, will not result in large continuous areas of habitat becoming unusable or result in habitat fragmentation. Impacts are likely to occur concurrently with the Salamander Project, however, other project timelines means that the full extent of habitat loss is unlikely to occur at the same time. Considering this, and as the habitats within the Study Area are common and widespread throughout the region (**Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.7.1**, **Figure 9-3**)), cumulative effects to offshore ornithology are expected to be, as a worst-case, **Minor**, which is **Not Significant** in EIA terms.

12.13.2.15 For offshore ornithology, habitat loss can also constitute loss or reduction of prey availability. Impacts, associated with all effect scoped in for cumulative effects assessment, to both benthic ecology receptors, considered in **Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology** (**Section 9.13**), and to fish populations, considered in **Volume ER.A.3, Chapter 10: Fish and Shellfish Ecology** (**Section 10.13**) were determined to be either Negligible or Minor. As such, impacts to foraging seabirds due to changes in prey availability are determined to be, as a worst-case, **Minor**, which is **Not Significant** in EIA terms.

Distributional Responses

12.13.2.16 A detailed assessment of distributional responses associated with the Salamander Project alone is described in **Section 12.11**. This assessment concluded that for all offshore ornithological receptors considered, distributional responses produce **Negligible** to **Minor** effects, which are Not Significant in EIA terms.

12.13.2.17 Not all projects listed in **Table 12-52** scoped all receptors in for distributional responses assessment, and some project applications presented quantitative assessments for some receptors. Those that have assessed displacement such that a quantitative comparison can be made across projects are listed within the following assessments.

12.13.2.18 Impacts associated with the Salamander Project alone are discussed and presented in **Section 12.11**, with additional information on the assessment of distributional responses presented in **Volume ER.A.4, Annex 12.5: Displacement Assessment**. As per the Salamander Project assessment, a range of displacement and mortality rates are considered, as discussed in **Section 12.11**.

12.13.2.19 As displacement impacts to some receptors associated with the Salamander Project were *de minimis*, such impacts are not expected to contribute measurably to cumulative effects. The following receptors are scoped out of CEA of distributional responses:

- **Puffin** – impacts to puffin, considering all displacement and mortality rates presented (**Section 12.11, Table 12-38**) would result in <0.005%-point change in baseline survival during the breeding season, resulting in immeasurable population-level effects. No impacts associated with distributional responses were predicted for the non-breeding season.

12.13.2.20 Therefore, the receptors included in the CEA of distributional responses are:

- **Kittiwake** – Salamander Project distributional responses impacts to kittiwake were determined to be **Negligible**, with Applicant Approach (i.e. lower range of NatureScot recommended: 30% displacement; 1% mortality) displacement and mortality rates giving rise to 0.006%-point changes in baseline survival. Considering the upper range of the recommended rates (30% displacement; 3% mortality), impact is a 0.017%-point decrease in survival rate.
- **Guillemot** – Salamander Project distributional responses impacts to guillemot were assessed as **Minor**, which, although is **Not Significant** in EIA terms, has potential to result in greater impacts cumulatively with other projects. Impacts associated with the Salamander Project may result in a 0.019%-point decrease in baseline survival rate, assuming the Applicant Approach rates (50% displacement and 1% mortality in all seasons); increasing to a 0.078%-point decrease when the upper range of the recommended rates are applied (60% displacement in all seasons; 5% mortality in the breeding season; 3% mortality in the non-breeding season).
- **Razorbill** – Salamander Project distributional responses impacts to razorbill were assessed as **Negligible**, with impacts of up to 0.004%-point decreases in survival rate predicted (based on Applicant Approach rates: 50% displacement and 1% mortality). Applying the upper range of the recommended rates (60% displacement in all seasons; 5% mortality in the breeding season; 3% mortality in the non-breeding season) results in a 0.018%-point decrease in survival rate.
- **Gannet** – Salamander Project distributional responses impacts to gannet were small, with maximum predicted impacts of a 0.003%-point decrease in survival rate. However, gannet is also

sensitive to collision, therefore, combined effects of displacement and collision are included in the CEA.

Collision

12.13.2.21 A detailed assessment of collision risk effects associated with the Salamander Project alone is presented in **Section 12.11**. This assessment concluded that for all offshore ornithological receptors considered, collision risk produces **Negligible** to **Minor** effects, which are **Not Significant** in EIA terms.

12.13.2.22 Not all projects listed in **Table 12-52** scoped all receptors in for collision assessment, and some project applications presented quantitative assessments for some receptors. Those that have assessed collision such that a quantitative comparison can be made across projects are listed within the following assessments.

12.13.2.23 Impacts associated with the Salamander Project alone are discussed and presented in **Section 12.11**, with additional information on the assessment of distributional responses presented in **Volume ER.A.4, Annex 12.3: Collision Risk Modelling Report**. The Salamander Project assessment is based on avoidance rates defined by Cook *et al.* (2014) as noted in Section 6 of current guidance (NatureScot, 2023i). Most projects scoped in for CEA also used these avoidance rates, however, some did not. Where alternative rates (e.g. those defined by Ozsanlav-Harris *et al.*, 2023)) are used, post-hoc amendments have been applied to ensure cross-project impacts are comparable; this is discussed under the specific receptor assessments.

12.13.2.24 As collision impacts to some receptors associated with the Salamander Project were *de minimis*, such impacts are not expected to contribute measurably to cumulative effects. The following receptors are scoped out of CEA of collision:

- **Great Black-backed Gull** – collision impacts to great black-backed gull were determined to be of small magnitude (**Section 12.11, Table 12-45**) with a maximum of three mortalities expected per year, all in the non-breeding season. Following adjustment to account for overlap of individuals being present in both seasons, with impacts assessed against the smaller population (i.e. the breeding population), effects on survival rate were small (0.003%-point change).
- **Herring Gull** – although impacts to herring gull can be considered moderate in comparison to the regional population size and effects on survival rate (**Section 12.11, Table 12-46**), this is due to an anomalously high number of individuals observed in November 2022. Almost all impacts predicted were associated with this unusually high abundance, which has been attributed to a foraging event associated with fishing activity, fishing discards, or detritus on the sea surface.

12.13.2.25 Therefore, the receptors included in the CEA of collision are:

- **Kittiwake** – Salamander Project collision impacts to kittiwake were determined to be **Negligible**, with a 0.012%-point change in baseline survival estimated. Considering the species is sensitive to both collision and displacement, therefore, combined effects are considered in the CEA.
- **Gannet** – Salamander Project collision impacts to gannet were small, with maximum predicted impacts of a 0.003%-point decrease in survival rate. However, gannet is also sensitive to distributional responses, therefore, combined effects of displacement and collision are included in the CEA.

Combined Effects of Distributional Responses and Collision

12.13.2.26 Impacts associated with distributional responses and collision have been summed and assessed together. This approach keeps the assessment proportionate to the scale of the development, reducing the number of PVA runs required. Impacts associated with other projects were derived from the MSP abundances, with displacement and mortality rates (distributional responses) and avoidance rates (collision assessment) applied post-hoc where these differed from the Salamander Project approach. Where such amendments have been made, this is stated for each receptor assessed below.

12.13.2.27 As discussed in **Section 12.11** and detailed within **Volume ER.A.4, Annex 12.8 Offshore Ornithology Regional Populations Report**, there is a level of overlap between individual birds present in the breeding season and in the non-breeding season. Therefore, to prevent impacts to the same bird being assessed twice, the non-breeding season estimated impacts were adjusted based on the ratio of birds present in the breeding season compared to the non-breeding season. Impacts were then assessed against the breeding population. For gannet, the ratio of 'UK birds' to 'all birds' in the BDMPS region (approximately 90%) was used to adjust the non-breeding season impacts.

Kittiwake

12.13.2.28 For kittiwake, breeding season predicted impacts were largely derived from the CEA undertaken for the Hornsea Four project (Ørsted, 2021) and supplemented from individual project applications where necessary. For some projects, impacts are presented based on seasons defined by Furness (2015), in which case, autumn migration impacts were multiplied by 0.2 and spring migration by 0.1 and then added to the 'migration free breeding period'. This gives estimates in alignment with the Salamander Project (i.e. NatureScot (2020) defined seasonality).

12.13.2.29 As per NatureScot advice received on a previous project, kittiwake non-breeding season impact predictions feeding into CEA were based on the Pentland Floating Offshore Wind Farm Variation and the Inch Cape revised design application (ICOL, 2018) and supplemented by the Hornsea Four CEA (Ørsted, 2021) and individual project applications where necessary.

12.13.2.30 Most projects determined collision impacts based on the Cook *et al.* (2014) avoidance rates, as used for the Salamander Project assessment, as per current guidance (Section 6 of NatureScot (2023i)). Where projects used alternative avoidance rates (e.g. those presented by Ozsanlav-Harris *et al.* (2023)), post-hoc amendments have been made to calculate collision estimates based on Cook *et al.* (2014) avoidance rates.

12.13.2.31 **Table 12-54** presents the predicted mortality estimates for kittiwake based on the MSP abundance at each project, with Applicant Approach and SNCB (2017) displacement and mortality rates (refer to **Section 12.11**). Collision impacts are also presented. Impacts at individual projects are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)** (**Table 4** and **Table 5**).

Table 12-54 Distributional responses and collision black-legged kittiwake (*Rissa tridactyla*) mortality estimates for the Salamander Project and totals for projects scoped in for cumulative assessment

Development	Applicant Approach Rate (30% displacement; 1% mortality) Mortality Estimates (indv.)		Recommended Rate (30% displacement, 3% mortality) Mortality Estimates (indv.)		Collision Mortality Estimates (indv.)	
	Breeding Season	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*
Salamander Project	11	1	33	2	23	3
Total Mortality Estimates (indv.)						
With Berwick Bank	145	126	432	377	594	1,437
Without Berwick Bank	82	51	242	152	284	1,249

12.13.2.32 As per the Scoping Opinion (MD-LOT, 2023), cumulative effects have been assessed including and excluding impacts associated with Berwick Bank. Considering the range of displacement and mortality rates, four scenarios are presented for kittiwake (**Table 12-55**). The impacts on adult survival rate presented in **Table 12-55** and fed into PVA are subsequent to adjustments accounting for overlap between breeding and non-breeding season birds (refer to **Sections 12.10.6** and **12.13.2** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**).

Table 12-55 Impact scenarios considered for black-legged kittiwake (*Rissa tridactyla*)

Scenario	Impacts Modelled	Mean Impact on Adult Survival Rate
Scenario 1: SNCB (2017) displacement / mortality rates, including Berwick Bank	Breeding season: 30% / 3% displacement + collision	0.992%
	Non-breeding season: 30% / 3% displacement + collision	
Scenario 2: Applicant Approach displacement / mortality rates, including Berwick Bank	Breeding season: 30% / 1% displacement + collision	0.783%
	Non-breeding season: 30% / 1% displacement + collision	
Scenario 3: SNCB (2017) displacement / mortality rates, excluding Berwick Bank	Breeding season: 30% / 3% displacement + collision	0.634%
	Non-breeding season: 30% / 3% displacement + collision	
Scenario 4: Applicant Approach displacement / mortality rates, excluding Berwick Bank	Breeding season: 30% / 1% displacement + collision	0.528%
	Non-breeding season: 30% / 1% displacement + collision	

12.13.2.33 In all scenarios, impacts to kittiwake baseline survival rate were >0.02%-points, therefore, each scenario has been taken forward and modelled through PVA. The 35-year (operational life) PVA outputs for kittiwake are presented in **Table 12-56**.

12.13.2.34 Further details and 25-year and 50-year PVA outputs are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**.

Table 12-56 Population viability analysis outputs for the black-legged kittiwake (*Rissa tridactyla*) cumulative assessment, CPC = counterfactual of population growth rate; CPS = counterfactual of population size

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Baseline (Unimpacted)	192,760	-	-
Scenario 1: SNCB (2017) displacement / mortality rates, including Berwick Bank	126,128	0.988	0.654
Scenario 2: Applicant Approach displacement / mortality rates, including Berwick Bank	137,899	0.991	0.715
Scenario 3: SNCB (2017) displacement / mortality rates, excluding Berwick Bank	146,752	0.992	0.762
Scenario 4: Applicant Approach displacement / mortality rates, excluding Berwick Bank	1,53,846	0.994	0.798

12.13.2.35 Salamander Project alone impacts to kittiwake were relatively small in comparison to those associated with other developments which may affect the regional populations. When the lower range of the SNCB (2017) mortality rate is applied (the Applicant Approach), as discussed in **Section 12.11**, the Salamander Project contribution to cumulative annual mortalities is <1.7% and <2.3% with and without Berwick Bank, respectively (Scenarios 2 and 4). As observed in **Table 12-54**, the greatest risk to kittiwake is associated with collision.

12.13.2.36 Where the baseline population is decreasing, use of the counterfactual of population size (CPS) should be treated with caution due to the methodology employed within PVA. The CPS is sensitive to density dependence / independence in the model, and thus may not be constrained by the model (i.e. the model is able to react in unrealistic ways). Therefore, where a decreasing population trend is observed, the counterfactual of population growth rate (CPC) is considered a more useful metric due to its lower sensitivity to density dependence. Similar precautions are noted in the recent West of Orkney application and in the East Anglia ONE North application, where impacts to kittiwake are discussed (SPR, 2019; West of Orkney Windfarm, 2023). However, both metrics are presented and discussed for completeness.

12.13.2.37 After a 35-year model, the kittiwake population is projected to decrease in all scenarios, including the baseline (i.e. unimpacted scenario), where the baseline population size is estimated to decrease by almost 5% to 192,760 indv. When impacts associated with OWF developments are considered, the reduction in population size is, as is to be expected, greater (**Table 12-56**). In Scenario 2 (the Applicant Approach, including Berwick Bank), the modelled population size is 137,899 indv. (28.5% smaller than the baseline), whereas excluding Berwick Bank (Scenario 4), it is 153,846 indv. (approximately 20% smaller than the baseline). Although CPS should be considered with caution, the model outputs suggest that there will be an effect on population size when comparing the baseline scenario with the impact scenarios. For the Applicant Approach, the CPS value for kittiwake is 0.715, including Berwick Bank, or 0.8798, excluding Berwick Bank.

12.13.2.38 In Scenarios 2 and 4, where a 1% mortality rate of displaced birds is applied, the CPC 0.991 and 0.994, respectively. Both values are greater than 0.990, representing a <1% change in population growth rate.

Therefore, considering the caution applied to the CPS values, the changes in modelled growth rate are not expected to result in material change in the regional kittiwake population.

12.13.2.39 It should be noted that the regional populations associated with the Salamander Project were defined using foraging ranges and informed by BDMPS outlined by Furness (2015). The CEA considers a wide range of projects which may affect the same regional population as the Salamander Project (as discussed in **Sections 12.7.1** and **12.10.6**, and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Impacts at other developments have not been apportioned to the same regional population giving a precautionary approach. Whilst impacts at other projects may affect the same population, the assessment made does not consider that these are unlikely to be solely against the same regional population. Therefore, the magnitude of impact (i.e., the proportion of the regional population discussed in **Sections 12.7.1 and 12.10.6**) is likely to be smaller than presented here.

12.13.2.40 It is also important to recognise that distributional responses and collision are mutually exclusive impacts (i.e., a displaced bird cannot collide with a WTG). Therefore, summing the two impacts for the purpose of assessment is considered a precautionary approach. As such, the collision impacts presented in **Table 12-54** are likely to be smaller, by up to 30%. However, this approach does not have an established precedent with Scottish regulators, and, therefore, is not accounted for in the below conclusions.

12.13.2.41 Considering the cumulative effect of OWF developments on the CPS, as well as an already declining population of kittiwake, effects may be measurable against the baseline population, however, are not likely to result in material change. As impacts on growth rate are <1% (CPC > 0.9) for the Applicant Approach, cumulative impacts to kittiwake are considered to be **Minor**. Excluding Berwick Bank from the assessment (Scenario 4) reduces the magnitude of the effect, however, the impacts remain as **Minor**. Impacts to kittiwake are **Not Significant** in EIA terms

12.13.2.42 A higher magnitude of effect would be expected if the upper mortality rate (3%) is applied to the assessment. Whilst the CEA conclusions above are based on the Applicant Approach (as discussed in **Section 12.10**), consideration is also given to the SNCB (2017) recommended rates, as per Scenarios 1 and 3 (**Table 12-56**). When applying SNCB recommended rates, effects on kittiwake growth rate and population size are greater, with the 35-year population size ranging from 126,128 indv. (including Berwick Bank) to 146,752 indv. (excluding Berwick Bank).

12.13.2.43 With the upper range of the recommended rates (SNCB, 2017) applied (30% displacement; 3% mortality), potential impacts are marginally higher, however, the impact to growth rate is >1% (CPC = 0.988) with Berwick Bank included. Excluding Berwick Bank reduces the magnitude of the impact on growth rate to <1% (CPC = 0.992). Impacts to population size are also greater, with the greatest effect associated with Scenario 1 (including Berwick Bank), where CPS is 0.654. Removing Berwick Bank from the assessment reduces the cumulative impact, bringing CPS to 0.762. Considering that CPS should be treated with caution in declining populations, considering the upper SNCB (2017) mortality rate (3%), impacts to kittiwake would remain as Minor.

Guillemot

12.13.2.44 Cumulative breeding and non-breeding season impacts to guillemot were primarily derived from the Hornsea Four CEA (Ørsted, 2021) and supplemented by individual project applications where necessary. Hornsea Four season definitions are not the same as those presented by NatureScot (2020) and used for the Salamander Project, therefore, corrections were applied. Breeding season impacts in Hornsea Four were reduced by 20% and non-breeding season impacts increased by an equal number of mortalities. This correction was not required for projects which presented impacts according to NatureScot (2020) seasonality.

12.13.2.45 Impacts were estimated from MSP estimates at each project, with a range of displacement and mortality rates applied (as discussed in **Section 12.10**), and to align with the Salamander Project assessment (**Section 12.10**). **Table 12-57** presents the predicted mortality estimates for guillemot. Impacts at individual projects are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)** (**Table 6**).

Table 12-57 Distributional responses common guillemot (*Uria aalge*) mortality estimates for the Salamander Project and totals for projects scoped in for cumulative assessment

Development	Applicant Approach Rate (50% displacement; 1% mortality) Mortality Estimates (indv.)		**Lower Recommended Rate (60% displacement, 3% breeding mortality, 1% non-breeding mortality) Mortality Estimates (indv.)**		**Upper Recommended Rate (60% displacement, 5% breeding mortality, 3% non-breeding mortality) Mortality Estimates (indv.)**	
	Breeding Season	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*
The Salamander Project	18	59	65	71	108	212
Total Mortality Estimates (indv.)						
With Berwick Bank	805	643	2,899	770	4,830	2,308
Without Berwick Bank	434	422	1,564	505	2,605	1,514

12.13.2.46 As per the Scoping Opinion (MD-LOT, 2023), cumulative effects have been assessed including and excluding impacts associated with Berwick Bank. Considering the range of displacement and mortality rates, six scenarios are presented for guillemot (**Table 12-58**). The impacts on adult survival rate presented in **Table 12-58** and fed into PVA are subsequent to adjustments accounting for overlap between breeding and non-breeding season birds (refer to **Sections 12.10.6** and **12.13.2** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**).

Table 12-58 Impact scenarios considered for common guillemot (*Uria aalge*)

Scenario	Impacts Modelled	Mean Impact on Adult Survival Rate
Scenario 1: Upper SNCB (2017) displacement / mortality rates, including Berwick Bank	Breeding season: 60% / 5% displacement	1.750%
	Non-breeding season: 60% / 3% displacement	
Scenario 2: Lower SNCB (2017) displacement / mortality rates, including Berwick Bank	Breeding season: 60% / 3% displacement	0.899%
	Non-breeding season: 60% / 1% displacement	
Scenario 3: Applicant Approach displacement / mortality rates, including Berwick Bank	Breeding season: 50% / 1% displacement	0.354%
	Non-breeding season: 50% / 1% displacement	
Scenario 4: Upper SNCB (2017) displacement / mortality rates, excluding Berwick Bank	Breeding season: 60% / 5% displacement	1.010%
	Non-breeding season: 60% / 3% displacement	
Scenario 5: Lower SNCB (2017) displacement / mortality rates, excluding Berwick Bank	Breeding season: 60% / 3% displacement	0.507%
	Non-breeding season: 60% / 1% displacement	
Scenario 6: Applicant Approach displacement / mortality rates, excluding Berwick Bank	Breeding season: 50% / 1% displacement	0.209%
	Non-breeding season: 50% / 1% displacement	

12.13.2.47 In all scenarios, impacts to guillemot baseline survival rate were >0.02%-points, therefore, each scenario has been taken forward and modelled through PVA. The 35-year (operational life) PVA outputs for kittiwake are presented in **Table 12-59**. Further details and 25-year and 50-year PVA outputs are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**.

Table 12-59 Population viability analysis outputs for the common guillemot (*Uria aalge*) cumulative assessment, CPC = counterfactual of population growth rate; CPS = counterfactual of population size

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Baseline (Unimpacted)	1,209,339	-	-
Scenario 1: Upper SNCB (2017) displacement / mortality rates, including Berwick Bank	595,234	0.980	0.492

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Scenario 2: Lower SNCB (2017) displacement / mortality rates, including Berwick Bank	841,287	0.990	0.696
Scenario 3: Applicant Approach displacement / mortality rates, including Berwick Bank	1,048,917	0.996	0.867
Scenario 4: Upper SNCB (2017) displacement / mortality rates, excluding Berwick Bank	804,411	0.989	0.665
Scenario 5: Lower SNCB (2017) displacement / mortality rates, excluding Berwick Bank	985,963	0.994	0.816
Scenario 6: Applicant Approach displacement / mortality rates, excluding Berwick Bank	1,111,892	0.998	0.919

12.13.2.48 The guillemot population is projected to increase in all scenarios, with PVA indicating the baseline population will increase by almost 200% from 407,959 indv. To 1,209,339 indv. In the 35-year unimpacted model (**Table 12-59**). Where the Applicant Approach displacement (50%) and mortality (1%) rates are applied, which, as discussed in **Section 12.10**, are considered to be the most appropriate and proportionate to the Salamander Project, the guillemot population is modelled to increase by 157 – 173%, with and without Berwick Bank, respectively.

12.13.2.49 In Scenario 3 (Applicant Approach, including Berwick Bank), guillemot growth rate is expected to decrease by up to 0.4%, which, modelled over 35 years results in an overall population of 1,048,917 indv. (13.3% smaller than the baseline). Excluding Berwick Bank from the assessment (Scenario 6) results in a smaller magnitude of effect, where growth rate is reduced by just 0.2% and population size by 8.1%, compared with the baseline projections (**Table 12-59**). The impact on growth rate is small and the effect on overall population size, although measurable, is not expected to constitute material change.

12.13.2.50 It is important to note that the regional populations associated with the Salamander Project were defined using foraging ranges and informed by BDMPS outlined by Furness (2015). The CEA considers a wide range of projects which may affect the same regional population as the Salamander Project (as discussed in **Sections 12.7.1** and **12.10.6**, and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Impacts at other developments have not been apportioned to the same regional population, giving a precautionary approach. Whilst impacts at other projects may affect the same population, the assessment made does not consider that these are unlikely to be solely against the same regional population. Therefore, the magnitude of impact (i.e., the proportion of the regional population affected) is likely to be smaller than presented here.

12.13.2.51 Based on the Applicant Approach, considering the above, the small cumulative magnitude of effect on growth rate (CPC > 0.990) and the relatively small effect on population size (CPS > 0.800), cumulative impacts to guillemot are expected to be measurable. The population is expected to be smaller than without cumulative effects, with changes up to 13.3% modelled. However, modelling outputs suggest that the population will continue to increase by up to 150% (2.5 times larger). Therefore, cumulative impacts to guillemot, including Berwick Bank, are **Minor**. Excluding Berwick Bank almost halves the adverse effect, reducing impacts to growth rate to just 0.2%; therefore, without Berwick Bank, cumulative impacts are **Negligible**. Impacts in both scenarios are **Not Significant** in EIA terms.

12.13.2.52 Where higher displacement (e.g. 60%) and mortality (e.g. up to 5%) rates are applied, greater cumulative impacts are expected. Whilst the CEA conclusions above are based on the Applicant Approach (as discussed in **Section 12.10**), consideration is also given to the SNCB (2017) recommended rates, as per Scenarios 1, 2, 4, and 5 (**Table 12-62**). When applying SNCB recommended rates, effects on growth rate and population size are greater, with the 35-year population size ranging from 595,234 indv. (Scenario 1; 51.2% smaller than baseline) to 985,963 indv. (Scenario 5: 18.4% smaller than baseline).

12.13.2.53 If the lower range of the recommended rates (60% displacement; 1 – 3% mortality) are applied, excluding Berwick Bank, the growth rate remains <1% smaller than baseline (CPC > 0.990) and the 35-year population size is <20% smaller (CPS > 0.800). Although effects would likely be measurable if this level of displacement and mortality were to occur, they would not be expected to result in material change and, with an increasing population in all scenarios, recovery would be likely to occur. Impacts, therefore, would be Minor.

12.13.2.54 With the upper range of the recommended rates (SNCB, 2017) applied (60% displacement; 3 – 5% mortality), potential impacts are higher. Without Berwick Bank, growth rate shows a 1.1% reduction compared with the baseline scenario, resulting in a 35-year population size almost 35% smaller. Including Berwick Bank, cumulative impacts to guillemot are higher: the change in growth rate is 2%, giving a 35-year population size 50% smaller than that of the baseline scenario. Therefore, assuming the worst-case (upper) displacement and mortality, impacts to guillemot would be considered Moderate.

Razorbill

12.13.2.55 As with guillemot, breeding and non-breeding season impacts to razorbill were primarily derived from the Hornsea Four CEA (Ørsted, 2021) and supplemented by individual project applications where necessary. Hornsea Four season definitions are not the same as those presented by NatureScot (2020) and used for the Salamander Project, therefore, corrections were applied. Breeding season impacts in Hornsea Four were reduced by 20% and non-breeding season impacts increased by an equal number of mortalities. This correction was not required for projects which presented impacts according to NatureScot (2020) seasonality.

12.13.2.56 Impacts were estimated from MSP estimates at each project, with a range of displacement and mortality rates applied (as discussed in **Section 12.10**, **Table 12-60** presents the predicted). **Table 12-60** presents the predicted mortality estimates for razorbill. Impacts at individual projects are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)** (**Table 7**).

Table 12-60 Distributional responses razorbill (*Alca torda*) mortality estimates for the Salamander Project and totals for projects scoped in for cumulative assessment

Development	Applicant Approach Rate (50% displacement; 1% mortality) Mortality Estimates (indv.)		**Lower Recommended Rate (60% displacement, 3% breeding mortality, 1% non-breeding mortality) Mortality Estimates (indv.)**		**Upper Recommended Rate (60% displacement, 5% breeding mortality, 3% non-breeding mortality) Mortality Estimates (indv.)**	
	Breeding Season	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*
Salamander Project	1	0	3	1	5	2
Total Mortality Estimates (indv.)						
With Berwick Bank	112	690	407	826	677	2,479
Without Berwick Bank	92	601	334	720	556	2,160

12.13.2.57 As per the Scoping Opinion (MD-LOT, 2023), cumulative effects have been assessed including and excluding impacts associated with Berwick Bank. Considering the range of displacement and mortality rates, six scenarios are presented for razorbill (**Table 12-61**). The impacts on adult survival rate presented in **Table 12-61** and fed into PVA are subsequent to adjustments accounting for overlap between breeding and non-breeding season birds (refer to **Sections 12.10.6** and **12.13.2** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**).

Table 12-61 Impact scenarios considered for razorbill (*Alca torda*)

Scenario	Impacts Modelled	Mean Impact on Adult Survival Rate
Scenario 1: Upper SNCB (2017) displacement / mortality rates, including Berwick Bank	Breeding season: 60% / 5% displacement	1.776%
	Non-breeding season: 60% / 3% displacement	
Scenario 2: Lower SNCB (2017) displacement / mortality rates, including Berwick Bank	Breeding season: 60% / 3% displacement	0.850%
	Non-breeding season: 60% / 1% displacement	
Scenario 3: Applicant Approach displacement / mortality rates, including Berwick Bank	Breeding season: 50% / 1% displacement	0.386%
	Non-breeding season: 50% / 1% displacement	
Scenario 4: Upper SNCB (2017) displacement / mortality rates, excluding Berwick Bank	Breeding season: 60% / 5% displacement	1.500%
	Non-breeding season: 60% / 3% displacement	
Scenario 5: Lower SNCB (2017) displacement / mortality rates, excluding Berwick Bank	Breeding season: 60% / 3% displacement	0.712%
	Non-breeding season: 60% / 1% displacement	
Scenario 6: Applicant Approach displacement / mortality rates, excluding Berwick Bank	Breeding season: 50% / 1% displacement	0.328%
	Non-breeding season: 50% / 1% displacement	

12.13.2.58 In all scenarios, impacts to razorbill baseline survival rate were >0.02%-points, therefore, each scenario has been taken forward and modelled through PVA. The 25-year PVA outputs for razorbill are presented in **Table 12-62.**

12.13.2.59 Further details and 35-year and 50-year PVA outputs are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**.

Table 12-62 Population viability analysis outputs for the razorbill (*Alca torda*) cumulative assessment, CPC = counterfactual of population growth rate; CPS = counterfactual of population size

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Baseline (Unimpacted)	20,836	-	-
Scenario 1: Upper SNCB (2017) displacement / mortality rates, including Berwick Bank	9,755	0.979	0.468
Scenario 2: Lower SNCB (2017) displacement / mortality rates, including Berwick Bank	14,498	0.990	0.697
Scenario 3: Applicant Approach displacement / mortality rates, including Berwick Bank	17,660	0.995	0.849
Scenario 4: Upper SNCB (2017) displacement / mortality rates, excluding Berwick Bank	10,977	0.982	0.528
Scenario 5: Lower SNCB (2017) displacement / mortality rates, excluding Berwick Bank	15,371	0.992	0.739
Scenario 6: Applicant Approach displacement / mortality rates, excluding Berwick Bank	18,113	0.996	0.871

12.13.2.60 Salamander Project alone impacts to razorbill were very small in comparison to those associated with other developments. Following the Applicant Approach, as discussed in **Section 12.10**, and to align with the Salamander Project assessment (**Section 12.10**). **Table 12-60** presents the predicted, the Salamander Project contribution to cumulative annual mortalities is just 0.13% and 0.15% with and without Berwick Bank, respectively. Therefore, the vast majority (>99.8%) of impacts to the regional razorbill population are associated with other projects.

12.13.2.61 Similar to kittiwake, the razorbill population is declining. After 35 years, the razorbill population is projected to decrease in all scenarios, including the baseline (i.e. unimpacted scenario), where the baseline population size is estimated to decrease by over 70% to 20,836 indv. As previously noted, where the baseline population is decreasing, use of the CPS should be treated with caution due to the methodology employed within PVA, the CPC is a more appropriate metric due to its lower sensitivity to density dependence (refer to **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)** and similar approaches adopted by SPR (2019) and West of Orkney Windfarm (2023)).

12.13.2.62 When impacts associated with OWF developments are considered, the reduction in population size is greater for all scenarios (**Table 12-62**), with Scenario 3 resulting in a population size of 17,660 indv. (approximately 15.1% smaller than the baseline) and Scenario 6 (excluding Berwick Bank), resulting a small effect (13.9% smaller population: 18,113 indv.). Although the CPS should be used with caution, the values for the 35-year model (Applicant Approach, as discussed in **Section 12.10**) suggest a measurable effect on population size compared with the baseline, however, this effect is not likely to constitute material change (CPS > 0.800).

12.13.2.63 For the Applicant Approach (Scenario 3 and Scenario 6), cumulative impacts on razorbill survival rate were <1% and after a 35-year model period, the CPC was close to 1.0 (CPC > 0.995). It is possible that the change in razorbill population would be measurable, however, with the effect on growth rate and the change in baseline survival rate <1%, it is not expected to have a material effect on the regional razorbill population.

12.13.2.64 Additionally, the regional populations associated with the Salamander Project were defined using foraging ranges and informed by BDMPS outlined by Furness (2015). The CEA considers a wide range of projects which may affect the same regional population as the Salamander Project (as discussed in **Sections 12.7.1** and **12.10.6**, and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Impacts at other developments have not been apportioned to the same regional population, giving a precautionary approach. Whilst impacts at other projects may affect the same population, the assessment made does not consider that these are unlikely to be solely against the same regional population. Therefore, the magnitude of impact (i.e., the proportion of the regional population discussed in **Sections 12.7.1** and **12.10.6**) is likely to be smaller than presented here.

12.13.2.65 Considering the above, the small cumulative magnitude of effect on razorbill growth rate (<1%), and the small contribution of the Salamander Project (up to 0.15%), cumulative impacts to razorbill are expected to be relatively small when the Applicant Approach. However, due to the already declining population, impacts are considered to be **Minor**, which is **Not Significant** in EIA terms. Excluding Berwick Bank had a small effect on the overall impact, thus, the conclusion of **Minor** (**Not Significant** in EIA terms) remains applicable.

12.13.2.66 However, should higher displacement (e.g. 60%) and mortality (e.g. up to 5%) rates be applied to the CEA, predicted impacts are greater. Whilst the CEA conclusions above are based on the Applicant Approach (as discussed in **Section 12.10**), consideration is also given to the SNCB (2017) recommended rates, as per Scenarios 1, 2, 4, and 5 (**Table 12-62**). The Salamander Project represents just up to 0.4% of cumulative annual impacts (Scenario 5). Appling SNCB recommended rates, effects on growth rate and population size are greater. With population size ranging from 9,755 indv. (Scenario 1; 53.2% smaller than baseline) to 15,371 indv. (Scenario 5: 26.1% smaller than baseline).

12.13.2.67 If the lower range of the recommended rates (60% displacement; 1 – 3% mortality) are applied, including or excluding Berwick Bank (Scenario 2 and Scenario 5), the growth rate is <1% smaller than baseline (CPC > 0.990), however, the 35-year population size is almost 30% smaller. This would comprise Minor impact.

12.13.2.68 With the upper range of the recommended rates (SNCB, 2017) applied (60% displacement; 3 – 5% mortality), potential impacts are higher. Without Berwick Bank (Scenario 4), growth rate shows a 1.8% reduction compared with the baseline scenario, resulting in a 35-year population size 47.2% smaller. Including Berwick Bank (Scenario 1), cumulative impacts to razorbill are greater. The effect on growth rate is 2.1%, giving a 35-year population size almost 53.2% smaller than that of the baseline scenario. Therefore, assuming the worst-case (upper) displacement and mortality, impacts to razorbill would be considered Moderate without Berwick Bank or Major with Berwick Bank impacts included.

12.13.2.69 As previously noted, it is important to recognise the contribution of the Salamander Project to cumulative effects. Impacts to razorbill associated with the Salamander Project represent no more than 0.40% of all predicted mortalities in all scenarios across the projects scoped in for assessment (**Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**). Therefore, even excluding impacts from the Salamander Project, the CEA conclusions would remain the same.

Northern Gannet

12.13.2.70 For gannet, breeding season predicted impacts were largely derived from the CEA undertaken for the Hornsea Four project (Ørsted, 2021) and supplemented from individual project applications where necessary. For some projects, impacts are presented based on seasons defined by Furness (2015), in which case, autumn migration impacts were multiplied by 0.3 and spring migration by 0.1 and then added to the 'migration free breeding period'. This gives estimates in alignment with the Salamander Project (i.e., NatureScot (2020) defined seasonality).

12.13.2.71 As per NatureScot advice received on a previous project, gannet non-breeding season impact predictions feeding into CEA were based on the Pentland Floating Offshore Wind Farm Variation and the Inch Cape revised design application (ICOL, 2018) and supplemented by the Hornsea Four CEA (Ørsted, 2021) and individual project applications where necessary. Following this, impacts for the non-breeding season were multiplied by 0.67 and added to the spring migration estimates to get values for the full NatureScot (2020) non-breeding period.

12.13.2.72 Most projects determined collision impacts based on the Cook *et al.* (2014) avoidance rates. Therefore, post-hoc amendments have been made to calculate collision estimates based on Ozsanlav-Harris *et al.* (2023) avoidance rates.

12.13.2.73 **Table 12-63** presents the predicted mortality estimates for gannet based on the MSP abundance at each project, with Applicant Approach and SNCB (2017) displacement and mortality rates (refer to **Section 12.10**). Collision impacts are also presented. Impacts at individual projects are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)** (**Table 8** and **Table 9**).

Table 12-63 Distributional responses and collision northern gannet (*Morus bassanus*) mortality estimates for the Salamander Project and totals for projects scoped in for cumulative assessment

Development	Applicant Approach Rate (70% displacement; 1% mortality) Mortality Estimates (indv.)		Recommended Rate (70% displacement, 3% mortality) Mortality Estimates (indv.)		Collision Mortality Estimates (indv.)	
	Breeding Season	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*	*Breeding Season*	*Non-breeding Season*
Salamander Project	3	3	9	8	5	4
Total Mortality Estimates (indv.)						
With Berwick Bank	194	216	580	653	743	748
Without Berwick Bank	161	204	481	616	642	737

12.13.2.74 As per the Scoping Opinion (MD-LOT, 2023), cumulative effects have been assessed including and excluding impacts associated with Berwick Bank. Considering the range of displacement and mortality rates, four scenarios are presented for gannet (**Table 12-64**). The impacts on adult survival rate presented in **Table 12-64** and fed into PVA are subsequent to adjustments accounting for overlap between breeding and non-breeding season birds (refer to **Sections 12.10.6** and **12.13.2** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**).

Table 12-64 Impact scenarios considered for northern gannet (*Morus bassanus*)

Scenario	Impacts Modelled	Mean Impact on Adult Survival Rate
Scenario 1: SNCB (2017) displacement / mortality rates, including Berwick Bank (0.65%)	**Breeding season: 70% / 3% displacement + collision**	0.624%
	Non-breeding season: 70% / 3% displacement + collision	
Scenario 2: Applicant Approach displacement / mortality rates, including Berwick Bank (0.47%)	**Breeding season: 70% / 1% displacement + collision**	0.436%
	Non-breeding season: 70% / 1% displacement + collision	
Scenario 3: SNCB (2017) displacement / mortality rates, excluding Berwick Bank (0.71%)	**Breeding season: 70% / 3% displacement + collision**	0.567%
	Non-breeding season: 70% / 3% displacement + collision	
Scenario 4: Applicant Approach displacement / mortality rates, excluding Berwick Bank (0.54%)	**Breeding season: 70% / 1% displacement + collision**	0.399%
	Non-breeding season: 70% / 1% displacement + collision	

12.13.2.75 In all scenarios, impacts to gannet baseline survival rate were >0.02%-points, therefore, each scenario has been taken forward and modelled through PVA. The 25-year PVA outputs for kittiwake are presented in **Table 12-65**. Further details and 35-year and 50-year PVA outputs are presented in **Volume ER.A.4, Annex 12.9: Cumulative Assessment Population Viability Analysis (PVA)**.

Table 12-65 Population viability analysis outputs for the northern gannet (*Morus bassanus*) cumulative assessment, CPC = counterfactual of population growth rate; CPS = counterfactual of population size

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Baseline (Unimpacted)	544,009	-	-
Scenario 1: SNCB (2017) displacement / mortality rates, including Berwick Bank	417,106	0.993	0.767
Scenario 2: Applicant Approach displacement / mortality rates, including Berwick Bank	451,731	0.995	0.831
Scenario 3: SNCB (2017) displacement / mortality rates, excluding Berwick Bank	427,347	0.993	0.786

Scenario	Median Population Size (indv.)	Median Counterfactuals	
		CPC	*CPS*
Scenario 4: Applicant Approach displacement / mortality rates, excluding Berwick Bank	459,297	0.995	0.844

12.13.2.76 In the unimpacted scenario (i.e. all OWF impacts, including those associated with developed and consented projects, removed), the regional gannet population is projected to increase from 423,894 to 544,009 indv. over a 35-year period (**Table 12-65**). When cumulative impacts are considered, the gannet population is projected to increase in all scenarios except Scenario 1. When the Applicant Approach (1% mortality rate) is applied to distributional responses, the projected population is 451,731 indv. (including Berwick Bank) or 459,297 indv. (excluding Berwick Bank).

12.13.2.77 The effect on growth rate is <1% (CPC > 0.990). Over a 35-year period, including Berwick Bank (Scenario 2) this results in a CPS of 0.831, a population size 16.9% smaller than the baseline (unimpacted) population. Excluding Berwick Bank from the assessment (Scenario 4)) results in a smaller effect, with a CPC of 0.995 and CPS of 0.844, the equivalent of approximately 7,500 indv. or a 1.7% larger population. Impacts to the population size are <20% (CPS > 0.800) for the Applicant Approach with and without Berwick Bank. With this level of effect, the small (<1% change in growth rate), and the predicted increase in population, impacts are not expected to result in a material effect on the gannet population.

12.13.2.78 It is important to recognise that the Salamander Project alone impacts were small (refer to **Section 12.11**, **Table 12-40** and **Table 12-47**) for all scenarios, with minimal effect on the regional population or the baseline survival rate predicted. Impacts associated with the Salamander Project represent <1% of cumulative annual impacts to gannet. With Salamander Project impacts removed, cumulative impacts to the regional gannet population are expected to be similar.

12.13.2.79 It should also be noted that, the regional populations associated with the Salamander Project were defined using foraging ranges and informed by BDMPS outlined by Furness (2015). The CEA considers a wide range of projects which may affect the same regional population as the Salamander Project (as discussed in **Sections 12.7.1** and **12.10.6**, and detailed in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Impacts at other developments have not been apportioned to the same regional population, giving a precautionary approach. Whilst impacts at other projects may affect the same population, the CEA does not consider that these are unlikely to be solely against the same regional population. Therefore, the magnitude of impact (i.e., the proportion of the regional population discussed in **Sections 12.7.1** and **12.10.6** affected by other developments) is likely to be smaller than presented here.

12.13.2.80 As previously discussed, distributional responses and collision are mutually exclusive impacts (i.e., a displaced bird cannot collide with a WTG). Therefore, summing the two impacts for the purpose of assessment is considered a precautionary approach. As such, the collision impacts presented in **Table 12-63** are likely to be smaller, potentially by up to 70%. It is noted, this approach has not previously been accepted at Scottish OWF developments thus far. Skov *et al.* (2018) investigated seabird collision avoidance at Thanet OWF in the UK. The study presented macro-avoidance rates (i.e., displacement), micro-avoidance and meso-avoidance rates (avoidance of individual WTGs within the array) separately. For gannet, the overall avoidance rate was 99.9%; however, excluding macro avoidance, the avoidance rate is 99.6%. In collision modelling for the Salamander Project, Cook *et al.* (2014) avoidance rates have been used (98.9% for gannet).

The results obtained by Skov *et al.* (2018) and recent avoidance rate review (Ozsanlav-Harris *et al.*, 2023) suggest that 98.9% avoidance is precautionary for the species and may not account for macro avoidance.

12.13.2.81 Therefore, considering that the small contribution associated with the Salamander Project, with wide geographical scope of projects included, and the precautionary approach of summing mutually exclusive impacts, cumulative impacts are considered to be **Minor**, which is **Not Significant** in EIA terms. Excluding Berwick Bank had a small effect on the overall impact, thus, the conclusion of **Minor** (**Not Significant** in EIA terms) remains applicable.

12.13.2.82 With the upper mortality rate (3%) applied to the assessment of distributional responses, impacts to gannet are, expectedly, greater. Whilst the CEA conclusions above are based on the Applicant Approach (as discussed in **Section 12.10**), consideration is also given to the SNCB (2017) recommended rates, as per Scenarios 1 and 3 (**Table 12-65**). When applying SNCB recommended rates, effects on gannet growth rate similar, however, impacts to population size are greater.

12.13.2.83 With the upper range of the recommended rates (SNCB, 2017) applied (70% displacement; 3% mortality) the effect on growth rate remains <1% compared with the baseline (unimpacted) scenario (CPC > 0.990), with and without Berwick Bank. Impacts to population size are greater, with the greatest effect associated with Scenario 1 (including Berwick Bank), where CPS is 0.767, approximately 23.3% smaller than the baseline model. Removing Berwick Bank from the assessment reduces the cumulative impact, however, the impact on population size remains greater than 20% (CPS = 0.786).

12.13.2.84 This magnitude of effect is likely to result in measurable changes in the regional population of gannet (CPS < 0.800), with the impacted population showing a decrease from the current population when Berwick Bank impacts are considered in the assessment. Impacts to growth rate are not expected to constitute material change (CPC > 0.990). However, as previously mentioned, it is important to note that impacts associated the Salamander Project are small (**Section 12.11**, **Table 12-40** and **Table 12-47**) and that the assessments made here do not account for mutual exclusivity between collision and displacement. Therefore, application of the upper recommended mortality rate for gannet would result in a precautionary Moderate impact.

Cumulative Effects Assessment Conclusions

12.13.2.85 Cumulative impacts associated with the Salamander Project and all other existing and reasonably foreseeable OWF projects and plans which may affect the same regional populations were assessed as **Minor** for all Offshore and Intertidal Ornithology receptors. Excluding Berwick Bank from the assessment resulted in a smaller magnitude of effect for all receptors, however, assessment conclusions remained the same (**Minor**), except for guillemot, where **Negligible** impacts are expected without Berwick Bank. Therefore, cumulative impacts to Offshore and Intertidal Ornithology are **Not Significant**.

12.13.2.86 On a precautionary basis, the quantitative assessment of distributional responses and collision do not account for mutual exclusivity between the two effects (i.e. a displaced bird cannot collide), however, this is reflected qualitatively in the assessment conclusions for kittiwake and gannet. Where species show an already declining population, it is noted that the CPS value should be treated with caution, thus, a greater degree of flexibility has been applied in two instances (for kittiwake and razorbill). However, CPS are presented and considered for context.

12.14 Transboundary Effects

12.14.1.1 Transboundary effects are defined as effects that extend into other European Economic Area (EEA) states. These may occur from the Salamander Project alone, or cumulatively with other plans or projects.

12.14.1.2 For Offshore and Intertidal Ornithology, impacts were assessed against regional population estimates. The regional populations were defined using seabird foraging ranges and SMP data (Woodward *et al.*, 2019; NatureScot, 2023c), but also clipped to UK waters and the North Sea, as described in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report** (**Section 2**). This approach is applicable to both the breeding and non-breeding seasons. Impacts associated with the Salamander Project alone, and cumulatively with other proposed and existing OWF projects, were determined to result in **Minor** effect at worst-case, with **Negligible** or **No Impact** predicted for most effects and pressures. This assessment is applicable to both the Scottish populations of seabirds and UK-wide populations, notably including east coast of England and the North Sea.

12.14.1.3 The Salamander Project is of small spatial scale and magnitude, constituting seven WTGs over up to 33.25 km^2. The OAA is located approximately 35 km from the Scottish coast, with the next nearest coastline (outside the UK) being southwest Norway, located in excess of 400 km away. This is a notable distance, even considering the foraging range of seabirds, and is outside the foraging range of species scoped in for assessment, except for fulmar and gannet. The nearest Norwegian gannet colonies are located much further north (Barrett, 2008; Barrett *et al.*, 2017), over 1,000 km away from the OAA. The OAA is approximately 500 km from Denmark and Germany, however, the OAA is on the outer extent of the species foraging range here (Woodward *et al.*, 2019) and thus interaction is likely to be minimal. Impacts to fulmar were assessed as minimal, with the species showing low sensitivity to the key impacts associated with OWFs (Furness *et al.*, 2013; Bradbury *et al.*, 2014), thus, impacts to transboundary populations, located excessive distances from the OAA, are expected to be minimal.

12.14.1.4 Therefore, transboundary impacts, which encompass wider populations and those more distant from the Offshore Development Area, are not expected to occur. Therefore, transboundary impacts are determined to be **Negligible**, and **Not Significant** in EIA terms.

12.15 Assessment of Impacts Cumulatively with the Onshore Development

12.15.1.1 The Onshore Development components are summarised in **Volume ER.A.2, Chapter 4: Project Description**. These Project aspects have been considered in relation to the impacts assessed within this Chapter.

12.15.1.2 The Assessment of Impacts Cumulatively with the Onshore Development considers the effects of the Offshore Development cumulatively with the Onshore Development. The potential for cumulative effects will arise in respect of those Offshore and Intertidal Ornithology receptors that will be affected by both the Onshore and Offshore Development. In respect of Offshore and Intertidal Ornithology receptors, this will include species which make use of the coast and intertidal environment for roosting, feeding, and / or nesting.

12.15.1.3 The Onshore Development and Offshore Development are very different developments in terms of their size, structure, and context which, in turn, affects the extents and magnitude to which their respective Ornithology Study Areas will be affected. The assessment of the Offshore Development presented in **Section 12.11** concludes that significant effects on Offshore and Intertidal Ornithology will not occur. The effects of the Onshore Development will be of a notably lower magnitude, largely owing to the relatively small scale of the Onshore Development. Interaction between the Onshore Development and Offshore and Intertidal Ornithology receptors will be limited to the coastal works at the landfall site.

12.15.1.4 The Onshore Development will involve trenchless operations from above MHWS, with an exit point no closer than 200 m from MHWS offshore. During the trenchless operations, the presence of personnel and construction equipment will result in disturbance of birds in the immediate vicinity of the ongoing works. Although disturbance is expected to occur, this will be temporary in nature, and will cover a limited spatial extent, thus significant effects are not expected to occur. The only potential impact to Marine Ornithology receptors in response to the Onshore Development is temporary disturbance.

12.15.1.5 The very limited potential for significant effects to arise on any of the Offshore and Intertidal Ornithology receptors as a result of the Onshore Development means that in considering the cumulative impacts of these developments, impacts will relate almost entirely to the effects of the Offshore Development and not the cumulative effects of the Offshore Development and Onshore Development.

12.16 Inter-related Effects

12.16.1.1 The following assessment considers the potential for inter-related effects to arise across the three project phases (i.e. project lifetime effects) as well as the interaction of multiple effects on a receptor (i.e. receptor-led effects).

- Project lifetime effects are considered to be effects that occur throughout more than one phase of the Salamander Project, (construction, operation and maintenance, and decommissioning) to interact to potentially create a more significant effect on a receptor, than if just assessed in isolation in these three key project phases (e.g. construction phase, operational phase and decommissioning).
- Receptor-led effects involve spatially or temporal interaction of effects, to create inter-related effects on a receptor or receptor group. Receptor-led effects might be short-term, temporary or transient effects, or incorporate longer term effects.

12.16.1.2 It is important to note that the inter-related effects assessment considers only effects produced by the offshore elements of the Salamander Project and not from other projects, which are considered within **Section 12.13**.

12.16.1.3 The significance of the individual effects as determined in **Section 12.11** is presented herein for each receptor group. A descriptive assessment of the scope for these individual effects to interact to create a different or greater effect has then been undertaken. This assessment incorporates qualitative and, where reasonably possible, quantitative assessments. It should be noted that the following assessment does not assign significance of effect for inter-related effects; rather, any inter-related effects that may be of greater significance than the individual effects acting in isolation on a given receptor are identified and discussed.

12.16.2 Collision and Distributional Responses

12.16.2.1 The main effects of collision and distributional responses were assessed separately following quantitative analysis (CRM and displacement matrices). Some species are sensitive to only one of the two effects, and thus, are not considered for inter-related effects of distributional responses and collision: great black-backed gull and herring gull are insensitive to distributional responses; and guillemot, razorbill, and puffin are insensitive to collision. For species which are sensitive to both distributional responses and collision (kittiwake and gannet), summing the impacts of both is considered a precautionary approach to inter-related assessment as the same individual cannot be displaced and collide.

12.16.2.2 Overall impacts arising from distributional responses and collision are expected to be small for both species, with population-level effects resulting in <0.02%-point changes in survival rate (as the inverse of mortality rate). **Table 12-66** presents the summed effects on the mortality rates of the regional populations of kittiwake and gannet.

12.16.2.3 As discussed in **Section 12.11**, for kittiwake and gannet, the lower end of the SNCB-advised mortality rates has been applied and taken forward for assessment. Cook *et al.* (2014) avoidance rates for CRM have been used to inform the assessment. The inter-related effects discussion is informed by the outputs of assessments based on these parameters. **Table 12-66** also presents mortality estimates based on the worst-case combination of displacement, mortality, and avoidance rates, which, for kittiwake and gannet, are the upper values of SNCB-advised mortality rates and the Cook *et al.* (2014) collision avoidance rates. Implementation of the Ozsanlav-Harris *et al.* (2023) avoidance rates would result in a lower predicted impact for both kittiwake and gannet.

12.16.2.4 Combined impacts on kittiwake (i.e. the sum of displacement and collision impacts) may result in up to 34 additional mortalities in the breeding season and up to two in the non-breeding season, adjusted to account for breeding season birds which remain present in the non-breeding season (details are provided in **Section 12.11** and **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**). Such increases, when assessed against the regional populations and baseline mortality, result in mortality rate changes of 0.017%-point. This increase is minimal and below the threshold for PVA. The small magnitude of change is not expected to have a measurable effect on the regional population. Therefore, the inter-related effects of collision and distributional responses on kittiwake are **Minor**.

12.16.2.5 The change in gannet survival rate is 0.003%-point, with an increase of up to 15 mortalities per year (sum of displacement and collision mortality estimates, adjusted to consider breeding population bird presence in the non-breeding season, details are provided in **Section 12.11** and in **Volume ER.A.4, Annex 12.8: Offshore Ornithology Regional Populations Report**) expected to result in no measurable effect on the regional population. As such, it is concluded that inter-related effects of collision and distributional responses on gannet are **Negligible**.

12.16.2.6 For both species, considering the worst-case rates (i.e. lowest avoidance rate and highest displacement and mortality rates), impacts remain relatively small. Impacts to kittiwake would be no greater than 58 mortalities per year, resulting in a maximum survival rate change of -0.029%. Gannet impacts are smaller, with up to 29 mortalities per year, equating to a 0.007%-point decrease in survival rate.

12.16.2.7 PVA scenarios have been run assuming the worst-case displacement, mortality, and avoidance rates (**Volume ER.A.4, Annex 12.4: Population Viability Analysis**). The outputs show impacts are unlikely to result in material change, with effects on growth rate <1% (CPC > 0.990) and population size <20% (CPS > 0.800).

Table 12-66 Summed mortalities from collision and displacement assessment, and associated effects on regional populations and baseline mortality rates of black-legged kittiwake (*Rissa tridactyla*) and northern gannet (*Morus bassanus*)

Species	Season	Baseline Metrics (indv.)			Impact Mortalities (indv.)			Mean Total Mortalities (indv.)	Mean Impacted Survival Rate	%-point Change
		Population	*Survival Rate*	*Mortalities*	*Displacement*	*Collision*	*Total*			
Ozsanlav-Harris et al. *(2014) collision avoidance rates; Applicant Approach mortality and displacement rates (i.e. lower end of SNCB mortality rates)*										
Black-legged kittiwake	Breeding	202,258	85.400%	29,530	11	23	34	29,566	85.383%	-0.017
	Non-breeding	627,816		91,661	1	1	2			
Northern gannet	Breeding	423,893	91.900%	34,335	3	4	8	34,350	91.897%	-0.003
	Non-breeding	248,385		20,119	3	2	7			
Worst-case rates (kittiwake: 30% displacement, 3% mortality, 98.9% annual avoidance; gannet: 70% displacement, 3% mortality, 98% breeding avoidance, 98.9% non-breeding avoidance)										
Black-legged kittiwake	Breeding	202,258	85.400%	29,530	33	23	56	29,588	85.371%	-0.029
	Non-breeding	627,816		91,661	1	1	2			
Northern gannet	Breeding	423,893	91.900%	34,335	9	9	18	34,363	91.893%	-0.007
	Non-breeding	248,385		20,119	8	3	11			

12.16.3 Temporary Habitat Loss

12.16.3.1 For all other effects, it is not possible to produce a quantitative assessment alone as the rest of the EIA relies on qualitative assessments, and it is not possible to quantify impacts to populations confidently. Therefore, a qualitative assessment of inter-related effects has also been conducted. Other effects primarily constitute loss of foraging or loafing habitat, including vessel disturbance and all activities which interact with the seabed or water column. As a result, all other effects from the Salamander Project have been assessed in relation to habitat loss.

12.16.3.2 Temporary habitat loss (long-term) is assessed under operation and maintenance impacts, however, this effect will begin during the construction phase and end during the decommissioning phase, as the Salamander Project infrastructure is installed and then removed. Short-term disturbance of supporting habitat, such as through installation, repair, or burial / reburial of cables may result in additional areas of habitat being lost to birds during the period of work and while the habitat is recovering.

12.16.3.3 While the presence of vessels and helicopters will not affect supporting habitat itself, these effects are also considered to represent additional temporary habitat loss (short-term), as displaced birds may be temporarily excluded from foraging areas. Effects associated with vessel disturbance will cease almost immediately once a vessel leaves the area, allowing seabirds to return to the foraging habitat.

12.16.3.4 While vessel disturbance, short-term habitat loss, and long-term habitat loss are considered cumulatively, it is important to recognise that there will be spatial and temporal overlap with these effects. For example, cable repair may take place within an area of habitat covered by 'long-term habitat loss', and therefore, the short-term loss (cable repair) and disturbance (vessel presence) will not be in addition to the already assessed long-term loss of habitat.

12.16.3.5 Distributional responses to the presence of operational WTGs in the OAA also constitute temporary habitat loss (long-term). Therefore, a two-tier assessment is considered here.

12.16.3.6 Firstly, for birds which are not displaced by the WTGs: an assessment has been undertaken of long-term habitat loss, short-term habitat loss, and vessel disturbance from construction, operation and decommissioning across the entire Offshore Development Area (Tier 1 Habitat Loss) assuming no disturbance from the WTGs themselves.

12.16.3.7 Secondly, an assessment accounting for birds which are displaced by WTGs, where it assumed that the entire OAA plus 2.0 km Buffer is classed as habitat loss, in addition to any loss (direct habitat loss and vessel disturbance-related loss) within the Offshore ECC (Tier 2 Habitat Loss).

Tier 1 Habitat Loss

12.16.3.8 As outlined in **Table 12-15** (**Section 12.11**), habitat loss may occur due to several factors, covering a relatively large spatial extent. To maintain a precautionary approach, the spatial extent of habitat loss and vessel trips are summed, even where there is overlap between effects. The total area of inter-related habitat loss is 17,305,200 m^2, or up to 17.3 km^2, within the Offshore Development Area, which is comprised of 5,178,350 m^2 (5.2 km^2) short-term loss in both construction and decommissioning (10,356,700 m^2, or 10.4 km^2, total) and 6,948,500 m^2 (7.0 km^2) long-term loss during operation and maintenance. Additionally, there are expected to be up to 8,540 vessel and 4,935 helicopter trips throughout the lifespan of the Salamander Project.

12.16.3.9 Up to 17.3 km^2 of cumulative habitat loss throughout the Salamander Project lifetime represents a small proportion of the total habitat available to seabirds considering species specific foraging ranges (Woodward *et al.*, 2019; NatureScot, 2023c) and the large extent of accessible alternative habitat in the region (refer to

Volume ER.A.3, Chapter 9: Benthic and Intertidal Ecology (**Section 9.7.1**, **Figure 9-3**)). Additionally, the duration of habitat loss should also be noted; with short-term loss occurring primarily in the construction and decommissioning phases, and long-term loss during operation and maintenance. Habitat loss will, therefore, not occur concurrently over the full 17.3 km^2, with short-term loss associated with construction recovering during the operation phase, and long-term loss ceasing and recovering during decommissioning.

12.16.3.10 As such, although inter-related effects may be marginally greater than effects associated with individual activities, impacts are not expected to be of greater magnitude and inter-related habitat loss is not predicted to have a notable effect on seabird populations.

Tier 2 Habitat Loss

12.16.3.11 For birds which are displaced by WTGs, habitat loss may occur over the entirety of the OAA, with additional loss occurring in the Offshore ECC. Therefore, the total area of habitat loss is 109 km^2, comprising of 92.2k m^2 in the OAA plus 2.0 km Buffer and 17.3 km^2 associated with infrastructure and seabed works. Additionally, there are expected to be up to 8,540 vessel and 4,935 helicopter trips throughout the lifespan of the Salamander Project.

12.16.3.12 Displacement from the OAA was determined to be **Minor** effect at worst, with either No Impact or Negligible effect predicted for most species (**Table 12-43**). The greatest significance is expected for guillemot, where Minor effect is predicted. This is due to the high numbers of auks observed during the 24-month DAS, most notably during the post-breeding moult period.

12.16.3.13 Additional loss of habitat (17.3 km^2) is unlikely to have notable additional effect on seabirds. Additionally, this additional habitat loss will be short-term and only occur during isolated events within the Offshore ECC.

12.16.3.14 Therefore, considering birds displaced by operational WTGs, habitat loss is unlikely to result in measurable effect on populations above that predicted for distributional responses. As such, inter-related habitat loss is not predicted to have a notable effect on seabird populations.

12.17 Conclusion and Summary

12.17.1.1 This chapter provided a baseline characterisation of the Offshore and Intertidal Ornithology within the Offshore Development Area and wider region, and investigated the potential effects of the construction, operation and maintenance, and decommissioning phases. The range of potential effects considered within this chapter has been informed by existing policy and guidance, the Scoping Opinion (MD-LOT, 2023), and stakeholder consultation workshops.

12.17.1.2 The Salamander Project and the associated Offshore and Intertidal Ornithology Study Areas are located in the North Sea, approximately 35 km east of Peterhead. The Offshore and Intertidal Ornithology Study Areas are characterised by ecologically important seabird species, such as kittiwake, large gulls, auks, and fulmar and gannet. Some species use the Study Area for foraging, whilst others use it for loafing / resting or for passage during migration or while accessing foraging grounds further offshore.

12.17.1.3 These receptor groups were used to assess the potential effects associated with the Salamander Project. A full summary of the results of the impact assessment is presented in **Table 12-51**, including the requirement for mitigation and consequent residual effects. All effects associated with the Salamander Project were assessed as having **No Impact** to **Minor** residual effects, which are considered **Not Significant** in EIA terms.

12.17.1.4 The CEA considered all proposed and existing OWF projects and developments within species-specific foraging range of the Salamander Project OAA. Cumulative effects are expected to be **Minor** at worst, when assessed against the regional populations outlined in **Table 12-9**, which is considered **Not Significant** in EIA terms.

12.17.1.5 No notable transboundary effects specific to Offshore and Intertidal Ornithology were identified. Any effects on international populations are expected to be **Negligible** and not measurable against baseline levels. This is also considered **Not Significant** in EIA terms.

12.17.1.6 The inter-related effects are not likely to result in a greater effect significance above that assessed for effects alone due to the small scale of the Salamander Project.

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